ENVIRONMENTAL ASSESSMENT

TOWN OF OAK ISLAND 2025 RENOURISHMENT PROJECT

Prepared for:
Town of Oak Island

and

Bureau of Ocean Energy Management

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List of Acronyms

AIWW	Atlantic Intracoastal Waterway
ASTM	American Society for Testing and Materials
BOEM	Bureau of Ocean and Energy Management
CORMP	Coastal Ocean Research Program
CEQ	Council on Environmental Quality
CRC	Coastal Resources Commission
DoN	Department of Navy
DPS	Distinct Population Segments
EA	Environmental Assessment
ESA	Endangered Species Act
EFH	Essential Fish Habitat
FMC	Fishery Management Councils
FMP	Fishery Management Plans
FT	Feet
HAPC	Habitat Area of Particular Concern
IOB	Inner Ocean Bar
IPaC	Information for Planning and Consultation
LFI	Lockwoods Folly Inlet
MEC	Munitions and Explosives of Concern
MHHW	Mean Higher High Water
MHW	Mean High Water
MLLW	Mean Lower Low Water
MLW	Mean Low Water
MM	Millimeter
NARW	North Atlantic Right Whale
NCGA	North Carolina General Assembly
NCDAQ	North Carolina Division of Air Quality
NCDCM	North Carolina Division of Coastal Management
NCDWQ	North Carolina Division of Water Quality
NCWRC	North Carolina Wildlife Resources Commission
NDBC	National Data Buoy Center
NEPA	National Environmental Policy Act
NLAA	Not Likely Adversely Affect
NMFS	National Marine Fisheries Service
NMI	Nautical Mile
NOSI	National Offshore Sand Inventory
ODMDS	Offshore Dredged Material Disposal Site
OIBMP	Oak Island Beach Management Plan
OSOKI	Offshore Oak Island
OCS	Outer Continental Shelf

PSO	Protected Species Observer
SAV	Submerged Aquatic Vegetation
SAR	South Atlantic Region
SARBO	South Atlantic Regional Biological Opinion
SOF	Statement of Findings
TAR	Tidewater Atlantic Research
Town	Town of Oak Island
UNCW	University of North Carolina at Wilmington
USACE	US Army Corps of Engineers
USFWS	US Fish and Wildlife Service
WHSMP	Wilmington Harbor Sand Management Plan

Executive Summary

The Town of Oak Island (Town) is seeking a Department of the Army permit from the US. Army Corps of Engineers Wilmington District (USACE) and a non-competitive negotiated agreement (NNA) from the Bureau of Ocean and Energy Management (BOEM) for a renourishment event along approximately 9 miles of oceanfront shoreline. The Proposed Action is an interim project while the Town continues to develop a longer-term beach and inlet management plan. The Proposed Action consists of excavating up to approximately 2.9 million cubic yards (Mcy) of beach compatible sand from the Outer Continental Shelf (OCS) and placing approximately 2.4 Mcy along the oceanfront of the Town's oceanfront from Station 210+00 to Station 680+00, approximately 47,100 linear ft. The proposed excavation is the minimum volume required to satisfy the purpose and need of the project.

Renourishment efforts on Oak Island have been ongoing since 2001 with the initial Wilmington Harbor Deeping project. Oak Island has received beneficial reuse material from the USACE's Inner Ocean Bar (IOB) maintenance dredging events in 2009 and 2018. Renourishment projects to restore habitats and shorelines occurred in 2009 and 2015. After Hurricanes Matthew and Florence in 2016 and 2018, the Town initiated dune restoration efforts in two phases, with the eastern and western portions completed in 2021 and 2022, respectively. While the eastern and western ends of the Town's shoreline benefit from periodic renourishment facilitated by beneficial use of dredged material from USACE maintained federally authorized navigation channels, the central portion of the island has not undergone substantial beach renourishment since 2001.

The Proposed Action utilizes a 250-acre Offshore Oak Island (OSOKI) borrow area as the sediment source, located 16.4 nautical miles south of Oak Island. The Town collected design level data to inform the final selection of OSOKI as the preferred borrow source. This borrow area design leverages reconnaissance level data acquisition efforts conducted by BOEM as a component of its National Offshore Sand Inventory (NOSI).

The beach fill design involves the construction of a berm to provide advanced fill for a 6-year renourishment interval, with the berm designed to be at elevation 7.0 ft NAVD88. The width of the berm will vary from around 40 ft to 150 ft, depending on historical erosion rates in each area. Damaged dunes will be restored to their original authorized specifications, designed to withstand a 25-year return period storm, with elevations ranging from 13.0 to 15.5 ft NAVD88 and specific slope ratios. Native vegetation will be planted along the dune slopes and crest, with no disturbance to existing stable dune vegetation during construction.

The project area includes marine areas within state and federal waters. The USACE would act as the lead agency and BOEM would act as a cooperating agency for the Proposed Action under the National Environmental Policy Act (NEPA). The USACE will lead the Section 7 consultation for potential impacts on threatened and endangered species, coordinating with the National Marine Fisheries Service (NMFS) Protected Resource Division and US Fish and Wildlife Service (USFWS). The USACE will lead the National Historic Preservation Act (NHPA) Section 106 process and consult with the State Historic Preservation Officer and Tribal Historic Preservation Officers in coordination with BOEM.

Pursuant to NEPA, the following document describes the affected environment, evaluated potential environmental impacts, and considered alternatives for the Town's Beach Renourishment Project.

1. Introduction

The Town of Oak Island (Town) is proposing the placement of approximately 2.4 Mcy along 9 miles of oceanfront shoreline. This Environmental Assessment (EA) was prepared to describe the alternatives considered and assess whether the Proposed Action will have significant impacts on the quality of the affected environment.

1.1. Authorization

The Proposed Action involves beach renourishment with the material originating from an offshore borrow area located on the OCS, approximately 16 miles offshore of Oak Island in Brunswick County, North Carolina. BOEM and the USACE have jurisdictional authorization over different facets of the project. BOEM has jurisdiction over the identified sand resources for this project under the Outer Continental Shelf Lands Act (OCSLA). BOEM may issue a non-competitive negotiated agreement (NNA) for use of OCS sand resources to construct the project pursuant to its authority under the OCSLA.

The USACE authorization includes complying with Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act for sand placement associated with beach renourishment.

The USACE, Wilmington District, is anticipating preparing a combined EA and Statement of Findings (SOF) pursuant to the NEPA. USACE will act as the lead federal agency managing the EA process. Pursuant to 40 CFR 1501, the Wilmington District has requested that the BOEM participate as a joint cooperating agency in the review of the Town's proposal and preparation of appropriate NEPA documentation. BOEM provided relevant information and collaborated with the USACE and the Town in the preparation of this EA, in accordance with NEPA regulations 40 CFR 1500-1508. Cooperating lead agency correspondence describing the roles of each agency can be found in Appendix A.

1.2. Project Location

The Town is situated on a 13-mile-long barrier island along the Atlantic Ocean, between the Cape Fear River Inlet to the east and Lockwoods Folly Inlet to the west in Brunswick County, North Carolina (NC). Oak Island is a south facing beach and is separated from mainland Brunswick County to the north by tidal marshes and the Atlantic Intracoastal Waterway. The Town can be accessed by driving south from Wilmington on U.S. Highway 17 past the towns of Belville and Bolivia, then following SR 1500 south across the Atlantic Intracoastal Waterway (AIWW) to the Island (Figure 1-1). The preferred borrow area for this project is the OSOKI borrow area, approximately 250 acres in size and 16.4 nautical miles south-southwest of the Oak Island Lighthouse. This proposed borrow area is within the BOEM OCS lease blocks 6336, 6337, and 6386, as shown in Figure 1-1.

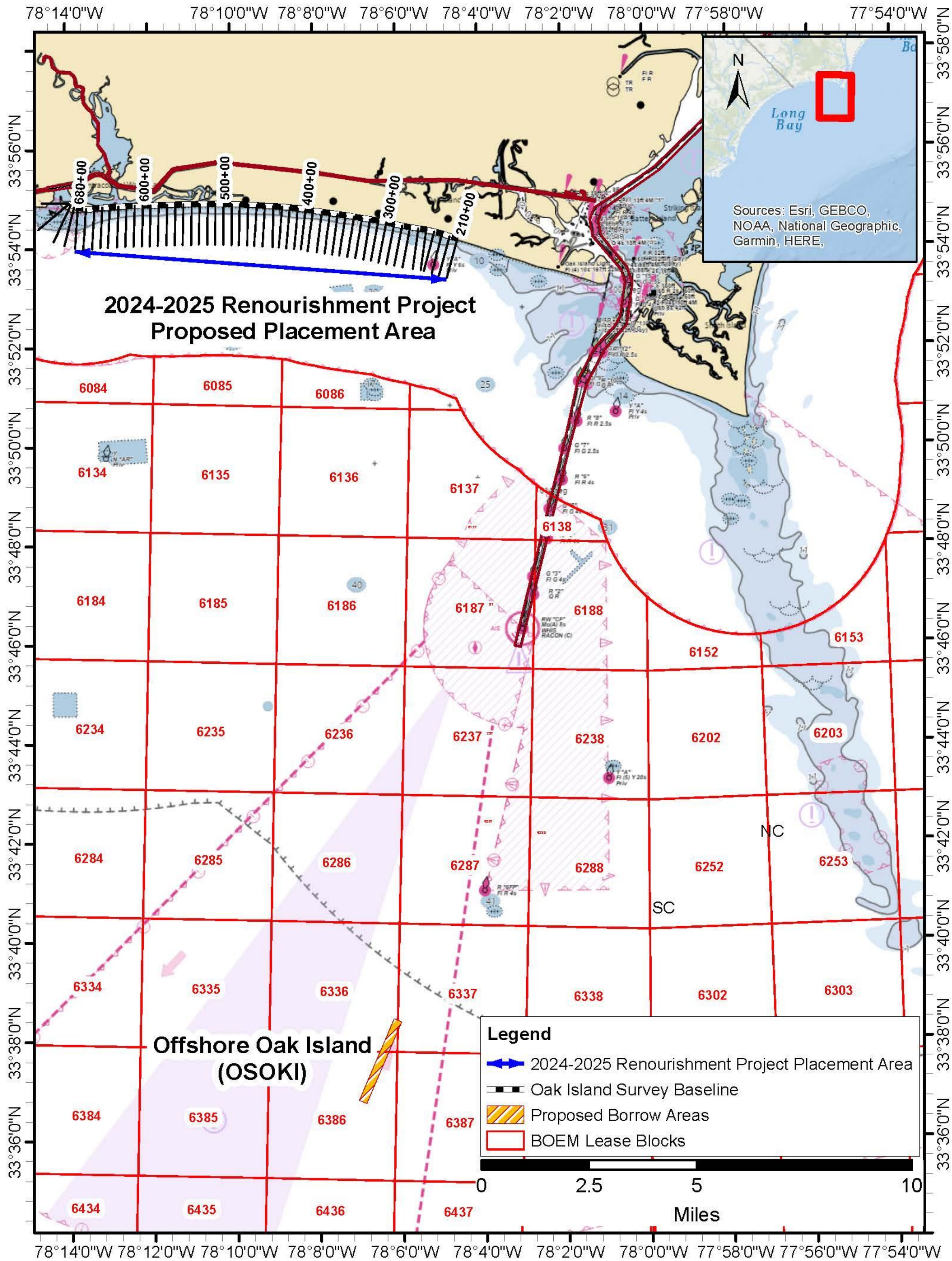

Figure 1-1: Proposed borrow source and placement area for beach renourishment

1.3. Proposed Action

The Town was awarded a directed grant in the amount of $20 million (M) in 2021 by the North Carolina General Assembly (NCGA). Section 5.9.(a) of the 2021 Disaster Relief and Mitigation Act (SL 2021-180) in North Carolina focuses on allocating funds for disaster relief, recovery, mitigation, and resiliency efforts. Specifically, it establishes the Disaster Relief and Mitigation Fund, which is administered by the Department of Public Safety's Division of Emergency Management and included a $20 M allocation to the Town of Oak Island as matching funds for shoreline stabilization to recover from Hurricane Isaias. The $20 M will be matched equally by the Town's beach renourishment fund to support long-term preventative measures for the purpose of restoring 9 miles of oceanfront shoreline and provide the necessary protection from storm impacts and background annual erosion. The NCGA directed grant is to be spent by the Town by 2025.

The Proposed Action consists of the excavation of approximately 2.9 Mcy of material from a borrow area located in the OCS, termed OSOKI, with beach placement of up to 2.4 Mcy along the oceanfront of the Town from Station 210+00 to Station 680+00, approximately 47,100 ft (Figure 1-1). This is the minimum volume required to satisfy the purpose and need of the project, as described below.

The Proposed Action is anticipated to occur within the regulatory dredging window of winter 2025/2026, specifically between November 16, 2025 and April 30, 2026, approximately 5.5 months in duration. The Proposed Action will utilize dredging industry standard hopper dredging means and methods. Avoidance and minimization measures have been developed to reduce effects to biological and cultural resources.

The Proposed Action would provide a 10-year to 25-year return period storm level of protection based on modelling results which considered existing conditions and recent projects. This Proposed Action is expected to provide protection to Town infrastructure by absorbing wave energy and would minimize wave and surge overtopping. The Proposed Action would also enhance sandy dune and beach habitat for nesting sea turtles and wildlife, provide a recreational beach for public access, and promote tourism. This Proposed Action would be designed primarily as a berm project with dune repair/replacement to be performed in areas where the design level of protection is not met. This dictates the minimum volume of material needed from the borrow source.

BOEM's federal action is to issue a NNA authorizing use of OCS sand within the OSOKI borrow area under the authority granted to the Department of the Interior by the Outer Continental Shelf Lands Act (OCSLA). BOEM may respond to the request of applicant(s) to approve, disapprove, or approve with modifications, as warranted.

Section 2 includes a detailed description of the Preferred Alternative (Proposed Action), and other alternatives evaluated in this EA.

1.4. Purpose and Need

Oak Island follows the typical profile of a coastal barrier island system. Winds, rising sea levels, and storms push sand from the ocean side of the island to the land side. The barrier island habitats follow a typical transition from open ocean to island shoreline, dune, over-wash, salt marsh, and finally marine sounds. Long-term erosion and storm impacts threaten the barrier island and the Town's infrastructure.

The Town is proactively working to restore the oceanfront shoreline and dune to provide necessary protection for its future. Recent dune renourishment projects conducted in 2021 and 2022 have increased the level of protection of the primary dune system, but to maintain this protection, ongoing beach management is necessary. In addition to shoreline and infrastructure protection, the Proposed Action would enhance sandy dune and beach habitat for nesting sea turtles and wildlife, provide a recreational beach for public access, and promote tourism. Increasingly frequent storm impacts, and background erosion have continued to impact the Oak Island oceanfront which increases the risk of damage of upland infrastructure within the Town, as was seen with Hurricane Isaias, a Category 1 storm, that made landfall in Oak Island on August 3, 2020. Based on annual shoreline surveys, the dune and berm system show signs of degradation from recent storm events, therefore there is an urgent need to implement a beach and dune renourishment project as soon as the Town is feasibility able to secure a construction contract within their budget. The project is anticipated to be constructed during the regulatory dredging window of November 16, 2025 – April 30, 2026.

The purpose of the Proposed Action is to:

- Repair the primary dune system to the previously authorized (SAW-2018-02230) design level of protection implemented in two renourishment efforts in 2020/2021 and 2021/2022 to protect upland infrastructure along the Town's oceanfront.
- Construct a berm to serve as advanced fill to provide a buffer volume to counteract six years of ongoing background erosion at current rates as estimated using beach profiles and statistical analysis. Enhance sandy dune and beach habitat for nesting sea turtles and wildlife.
- Provide a recreational beach for public access and promote tourism.
- Implement the directed $20M grant awarded by the NCGA by 2025, with the Proposed Action to renourish the Town's beach and protect infrastructure and utilize $20 M of allocated Town funds to match the grant and meet the total funding needs of the project, estimated at $40M.

The Town has established an Oak Island Beach Management Plan (OIBMP), approved by the North Carolina Coastal Resources Commission, which is a comprehensive, long-term (30-year) plan to improve the level of storm protection along the Town's oceanfront shoreline. The OIBMP would mitigate chronic and ongoing shoreline erosion through long-term actions that would restore and maintain the oceanfront shoreline of Oak Island, North Carolina. The Proposed Action would provide near term shoreline protection for the beach and Town infrastructure due to the current degraded state of the beach and dunes. Future efforts, as described in the OIBMP, would build upon the action proposed here for subsequent beach renourishment actions. Funding for future beach renourishment events are not currently available. Though the long-term beach management plan outlines a 30-year storm protection plan, future beach renourishment projects are not considered foreseeable actions relative to this Proposed Action.

Town infrastructure and beach and dune habitat are currently at imminent risk from storm surge, overtopping and repeated erosive events. Threatened infrastructure includes roads, homes, businesses and rental properties, and access to public recreational beach. The eroding beach and dune not only threaten the infrastructure, but also result in loss of natural habitat. Beach renourishment projects can mimic the natural environment and be designed to optimize storm risk management and prevent further habitat loss for nesting sea turtles and other wildlife that depend on a healthy beach ecosystem. Beach and dune renourishment also provides the additional benefit of providing access to recreational beach for residents and visitors and supports economic sustainability.

BOEM is authorized under Public Law 103-426 [43 United States Code (U.S.C.) 1337(k)(2)] to negotiate on a non-competitive basis the rights to OCS sand resources for shore protection projects. BOEM's purpose would be to authorize the use of up to 2.9 million cubic yards of OCS sand/sediment resources from the OSOKI Borrow Area to renourish approximately 47,100 linear ft of oceanfront shoreline. Authorization by BOEM to utilize OSOKI as the primary sediment source within the OCS would provide the Town access to a critical sand resource in a sand-limited region.

The Town of Oak Island applied to BOEM to use OCS sand resources in the proposed beach renourishment project.

1.5. Project History

North Carolina has a long history of being impacted by storms and hurricanes, only surpassed by Florida, Louisiana, and Texas. The protruding coastline contributes to its vulnerability to storms (Moffatt & Nichol, 2009). The history of beach renourishment projects on Oak Island dates to 2001 with the introduction of the Wilmington Harbor deepening project administered by the USACE and the periodic maintenance of the harbor entrance regulated by the Wilmington Harbor Sand Management Plan (WHSMP). Table 1-1 provides a summary of historical beach renourishment events on Oak Island. The central portion of the island has not experienced a substantial beach renourishment event since 2001. All past USACE and Town beach renourishment project placement volumes and extents discussed above are shown in Figure 1-2.

Table 1-1: Beach renourishment history

Year	Placement Location	Borrow Area	Project Volume (cy)
2001	Caswell Beach (Sta 60+00 to 80+00, 121+00 to 210+00)	Wilmington Harbor Entrance Channel (Ocean Entrance/Baldhead Shoal thru Snows Marsh)	673,000
2001	Oak Island - East End (Sta 210+00 to 294+00)	Wilmington Harbor Entrance Channel (Ocean Entrance/Baldhead Shoal thru Snows Marsh)	509,000
2001	Oak Island - Central, West, West End (Sta 415+00 to 665+50)	Wilmington Harbor Entrance Channel (Ocean Entrance/Baldhead Shoal thru Snows Marsh)	1,270,000
2001	Oak Island - East (Sta 294+00 to 415+00) & (Sta 309+63 to 399+33)	Yellow Banks	2,650,000
2009	Caswell Beach (Sta 60+00 to 95+00, 120+00 to 210+00)	Wilmington Harbor Entrance Channel (Ocean Entrance/Baldhead Shoal thru Snows Marsh)	728,400
2009	Oak Island - East End (Sta 210+00 to 260+00)	Wilmington Harbor Entrance Channel (Ocean Entrance/Baldhead Shoal thru Snows Marsh)	336,000
2009	Oak Island - West End (57th Pl.)	Lockwoods Folly River Crossing	19,220
2015	Oak Island - West End (Sta 649+50 to 678+64)	Eastern Channel	227,315
2017	Oak Island - East (Sta 300+00 to 373+50)	Upland Borrow Site	37,228
2018	Oak Island - East/Central/West/West End (Sta 300+00 to 410+00, 430+00 to 490+00, 530+00 to 550+00, 570+00 to 600+00, 607+00 to 620+00)	Upland Borrow Site	106,418
2018	Caswell Beach (Sta 60+00 to 95+00, 120+00 to 210+00)	Wilmington Harbor Entrance Channel (Ocean Entrance/Baldhead Shoal thru Snows Marsh)	639,300
2018	Oak Island - East End/East (Sta 210+00 to 310+00)	Wilmington Harbor Entrance Channel (Ocean Entrance/Baldhead Shoal thru Snows Marsh)	640,300
2019	Oak Island - West End (Sta 650+00 to 680+00)	Lockwoods Folly Inlet AIWW Crossing	121,300
2021	Oak Island - West End (Sta 652+00 to 680+00)	Lockwoods Folly Inlet AIWW Crossing & Bend Widener	161,200
2021	2020/2021 Renourishment Project	Jay Bird Shoals	728,800
2022	2021/2022 Renourishment Project	Jay Bird Shoals	768,068
2022	Oak Island - West End (Sta 650+00 to 680+00)	Lockwoods Folly Inlet AIWW Crossing	90,000
		Caswell Beach Total	**2,040,700**
		Oak Island Total	**7,664,849**

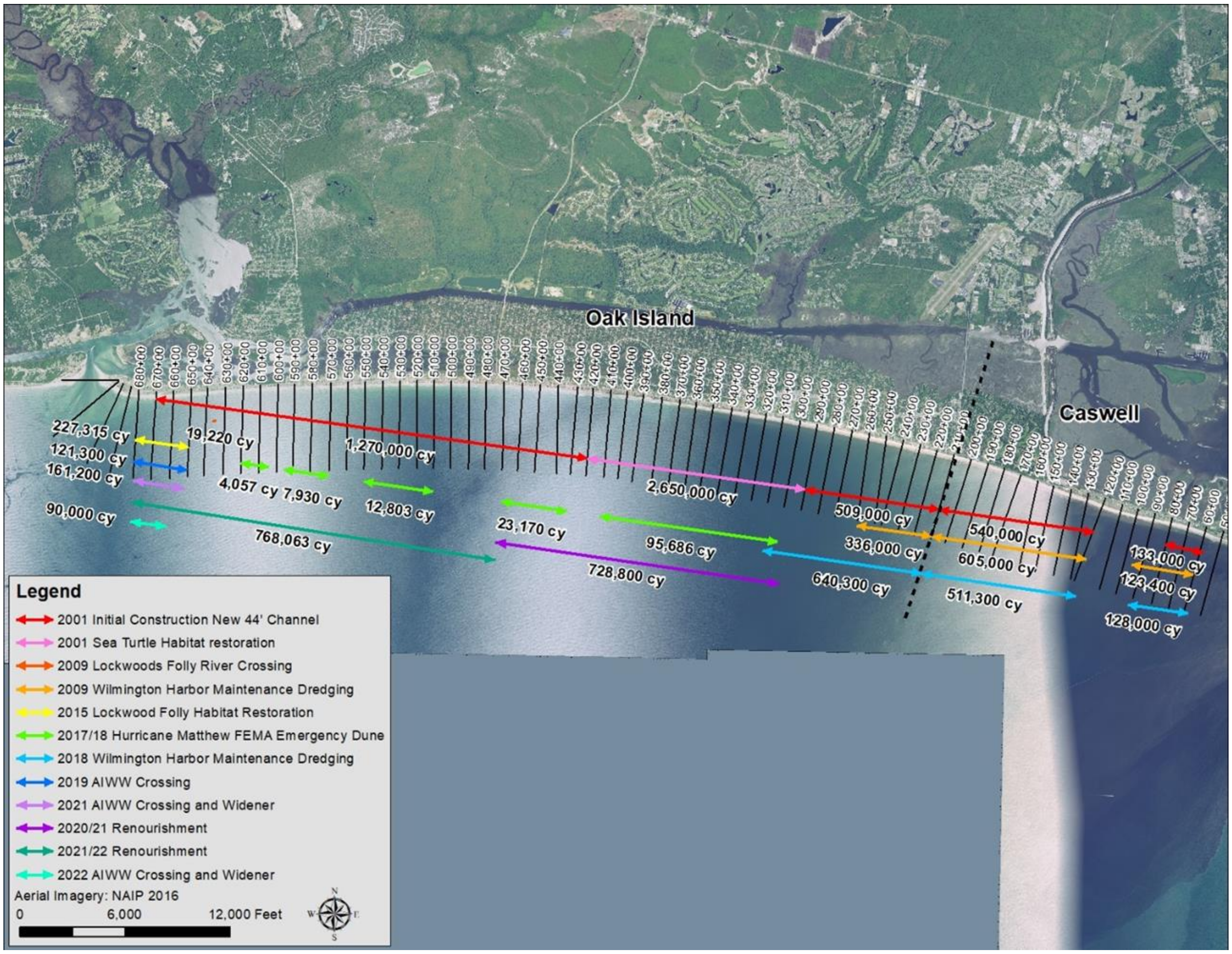

Figure 1-2: Oak Island beach nourishment summary

2. Alternatives

Chapter 2 is a review of alternatives considered to meet the purpose and need of the project. Three alternatives were considered: 1) beach and dune renourishment using the OSOKI borrow source (Preferred Alternative), 2) abandon and retreat, and 3) no action.

2.1. Beach and Dune Renourishment using the OSOKI Borrow Source (Preferred Alternative)

Beach and Dune Renourishment using the OSOKI Borrow Source (Preferred Alternative) would include placement of up to 2.4 Mcy of beach compatible sediment along the oceanfront shoreline of Oak Island. This alternative would require one to two large capacity hopper dredge(s) to transport material from the offshore borrow area, approximately 16 miles offshore, to the placement site. The OSOKI borrow area has been evaluated using geophysical and geological data collection and has been shown to have the minimum volume of compatible sand to carry out the full project and meet the project's purpose and need. The proposed project is funded in part by State funding allocated directly to the Town through S.L.2021-180, Sec. 5.9(a), as matching funds for shoreline stabilization to recover from Hurricane Isaias [SL 2021-180 (SB 105) (ncleg.gov)]. The Town has secured all necessary easements and rights of way from oceanfront property owners to construct the project in the winter of 2025.

2.1.1. Project Design

The Proposed Action, as the Town's Preferred Alternative, is an interim beach renourishment event, while the Town continues to develop a longer-term beach and inlet management plan. The Proposed Action includes creating a berm to serve as advanced fill to accommodate six years of background erosion at the current rates. The berm is proposed to be constructed at elevation 7.0 ft NAVD88, with the berm width varying from approximately 40 ft to 150 ft depending upon the historical volumetric erosion rates in that reach. Where escarpment and substantial erosion of the built dunes constructed in the previously authorized projects in 2021 and 2022 is observed, the dunes would be repaired to the same template as authorized. The Town will conduct a shoreline survey up to six weeks prior to construction to confirm final design.

The dune template previously constructed in 2021 and 2022 consisted of a design to withstand a 25-year return period storm. The dune elevation ranged from 13.0 to 15.5 ft NAVD88 with a crest width of 10 ft. The front slope of the dune was 4 Horizontal:1 Vertical (H:V) and the back slope of the dune was 5H:1V. Native dune planting would be performed once each section is completed to restore native vegetation and stabilize the dune system. Dune planting would occur along the landward slope, dune crest, and 1/4 the distance down the seaward slope where needed to stabilize dune infrastructure. No existing stable dune vegetation shall be disturbed during construction. For a detailed plan and profile view of dune and berm design, see the Design Plans in Appendix B.

Subline Placement

During the Town's 2021/2022 Beach Renourishment Project, a total of six nearshore sublines were cleared for hardbottom and cultural resources via a combination of sidescan sonar, bounce dives, and sediment grab sampling by researchers from the University of North Carolina at Wilmington (UNCW). The corridors that were cleared for hardbottom and cultural resources in 2022 are illustrated in Figure 2-2 with survey data and results provided in Appendix C.

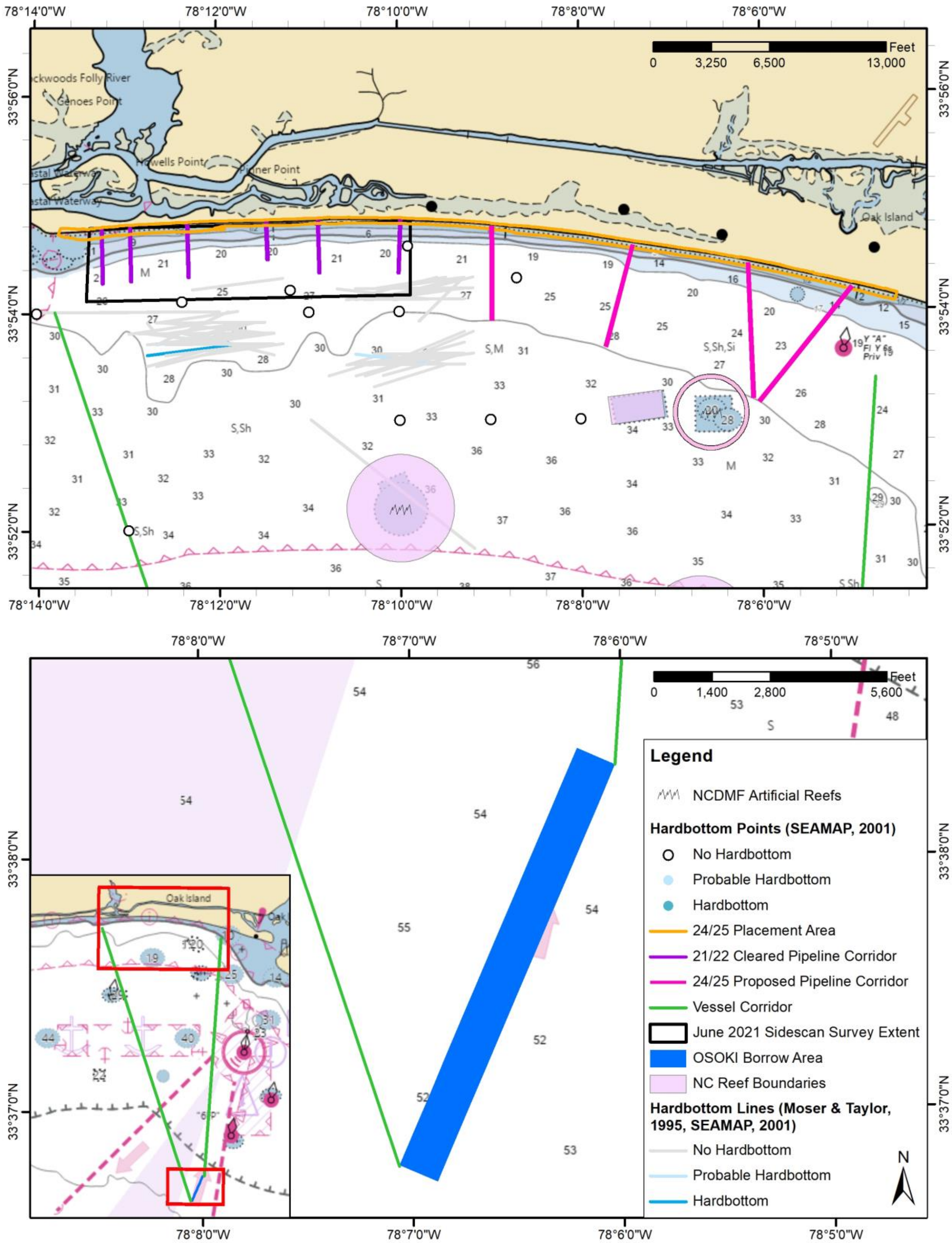

Figure 2-1: Area of potential effect depicting nearshore sublines, borrow area and vessel transit corridor

Because the upcoming beach renourishment project, anticipated to be constructed in the regulatory dredging window of 2025/2026, will extend further east to the Town's limits, it is anticipated that the selected contractor for the project will need to use additional sublines to pump sand on the eastern extent of the project. The Town established a contract with UNCW to survey for the presence of hardbottom and cultural resources within four selected 500-ft wide corridors, to be surveyed out to -30 ft NAVD88, due to the temporary placement of sublines during construction.

Four subline corridors on the eastern side of the project, shown in Figure 2-2, were selected based on the avoidance of available data for hardbottom, artificial reefs (AR 430, AR 425, AR 420), wrecks and obstructions. These proposed pipeline corridors allow for a 2,000 ft buffer from existing known hardbottom, artificial reefs, and wrecks/obstructions. This existing data can be used for purposes of evaluating potential impacts, with clearance to follow at either these corridors or other corridors preferred by the selected contractor, provided to the agencies at least 6 weeks before subline is installed, for agency review and concurrence. In addition, if the previously cleared corridors on the western side of the project are not sufficient for use based on the contractor's construction plan, clearance of new corridors would be provided at least 6 weeks before subline pipes are installed, for agency review and concurrence.

At the time of this EA, the Town completed a sidescan survey of the four proposed subline corridors on the eastern side of the project October 9, 2024, for the presence/absence of benthic resources and cultural resources. Preliminary analysis of the sidescan sonar survey and diver ground truthing confirmed the proposed pipeline corridors are clear of hardbottom resources. All data and results will be provided to the agencies ahead of project construction.

To construct the proposed project efficiently, the dredge contractors bidding on the job need to analyze their own dredge plant availability and project parameters to determine the optimal construction means and methods. Due to the uncertainty in which contractor will be selected and which dredge plant they will choose to use, it is difficult to pre-select dredging corridors. Hopper dredge plants vary in size and capacity between small, medium, and large dredges. Different size dredges require varying amounts of draft for cube hookup (approximately 30 ft for smaller dredges and up to approximately 45 ft for larger dredges), meaning dredge hookup locations will vary in distance offshore depending on the size of the dredge being used and offshore bathymetry. In addition, each size dredge has a limited length of pipe through which they can pump from the dredge, through the subline, and onto shore through the pipeline without the costly addition of a booster. The distance offshore that the cube hookup is located due to draft requirements combined with the length of pipe each dredge size is efficiently able to pump through determines the location and number of sublines required to complete the project. Therefore, without knowing which contractor and dredge plant will be constructing the project, it is difficult and very limiting to the contractor to pre-select pipeline corridors. It would tremendously limit which dredges could be used and create considerable economic implications to the overall project price if the dredging contractor is not allowed to select the best dredge plant for the job and the most efficient subline corridors for that specific plant. Corridor clearance would be best completed after the selection of a contractor to ensure the most efficient project construction, both in terms of timeliness and economics.

Borrow Area

During initial consultation with BOEM and the USACE in May 2023, the Town was advised to propose a borrow area design to meet the maximum desired volume beach fill template on the beach. Vibracore data was collected to inform the design. This borrow area design was based on State sediment criteria guidelines.

The Town's preferred borrow area consists of the OSOKI borrow area, a 10,888 ft by 1,000 ft rectangle with an area of approximately 250 acres (see Figure 2-3). The borrow area is subdivided into areas that vary in elevation based on the depth of compatible sediment at each vibracore location. A summary of the requested permitted elevations within OSOKI is shown in Table 2-1 and Figure 2-3. Because there are variable cut depths within the 1,000 ft by 1,000 ft square represented by each vibracore, the deepest cut depths within the square are shown in the table. The center of the borrow area is approximately 16.4 nautical miles south-southwest of the Oak Island Lighthouse. This proposed borrow area is within the BOEM OCS lease blocks 6336, 6337, and 6386. For a detailed plan view and sections of the proposed borrow area, see Appendix B.

The OSOKI borrow area has been identified to contain approximately 5.0 Mcy of beach-compatible material available, based on initial evaluation of survey data. However, based on detailed examination of the geophysical and geological data sets and coordination with BOEM and the USACE, the Town made a substantial effort to de-risk the OSOKI borrow area due to the presence of characteristics of a paleochannel and subsequent infill as described in the geophysical report (Appendix E), however, it does not show evidence of habitation (Appendix G). Limiting dredging as proposed would minimize the risk of impacts to pre-contact resources due to the lack of features indicating human habitation as well as the unlikely site preservation due to high energy marine processes.

Proposed excavation volume removed from the borrow area has been reduced to minimize risk of potential impacts to potential cultural resources. The Town understands the imprecision in modern survey methodology and resulting assessments and relevant implications to the proposed volume extracted within the sediment layers. As further discussed in Section 3.1.1, sediment layers within OSOKI were identified as H1 and H2 horizons, and the Town conducted further design evaluations to minimize the associated risk within these sediment layers. The Town is committed to measures to monitor and develop a procedure and contact plan during construction in case of any inadvertent discovery. Inadvertent discovery protocols have been added to the project's technical specifications.

Based on updated existing 2024 shoreline conditions the anticipated beach fill placement volume along the 9-mile oceanfront shoreline footprint is approximately 2.4 Mcy. Given hopper dredging standards resulting in up to 20% potential losses during the dredging process, this would require the excavation of up to 2.9 Mcy from OSOKI, the minimum volume needed to meet the purpose and need of the project. Detailed sediment characteristics for the OSOKI borrow area are presented in Appendix D.

The sediment characteristics of each vibracore within the OSOKI borrow area were composited down to the permitted elevation and meet all the grain size criteria for beach placement as established in 15A NCAC 07H.0312 (Table 2-2, Appendix D). The typical sediment type in OSOKI is sand (mean size = 0.36 mm). This comparison shows the proposed OSOKI borrow area sediments to be similar to the native material. The selected contractor will be required to visually monitor sediment quality daily (via visual inspection) and twice a week (via sediment analysis). All sediment results will be provided to the agencies weekly during construction.

The rate of infilling in borrow areas can vary based on their location and the prevailing hydrodynamic conditions. Offshore borrow sites, such as the OSOKI borrow site, are positioned outside the primary sediment transport processes and can result in a slower rate of infilling compared to nearshore sites. This is due to the reduced influence of sediment transport mechanisms like wave action and coastal currents in deeper, offshore areas. Consequently, since the OSOKI borrow site is located 16 mi offshore, it is less affected by these sediment transport processes, leading to a slower rate of sediment deposition back into the borrow site (Peterson, 2005).

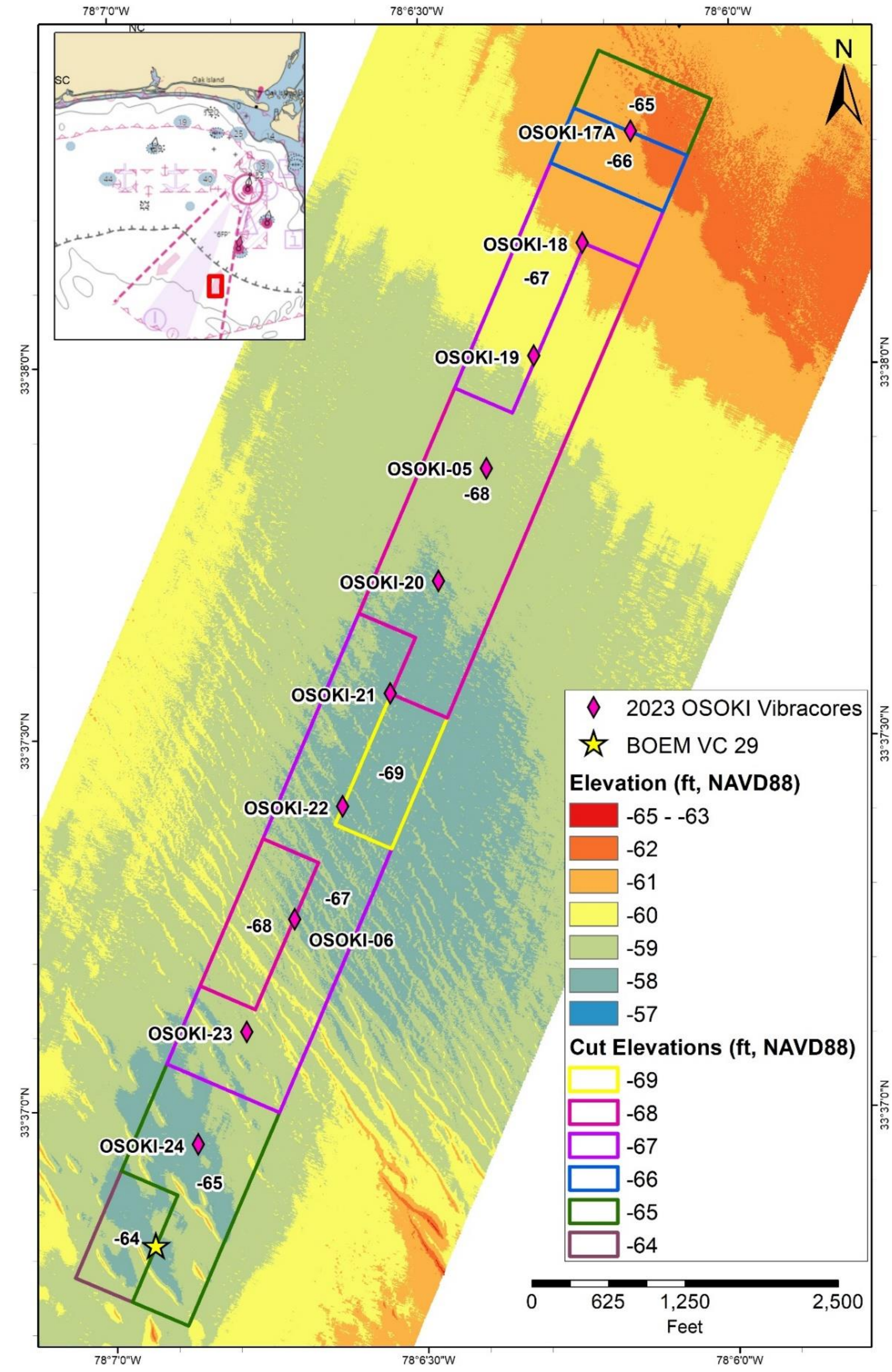

Figure 2-2: Vibracore locations and cut elevations within limits of the borrow area

Table 2-1: OSOKI proposed dredge cut elevations

Vibracore	Proposed Dredge Cut (ft, NAVD88)*
2023-OSOKI-17A	-66.00
2023-OSOKI-18	-68.00
2023-OSOKI-19	-68. 00
2023-OSOKI-05	-68. 00
2023-OSOKI-20	-68. 00
2023-OSOKI-21	-69. 00
2023-OSOKI-22	-69. 00
2023-OSOKI-06	-68.00
2023-OSOKI-23	-68.00
2023-OSOKI-24	-65.00
BOEMVC-2022-NC-29	-65.00

**Elevations shown are the deepest cut elevations within a 1000 ft by 1000 ft square around each vibracore. Variable cut elevations are shown in Figure 2-3.*

Table 2-2: Composite sediment characteristics of proposed beach fill compared to native sediment

Sediment Compatibility	2019 Native Global	OSOKI Composite	NCAC Maximum
Gravel	0.45%	0.67%	6%
Granular	0.71%	1.37%	11%
Sand	96.96%	93.99%	-
Fines	1.88%	3.97%	7%
Carbonate	9.72%	5.97%	25%
Mean (mm)	0.27	0.36	-

Construction Methods

The proposed project entails the maximum use of up to two medium to large hopper dredges to extract sand from the OSOKI borrow area. Given the distance offshore the OSOKI borrow area is located, as well as the water depths excavation will occur, a medium to large hopper dredge will be necessary. A hopper dredge will be used to load material into the vessel's hull and pump it ashore through pre-positioned submerged pipelines and pre-approved vessel routes and nearshore pump stations.

Work will progress in sections within the borrow area and along the beach. Fill placement along the beach will typically progress at a rate of 400-700 linear feet per day or a load cycle of 20,000 cy per day. Construction activities will involve the movement of heavy equipment and pipe along approximately 1 mile reaches per 1 to 2 weeks; resulting in a 4-month active construction timeframe. Once a section is complete, pipes and heavy equipment will be shifted to a new section, and the process repeated. Contractors utilizing the proposed staging areas will be required to stage equipment and materials landward of the primary frontal dune, and in a manner that ensures that there will be no impacts to the frontal dune system. All dredging and beach fill construction activities are anticipated to take place within the regulatory dredging window of November 16, 2025 – April 30, 2026 to avoid and minimize effects to fish and wildlife, including sea turtle nesting activities.

Hopper Dredges

A hopper dredge is a self-propelled vessel that can independently load, transport and unload dredged material. The hopper dredge has a trailer suction pipe with a draghead that strips off approximately 2' thick layers of sediment with each pass and hydraulically suctions the material into the hopper. For the proposed project, material would be offloaded by direct pump-out through a submerged pipeline while the vessel is moored offshore. There are potential environmental impacts associated with using hopper dredges, such as entrainment of threatened and endangered species by the draghead, localized turbidity plumes at the draghead site and near the surface as the hoppers are filled. However, advances in design have included under hull release of overflow sediment and anti-turbidity valves, which help reduce sediment plumes (W.F. Baird and Associates, 2004). Efforts to mitigate the take of listed species include relocation trawling, both prior to and during project construction, and installation of turtle deflectors on dragheads. Additionally, the borrow area has been designed to maximize efficiency and reduce entrainment risk through measures such as minimizing the number of turns and drag head "pick-ups" that would be required should a hopper dredge be used. Additional environmental considerations incorporated into the borrow area designs are discussed in Section 6.

Management of Materials on the Beach/Dunes

Once the material is discharged from the pipe onto the beach, onshore construction crews will shape the material into the desired construction template. The material is typically managed in a way that reduces turbidity by constructing shore parallel berms along which the water from the slurry will run, allowing additional time for material to settle out of suspension before the seawater returns to the ocean. Equipment such as bulldozers and front-end-loaders are typically used to shape sand on the beach and move pipes as necessary. At the location where the submerged pipeline comes ashore, the slurry flow is typically diverted with a 90-degree elbow to direct the flow towards the project area. As portions of the project are constructed, the pipeline is extended to allow for the next section of beach to be constructed.

Avoidance and Minimization

Avoidance and minimization include measures to avoid and minimize effects on historical and biological resources including protected species, hardbottom habitat, cultural and tribal resources.

<u>Construction Activities</u>

Contractors utilizing the proposed staging areas will be required to stage equipment and materials landward of the primary frontal dune, and in a manner that ensures that there will be no impacts to the frontal dune system. All dredging and beach fill construction activities are anticipated to take place between November 16, 2025 – April 30, 2026, the regulatory dredging window.

<u>Cultural and Tribal Resources</u>

Historical research and geophysical data review were performed by Tidewater Atlantic Research (TAR). TAR reports concluded no significant sites within the proposed borrow area needed avoidance or additional investigation (Appendices G and H). Historical maritime context showed no documented wrecks associated with the proposed borrow area. Based on the geological and cultural context, it was considered that the OSOKI borrow area did not have significant risk of adverse effects on cultural resources. However, due to imprecision in the survey methodology and uncertainty in geophysical interpretations, there is potential residual risk of impacts to prehistoric artifacts when utilizing paleochannel infill. Due to this concern, the initially estimated volume needs were re-evaluated for the project based on a recent (April 2024) survey and determined that 2.4 Mcy of compatible material was needed to attain the desired beach fill placement template. To minimize risk to possible cultural resources, including possible prehistoric artifacts within the paleochannel, cut depths were reduced based on the revised design volume requirement. Figure 2-3 shows the revised cut elevations for the OSOKI borrow area along with the corresponding vibracore locations.

Table 23 shows the reduced cut depths corresponding to each vibracore. Because there are variable cut depths within the 1000 ft by 1000 ft square represented by each vibracore, the deepest cut depths within the square are shown in the table. These project modifications have reduced the minimum volume need from 4.2 Mcy to 2.9 Mcy and were designed to minimize impacts to potential cultural resources. Section 106 consultation with the THPO and SHPO was completed on October 3, 2024. Agency correspondence is provided in Appendix A.

2.1.2. Alternative Development and Evaluation

The following design constraints and project considerations were reviewed in the development of alternatives. Each of these considerations are essential to ensure that the selected alternative meets the purpose and need of the project as described in Section 1.4.

Volume of Available Source Material

The project would require a minimum of approximately 2.4 Mcy of compatible sand to satisfy the purpose and need of the project. Given hopper dredging standards resulting in up to 20% potential losses during the dredging process, this would require identification of borrow sites with an excavation capacity of up to 2.9 Mcy.

Sediment Compatibility Design Standards

Regional sediment composition, sediment size and sediment shape are among the many variables affecting a coastline's morphology. Taking material from offshore and placing it onto the beach has the potential to alter the physical characteristics of the native beach. To minimize the risk of such alterations, projects are designed to use similar sediment with regards to sorting, mean grain size, median grain size, and sediment composition. Furthermore, the North Carolina State Sediment Criteria Rule (15A NCAC 07H .0312), sets state standards for beach renourishment projects to prevent the disposal of incompatible material on the native beach. The appropriate borrow sites for development of alternatives should meet state standards. The rule sets forth the following requirements to ensure the sediment characteristics of material placed on the recipient beach are compatible with the native sediment:

- The average percentage by weight of fine-grained sediment (less than 0.0625 mm) in each borrow site shall not exceed the average percentage by weight of fine-grained sediment of the recipient beach characterization plus five (5) percent.
- The percentage by weight of granular (coarse-grained) sediment (greater than or equal to 2 mm and less than 4.76 mm) in each borrow site shall not exceed the average percentage by weight of granular sediment of the recipient beach characterization plus five (5) percent.
- The percentage by weight of gravel (greater than or equal to 4.76 mm) in a borrow site shall not exceed the average percentage by weight of gravel-sized sediment for the recipient beach characterization plus five (5) percent.
- The average percentage by weight of calcium carbonate in a borrow site shall not exceed the average percentage by weight of calcium carbonate of the recipient beach characterization plus 15 percent.
- Sediment completely confined to the permitted dredge depth of a maintained navigation channel or associated sediment deposition basins within the active nearshore, beach, or inlet shoal system shall be considered compatible if the average percentage by weight of fine-grained (less than 0.0625 mm) sediment is less than 10 percent.

Presence of Biological Resources

There are a total of 20 federally listed species that may occur within the Area of Potential Effect (APE), including six marine mammal species, four bird species, five sea turtle species, two fish species, two elasmobranch species, and one plant species. The APE for the Proposed Action includes the offshore borrow area as well as the potential vessel transit area, and beach sand placement area, as illustrated in Figure 2-1. These species are discussed in additional detail in Section 3.2.3. Proposed Action elements including dredging and placement effects on protected species was considered in the selection of borrow source material and in placement of materials.

Cost

The cost of dredging and placement of fill is a design consideration. The Town's maximum project budget based on the NCGA directed grant funds awarded is $40 M for construction to place approximately 2.9 Mcy, the minimum volume to meet the project's purpose and need. The total cost of the project was used to calculate an approximate placement cost, based on recent standard industry estimates. Placement costs <$20.00/cy was a threshold cost for the purposes of this project considering the Town's budget limitations.

Feasibility/Logistics

The Town received a $20M directed allocation by the State in Session Law 2021-180 as matching funds for shoreline stabilization to recover from Hurricane Isaias (2020). Given the urgency of infrastructure at risk of being imminently threatened due to recent storms including Hurricane Isaias in 2020, and Hurricane Ian in 2022, and an annual cumulative volume change of -822,819 cy above -25 ft NAVD88 between 2022 and 2023, the timing of project implementation is a critical aspect of the feasibility. Borrow areas with completed assessments of the above referenced suitability criterion are more feasible in terms of the project timing.

Practicability Screening: Since 2022, the Town has evaluated potentially viable borrow sources for implementation of the Proposed Action within the regulatory dredging window (November 16 – April 30), through the collection of geophysical (multibeam survey, side scan and magnetometer survey, and sub-bottom survey) and geological data (vibracore sampling and sediment gradation analysis). Many of the borrow areas have undergone comprehensive evaluations to determine the suitability of the sediment in terms of quality, biological impacts, infilling rate, underlying geology and economic feasibility, which all contribute to the timeframe in which each borrow source would be ready for use based on regulatory compliance. Offshore borrow sources evaluated, as depicted in Table 2-3, consist of the Old and New Offshore Dredged Material Disposal Sites (ODMDS), the Lockwoods Folly Inlet (LFI) Complex, Yellow Banks, Frying Pan Shoals (State and Federal portions), Jay Bird Shoals, OSOKI, and the Wilmington Harbor IOB. These borrow sources were evaluated in terms of quantity and quality of sediment, biological and cultural resource significance, suitability for the Proposed Action, and viability to be authorized for implementation in the regulatory dredging window of November 16, 2025 through April 30, 2026. Table 2-1 presents the estimated available volumes in each of the potential borrow areas. Table 2-4presents the initial screening of borrow areas for practicability.

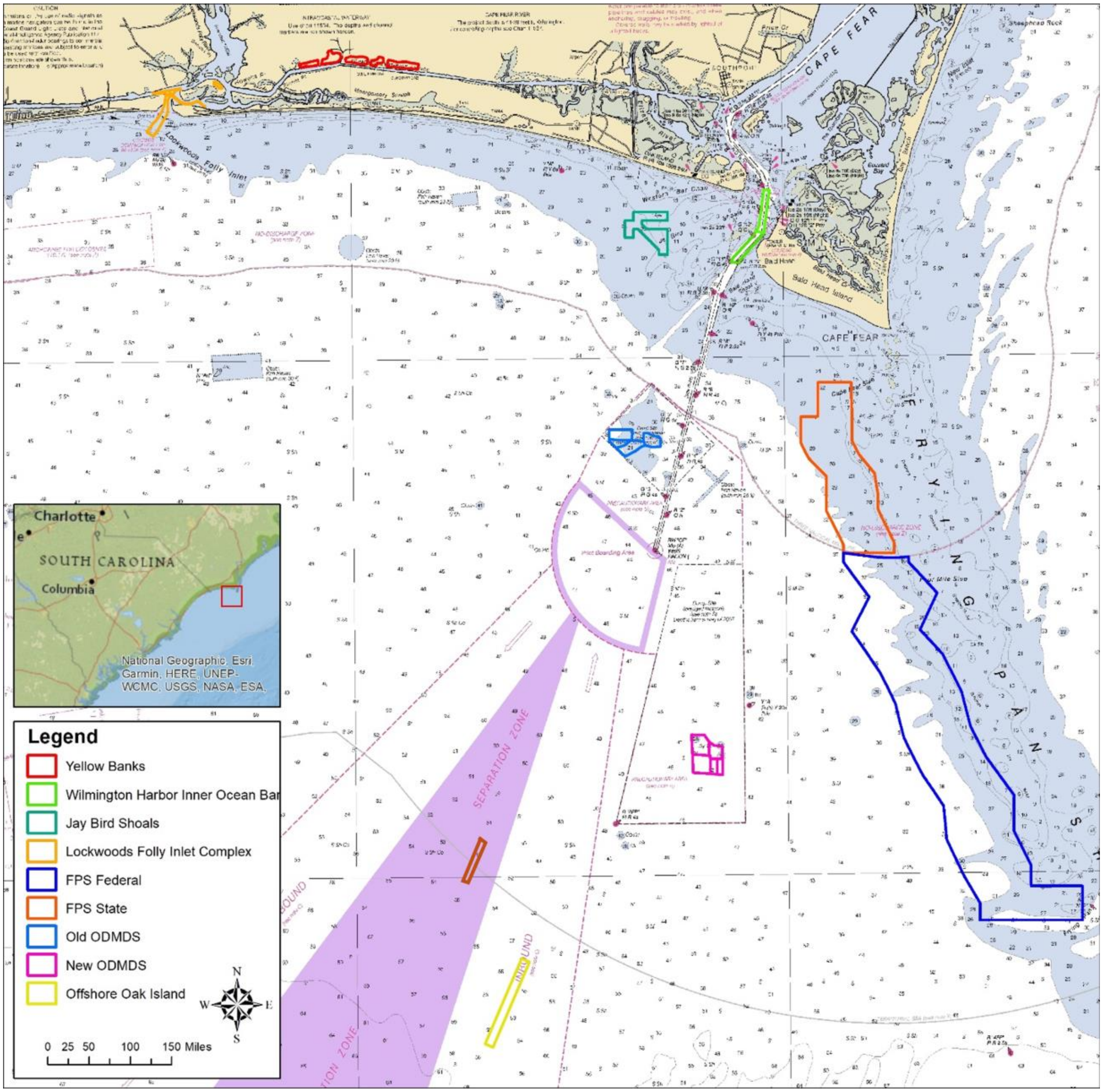

Figure 2-3: Identified potential sediment sources

Table 2-3: Potential borrow source volumes

Area	Total Preliminary Volume (cy) [1]
Old ODMDS	1,000,000
New ODMDS	700,000
Lockwoods Folly Inlet Complex LFI Bend Widener, Eastern Channel, Sheep Island	4,052,000
Yellow Banks	4,200,000
Frying Pan Shoals – Federal	58,000,000
Frying Pan Shoals – State	29,000,000
Jay Bird Shoals	N/A[2]
Offshore Oak Island (OSOKI)	2,900,000[3]
Wilmington Harbor Inner Ocean Bar (IOB)	1,427,000

[1] Preliminary volumes are based on adherence to the North Carolina Technical Standards for Beach Fill Projects (15A NCAC 07H.0312).
[2] The Town is conducting a 3-year infill and sediment composition study on Jay Bird Shoals. At the time of this document, sufficient material is not available for the Proposed Action.
[3] The available volume has since been reduced based on mitigation measures implemented to avoid impacts to prehistoric resources located within the H2 horizon of OSOKI.

Table 2-4: Practicability screening analysis of borrow area sources

Metric	Proposed Action Screening Threshold	Old and New ODMDS	LFI Complex	Yellow Banks	Frying Pan Shoals	Jay Bird Shoals	OSOKI	IOB	OSOKI & IOB
Volume	> 2.9 Mcy available	*No*	Yes	Yes	Yes	No	Yes	*No*	Yes
Sediment Compatibility	Meets State Standards	*No - Needs Additional Evaluation*	Yes	*No - Needs Additional Evaluation*	*No - Needs Additional Evaluation*	*No*	Yes	Yes	Yes
Presence of Biological Resources	Likely No Adverse Effects	Yes	Yes	Yes	*No - Needs Additional Evaluation*	*No - Needs Additional Evaluation*	Yes	Yes	Yes
Cost	Placement Cost Estimated < $20/Cy	*No - Needs Additional Evaluation*	*No - Needs Additional Evaluation*	*No - Costs > $20/Cy*	*No - Needs Additional Evaluation*	*No - Needs Additional Evaluation*	Yes	Yes	Yes
Feasibility / Logistics	<3 Months to Prepare Borrow Source Documentation	*No - Needs Additional Evaluation*	*No - Needs Additional Evaluation*	*No - Needs Additional Evaluation*	*No - Needs Additional Evaluation*	*No - Needs Additional Evaluation*	Yes	*No -Needs Additional Evaluation*	*No – Needs Additional Evaluation*

Borrow Sources Evaluated but Eliminated from Further Consideration

Old & New ODMDS, the LFI Complex, Yellow Banks, Frying Pan Shoals, and Jay Bird Shoals were evaluated against design constraints and project considerations and eliminated from further consideration (Table 2-4).

<u>Old and New ODMDS</u>

The Old and New ODMDS total preliminary volumes are 1 Mcy and .7 Mcy, respectively. The total preliminary volumes do not meet minimum project volume threshold requirements. Removal of material from the borrow source is not anticipated to affect biological resources including protected species, sediment compatibility, cost, and feasibility and logistics need further evaluation. For these reasons, Old and New ODMDS were eliminated from further consideration as the borrow source for the project.

<u>Lockwoods Folly Inlet Complex</u>

Lockwoods Folly Inlet (LFI) Complex includes LFI bend widener, Eastern Channel, and Sheep Island, and has a total preliminary volume of 4 Mcy which would be adequate for the purposes of the project. Approximately 227,315 cy were dredged from Eastern Channel in 2015 with full recovery of that volume currently incomplete. The LFI inlet crossing is dredged annually with volumes on the order of 100,000 cy which are insufficient alone. Sheep Island is an upland USACE dredge disposal site containing only beach compatible material, which contains sufficient material to conduct the project, however, because this is an upland site, project logistics are more complicated and would require upland excavation, transit, and pumping a considerable distance, likely leading to costs exceeding the $20/cy threshold. Sediment compatibility is adequate and meets state technical sediment standards and effects to biological resources including protected species are not anticipated. Feasibility and logistics need further evaluation as borrow sources would require federal authorization through USACE Civil Works and Section 408. The anticipated authorizations may not be complete by the time funding has expired. For these reasons LFI Complex was eliminated from further consideration as the borrow source for the project.

<u>Yellow Banks</u>

Yellow Banks is an upland borrow area located along the AIWW in Brunswick County. This site was previously utilized by the USACE for a sea turtle habitat restoration project in which they placed a significant volume of rock material on the beach resulting in impacts to native sediment composition, sea turtle nesting and other biological resources. Based on initial sampling, Yellow Banks contains a total preliminary sediment volume of 4.2 Mcy, which would be adequate for the project. A full sediment compatibility assessment has not yet been completed to further understand the presence of other rock material and whether the borrow area meets State compatibility standards. This borrow area is an upland USACE dredge disposal site, which is only accessible by water. This site would require equipment to be staged on a barge, excavation, transit, and pumping a considerable distance, leading to costs exceeding the $20/cy threshold. The feasibility and logistics for the permitting and use of this borrow source need further evaluation, which would not be able to be completed before the timeframe required for the proposed project. For these reasons, Yellow Banks was eliminated from further consideration as a borrow source for the project.

<u>Frying Pan Shoals (Federal and State)</u>

Frying Pan Shoals, a cape-associated shoal complex, has a total preliminary sediment volume of 58 Mcy for the federal site and an additional 29 Mcy for the state site. Borrow sources identified within the shoal complex would provide adequate volume for the project. Sediment compatibility, effects on biological resources, placement cost per cubic yard, feasibility, and logistic need further evaluation. BOEM Marine Minerals Program has funded a study to further examine the habitat and geophysical environment at Frying

Pan Shoals, conducted by UNCW (Fish Fry: Frying Pan Shoals Biophysical Dynamics (MM-22-03) (boem.gov)). The study outcomes will inform future impact analyses through the collection of baseline information, associated ecosystem trade-offs, and development of future monitoring requirements.

Frying Pan Shoals is designated by the National Marine Fisheries Service (NMFS) as Essential Fish Habitat (EFH) and Habitat Area of Particular Concern (HAPC). The study will provide valuable information for permitting agencies to assess the suitability of this area as a borrow site, but without the information available, the timing is incompatible with further evaluation for this project. Physical and biological ecosystem function drivers of this highly productive and dynamic system are poorly understood. For these reasons Frying Pan Shoals was eliminated from further consideration as the preferred borrow source for the project.

Jay Bird Shoals

The Town is conducting a 3-year infill and sediment composition study on Jay Bird Shoals. Currently, sufficient material to meet the volume need of the Proposed Action is not available in the near term. Based on recent surveys, infill sediment is not beach quality, nor does it meet state technical sediment standards. For this reason, Jay Bird Shoals was eliminated from further consideration as the borrow source for the Proposed Action.

Wilmington Harbor Inner Ocean Bar

The Wilmington Harbor IOB has a total preliminary volume of 1.4 Mcy which is not adequate as a stand-alone source for the project. IOB was considered by the Town as a secondary borrow source by the Town to supplement sand dredged from OSOKI. The IOB has sufficient compatible material. Use of this site would include a large capacity hopper dredge to dredge material from IOB and transport it to the placement site. Compared to OSOKI, costs would have been lower. The quantity of materials from IOB would have been commensurate with volumes placed in the past by USACE and in a similar placement as the previous project in 2018. Objections from adjacent communities transmitted to the USACE during the public comment period resulted in the Town eliminating the IOB as a secondary borrow source (Appendix A). Due to the need for further coordination, the borrow source does not meet the purpose and need as it would extend the timeframe for implementation and was therefore eliminated from further consideration.

2.1.3. Determination

Determination: a) this alternative meets the purpose and need b) this alternative is the Proposed Action/Preferred Alternative and c) the environmental consequences of this alternative will be analyzed.

2.2. Abandon and Retreat

Under this alternative, all shoreline management efforts by the Town of Oak Island would be ceased and infrastructure and buildings threatened by erosion or storm surge, would either be demolished and abandoned or moved landward to existing vacant lots.

2.2.1. Evaluation of Alternative

Long-Term Erosion Threat

An analysis of long-term background volumetric erosion was performed as part of the Town’s Beach Management Plan, approved by the CRC in June 2023. Table 2-5shows the annual background volume change to the -12 ft contour, estimated using a Monte Carlo simulation based on historical measured losses from 2014 to 2020. Over a 30-year period, the background volumetric erosion or estimated need to maintain the beach is 6.4 to 7.7 Mcy at the 50% and 75% non-exceedance probability level, respectively.

Table 2-5: Oak Island background erosion volume

	-12 Annual Loss 50% (cy)	-12 Annual Loss 75% (cy)
Total Annual Volume Change (w/ storm)	-271,076	-322,678
Total Annual Volume Change (w/o storm)	-213,247	-258,049
6-yr Beach Renourishment Cycle Volume Need (w/o storm)	-1,279,480 (-1.28 Mcy)	-1,548,293 (-1.55 Mcy)
30-yr Volume Need (w/o storm)	-6,397,398 (-6.4 Mcy)	-7,741,466 (-7.75 Mcy)

Storm-Induced Erosion Threat

As part of the Town's long-term planning efforts, storm-induced erosion was also evaluated using the numerical model SBEACH (Larson and Kraus, 1989). The Town was impacted by both Hurricane Matthew in October 2016 and Hurricane Florence in September 2018. Impacts from these storms substantially altered the existing conditions for the entire island, removing much of the dune system. The numerical model SBEACH was calibrated using pre- and post-Florence beach profile surveys and validated using pre- and post-Hurricane Matthew surveys. This calibrated model was employed to evaluate potential storm impacts on an eroded condition profile. The initial beach profile conditions evaluated corresponded to an October 2018 beach profile survey.

Representative beach profiles were evaluated using forcing conditions corresponding to return periods ranging from a 2-year storm to a 100-year storm (Table 2-6).

Table 2-6: Peak wave height, peak wave period, and maximum total water level input for SBEACH design storm simulations

Return Period	Significant Wave Height, H_s (ft)	Peak Wave Period T_P (sec)	Water Level (ft NAVD88)
2-year	14.76	14.66	3.70
5-year	16.82	14.66	4.50
10-year	18.22	14.66	5.10
25-year	19.92	14.66	6.20
50-year	21.13	14.66	8.00
100-year	22.29	14.66	12.00

The results and discussion of SBEACH storm simulations show that prior to the 2020/21 and 2021/22 projects, the Town was exceedingly vulnerable to a 25-year storm. The long-term erosion when combined with the potential for storm-induced erosion is likely to impact the first row of parcels at a minimum.

Table 2-7: Total value of first row of parcels in project area

Item	First Row Total Value
Land Value	$213,652,880
Building Value	$156,459,690
Other Buildings and Extra Features	$6,478,910
Total Market Value (2022)	**$376,591,480**

2.2.2. Determination

This alternative would result in vulnerability to the community, risk to public health and safety, risk to properties and economic losses (See Table 2-7). This alternative does not meet the purpose and need as described in Section 1.4, including the enhancement of dune habitat for wildlife and provide recreational access to the public. For these reasons, this alternative was not carried forward.

2.3. No Action

The No Action Alternative is defined as a continuation of the various actions the Town has historically taken to protect their oceanfront shoreline and infrastructure from storm events and chronic erosion. These measures include town sponsored programs and local resident initiatives to install native dune vegetation and sandbags along vulnerable sections of the dune. Additional actions by individual property owners to rebuild storm damaged dunes include authorization of beach scraping (bulldozing) through general permits. Several individual property owners have installed temporary sandbag revetments to protect imminently threatened structures on the west end of Town.

With the No Action Alternative, BOEM would not issue a non-competitive lease to access an OCS borrow area. Similarly, USACE would not issue a federal permit for any beach renourishment activities. This alternative would not provide the base level of protection due to the current degraded state of the beach and dunes.

2.3.1. Beneficial Use Placement

Historically, beach-compatible sand resources have been beneficially placed on adjacent beaches through various navigation-related dredging projects in the Cape Fear Region. However, the current demand for sand exceeds the available volume and frequency of navigation dredging events, and navigation dredging is not considered a long-term solution. The Town receives sediment on the eastern quarter of the beaches from the maintenance dredging events of Wilmington Harbor Ocean Bar Channel, which is performed by the USACE. The USACE maintains the authorized channel depths through maintenance dredging events, every 2 to 3 years. The material is placed in rotation on Oak Island, Bald Head Island, and Caswell Beach, resulting in beach renourishment events every 6 to 9 years. While the material is placed on the beach, it does not provide a beach renourishment design template to maximize the shore protection benefits.

Maintenance of the Lockwoods Folly Inlet Crossing (LFIX) also provides beneficial use material to Oak Island’s western point. Maintenance of Lockwoods Folly Inlet typically consists of the outer bar or the interior channels and AIWW crossing. Beneficial use material placement occurs with the interior channel and AIWW maintenance while common practices for maintaining the outer bar include sidecast dredging or hopper dredging. The hopper dredging events may place excavated material within the nearshore region along the shoreline while sidecast events leave the material adjacent to the navigation channel. Maintenance of the interior channel and AIWW crossing occurs on an approximate 2-year reoccurring schedule while maintenance of the outer bar may occur four times per year.

2.3.2. Evaluation of the No Action

While the beneficial use material provides some protection, it does not provide the quantity of sand, or the level of protection needed to fulfil the purpose and need.

2.3.3. Determination

This alternative will be carried forward for further evaluation/the environmental consequences will be analyzed as required by NEPA.

3. Affected Environment

The affected environment within the proposed project area is described below. "Project footprint" is used to describe the specific areas where the project will be constructed. The project footprint is defined by the location of the proposed beach renourishment along the shoreline, borrow areas, pipeline corridors, staging areas, and vessel routes.

The term "project area" is a broader term and refers to all areas that could be affected by the proposed alternative. The project area includes the project footprint as well as the extent of all project-related impacts. Project-related impacts may extend beyond the project footprint and are included in the extent of the project area.

3.1. Physical Environment

The Town of Oak Island is located on the coast of southeastern North Carolina in Brunswick County. It is located on a 13-mile-long barrier island located west of Cape Fear with an east-west orientation, facing the Atlantic Ocean to the south and separated from mainland Brunswick County to the north by tidal marshes and the Atlantic Intercoastal Waterway. The west end of Oak Island is backed by a narrow fringe of tidal marsh that separates the island from a waterway known as the Eastern Channel.

3.1.1. Geology and Geomorphology

Oak Island is in Long Bay immediately west of the Cape Fear River, Caswell Beach, and Bald Head Island. The term 'Oak Island' refers to a segment of the mainland isolated by the construction of the AIWW in 1930. Apart from Yaupon Beach, a 1.6 mi long, subaerial headland segment, Oak Island consists of two transgressive barrier spits (Caswell and Long Beaches) comprised of a variably thick layer of sand that is perched on top of Holocene and Pleistocene units. The headland dominated shoreline segment at Yaupon Beach is underlain by a Quaternary sequence consisting of a Pleistocene humate sandstone and Coquina limestone. This sequence extends beneath Oak Island, the nearby mainland. Caswell Beach is a narrow 2.5 mi long spit that extends eastward from the headland toward the Cape Fear River estuary. The remaining portion of Oak Island is composed of the "Long Beach" spit that extends 8.7 miles westward towards bordering Lockwoods Folly Inlet. This morphologically complex spit fronts a narrow marsh filled lagoon.

Extensive studies have been conducted to better understand the regional sediment dynamics along the coastline. A prominent morphologic feature along the Long Bay shoreline includes Frying Pan Shoals, a cape-associated shoal complex located southeast of Bald Head Island and extends seaward from the cape. The shoal complex contains a substantial percentage of the total volume of sediment in the overall coastal system. The shoal is generally thought to be a major sink in the coastal sediment-transport system.

The inner continental shelf of Long Bay is a sediment-starved environment with a geological framework dominated by Cretaceous and Tertiary rock units. Inputs of new sediment to the inner shelf/barrier island system are minimal, resulting in thin subaerial barriers that are settled on top of older rock units that constitute the shoreface (Cleary, 2008). The older shoreface/inner-shelf geologic units have a thin covering of modern sediment that is derived primarily from the erosion of relict Pleistocene and older inner-shelf deposits during the Holocene marine transgression (Denny et al., 2013). The shoreface along Oak Island is dominated by Cretaceous to Eocene Age sandstones and limestones that are covered by a thin and discontinuous veneer of modern sediment (Cleary, 2008). Oak Island's native material is characterized as fine-grained sand under the ASTM Unified Soil Classification System with a mean grain size of 0.26 mm.

Much of the oceanfront beach on Oak Island has experienced long-term net erosion over the last 70 years. Erosion has been the most severe along the island's west end, specifically forming an erosional hotspot. Shoreline and dune erosion as a result of storm surge and overwash during Hurricanes Matthew (2016), Florence (2018), Isaias (2020), and Ian (2022) were particularly substantial along the proposed project area.

Since 2001, numerous beach renourishment projects have been implemented along this western reach to mitigate erosion.

In 2022, BOEM funded the acquisition and analysis of reconnaissance level geophysical and geological data in North Carolina and South Carolina as a component of its National Offshore Sand Inventory (NOSI). One of the high priority areas was the OCS offshore of Brunswick County because of the projected demand for OCS sediment and the deficit outlined in the USACE Sand Availability and Needs Determination Report (USACE, 2024). The OCS could potentially provide sand resources to cover deficits needed for beach renourishment projects.

In 2023, APTIM performed reconnaissance level geophysical and geological data acquisition and analysis in several areas along North Carolina, including the OCS of Brunswick County. The study found numerous surficial sedimentary deposits in the area. The deposits range from 4-8 ft thick, some of the areas potentially thicker. The seafloor off the coast of Brunswick County is relatively muddy, with large areas of outcropping Cretaceous basement rock. The complex strata display highly variable fill architecture and are incised with numerous paleovalleys and paleochannels. According to the APTIM report, “the lithology of these valley fills and overlying surficial sediments ranges considerably, reflecting the contribution of fluvial sources, reworking of underlying Cretaceous lithified strata, and coastal processes.” The sandy areas found in the study likely reflect erosion and reworking by shelf processes of adjacent outcropping paleochannel deposits. Additionally, the report states “paleovalley and paleochannel systems themselves appear to be compound features with multiple overprinting cut and fill cycles and highly variable composition that may be controlled by relative proximity to fluvial sources” (APTIM, 2023).

The Town coordinated extensively with BOEM and the USACE prior to conducting survey activities, beginning in May 2023, at which time BOEM shared geophysical tracklines and cores for an area offshore of Oak Island. The Town modified their existing authorization and plans for vibracore data collection in Summer 2023 to include data collection along the BOEM tracklines in an area with potential sediment resources, a portion of which became the present proposed borrow area. Meetings were held with BOEM in October 2023 to evaluate authorizations for collection of additional geophysical data in the proposed borrow area, now known as OSOKI, as well as to review key milestones and schedule. BOEM authorized the Town’s high-resolution geophysical survey request in November 2023 in which detailed geophysical surveys were conducted by the Town at the offshore OSOKI borrow site in January 2024. These surveys were primarily conducted for the purpose of clearing the OSOKI borrow area for cultural resources, tribal resources, and hardbottom. These surveys included multibeam bathymetry, side scan sonar, magnetometer, and sub-bottom profiler data. The data collection process and results are described in the report included as Appendix E: *East Long Bay Geophysical Survey*, prepared by Geodynamics, an NV5 company. This report concludes the following:

- The bathymetry data revealed a series of sand waves and ripples in the area with ocean floor elevations ranging from -57.8 to -65.2 ft NAVD88.
- The geophysical datasets did not reveal hardbottom across the survey areas.
- Only one significant side scan sonar contact was detected, located near the northern edge of the survey area and outside of the proposed borrow area.
- The magnetometer data detected ten (10) anomalies, but none posed any archaeological concern (as described in the summary of marine archaeological assessment below).
- Sub-bottom profiler data identified three horizons: H1, spanning from 1 ft to 11 ft below the seafloor, representing well to poorly graded sands; H2, representing 6.5 ft to 18 ft below the seafloor and including paleochannel features; and H3, which narrowly mirrors the H2 reflector and is likely the Pleistocene to Holocene boundary and is indicative of denser material.
- It was noted that in the center of the borrow area, there are less distinct differences between the H1 horizon and the horizon below (H2) indicating that those sediments are more similar.

The 2024 survey results identified a layer of sand between 6.6 and 18 feet thick of Holocene sediments, compatible with the NC Coastal Resources Commission (CRC) Technical Standards for Beach Fill Projects (15A NCAC 07H.0312) (Appendix D). Results related to the environmental setting are discussed below.

The Late Pleistocene into Holocene is well known for glacial eustatic changes in sea level. Research has suggested sea level has risen close to 125 m in the last 21,000 years as these two epochs transitioned (Peltier, 2004). Studies focused on the coastline of North Carolina reveal a trend of sea level rise over the last 10,000 years to recent, rising from up to 30 m below current water levels (Horton et al, 2009, Figure 3-1).

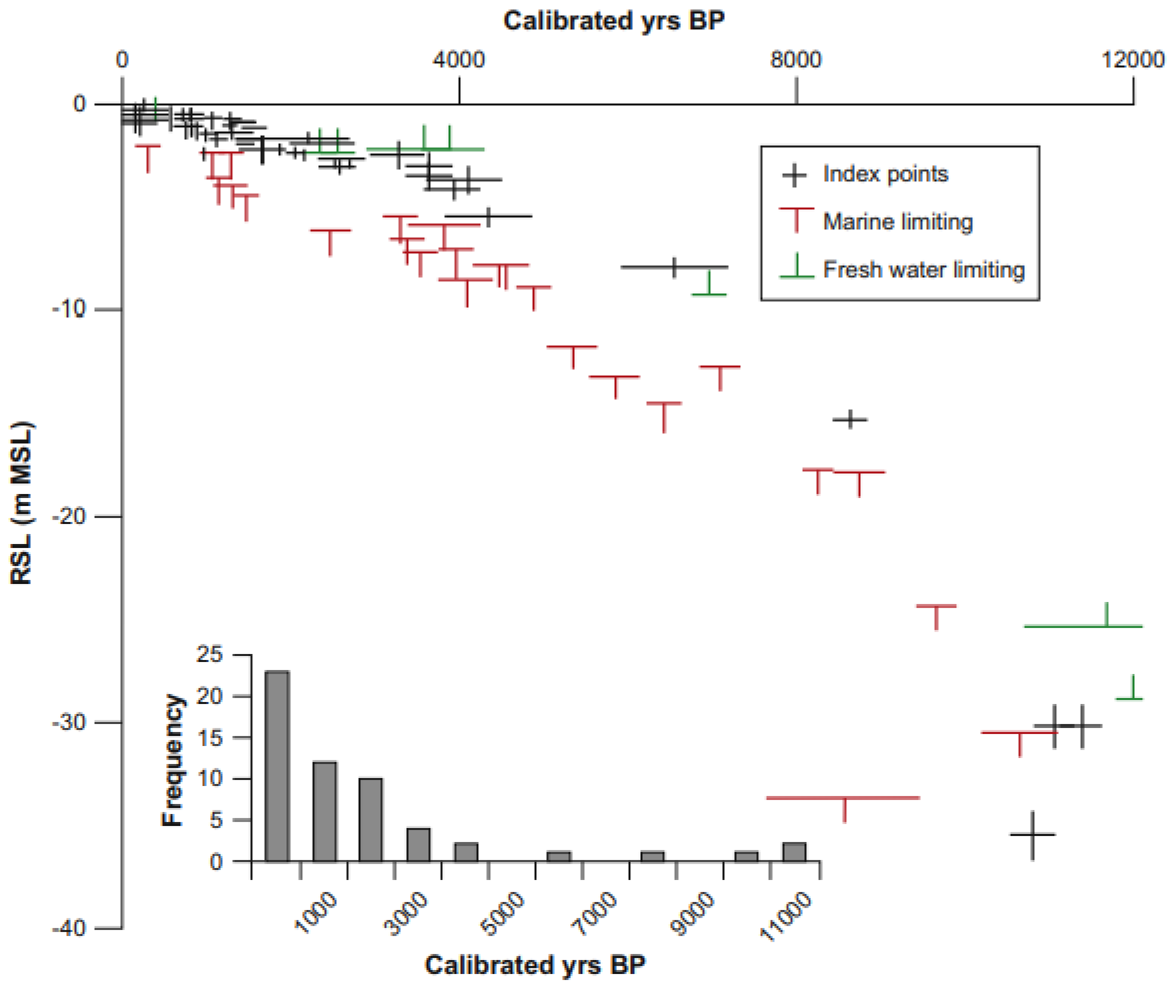

Figure 3-1: Figure from Horton et al. (2009), showing relative sea-level index points and limiting data over time

During this time, many transgressive and regressive cycles occurred, inundating and eroding shorelines and building complex depositional and erosional stratigraphic sequences across the passive margin of North Carolina. The beginning of this transition is interpreted to be represented by the H2 reflector, described in the NV5 report, where fluvial stratigraphic facies begin to overlie a high impedance horizon associated with limerock. This ravinement surface likely documents the last glacial maximum (~20,000 years ago) or earlier, as it is the base of the sediment facies that have developed an erosion-resistant unit, interpreted as limerock from the cores. A shallow channel, starting at 5 ft deep to the southwest and weaning out of detection to the northwest, spans ~800 ft wide towards the south to ~50 ft wide towards the north (see

Table 2-3 for reference). This feature appears to be an erosional feature into the limestone, with fluvial deposits directly above. H2, the overlying horizon, contains various sequences of paleoincisions ranging from 0 to 10 ft thick throughout the unit. These incisions reveal clinoform downlaps and crosscuts into existing incisions with soft to hard returns. To the north, a wide and shallow infill sequence with high returns that match sequences of weathered limerock fragments reworked from the ravinement surface, mixed with sand and silt. Cores that penetrate the downlapping and crosscutting infill sequences reflect a medium- to high-energy environment, documenting well to poorly graded sand with trace silty sand lenses for the infill sediments, occasional shell fragments, with occasional rock fragments at the base that are reworked from the transgressive surface below. These infill sequences within the H2 horizon are slightly eroded at the tops and transition softly into the overlying Holocene sediments of the H1 horizon. In the middle of the survey area, the two units appear acoustically homogenous. This indicates a mild transition in depositional environments between the two units and more uncertainty about the distinct location of the H1 reflector position. It is noted that without radiocarbon or optically stimulated luminescence dating methods, the relative timing of depositional events is only theorized.

From the cores, there is no evidence of estuarine or land-based remnants, e.g. peat, trees, organics associated with low-energy, back barrier environments common to the current and paleo-shorelines of the southeast (Long et al., 2021). The first incision resembles a late Pleistocene/early Holocene model developed for the offshore of South Carolina and Georgia by Long et al. (2021) (Figure 3-2), where earlier transgressive/regressive cycles incised into the erosion-resistant unit, creating accommodation space for the transgressive sand-rich deposits above. Because of the changes in sea level and high energy marine processes occurring during the evolution of coastal paleolandscapes, it is likely that there is little site preservation potential, even if archaeological resources had been present at one time.

As noted in the TAR report, Volume 1 (Appendix F), there have been other sites with well-defined previously documented geological landform features (e.g. well-defined levee, dune, channel, and/or channel confluences) that would be expected to be associated with prehistoric habitation. Although this site has characteristics of a paleochannel and subsequent infill as described previously and in Figure 3-2, it does not show evidence of such habitation. Limited dredging as proposed would not impact pre-contact resources due to the lack of features indicating human habitation as well as the unlikely site preservation due to high energy marine processes.

It is noted that a study was conducted on behalf of BOEM in 2012 (TRC Environmental Corporation, 2012), which aimed to evaluate theories on prehistoric settlement patterns, paleoshoreline positions, relative sea level rise, and regional geology to identify potential areas where prehistoric sites may be located as well as to construct a database of historic shipwrecks within the Atlantic OCS region. The proposed borrow site is within the Middle Atlantic region of this study. While this report includes a figure (Figure 3-2) indicating that this borrow area lies within a high priority feature identified as the Cape Fear Terrace, it is a relatively small-scale feature which has low preservation potential for the reasons described in this section.

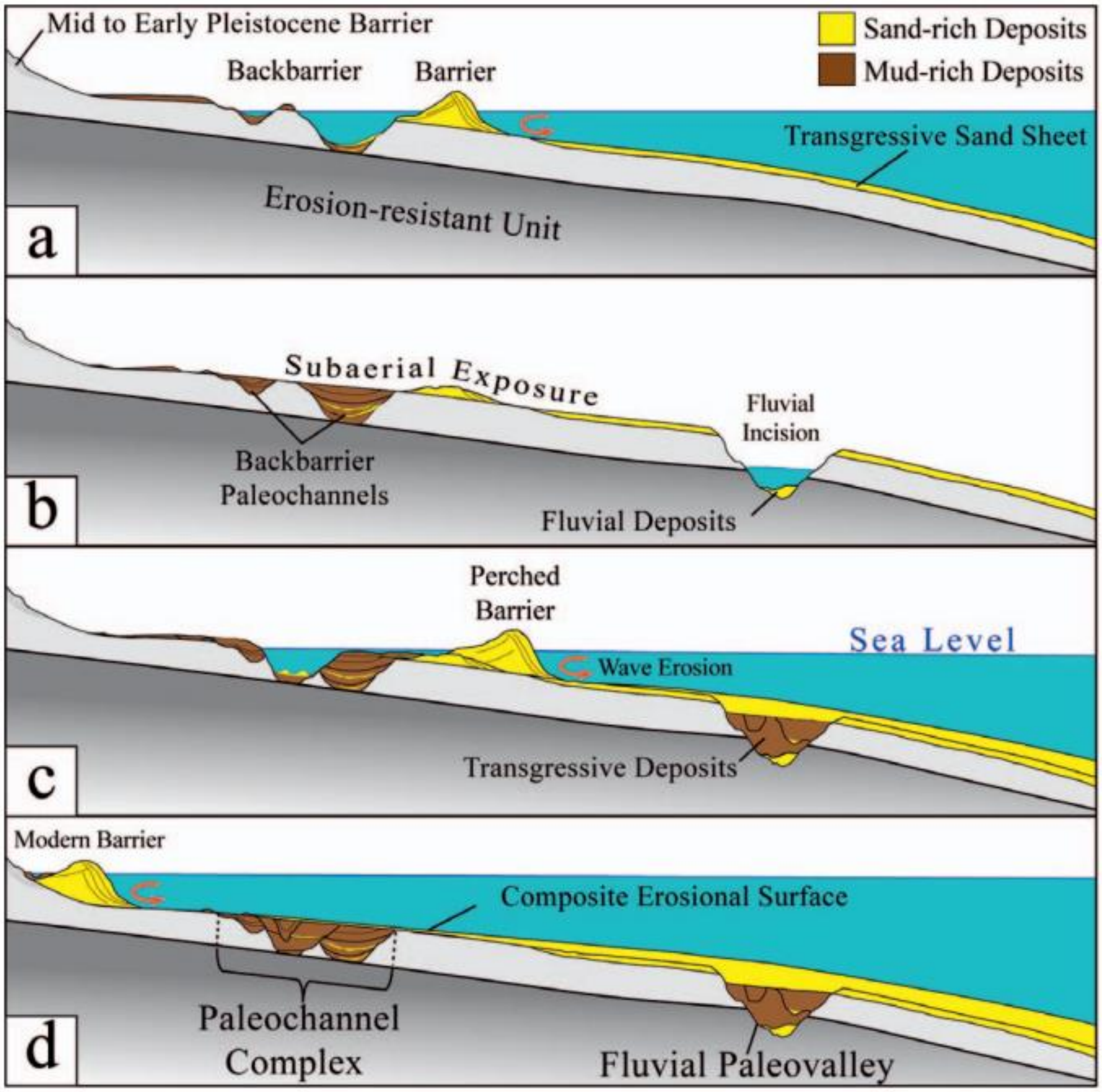

Figure 3-2: Figure from Long et al., 2009A, displaying a simplified general model for backbarrier paleochannel development*

**(a) Late Pleistocene. (b) Late Pleistocene/early Holocene (approximate Last Glacial Maximum). This configuration is similar to the scarp and terrace morphology of the SE U.S. coastal plain (Cooke, 1936). (c) Middle to late Holocene. (d) Modern. Incorporates concepts from Allen and Posamentier (1993); Belknap and Kraft (1985); Hine and Snyder (1985); Hoyt, Weimer, and Henry (1964); and Swift, Phillips, and Thorne (1991).*

3.1.2. Native Beach Sand Quality and Composition

Sediment variables such as composition, size, and shape affect coastline morphology. Oak Island is made up of a variably thick surface layer of sand across the island. Vibracore data show the shoreface consisting of variably thick sequences of gravelly, muddy sands and muddy, sandy gravels intercalated with muds and muddy sands (Cleary, 1999a; Cleary et al., 2001; Cleary 2008). Sediment collection efforts and sediment quality of the beach are discussed above.

3.1.3. Borrow Area Sediments Sand Quality and Composition

Sediment collection efforts and sediment quality of the proposed borrow areas are discussed in Section 2.9.2.

3.1.4. Littoral Processes

Beaches in Brunswick County experience active movement of littoral sediments in eastward and westward directions, depending on the wave conditions, with net transport moving westward. This is due to the nearshore bathymetric contours and coastline coupled with strong easterly directionality of offshore wave climate. The primary mechanism driving sediment movement along the open coast is the action of waves and associated currents, known as littoral processes. Changes in water level are tidally influenced and driven by changes in climate, sea level rise, and subsidence. It is necessary to properly characterize the wave climate to understand the magnitude and direction of sediment movement. Nearshore bathymetry and the angle at which waves approach the coastline influence shoreline changes. Cross-shore and long-shore sediment transport is impacted by wave characteristics. Beach width and elevation changes can occur during large storm events, which bring elevated wave conditions. Frequent storms and wave events generally drive the overall shoreline position. Wave climate characterization is necessary to understand and model sediment movement and shoreline change.

Longshore transport near the proposed borrow area, OSOKI, is heavily influenced by Frying Pan Shoals and the large ebb tide shoals, resulting in very dynamic shorelines, as depicted in Figure 3-3 (McNinch., 1999 and Luettich, 2020). A substantial portion of overall littoral transport is due to storm events, particularly in the sheltered eastern portions of the county including Oak Island. Shoal features form at inlets along the shoreline. These shoal features are dynamic and affected by longshore sediment transport entering the inlet and localized hydrodynamics due to typical and storm induced conditions. The net impact of this littoral transport is sediment accretion in some areas and persistent erosion in other areas. Muddy sediment is added when the Cape Fear River is in flood stage.

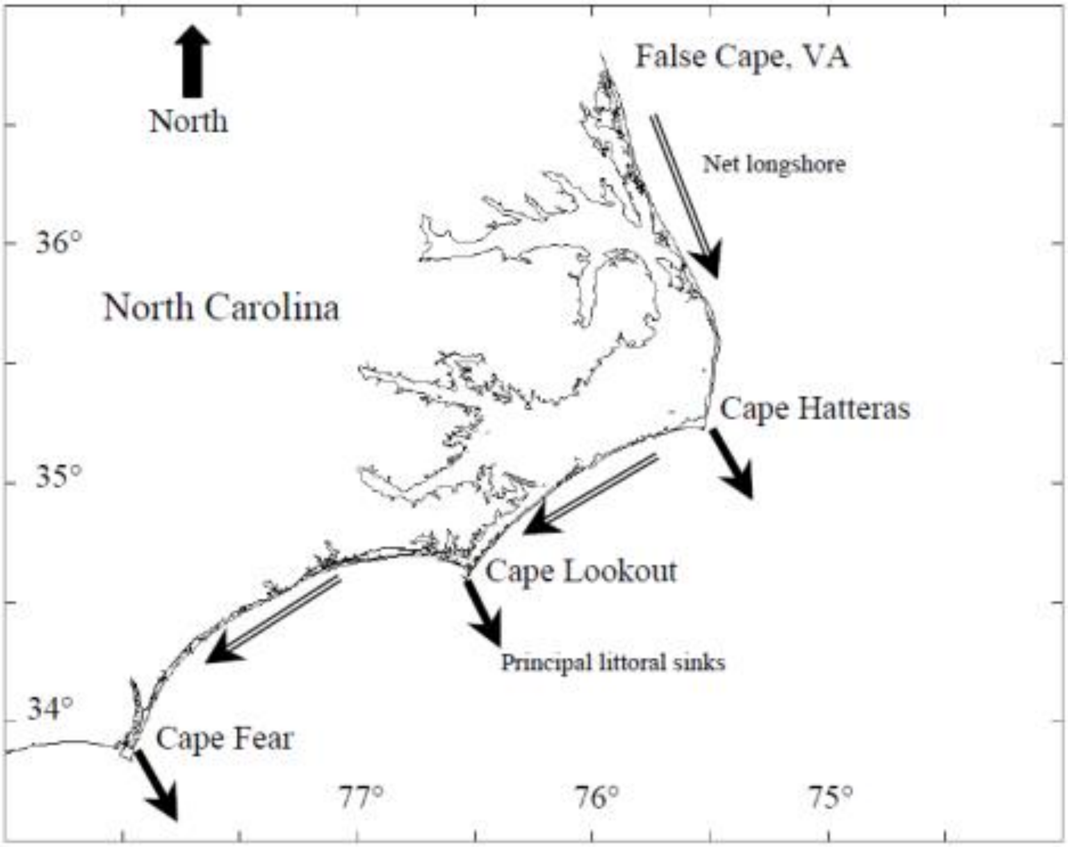

Figure 3-3: Map depicting principal littoral cells and long-term sediment sinks offshore NC (Figure from McNinch et al. 1999)

3.1.5. Tidal Conditions

Water level fluctuations in the vicinity of the project are primarily due to astronomical tides, storm surge, and wave-induced setup. These tidal conditions affect the movement of sediment, with storm events impacting shoaling of channels and development of inlets. Currents in inlets and channel can be generated by tides, which in turn can influence the morphology of the beach and create localized hotspots.

NOAA has several historical and active tide stations in the vicinity of Oak Island. Southport, Oak Island, and Sunset Beach Pier are historical tide stations, while Wrightsville Beach and Wilmington, NC are currently operable tide stations (Figure 3-4).

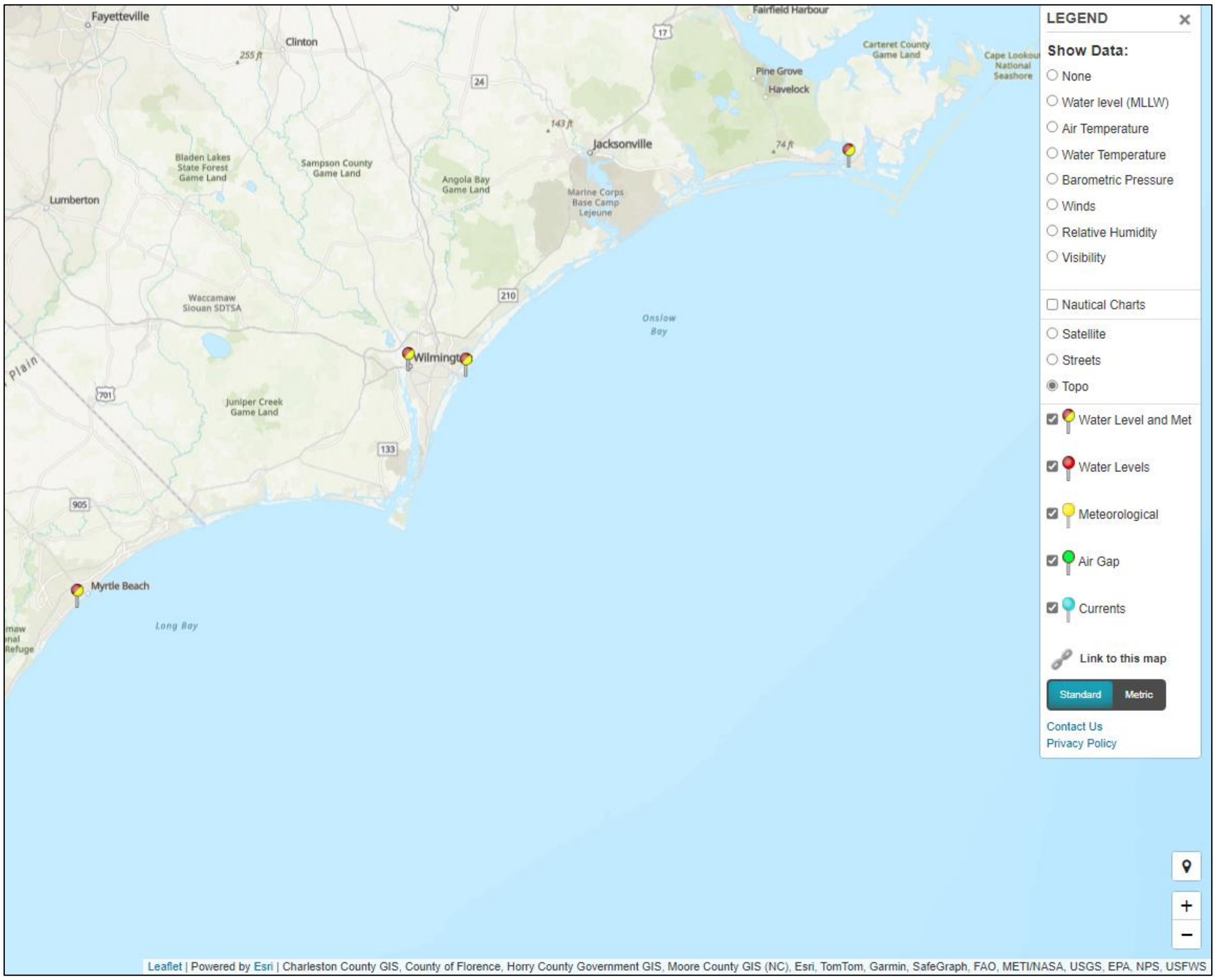

Figure 3-4: Historical and active tide stations in the vicinity of Oak Island

NOAA's published tidal datum indicates a range of 5.27 ft between Mean Higher High Water (MHHW) and Mean Lower Low Water (MLLW), with a range of 4.72 ft between Mean High Water (MHW) and Mean Low Water (MLW). The buoy is located approximately 15 miles southeast of Oak Island.

Wind/Wave Climate

On the inner shelf of Long Bay, local wind stress is the principal driver of alongshore currents, while tides are responsible for much of the cross-shelf current (Pietrafesa et al., 1985). Wind-driven currents are strongly correlated with synoptic scale (2 to 14 days), wind events that are driven by low/high pressure systems and associated cold/warm fronts. Results from wave hindcast studies indicate that the ocean wave climate along the western flank of Cape Fear is dominated by small (mean = three feet), short period (mean = 5.2 seconds) wind waves out of the southeast sector (Jensen, 2010). During the spring and summer, prevailing winds are out of the southwest, and the predominant direction of wave approach is from the south. As the prevailing winds shift to the northeast in the fall, the predominant direction of wave approach shifts to the southeast. During the winter, the prevailing winds are out of the north-northwest, and the predominant direction of wave approach is from the east. The wave climate is influenced by Cape Fear and its associated shoal complex, Frying Pan Shoals, which shelter the west-adjacent Brunswick County beaches from the high-energy northeast winds and waves that otherwise dominate the region. The sheltering effect results in a relatively low-energy nearshore wave regime dominated by small, short-period, southerly waves (Jensen 2010).

There are several sources of wave data in the vicinity of the project. Three directional wave buoys have been employed by the National Data Buoy Center (NDBC) and the USACE Wave Information Studies (WIS) wave hindcast simulation archive. The NDBC measurements include wave heights, period, and direction collected approximately hourly. The WIS archive includes simulated wave heights, period, and direction at one-hour intervals for a period of 34 years from 1980-2021. In addition, UNCW's Coastal Ocean Research Program (CORMP) maintains a wave buoy offshore of Sunset Beach (SSBN7) which has data from 2012 – 2018.

Data indicates that offshore of Oak Island, waves are predominantly from the south-southwest through the east-southeast sectors, with measured significant wave heights predominantly between 0.5 m (1.6 ft) and 2.0 m (6.6 ft). Measured significant wave heights exceed 2.0 m (6.6 ft) approximately 3.2% of the time, and they exceed 2.5 m (8.2 ft) approximately 1.0% of the time.

3.1.6. Water Quality

The North Carolina Division of Water Quality (NCDWQ) assigns a primary surface water classification to all surface waters in North Carolina. Each classification must meet a specific set of water quality standards. All ocean waters within the project area are classified as SB waters, which support primary recreation, including frequent and/or organized swimming, and must meet water quality standards for fecal coliform bacteria. All waters of the AIWW, LFI, and the Lower Lockwoods Folly River from the AIWW to SR 1200 have a primary classification of SA. SA waters support commercial shell fishing and are subject to fecal coliform bacteria standards, restrictions on domestic wastewater discharges and specific stormwater control measures. All SA waters are also classified as HQW, which have excellent water quality and/or important functions such as primary nursery areas. Waters of the Lower Lockwoods Folly River are also classified as Special Management Strategy Waters in accordance with 15A NCAC 2B .0227 (Water Quality Management Plans).

3.1.7. Air Quality

The Clean Air Act (CAA), as amended (42 U.S.C. 7401 et seq.), requires Federal actions to conform to an approved state implementation plan (SIP) designed to achieve or maintain an attainment designation for air pollutants as defined by the National Ambient Air Quality Standard (NAAQS). The NAAQS were designed to protect public health and welfare. The criteria pollutants include carbon monoxide (CO), ozone (O3), nitrogen dioxide (NO2), sulfur dioxide (SO2), particulate matter (PM2.5 and PM10; particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 and 10 microns), volatile organic compounds (VOC), and lead (Pb). The General Conformity Rule (40 CFR Parts 51 and 93) implements these requirements for actions occurring in air quality nonattainment areas.

The U.S. Environmental Protection Agency (USEPA) (40 CFR § 81.310) designates air quality compliance on a county level. A review of USEPA data indicates that the project area is in attainment status for all the criteria pollutants. Brunswick County is included in the nonmetropolitan statistical area of North Carolina's southern coastal plain. The Wilmington Regional Office of the NCDENR has jurisdiction over the air quality in onshore and in state waters, and it has been determined that the ambient air quality for the area complies with the National Ambient Air Quality Standards.

On January 9, 2023, the Council on Environmental Quality (CEQ) issued NEPA Guidance on Consideration of Greenhouse Gas Emissions and Climate Change (CEQ-2022-0005). Recent CEQ NEPA Implementing Regulations (40 CFR 1500-1508) further adopted these requirements into NEPA documents. The CEQ guidance is intended to assist agencies in disclosing and considering the effects of greenhouse gas (GHG) emissions and climate change. Consistent with section 102(2)(C) of NEPA, Federal agencies must disclose and consider the reasonably foreseeable effects of their proposed actions including the extent to which a proposed action and its reasonable alternatives (including the no action alternative) would result in reasonably foreseeable GHG emissions that contribute to climate change.

CEQ defines GHGs as carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons, perfluorocarbons, nitrogen trifluoride, and sulfur hexafluoride. CO2 is the primary GHG emitted from diesel engines. CH4 is emitted to a lesser extent but, over a 100-year period, the emissions of a ton of methane contribute 28 to 36 times as much to global warming as a ton of CO2.

3.1.8. Noise

Existing daytime ambient noise levels for various coastal areas ranged from 55 dBA to 35 dBA (VHB 2020). Nighttime noise levels ranged from 45 dBA to 25 dBA (VHB 2020). Ambient noise levels were lowest in low population density areas and highest in the higher population density areas. Oak Island has a population density of approximately 476 people per square mile and is anticipated to have an ambient daytime noise level of approximately 45 dBA and a nighttime ambient noise level of 35 dBA based on available noise and population density data (VHB, 2020). The project also includes dredging offshore areas away from human activity. Daytime ambient noise levels at these offshore locations are estimated to be 35 dBA and nighttime ambient noise levels are estimated to be 25 dBA based on available noise data and distance to populated areas (VHB, 2020).

Sources of existing underwater noise within the project area include biological sources such as the vocal activity of animals, weather, and anthropogenic sources such as vessel use including commercial shipping operations, recreational watercraft activity and periodic maintenance dredging of federally maintained navigation channels. Fish choruses may increase ambient noise levels by 20 dB (National Research Council [NRC], 2003). Rain can increase ambient noise levels by up to 35 dB (NRC, 2003). Commercial ships can produce noise levels can range from 195 dB at 1 m for fast-moving (>20 knots) supertankers to 140 dB at 1 m for small fishing vessels (NRC, 2003). Small boats with outboard or inboard engines produce sound levels that range from 150 dB to 180 dB at 1 meter (Erbe, 2002, Kipple and Gabriele, 2003 and 2004 as cited in Hildebrand, 2009). Dredge noise can depend on the type and size of dredge used.

A baseline bioacoustics characterization was completed by BOEM for offshore renewable energy development at wind planning areas in North Carolina and Georgia (BOEM 2015). The study recorded ambient noise at three offshore sites in North Carolina and three offshore sites in Georgia. Noise levels produced by fish choruses reached up to approximately 100 dB at the sites. Noise produced by right whale communications was recorded at up to approximately 80 dB at the sites. Vessel noise ranged from 80 dB to 120 dB at the sites. Noise related to weather was recorded at up to 120 dB at times. Based on available data, in-water ambient noise within the project area has been conservatively estimated to be 110 dB.

3.2. Biological Resources

3.2.1. Fish and Wildlife Resources

Terrestrial

The terrestrial environment in the APE includes beach and dune habitats. Dune habitat includes vegetated mounds of unconsolidated sediment found landward of the active beach. Dunes are formed when beach sediments carried by winds encounter resistance from vegetation, which causes the wind to deposit material. Dunes are typically comprised of finer sands, while berms and beach faces are comprised of courser sands (Rogers and Nash, 2003). Dunes are dynamic, with factors such as seasonal fluctuations in wave height and storm activity causing accretion and erosion. Vegetation is essential to maintaining the structure of the dune and is generally hearty, tolerant plants.

Beaches are formed by coastal currents and wave transport, which deposit material. They are dynamic and experience erosion during winter due to rough seas and strong winds. In spring and summer, conditions are typically calmer, and beaches generally experience accretion. The intertidal zone is cyclically exposed due to tides. The dry beach begins at the berm, then slopes upward to the foot of the dune. The intertidal zone is mainly sandy bottom habitat that supports benthic and infaunal organisms, which provide foraging areas for birds and finfish. The dry beach provides habitat for roosting birds and invertebrates. Shorebirds and colonial nesting birds utilize the beach habitat year-round, but primarily in the spring and fall. The beach is important migratory, wintering, and breeding habitat for shorebirds including American oystercatcher, piping plover (*Charadrius melodus*), willet, and Wilson's plover (*C. wilsonia*), as well as colonial nesting water birds including black skimmer, several gulls (laughing, herring, and great black-backed), and several species of terns including gull-billed, Caspian, royal, sandwich, common, Forster's, least, and sooty.

The dry ocean beach is typically without vegetation, but dunes can have a variety of plant species inhabit them such as succulents and grasses, primarily herbaceous species. Some dunes are considered upland hammocks and consist of more maritime shrubs and evergreen forest type species. These hammocks protect from saltwater intrusion and extreme salt spray.

Marine

The marine habitat, or water column, is the area from the surface of the ocean to the ocean floor. The marine water column in the project vicinity provides habitat for a variety of species. The marine water column is a medium for ocean organisms to survive in. It connects all other habitat types because it is the key to fish movement between each habitat. In the water column, sunlight can reach aquatic plants and algae and allows oxygen and other essential dissolved nutrients to be delivered to aquatic plants and animals. The marine water column is especially important for pelagic fish species. Some pelagic species also rely on the nearshore boundary of the marine water column as nursery habitats. Fish larvae are an important piece of the zooplankton community in the marine water column and certain species are more abundant at various times of the year. The marine water column provides transportation of fish eggs and larvae from spawning grounds to nursery and foraging areas. Additionally, all fish use this habitat to forage for food. In the marine water column, there is typically a high level of biodiversity and productivity, but the health of the water column has direct effects on the health of all other habitats off the coast of North Carolina. Trawl and dredge bycatch species captured during the Oak Island 2021/2022 renourishment project are summarized below in Table 3-1. The list of species presented is based on observations of NOAA-certified Protected Species Observes onboard the relocation trawler and dredge throughout construction.

Table 3-1: Trawl and dredge bycatch species - Oak Island 2021/2022 renourishment project

Trawl Bycatch Species	Dredge Bycatch Species
Horseshoe Crab	Horseshoe Crab
Blue Crab	Whelk
Spider Crab	Southern stingray
Atlantic blacktip shark	Cownose ray
Atlantic spiny dogfish shark	Clearnose ray
Bonnethead shark	Atlantic stingray
Sand tiger shark	Atlantic menhaden
Thresher shark	Southern Flounder
Sandbar shark	Grouper
Spinner shark	Vermillian snapper
Dusky shark	Spadefish
Unidentified shark	
Southern stingray	

Trawl Bycatch Species	Dredge Bycatch Species
Cownose ray	
Clearnose ray	
Atlantic stingray	
Butterfly ray	
Unidentified ray	
Atlantic croaker	
Atlantic menhaden	
Southern Flounder	
Black drum	
Red drum	
Whiting	
Harvestfish	
Butterfish	
Herring	
Moonfish	
Striped Burr fish	
Sheepshead	
Flounder	
Pompano	
Pufferfish	

Material deposition for beach and berm construction would occur in the nearshore zone which includes ocean waters from below mean low tide to a depth of about 30 ft. NAVD88. Benthic organisms, phytoplankton, and seaweeds are the major primary producers in this community with species of *Ulva* (sea lettuce), *Fucus*, and *Cladocera* (water fleas) being common where suitable habitat occurs. Many species of fish-eating birds are typically found in that area including gulls, terns, cormorants, loons, and grebes.

The water column habitat is further discussed in Section 3.2.2.

Avian

Avian usage of beach and dune habitats is discussed above. The water column, discussed above, and in Section 3.2.2, provides a foraging habitat for colonial sea birds including terns, gulls, brown pelicans, black skimmers, and double crested cormorants. They primarily feed on small fish by plunge diving, skimming the water surface, or diving beneath the water surface. Colonial nesting sea birds are present year-round, but most abundant during spring and fall migration. Non-colonial waterbirds, including common and red-throated loons, diving ducks, bufflehead, common eider, common goldeneye, scaup, horned grebe, and hooded and red breasted mergansers may also occur in marine waters in the vicinity of the project area.

3.2.2. Essential Fish Habitat and Managed Species

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) of 1976, with 1996 and 2006 amendments, mandates the identification and protection of essential marine and anadromous fish habitats by NMFS, regional Fishery Management Councils (FMC), and other agencies. Fishery management plans are developed to provide a basis for the management of their fishery resources. In addition, essential fish habitat is defined for managed species, to support the primary goal of maintaining sustainable fisheries. Federal permitting agencies whose actions could adversely affect managed species and their EFHs must consult with the NMFS regarding a project’s potential EFH effects. This section summarizes the EFH Assessment for this project and is also provided as Appendix I.

EFH is defined in the Magnuson-Stevens Act as, "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH is further clarified with the following definitions: waters - aquatic areas and their associated physical, chemical, and biological properties used by fish, and may include aquatic areas historically used by fish; substrate - sediment, hardbottom, underlying structures, and associated biological communities; necessary - the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and spawning, breeding, feeding, or growth to maturity - stages representing a species' full life cycle where any EFH may be a subset occupied by species during life cycles [South Atlantic Region (SAR) 2008a].

A summary of the managed species and EFH habitat types in the vicinity of the project area is provided in Table 3-2.

Table 3-2: Managed species, fishery councils, and designated EFH in the vicinity of the project area

Species	Life Stages in Vicinity of Project Area	Management Agency	Summary of EFH in Vicinity of the Project Area
Invertebrates			
Brown shrimp (*Farfamtepenaeus azteucs*)	Egg, Larvae, Juvenile, Adult	SAFMC	
Pink shrimp (*Farfantepenaeus duorarum*)	Egg, Larvae, Juvenile, Adult	SAFMC	Offshore marine, inshore nursery areas (non-vegetated flats)
White shrimp (*Litopenaues setiferus*)	Egg, Larvae, Juvenile, Adult	SAFMC	
Spiny lobster *(Panulirus argus)*	ALL	SAFMC	Nearshore/oceanic waters, shallow subtidal bottom, soft sediments, and live/ hardbottom
Snapper-Grouper Management Unit			
Black sea bass (*Centropristis striata*)	Larvae, Juvenile, Adult	SAFMC	Live/hardbottom, artificial reefs, water column, soft sediments
Gray snapper *(Lutjanus griseus*)	Juvenile	SAFMC	
Coastal Migratory Pelagic Species			
Spanish mackerel (*Scomberomorous maculatus*)	Juvenile, Adult	ASMFC/ MAFMC	
King mackerel (*Scomberomorous cavalla*)	Juvenile, Adult	SAFMC	Sandy shoals of capes and offshore bars, high profile rock bottom, water column from surf to shelf break zone
Cobia (*Rachycentron canadum*)	Egg, Larvae, Juvenile, Adult	SAFMC	
Coastal Demersal			
Red drum (*Sciaenops ocellatus*)	Egg, Larvae, Juvenile, Adult	ASFMC	Soft sediments, ocean high salinity surf zones, artificial reef

Species	Life Stages in Vicinity of Project Area	Management Agency	Summary of EFH in Vicinity of the Project Area
Bluefish (*Pomatomus saltarix*)	Egg, Larvae, Juvenile, Adult	ASFMC/ MAFMC	Pelagic waters
Summer flounder (*Paralichthys dentatus*)	Larvae, Juvenile, Adult	ASFMC/ MAFMC	Waters over the Continental Shelf to depths of 500 ft deep
Atlantic butterfish *(Peprilus triacanthus)*	Adult/ Juvenile	MAMFC	Pelagic waters
Highly Migratory			
Spiny dogfish (*Squalus acanthias*)	Juvenile, Adult	NOAA	Pelagic and epibenthic habitats
Sandbar shark (*Carcharhinus plumbeus*)	Juvenile, Adult	NOAA	Atlantic coastal waters, sand, mud, shell, and rocky benthic habitat
Atlantic sharpnose shark (*Rhizoprionodon terraenovae*)	Neonate, Juvenile, Adult	NOAA	Inshore and nearshore waters, offshore waters to 180 meters
Spinner shark *(Carcharhinus brevipinna)*	Neonate, Juvenile/Adult	NOAA	Coastal areas to 90-meter depth, sandy bottoms,
Scalloped hammerhead shark *(Sphyrna lewini)*	Juvenile/Adult	NOAA	Atlantic Ocean from NC to Florida Keys
Tiger shark *(Galeocerdo cuvier)*	Neonate, Juvenile/Adult	NOAA	Atlantic coastal waters, offshore pelagic habitats from continental shelf break to seaward extent of U.S. EEZ boundary
Blacktip Shark (Atlantic stock) *(Carcharhinus limbatus)*	Juvenile/Adult	NOAA	Atlantic coastal waters, shell, sand, and rocky habitats
Blacknose shark (Atlantic stock) *(Carcharhinus acronotus*	Juvenile/Adult	NOAA	Coastal areas within 90 m from shore
Smoothhound shark (Atlantic stock*) (Mustelus mustelus*)	ALL	NOAA	Atlantic coastal waters
Bonnethead shark (Atlantic stock) *(Sphyrna tiburo)*	Juvenile/Adult	NOAA	Atlantic east coast inshore and nearshore waters
Sand tiger shark *(Carcharias taurus)*	Neonate/Juvenile Adult	NOAA	Atlantic coastal waters, rocky and mud substrate
Dusky Shark (*Carcharhinus obscurus*)	Juvenile/Adult	NOAA	Coastal and pelagic waters
Anadromous			
Atlantic sturgeon (*Acipenser oxyrhynchus*)	Adult	ASMFC	
Shortnose sturgeon (*Acipenser brevirostrum*)	Adult	ASMFC	Marine water column, soft bottom habitat[1]
Striped bass (*Morone saxatillis*)	Juvenile, Adult	ASMFC	
American shad (*Alosa sapidissima*)	Juvenile, Adult	ASMFC	

An additional habitat designation authorized by the FMCs is HAPCs. These are EFH partitions of rare, ecologically important, highly susceptible to human degradation, or environmentally stressed areas. Several HAPCs are designated within North Carolina waters including, but not limited to tidal inlets, primary nursery areas, secondary nursery areas, submerged aquatic vegetation (SAV), mangroves, oystery/shell habitat, hardbottom, and the sandy shoals of Capes Lookout, Cape Fear, and Cape Hatteras (SAFMC 1998). There are no HAPCs within the project area. However, tidal inlets, nursey areas, the Cape Fear River sandy shoal, and hardbottom do occur within the vicinity of the project area.

3.2.3. Threatened and Endangered Species

There are a total of 20 federally listed species that may occur within the project area, including six marine mammal species, four bird species, five sea turtle species, two fish species, two elasmobranch species, and one plant species (Table 3-3). These species are discussed in additional detail in below. Existing Endangered Species Act (ESA) Section 7 programmatic consultations applicable to this project include the 2020 South Atlantic Regional Biological Opinion (SARBO) for Dredging and Material Placement Activities in the Southeast United States (NMFS, 2020) and North Carolina Coastal Beach Sand Placement Statewide Programmatic Biological Opinion (USFWS, 2017a). All applicable conservation measures, Project Design Criteria (PDC), Reasonable and Prudent Measures (RPMs), and Terms and Conditions (T&Cs), etc. will be adhered.

Table 3-3: Federally listed species and critical habitat under the Endangered Species Act

Common Name	Scientific Name	Agency	Status	Critical Habitat
Fish				
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	NMFS	Endangered	Occurs in area
Shortnose sturgeon	*Acipenser brevirostrum*	NMFS	Endangered	None designated
Sea Turtles				
Leatherback sea turtle	*Dermochelys coriacea*	NMFS, USFWS	Endangered	Not present
Loggerhead sea turtle	*Caretta caretta*	NMFS, USFWS	Threatened	Occurs in area
Green sea turtle	*Chelonia mydas*	NMFS, USFWS	Threatened	Proposed in area
Hawksbill sea turtle	*Eretmochelys imbricata*	NMFS, USFWS	Endangered	Not present
Kemp’s ridley sea turtle	*Lepidochelys kempii*	NMFS, USFWS	Endangered	Not present
Marine Mammals				
North Atlantic right whale	*Eubalaena glacialis*	NMFS	Endangered	Occurs in Area
Fin Whale	*Balaenoptera physalus*	NMFS	Endangered	None designated
Sei Whale	*Balaenoptera borealis*	NMFS	Endangered	None designated
Blue Whale	*Balaenoptera musculus*	NMFS	Endangered	None designated
Sperm Whale	*Physeter macrocephalus*	NMFS	Endangered	None designated
West Indian manatee	*Trichechus manatus*	USFWS	Endangered	Not present
Elasmobranchs				
Smalltooth sawfish	*Pristis pectinata*	NMFS	Endangered	Not present
Giant Manta Ray	*Manta birostris*	NMFS	Threatened	None designated

Common Name	Scientific Name	Agency	Status	Critical Habitat
Birds				
Piping plover	*Charadrius melodus*	USFWS	Threatened	Occurs in area
Red knot	*Calidris canutus rufa*	USFWS	Threatened	Proposed in area
Wood stork	*Mycteria americana*	USFWS	Threatened	None designated
Roseate Tern	*Sterna dougallii dougallii*	USFWS	Endangered	None designated
Plants				
Seabeach amaranth	*Amaranthus pumilus*	USFWS	Threatened	None designated

Fish Species (Shortnose Sturgeon and Atlantic Sturgeon)

Atlantic Sturgeon

The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus)* was listed under the Endangered Species Act (ESA) in 2012 as five distinct population segments (DPS). Atlantic sturgeon relies on freshwater for spawning and embryo transfers, and marine waters for growth (NMFS, 2020a). As the larvae develop, they gradually move downstream toward estuaries. Young-of-the-year are typically found in freshwater environments but can be found in estuaries. Juveniles occur in estuarine environments for their first two years, but as they become more salt tolerant in their subadult and adult life phases they begin moving out into marine waters however they still regularly occur in estuaries. Adult sturgeon resides in marine nearshore waters for much of their life but migrate to the rivers they were born to spawn (Wirgin et al., 2002). When sturgeon are in the open ocean, they typically occur within the 50-meter depth contour over sand and gravel substates (NMFS, 2020a). They are bottom feeders and adults feed on mollusks, amphipods, gastropods, annelids, decapods, isopods, and small fish, while juveniles feed on aquatic insects, insect larvae, and other invertebrates. (Atlantic Sturgeon Review Team, 2007).

Atlantic sturgeon could occur in the project area during any time of the year. Winter is the primary time of year (November – March) when both immature and mature life stages of Atlantic sturgeon would be most likely to occur in the ocean off the Cape Fear Inlet (Personal communications, F. Scharf, 2024). Preliminary data suggests that migratory juveniles and subadults leave Cape Fear River in November and December and re-enter the river in March and April. Adults typically stage off South Carolina and move up the coast to enter the Cape Fear River in February and March for their spring spawning run. The adults emigrate in late April and early May and generally head north to spend the summer in the ocean waters of the mid-Atlantic (Personal communications, F. Scharf, 2024). Based on incidental capture data from tagging cruises, shallow nearshore ocean waters along the North Carolina coast may represent a winter (January - February) aggregation site for Atlantic sturgeons (Laney et al., 2007). During the Oak Island 2021/2022 renourishment project, which lasted for 59 days from February 20, 2022, to April 20, 2022, the Town of Oak Island voluntarily chose to trawl and relocate sea turtles to mitigate risk of entrainment by the hopper dredge. Twenty-seven (27) Atlantic sturgeon were incidentally captured as a component of these sea turtle relocation trawling activities. The size class of the 27 Atlantic sturgeon incidentally captured within the Jay Bird Shoals borrow area ranged in total length (TL) from 20.3 in to 77.5 in (Table 3-4). This data was provided by NOAA-certified Protected Species Observers onboard the relocation trawler. Data were reported to agencies and documented.

Table 3-4: Town of Oak Island's 2022 Atlantic Sturgeon relocation data

Date	Tow #	Species Capture #	TL (in)	TL (ft)	PIT Tag
02/23/22	240	1	20.3	1.69	989001039097911
02/24/22	290	2	41.8	3.48	989001039097846
02/24/22	290	3	77.5	6.46	989001039097876
02/27/22	387	4	27.6	2.3	989001039097821
03/02/22	529	5	29.2	2.43	989001039097835
03/03/22	544	6	41	3.42	989001039097845
03/04/22	572	7	36.5	3	989001038168932
03/05/22	638	8	44.3	3.7	989001039097907
03/07/22	648	9	24.4	2.03	989001039097880
03/07/22	648	10	44.2	3.68	989001039097933
03/08/22	728	11	24.3	2.03	989001038168939
03/13/22	806	12	27.5	2.29	989001038168968
03/13/22	830	13	24	2	989001038168938
03/13/22	830	14	70.9	5.91	989001038168974
03/14/22	840	15	33.3	2.78	989001038168941
03/15/22	904	16	45.1	3.76	989001038168910
03/16/22	927	17	24.1	2.01	989001038168951
03/17/22	956	18	27.4	2.28	989001038168952
03/17/22	967	19	26.5	2.21	989001038168922
03/18/22	990	20	51.4	4.28	989001038168961
03/20/22	1068	21	27.9	2.33	989001039097841
03/21/22	1084	22	26.7	2.23	989001039097932
03/22/22	1120	23	71.1	5.93	989001039097917
03/28/22	1269	24	33.2	2.77	989001039097872
04/10/22	1523	25	60.7	5.06	989001040620521
04/11/22	1529	26	37.3	3.03	989001040620478
04/20/22	1831	27	48.2	4.02	989001040620475

Atlantic sturgeon critical habitat exists at the eastern tip of Caswell Beach and Southport, where the mouth of the Cape Fear River, meets the Atlantic Ocean (Figure 3-5). Critical habitat is outside of the APE, but within the general project vicinity. The PCEs determined essential to the conservation of Atlantic Sturgeon are (82 FR 39160):

- PCE 1 **-** Hardbottom substrate (*e.g.,* rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (*i.e.,* 0.0-0.5 ppt range) for settlement of fertilized eggs and refuge, growth, and development of early life stages.

- PCE 2 **-** Transitional salinity zones inclusive of waters with a gradual downstream gradient of 0.5- up to 30 ppt and soft substrate (*e.g.,* sand, mud) between the river mouths and spawning sites for juvenile foraging and physiological development.

- PCE 3 - Water of appropriate depth and absent physical barriers to passage (*e.g.*, locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouths and spawning sites necessary to support:

  i. Unimpeded movement of adults to and from spawning sites;
  ii. Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and
  iii. Staging, resting, or holding of subadults or spawning condition adults.

  Water depths in main river channels must also be deep enough (at least 1.2 m) to always ensure continuous flow in the main channel when any sturgeon life stage would be in the river.

- PCE 4 - Water quality conditions, especially in the bottom meter of the water column, between the river mouths and spawning sites with temperature and oxygen values that support:

  i. Spawning;
  ii. Annual and inter-annual adult, subadult, larval, and juvenile survival; and
  iii. Larval, juvenile, and subadult growth, development, and recruitment. Appropriate temperature and oxygen values will vary interdependently and depending on salinity in a particular habitat. For example, 6.0 mg/L DO or greater likely supports juvenile rearing habitat, whereas DO less than 5.0 mg/L for longer than 30 days is less likely to support rearing when water temperature is greater than 25 °C. In temperatures greater than 26 °C, DO greater than 4.3 mg/L is needed to protect survival and growth. Temperatures of 13 °C to 26 °C likely to support spawning habitat.

Shortnose Sturgeon

The shortnose sturgeon was listed as endangered under the ESA on March 11, 1967 (32 FR 4001). Shortnose sturgeon are freshwater amphidromous, typically occurring in freshwater environments and estuaries. Unlike the Atlantic sturgeon, shortnose sturgeon distribution does not extend into high salinity areas. When in estuaries they typically stay close to shore in low salinity areas. Juvenile shortnose sturgeon have low salinity tolerances, so they occur primarily in freshwater systems (NMFS, 2020a). They prefer sandy-mud bottom substrates (NMFS, 2010). Shortnose sturgeon use their four barbels and vacuum-like mouth to feed (NMFS, 2010) on crustaceans, worms, insect larvae, and mollusks (NMFS, 1998). Critical habitat for shortnose sturgeon has not been designated.

Shortnose sturgeon are not anticipated to be common in the project area as population occurrence in the Cape Fear River is limited (NC Wildlife, 2023). Additionally, many of the project activities occur in marine and estuarine waters, while shortnose sturgeon distribution is typically limited to freshwater and low salinity waters. Shortnose sturgeon were thought to be extirpated from NC waters until an individual was captured in the Brunswick River in 1987 (Ross et al., 1988). Subsequent gill-net studies (1989-1993) resulted in the capture of five shortnose sturgeons, thus confirming the presence of a small population in the lower Cape Fear River (Moser and Ross, 1995).

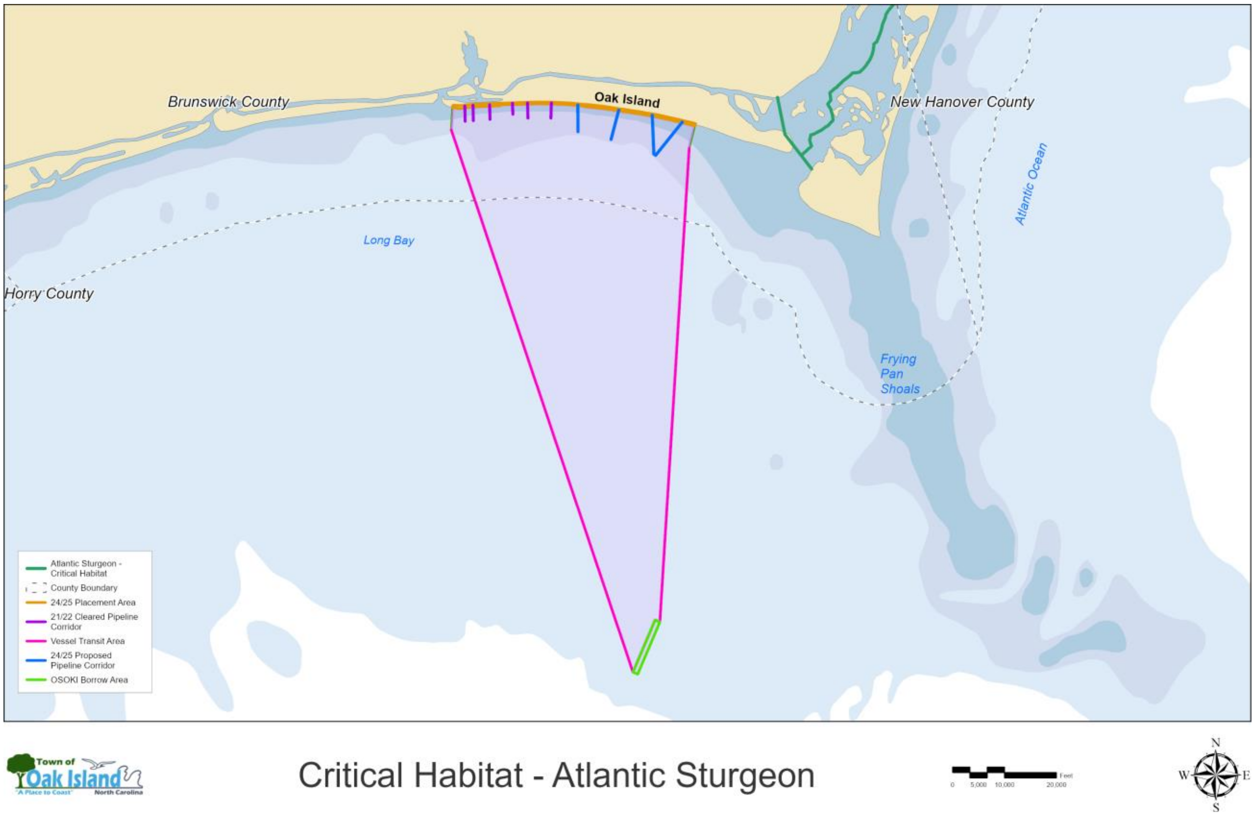

Figure 3-5: Atlantic Sturgeon critical habitat map

<u>Sea Turtles (Leatherback, loggerhead, green, hawksbill, and Kemp's ridley sea turtle)</u>

Leatherback, loggerhead, green, hawksbill and Kemp's ridley could occur in the project area. Of the five sea turtle species that could occur in the project area, loggerhead sea turtles are the most likely to nest within the project area. Green sea turtles occasionally nest in North Carolina, and leatherback, hawksbill, and Kemp's ridley rarely nest in North Carolina.

<u>Leatherback Sea Turtle</u>

The leatherback sea turtle (*Dermochelys coriacea*) was listed as endangered throughout its range on June 2, 1970 (35 FR 8491). Leatherbacks typically occur at temperate latitudes in the summer, early fall, and late spring. In the late fall, winter, and early spring leatherbacks are generally more widely dispersed (Dodge et al., 2014). This seasonal shift is predictably tied to leatherbacks foraging behavior. Leatherbacks feed exclusively on gelatinous zooplankton, which are in high abundance at temperate latitudes, during spring and summer months. Studies have indicated high use areas along the U.S east coast from April to June and October to December (NMFS, 2020b). In the Northwest Atlantic, leatherback sea turtles nest primarily on tropical beaches in Florida, but nesting has also been documented in North Carolina on rare occasions (NMFS, 2020b). Nesting occurs along high energy unobstructed beaches with coarse-grained sand. A steeply sloping littoral zone is also required to limit the distance to dry sand. During the nesting season leatherback sea turtles will remain close to shore within proximity to their nesting beach. Leatherback sea turtle critical habitat does not occur in the project area.

Leatherbacks could occur in the project area; however, their presence is anticipated to be uncommon especially during the colder months when jellyfish prey abundance is low. Leatherbacks are primarily a pelagic species, preferring deep, offshore waters, however they may occasionally occur in nearshore waters foraging especially during spring when prey are available in high numbers. From 2012 to 2022, there have been two documented leatherback strandings on Oak Island (Seaturtle.org, 2023). Nesting could occur in the project area on rare occasions. Sporadic rare nesting activity has occurred in North Carolina, with one nest site being found on Holden Beach in 2010 (Dial Cordy and Associates Inc., 2018).

Loggerhead sea turtle

The loggerhead sea turtle was listed as a part of the ESA in 1978 (43 FR 32800 32811). In North Carolina, loggerheads account for the vast majority of the sea turtle nests. Loggerheads can be found in oceanic waters several miles from shore as well as inshore areas (NMFS, 2009a). Nesting sites can be found across the northwest Atlantic including areas of North Carolina. Nesting for the loggerhead sea turtle occurs on beachfronts and estuarine shorelines. Loggerhead nests are typically found between the mean high-water line and the toe of the dune or line of permanent vegetation (Halls and Randall, 2018). Nests are typically laid on beaches with high-humidity substrate that allows for sufficient gas exchanges as well as temperatures conducive to egg development (NMFS, 2009a).

Loggerheads are anticipated to occur in the project area regularly. Loggerheads are anticipated to be most common in inshore and nearshore waters from spring to early winter and would be anticipated to move offshore during the late fall and early winter to warmer waters. From 2012 to 2022, there have been 47 documented loggerhead strandings on Oak Island (Seaturtle.org, 2023). Loggerhead sea turtles are also likely to nest in the project area with nesting occurring from late May to early August (Halls and Randall, 2018). In 2022, approximately 138 nests were recorded on Oak Island (Seaturtle.org, 2023).

Loggerhead critical habitat occurs in the project area (Figure 3-6). Loggerhead critical habitat in the Atlantic includes a total of 38 units and encompasses approximately 400 km of the Atlantic Ocean shoreline. Of these 38 units, LOGG-N-02 and LOGG-N-05 occur in the project area. LOGG-N-02 is wintering habitat that extends from the 20 m depth contour to the 100 m depth contour. LOGG-N-05 is nearshore reproductive habitat that extends from the MHW line seaward 1.6 km. LOGG-N-02 does not occur within the project footprint but does occur in the vicinity of the project area, approximately 22 miles from OSOKI. LOGG-N-05 overlaps with the proposed project footprint (Figure 3-5).

The PCEs determined essential to the conservation of North Atlantic Loggerheads t are identified by habitat type below:

Nearshore reproductive habitat: A portion of the nearshore waters adjacent to nesting beaches that are used by hatchlings to egress to the open-water environment as well as by nesting females to transit between beach and open water during the nesting season. The following PCEs support this habitat:

- PCE 1 - Nearshore waters directly off the highest density nesting beaches and their adjacent beaches, as identified in 50 CFR 17.95(c), to 1.6 km offshore;
- PCE 2 - Waters sufficiently free of obstructions or artificial lighting to allow transit through the surf zone and outward toward open water; and
- PCE 3 - Waters with minimal manmade structures that could promote predators (*i.e.*, nearshore predator concentration caused by submerged and emergent offshore structures), disrupt wave patterns necessary for orientation, and/or create excessive longshore currents.

Wintering habitat PCEs: Warm water habitat south of Cape Hatteras near the western edge of the Gulf Stream used by a high concentration of juveniles and adults during the winter months. PCEs that support this habitat are the following:

- PCE 1 - Water temperatures above 10 °C from November through April;
- PCE 2 - Continental shelf waters in proximity to the western boundary of the Gulf Stream; and

- PCE 3 - Water depths between 20 and 100 m.

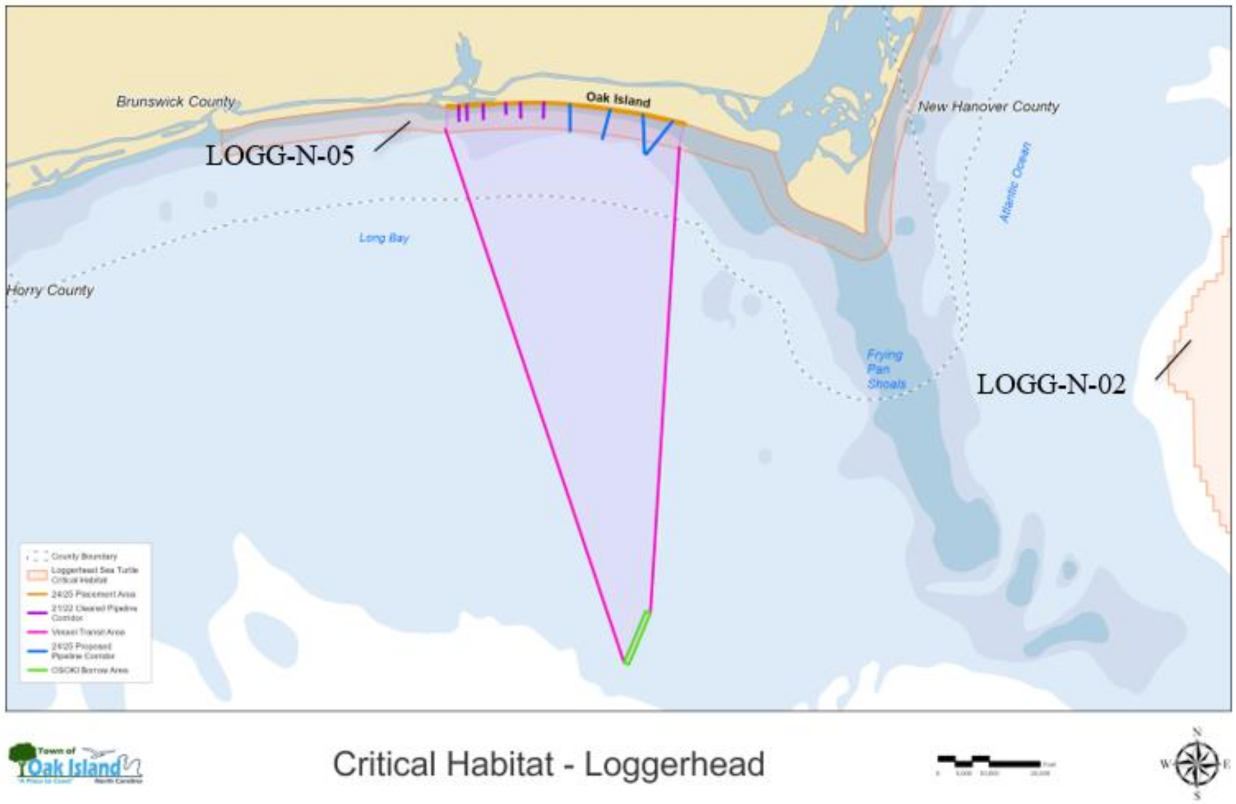

Figure 3-6: Loggerhead Turtle critical habitat at Oak Island

<u>Green sea turtle</u>

The Green sea turtle was listed under the ESA in 1978 (43 FR 32800 32811). According to NMFS (2015a), green sea turtle post-hatchlings move to oceanic waters before returning to the continental shelf waters. Juveniles and adults typically remain in the neritic zone but may periodically move between the neritic zone and oceanic zones. Green sea turtles typically forage in nearshore reefs, seagrass beds, inshore bays, and estuaries. They forage for benthic macroalgae and seagrass. In the North Atlantic, the majority of nesting occurs in Costa Rica, Mexico, the Florida coast of the U.S., and Cuba, but nesting has been documented in smaller numbers along the shores of North Carolina (NMFS, 2015a). Between 4 and 44 nests are laid annually in North Carolina (USFWS, 2017a). Green turtles nest at night at the base of primary dunes predominantly on beaches that typically have intact dunes, native vegetation, and no artificial lighting (NMFS, 2015a). A study showed that green sea turtles prefer nesting at the base of the primary dune, on beaches that receive high wave energy, and have coarse sands, steep slopes, and prominent foredunes (Witherington et al., 2006).

Green sea turtles could occur in the project area. They have been recorded off southeastern NC year-round (DoN, 2008). From 2012 to 2022, there have been 14 documented green sea turtle strandings on Oak Island (Seaturtle.org, 2023). They are anticipated to be most common in inshore and nearshore waters from spring to early winter and would be anticipated to move offshore during the late fall and early winter to warmer waters. Nesting individuals may also occur in the project area in low numbers. In 2022, zero nests were recorded for Oak Island (Seaturtle.org, 2023). It is anticipated that nesting and hatching individuals may occur in the project area from May 15 through November 15.

Critical habitat was proposed within the project area for the North Atlantic DPS of green sea turtles on July 19, 2023 (88 FR 46572). Proposed critical habitat includes waters from the MHW line to a 20-meter depth from North Carolina to South Carolina as well as sargassum habitat from the 10-meter depth or the edge of the Gulf Stream to the Exclusive Economic Zone (EEZ). The following features were determined essential to the conservation of North Atlantic green sea turtles that could be present within the Action Area are identified below (88 FR 46572).

- Reproductive essential feature: From the mean high-water line to 20 m depth, sufficiently dark and unobstructed nearshore waters adjacent to nesting beaches proposed as critical habitat by USFWS, to allow for the transit and mating of reproductive individuals and the transit of post-hatchlings.
- Migratory essential feature: From the mean high-water line to 20 m depth, sufficiently unobstructed corridors that allow for unrestricted transit between foraging and nesting areas for reproductive individuals.
- Benthic foraging/resting essential feature: From the mean high-water line to 20 m depth, underwater refugia (e.g., sandy troughs, hardbottom substrates, and Sabellariid worm reefs) and food resources (i.e., seagrass, marine algae, and/or invertebrates) of sufficient condition, distribution, diversity, abundance, and density necessary to support survival, development, growth, and/or reproduction.
- Surface-pelagic foraging/resting essential feature: Convergence zones, frontal zones, surface-water downwelling areas, the margins of major boundary currents, and other areas that result in concentrated components of the sargassum-dominated drift community, as well as the currents which carry turtles to Sargassum-dominated drift communities, which provide sufficient food resources and refugia to support the survival, growth, and development of post-hatchlings and surface-pelagic juveniles, and which are located in sufficient water depth (at least 10 m) to ensure offshore transport via ocean currents to areas which meet forage and refugia requirements.

Hawksbill sea turtle

The hawksbill sea turtle (*Eretmochelys imbricata*) was listed as endangered on June 2, 1970 (35 FR 8491). Hawksbills are typically found utilizing rocky areas, coral reefs, shallow coastal areas, lagoons or oceanic islands, and narrow creeks, and rarely seen in water deeper than 65 feet. They primarily feed on sponges, but may also eat algae, corals, mollusks, crustaceans, tunicates, small fish, jellyfish, and sea urchins (NMFS, 2023a). Hawksbills nest at night high up on the beach under or in vegetation. They typically nest at beaches with rocky approaches and little to no sand (NMFS, 2023a). Within the United States, nesting is rare (NMFS, 2013). Nests have only been identified within the U.S along the shores of Florida and North Carolina. Two nests have been identified in North Carolina, both in 2015 (USFWS, 2017a). Hawksbill critical habitat does not occur in the project area.

Foraging hawksbills may occur in the project area, but occurrences are very rare. Hawksbill sea turtles rarely nest in North Carolina. From 2012 to 2022, there have not been any documented hawksbill strandings on Oak Island (Seaturtle.org, 2023). Therefore, it is unlikely that individuals would be present within the project area.

Kemp’s ridley sea turtle

The Kemp’s ridley sea turtle was listed as endangered throughout its range under the ESA on December 2, 1970 (35 FR 18319). Kemp’s ridley sea turtles occur primarily in coastal waters of the Gulf of Mexico and the western North Atlantic Ocean. They typically occur in waters less than 120 ft deep but are occasionally found in deeper offshore waters (NMFS, 2020a). Kemp’s ridley typically feed on crabs, mollusks, sea horses, jellyfish, and cownose rays (NMFS, 2015b). They use a variety of substrates for foraging activities, including oyster reefs, seagrass beds, sandy and mud bottoms (NMFS, 2015b). Nesting is essentially limited to the western side of the Gulf of Mexico, primarily to the northeastern coast of Mexico, although rare nesting events have been recorded from the southeastern US (NMFS, 2015b). Ninety-five percent of nesting occurs in Tamaulipas (NMFS, 2022a). Kemp's ridley critical habitat does not occur in the project area.

Kemp's ridley could occur in the project area. From 2012 to 2022, there have been 53 documented Kemp's ridley strandings on Oak Island (Seaturtle.org, 2023). Their occurrence in nearshore waters is anticipated to be more common from the spring to early winter (April to November). Kemp's Ridley would be anticipated to move offshore during the late fall and early winter to warmer waters. Kemp's ridley sea turtles rarely nest on the shores of North Carolina (NMFS 2015b, McGrath 2023). Therefore, it is unlikely that Kemp's ridley would occur nesting in the project area during the proposed project.

Whales (North Atlantic Right, Fin, Sei, Blue and Sperm Whale)

Several species of whales have the potential to occur in the project area. A North Atlantic whale calving area has been designated in the project area and it is anticipated that North Atlantic Right Whale could occur in the project area, especially during winter months. Fin whales, sei whales, blue whales, and sperm whales could occur in the project area, however their presence is anticipated to be rare as they are more commonly associated with deep offshore water that would not be impacted by the proposed project. Additional species information is discussed below.

<u>North Atlantic Right Whale</u>

The North Atlantic right whale was listed as endangered in April 2006 (73 FR 12024). North Atlantic Right Whales are filter feeders and feed on dense patches of copepods and other zooplankton (NMFS, 2023b). Right whales can be found throughout the water column from surface waters to deep bottom waters. The North Atlantic right whale distribution primarily includes wintering and calving areas in coastal waters along the southeastern U.S to feeding grounds in New England as well as the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence (NMFS, 2022b). Mothers and newborn calves reside within the southeast through winter and generally depart the calving grounds by the end of March or early April (Reeves et al., 2001).

North Atlantic right whales could occur throughout the project area, particularly during winter months. The North Carolina coastline is a potential calving/wintering ground for the North Atlantic right whale and is a part of their migratory corridor. Data regarding right whale movements and distribution along the North Carolina coastline and greater mid-Atlantic region is limited. According to a report by the U.S. Navy, North Atlantic right whales have been spotted off the coast of North Carolina, but sightings were comprised of a single, possibly transient, individual (DoN 2008). Acoustical right whale surveys conducted in 2012 off the coast of North Carolina from June 2012 through April 2013 detected North Atlantic right whales during 7 of the 11 monitored months (Hodge et al. 2015). Of the monitored months, North Atlantic right whales were not detected in August, October, November, and April while peak detections occurring in winter. Knowlton et al. (2002) analyzed North Atlantic right whale sightings between 1974 and 2002 and found that 94.1% of all sightings are within 30 nm of the coast, and well over half of the sightings (63.8%) were found within 10 nm of the coast. Sightings near Morehead City and Wilmington are seen in October through April, with peak sightings being recorded in March and February (Knowlton et al., 2002). Critical habitat was designated in 2016 and includes a calving area located off the coast of North Carolina, South Carolina, Georgia and Florida (Figure 3-7). The project area is within the critical habitat.

The physical features essential to the conservation of the North Atlantic right whale, are:

- Sea surface conditions associated with Force 4 or less on the Beaufort Scale
- Sea surface temperatures of 7°C to 17°C

- Water depths of 6 to 28 m, where these features simultaneously co-occur over contiguous areas of at least 231 nmi² of ocean waters during the months of November through April.

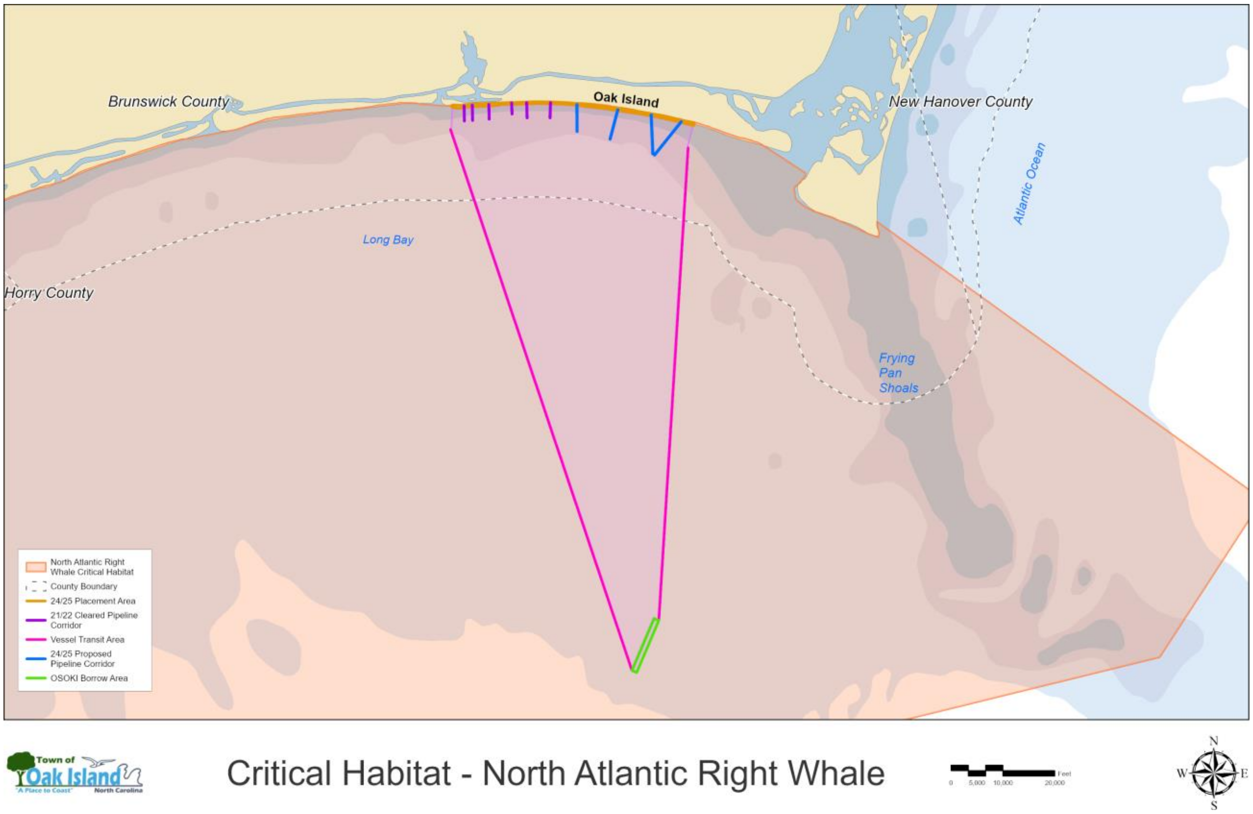

Figure 3-7: Northern Right Whale critical habitat map

<u>Fin Whale</u>

The fin whale was listed as endangered under the ESA in 1970 (35 FR 18319). They are typically found in deep offshore waters at temperate and polar latitudes. Fin whales are filter feeders and feed on krill, small fish, and squid. Fin whales can be found year-round along the U.S East Coast in areas primarily north of 35° N. While the proposed project is located south of 35° N at approximately 33°51' N, studies have indicated that fin whales may be present year-round north of 30° N (Edwards et al., 2015). Fin whales typically feed in the Gulf of Maine and waters near New England. Little information exists about their mating, calving, and wintering patterns. Critical habitat has not been designated for fin whales.

Fin whales may occur in the project area year-round, however their presence is anticipated to be uncommon. The proposed activities occur at approximately 33°51' N, a latitude that fin whales may occasionally occur at, but are not anticipated to occur frequently. Fin whales may occur on rare instances within proximity to the offshore borrow area. Fin whales would not be anticipated to occur within proximity to the nearshore borrow area or placement areas.

<u>Sei Whale</u>

The sei whale was listed as endangered under the ESA in 1970 (35 FR 12222). Sei Whales can be found in subtropic, temperate, or subpolar waters, but densities are often highest in mid-latitude temperate regions. They tend to inhabit deep waters far from the coastline in deep basins or along the continental slope. They are opportunistic feeders which a diverse diet, but typically feed on plankton, small schooling fish and cephalopods (NMFS, 2021a). They feed by filtering prey through their baleen and in the North Atlantic, they have been observed skim feeding. Critical Habitat has not been designated for Sei whales.

Sei whales are anticipated to be uncommon in the project area. The NOAA Passive Acoustic Cetacean Map has recorded Sei whale detection within 50 miles of the proposed Project (NMFS, 2023c). Given the limited distribution data, unpredictable nature of the species, and occasional detections within the vicinity of the project area, it has been conservatively assumed that Sei whales could occur within the project area near the offshore borrow area on rare occasions. Sei whales would not be anticipated to occur within proximity to the nearshore borrow area or placement areas.

Blue Whale

The blue whale was listed throughout its range as endangered under the ESA in 1970 (35 FR 18319). Krill is the main diet of blue whales, but they may also feed on fish and copepods (NMFS, 2023d). Blue whales filter feed on large schools of krill, using their baleen plates to trap the krill in their mouth (NMFS, 2023d). They can feed at surface level or at depths up to 100 meters (NMFS, 2020c). Blue whales seasonally migrate from winter breeding ground to summer feeding grounds and occur throughout the North Atlantic Ocean (NMFS, 2023d). No critical habitat has been designated for the blue whale.

It is considered unlikely that blue whales would occur within the project area as they are typically associated with areas north of the proposed project (NMFS, 2020c). Information regarding breeding areas is limited, however recent tracking studies indicate that they may use Mid-Atlantic Bight as a breeding and calving area. Their use of this area off the US eastern coast is mainly limited to deep offshore waters that would not be anticipated to be impacted by the proposed project.

Sperm Whale

The sperm whale was listed as endangered under the ESA in 1970 (35 FR 8491 8498). They exhibit social behavior and form various types of groups, including nursery schools, mixed schools, juvenile schools, bachelor schools, bull schools, and solitary bulls. These groups usually comprise of 20-40 individuals (NMFS, 2020d). Sperm whales tend to inhabit waters with a depth of 1970 ft or more and rarely appear in depths less than 985 ft (NMFS, 2021b). Their primary prey is large squid along with some sharks and large fish. Critical Habitat has not been designated for Sperm whales.

It is considered unlikely that sperm whales would occur in the project area. Sperm whale distribution is typically centered north of the project area. In the winter, they are typically found to the east and northeast of Cape Hatteras which is situated 175 miles northeast of the proposed project and during the remaining months their distributions shifts further northward. Furthermore, sperm whales typically occur in deep offshore waters that would not be anticipated to be impacted by the proposed project. In 2013 and 2017, a Sperm whale was reported beached along and coast of North Carolina (NMFS, 2020d).

West Indian Manatee

West Indian manatees were initially listed as endangered under the ESA but were later reclassified as threatened in 2017 (82 FR 16668). West Indian manatees reside in marine, brackish and freshwater systems near coastal areas that have underwater vegetation, specifically seagrass and eelgrass (USFWS, 2023a). West Indian manatees prefer shallow water environments (NWF, 2023) with temperatures no lower than 68 degrees (USFWS, 2023a). Habitats include slow-moving rivers, estuaries, saltwater bays, canals and coastal areas (NWF, 2023). Manatees are intolerant of cold-water temperatures and therefore their distribution is generally limited to areas with water temperatures above 68°F (USFWS, 2023a). West Indian manatees typically feed on aquatic plants such as cordgrass and eelgrass, occasionally feeding on fish and invertebrates as well (NWF, 2023).

West Indian manatees may occur in shallow waters within the project area during warmer weather months. West Indian manatees are known to occur in the inland and coastal waters of North Carolina for at least five months of the year (June through October) when water temperatures exceed 68°F (Cummings et al., 2014). Sightings dropped off considerably in November and appear to be completely absent from December through February (Cummings et al., 2014). West Indian manatee critical habitat does not occur in the project area.

Elasmobranchs (Smalltooth sawfish, giant manta ray)

Giant Manta Ray

The giant manta ray was listed as threatened under the ESA in 2018 (83 FR 2916). They prefer water temperatures no lower than 66 °F (NMFS, 2023f). They have been known to travel to depths that exceed 1,000 meters (Marshall et al., 2011) while juvenile giant manta rays frequently occur in water less than 5 meters in depth (NMFS, 2020a). Giant manta ray diet consists mainly of planktonic organisms, including copepods, mysids, euphausiids, decapod larvae and shrimp (NMFS, 2020a). They are often found feeding on zooplankton near the water's surface (NMFS, 2020a). Critical habitat for giant manta ray has not been designated.

The giant manta ray frequently occurs off the coast of Florida and has a northern limit of New Jersey (NMFS, 2020a). It is expected that giant manta rays occur near North Carolina from June to October as they migrate to northern waters in warmer months (NMFS, 2023f; Farmer et al., 2022).

Smalltooth Sawfish

The smalltooth sawfish was listed as endangered under the ESA on April 1, 2003 (68 FR 15674).

They tend to inhabit nearshore waters; however, depth preferences depend on the size of the sawfish. Their primary prey is unknown, but observations show clupeids, carangids, mugilids, dasyatids, pinfish and pink shrimp are common prey (NMFS, 2018). Smalltooth sawfish typically reside in waters that are warmer than 64°F (NMFS, 2023e). Smalltooth sawfish critical habitat does not occur in the project area.

Smalltooth sawfish have been reported in the North Carolina area multiple times, however not in over 20 years (NMFS, 2009b). Due to their preference for water temperatures no lower than 46 to 53 degrees Fahrenheit, North Carolina is expected to be their northern limit (NMFS, 2009b). Therefore, it is considered unlikely that smalltooth sawfish would occur in North Carolina.

Bird Species (Piping Plover, Red knot, Wood stork, Roseate tern)

Piping Plover

The Piping plover was listed under the ESA on December 11, 1985 (50 FR 50726). Piping plovers reside in coastal habitats such as small islands, tidal flats, sand spits, shoals, and sandbars (USFWS, 2023b). Piping plovers often forage in sandy mud flats, ephemeral pools, and seagrass beds (USFWS, 2023b). Foraging habitat use is dependent on prey distribution and accessibility (USFWS, 2020a). Invertebrates are the largest part of piping plover's diet, and selection is based on availability (USFWS, 2023b). The preferred breeding habitat for piping plovers is inlet beaches and nests are typically located on the backshore of the beach (Maslo et al., 2011). Plover nests are also commonly located in dune blowout areas, where wind or water has overtopped the dune and created a minimally vegetated sandy foredune (Davis and Fitzgerald 2004, cited in Maslo et al. 2011). The Atlantic Coast DPS breeding season extends from late March through August in North Carolina. Breeding and nesting sites in North Carolina are principally confined to undeveloped barrier islands along the northern section of the coast, mostly within the Cape Lookout National Seashore, Cape Hatteras National Seashore, Pea Island National Wildlife Refuge, and on Lea and Hutaff Islands (USFWS 2009; Dinsmore et al., 1998). A few pairs nest sporadically along the southern coast as far south as Brunswick County. Breeding sites along developed barrier islands in North Carolina are restricted to the accreting ends of the islands at tidal inlets.

Piping plovers could occur in the project area year-round. Piping plovers from all three populations have been sighted in North Carolina (USFWS, 2020a). The breeding, migratory, and wintering ranges of the piping plover overlap in North Carolina; and consequently, piping plovers can be found in the state during every month of the year (Cameron et al., 2009). Inlet habitat along Oak Island's west end provides broad, open, sand flats for feeding, coupled with undisturbed flats with low dunes and sparse dune grasses for nesting.

Piping plovers have been observed at LFI during the months of March, April, and May, July, August, and September based on discussions with the North Carolina Wildlife Resources Commission (NCWRC) (Personal communication, C. Johnson, NCWRC January 9, 2024). Breeding observations at Lockwoods Folly Inlet (LFI) are rare, and nesting has not been observed since 1989. Breeding plovers arrive on North Carolina breeding grounds and initiate courtship between late March and early April. Nesting begins in mid- to late April, and plovers may continue to initiate nests during May and June. Chicks and fledglings may be present on North Carolina breeding grounds from May through August. Southward fall migration to the wintering grounds occurs during August, September, and October.

On Oak Island, piping plovers have been spotted from the west end of the island to as far east as Fort Caswell. The eBird explorer (ebird.org) provided piping plover sighting data within the vicinity of the project from latitude/longitude 33°54'54.42" N, 78°14'39.39" W to 33°50'58.12"N, 77°58'19.27"W. Sighting data between these two locations was reviewed for all areas within 0.5 miles of the water's edge. According to data retrieved from eBird, as many as 169 individuals have been observed from 3/16/1953 to 5/30/2023 (eBird, 2023), with the most sightings centred around the marsh area along Davis Canal, between 10th Pl W and NW 10th St, approximately 0.51 miles from the proposed placement site (Ebird 2023, Explore - eBird).

Critical habitat for wintering piping plovers occurs in the project area. Critical habitat on Oak Island extends from the end of West Beach Drive, west to MLLW at Lockwoods Folly Inlet, including emergent sandbars south and adjacent to the island (66 FR 36038). This critical habitat unit includes land from MLLW on Atlantic Ocean across to MLLW adjacent to the Eastern Channel and the Intracoastal Waterway (Figure 3-8). present within the Action Area are identified below (66 FR 36038):

- PCE 1 - Space for individual and population growth and for normal behavior;

- PCE 2 - Food, water, air, light, minerals, or other nutritional or physiological requirements;
- PCE 3 - Cover or shelter; and
- PCE 4 - Habitats that are protected from disturbance or are representative of the historic, geographical, and ecological distributions of a species.

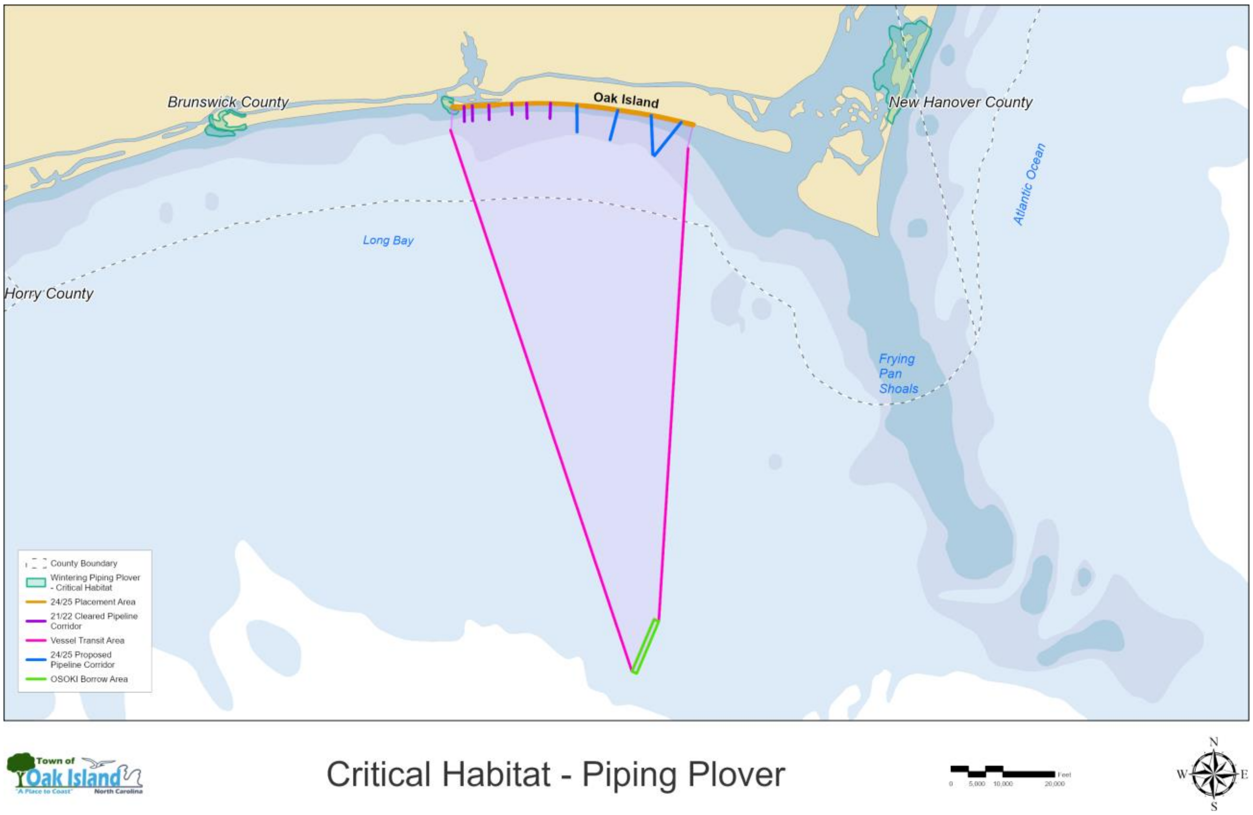

Figure 3-8: Piping Plover critical habitat map

<u>Rufa Red Knot</u>

The rufa red knot (herein after referred to as "red knot") was listed as threatened under the ESA on 12 January 2015 (79 FR 73705 73748). Red knots prefer coastal marine and estuarine habitats during both migration and overwintering (USFWS, 2023c). Red knots typically nest in the Canadian Arctic (Burger et al., 2012) and they typically nest in dry, slightly elevated tundra locations that have little vegetation. Red knots diet primarily consists of hard-shelled mollusks (USFWS, 2023c).

Red knots could occur in the project area year-round but are most abundant in North Carolina in May and June (Dinsmore et al., 1998). Red knots appear to be most abundant on Oak Island in May during the spring migration (Personal communication, C. Johnson, NCWRC January 9, 2024). Known stopover sites for red knots in Brunswick County include Tubbs Inlet and Ocean Isle Beach during April (Niles et al., 2008) and Bald Head Island during May and June (USACE 2014). Aerial surveys conducted by the Center for Conservation Biology (College of William and Mary), North Carolina Audubon, and NCWRC during May 2009 recorded a group of 18 red knots on western Long Beach on Oak Island (Personal communication, S. Schweitzer, NCWRC 17 October 2014).

On Oak Island, red knots have been spotted from the west end of the island to as far east as Fort Caswell. Ebird red knot sighting data was reviewed within the vicinity of the project area from latitude/longitude

33°54'54.42" N, 78°14'39.39" W to 33°50'58.12" N, 77°58'19.27"W. Sighting data between these two locations was reviewed for all areas within 0.5 miles of the water's edge. According to data retrieved from eBird, as many as 94 individuals have been observed from 11/26/1997 to 8/3/2023 (eBird 2023), with the most sightings centered around the marsh area along Davis Canal, between 10th Pl W and NW 10th St, approximately 0.51 miles from the proposed placement site (Ebird 2023, Explore - eBird).

Proposed rufa red knot critical habitat occurs in the project area (Figure 3-9). Proposed critical habitat for Rufa red knot extends from Shallotte Inlet to Tubbs Inlet along the Cape Fear River. The PBFs determined essential to the conservation of rufa red knots that could be present within the Action Area are identified below (86 FR 37325):

- PBF 1 - Beaches and tidal flats used for foraging;
- PBF 2 - Upper beach areas used for roosting, preening, resting, or sheltering;
- PBF 3 - Ephemeral and/or dynamic coastal features used for foraging or roosting;
- PBF 4 - Ocean vegetation deposits or surf-cast wrack used for foraging and roosting;
- PBF 5 - Intertidal peat banks used for foraging and roosting;
- PBF 6 - Features landward of the beach that support foraging or roosting; and
- PBF 7 - Artificial habitat mimicking natural conditions or maintaining the physical or biological features 1 to 6 (above).

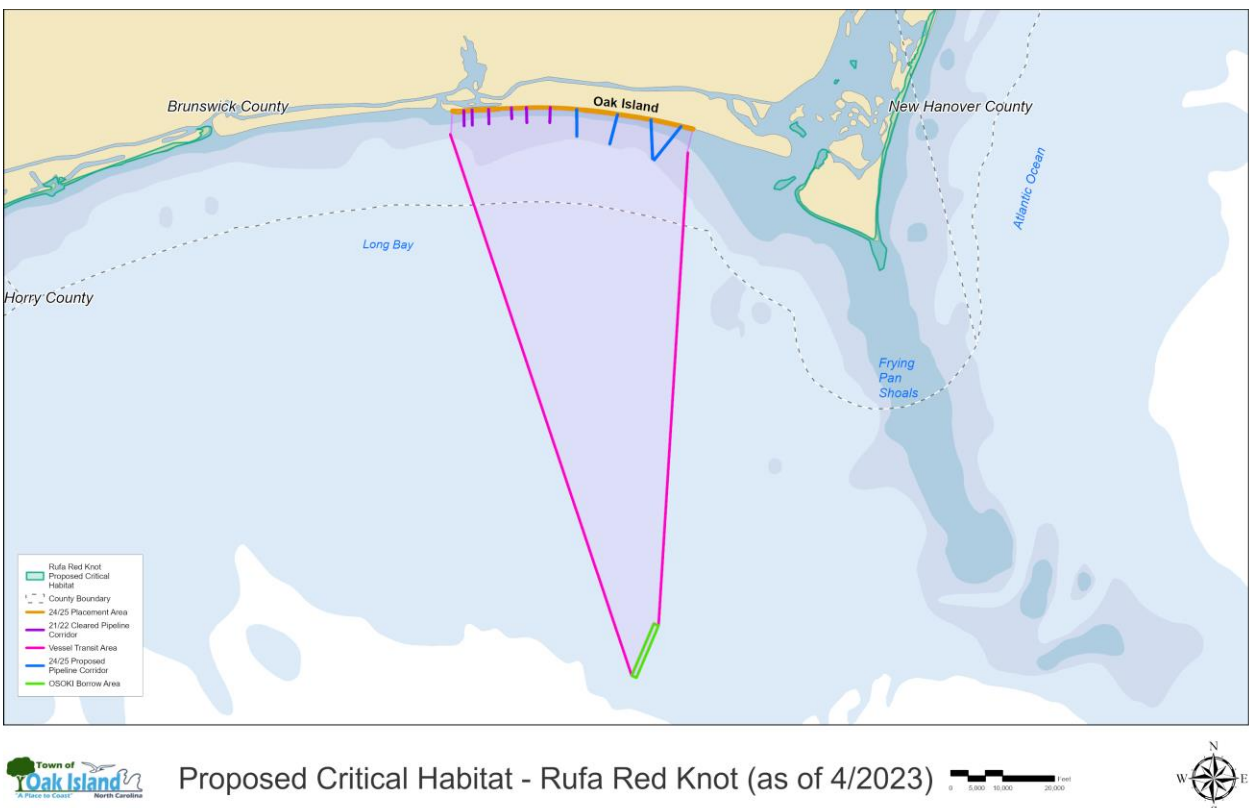

Figure 3-9: Rufa Red Knot proposed critical habitat map

Wood Stork

The wood stork was listed as endangered under the ESA in 1984 and was downlisted to threatened in June 2014 (79 FR 37078). Wood storks typically occur in wetland habitats (USFWS, 2007). Wood stork diet preference is mainly small, freshwater fish (NPS, 2021). Preferred foraging habitats are wetlands with a mosaic of submerged or emergent aquatic vegetation and shallow open-water areas (USFWS, 2007). Wood storks nest colonially in medium to tall trees that are in inundated swamps or on small islands that are surrounded by open water. The current breeding range of the wood stork includes peninsular Florida, the Florida panhandle, the Coastal Plain and large river systems of Georgia and South Carolina, and the southeastern Coastal Plain of North Carolina (79 FR 37078). The US breeding population has been increasing and expanding its range since it was listed in 1984 (USFWS, 2007). In 2005, the first North Carolina colony consisting of 32 nesting pairs was recorded in Columbus County (USFWS, 2007). In 2013, a total of 205 nesting pairs were documented in North Carolina (79 FR 37078). Wood stork critical habitat has not been designated.

Wood storks could occur in the project area year-round but are primarily sighted in North Carolina from early June to November. Although very rare in North Carolina during the winter, there have been several occurrences reported during December, January, and February. Wood stork occurrence has been increasing in North Carolina, particularly in the southeastern portion of the state. Wood storks are considered summer residents and post-breeding visitors to several areas of coastal North Carolina. They are common at the primary breeding site at Lays Lake in Columbus County and the post-breeding site at Twin Lakes, the mainland portion of Sunset Beach in Brunswick County just west of Oak Island. They are rare but increasing in other portions of Columbus and Brunswick Counties, Robeson County, along the Black River and as far north as the Outer Banks (LeGrand, 2023). Wood storks have been sighted on Holden Beach, Oak Island, and along the Lockwoods Folly River. Most sightings in recent years have been recorded in July through October (eBird, 2023).

On Oak Island, wood storks have been spotted from the west end of the island to as far east as Fort Caswell. Ebird wood stork sighting data was reviewed within the vicinity of the project from latitude/longitude 33°54'54.42" N, 78°14'39.39" W to 33°50'58.12" N, 77°58'19.27" W. Sighting data between these two locations was reviewed for all areas within 0.5 miles of the water's edge. According to data retrieved from eBird, as many as 242 individuals have been observed from 10/23/1987 to 10/19/2023 (eBird, 2023), with the most sightings centered around the marsh area along Davis Canal, between 10th Pl W and NW 10th St, approximately 0.51 miles from the beach renourishment site project site (eBird 2023, Explore - eBird).

Roseate Tern

The roseate tern was listed as endangered under the ESA on December 2, 1987 (52 FR 42064). Roseate terns nest in sand, shell, rock, and vegetation and typically reside near shallow-waters for access to fishing (NYNHP, 2023). Staging habitats typically occur near breeding habitats and include tidal flats, sandbars, and low-lying barrier island beaches (USFWS, 2020b). Roseate tern diet preference is forage fish, specifically sand lance (NPS, 2023). They may also consume herring, bluefish, mackerel, silversides, and anchovies (NPS, 2023). Roseate tern critical habitat has not been designated.

The current range of ESA listed roseate tern extends to North Carolina, however data indicates that their occurrence in the project area is rare. The roseate tern may occur passing or migrating through the area. The nearest documented breeding location is Florida, and therefore breeding individuals are not anticipated to occur in the project area. The northeastern population could potentially occur in the project area during migration to wintering habitats, however it is unlikely. It is unlikely that the Caribbean population would occur in the project area as the breeding habitat occurs south of the project area.

Roseate tern sighting data was reviewed within the vicinity of the project area from latitude/longitude 33°54'54.42" N, 78°14'39.39" W to 33°50'58.12" N, 77°58'19.27" W. Sighting data between these two locations was reviewed for all areas within 0.5 miles of the water's edge. According to data retrieved from eBird only two sightings have occurred, and both sightings occurred on the West End of Oak Island in May 2022 (eBird 2023).

Seabeach Amaranth

Seabeach amaranth was listed as threatened under the ESA on April 7, 1993 (58 FR 18035 18042).

Seabeach amaranth typically grows in areas with minimal vegetation (USFWS, 2023d). Principal habitats include overwash flats on the accreting ends of islands, lower foredunes, and the upper strand on non-eroding beaches (USFWS, 1996). Seabeach amaranth is intolerant of competition; and consequently, its survival depends on the continuous creation of newly disturbed habitats through natural barrier island and inlet processes. Seabeach amaranth is an annual, meaning that the presence of plants in any given year is dependent on seed production and dispersal during previous years (USFWS, 1996). Seabeach amaranth overwinters as seed (USFWS, 2023d). Germination generally occurs from April to July. Flowering begins as early as June, and seed production begins in July or August. Flowering and seed production continues until the death of the plant in late fall. (USFWS, 1996).

Seabeach amaranth may occur within the project area. Seabeach amaranth's range extends to North Carolina and has the potential to occur along the coastal beaches of Oak Island (USFWS, 2023d). The USACE has conducted seabeach amaranth surveys following USACE placement events on Oak Island since 1999 (Personal Communications, Justin Bashaw, USACE, 2024). Oak Island has historically supported thousands of plants each year; however, USACE surveys have only identified seven plants since 2012. From 2019 through 2023, zero plants were observed.

3.3. Cultural Resources

Section 106 of the National Historic Preservation Act and its implementing regulations, 36 CFR Part 800, require an assessment of the potential impact of the proposed project on historic properties that are within the proposed project area/borrow area, also known as the APE. The APE, as defined by Section 106, includes the area within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The APE for the proposed project includes the offshore borrow area as well as the potential vessel transit area, and beach sand placement area. The full APE is illustrated in Figure 2-1.

Historical research and review of the geophysical data was performed by Tidewater Atlantic Research (TAR). Appendix F contains the TAR report, *A Phase I Remote-Sensing Submerged Cultural Resource Survey of Proposed East Long Bay Borrow Site Located off Frying Pan Shoals, Volume 1: Submerged Cultural Resources Technical Assessment*, and Appendix G contains the TAR report, *Volume 2: Historical Maritime Context*. TAR provided archaeological analysis of the remote sensing data collected by Geodynamics including review and assessment of the side scan sonar, magnetometer, and sub-bottom profiler data. This review was designed to identify and evaluate sonar target features, sub-bottom features, and magnetic anomalies (Volume 1). In addition, TAR carried out an archival and literature review, investigation of relevant cartographical sources, and preparation of a maritime overview (Volume 2).

The data assessment methodology was developed to comply with the criteria of the National Historic Preservation Act of 1966 (Public Law 89-665), the National Environmental Policy Act of 1969 (Public Law 11-190), Executive Order 11593, the Advisory Council on Historic Preservation Procedures for the protection of historic and cultural properties (36 CFR Part 800), the updated guidelines described in 36 CFR 64 and 36 CFR 66, Archaeological Resource Protection Act (16 USC 470), "Abandoned Shipwreck Law" (North Carolina General Statute [NCGS] 121, article 3) and the North Carolina Archaeological Resources Protection Act (NCGS 70, article 2). Results of the TAR assessment provide the archaeological analysis to comply with federal and State of North Carolina submerged cultural resource legislation and regulations (Appendix F and Appendix H).

Analysis of the data identified anomalies at 10 sites. Because dual magnetometers were employed in data collection, six of the ten sites identified dual anomalies. All the anomalies proved to be associated with small ferrous objects. Acoustic data covered both the proposed borrow site and the surrounding border area. Analysis of the sonar data in both areas identified no features potentially associated with submerged cultural resources. Analysis of the sub-bottom profiler data collected in both areas generated results similar to the sonar data. No sub-bottom features were identified with characteristics previously associated with historical vessel remains or relict landforms associated with prehistoric habitation.

Based on assessment of the remote sensing data performed by TAR, the proposed borrow site location is clear of any evidence of potentially significant submerged cultural resources. Consequently, no additional investigations or site avoidance measures are recommended within the proposed borrow area. These reports (Appendix F and Appendix H) conclude the following key points:

Volume 1: Submerged Cultural Resources Technical Assessment

- Magnetic anomalies were isolated and analyzed in accordance with intensity, duration, areal extent, and signature characteristics. Magnetic anomalies were identified at 10 sites within the proposed borrow area. All the anomalies proved to be associated with small ferrous objects. None of the magnetic anomalies identified by the survey have signature characteristics that suggest an association with potentially significant cultural material.
- Analysis of the side scan data indicated that much of the survey area bottom surface was for the most part featureless. In other areas, bottom surface features consisted primarily of sand ridges and sand waves of various intensity. No features potentially associated with submerged cultural resources were identified on the bottom surface in either the borrow site or the bordering survey area.
- Sub-bottom profiler data were analyzed to identify features based on configuration, areal extent, signature intensity and contrast with background, depth below bottom surface and image association with side scan sonar targets and/or magnetic anomalies. No sub-bottom features with characteristics previously associated with historical vessel remains were identified.
- Likewise, no previously documented inundated geological landform features such as well-defined levee, dune, channel and/or channel confluences previously or theoretically associated with prehistoric habitation were present in the current data.
- Volume 1 concludes that no sites within the proposed borrow area are recommended for avoidance or additional investigation.

Volume 2: Historical Maritime Context

- Documentation of maritime history in the region begins in the sixteenth century describing French and Spanish vessels transiting the region with documented settlement in 1526 and one Spanish vessel documented as lost near the mouth of the Cape Fear River.
- A flyboat was documented as lost near modern Jay Bird Shoals in the seventeenth century.
- In the eighteenth century, permanent settlements along the lower Cape Fear River were documented. During this time frame a maritime economy developed and vessels of varying size entered the Cape Fear from other coastal ports, and the region played a minor role in the events of the American Revolutionary War.

- Documented shipwrecks in the eighteenth century included several colonial ships destroyed at anchor during the war as well as two shipwrecks at Frying Pan Shoals in February of 1784.
- Near the conclusion of the eighteenth century the Cape Fear Lighthouse was constructed and first lit in December 1794.
- Documentation of numerous commercial shipping vessels throughout the nineteenth century was obtained, with wrecks of the Iris (1807), Balaboo (1812) specifically mentioned during the early parts of the century.
- Shipping was disrupted during the Civil War with maritime operations shifted to the military and Wilmington emerging as an important harbor and location for blockade runners.
- Ships lost at Frying Pan Shoals and adjacent areas during this period included the Violet (1864), Antonica (1863), North Carolina (1864), Messenger (1886), and Barge No. 4 (1898).
- By the twentieth century, mapping and navigation at Frying Pan Shoals had improved with increased commercial fishing activity supporting the local economy. In 1945, the State Port Authority was formed, supporting ports in Wilmington and Morehead City.
- The report concludes by mentioning that the likely actual number of shipwrecks in the Frying Pan Shoals region probably runs into the hundreds. However, none of the wrecks mentioned in this historical review were associated with the proposed borrow area.

3.3.1. Historic Properties / Munitions and Explosives of Concern

Considering the frequency of encountering munitions within new offshore borrow sites throughout the South Atlantic region over the last few years, a Munitions and Explosives of Concern (MEC) assessment was developed to evaluate the probability of encountering MEC within the proposed OSOKI borrow site (Appendix J). A MEC Assessment was conducted by the Town based on guidance provided in the USACE's Safety and Health Requirements Manual (Engineering Regulation 385-1-95) that outlines risk of munitions and provides a formula for conducting a probability assessment (USACE, 2013). This MEC Assessment was performed using the USACE's Formerly Used Defense Sites (FUDS) Viewer and historical research from Tidewater Atlantic Research (pers. comm., Gordon Watts, September 26, 2024).

The FUDS Viewer shows no FUDS located at the site of the OSOKI borrow area. In the general vicinity, upland and over 16 nautical miles inland from the borrow area, the following FUDS are located, listed in order of distance from the borrow site (nearer to further):

- Fort Caswell - Fort constructed during 1826-38. Utilized during the Civil War, the Spanish-American War, and WWI.
- Southport Radar Exp St - Utilized for research, experiment, and development of projects for US Army Air Forces.
- Fort Johnston – Former US Army post.
- Sunny Pt Army Terminal - Utilized as a military port facility.
- Fort Fisher - The site was used as a training center by Army ground forces.
- Military Ocean Terminal Sunny Point - Strategic shipping and military hub used since 1795.

There is no documented evidence in the literature of any MEC from any of these sites being transported to, utilized in, or disposed of in the OSOKI borrow area.

Historical research by Gordon Watts of Tidewater Atlantic Research (TAR) (pers. comm. Sept. 26, 2024) noted that War-Between-the-States-era ordnance at Fort Caswell was collected after an on-site explosion during WWI and dumped offshore. [Source: Charles Foard who was stationed at Fort Caswell during WWI.] While the Wilmington newspaper reported on the explosion no mention was made of the location for dumping the ordnance somewhere offshore. This location may never have been recorded. There is a charted ordnance related anchorage site approximately 2 miles off the central part of Holden Beach but there is no likely association with the Fort Caswell dump site. It is noted that the charted dump site off of Holden Beach is significantly closer to shore than the Town's proposed OSOKI borrow area.

While the possibility of MEC exists anywhere offshore in the general vicinity of Fort Caswell, the relatively small size of the borrow area and the substantial distance offshore makes it unlikely that the Fort Caswell MEC was dumped in the OSOKI borrow area.

In addition to the MEC Assessment developed for this project, the *Phase I Remote-Sensing Archaeological Survey for Proposed East Long Bay Borrow Site Located Off Frying Pan Shoals* was reviewed to ascertain the risk of encountering munitions while dredging within the OSOKI borrow site (Appendix F).

There were two references to munitions in the report:

"On 15 April 1898, the newly commissioned USS Wompatuck [ex-Atlas] departed the New York Navy Yard harbor, stopped at Fort Liberty [NJ] for ammunition and commenced its scheduled passage to Key West. During a planned stopover at Norfolk, the tug coaled, took on water, and waited for its tow, Barge No. 4. By 22 April, Wompatuck proceeded to sea at daylight and subsequently "Encountered bad weather" on the second day at sea off the coast of North Carolina."

On 24 April, Barge No. 4 … "sank off Frying Pan Shoal in a S.W. gale and a heavy sea". Unable to prevent the loss of the barge [loaded with coal], the tug resumed course and reported the marine casualty at the Port Royal, South Carolina U.S. navy facility (Jungen 1898). [The 130-foot, 323-ton Atlas was an iron-hulled, screw tug built by Harlan and Hollingsworth in 1886; acquired from Standard Oil Company on 4 April 1898 and renamed Wompatuck; Figure 44]

"In 1955, the military established the Sunny Point Military Ocean Terminal. The facility serves as a terminal for shipping military hardware and ammunition to American forces around the globe. The base is a major employer in the area and local service and retail industries serving the military contribute to the economic prosperity of the region."

Analysis of the sub-bottom profiler data collected in both areas generated results similar to the sonar data. No sub-bottom features were identified with characteristics previously associated with historical vessel remains or relict landforms associated with prehistoric habitation.

Based on assessment of the remote sensing data performed by TAR, the proposed borrow site location is clear of any evidence of potentially significant submerged cultural resources. Consequently, no additional investigations or site avoidance measures are recommended within the proposed borrow area.

3.4. Socioeconomic Resources

The Town has a large percentage of both part-time and retired residents. According to U.S. Census data, over 51% of Oak Island's year-round residents are not a part of the labor force. This percentage is higher than the State's rate, but comparable to other similar beach communities in the area. The Town has a substantial number of retirees, with 37.5% of the population aged 65 years and older. According to the Town's 2017 CAMA Land Use Plan, in Oak Island, as in other beach communities across the state, the residents tend to be more educated and hold more advanced degrees than the average North Carolina citizen. In fact, according to the US Census, nearly 45% of Oak Island's residents have an associate's degree or higher compared to just 36% of the state's population.

For full-time residents in the workforce, the major industry employers in Oak Island include the education and health services, with about a quarter of employed year-round residents working in these fields. The median household income in Oak Island was found to be $85,513 in 2022 (US Census data). In addition to full-time work driving the economy, tourism also heavily impacts the local economy, especially during the summer months. Oak Island's coastal environments and recreational beaches attract tourists and generate revenue for the Town. The impacts of tourism within Brunswick County contribute to more than 5,000 jobs and over $470 million in tourism-related expenditures (Town of Oak Island Comprehensive Land Use Plan, 2017). According to the 2016 Impact of Travel on North Carolina Counties, Brunswick County expenditures were $544,350,000; payroll was $105,400,000; employment was $5,650,000; State tax receipts were $25,420,000; and local tax receipts were $33,000,000. Each of these parameters increased in value from the 2015 report (U.S. Travel Association, 2017).

In 2018/2019, Brunswick County collected a 1% occupancy tax on all hotel, motel, and condominium rentals. This occupancy tax is for the Tourism Development Authority, which is used to promote travel and tourism. Brunswick County received $1,677,037 from this occupancy tax rate. Oak Island, within Brunswick County, had a 5% occupancy tax in 2018/2019, which was allocated to the Town Board of Commissioners. The first 3% of the occupancy tax was used for tourism-related expenditures; the remaining 2% was used for beach renourishment and protection measures. From 2018-2019, the Town of Oak Island received $2,017,746 from this occupancy tax rate (Profile of North Carolina Occupancy Taxes and Their Allocation, Version 5.0, 2021).

Recreational fishing also contributes to the Town's economy. Particularly, the king mackerel is an economically important fishery to the Town of Oak Island. The Town has held the U.S. Open King Mackerel Tournament every year since 1979 and takes place over the course of a couple of days in October. According to the event page for the Tournament, the event draws around 400 boats annually. The total prize for the tournament is $322,000. In 2019, a reported number of 496 boats fished the tournament, from over 147 cities, some from Florida, Maryland, Pennsylvania, New York, South Carolina, Virginia, and West Virginia. The Southport-Oak Island Chamber of Commerce officials estimate an economic impact of $2,141,280 from the U.S. Open King Mackerel Tournament.

3.4.1. Environmental Justice

EO 12898 directs federal agencies to identify and address disproportionately high and adverse environmental and human health effects of their actions on minority and low-income populations. Pursuant to EO 12898, federal agencies must develop environmental justice strategies to ensure that their programs, policies, and activities are conducted in a manner that does not exclude persons (including populations) from participation in, deny persons the benefits of, or subject persons to discrimination under their programs, policies, and activities because of their race, color, or national origin.

Census data reported that, as of 2022, a population of approximately 9,500 residents in the Town of Oak Island. The racial makeup of the 2022 population was 94.9% white, 1% Black/African American, 0.1% American Indian/Alaska Native, 0.9% Asian, 1.2% Hispanic or Latino, and 3% two or more races. The median household income for the Town of Oak Island is higher than the median household income reported for North Carolina, which indicates a substantial percentage of households reporting retirement incomes in the Town. The percentage of those living below the poverty line for the Town is 11.1 %, less than the percentage of those living below the poverty line for the State at 14%[1].

The Climate and Economic Justice Screening Tool, an interactive mapping tool, identified a disadvantaged community census tract located approximately 4 miles north of the project area. The disadvantaged census tract is defined as being marginalized by underinvestment and overburdened by pollution.

[1] Census.gov

3.5. Recreational / Tourism and Scenic Resources

The total environment of barrier islands, beaches, ocean, estuaries, and inlets attract many residents and visitors to the area to enjoy the sights, wildlife, and ocean. Two ocean piers, Oak Island and Yaupon, are in the project area and are considered important recreational facilities. During fall months, recreational surf fishing is a popular activity, as well as fishing in the intracoastal waterway. Many residents will use a private dock slip, but some will use Blue Water Point Marina. Fort Caswell and the Oak Island Golf Club also provide recreational activities for residents and visitors. The inlet shoals of Lockwoods Folly Inlet, Sheep Island, and the western end of Oak Island (the Point) are primarily used in the summer months for swimming, fishing, and shell collecting. Since 2001, there has been no substantial beach renourishment event to replenish the beach and dunes for the Town. Moreover, constant erosion, tidal inundation, and vast dune escarpments have led to a lack of dunes for wildlife nesting habitat. Given this, the Town risks losing recreational user groups, such as property owners, business owners, tourists, and other visitors, who value the coast and its wildlife.

4. Impacts Associated with Each Alternative

Overall, there are numerous impacts as well as benefits associated with beach renourishment projects including infrastructural, economic, and biological. The Preferred Alternative would provide protection of upland structures and infrastructure, restore beach and dune habitat for wildlife, and provide recreational and economic benefits by improving the beach for human use. Potential adverse impacts, generally short-term and minor in nature, are also possible with the Preferred Alternative. Potential beneficial and adverse impacts associated with the Preferred Alternative and the No Action Alternative are discussed in detail below.

The environmental consequences described below include those potential effects that could be considered significant (40 CFR 1508.27). Relevant information regarding environmental consequences obtained through consultation and review by interested parties was also included. The USFWS Information for Planning and Consultation planning tool (IPaC) was used to identify potential effects to USFWS trust resources, such as migratory birds, species and critical habitat proposed or listed under the ESA (USFWS, 2023e). This analysis was completed and is consistent with 40 CFR Parts 1500-1508; July 2024.

4.1. Physical Environment

4.1.1. Geology and Geomorphology

Associated Impacts with No Action Alternative

Under the No Action Alternative, short-term erosion protection measures would continue to be taken by the Town and residents to reduce impacts from erosion and storm impacts such as beach scraping using bulldozers, sandbag and sand fence installation, introducing minor mechanical substrate disturbance. In addition, there would be episodic/opportunistic nourishment from channel maintenance projects on the western end and the eastern end of the project as described in Section 2.9.4. For renourishment activities, there would be short-term, minor impacts to geology and geomorphology from dredging activities within Lockwoods Folly Inlet and Cape Fear River Harbor. There would be long-term beneficial effects from placement of sediment for beach nourishment, but the benefits would be limited to the western and eastern project termini. There would be no effects to geology and geomorphology from short-term erosion protection activities which do not involve dredge and fill operations. On-going long-term adverse effects would include continued erosion and loss of sediment, particularly in the central portion of the project where only short-term erosional protection measures would occur as towns and residents choose to implement them.

Associated Impacts with Preferred Alternative

Under the Preferred Alternative, dredging operations would take place in the proposed OSOKI borrow area. Dredging activities in OSOKI would excavate to a maximum elevation of -69 ft, NAVD88 (See Figure 4-1). As reported in Appendix D, the borrow area contains sediments that are compatible for beach nourishment. Impacts to substrates and native beach sand quality and composition are summarized.

Impacts to Substrates: There would be short-term, minor, adverse impacts to the geology and geomorphology for dredge operations and beach nourishment. Sediment removal has the potential to result in short-term, minor impacts to benthic habitat by altering seabed topography, particularly if sediment removal in the borrow area results in a deep hole. Substantial changes to existing topography have been avoided to the extent feasible. The borrow area depths have been designed to not differ substantially from the depths of the surrounding areas. The maximum dredge depth will be -69 ft NAVD88, while the existing surrounding areas reach depths of approximately -65 ft NAVD88 (Figure 2-3). In addition, dredge cuts have been minimized to the extent feasible. The maximum dredge cut is approximately 11 ft (Figure 4-1). Post-dredge material will be similar in composition to the existing seafloor. Only trace shell fragments were observed in the borrow area vibracores (Appendix D), with sizes generally less than 1-2 inches. These shell fragments would not be retained on the screens employed for turtle exclusion (4 in x 4 in). Because this proposed borrow area location is in relatively deep water (existing ocean floor elevations on the order of 60 ft NAVD 88), any infilling would likely occur over decadal time frames. Dredged areas could accumulate fine sediments over time resulting in a shift in the composition of post dredge surficial sediments; however, the rate of infilling is highly variable.

There would be short-term, minor, adverse effects to soft-bottom habitat as a result of development of construction-related transportation corridors and landward pipeline corridors. The spatial area taken by the temporary piping would be minimal. Impacts may include changes in topography and changes in substrate composition.

There would be long-term, benefits to substrates from beach nourishment activities. Beach nourishment would restore substrates to pre-storm conditions. Sand placed on the beach would be similar to existing substrate (as verified by grain size, percent fines, calcium carbonate, color, and clast count).

Native Beach Sand Quality and Composition: Direct, short-term impacts to native beach sand quality and composition could be expected. Placement of materials could result in impacts to the nearshore sand bottom. While these impacts are possible, the use of compatible substrate would be expected to minimize impacts on the native beach sand quality and composition.

Impacts to Potential Paleochannel Resources: There would be no effect on potential paleochannel pre-contact resources. The borrow site has characteristics of a paleochannel and subsequent infill as described previously and in Figure 3-2. There is no evidence of habitation. Limited dredging as proposed would not impact pre-contact resources due to the lack of features indicating human habitation as well as the unlikely site preservation due to high energy marine processes.

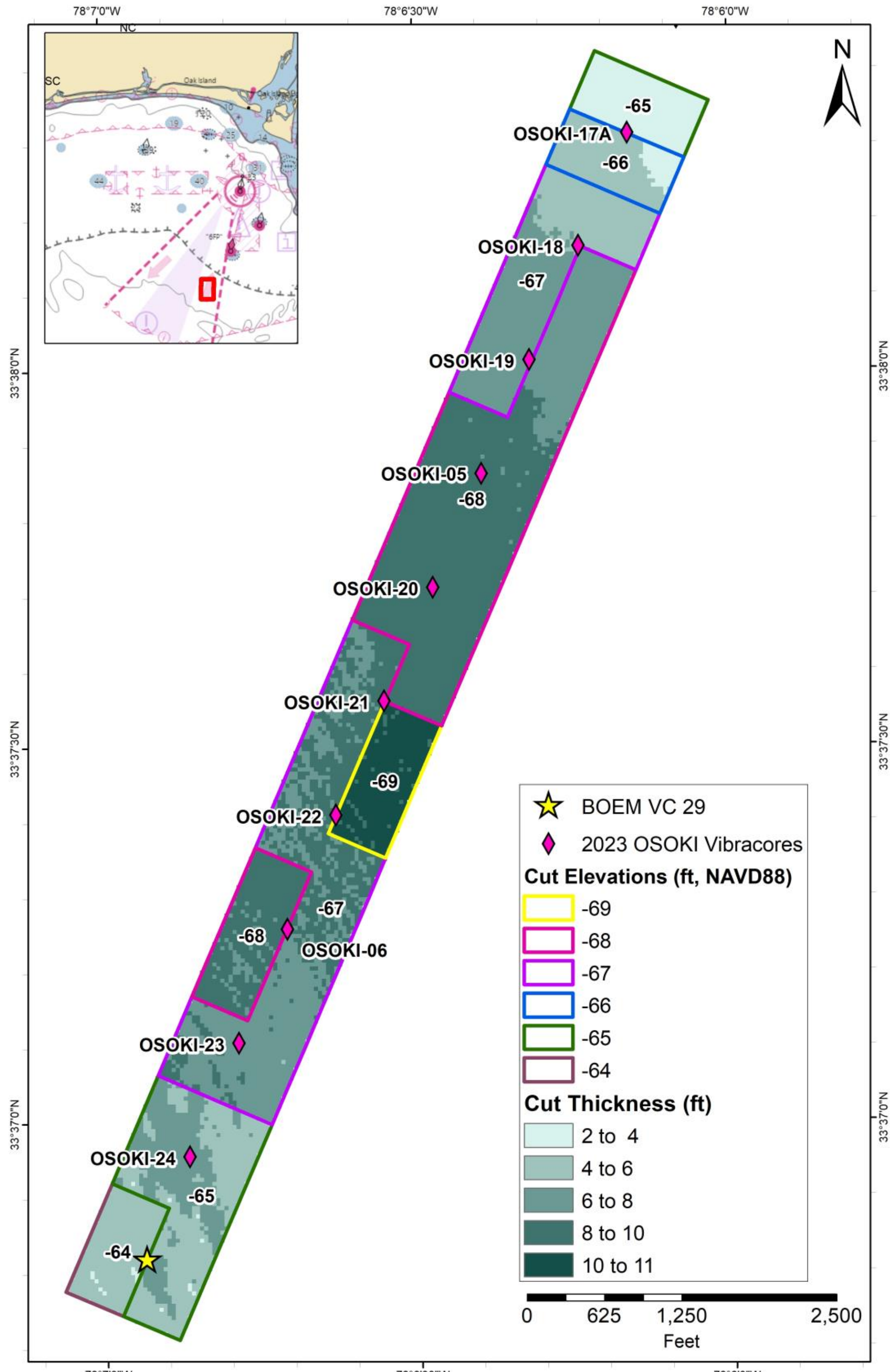

Figure 4-1: Dredge cut thickness across the OSOKI borrow area determined as the difference between existing ocean floor elevations and cut elevations

4.1.2. Littoral Processes

Associated Impacts with No Action Alternative

Under the No Action Alternative, beach scraping, sandbag installation, would take place, but no new material would be introduced to the system from these activities and no direct or indirect impact to littoral processes are expected from these activities. There would be sporadic beach renourishment/maintenance dredging (every 2-6 years) on the western and eastern termini of the project. There would be short-term, minor, beneficial effects on sediment movement resulting from localized reconfiguration of beach areas at the eastern and western termini of the project. There would be active movement of additional sediment westward and eastward, depending on wave condition; net transport would move sediment westward.

Associated Impacts with Preferred Alternative

The Proposed Action includes an offshore borrow source, identified as OSOKI, positioned approximately 16 miles offshore of Oak Island and Caswell Beach. The OSOKI borrow area is located outside the primary nearshore sediment transport processes and therefore infill rates may be slower than those which may occur in nearshore environments (Peterson, 2005). The excavation of 2.9 Mcy from OSOKI may exceed the threshold where bottom bathymetry due to sand removal may result in changes in the magnitude of wave patterns within the borrow area and result in a low potential for infill of littoral material. However, due to the reduced excavation dredging cuts within the borrow area, it is anticipated that minor impacts will occur to littoral processes within and around the borrow area. It is understood that a complex relationship exists between the discharge of sediment from the Cape Fear River and the longshore transport of materials from the north leading to minimal sand deposition in the proposed borrow area from adjacent cuspate foreland shoal features, such as Frying Pan Shoals. Longshore current velocity, and thus the delivery of sediments is driven chiefly by wave direction and intensity. It is not anticipated that wave direction or intensity would be affected by the Preferred Alternative, leading to similar magnitude of the southern longshore drift.

4.1.3. Tidal conditions

Associated Impacts with No Action Alternative

There would be no effect to tidal conditions including currents and circulation that affect movement of sediment as a result of implementation of the No Action Alternative which would include beach grading, sandbag revetments and sporadic beach renourishment at the western and eastern termini of the project.

Associated Impacts with Preferred Alternative

There would be no effect to tidal conditions including currents and circulation that affect movement of sediment as a result of the construction of the Preferred Alternative which would include dredge operations and beach renourishment activities.

4.1.4. Water Quality

Associated Impacts with No Action Alternative

Short-term storm protection measures (beach scraping and sandbag installation) that would be implemented under the No Action Alternative would have no effect on water quality impacts in the marine environment. There could be short-term, minor water quality impacts from sporadic maintenance dredging and beach renourishment activities on the western and eastern termini of the project.

Associated Impacts with Preferred Alternative

Effects to water quality from hopper dredging activities, sand placement, and potential hypoxic effects are described here. Turbidity impacts on wildlife and threatened and endangered species are further discussed in Sections 4.2.1 and 4.2.9.

Turbidity Effects from Hopper Dredging Activities: There would be short-term, minor, adverse effects on water quality as a result of turbidity from hopper dredge operations. Hopper dredges re-suspend sediment both when the draghead comes into contact with the substrate and during the release of overflow waters. Contact with the bottom creates a plume that is typically confined to the bottom layer of the water column. Overflow release creates a surface flow plume. The total extent of turbidity plumes depends on grain size and hydrographic patterns. Near-field turbidity concentrations for hopper dredging typically range from 80.0 to 475.0 mg/L (Anchor Environmental, 2003 as cited in NMFS, 2024). The sediment composition at the borrow site consists of a mean grain size of 0.36 mm and low silt content of 3.97%. Hopper dredge operations can result in bottom plumes of up to approximately 4,000 ft. (Wilber and Clarke, 2001 as cited by NMFS, 2024). Surface plumes can be greater but depend on whether overflow procedures are occurring. Dredging in sandy sediments, such as those that occur at the borrow site, would be anticipated to result in smaller scale plumes. This is because sand substrates resettle rapidly in the immediate vicinity of the dredge compared to fine silt/clay particles which have relatively slow settling velocities (Schroeder, 2009). Sediment plumes produced during hopper dredging of sand and aggregate in the United Kingdom were monitored extensively and it was found that many sandy plumes settled out within 984 feet of the source (Coastline Surveys Ltd, 1999b as cited in USACE, 2015). Based on the sediment composition at the borrow site, it is anticipated that sediment plumes would be similar in scale to those observed during the referenced study. Several studies have indicated that sediment plumes generally last approximately an hour or less (USACE, 2015).

Turbidity Effects from Sand Placement: There would be short-term, minor, adverse impacts to water quality from increased disturbance and turbidity associated with beach renourishment activities. Placement activities may also result in increases in turbidity within the surf zone. This is a high energy environment that is typically characterized by high levels of disturbance and turbidity. Several studies have indicated that turbidity plumes associated with beach renourishment projects are typically limited to approximately 1,640 ft. from the discharge pipe in the swash zone (Burlas et al. 2001; Wilber et al. 2006). Sediment discharge from the outflow pipe on the beach will be managed using horizontal sand dikes to control the release of flow into the surf zone.

Hypoxic Conditions Resulting from Dredge Activities: There could be short-term, minor impacts to water quality if hypoxic conditions are created as a result of changes in bathymetry or substrate. Data on dredge pit water quality impacts is limited. However, studies have indicated that the creation of deep holes can reduce water flow and result in hypoxic conditions (Swartz and Brinkhuis, 1978; Thompson et al., 2021). Oxygen levels typically decrease with depth within the pit while many existing studies focus on borrow pits that are deeper and outside of the depth range of the proposed project (Swartz and Brinkhuis, 1978; Thompson et al., 2021). Dredge cuts for the proposed OSOKI borrow area have been minimized to the extent feasible and will not exceed approximately 11 ft. (Figure 2-2). This is anticipated to increase waterflow and reduce the risk of creating hypoxic conditions.

Hypoxic conditions within dredge pits can be affected by the sediment oxygen consumption rates of the post-dredge material. Post-dredge substrates are anticipated to consist mainly of sands, with low silt content (Table 2-2). Sediment oxygen consumption rates for sandy sediments are lower than those of mud substrates due to lower rates of organic matter and more physical mixing. Based on the sediment composition at the borrow site, sediment oxygen composition rates of the post-dredge material are anticipated to be low. However, dredge pits can infill and collect fine grain particles and organic matter. Infill conditions are heavily influenced by adjacent sediment sources and pit geometry (Thompson et al., 2021). Known sources of high organic matter material within proximity to the borrow area include discharge from the Cape Fear River. Post-dredge material is anticipated to consist mainly of sands, however dredged areas could accumulate fine sediments over time.

4.1.5. Air Quality

Associated Impacts with No Action Alternative

There would be negligible to short-term, minor, adverse effects to air quality as a result of implementing the No Action Alternative. The No Action alternative includes a continuation of various minor actions to protect the oceanfront shoreline and infrastructure from storm events and chronic erosion. These actions may require the use of heavy equipment such as bull dozers that have the potential to result in minor, short-term emissions.

Associated Impacts with Preferred Alternative

Emissions of criteria pollutants, greenhouse gases, and other hazardous air pollutants will result from operation of the dredge pumps and coupled pump-out equipment, dredge propulsion engines, and tugs, barges, and support vessels used in the placement and relocation of mooring buoys. In addition, air emissions will result from bulldozers, trucks, and other heavy equipment used in the construction of the berm, beach, and dunes. Carbon monoxide and particulate emissions at the project site, during construction, may be considered offensive; but are generally not considered far-reaching. The primary emissions will result from the burning of fossil fuels by this equipment. Variables that will affect the impact to ambient air quality include the amount of material dredged, the distance from shore at which the dredge operates, and meteorological conditions (e.g., wind velocity and direction). Generally, the dredge produces the majority of emissions during a nourishment project.

To ensure the proposed activity's emissions do not violate NAAQS for criteria pollutants including carbon monoxide (CO), nitrogen dioxide (NO_2), lead (Pb), sulfur dioxide (SO_2), hydrocarbons (HC) and particulate matter (PM), an emissions analysis was performed to estimate the levels of each of these pollutants that may be generated during project construction. In cooperation with BOEM, ENVIRON International Corp. and the Woods Hole Group developed a Dredging Project Emissions Calculator (DPEC) to estimate the emissions levels that will be generated by proposed beach nourishment and coastal restoration projects (ENVIRON International Corp. and Woods Hole Group, 2013). This Microsoft Access program can be used to calculate emissions during multiple phases of a project, from dredging, to pump-out and sand placement, thereby providing a basis to determine conformity with regulations and impacts analysis. The analysis was run for the Oak Island nourishment project using a large hopper dredge with 6,540 CY hopper capacity, and the OSOKI Borrow Area, which represents the farthest distance the dredge will need to travel. The analysis was run with the hopper dredge continuously working for 24 hours, to analyze a scenario in which two hopper dredges may be working on the project in unison. The hopper dredge is the likeliest methodology employed for this project. The following analysis also included auxiliary equipment (such as tenders, tow boats and crew boats) as well as shore-based equipment (such as loaders and excavators). Estimated emissions levels generated by the DPEC for this project are shown in Table 4-1. These emissions are from the initial renourishment effort considered in this EA but could be repeated with similar air quality impacts for future borrow area use requests. The total project emissions are dominated by CO_2 followed by NOx (represents the sum of Nitric oxide (NO) and NO_2 emissions). CH_4 emission factors are 2% of HC emission factors (USEPA, 2022) and were also calculated as part of this emissions analysis. CH_4 emissions from diesel engines are of minor importance (Cooper and Gustafsson, 2004).

There will be no long-term accumulation of particulates in the project area because offshore sea breezes are likely to disperse pollutants away from the coast and the construction activity is brief and temporary in nature. Exhaust from the construction equipment will have an effect on the immediate air quality around the construction operation but should not impact area away from the construction area. These emissions will subside upon cessation of operation of heavy equipment. No air quality permits are required for this borrow area lease.

Table 4-1: Summary of project emissions by source and location for hydrocarbons (HC), volatile organic compounds (VOC), carbon monoxide (CO), NOx (represents the sum of Nitric oxide (NO) and nitrogen dioxide (NO_2) emissions), particulate matter (PM), carbon dioxide (CO_2), and methane (CH_4)

EMISSIONS IN TONS									
Type	**Mode**	**HC**	**VOC**	**CO**	**NOx**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**
Inside State Waters									
Crew Boat		0.07	0.07	0.42	2.61	0.06	0.06	177.03	0.001
Tender 1		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Tow Boat		0.14	0.15	0.94	4.79	0.10	0.10	354.06	0.003
Bulldozer		0.01	0.01	0.01	0.02	0.00	0.00	31.78	0.0002
Bulldozer		0.01	0.01	0.01	0.02	0.00	0.00	31.78	0.0002
Excavator		0.01	0.01	0.01	0.02	0.00	0.00	32.13	0.0002
Dredge Vessel Generator	Transit	0.01	0.01	0.08	0.48	0.01	0.01	33.55	0.0002
Dredge Vessel Main	Transit	0.12	0.12	2.18	9.27	0.18	0.18	596.86	0.002
Dredge Vessel Generator	Pumping	0.03	0.03	0.16	1.01	0.02	0.02	69.78	0.0006
Dredge Vessel Main	Pumping	0.24	0.26	4.53	19.28	0.38	0.37	1241.28	0.005
Outside State Waters									
Dredge Vessel Generator	Dredging	0.01	0.01	0.08	0.51	0.01	0.01	35.08	0.0002
Dredge Vessel Main	Dredging	0.12	0.13	2.28	9.69	0.19	0.19	624.03	0.002
Dredge Vessel Generator	Transit	0.04	0.05	0.26	1.61	0.04	0.04	111.84	0.0008
Dredge Vessel Main	Transit	0.39	0.41	7.26	30.89	0.61	0.60	1989.53	0.008
All Locations and Sources									
Total Emissions (in tons)		1.2	1.27	18.22	80.2	1.6	1.58	5328.73	0.024

4.1.6. Noise

Associated Impacts with No Action Alternative

The No Action Alternative may produce short-term, minor, impacts to noise levels during beach grading, sandbag revetment construction and sporadic beach renourishment at the western and eastern termini of the project. Noise levels may temporarily increase due to equipment usage on the beach but will return to ambient levels after completion.

Associated Impacts with Preferred Alternative

There would be short-term, minor, adverse effects due to construction related noise. Dredging in the marine environment produces sound that elevates levels above ambient and may have adverse effects to some marine fauna including invertebrates, fishes, mammals and sea turtles; these are discussed in detail in Section 4.2. During project activities, noise levels would be expected to increase above ambient noise levels in the project area. Marine dredging has the potential to result in elevated in-water noise levels. Sounds produced by hydraulic dredges are continuous except during transitional activities (e.g., system flushing, repositioning, etc.). Large (6,000 to 9,000 m3 capacity) hopper dredges excavating gravely sand produced noise levels of 179 to 187 dB at the source (Reine and Dickerman, 2014). Medium size (835 to 1521 m3 capacity) hopper dredges excavating sand produced noise levels of 161 to 178 dB at the source (Reine and Dickerman, 2014).

There would be noise impacts from equipment operations that would affect occupants that inhabit residential structures along and adjacent to the project area where beach renourishment activities would occur. Fill placement along the beach will typically progress at a rate of 400-700 linear feet per day or a load cycle of 20,000 cy per day. Construction activities will involve the movement of heavy equipment and pipe along approximately 1 mile reaches per 1 to 2 weeks; resulting in a 4-month active construction timeframe. Noise effects to residential occupants will be temporary as operations will only be in the proximity of individual residences for a short timeframe.

At the beach renourishment site, noise levels will also be elevated during beach construction due to the presence of heavy machinery such as excavators and front-end loaders. Short-term, adverse effects may include displacement of birds and sea turtles from beach habitat where activities will occur. Noise levels will only be elevated during active construction and will return to pre-construction levels upon project completion. A complete description of the effects of beach renourishment noise on fish and wildlife species is discussed in Section 4.2. Elevated noise levels may cause short-term, minor impacts to the surrounding residents. These impacts would only be expected during active construction. Following construction, noise levels would return to pre-construction conditions.

4.2. Biological Environment

4.2.1. Fish and Wildlife Resources

Associated Impacts with No Action Alternative

There would be short-term, adverse impacts to fish and wildlife species and their habitat as a result of individually led storm protection measures (beach scraping and sandbag installation). In addition, overtime, the no action alternative would result in an overall loss of beach habitat. Adverse impacts to habitat include degradation of the beach and dune habitats, persistent erosion in the dry beach areas, particularly in the central region of the project area. There would be adverse effects for wildlife including birds, shorebirds, and sea turtles that rely on the areas for forage, roosting, loafing and nesting (See Section 3.2.1). Local short term protection initiatives such as beach scraping and temporary sandbag revetments, are not coordinated and would not provide protection against these impacts.

There would be short-term, adverse, impacts to fish and wildlife species as a result of sporadic beach renourishment/maintenance dredging on the western and eastern termini of the project. Maintenance dredging/beach renourishment would occur every 2 to 6 years and would be smaller in scale than the Preferred Alternatives. There would be short-term beneficial effects to wildlife species from the creation of additional habitat on the western and eastern termini of the project. Additional stopover and nesting habitat would support wildlife including migratory birds, shorebirds, and sea turtles that rely on the areas for forage, roosting, loafing and nesting.

Associated Impacts with Preferred Alternative

During construction, short-term, minor adverse impacts to fish and wildlife species could occur. Construction-related impacts to species are expanded upon in Section4.2.2 and 4.2.3, but generally include minor short-term impacts and temporary displacement of species due to increased noise, decreased water quality, habitat disturbances, entrainment, and decreased prey availability.

There would be long-term, beneficial effects from sand placement on the beach and dune. Created beach and enhanced dune habitat would provide long-term benefits to benthic infaunal species in the intertidal and subtidal beach, including polychaetes, amphipod, crustaceans, and gastropods. These organisms are integral to supporting the biological community and provide food for ghost crabs, fish, and birds. The increase in beach and dune area would also provide additional foraging, nesting, and loafing habitat for birds. Nesting sea turtles would benefit from increased nesting habitat.

4.2.2. EFH and Managed Species

This section summarizes the findings of the Town of Oak Island Beach Renourishment Project Essential Fish Habitat (EFH) assessment (Appendix I).

Associated Impacts with No Action Alternative

The No Action alterative would not involve in-water work for beach grading and sand revetment activities and would not affect EFH or managed species. Sporadic beach renourishment at the western and eastern termini of the project has minor, short-term, adverse effects to EFH and managed species that utilize nearshore waters, shallow subtidal bottoms, softbottom, and nearshore water column. Effects are short-term, temporary, and sporadic.

Associated Impacts with Preferred Alternative

Essential Fish Habitat: EFH identified as having potential to occur in the vicinity (see Section 3.2.2) can be divided into three main categories; marine water column, marine soft bottom, and live/hardbottom. Potential EFH effects are summarized here and discussed in detail in the EFH Assessment (Appendix I).

Marine Water Column: The primary effects to water column EFH, would be potential short-term decreases in water quality and increases in in-water noise. The project may impact water quality in terms of elevated turbidity, both within proximity to the offshore borrow site and in the surf zone associated with the placement activities. Based on available data and sediment composition at the site, turbidity plumes during dredging and placement activities are anticipated to extend up to 1,640 ft from the source (Coastal Surveys Ltd, 1999 as cited in USACE 2015, Burlas et al. 2001; Wilber et al., 2006). Several studies have indicated that sediment plumes last approximately an hour or less (USACE, 2015). Project-related dredging is anticipated to produce noise levels of up to 178 dB (Reine and Dickerman, 2014). To minimize the risk of long-term impacts to marine water column EFH, such as hypoxic conditions, dredge cuts have been minimized the extent feasible and post-dredge elevations will not differ substantially from adjacent areas (Figure 2-3).

Marine Soft Bottom: The Proposed Action activities will result in short-term, minor impacts to sandy bottom EFH. Impacts may include changes in topography, changes in substrate composition, and impacts to benthic communities. Changes to existing topography have been minimized to the extent feasible. Post-dredge material will be similar in composition to the existing seafloor, based on the analysis of sediment cores (Appendix D). Dredged areas could accumulate fine sediments over time resulting in a shift in the composition of post dredge surficial sediments. Benthic communities in frequently disturbed shallow water benthic habitats, such as the proposed placement area, typically recolonize disturbed sediments rapidly (Wilber and Clarke, 2007). Benthic organisms in these environments are often characterized by low-diversity benthic assemblages that can readily reestablish. Most benthic recovery studies have reported rapid recovery within seven months of the initial impact when highly compatible beach fill sediments were used and peak larval recruitment periods were avoided (Van Dolah et al. 1992, Gorzelany and Nelson 1987, Saloman and Naughton 1984, Hayden and Dolan 1974). Benthic recovery in deeper more stable environments, such as the proposed borrow area, may be less rapid. Monitoring studies of post-dredge recovery rates indicate that most borrow areas usually recover within less than 4 years (Wilber and Clarke 2007). Effect on marine soft bottom would be limited to the 250-acre borrow area footprint and are considered to be short term and recoverable.

Live/Hardbottom: Existing data (Steward et al. 2022; BOEM 2016) and subline corridor surveys from 2022 (Appendix C and Appendix G) and most recently, October 2024, indicate that live/hardbottom habitat does not occur at the borrow site or within proposed subline corridors confined to the surf zone, but patchy hardbottom does occur within the vicinity. In October 2024, additional subline corridor surveys within four proposed corridors approximately 500 ft wide and out to -30 ft NAVD88, was completed by UNCW to verify the presence/absence of hardbottom in the nearshore environment potentially affected by the Proposed Action. Preliminary results and analysis of sidescan sonar survey and diver ground truthing confirmed the proposed pipeline corridors are clear of hardbottom resources. All data and results will be provided to the agencies ahead of project construction.

No construction activities will occur within 500 meters (1,640 ft) of any identified hardbottom or reef areas (both natural and artificial). Based on the sediment composition at the borrow site and existing data regarding dredge /renourishment-related sediment plumes, it is anticipated that sediment plumes would settle out within up to approximately 1,640 ft of the proposed activities (Coastline Surveys Ltd 1999 as cited in USACE, 2014; Burlas et al., 2001; Wilber et al., 2006.) Therefore, the 1,640 ft buffer would be anticipated to be protective against any potential turbidity impacts to hardbottom or artificial reefs. There would be No Effect on live/hardbottom habitat.

Managed Species

The Project may have effects on managed species found within the project area. Impacts could occur due to noise, water quality, entrainment, habitat disturbance, and/or impacts to prey species.

Project-related dredging is anticipated to produce noise levels of up to 178 dB. Fish typically avoid areas of elevated continuous noise sources, and it is therefore unlikely that fish would remain in proximity to the proposed Project activities and be exposed to noise levels that could result in substantial adverse impacts (NMFS, 2012). Injurious noise impacts to managed species are not anticipated. Non-injurious, adverse noise impacts would be short-term, minor, and localized. Anticipated near-field turbidity concentrations for hopper dredging typically range from 80.0 to 475.0 mg/L (Anchor Environmental, 2003). This is below the threshold at which substantial impacts to managed species would occur (Wilber and Clarke, 2001). Therefore, substantial impacts due to decreases in water quality are not anticipated.

Entrainment by hopper dredges could occur, in particular entrainment of bottom dwelling fish and invertebrates. Larval entrainment by dredging equipment or burial during sand placement is possible, but likely minor considering the spatially limited dredging area and seasonal window (November 16, 2025 – April 30, 2026). To minimize the risk of entrainment, a rigid draghead deflector would be used during dredging.

The Town will follow all Terms and Conditions and PDC from the existing SARBO to minimize impacts to ESA-listed species including mitigation measures such as relocation trawling at the proposed borrow area if deemed necessary during construction. In the event that relocation trawling is required as a mitigation measure during construction, the incidental take of sturgeon will require immediate release after capture, away from the dredge site or into already dredged areas, unless the relocation trawler is equipped with a suitable well- aerated seawater holding tank, container, trough, or pool where a maximum of a single fish may be held for not longer than 30 minutes before it must be released or relocated away from the dredge site. During the Oak Island 2021/2022 renourishment project, which lasted for 59 days, 27 non-lethal relocations of Atlantic Sturgeon were performed within the Jay Bird Shoals Borrow Area. Aquatic species, including managed species captured as bycatch during relocation trawling would be released back into the water column. The project will result in benthic habitat disturbances which could result in impacts to benthic communities. Direct impacts on benthic infaunal communities may reduce benthic prey availability. However, benthic infaunal recruitment is expected to provide substantial prey resources within a short period, especially within proximity to the nearshore placement site. Additionally, undisturbed foraging habitat would be available during benthic recovery periods. Consequently, the effects of benthic prey loss on managed species are anticipated to be short-term, minor, and localized.

4.2.3. Threatened and Endangered Species

This section outlines the potential effects of the Preferred Alternative Action and the No Action Alternative as they pertain to the threatened and endangered species identified as having potential to occur in the project area. Existing Endangered Species Act (ESA) Section 7 programmatic consultations applicable to this project include the 2020 South Atlantic Regional Biological Opinion (SARBO) for Dredging and Material Placement Activities in the Southeast United States (NMFS, 2020a) and North Carolina Coastal Beach Sand Placement Statewide Programmatic Biological Opinion (USFWS, 2017).

Associated Impacts with No Action Alternative

Under the No Action Alternative various measures would continue to be taken by the town and residents to reduce erosion such as beach scraping using bulldozers, and sandbag installation throughout the central region of the project. The erosion reduction measures under the No Action Alternative do not involve in-water work and therefore temporary in-water construction related impacts such as decreased water quality, increased in-water noise, entrainment, vessel collisions, and in-water habitat impacts would not occur. The erosion reduction measures under the No Action Alternative do not introduce new sand to the system and therefore the beach and dune would continue to experience persistent erosion, particularly during storm events. Loss of beach and dune habitat would result in adverse impacts to sea turtle nesting areas and foraging habitat for piping plover, red knot, wood stork, and Roseate tern. The frequent smaller scale erosion reduction activities associated with the No Action Alternative would be anticipated to reduce the ability of the beach and dune habitat to recover which may result in adverse habitat impacts to sea turtles and birds.

The No Action would also include sporadic beach renourishment at the western and eastern termini of the project. In-water work and renourishment activities would result in short-term, adverse impacts such as decreased water quality, increased in-water noise, and disruption of in-water habitat. The introduction of new sand to the system and therefore the beach and dune would provide erosion reduction benefits, particularly during storm events. Creation of beach and dune habitat at the western and eastern termini of the project would result in short-term, adverse impacts during construction, primarily temporary disturbance of foraging habitat for piping plover, red knot, wood stork, and Roseate tern. While sea turtles utilize beach areas, construction would not occur during sea turtle nesting season. Seabeach amaranth is not likely to occur in the project area. A detailed description of impacts to threatened and endangered species and their critical habitats is provided in for the Preferred Alternative in Sections 4.2.3 through 4.2.10. Similar adverse impacts would occur here, but on a smaller scale. Preliminary ESA effects range from No Effect (NE) to Not Likely to Adversely Affect (NLAA) for protected birds, sea turtles and plants, and where applicable their critical habitat.

There would be beneficial effects to sea turtle nesting areas and foraging habitat for piping plover, red knot, wood stork, and Roseate tern at the western and eastern termini of the project as a result of sporadic beach renourishment activities (2–6-year increments).

Associated Impacts with Preferred Alternative

Effect determinations, including critical habitat effect determinations for the Proposed Action, are summarized in Table 4-2 and described in additional details in Sections 4.2.3 through 4.2.10. These determinations are based on the SARBO for Dredging and Material Placement Activities in the Southeast United States (NMFS, 2020) and North Carolina Coastal Beach Sand Placement Statewide Programmatic Biological Opinion (USFWS, 2017). Due to similar routes of effects for several of the identified species, impacts are broken out into distinct sections: fish species, sea turtles, whale species, West Indian manatee, elasmobranchs, bird species, and plant species. It is the Town's intention for the Proposed Action to operate under the SARBO and adhere to all PDC. A risk of lethal and nonlethal take of protected species associated with the Proposed Action has been recognized by the Town, however, though a take may occur, there is no significant impact at the population level for any of the species further described below.

Table 4-2: Summary of effect determinations

Common Name	Scientific Name	Agency	Status	Critical Habitat	Species Determination	Critical Habitat Determination
Fish						
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	NMFS	Endangered	Not present in action area	LAA	NLAA
Shortnose sturgeon	*Acipenser brevirostrum*	NMFS	Endangered	None designated	LAA	--
Sea turtles						
Leatherback sea turtle	*Dermochelys coriacea*	NMFS, USFWS	Endangered	Not present	NLAA	--
Loggerhead sea turtle	*Caretta caretta*	NMFS, USFWS	Threatened	Occurs in area[1]	LAA	NLAA
Green sea turtle	*Chelonia mydas*	NMFS, USFWS	Threatened	Proposed in area	LAA	NLAA proposed critical habitat
Hawksbill sea turtle	*Eretmochelys imbricata*	NMFS, USFWS	Endangered	Not present	NLAA	--
Kemp's ridley sea turtle	*Lepidochelys kempii*	NMFS, USFWS	Endangered	Not present	LAA	--
Marine Mammals						
North Atlantic right whale	*Eubalaena glacialis*	NMFS	Endangered	Occurs in Area	NLAA	No Effect
Fin Whale	*Balaenoptera physalus*	NMFS	Endangered	None designated	NLAA	--
Sei Whale	*Balaenoptera borealis*	NMFS	Endangered	None designated	NLAA	--
Blue Whale	*Balaenoptera musculus*	NMFS	Endangered	None designated	NLAA	--
Sperm Whale	*Physeter macrocephalus*	NMFS	Endangered	None designated	NLAA	--
West Indian manatee	*Trichechus manatus*	USFWS	Endangered	Not present	NLAA	--
Elasmobranchs						
Smalltooth sawfish	*Pristis pectinata*	NMFS	Endangered	Not present	LAA	--
Giant Manta Ray	*Manta birostris*	NMFS	Threatened	None designated	LAA	--
Birds						
Piping plover	*Charadrius melodus*	USFWS	Threatened	Occurs in area	LAA	NLAA
Red knot	*Calidris canutus rufa*	USFWS	Threatened	Occurs in area	LAA	NLAA proposed critical habitat
Wood stork	*Mycteria americana*	USFWS	Threatened	None designated	NLAA	--
Roseate Tern	*Sterna dougallii*	USFWS	Endangered	None designated	NLAA	--
Plants						
Seabeach amaranth	*Amaranthus pumilus*	USFWS	Threatened	None designated	LAA	--

-- Critical habitat has not been designated for the species; therefore, effect determinations are not applicable.
[1] Loggerhead sea turtle critical habitat includes nearshore reproductive habitat (Unit N-05) and nesting habitat (LOGG-T-NC-07).

4.2.4. Fish Species (Shortnose sturgeon, Atlantic sturgeon)

The project has the potential to result in adverse impacts to sturgeon due to noise, water quality, entrainment, habitat disturbance, and/or impacts to prey species. These potential impacts are discussed further below. Atlantic sturgeon may occur in the project area in marine nearshore waters during anytime of the year. Shortnose sturgeon are typically found in the upper portions of rivers above the freshwater-saltwater interface; and therefore, their presence at the proposed offshore borrow area is considered unlikely. Furthermore, shortnose sturgeon presence within North Carolina is anticipated to be limited.

Water Quality

Decreased water quality has the potential to directly impact fish. As discussed in additional detail in Section 4.1.4, the project may create focused areas of minor temporary water quality impacts due to suspended sediments during in-water construction activities including dredging and beach renourishment. Near-field turbidity concentrations for hopper dredging typically range from 80.0 to 475.0 mg/L (Anchor Environmental, 2003).

There are several mechanisms by which suspended sediment could potentially impact fish. These mechanisms include:

- Direct mortality - As turbidity rises, dissolved oxygen levels decrease (NMFS, 2023g). Elevated turbidity levels at sufficient concentration can result in mortality of juvenile and even adult fish.
- Gill tissue damage - Suspended sediment can clog fish gills and result in a decrease in their capacity for oxygen exchange (NMFS, 2002 and NMFS, 2023g). The nature of the sediment particle, the concentration, water temperature, the duration of exposure, age, and species all affect fish response to suspended sediment.
- Physiological stress - Suspended sediments have been shown to cause stress in fish (NMFS, 2002). Stress is generally produced by prolonged exposure to high levels of suspended sediments.
- Behavioral changes - Behavioral responses to elevated levels of suspended sediment include feeding disruption and changes to normal movements. Minor behavioral impacts could occur due to TTS; however, these minor movements are anticipated to be too small to measure and therefore impacts are anticipated to be negligible.

In general, TTS levels below 1,000 mg/L for fewer than 14 days will not result in adverse impacts on sturgeon (Wilber and Clarke, 2001, as cited by NMFS 2023g). However, sturgeon are particularly susceptible to impacts from increased turbidity. They have been shown to respond to stressful water quality conditions by aggregating in small areas to seek refuge. This aggregation can make them more susceptible to other dredging impacts such as entrainment. Additionally, during periods of lower water quality, sturgeon may be physiologically stressed and unable to avoid interaction with dredge equipment like they normally would in good water quality conditions. Hopper dredging would be limited to the regulatory dredging window of November 16, 2025 through April 30, 2026, when water quality is not seasonally degraded.

Prolonged exposure is not a concern for this project because the dredging events will be short-term in nature and fish are not confined to the dredge area. Additionally, typical small-scale sediment plumes (such as those caused by dredging) are not anticipated to create suspended sediment concentrations high enough to cause stress. With the proposed avoidance and minimization measures, water quality impacts during dredging and beach renourishment are anticipated to be short-term, minor.

Noise

The main hearing organ in fish is the lateral line system, which is sensitive to particle motion. Pressure waves can cause changes in the swim bladder that may cause damage or reduced hearing sensitivity. Criteria for assessing dredging noise impacts on fish have not been established. However, in 2008 the Fisheries Hydroacoustic Working Group (FHWG), which included NMFS, USFWS, the Departments of Transportation for California, Oregon, and Washington, and national experts on sound propagation developed the interim injury criteria level threshold and a behavioral guideline for assessing potential pile driving noise impacts (FHWG, 2008; Table 4-3). Excessive in-water noise has the potential to directly impact fish species by causing physical injury or altering behavior when thresholds/guidelines are exceeded. The FHWG established injury thresholds were developed to only apply to impulsive impact pile driving noise sources, not continuous noise sources such as those produced during dredging.

Table 4-3: FHWG established noise guidelines and thresholds for fish

	Interim Injury Criteria (Impulsive, Impact Pile Driving) dB Peak	**Interim Injury Criteria (Impulsive, Impact Pile Driving) SEL Cum Fish > 2g**	**Interim Injury Criteria (Impulsive, Impact Pile Driving) SEL Cum Fish < 2g**	**Behavioral Guideline (Impulsive & Continuous) dBrms**
Threshold/ Guidelines	206	187	183	150

Source: FHWG, 2008

The use of a hydraulic dredge has the greatest potential to result in elevated in-water noise levels. Sounds produced by hydraulic dredges are continuous except during transitional activities (e.g., system flushing, repositioning, etc.). Large (6,000 to 9,000 m3 capacity) hopper dredges excavating gravely sand produced noise levels of 179 to 187 dB at the source (Reine and Dickerman, 2014). Medium size (835 to 1521 m3 capacity) hopper dredges excavating sand produced noise levels of 161 to 178 dB at the source (Reine and Dickerman, 2014). Because the proposed project involves dredging in soft sandy sediment and will likely use a medium to large size dredge, project-related dredging is anticipated to produce noise levels of up to 178 dB.

Fish typically avoid areas of elevated continuous noise sources (NMFS, 2012), and it is therefore unlikely that fish would remain in proximity to the Proposed Action activities and be exposed to noise levels that could result in substantial adverse impacts. Injurious noise impacts are not anticipated. Non-injurious noise impacts would be minor, temporary, and localized. Furthermore, if smaller class dredges are used, in-water noise would be anticipated to be less than that used in this analysis.

Entrainment

Based on its low probability of occurrence in the project area and the absence of reported dredge interactions along the South Atlantic Coast, it is expected that the risk of shortnose sturgeon entrainment would be negligible. Neither species are anticipated to occur within proximity to the offshore borrow area.

Dredging would be completed with a hopper dredge. Hopper dredges are known to cause mortality to sturgeon. In 2018, 14 Atlantic sturgeon were entrained by hopper dredges under projects authorized by SARBO (NMFS, 2020a). A total of 53 reported takes of Atlantic sturgeon from SARBO authorized hopper dredging have occurred between the years of 1998 and 2018 (NMFS, 2020a). Entrainment by hopper dredges is believed to mainly occur when the draghead is operating on the bottom. Sturgeon are bottom-dwelling fish making them susceptible to entrainment by hopper dredges. In addition, sturgeon could become crushed on the bottom by moving the draghead. The project will comply with all applicable PDC from the SARBO including, but not limited to using draghead deflectors and having a protected species observer (PSO) present during hopper dredging. These measures are anticipated to reduce the risk of sturgeon entrainment to very low.

The Town will follow all Terms and Conditions and PDC from the existing SARBO to minimize impacts to ESA-listed species including mitigation measures such as relocation trawling at the proposed borrow area if deemed necessary during construction. Tow speeds will not exceed 3.5 knots. capture and relocation of sturgeon will be conducted in accordance with the protocols set forth in the SARBO (NMFS 2020a) including measures pertaining to handling, relocation, data recording, tagging, and genetic sampling. During the Oak Island 2021/2022 renourishment project, which lasted for 59 days, 27 non-lethal relocations of Atlantic Sturgeon were performed within the Jay Bird Shoals Borrow Area. Take of Atlantic or shortnose sturgeon did not occur.

Entrainment impacts could also occur to sturgeon prey species as further discussed below.

Habitat Impacts

The project will result in benthic habitat disturbances during dredging and sediment placement activities. Dredging operations could result in disturbance of benthic habitat. Because the borrow area is in relatively deep water (existing ocean floor elevations on the order of 60 ft NAVD 88), any infilling would likely occur over multi-decadal time frames (Gonzalez et al., 2010; Barley, 2020). Sturgeon are anticipated to occur within the offshore borrow site however given the limited borrow area size and availability of other foraging sources, dredging at this location is not anticipated to result in habitat impacts to sturgeon.

The placement of sediment on the beach will result in approximately 197 acres of benthic habitat impacts waterward of the MHHW line. However, substrate would be similar in nature to the existing substrate to minimize potential habitat modifications. Beach renourishment would not be anticipated to result in substantial habitat changes to baseline conditions but would instead restore habitat to pre-storm conditions.

Prey Species

Impacts to prey species have the potential to cause indirect impacts to their predators through reduced food supply. Sturgeon prey that could occur in the project area includes flies, mollusks, crustaceans, and small fish.

The project will result in benthic habitat disturbance during dredging activities and during placement activities. Benthic habitat impacts have the potential to result in impacts to benthic prey species.

Sand placement within the intertidal zone temporarily buries existing benthic habitat, reducing infauna availability to benthic feeders (Wilber, 2003). Disturbed benthic habitat at the beach renourishment location is anticipated to be quickly recolonized by benthic species and in-benthic invertebrates. Benthic communities in frequently disturbed shallow water benthic habitats typically recolonize disturbed sediments rapidly (Wilber and Clarke, 2007). The principal project-related factors that influence benthic community recovery rates are the compatibility of the beach fill sediments with those of the native beach and the timing of beach renourishment projects relative to spring benthic invertebrate larval recruitment periods (Wilber et al., 2009). Most benthic recovery studies have reported rapid recovery within seven months of the initial impact when highly compatible beach fill sediments were used and peak larval recruitment periods were avoided (Van Dolah et al., 1992, Gorzelany and Nelson, 1987, Salomona and Naughton, 1984, Hayden and Dolan, 1974). Conversely, longer recovery periods of up to 15 months (Rakocinski et al., 1996) have been associated with the use of incompatible beach fill sediments containing excessively large quantities of fine silt and clay material. Beach renourishment substrate would be similar in nature to the existing substrate, and therefore recolonization is anticipated to be rapid. To further reduce the potential for impacts, an environmental dredging window (November 16, 2025 – April 30, 2026) would be implemented which would avoid peak benthic invertebrate recruitment periods in North Carolina (May through September).

The direct excavation or removal of sediment at the offshore borrow site will impact benthic resources. The proposed OSOKI borrow area is approximately 250 acres in size and is located 16.4 nautical miles offshore. Benthic recovery in deeper more stable environments, such as the proposed borrow area, is less rapid than shallow water benthic recovery. Additionally, larger scale disturbances typically require longer recovery times. A study completed by Guerra-Garcia et al. (2003) found that benthic recovery in small 105m^2 patches took seven months, while recovery for larger 1,000 m^2 disturbances took years. Sediment type also impacts recovery rates. Recovery times for mud habitats can range from 6-8 months while recover times for sand and gravel substrates can range from 2-3 years (Newell et al., 1998). Monitoring studies of post-dredge recovery rates indicate that most borrow areas usually show substantive recovery within 1 to 2 years (USACE, 2014). Sturgeon are anticipated to occur within the vicinity of offshore borrow site, however, given the limited size of the borrow area and the presence of other foraging areas, impacts to prey species at this location are not anticipated to result in impacts to sturgeon.

Fish prey species could be impacted by noise emitted during in-water construction activities. project related noise would not be anticipated to result in injurious noise impacts and any potential non-injurious noise impacts would be minor, temporary, and localized. Fish prey species could also become entrained during hydraulic dredge activities.

ESA Effect Determination

Endangered Species Act (ESA) consultations for the Project are consistent with those completed under the 2020 SARBO for Dredging and Material Placement Activities in the Southeast United States (NMFS, 2020). In accordance with SARBO, the project is LAA, but not likely to jeopardize the continued existence of Atlantic sturgeon and shortnose sturgeon.

Critical Habitat Effects Determination

Atlantic sturgeon critical habitat exists at the eastern tip of Caswell Beach and Southport, where the mouth of the Cape Fear River, meets the Atlantic Ocean. Critical habitat is outside of the project footprint, but within the general project vicinity. Critical habitat for Atlantic sturgeon occurs in the project area at the Cape Fear River. In accordance with SARBO, the Project is NLAA Atlantic sturgeon critical habitat. The physical features essential to the conservation of the Atlantic sturgeon include hardbottom substrate in low salinity waters, soft bottom substrate in waters with a gradual salinity gradient, water of appropriate depths without physical barriers, and acceptable water quality conditions for various life stages. Dredging within the Cape Fear River is not proposed, and therefore the project is not anticipated to impact the physical features essential the conservation of the Atlantic Sturgeon in the Cape Fear River. Construction-related noise or adverse water quality conditions may create temporary barriers to sturgeon movement. However, for the reasons given above, potential noise and water quality impacts are anticipated to be minor and temporary. PSOs would monitor for potential take of sturgeon during dredging, further reducing the risk of impacts from poor water quality conditions.

Shortnose sturgeon critical habitat has not been designated and therefore the Project would have No Effect on shortnose sturgeon critical habitat.

4.2.5. Sea Turtles (Leatherback, loggerhead, green sea turtle, hawksbill, kemp's ridley)

Loggerhead, green sea turtle, and Kemp's Ridley are likely to occur in nearshore marine waters within the project area especially during the warmer months from spring to early winter. They are anticipated to move offshore to warmer waters during the early winter months. Leatherbacks may also occur in the project area; however, they are primarily associated with deep offshore waters and therefore their presence in nearshore marine waters is considered unlikely. Hawksbills have the potential to occur in the project area, but their presence is anticipated to be rare. Of the five sea turtle species, loggerheads are the most likely to occur nesting along the shorelines of Oak Island. Green sea turtles may occasionally nest in North Carolina. Leatherback, hawksbill, and Kemp's Ridley rarely nest in North Carolina.

Water Quality

Decreased water quality has the potential to directly impact sea turtles. The project may create focused areas of minor temporary water quality impacts due to suspended sediments during in-water construction activities. Dredging poses the greatest potential for creating elevated levels of turbidity. Hopper dredging can result in TTS of up 475 mg/L (NMFS, 2023g).

The impacts of elevated turbidity on sea turtles have not been thoroughly studied, however turbidity is not believed to impact sea turtles (NMFS, 2020a). Sea turtles are highly mobile and therefore would be anticipated to move away from poor water quality conditions. Additionally, sea turtles breathe air and are therefore not as susceptible to turbidity related water quality issues such as low dissolved oxygen. It is assumed that turbidity could result in minor behavioral impacts. For instance, sea turtles may alter their movements to avoid turbidity plumes. Potential alterations in behavior are anticipated to be too small to be meaningful.

Noise Impacts

In-water noise impacts to sea turtles have not been thoroughly studied. Sea turtles are not known to use sound for communication (NOAA, 2016), and it is thought that they have poor auditory sensitivity (U.S. Navy, 2017). Electrophysiological and behavioral studies have indicated that sea turtles detect low frequency acoustics, and it is anticipated that they may use sound for navigation, finding prey, and avoiding predators (NOAA, 2016). NMFS SERO has established guidance for assessing noise impacts to sea turtles (NMFS SERO, 2022). The established thresholds are summarized below in Table 4-4.

Table 4-4: NMFS SERO noise guidelines and distances to guidelines for sea turtles

	PTS (Impulsive) dB SELcum	**PTS (Impulsive) dB peak**	**PTS (Continuous) dB SELcum**	**Behavioral Guideline (Impulsive and Continuous) dBrms**
Threshold	204 dB SEL	232 dB peak	220 dB SEL	175 dBrms

Source: NMFS SERO, 2022

The use of a hydraulic dredge has the greatest potential to result in elevated in-water noise levels. Sounds produced by hydraulic dredges are continuous except during transitional activities (e.g., system flushing, repositioning, etc.). As discussed in additional detail in Section 4.1.6, hydraulic dredging could result in noise levels of up to 178 dB at the source. Therefore, dredging would not be anticipated to result in underwater noise that could exceed the permanent threshold shift (PTS) noise thresholds sea turtles. Dredging could slightly exceed behavioral guidelines within very limited areas in the immediate vicinity of the proposed dredge footprint. Non-injurious noise impacts would be minor, temporary, and localized. Furthermore, if smaller class dredges are used, in-water noise would be anticipated to be less than that used in this analysis.

Entrainment

Entrainment impacts to sea turtles could occur during hopper dredging. Hawksbill sea turtles are not anticipated to be at risk of becoming entrained due to their association with reef habitat where hopper dredging would not occur. Leatherback sea turtles are not anticipated to be at risk of entrainment due to their large size and their preference for pelagic habitats where the Project would not occur. Hopper dredge entrainment is believed to occur when the draghead is operating on the bottom. Sea turtles resting or foraging on the seafloor may become entrained. In addition, sea turtles could become crushed on the bottom by the moving draghead.

The project has limited hopper dredging to the regulatory dredging window of November 16, 2025 through April 30, 2026 when sea turtle abundance within the Project Area is anticipated to be lower. To further reduce the risk of potential entrainment, mitigation measures to minimize impacts to ESA-listed species include fitting hopper dredges with rigid draghead deflectors to reduce entrainment risks and the potential use of relocation trawling if deemed necessary during project construction. Tow speeds of the relocation trawler will not exceed 3.5 knots. Capture and relocation of sea turtles will be conducted in accordance with the protocols set forth in the SARBO (NMFS 2020a) including measures pertaining to relocation, data recording, tagging, and genetic sampling. During the Oak Island 2021/2022 renourishment project, which lasted for 59 days, there were successful relocations of nineteen Kemps ridleys, nine loggerheads, and one leatherback within the Jay Bird Shoals Borrow Area. Two takes occurred, one Kemps ridley and one leatherback sea turtle.

With the proposed avoidance and minimization measures discussed in Section 6, such as having a PSO present during hopper dredging, using draghead deflectors, and implementation of a hopper dredging work window that coincides with periods when sea turtle abundance is anticipated to be lower, the risk of sea turtle entrainment is anticipated to be reduced.

Entrainment impacts could occur to sea turtle prey species as further discussed below.

Vessel Collision

Because sea turtles' surface to breathe, they are susceptible to propeller strikes and vessel collisions. Vessel transit will occur regularly during active construction throughout the APE to support daily project activities. There is no proposed long-term increase in boat use as a result of project. Therefore, long-term operational vessel collision risks are not anticipated. Vessels proposed for use during construction could include trailing suction hopper dredges and support vessels such as tugboats. trawler, and work boats.

Dredging and placement activities will be completed with slow moving barges that would not be anticipated to pose a substantial risk of vessel collisions with sea turtles while dredging. However, the risk for vessel collisions occurs when transiting between pumpout locations. Additionally, smaller support vessels could be moving faster and pose a risk of vessel collisions with sea turtles. These types of vessels are typical throughout the project area and do not pose a substantial deviation from normal boating activity. The project will comply with all applicable PDC from the SARBO including, but not limited to requiring that all vessel operators and crew monitor for the presence of sea turtles and shut down operations when within proximity to sea turtles. These measures are anticipated to further minimize the risk of vessel collisions. With the proposed avoidance and minimization measures, vessel collision impacts are considered unlikely.

Habitat Impacts

Dredging and beach renourishment could result in impacts to sea turtle habitat. Habitat impacts during dredge events are anticipated to be temporary. Sea turtles may avoid areas within the vicinity of active construction. Temporary construction-related habitat impacts would be minimized by limiting hopper dredging and beach renourishment activities to November 16 through April 30, thus avoiding periods of peak sea turtle abundance and the nesting and hatching season (anticipated to be May 1 through November 15). It is anticipated that any sea turtles that are disturbed by construction activities will utilize ample adjacent suitable in-water habitat during temporary construction disturbances. Due to the ample adjacent in-water habitat and implementation of the work window, temporary construction-related habitat impacts are anticipated to be minor and temporary.

Beach renourishment could result in short-term impacts to sea turtle nesting habitat due to changes to beach characteristics. Adverse impacts are due to changes to the beach profile, incompatible sand placement, beach compaction, and/or escarpment formation (Brock et al., 2009; Ernest, 2001). Sand placement may temporarily reduce the quality of potential nesting habitat through modification of beach profile morphology and/or changes in sediment composition and other physical substrate properties. The initial post-construction profile is flatter than the natural beach profile; and consequently, is subject to a period of adjustment during which sediments are sorted and redistributed by wave and wind driven transport processes. This adjustment process often results in the formation of escarpments that can prevent sea turtles from accessing upper dry beach nesting habitats.

The use of heavy machinery to redistribute and establish the design beach profile can result in compaction of the newly deposited beach sediments, which in turn can impede sea turtle nest excavation. Sediment compaction and changes in sediment composition can also affect the suitability of the nest incubation environment and the ability of hatchlings to emerge from the nest (Crain et al., 1995). Embryonic development and hatching success are influenced by temperature, gas exchange, and moisture content within the nest environment. Changes in substrate characteristics such as grain size, density, compaction, organic content, and color may alter the nest environment; leading to adverse effects on embryonic development and hatching success (Crain et al. 1995, and Ackerman, 1996). Nourished beaches often retain more water than natural beaches, thus impeding gas exchange within the nest (Ackerman, 1996). Uncharacteristically dark sediments absorb more solar radiation, thus potentially resulting in warmer nest temperatures (Hays et al., 2001). Nest temperature also influences sex determination in hatchlings, with warmer temperatures producing more females and cooler temperatures producing more males (Wibbels, 2003), thus indicating that the use of uncharacteristically dark beach fill sediments could potentially alter hatchling sex ratios.

Holloman and Godfrey (2008) studied the effects of multiple beach renourishment events on sea turtle nesting and hatching success on Bogue Banks. This five-year study (2002-2007) included monitoring of nesting activity, hatching success, substrate compaction, and nest temperature. No substantive beach renourishment effects on nesting success (i.e., nest/false crawl ratios) were detected, and there was no indication that renourishment adversely affected egg development or hatching success, except for one nest that apparently failed due to poor gas exchange. Renourishment had limited effect on compaction; however, nests in nourished areas were on average 1.9°C warmer than nests laid at the same time on undisturbed beaches. Although sex ratios were not determined, Holloman and Godfrey (2008) concluded that the increase in nest temperature on nourished beaches increased the number of females produced. Studies documenting declines in nesting success on nourished beaches have attributed this to substrate compaction, escarpment formation, and/or modification of the natural beach profile. These studies have reported a return to normal nesting activity by the second or third post-nourishment nesting season (Crain et al., 1995; Ernest and Martin, 1999; Herren, 1999; Rumbold et al., 2001; Byrd 2004, and Brock et al., 2009). In contrast, studies have also reported immediate increases in nesting success following renourishment projects on chronically eroded beaches (Byrd, 2004). Brock (2009) found that loggerhead nest success increased during the second season post-nourishment. The variation in responses has been attributed to differences in the physical attributes of individual projects, the extent of erosion on the pre-nourishment beach, and construction techniques (Brock et al., 2009).

Prey Species Impacts

Impacts to sea turtle prey species have the potential to cause indirect impacts to sea turtles through reduced food supply. As discussed in Section 3.2.3, sea turtle diet varies among species. Green sea turtles typically feed on algae, seagrasses, and seaweed, Kemps Ridley consume mollusks, crustaceans, and fish, loggerhead primarily consume mollusks, crustaceans, and sponges, hawksbills feed on encrusting organisms such as sponges, tunicates, bryozoans, mollusks, and algae, and leatherbacks feed exclusively on gelatinous zooplankton.

Impacts to aquatic vegetation food sources are not anticipated. Dredging would not occur in areas with mapped submerged aquatic vegetation or in areas with hard surfaces such as coral reefs that could support vegetation growth. Dredging is limited to soft-bottom habitats devoid of vegetation. Therefore, foraging impacts to herbivorous sea turtles are not anticipated.

The project will result in benthic habitat disturbance during dredging and sand placement activities. Dredging and placement activities have the potential to bury or remove areas that could be inhabited by benthic prey species. Dredging could cause temporary disturbances of soft bottom benthic habitat and could result in the entrainment of sessile benthic organisms that are not able to avoid the construction area. Benthic prey species would quickly recolonize dredged benthic habitats, especially within proximity to the nearshore placement site. Therefore, impacts to benthic prey species as a result of dredging events are anticipated to be minor and temporary. Furthermore, hopper dredging, and beach renourishment would be limited to November 16 through April 30 which would avoid peak benthic invertebrate recruitment periods in North Carolina (May through September) and is when sea turtle populations in the area are anticipated to be lowest.

Fish prey species could be impacted by noise emitted during in-water construction activities. As discussed in Section 4.1.6, project related noise would not be anticipated to result in injurious noise impacts and any potential non-injurious noise impacts would be minor, temporary, and localized. As discussed in Section 4.2.4, hopper dredges may entrain fish species and therefore draghead deflectors would be used to minimize the risk of entrainment.

Ample adjacent foraging areas exist outside of the project footprint that could be utilized if temporary prey species impacts occur during construction. With the implementation of a work window, use of a draghead deflector, and avoidance of areas with mapped sea grass or hard substrate, impacts to sea turtles as a result of prey species impacts are considered unlikely.

Effect Determination

In accordance with SARBO (2020), the Proposed Action is NLAA leatherback, and hawksbill sea turtles. The project is LAA, but not likely to jeopardize the continued existence of loggerhead, green, and Kemp’s Ridley sea turtles.

Critical Habitat Effect Determination

Nearshore reproductive habitat and wintering loggerhead critical habitat occurs in the project area. Only the nearshore reproductive habitat unit overlaps with the Project footprint. The wintering critical habitat is located more than 15 miles from the project footprint. The project is NLAA nearshore reproductive habitat and would have No Effect on wintering loggerhead critical habitat.

The physical features essential to the conservation of the loggerhead include nearshore waters with proximity to nesting beaches, waters without obstructions or artificial lighting, and waters with minimal man-made structures that could promote predation. The project would occur outside of the nesting and hatching season to minimize construction-related barriers. Additionally, the project has been designed to minimize potential nesting barriers. Beach renourishment will mimic natural beach conditions and be placed in a way that minimizes scarps and compaction. The project does not propose man-made structures that could increase predation.

The PCEs identified for wintering critical habitat include water temperatures above 10 °C from November through April, continental shelf waters in proximity to the western boundary of the Gulf Stream; and water depths between 20 and 100 m. The Project would not impact any of these PCEs. Therefore, the Project would have No Effect on wintering loggerhead critical habitat.

Critical habitat for green sea turtles is proposed in the project area. The features essential to the conservation of the green sea turtle include nearshore waters with proximity to nesting beaches, nearshore unobstructed migratory corridors, nearshore foraging habitat and sargassum foraging areas. The project is NLAA proposed green sea turtle critical habitat. The project would occur outside of the nesting and hatching season and would minimize construction-related barriers to the extent feasible. To minimize impacts to foraging, project activities would not occur in areas with SAV or hardbottom.

Critical habitat for leatherback, hawksbill, and Kemp's Ridley sea turtles does not occur and is not proposed in the project area. Therefore, the Project Action would have No Effect on critical habitat for these species.

4.2.6. Whale Species (North Atlantic, fin, sei, blue, and sperm whale)

North Atlantic right whale (NARW) calving area occurs in the APE and it is anticipated that NARW could occur in the project area, especially during winter months. Implementation of the regulatory environmental dredging window (November 16 through April 30) is anticipated to minimize impacts to other species such as sea turtles but will put the project within a period when NARW are known to occur. Fin whales, sei whales, blue whales, and sperm whales could occur in the project area, however their presence is anticipated to be rare as they are more commonly associated with deep offshore water that would not be impacted by the Proposed Action.

Water Quality

Decreased water quality has the potential to directly impact whales. The Proposed Action may create focused areas of minor temporary water quality impacts due to suspended sediments during in-water construction activities. Dredging poses the greatest potential for creating elevated levels of turbidity. Hopper dredging can result TTS of up 475 mg/L (NMFS, 2023g). Based on available dredging turbidity data, it has been assumed that turbidity plumes could extend up to 4,000 ft. from the proposed dredging activities (Wilber and Clarke, 2001).

Fin whales, sei whales, blue whales, and sperm whales typically occur in deep offshore waters, outside of the potential extent of turbidity impacts. However, NARW has the potential to occur in proximity to dredging operations and therefore be exposed to increased turbidity, especially during winter months. The impacts of elevated turbidity on whales have not been thoroughly studied and information on potential impacts is not available. However, it is assumed that turbidity as result of dredging activities would lead to minor behavioral impacts such as whales may alter their movements to avoid turbidity plumes.

Noise Impacts

Noise has the potential to directly impact marine mammals by causing physical injury or altering behavior when noise threshold levels are exceeded. NMFS has identified Level A (potential injury) and Level B (potential disturbance) noise thresholds for marine mammals based on their hearing class (NMFS 2020a, Table 4-5). NARW, fin whales, blue whales, and sei whales are all low frequency cetaceans (Table 4-5). Sperm whales are mid-frequency cetaceans.

Table 4-5: Marine mammal noise thresholds

Hearing Group	Impulsive Level A dB SELcum	Impulsive Level A dB Peak	Impulsive Level B dBrms	Non-impulsive Level A dB SELcum	Non-impulsive Level B dBrms
Low Frequency Cetaceans	183	219	160	199	120
Mid Frequency Cetaceans	185	230	160	198	120

Source: NMFS, 2020

The use of a hydraulic dredge has the greatest potential to result in elevated in-water noise levels. Sounds produced by hydraulic dredges are continuous except during transitional activities (e.g., system flushing, repositioning, etc.). As discussed in additional detail in Section 4.1.6, dredging could produce noise levels of up to 178 dB at the source.

Dredging activities would not result in underwater noise that could exceed injury noise thresholds for whales. Exceedances over the Level B behavioral threshold could occur. Fin whales, blue whales, sei whales, and sperm whales occur in deep offshore waters where project activities would not occur.

Therefore, noise levels would attenuate before reaching areas in which these whale species could occur. However, NARW are known to occur in nearshore areas. If whales are disturbed by elevated noise levels, they would be anticipated to avoid the area while work is occurring and return to the area after construction ceases. Furthermore, because NARW are not known to communicate with calves while in calving areas, masking impacts are not anticipated.

Vessel Collisions

Because whales surface to breathe, they are susceptible to propeller strikes and vessel collisions. Vessels proposed for use during construction could include trailing suction hopper dredges and support vessels such as tugboats, trawler, and work boats. Fin whales, blue whales, sei whales, and sperm whales occur in deep offshore waters where project activities would not occur. Therefore, vessel collisions with these species are limited. However, NARW could occur in the nearshore areas where construction-related vessel activity would occur. Additionally, NARW can be particularly susceptible to vessel strikes due to their lack of a dorsal fin making them difficult to spot at the water's surface.

Dredging and placement activities will be completed with slow moving medium to large barges that would not be anticipated to pose a substantial risk of vessel collisions with whales while dredging. However, the risk for vessel collisions occurs when transiting between pumpout locations. The risk of vessel strikes will be reduced by adhering to relevant SARBO PDCs including, but not limited to limiting speeds to less than 10 knots when a NARW is observed or reported within 38 nmi of dredge or support vessels and ceasing operations if a NARW is observed by a PSO within 500 yards (1,500 ft.) of the proposed dredging operations.,. Additionally, in accordance with SARBO, if a whale (other than a NARW) is spotted by a PSO, a distance of at least 300 ft would be maintained. Smaller support vessels could be moving faster and pose a risk of vessel collisions with whales.

With the avoidance and minimization measures proposed in Section 6, including all applicable SARBO PDCs such as orders to reduce speed, alter course, or cease operations when in proximity to ESA-listed whales, the increased risk of vessel collision due to construction related boating activity is considered minor. There is no proposed long-term increase in boat use in project area as a result of project. Therefore, long-term operational vessel collision risks are not anticipated.

Habitat Impacts

Whales are pelagic species and therefore benthic habitat impacts from the proposed dredging and placement activities are not anticipated. Additionally, the avoidance and minimization measures proposed in Section 5 including ceasing work, reducing vessel speed, or modifying vessel course would limit the risk that the Proposed Action would interfere with the habitat use of ESA-listed whales.

Prey Species Impacts

Fin whales, blue whales, sei whales, and sperm whales predominately occur in deep offshore waters where project activities would not occur. Therefore, foraging impacts are not anticipated for these species. NARW could occur within the vicinity of the proposed nearshore activities, however NARW are not known to use the project area for foraging. The area is predominately used for calving and migrating. Therefore, the project is not anticipated to result in impacts to NARW by altering prey availability.

Effect Determination

In accordance with SARBO, the project is NLAA NARW, fin whales, blue whales, sei whales, and sperm whales.

Critical Habitat Effect Determination

North Atlantic right whale critical habitat occurs in the project area. The physical features essential to the conservation of the NARW are sea surface conditions of less than 4 on the Beaufort scale, sea surface temperatures of 7 degrees Celsius to 17 degrees Celsius, and water depths of 6 to 24 meters (20 to 92 ft.). The proposed dredging and placement activities will not impact any of these features. In accordance with SARBO and with the implementation of all SARBO PDC, the project will have No Effect on NARW critical habitat.

4.2.7. West Indian Manatee

West Indian manatees could occur in the inland and coastal waters of the project area for at least five months of the year (June through October) when water temperatures exceed 68°F.

Water Quality

Decreased water quality has the potential to directly impact West Indian manatee. The Project may create focused areas of minor temporary water quality impacts due to suspended sediments during in-water construction activities. Dredging poses the greatest potential for creating elevated levels of turbidity. Hopper dredging can result in TTS of up 475 mg/L (NMFS, 2023g).

Turbidity increases could result in minor behavioral impacts. For instance, West Indian manatee may alter their movements to avoid turbidity plumes. Hopper dredging and beach renourishment activities would be limited to November 16 through April 30, which are colder weather months when West Indian Manatee would be considered unlikely to occur in the project area. With the proposed avoidance and minimization measures, water quality impacts are anticipated to be minor.

Noise

Noise has the potential to directly impact marine mammals by causing physical injury or altering behavior when noise threshold levels are exceeded. NMFS has identified Level A (potential injury) and Level B (potential disturbance) noise thresholds for marine mammals based on their hearing class. Marine mammal hearing classes with established noise thresholds include phocids, otariids, high-frequency cetaceans, mid-frequency cetaceans, and low-frequency cetaceans. West Indian manatees are sirenians and NMFS has not developed noise thresholds for this hearing class.

Little data exists regarding manatee's sensitivity to noise. However, existing data suggests that manatees hearing capabilities may be similar to phocid pinnipeds (BOEM, 2014). The NMFS established thresholds for phocid pinnipeds are shown in Table 4-6. Noise thresholds have also been estimated using available auditory data for sirenians and available auditory data for other species groups (Southall et al., 2019, Table 4-6).

Table 4-6: Sirenians noise thresholds and distances to thresholds for West Indian Manatees

Hearing Group	Impulsive Injury (PTS) dB SEL	Impulsive Injury (PTS) dB Peak	Impulsive Behavioral	Non-impulsive Injury (PTS)	Non-impulsive Behavioral
Sirenians[1]	190 dB	226 dB	--	206 dB	--
Phocid Pinnipeds[2]	185 dB	218 dB	160 dB	201 dB	120 dB

[1] *Source: Southall et al., 2019*
[2] *Source: NMFS, 2020a*

The use of a hydraulic dredge has the greatest potential to result in elevated in-water noise levels. Sounds produced by hydraulic dredges are continuous except during transitional activities (e.g., system flushing, repositioning, etc.). As discussed in additional detail in Section 4.1.6, hydraulic dredging could result in noise levels of up to 178 dB at the source. Hopper dredging would be limited to colder weather months when manatees are unlikely to occur in the project area and as such noise impacts from hopper dredging are not anticipated. Based on available noise thresholds, dredging would not be anticipated to result in underwater noise that could cause injury to West Indian manatee (Table 4-6). Behavioral impacts could occur, but the extent of potential exceedances would be dependent upon the vessel type and substrate to be dredged. The West Indian manatee is anticipated to avoid the immediate construction area, thereby minimizing the risk of potential exposure to noise levels that exceed the Level B threshold.

Vessel Collision

Manatees spend time at the water’s surface and are therefore susceptible to propeller strikes and vessel collisions. Vessels will occur during construction throughout the project area to support Project activities. Vessels proposed for use during construction could include trailing suction hopper dredges and support vessels such as tugboats, trawler, and work boats.

Hopper dredging would be limited to colder water months when manatees are unlikely to occur in the project area. Manatees typically occur in nearshore areas, and it is therefore unlikely that manatees will be struck by vessels operating near the offshore borrow site. Dredging and placement activities will be completed with slow moving barges that would not be anticipated to pose a substantial risk of vessel collisions with manatees. Vessel collision could occur during transit between dredging areas and disposal sites. Smaller support vessels will also be used and could be moving faster and pose a risk of vessel collisions. These types of vessels are typical throughout the project area and would not result in a substantial deviation from normal boating activity in the project area. To minimize the risk of vessel collisions, the Project will adhere to USFWS Guidelines for Avoiding Impacts to the West Indian Manatee: Precautionary Measures for Construction Activities in North Carolina Waters. These guidelines include implementing precautionary measures if a manatee is seen within 100 yards of active construction and shutting down moving equipment if a manatee is within 50 ft of operational equipment.

The increased risk of vessel collision due to construction related boating activity is considered minor. The avoidance and minimization measures proposed in Section 6 such as adherence to USFWS Guidelines for Avoiding Impacts to the West Indian Manatee: Precautionary Measures for Construction Activities in North Carolina Waters and limiting hopper dredging to colder winter months would further reduce the risk of vessel collisions. With the proposed minimization measures, vessel collision impacts are considered unlikely. There is no proposed long-term increase in boat use in project area as a result of project. Therefore, long-term operational vessel collision risks are not anticipated.

Habitat Impacts

The project will result in benthic habitat disturbances during dredging and sediment placement activities. Dredging would not occur in areas with SAV that could provide foraging habitat for manatees. Manatees occur in nearshore areas and therefore dredging at the offshore borrow site is not anticipated to result in habitat impacts to manatees. The placement of sediment on the beach will result in benthic habitat impacts. However, placement activities will occur primarily shoreward of the high tide line at +7ft NAVD88 and therefore habitat impacts to manatees are not anticipated.

Prey Species

Manatees are herbivores and feed along grass bed margins with access to deep water channels, where they flee when threatened. They feed on a variety of submerged, floating and emergent plants including manatee grass, turtle grass, shoal grass, widgeon grass, hydrilla, tape grass, water hyacinth, and water lettuce. The project has been designed to avoid impacts to SAV. Therefore, impacts to manatee prey species are unlikely.

Effect Determination

Due to the low probability of manatee occurring in the project area during the proposed hopper dredging and beach renourishment construction window, lack of identified substantial impacts and the proposed avoidance and minimization measures, the Project is NLAA manatees.

Critical Habitat Determination

Manatee critical habitat does not occur in the project area. Therefore, the project will have No Effect on manatee critical habitat.

4.2.8. Elasmobranchs (Smalltooth sawfish, giant manta ray)

As discussed in additional detail in Section 3.2.3, giant manta rays may occur near in the project area during the warmer months from June to October. It is considered unlikely that smalltooth sawfish will occur in the project area based on available sighting data and their preference for warmer waters than those which would typically occur in the project area.

Water Quality

Decreased water quality has the potential to directly impact giant manta ray and smalltooth sawfish. The Project may create focused areas of minor temporary water quality impacts due to suspended sediments during in-water construction activities. Dredging poses the greatest potential for creating elevated levels of turbidity. Hopper dredging can result in TTS of up 475 mg/L (NMFS, 2023g).

If giant manta ray or smalltooth sawfish are exposed to increases in turbidity, minor behavioral impacts could occur. For instance, they may alter their movements to avoid turbidity plumes. Hopper dredging and beach renourishment activities would be limited to November 16 through April 30, which are colder weather months when giant manta ray and smalltooth sawfish would be considered unlikely to occur in the project area. With the proposed avoidance and minimization measures, water quality impacts are anticipated to be minor.

Noise

Elevated noise levels have the potential to impact elasmobranchs, however noise thresholds for elasmobranchs have not been developed. Little data exists regarding the noise sensitivity to noise. Dredging could result in elevated in-water noise levels that could cause behavioral impacts within small, localized areas. Hopper dredging would be limited to colder weather months when the giant manta ray and smalltooth sawfish are unlikely to occur in the project area and as such, noise impacts from hopper dredging are anticipated to be unlikely.

Vessel Collision

Giant manta rays spend time at the water’s surface and are therefore susceptible to propeller strikes and vessel collisions. Smalltooth sawfish are bottom dwelling and would not be anticipated to be susceptible to propellor strikes. Vessels will occur during construction throughout the project area to support Project activities. Vessels proposed for use during construction could include trailing suction hopper dredges and support vessels such as tugboats, trawler, and work boats.

Hopper dredging would be limited to colder water months when giant manta ray is unlikely to occur in the project area. Furthermore, dredging and placement activities will be completed with slow moving barges that would not be anticipated to pose a substantial risk of vessel collisions. Vessel collision could occur during transit between dredging areas and disposal sites. Smaller support vessels will also be used and could be moving faster and pose a risk of vessel collisions. These types of vessels are typical throughout the project area and would not result in a substantial deviation from normal boating activity in the project area.

With the proposed minimization measures, vessel collision impacts are considered unlikely. There is no proposed long-term increase in boat use in project area as a result of project. Therefore, long-term operational vessel collision risks are not anticipated.

Habitat Impacts

The project will result in benthic habitat disturbances during dredging and sediment placement activities. Because the OSOKI borrow area is in relatively deep water (existing ocean floor elevations on the order of 60 ft NAVD 88), any infilling would likely occur over multi-decadal time frames (Gonzales et al., 2010; Barley, 2020). The placement of sediment on the beach will result in benthic habitat impacts. However, placement activities will occur primarily shoreward of the high tide line at +7ft NAVD88 and therefore habitat impacts to manta rays and smalltooth sawfish are not anticipated.

Prey Species

Impacts to prey species have the potential to cause indirect impacts to their predators through reduced food supply. The project will result in temporary benthic habitat disturbance during dredging activities. Benthic habitat impacts have the potential to result in impacts to benthic prey species. Dredging could result in the entrainment of sessile benthic organisms that are not able to avoid the construction area. Benthic prey species would quickly recolonize dredged benthic habitats and therefore impacts due to reduced food supply are considered unlikely.

Effect Determination

In accordance with SARBO, the project is LAA giant manta rays and smalltooth sawfish.

Critical Habitat Determination

Giant manta ray or smalltooth sawfish critical habitat does not occur in the project area.

4.2.9. Bird Species (Piping Plover, Red Knot, Wood Stork, Roseate Tern)

As discussed in Section 3.2.3, piping plover, red knot, and wood stork could occur in the project area. Roseate tern could also occur in the project area on rare occasions. Piping plover critical habitat has been designated on the western end of Oak Island, approximately 1,500 ft. from the proposed placement activities. The breeding, migratory, and wintering ranges of the piping plover overlap in North Carolina; and consequently, piping plovers can be found in the state during every month of the year. Breeding season observations near the placement site are rare, and nesting has not been observed in proximity to the placement site at LFI since 1989. Red knots could also occur in the project area year-round but are most abundant around May during spring migrations. Lastly, wood stork could occur in the project area year-round but are primarily sighted from early June to November.

Noise

Elevated noise levels have the potential to impact bird species, however noise thresholds for the special-status bird species that could occur in the project area have not been developed. It is anticipated that the use of heavy machinery for beach renourishment activities could result in elevated in-air noise levels that could cause behavioral impacts to birds. Behavioral impacts could include the disruption of normal activities such as foraging and potentially fleeing the area. Residential structures between the proposed placement activities and Davis Canal, where ESA-listed bird species are anticipated to be most common, would attenuate project-related noise levels. Any behavioral responses would be temporary and any bird species that do leave the area would be anticipated to return once construction activities cease. Beach renourishment activities would occur from November 16 through April 30, when red knot and wood stork would be less common in the project area. Additionally, the environmental dredging construction window (November 16, 2025 – April 30, 2026) would avoid much of the piping plover breeding season which occurs from late

March to August. With the proposed construction window, noise impacts to bird species are anticipated to be minor and temporary.

Habitat Impacts

The proposed beach renourishment activities could result in short-term habitat impacts. Impacts to piping plover breeding habitat are unlikely. The nearest known piping plover breeding area is LFI, and breeding activity has not occurred there since 1989. Furthermore, the November 16 through April 30 construction window would avoid much of the piping plover breeding season. Therefore, beach renourishment activities would be unlikely to have any impact on piping plover breeding and/or nesting habitat.

Short-term habitat disruptions could occur from the use of heavy equipment operations, night-time lighting, generator use, pipeline placement, and other construction activities. Beach renourishment activities would occur from November 16 through April 30, when red knot and wood stork would be less common in the project area. Studies indicate that beach renourishment events do not result in substantial changes in mean waterbird and shorebird abundance post construction (Grippo et al. 2007). Any potential habitat impacts are anticipated to be temporary. Construction activities would be largely confined to the developed oceanfront beach, where habitat use is expected to be lower; however, beach renourishment activities at the western end of the project may have the potential to disturb and displace rufa red knots, piping plovers, wood stork, and roseate tern from more suitable habitats along the shorelines of LFI.

To further minimize potential habitat disturbances, directional, shielded, and low intensity lighting would be employed, and idle construction equipment would be stored off the beach to the extent practicable during nighttime hours. Additionally, the transitioning of equipment along the LFI shoulder will not occur. With the proposed measures, habitat impacts are anticipated to be minor and temporary. The proposed beach renourishment activities could provide long-term benefits to piping plovers, rufa red knots, wood stork, and roseate tern by enhancing beach habitat on sand starved beaches.

Prey Species

Sand placement would eliminate much of the intertidal benthic invertebrate infauna within the beach fill footprint; thus, temporarily reducing the availability of potential prey for bird species. The potential effects of infaunal prey-loss on birds may include a temporary reduction in foraging efficiency and/or temporary displacement to adjacent undisturbed intertidal foraging habitats. However, benthic recovery in the nearshore is anticipated to be rapid and therefore impacts due to reduced prey availability are anticipated to be minor.

Effect Determination

In accordance with the North Carolina Coastal Beach Sand Placement Statewide Programmatic Biological Opinion the project is LAA piping plover and red knots. Due to the lack of identified substantial impacts identified above and the proposed avoidance and minimization measures, the project is NLAA wood stork and roseate tern.

Critical Habitat Determination

Critical habitat for the wintering population of the piping plover, designated on July 10, 2001, occurs in the project area but does not occur within the Proposed Action footprint. The physical features essential to the conservation of piping plovers include space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; and habitats that are protected from disturbance or are representative of the historic, geographical, and ecological distributions of a species. The proposed activities including beach renourishment will not occur in piping plover critical habitat and therefore impacts are anticipated to be limited. In accordance with the

North Carolina Coastal Beach Sand Placement Statewide Programmatic Biological Opinion the project is NLAA for critical habitat for the wintering population of the piping plover.

Proposed rufa red knot critical habitat does not occur in the project area nor in the Proposed Action footprint. The physical features essential to the conservation of rufa red knot include beaches and tidal flats for foraging; upper beach areas used for roosting, preening, resting, or sheltering; ephemeral and/or dynamic coastal features used for foraging or roosting; ocean vegetation deposits or surf-cast wrack used for foraging and roosting; intertidal peat banks used for foraging and roosting; features landward of the beach that support foraging or roosting; and artificial habitat mimicking natural conditions or maintaining the physical or biological features of those listed above. The proposed activities including beach renourishment will not occur in proposed rufa red knot critical habitat based on the April 13,2023 proposed rule [2023-06619.pdf (fws.gov)] and therefore impacts are not anticipated.

Critical habitat for wood stork and roseate tern has not been designated.

4.2.10. Plant Species (Seabeach Amaranth)

As discussed in Section 3.2.3 seabeach could occur in the project area, however occurrences on Oak Island have been rare during recent years.

Physical Disturbance

The proposed beach renourishment activities and associated use of construction equipment could result in trampling or burial of seabeach amaranth. The proposed project construction window (November 16, 2025 through April 30, 2026) would be anticipated to avoid the germination phase which typically occurs from April to July as well as the flowering and seed production phase which typically occurs from June to late fall. However, sand placement may prevent some seeds from germinating due to burial. Additionally, sand placement and grading operations may redistribute some seeds to unsuitable habitats, thereby preventing successful germination and/or growth. Conversely, beach renourishment may redistribute seeds that have been deposited offshore, placing them on the beach and increasing the number of plants. Due to the low likelihood of seabeach occurrence and with the proposed construction window, substantial impacts from the physical disturbance of seabeach amaranth are not anticipated.

Habitat Disturbance

The effects of beach renourishment on seabeach amaranth are not fully understood. Although the full effects of beach renourishment are not known, the USFWS generally believes that renourishment projects completed during the winter are not detrimental to seabeach amaranth (USFWS, 2005). The proposed beach renourishment construction window would avoid the germination, flowering, and seeding season. Therefore, impacts due to habitat disturbances are anticipated to be limited. Additionally, the restoration of a wider vegetation-free dry beach may improve the quality of potential habitat along severely eroded beaches; and seeds that are banked in borrow site sediments may be transferred to suitable beach habitats (USFWS, 2005). Furthermore, seabeach amaranth can colonize newly disturbed habitats, and because seabeach amaranth is intolerant of competition its survival depends on the disruption of habitats.

Determination

In accordance with the North Carolina Coastal Beach Sand Placement Statewide Programmatic Biological Opinion the project is likely to adversely affect seabeach amaranth.

Critical Habitat

Critical habitat for seabeach amaranth has not been designated.

4.3. Cultural Resources

4.3.1. Associated Impacts on Cultural Resources

Associated Impacts with No Action Alternative

No impacts to cultural resources are expected under the No Action Alternative. Beach grading, sandbag revetments and sporadic beach renourishment from maintenance dredging at the western and eastern termini of the project would be completed in areas where there would be limited, if any cultural resources.

Associated Impacts with Preferred Alternative

The APE for the Preferred Alternative includes the offshore borrow area, vessel transit area, subline corridors, and beach placement footprint. Potential effects on cultural resources include direct sand placement along the oceanfront shoreline, temporary placement of sublines in the nearshore to transport sand from the dredge to the beach, and excavation of sand from the offshore borrow area. The full APE is illustrated in Figure 2-1. Geophysical surveys and review of available marine archaeological resource assessments were performed for these areas and are further discussed in Section 3.

No adverse effects to cultural resources are anticipated as a result of the implementation of the Preferred Alternative due to substantial revisions in the project design to reduce dredge cut elevations and limit disturbance in the OSOKI borrow area. In accordance with the National Historic Preservation Act of 1966, the USACE initiated Section 106 consultation with the Catawba Tribal Historic Preservation Office (THPO) and the North Carolina State Historic Preservation Office (SHPO) on August 14, 2024. The Catawba THPO confirmed on October 3, 2024, that there were no immediate concerns with regard to traditional cultural properties, sacred sites or Native American archaeological sites within the boundaries of the proposed project area. The SHPO confirmed no historic resources would be affected by the project (Section 106 correspondence is provided in Appendix A). The initially estimated volume needs were re-evaluated for the project based on a recent (April 2024) survey and determined that 2.4 Mcy of compatible material was needed to attain the desired beach fill placement template. To minimize risk of any potential impacts to possible prehistoric artifacts in the H2 horizon as described in Section 3.1.1, cut elevations were reduced from the originally proposed depths as shown in Table 4-7. It is noted that the dredge cut penetration into the H2 sediment horizon has been reduced, most significantly on the northeast and southwest ends of the borrow area where a more distinct difference between the H1 and H2 horizons was observed. Volume estimates needed from the borrow area were significantly reduced from those initially requested, from 4.2 Mcy to 2.9 Mcy. This effort by the Town has been made to minimize the risk of possible impacts to prehistoric artifacts.

Table 4-7: Original and current proposed dredge cut elevations and sediment horizon elevations

Vibracore ID (NE to SW)	Original Proposed Dredge Cut Elevation (ft NAVD88)	Current Proposed Dredge Cut Elevation* (ft NAVD88)	H1 Elevation (ft NAVD88)	H2 Elevation (ft NAVD88)	Dredge Cut Exceeds H1 (ft)
OSOKI-17A	-70.27	-66.00	-65.2	-69.5	-0.8
OSOKI-18	-71.57	-68.00	-66.6	-70.4	-1.4
OSOKI-19	-71.25	-68.00	-67.2	-71.8	-0.8
OSOKI-05	-72.49	-68.00	-67.5	-71.8	-0.5
OSOKI-20	-72.67	-68.00	-69.5	-73.3	1.5**
OSOKI-21	-69.14	-69.00	-66.7	-73.3	-2.3
OSOKI-22	-74.25	-69.00	-67.0	-73.8	-2.0
OSOKI-06	-70.02	-68.00	-67.1	-72.5	-0.9
OSOKI-23	-76.69	-68.00	-67.3	-74.8	-0.7
OSOKI-24	-76.59	-65.00	-65.4	-74.2	0.4**
BOEMVC-2022-NC-29	-72.7	-65.00	-64.8	-74.2	-0.2

*Elevations shown are the deepest cut elevations within a 1000 ft by 1000 ft square around each vibracore. Variable cut elevations are shown in Figure 1-3 and were selected based on raster surfaces indicating the H1 and H2 reflector elevations.
**H1 horizon not exceeded.

The following figures illustrate the decision-making process and the effects on the H1 and H2 horizons. Figure 4-2 shows the elevations of the bottom of the H1 horizon (the H1 reflector), which were obtained by subtracting the H1 horizon isopach thickness (shown in the NV5 report, Figure 25) from the multibeam bathymetry survey elevations. The revised cut elevations were developed using this surface as a guide. As shown in the figure, the effort was made to align the cut elevations to the approximate elevations of the H1 horizon. Where that horizon was deeper, as shown by the color scale on the elevation surface, the proposed cut elevations were also made deeper. Because the volume requirements of the project were greater than the available material in the H1 layer, the decision was made to lower the cut elevations into the H2 horizon in some portions of the borrow area. The areas with more well-defined channel features towards the southwestern portion of the borrow area were minimized more than those in the other portions of the area.

Figure 4-3 shows the cut elevations overlaid on the H2 reflector (bottom of H2 horizon) elevations, which were developed by subtracting the H2 horizon isopach thickness (shown in the NV5 report, Figure 26), from the multibeam bathymetry survey elevations. In this figure the paleochannel feature identified by NV5 and discussed with BOEM is shown as the deeper elevations (yellow to blue to purple). Figure 4-4 shows how far below the H1 horizon elevations the proposed cut elevations are. White indicates that the cut elevations are above the H1 horizon, and as the gray color get darker, the cut is deeper into the H2 horizon. The maximum incursion into that horizon is 2.7 ft, with much of the incursions less than 1 ft.

Volume computations were made in GIS to quantify the amount of volume removed from the H1 and H2 horizons. Within the borrow area, the volume proposed to be removed from above the H1 horizon at the proposed cut elevations is approximately 2.76 Mcy with 140,000 cy removed from the H2 horizon (for a total of approximately 2.9 Mcy). To provide some perspective on this volume, a cut-fill analysis was conducted between the bathymetry and the H1 reflector and between the H1 and H2 reflectors. The entire volume available in the borrow area above the H1 reflector elevation was computed as 2.87 Mcy. It is noted that it is not feasible to dredge exactly this volume due to variability in the reflector elevations. The volume available between the H1 and H2 reflector elevations was computed as 2.21 Mcy. The 140,000 cy to be removed from the H2 horizon represents approximately 6% of the volume available. It is noted that this volume would be removed from the top of the H2 horizon. This minimizes the risk of any possible impact to pre-contact cultural resources.

Figure 4-5 shows the rotated borrow area with the corresponding sub-bottom profiler data along a line intersecting with the vibracores collected in the summer of 2023 (this figure is taken from the NV5 report, Figure 24). Below this, a cross-section depicting the elevations presented in Table 4-7, including the ocean floor elevation from the multibeam bathymetry, the H1 horizon elevation, the H2 horizon elevation, the original proposed cut elevation, and the revised, minimized cut elevation (plot shows the lowest elevation within a 1000 ft x 1000 ft square surrounding the vibracore, although the cut elevations vary spatially as shown in the top panel).

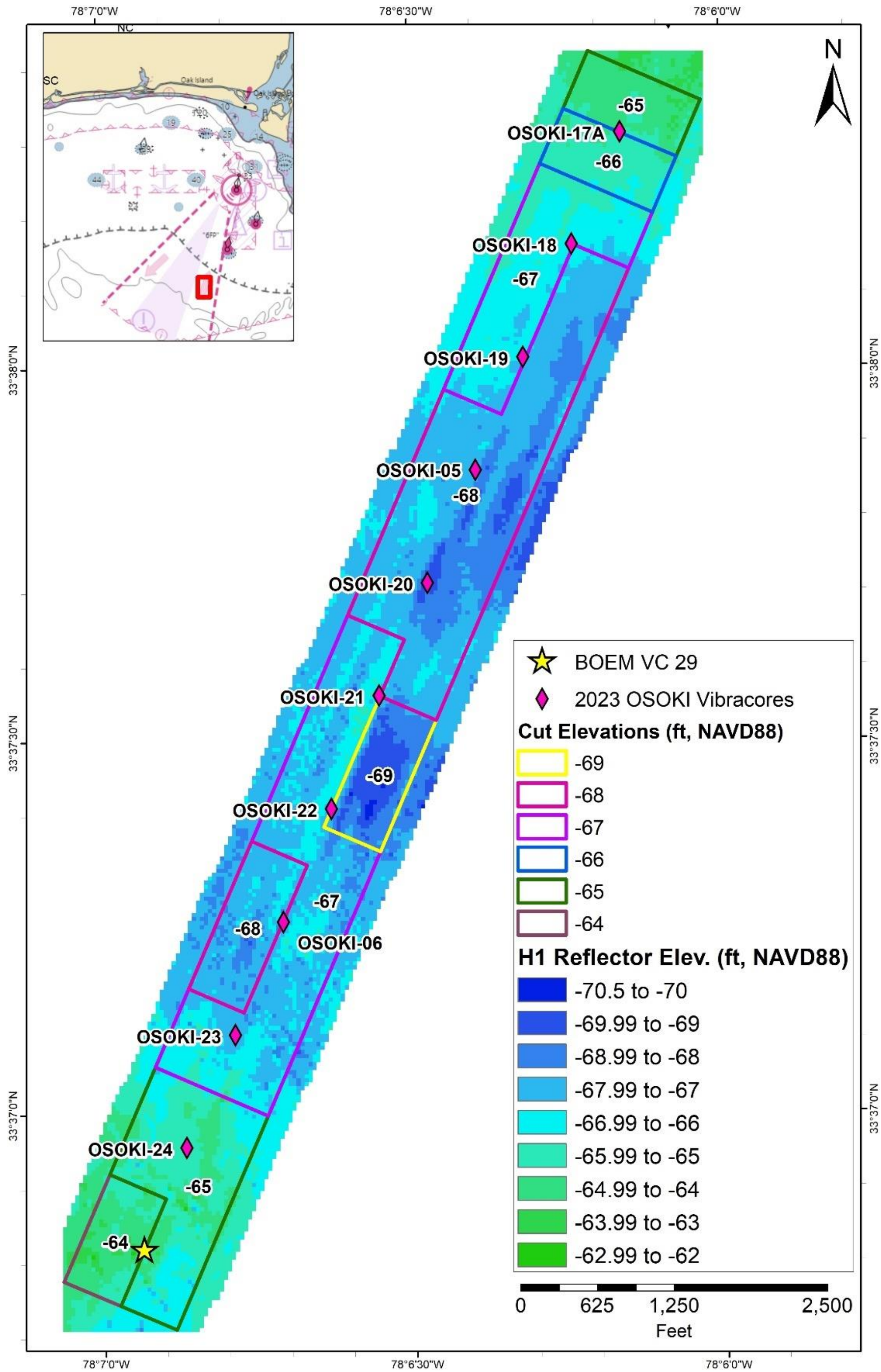

Figure 4-2: Revised cut elevations with H1 reflector elevations, obtained by subtracting the H1 isopach from the multibeam bathymetry elevations

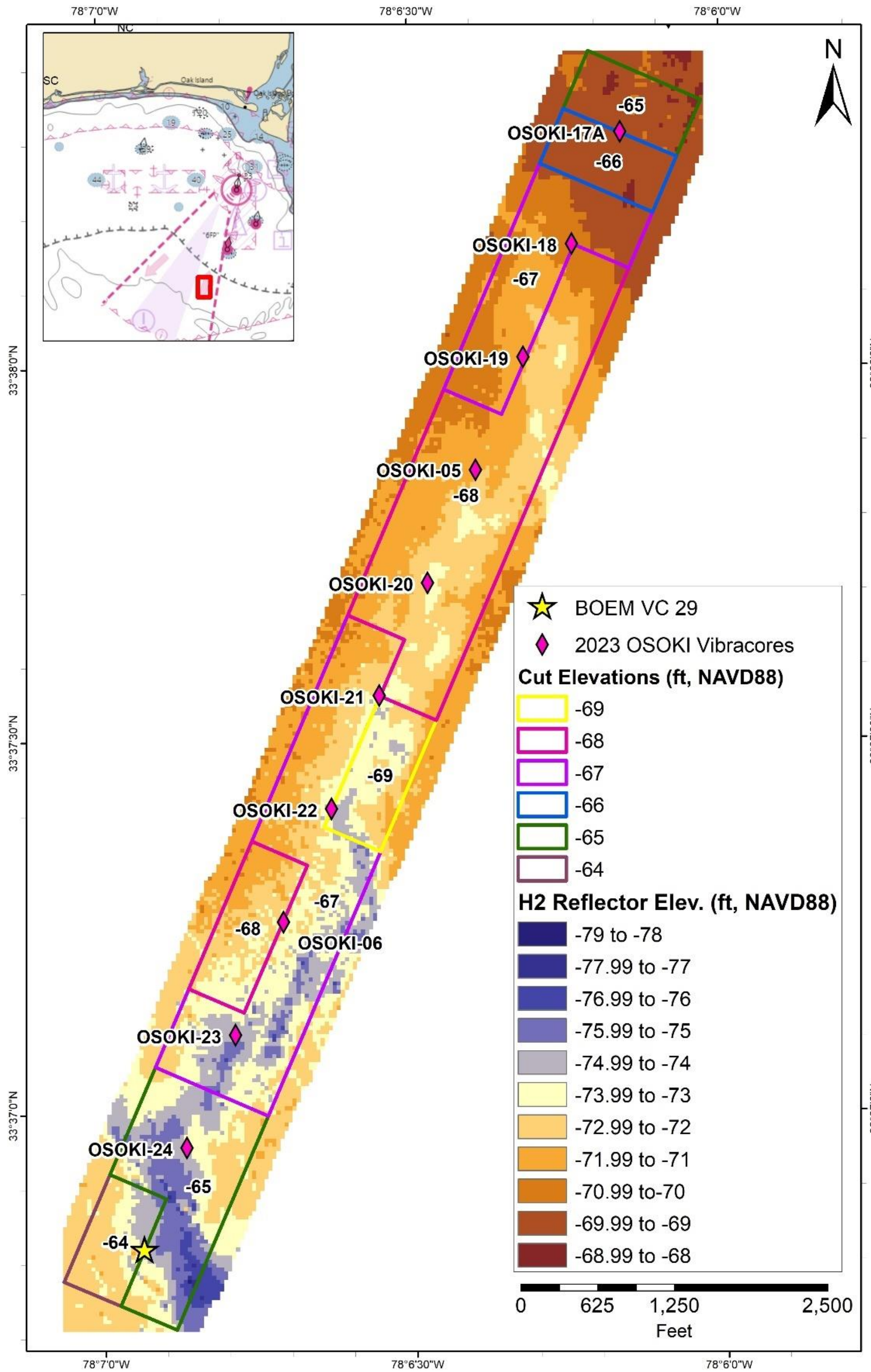

Figure 4-3: Revised cut elevations with H2 reflector elevations, obtained by subtracting the H2 isopach from the multibeam bathymetry elevations

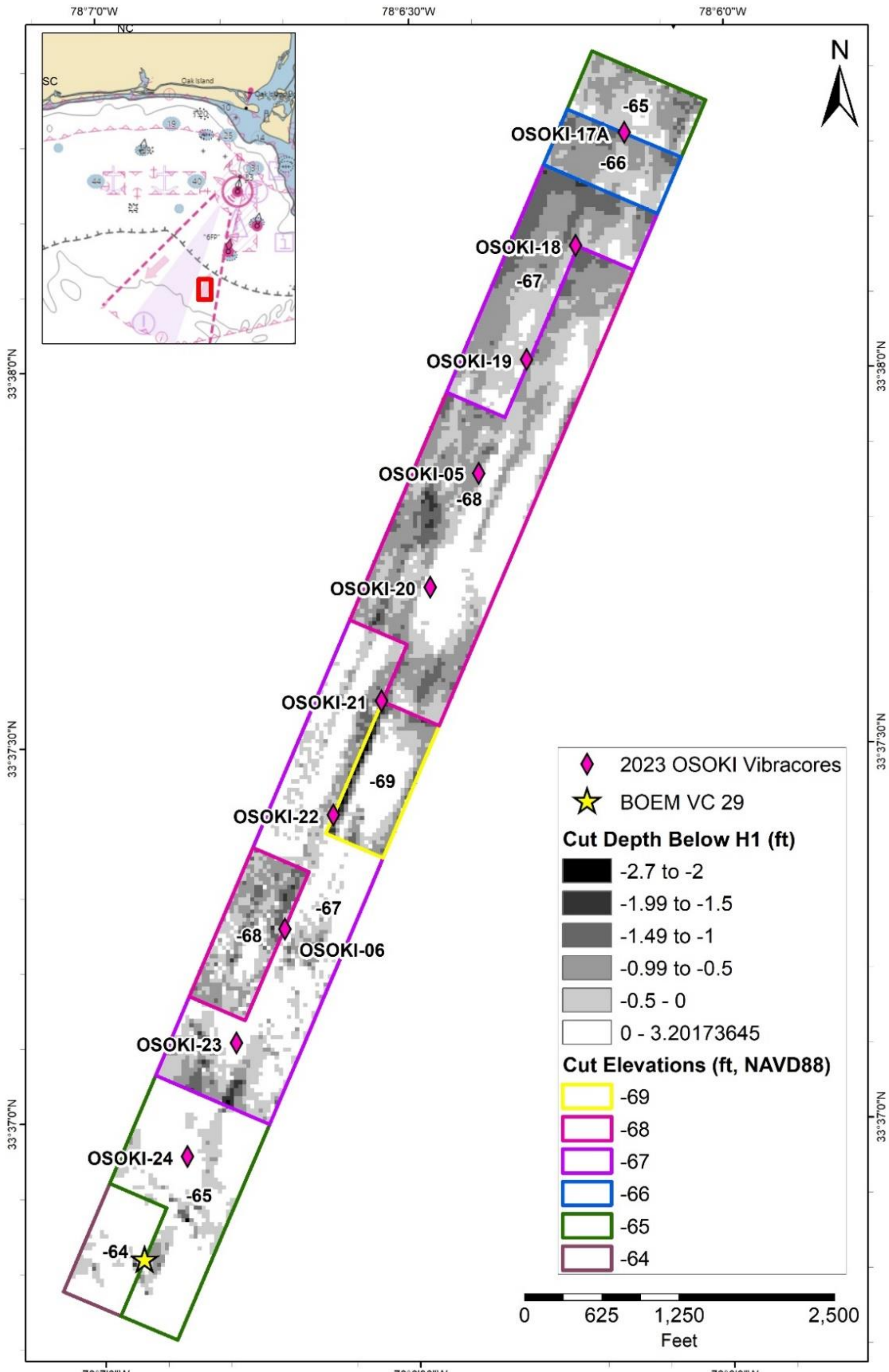

Figure 4-4: Locations where cut elevations are below the H1 layer elevations

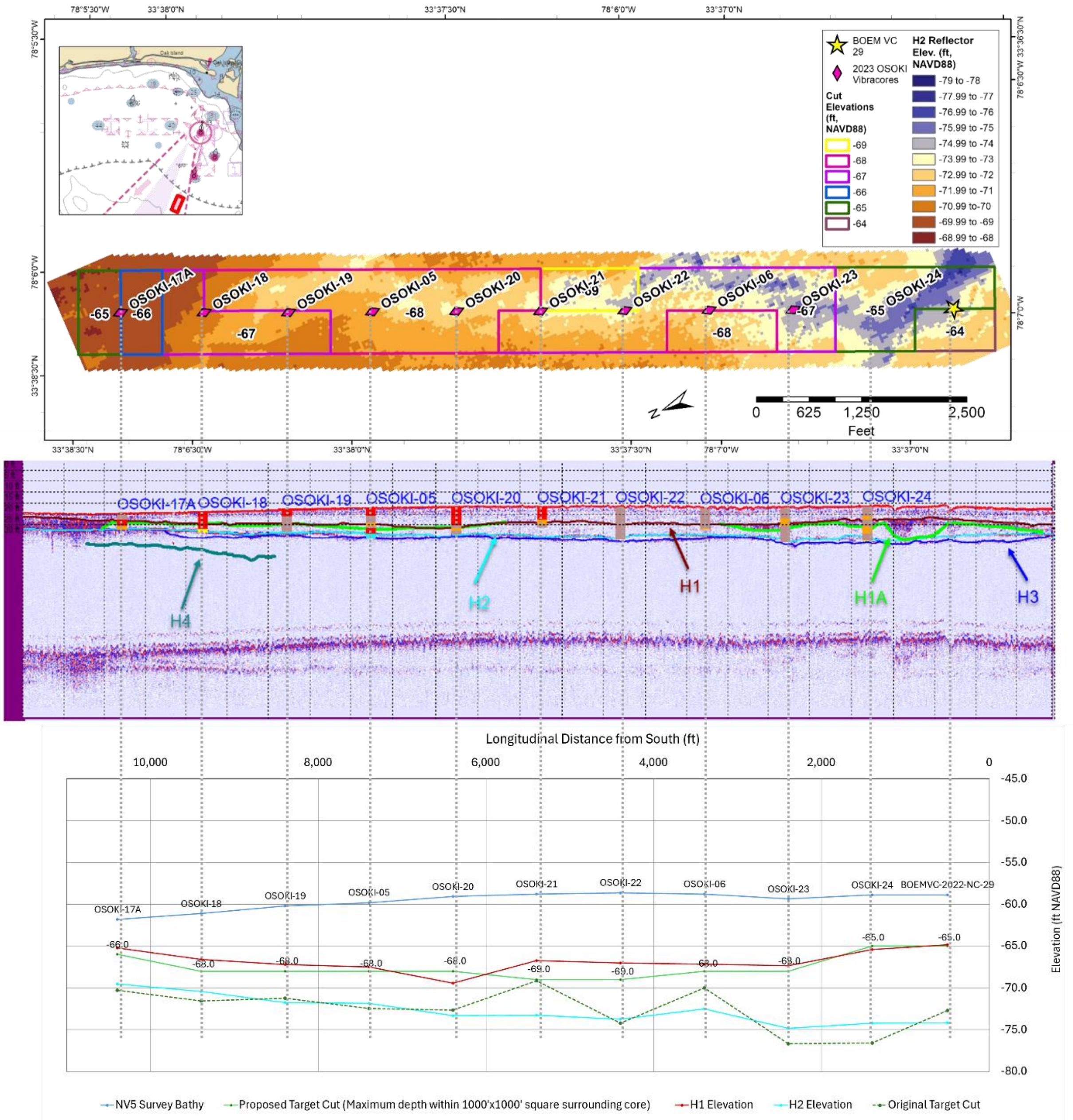

Figure 4-5: Top panel shows the rotated borrow area, with the northeast side on the left and the southwest side on the right*

** The middle panel is Figure 24 from the NV5 Geophysical Report showing the sub-bottom profiler line along with the cores sampled by Amdrill in the summer of 2023. For the cores, red correlates to poorly graded sand, orange represents poorly graded silty sand, and pink indicates well-graded sand. The bottom panel shows the surveyed bathymetry depths at each of the core locations (blue), the elevations of the H1 layer (red), H2 layer (teal), and the original proposed target cut elevations (green dotted line), along with the current proposed cut elevations, with the maximum depth within a 1000x1000 ft square around each core shown to be conservative. The spatially varying cut elevations are shown in the top panel.*

As discussed in Section 3.3, comprehensive surveys were undertaken within the nearshore and borrow areas to identify potential cultural resources. Geological and geophysical offshore data were collected by APTIM (2023), under a contract from the BOEM and were reviewed by a certified marine archaeologist[2]. The primary objective was to evaluate the presence of cultural resources at proposed vibracore sites within the OSOKI borrow area. This evaluation included magnetic data from a cesium vapor magnetometer and sonar imagery from a high-frequency dual-channel sidescan sonar. TAR's analysis of the APTIM survey data determined that no historical or cultural resources were present at the proposed vibracore sites, which were subsequently sampled by Amdrill in the summer of 2023. In January 2024, Geodynamics conducted a detailed geophysical remote-sensing survey aimed at identifying and documenting submerged cultural resources within the OSOKI borrow area and a surrounding 500-meter buffer zone. The survey used a multibeam echosounder, sidescan sonar, sub-bottom profiler, and gradiometer to detect any cultural resources or significant anomalies. The subsequent review by TAR of Geodynamics data focused on identifying potential sonar targets, sub-bottom features, and magnetic anomalies that might suggest the presence of significant submerged cultural resources.

The analysis revealed no sonar or sub-bottom features linked to cultural resources. Although magnetometer data identified anomalies at ten locations within the borrow area, these were characterized by low-intensity, short-duration signals, indicating no association with significant cultural artifacts. TAR's comprehensive assessment concluded that there are no significant prehistoric or historical cultural remains within the proposed borrow site. No evidence of inundated geological landforms associated with prehistoric habitation was found, and no significant cultural targets were identified. Based on the assessment, the proposed borrow source is clear of any evidence of potentially significant submerged cultural resources. The USACE and BOEM have compiled the studies described here and initiated Section 106 consultation with the State Historic Preservation Office and Tribal Historic Preservation Office for the Preferred Alternative. The USACE indicated in their letter, dated August 21, 2024, addressed to the Catawba Indian Nation, that based on their evaluation of the available information as described above, did not identify any potentially significant historic properties. The USACE determined the Proposed Action will have No Effect to historic properties listed or eligible for listing in the National Register of Historic Places. Additionally, the project would adhere to the condition that should any previously unknown cultural resources are discovered while accomplishing the work, the USACE and BOEM must be notified immediately.

4.4. Socioeconomic Resources

4.4.1. Associated Impacts on Socioeconomic Resources

Associated Impacts with No Action Alternative

Implementation of the No Action Alternative would result in long-term, adverse effects to socioeconomic resources including reduction of property values, property losses, reduction of the tax base, tourism, and tourism related business. Under the No Action Alternative, property owners along the coastline would continue using temporary and potentially less effective measures to protect their properties from erosion and storm damage. The lack of a comprehensive beach renourishment project would have several socioeconomic impacts. Without beach renourishment, beachfront structures are at an increased risk of severe damage or destruction due to storms and coastal erosion. This could lead to a substantial number of properties becoming uninhabitable and ultimately being demolished. The loss of these structures would significantly diminish property values and reduce the tax base of the town. The reduction in property values and the subsequent loss of tax revenue would negatively impact the town's budget, potentially leading to cuts in public services and infrastructure investments. This economic strain could reduce the quality of life for residents and deter potential investors or new residents. Erosion can lead to smaller beaches and less attractive shorelines, which could decrease the number of tourists visiting the area. A decline in tourism

[2] Gordon P. Watts, Jr., Ph.D., Tidewater Atlantic Research, Inc.

would hurt local businesses, such as hotels, restaurants, and retail stores, which rely heavily on visitor spending.

Associated Impacts with Preferred Alternative

The Preferred Alternative involves a comprehensive beach renourishment project, which would have several short-term and long-term socioeconomic impacts. Short-term, minor, adverse effects would occur during the construction of the Preferred Alternative. With the Preferred Alternative, construction would take place on the beach. The section of the beach under construction would be closed to the public for safety. The borrow area and pump out location would be closed to boat traffic. While this could lead to a temporary decrease in beach visitors, short-term, beneficial, effects of the project would include construction-related job opportunities and require a workforce that would spend money on local goods and services, thereby providing an economic boost to the area during the construction period. Local businesses could benefit from increased demand for lodging, dining, and other services catering to workers and contractors involved in the project.

Once completed, the renourished beach would provide long-term benefits including enhanced protection for residential and commercial properties against storm damage and erosion. This increased protection could lead to higher property values and reduced insurance costs, providing substantial economic benefits to property owners. The enhanced beach also contributes to a more attractive environment, potentially attracting new residents and investors, further boosting the local economy.

4.4.2. Environmental Justice

Associated Impacts with No Action Alternative

The characteristics of the project area were reviewed and there are no communities in the vicinity of the project area with environmental justice concerns. Implementation of the No Action Alternative would not result in a disproportionate adverse impact to low income or minority communities.

Associated Impacts with Preferred Alternative

The characteristics of the project area were reviewed and there are no communities in the vicinity of the project area with environmental justice concerns. Implementation of the Preferred Alternative would not result in a disproportionate adverse impact to low income or minority communities.

4.5. Recreational and Scenic Resources

4.5.1. Associated Impacts on Recreational and Scenic Resources

Associated Impacts with No Action Alternative

Implementation of the No Action Alternative would result in long-term adverse impacts to recreational and scenic resources. As storm-induced erosion causes shoreline recession, the short-term protection measures potentially taken by some property owners can alter the recreational and aesthetic value of the beach. Activities such as beach scraping and sandbag placement effectively reduce the amount of recreational beach available, as well as reduce the aesthetic nature of the shoreline. Scenic resources will deteriorate if any of the at-risk properties are abandoned and left to the elements. Damages incurred by the structures from coastal processes such as winds, waves and erosion will eventually render the structures uninhabitable and may make the beach area in the immediate vicinity unsafe for any recreational activities due to debris field left by abandoned structures. The recreational value of the beach will also depreciate as storm induced erosion reduces the amount of beach available for activities. These effects may be slowed in the western and eastern termini of the project where sporadic beach renourishment from maintenance would occur every 2 to 6 years.

Associated Impacts with Preferred Alternative

There would be short-term, minor, adverse impacts and long-term beneficial effects to recreational and scenic resources as a result of implementation of the Preferred Alternative. Short-term, minor, adverse effects would occur during the proposed four-month construction timeframe between November 16, 2025 – April 30, 2026, which may overlap with recreational use of the beach. Beachgoers and fishermen will temporarily be exposed to elevated noise levels due to construction activities on the beach, and sections of the beach and nearshore environment will be off-limits to the public for safety reasons. Long-term beneficial effects, after construction of the project, would include a wider beach which will allow for more recreational activities and increased aesthetics to local and visiting beach users.

5. Potential Cumulative Impacts

The CEQ Regulations define cumulative impacts as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR §1508.7). Direct and indirect impacts of past, present, and reasonably foreseeable future events were considered in the analysis of the proposed project consequences.

5.1. Reasonably Foreseeable Trends and Planned Actions-Affected Environment

Ongoing and reasonably foreseeable future actions within the project vicinity are listed in Table 5-1. Many of the actions identified within the vicinity of the project include maintenance of the federal Wilmington Harbor Channel with subsequent beneficial use of dredged sand planned by the USACE for many Brunswick County communities including Village of Bald Head Island, Caswell Beach, and Oak Island. Additionally, the USACE conducts regular maintenance of federal navigation channels, including Lockwood Folly Inlet/AIWW crossing with beneficial placement of dredge material on Holden Beach and Oak Island. These activities are regular occurrences and are anticipated to continue into the foreseeable future.

The USACE has initiated the feasibility study of a 50-year Coastal Storm Risk Management (CSRM) plan for local non-federal sponsors, Town of Holden Beach and Oak Island, in accordance to Section 203 of the Flood Control Act of 1966. Various risk management alternatives will be examined, including no action, non-structural measures, and structural measures, such as beach nourishment. The timeline for implementation of these actions is unknown at the time this document was prepared. It is reasonable to note that the USACE will investigate similar borrow areas as identified for this project, including, but not limited to, Lockwood Folly Inlet and offshore sandy shoals.

In addition to federal and non-federal dredge and fill projects occurring in the project vicinity, two energy renewable infrastructure projects (commercial wind energy facilities) have been initiated in the Carolina Long Bay area. It is expected for these projects to consist of data collection for the foreseeable future and will not result in overlapping construction activities.

The demand for sand resources in Long Bay creates complex multi-user interactions, including issues of resource allocation, cumulative impacts from repeated use, potential renewable energy infrastructure and impacts on EFH. The proposed project is scheduled to occur in winter 2025/2026 (November 16, 2025 – April 30, 2026) with anticipated overlap with the federal maintenance of the Wilmington Harbor Inner Ocean Bar with placement on Caswell Beach and the east end of Oak Island. The maintenance of the Lockwood Folly Inlet Crossing with beneficial placement on the west end of Oak Island is planned to occur in winter 2024/2025. While the details are unknown, the Village of Bald Head Island proposes to dredge from Jay Bird Shoals with beach placement during the upcoming winter dredging window (2024/2025).

Table 5-1: Past and future projects within the project vicinity

Entity	Project	Methodology	Placement	Borrow Area	Quantity (cy)	Anticipated Timing
Village of Bald Head Island	Local Beach Nourishment	Pipeline Dredge	Bald Head Island	Jay Bird Shoals	1,400,000	Winter 2024
Village of Bald Head Island	Local Beach Nourishment	Hopper Dredge	Bald Head Island	Frying Pan Shoals	Unknown	Unknown
USACE	Wilmington Harbor Federal Navigation /Military Ocean Terminal Sunny Point	Hopper dredge or disposal scow (split hull)	ODMDS – non-beach compatible material	N/A	2,050,000	Annually
USACE	Section 403 Wilmington Harbor Deepening	Unknown	ODMDS/Beneficial Use Placement	N/A	Unknown	Unknown (EIS to be completed in 2027)
USACE	AIWW Maintenance	Pipeline Dredge	West End of Oak Island (beneficial use)	Lockwood Folly Inlet Crossing	65,000	Winter 2024/2025
USACE	Navigation maintenance	Sidecast Dredging	N/A	Lockwood Folly Inlet	N/A	Summer 2024
USACE	Wilmington Harbor Federal Channel Maintenance	Pipeline Dredge	Caswell Beach / Oak Island	Inner Ocean Bar	1,200,000	Winter 2025/2026
USACE / Oak Island	Coastal Storm Risk Management General Reevaluation Study	Unknown	Oak Island (9 miles of oceanfront shoreline)	Unknown	Unknown	Winter 2027
Oak Island	Beach and Inlet Management Plan	Hopper Dredge	Oak Island (9 miles of oceanfront shoreline)	Multiple Borrow Areas (Frying Pan Shoals)	2,000,000	Winter 2031
USACE/ Holden Beach	Coastal Storm Risk Management General Reevaluation Study	Unknown	Holden Beach (8 miles of oceanfront shoreline)	Unknown	Unknown	Winter 2026

Entity	Project	Methodology	Placement	Borrow Area	Quantity (cy)	Anticipated Timing
Holden Beach	AIWW Maintenance	Pipeline	East End of Holden Beach	Lockwood Folly Inlet Crossing	100,000 – 150,000	Winter 2025
Holden Beach	Local Beach Nourishment	Hopper	Central Reach of Holden Beach	Offshore Borrow Area	1,500,000	Winter 2027
Holden Beach	Inlet Management/ Local Beach Nourishment	Split Hull Hopper	Nearshore Placement	Lockwood Folly Inlet Ebb Shoal	60,000	Unknown
BOEM / TotalEnergies Carolina Long Bay, LLC	Renewable Energy Development	N/A	N/A	N/A	N/A	Unknown
BOEM / Cinergy Corp	Renewable Energy Development	N/A	N/A	N/A	N/A	Unknown

5.2. Reasonably Foreseeable Planned Actions-Environmental Consequences

This section provides a summary of the analysis of the anticipated effects (or impacts) from the Proposed Action with the addition of the potential effects of those reasonably foreseeable planned actions. The environmental consequences analysis below focuses on adverse effects from planned actions that would contribute to the environmental consequences resulting from the Proposed action. Resources considered that have the potential contribute to cumulative impacts include geology and geomorphology, water quality, air quality, noise, fish and wildlife resources, EFH-managed species/habitats, endangered species, cultural resources, socioeconomic, recreational resources, visual resources, and environmental justice. Cumulative impacts were identified not just within relevant resources, but the analysis also considered how resource impacts could relate to other resources.

Implementation of the Preferred Alternative would have short-term, minor, adverse impacts to physical resources including geology and geomorphology, water quality, air quality and noise from dredging, sand placement, and use of heavy equipment. There would be short-term, minor, adverse impacts to fish and wildlife resources, and EFH-managed species/habitats, from dredging, sand placement, and heavy equipment use resulting in noise, water quality, entrainment, habitat disturbance, and/or impacts to prey species. Similar impacts were considered for threatened and endangered species and, where applicable their critical habitats. ESA effects range from No effect to Likely to Adversely Affect and would be consistent with determinations in the SARBO. There would be no effect on cultural resources based on SHPO and THPO review and coordination, completed as of October 3, 2024 (Appendix A). There would be short-term minor, adverse effects to socioeconomic, recreational, and visual resources from temporary beach and waterway closures, and equipment operation related to sand placement. Implementation of the Preferred Alternative would not result in a disproportionate adverse impact to low income or minority communities. Section 6 provides a list of proposed avoidance and minimization measures to reduce adverse impacts to physical, biological, cultural, socioeconomic, and visual resources.

Many of the foreseeable planned actions are dredge and placement projects similar in activities to the Proposed Action/Preferred Alternative. These maintenance dredge activities and nourishment projects vary in timing, location, scope, and duration. In general, properly designed and reviewed projects would be similar in adverse effects and typically, similar avoidance measures would be developed and implemented to minimize adverse impacts to physical, biological, cultural, socioeconomic resources, and visual resources. While renewable energy projects are on-going, it is unlikely that the construction of these projects would overlap with the construction of the Preferred Alternative.

When the adverse effects on physical, biological, and socioeconomic resources from the Proposed Action are considered in combination reasonably foreseeable planned actions are not expected to contribute substantially to short-term or long-term cumulative adverse impacts.

6. Proposed Avoidance and Minimization Measures

The project will comply with all applicable Terms and Conditions and PDC from the 2020 SARBO for Dredging and Material Placement Activities in the Southeast United States (NMFS, 2020a) and North Carolina Coastal Beach Sand Placement Statewide Programmatic Biological Opinion (USFWS, 2017). Key avoidance and minimization measures are summarized in Table 6-1. The purpose of this table is to provide a brief overview of applicable conditions and is not meant to be an exhaustive list of all proposed avoidance and minimization measures.

Table 6-1: Key avoidance and minimization measures

	Proposed Avoidance and Minimization Measures
Equipment Positioning	Equipment will be staged, placed, and moved in areas and ways that minimize effects to species and resources in the area, to the maximum extent possible. Specifically: • Equipment and materials will be staged landward of the primary frontal dune in a manner that ensures no impacts to the frontal dune system. • All vessels will preferentially follow deep-water routes (e.g. marked channels) to avoid potential groundings or damaging bottom resources whenever possible and practicable. • Barges, scows, and other similar support equipment are used, they will be positioned away from areas with sensitive bottom resources such as non- ESA-listed seagrasses, corals, and hardbottom, to the maximum extent possible. • Pipelines will be placed in areas away from bottom resources and of sufficient size or weight to prevent movement or anchored to prevent movement or the pipeline will be floated over sensitive areas.
Sediment Compatibility	All beach fill material would comply with the State of North Carolina Technical Standards for Beach Fill Projects (15A NCAC 07H .0312). The Technical Standards require the characterization of sediments from the recipient beach and the proposed borrow site. Sediment characteristics that are considered include percent weight of fine-grained sediment, percent weight of granular sediment, percent weight of gravel, and percent weight of calcium carbonate. Results of the characterization studies are submitted to the NCDCM, which determines the suitability of sediments from the proposed, borrow site. Daily monitoring of beach renourishment activities would be conducted to further ensure the compatibility of the beach fill material. Visual monitoring of the fill material would be conducted at the dredge pipe outfall before it is redistributed along the beach. If any incompatible fill material is detected, the contractor will cease operations and immediately contact the Wilmington District Regulatory Branch, NCDCM, and state and federal agencies to determine the appropriate course of corrective action. Compatibility includes grain size, percent fines, calcium carbonate, color, and clast count. No material placed on the beach should have a wet Munsell value darker than 10 YR-5.
Hopper Dredging	Compliance with all relevant PDCs of the SARBO (2020) will be adhered to.

	Proposed Avoidance and Minimization Measures
Dune Construction and Beach Profile	A pre-construction survey will be conducted approximately six to eight weeks prior to construction to provide an accurate representation of the beach profile and to allow for any revisions to the final design in coordination with permitting agencies. Any new or modified material placed on the beach will tie into the existing profile in a manner to not create backslope or troughs landward the dune crest. Dune grass planting will occur immediately after dune construction in spring 2025. Native grasses will be planted on the dune crest and the landward slope of the dune down from the crest of the dune for 1/4 the distance or 25% the length of the dune face.
Monitoring	Operations of moving equipment will cease if an ESA-listed species is within 150 ft of operations. If an ESA-listed species is spotted within the vessel’s path, initiate evasive maneuvers to avoid collision
Sea Turtles	To avoid periods of peak sea turtle abundance during warm water months and minimize impacts to sea turtles, the proposed hopper dredging and beach renourishment window for this project is November 16, 2025 through April 30, 2026. Beach renourishment would be designed to mimic natural beach conditions. Substrate would be placed in a way that minimizes the formations of scarps and compaction. Immediately after the beach construction operation is complete and prior to 1 May, surveys for escarpments will be conducted and sand compaction will be monitored. Results will be coordinated with USFWS, and escarpments may be leveled, and the area tilled if required. Vessel operators and crew will monitor for the presence of sea turtles and shut down operations when within proximity to sea turtles. The contractor will ensure that the beach slopes naturally to the ocean and that depressions are not present in the constructed beach profile. To the extent feasible, beach renourishment will be designed to allow for the maximum amount of time between beach renourishment events and the onset of the nesting season. Lighting associated with beach renourishment construction activities will be minimized through reduction, shielding, lowering, and/or use of turtle friendly lights, to the extent practicable without compromising safety.

	Proposed Avoidance and Minimization Measures
Whales	If a NARW is sighted within 500 yards during dredging operations or vessels underway, operations will cease until the observers are confident that the whale has left the area. If a whale (other than a NARW) is spotted, maintain a distance of at least 300 ft between vessels underway and the whale. Orders to reduce speed, alter course, and/or cease operations may be employed. Speed requirements must be followed if a NARW has been spotted or reported in the area. NARW presence may be determined by observers on the vessel, reports from aerial surveys, or confirmed public sighting reports. All captains are required to use daily available information and reports on the presence of NARW and aerial survey activities in the project area. When a NARW is observed or reported within 38 nmi of dredge or support vessels, vessels must slow to 10 knots or slowest safe navigable speed for 36 hours or until next NARW survey when no whales are observed, whichever is shorter.
West Indian Manatee	The Project will adhere to USFWS Guidelines for Avoiding Impacts to the West Indian Manatee: Precautionary Measures for Construction Activities in North Carolina Waters. Hopper dredging and beach renourishment activities would be limited to November 16 through April 30, which are colder weather months when West Indian manatee would be considered unlikely to occur in the project area.
Birds	The staging area and refuelling location for construction equipment (bulldozers, front-end loaders, pickups, etc.) would be located off the beach. During nighttime hours, idle construction equipment would be stored off the beach to the extent practicable. Directional, shielded, and low intensity lighting would be employed to minimize the potential effects of artificial nighttime lighting on shorebirds. Transitioning of equipment along the Lockwoods Folly Inlet shoulder will not occur.
Cultural Resources	If the dredge operators discover any archaeological resources prior to dredging operations in the borrow areas, within pipeline corridors or in the vicinity of placement operations, the appropriate agencies will be notified within 24 hours and will be coordinated with on the measures needed to evaluate, avoid, protect, and, if needed, mitigate adverse impacts from an unanticipated discovery. If any archaeological resources are discovered while conducting dredging operations, the dredge and/or placement operations will be halted immediately, and the dredge will avoid the resource and contact the resource agencies. If investigations determine that the resource is significant, the Parties will together determine how best to protect the resource.

7. Consultation and Coordination

On November 11, 2023, the Town of Oak Island held an interagency scoping meeting with state and federal agencies including the North Carolina Division of Coastal Management (NCDCM), NCWRC, USACE, USFWS, North Carolina Division of Water Resources (NCDWR), BOEM, and NOAA Fisheries. The purpose of the meeting was to present the scope of the Town's Beach Renourishment Project. The meeting minutes and presentation from the interagency scoping meeting are found within Appendix H.

Because the project involves the use of an OCS borrow area, which falls under the BOEM jurisdiction, and placement of material on the beach, which falls under the USACE's jurisdiction, it was determined that BOEM and the USACE would act as joint federal cooperating agencies for NEPA purposes. In a letter between USACE and BOEM dated December 11, 2023, the USACE requested BOEM's participation as a cooperating agency in the review of the Town's proposal and the preparation of appropriate NEPA documentation. BOEM and the USACE agreed to cooperate, splitting lead agency status based on jurisdiction, in the required ESA National Historic Preservation Act, Coastal Zone Management Act, USACE 408 Program compliance, and the Magnuson-Stevens Fishery Management and Conservation Act. It was confirmed that the USACE will lead Section 7 consultation for potential impacts on threatened and endangered species, coordinating with NMFS Protected Resource Division and USFWS. BOEM will collaborate with the USACE on the use of the SARBO, with joint responsibility for its implementation. The USACE will also lead in the implementation of the USFWS 2017 State Programmatic Biological Opinion for Beach Placement. BOEM will take the lead on consulting with NOAA Fisheries on EFH. The USACE will take the lead on NHPA Section 106 and CZMA Section 307 compliance, with BOEM acting in a consulting role.

On February 2, 2024, the USACE received the Town's permit application and a public notice was posted on February 15, 2024. At the conclusion of the 30-day public notice period, the USACE received comments from resource agencies as well as adjacent municipalities. The commenting agencies included the USFWS, the NC Wildlife Resources Commission, and the United States Environmental Protection Agency (US EPA), Region 4. Municipality comments were submitted by the Village of Bald Head Island, and Coastal Protection Engineering of North Carolina representing the Town of Caswell Beach. The following is a summary of comments received through the public notice (Appendix A):

- The USFWS agrees that, if all conservation measures and terms and conditions of the August 28, 2017, Statewide Programmatic BO for NC Beach Sand Placement Projects can be met (with emphasis on the requirements to work only during the winter work window and ensure compatibility of placed material with sea turtle nesting), the issuance of the permit or permit modification can be covered by the SPBO.
- The NCWRC made several recommendations and have been incorporated into the document's avoidance and minimization action measures.
- The Village of Bald Head Island believes the use of material out of the IOB contradicts the agreed upon Sand Management Plan referenced in the Wilmington Harbor Project NEPA analysis.
- Coastal Protection Engineering on behalf of Caswell Beach opposes the use of the IOB as a sand source as it again contradicts the SMP and could have negative impacts and placed on Caswell Beach.

As of the date of this EA, the following permits, coordination, and consultations are under review or have been obtained (Appendix A):

- North Carolina Department of Environmental Quality Individual 401 Water Quality Certification (DWR #20181344v4): Certificate No. WQC007062 received on August 1, 2024

- Coastal Area Management Act (CAMA) Major Permit: submitted to the NC Division of Coastal Management March 2024 and received CAMA Major Permit on August 21, 2024.
- Department of the Army authorization pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act (SAW-2021-00389): application submitted and an internal USACE Environmental Assessment and Statement of Findings is in process.
- Endangered Species Act Section 7 Consultation: USFWS consultation complete and recommendation is to use the North Carolina Coastal Beach Sand Placement Statewide Programmatic Biological Opinion (USFWS 2017). The project will be completed under the SARBO for Dredging and Material Placement Activities in the Southeast (NMFS 2020a).
- Magnuson Stevens Act: Essential Fish Habitat Assessment (EFH) reviewed by BOEM, and comments addressed. The EFH Assessment was distributed to NOAA Fisheries for review on September 3, 2024. Conservation recommendations were provided by NOAA Fisheries on September 27, 2024. BOEM’s formal response, dated October 16, 2024, completes the EFH consultation based on implementation of the conservation recommendations and updated EFH Assessment.
- Section 106 of the National Historic Preservation Act of 1966: Section 106 consultation initiated with the Catawba THPO on August 21, 2024, and was completed on October 3, 2024 (Appendix A). Consultation with the SHPO and THPO has been completed with a No Effect determination.

8. Conclusion

This EA incorporates updated information previously analyzed for the Town of Oak Island's 2021 and 2022 beach renourishment projects, which were authorized by the USACE, NCDWR, and NCDCM. To mitigate potential environmental and cultural resource impacts, the proposed dredge cut depths and excavation volume has been reduced, resulting in minimizing effects on the post-dredge environment and protecting potential paleo-landforms in the OCS. The avoidance and minimization measures detailed within this document will be implemented by the Town as part of the Proposed Action. Section 6 provides a list of proposed avoidance and minimization measures to reduce adverse impacts to physical, biological, cultural, socioeconomic, and visual resources.

Implementation of the Proposed Action would have short-term, minor, adverse impacts to physical resources including geology and geomorphology, water quality, air quality and noise from dredging, sand placement, and use of heavy equipment. There would be short-term, minor, adverse impacts to fish and wildlife resources, and EFH-managed species/habitats, from dredging, sand placement, and heavy equipment use resulting in noise, water quality, entrainment, habitat disturbance, and/or impacts to prey species. Similar impacts were considered for threatened and endangered species and, where applicable their critical habitats. ESA effects range from No effect to Likely to Adversely Affect and would be consistent with determinations in the SARBO and the Statewide Programmatic BO. There would be No Effect on cultural resources based on SHPO and THPO review and consultation. There would be short-term minor, adverse effects to socioeconomic, recreational, and visual resources from temporary beach and waterway closures, and equipment operation related to sand placement. Implementation of the Preferred Alternative would not result in a disproportionate adverse impact to low income or minority communities.

Based on the analysis in this EA and the inclusion of these mitigation measures, it is anticipated that impacts from Alternative #2: Proposed Action will be temporary, confined to the project area, and not result in significant effects to physical, biological, cultural socioeconomic, recreational, and visual resources.

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APPENDICES A-J

Available Upon Request