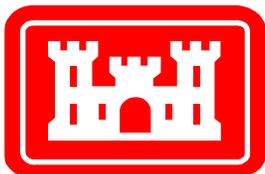

**FINAL
INTEGRATED
FEASIBILITY REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT
COASTAL STORM DAMAGE REDUCTION**

**BOGUE BANKS, CARTERET COUNTY
NORTH CAROLINA**

**APPENDIX I
CUMULATIVE IMPACTS**



**US Army Corps
of Engineers
Wilmington District**

APPENDIX I
Cumulative Impact Assessment
Bogue Banks, NC
Coastal Storm Damage Reduction Project

The Council on Environmental Quality (CEQ) defines cumulative impact as:

The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable 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). This analysis follows the 11-step process outlined by the CEQ in their 1997 publication Considering Cumulative Effects Under the National Environmental Policy Act (Table I-1).

Table I-1. Steps in the Cumulative Effects Analysis (as adapted from CEQ 1997)

Environmental Impact Assessment Components	CEA Steps
I. Scoping	<ul style="list-style-type: none"> a. Identify the significant cumulative effects issues associated with the proposed action and define the assessment goals. b. Establish the geographic scope for the analysis. c. Establish the time frame for the analysis. d. Identify other actions affecting the resources, ecosystems, and human communities of concern.
II. Describing the Affected Environment	<ul style="list-style-type: none"> a. Characterize the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stresses. b. Characterize the stresses affecting these resources, ecosystems, and human communities and their relation to regulatory thresholds. c. Define a baseline condition for the resources, ecosystems, and human communities.
III. Determining the Environmental Consequences	<ul style="list-style-type: none"> a. Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities. b. Determine the magnitude and significance of the cumulative effects. c. Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects. d. Monitor the cumulative effects of the selected alternative and adapt management.

1. Significant Cumulative Effects Issues

This assessment of cumulative impacts will focus on significant coastal shoreline resources and the impacts associated with offshore dredging activities and the placement of compatible sediment on the beach (whether for beach nourishment or disposal of dredge maintenance material). The following referenced reports prepared by the USACE Wilmington District include comprehensive assessments of state-wide cumulative impacts through the date in which they were prepared. This assessment will update these previous documents by incorporating all subsequent dredging and beach placement actions completed to date and evaluate the relative cumulative effect of the proposed action.

- U.S. Army Corps of Engineers Dare County Beaches (Bodie Island Portion) Final Feasibility Report and EIS on Hurricane Protection, dated September 2000
- U.S. Army Corps of Engineers Draft Evaluation Report and Environmental Assessment, Morehead City Harbor Section 933, dated May 2003.
- U.S. Army Corps of Engineers Final Integrated General Reevaluation Report and Environmental Impact Statement, Shore Protection, West Onslow Beach and New River Inlet (Topsail Beach), North Carolina, dated March 2009.
- U.S. Army Corps of Engineers Final Integrated Feasibility Report and Environmental Impact Statement, Coastal Storm Damage Reduction, Surf City and North Topsail Beach, North Carolina, dated December 2010.
- U.S. Army Corps of Engineers Draft Integrated General Reevaluation Report and Environmental Impact Statement, Coastal Storm Damage Reduction, Brunswick County, North Carolina.

In discussing the potential cumulative impacts of offshore borrow area dredging and beach nourishment, we consider time crowded perturbations, and space crowded perturbations, as defined below, to be pertinent to this action.

Time crowded perturbations – repeated occurrence of one type of impact in the same area.

Space crowded perturbations – a concentration of a number of different impacts in the same area.

2. Geographic Scope

This analysis will consider the impacts associated with dredging an offshore borrow area and beach placement of sediment along the Bogue Banks Beaches relative to the cumulative nature of these activities along the entire North Carolina coastline. It will focus on cumulative impacts within the project area since all of affected beaches under the current proposal have received beach placement of sediment in the past, the proposed action represents zero additional miles of North Carolina beaches affected by sand placement as described documents referenced above. Additionally, this analysis will study the cumulative impacts within the project area associated with increased offshore borrow area use. The proposed project utilizes borrow material from a three borrow

areas and represents new impacts to the offshore benthic resources in the study area and throughout North Carolina. Cumulative impacts of beach nourishment/disposal and offshore borrow area use on a statewide scale will also be assessed herein.

3. Time Frame

This analysis considers known past, present and the reasonably foreseeable future sand placement and offshore borrows on a statewide scale and project vicinity scale over a 50-year period of analysis from 1965 to 2015. This time period was selected to include the first U.S. Army Corps of Engineers Wilmington District, beach nourishment projects in 1965 and includes the first Wilmington District beach placement of dredged material within the project area in about 1991. Projections were extended to 2015, as that date represents a reasonably foreseeable future and the majority of remaining ocean beach that could reasonably be expected to have federal and non-federal projects implemented or studies initiated. Additional non-federal projects will likely be pursued beyond 2015, but for the purposes of this assessment, it is assumed that these actions will be re-occurring within areas that had already been previously permitted and constructed (non-federal) or authorized (federal). This cumulative analysis also considers the potential that future federal and non-federal CSDR/beach nourishment projects under study could be constructed.

4. Actions Affecting Resources of Concern

This analysis of cumulative effects of the proposed action will focus on the impacts of dredging from the proposed ocean borrow sites and placement of sand material on the beach. In making this assessment, we have reviewed an Environmental Report prepared for and published by the U.S. Department of Interior, Bureau of Ocean Energy and Management (BOEM) (previously Minerals Management Service (MMS)), entitled "Use of Federal Offshore Sand Resources for Beach and Coastal Restoration in New Jersey, Maryland, Delaware, and Virginia," dated November 1999 (DOI 1999) and the report titled "Collection of Environmental Data Within Sand Resource Areas Offshore North Carolina and the Environmental Implications of Sand Removal for Coastal and Beach Restoration," dated 2003 (Byrnes et al. 2003). Additionally, a detailed review of the current pier reviewed scientific literature on the effects of dredging and beach placement of sediment was conducted and cited in sections 2.0 and 7.0 of the main report.

4a. Actions Affecting Benthic Resources

Dredging: Table I-2 summarizes federal and non-federal documents with placement of sediment on the beach as well as the currently identified borrow sources. For North Carolina projects, borrow areas have been identified predominantly within inlets and associated channels as well as offshore borrow areas between approximately 1-5 miles offshore. Additionally, portions of ebb shoals and cusped forelands have been dredged or identified to be dredged. Upland borrow sources as well as Confined

Disposal Facilities (CDF's) have also been utilized; however, this assessment will only focus on the marine benthic resources.

Existing literature and monitoring reports have documented that dredging activities may result in impacts to benthic resources; however, the significance of impacts is dependent on a myriad of planning considerations relative to the borrow area design, location, dredge type, etc. However, careful consideration of mitigation conditions during borrow area use planning, re-colonization by opportunistic species is expected to begin soon after the dredging activity stops. Due to the opportunistic nature of the species that inhabit these soft bottom benthic habitats, recovery is expected to occur within 1-2 years. Rapid recovery is expected from re-colonization from the migration of benthic organisms from adjacent areas and by larval transport.

Monitoring studies of post dredging effects and recovery rates of borrow areas indicates that most borrow areas usually show significant recovery by benthic organisms approximately 1 to 2 years after dredging (Naqvi and Pullen, 1982; Bowen and Marsh, 1988; Johnson and Nelson, 1985; Saloman *et al.*, 1982; Van Dolah *et al.*, 1984; and Van Dolah *et al.* 1992). According to Posey and Alphin (2000), benthic fauna associated with sediment removal from borrow areas off of Carolina Beach recovered quickly with greater inter-annual variability than differences from the effects of direct sediment removal. However, a potential change in species composition, population, and community structure may occur from the initial sediment removal impact as well as the change in surficial sediment characteristics, resulting in the potential for longer recovery times (2-3 years) (Johnson and Nelson, 1985; Van Dolah *et al.*, 1984). Differences in community structure may occur that may last 2-3 years after initial density and diversity levels recover (Wilber and Stern, 1992). Specifically, large, deeper-burrowing infauna can require as much as 3 years to reach pre-disturbance abundance. According to Turbeville and Marsh (1982), long term effects of a borrow site at Hillsboro Beach, FL, indicated that species diversity was higher at the borrow site than at the control site. Jutte *et al.* (1999 and 2001) evaluated recovery rates of post-hopper dredged borrow areas and found that hopper dredging creates a series of ridges and furrows, with the ridges representing areas missed by the hopper dredge. Rapid recolonization rates were documented due to the dredge's inability to completely remove all of the sediment. Furthermore, Jutte *et al.* (2002) documented that dredging to shallower depths is less likely to modify wave energy and currents at a borrow site; thus, reducing the likelihood of infilling of fine grained sediment. As a result of the significant number of borrow areas identified throughout NC for beach nourishment sand, there is concern for potential cumulative impacts to benthic organisms due to statewide borrow area cumulative acreage, spatial relationship, and frequency of dredging which may impact recovery times.

Other factors affecting Benthic Resources: Many factors unrelated to dredging of sand from borrow areas may affect benthic resources including, beach resources and ocean fish stocks. The factors can be a result of natural events such as natural population cycles or as a result of favorable or negative weather conditions including La Niña, El Niño, climate change, and major storms or hurricanes to name a few. These global

events have far greater impacts on these resources at the population level than relatively local activities such as removal of sand from a given area of ocean bottom. Primary man-induced factors affecting fish stocks are over fishing and degradation of water quality due to pollution. When examining the cumulative effect of space crowded perturbations, these other factors may outweigh the potential incremental effects of borrow dredging of sand on benthic or fish populations.

4b. Actions Affecting Beach Resources

Sources of beach impacts include local beach maintenance activities (i.e. beach nourishment, beach scraping, sand bags, etc.), disposal of dredged material from maintenance of navigation channels, and beach nourishment (berm and dune construction with long-term periodic maintenance). Of particular concern are macroinvertebrate, fisheries, shorebird, and sea turtle species that utilize or occur on or adjacent to ocean beaches. These resources are also impacted by natural events and anthropogenic activities that are unrelated to disposal of sand on the beach as discussed below.

Local Maintenance Activity: Under the existing condition the project area is subjected to repeated and frequent maintenance disturbance by individual homeowners and local communities following major storm events. These efforts are primarily made to protect adjacent shoreline property. Such repairs consist of dune rebuilding using sand from beach scraping and/or upland fill. Limited fill and sandbags are generally used to the extent allowable by CAMA permit. Such frequent maintenance efforts could keep the natural resources of the barrier island ecosystems from re-establishing a natural equilibrium with the dynamic coastal forces of the area.

Non-Federal Beach Nourishment: Several large local beach nourishment efforts have been conducted or are in the permitting process throughout NC (Table I-2). The number of locally funded beach nourishment activities has increased significantly in the last 10 years as local communities continue to seek avenues for restoring severely eroding shorelines. Though non-federal beach nourishment efforts continue to increase, many of these projects are being pursued as one-time interim efforts until the federal beach nourishment projects can be implemented. Therefore, this increase in permitted non-federal projects does not necessarily reflect a subsequent increase in resource acreage impacts. Many of the non-federal projects occur within the limits of federal projects which are already authorized but un-funded (i.e. Dare County Beaches) or projects which are under study (i.e. Bogue Banks). Beaches that have been nourished under permit, or have submitted a permit application to be nourished are provided in Table I-2. Individually, these projects total approximately 93 miles of beach or 29% of North Carolina beaches. These frequent maintenance efforts could keep the natural resources of the barrier island ecosystems from reestablishing a natural equilibrium with the dynamic coastal forces of the area.

Federal (USACE) Beach Nourishment: Federal beach nourishment activities typically include the construction and long-term (50-year) maintenance of a berm and dune. The degree of cumulative impact would increase proportionally with the total

length of beach nourishment project constructed. The first federal North Carolina beach nourishment projects were constructed at Carolina and Wrightsville Beaches in 1965, and totaled approximately 6.4 miles. An additional 3.8 miles of federal beach nourishment project was constructed in 1975 at Kure Beach. In 2004, a coastal storm damage reduction project along 14 miles of Dare County Beaches was authorized, but has not yet been constructed. Most of the remaining developed North Carolina beaches (including the proposed project area) are currently under study by the Wilmington District for potential future beach nourishment projects (Table I-2) or are awaiting authorization and/or appropriation. Individually, these existing or proposed federal projects total approximately 122 miles of beach or 38% of North Carolina beaches. Considering all existing and proposed federal and non-federal nourishment projects, and recognizing that some of the projects are overlapping or represent the same project area, approximately 112 miles or 35 % of the North Carolina coast could have private or federal beach nourishment projects by 2015.

Table I-2. Summary of federal and non-federal beach nourishment projects in North Carolina that have recently occurred, are currently underway, or will occur in the reasonably foreseeable future. (This list is not entirely comprehensive and does not include all small scale beach fill activities (i.e. dune restoration, beach scraping, etc.). (* - federal or non-federal projects which may utilize the same borrow sources and/or overlap beach placement locations).

Federal / Non-Federal	Project	Source of Sand for Nourishment	Beachfront Nourished	Approximate Length of Shoreline (miles)	Approximate Distance From the Project Area (miles)
Federal	*Dare County Beaches, NC Bodie Island (Coastal Storm Damage Reduction)	Offshore Borrow Areas	Kitty Hawk and Nags Head Beaches	14	250
	Dare County Beaches, NC Hatteras to Ocracoke Portion	NA	Hatteras and Ocracoke Island (Hot Spots)	10	150
	Cape Lookout National Seashore -East Side of Cape Lookout Lighthouse	Channel	East Side of Cape Lookout Lighthouse	1	100
	*Beaufort Inlet Dredging - Section 933 Project (Outer Harbor)	Beaufort Inlet Outer Harbor	Indian Beach, Salter Path, and Portions of Pine Knoll Shores	7	100
	*Beaufort Inlet and Brandt Island Pumpout - Section 933 (Dredge Disposal to Eastern Bogue Banks)	Beaufort Inlet Inner Harbor and Brandt Island Pumpout	Fort Macon and Atlantic Beach	4	100
	*Bogue Banks, NC (Coastal Storm Damage Reduction)	Offshore Borrow Areas	Communities of Bogue Banks	24	100
	Surf City and North Topsail Beach - (Coastal Storm Damage Reduction)	Offshore Borrow Areas	Surf City and North Topsail Beach	10	50
	*West Onslow Beach New River Inlet (Topsail Beach) (Coastal Storm Damage Reduction)	Offshore Borrow Areas	Topsail Beach	6	50
	Wrightsville Beach (Coastal Storm Damage Reduction)	Masonboro Inlet and Banks Channel	Wrightsville Beach	3	30
	Carolina Beach and Vicinity, NC Carolina Beach Portion (Coastal Storm Damage Reduction)	Carolina Beach Inlet	Carolina Beach	2	20
	Carolina Beach and Vicinity, NC Kure Beach Portion (Coastal Storm Damage Reduction)	Wilmington Harbor Confined Disposal Area 4 and an Offshore Borrow Area	Kure Beach	2	20
	*Brunswick County Beaches, NC - Oak Island, Caswell, and Holden Beaches (Coastal Storm Damage Reduction)	Offshore Borrow Areas - Frying Pan Shoals	Caswell Beach, Oak Island, Holden Beach	30	0
	*Wilmington Harbor Deepening (Section 933 Project) - Sand Management Plan	Wilmington Harbor Ocean Entrance Channels	Bald Head Island, Caswell Beach, Oak Island	4	0
	*Holden Beach (Section 933 Project)	Wilmington Harbor Ocean Entrance Channels	Holden Beach	2	0
	*Oak Island Section 1135 - Sea Turtle Habitat Restoration	Upland Borrow Area - Yellow Banks	Oak Island	2	0
Ocean Isle Beach, NC (Coastal Storm Damage Reduction)	Shalotte Inlet	Ocean Isle Beach	2	20	

Non-Federal	*Town of Kill Devil Hills - Beach Nourishment Project	Offshore Borrow Areas	Kill Devil Hills	4	250
	*Town of Nags Head - Beach Nourishment Project	Offshore Borrow Areas	Nags Head	10	250
	*Emerald Isle FEMA Project	USACE ODMDS – Morehead City Port Shipping Channel	Emerald Isle	4	100
	*Emerald Isle "Hotspots" FEMA Project	USACE ODMDS – Morehead City Port Shipping Channel	Emerald Isle	7	100
	*Bogue Banks FEMA Project	USACE ODMDS – Morehead City Port Shipping Channel	Emerald Isle (2 segments), Indian Beach, Salter Path, Pine Knoll Shores	13	100
	*Bogue Banks Restoration Project – Phase I – Pine Knoll Shores and Indian Beach Joint Restoration	Offshore Borrow Areas	Pine Knoll Shores and Indian Beach	7	100
	*Bogue Banks Restoration Project – Phase II – Eastern Emerald Isle	Offshore Borrow Areas	Indian Beach and Emerald Isle	6	100
	*Bogue Banks Restoration Project – Phase III– Bogue Inlet Channel Realignment Project	Bogue Inlet Channel	Western Emerald Isle	5	100
	*North Topsail Dune Restoration (Town of North Topsail Beach)	Upland borrow source near Town of Wallace, NC	North Topsail Beach	NA	60
	*North Topsail Beach Shoreline Protection Project	New River Inlet Realignment and Offshore Borrow Area	North Topsail Beach	11	60
	*Topsail Beach - Beach Nourishment Project	Disposal Island	Topsail Beach	6	50
	*Topsail Beach - Beach Nourishment Project	New Topsail Inlet	Topsail Beach	6	50
	Figure Eight Island	Banks Channel and Nixon Channel	North & South Sections of Figure Eight Island	3	30
	Rich Inlet Management Project	Relocation of Rich Inlet	Figure Eight Island	NA	30
	Mason Inlet Relocation Project	Mason Inlet (new channel) and Mason Creek	North end of Wrightsville Beach and south end of Figure Eight Island	2	30
	New Hanover County Beaches - Beach Nourishment	TBD	Wrightsville Beach, Carolina Beach, Kure Beach	TBD	20
	Bald Head Island Creek Project	Bald Head Creek	South Beach	0.34	10
	Bald Head Island - Beach Nourishment	Offshore Borrow Area (Jay Bird Shoals)	West and South Beach of Bald Head Island	4	10
	Bald Head Island - Terminal Groin and Beach Nourishment	TBD	TBD	TBD	10
	*Holden Beach - Terminal Groin and Beach Nourishment	TBD	Holden Beach w/in vicinity of Lockwood Folly Inlet	TBD	0
	*Holden Beach Interim Beach Nourishment	Offshore Borrow Area	Holden Beach	4	0
	*Holden Beach East & West	Upland Borrow Source (Truck Haul)	Extension of 933 Project	3	0
*Ocean Isle - Terminal Groin and Beach Nourishment	TBD	Ocean Isle Beach w/in vicinity of Shallotte Inlet	TBD	15	

Federal (USACE) Navigation Beach Disposal: Maintenance material from dredging the AIWW, inlets, and connecting channels in the vicinity of study area has historically been disposed within authorized disposal limits along the beach (Table I-3). Throughout North Carolina, a total of approximately 41 miles of beach (~13% of North Carolina beaches) are authorized for disposal of beach quality dredged material from maintenance dredging of navigation channels. However, not all of these projects are routinely dredged and a majority of the authorized disposal limits are not actually disposed on to the full extent. Additionally, many of the authorized disposal limits overlap with existing federal or non-federal beach projects. Therefore, without double counting for overlapping beach projects, navigation dredged material is placed along approximately 19 miles, or 6% of North Carolina beaches. The Wilmington District currently uses about 50 percent of the length of beach in North Carolina that is approved for this purpose and does not anticipate significant increases in beach disposal in the foreseeable future.

Beach quality sand is a valuable resource that is highly sought by beach communities to provide wide beaches for recreation and tourism, as well as to provide hurricane and wave protection for public and private property in these communities. When beach quality sand is dredged from navigation projects, it has become common practice of the Corps to make this resource available to beach communities when applicable laws, regulations, funding and other considerations allow. Placement of this sand on beaches represents return of sediment to the littoral system. The design of beach placement sites generally extends the elevation of the natural berm seaward.

TableI-3. Summary of dredged material disposal activities on the ocean front beach associated with navigation dredging. Projects listed and associated disposal locations and quantities may not be all encompassing and represent an estimate of navigation disposal activities for the purposes of this cumulative impacts assessment. (* - Navigation disposal sites which may overlap with existing Federal or Non-Federal beach nourishment projects).

<u>PROJECT</u>	<u>DISPOSAL LOCATION</u>	<u>APPROVED DISPOSAL LIMITS</u>	<u>ESTIMATED ACTUAL DISPOSAL LIMITS</u>	<u>ESTIMATED QUANTITY (CY)</u>	<u>COMMENTS</u>	
Outer Banks	Avon	Begins at a point 1.15 miles south of Avon Harbor and extends north 3.1 miles	3.1 miles (16,368 lf)	0.4 miles or 2,000 linear feet	<50,000 every 6 yrs	Special Use Permit Required From NPS/CHNS
	Rodanthe	Extends from rd to Rodanthe Harbor south 700' to south end of beach disposal area (straight out from existing dirt road). North end at Wildlife Refuge Boundary (PINWR)	.91 miles (4,800 lf)	0.4 miles or 2,000 linear feet	<100,000 every 6 yrs	Special Use Permit Required From NPS/CHNS
	Ocracoke Island	Begins at a point 5,000 linear feet south of Hatteras Inlet and extends southward about 3,000 linear feet.	0.6 mile (3,000 lf)	0.4 mile or 2,000 linear feet	<100,000 every 2 to 3 years	Special Use Permit Required From NPS/CHNS
	Rollinson (Hatteras)	Begins at a point 0.85 miles south of Hatteras Harbor and extends north 5.85 miles to a point north of Frisco, NC	5.85 miles (30,888 lf)	0.4 miles or 2,000 linear feet	<60,000 every 2 years	Special Use Permit Required From NPS/CHNS
	Silver Lake (Teaches Hole/Ocracoke)	From a point 2,000' NE of inlet and extending approximately 2,000 linear feet (0.4 miles) to the NE (Ocracoke Island)	0.4 miles (2,000 lf)	0.4 miles or 2,000 linear feet	<50,000 every 2 yrs	Special Use Permit Required From NPS/CHNS
	Oregon Inlet	Pea Island National Wildlife Refuge (PINWR)	3 miles(15,840 lf)	1.5 miles or 7,920 linear feet	300,000 Annually	Special Use Permit Required From USFWS/PINWR
	Drum Inlet	Core Banks. From a point 2,000 feet on either side of inlet extending for 1 mile in either direction	2 miles (10,560 lf)	1 mile or 5,280 linear feet	298,000 initial, 100,000 maint. (Assume 8 year cycle)	SUP from NPS/CLNS (Included in analysis; however, no determination of site being reused can be made at this time)
Beaufort	*Morehead City	2,000 ft west of inlet, Fort Macon and Atlantic Beach to Coral Bay Club, Pine Knoll Shores	7.3 miles (38,300 lf)	5.2 miles or 27,800 linear feet	3.5 million every 8 yrs	Material from Ocean Bar routinely placed in nearshore berm or ODMDS on annual basis

	*AIWW Section I, Tangent B	Pine Knoll Shores, vicinity of Coral Bay	2 miles (10,500 lf)	0.4 miles or 2,000 linear feet	<50,000 every 5 yrs	This area is included every 8 years as part of the pumpout of Brandt Island. Also included in the area under investigation for beach nourishment at Bogue Banks.
Swansboro	*AIWW Bogue Inlet Crossing Section I, Tangent-H through F	Approx. 2,000 feet from inlet going east to Emerald Point Villas, Emerald Isle (Bogue Banks)	1 mile (5,280 lf)	0.4 miles or 2,000 linear feet	<100,000 annually	The Town of Emerald Isle has received permits to place the material directly on the west end of Emerald Isle at Bogue Inlet.
Browns Inlet	AIWW Section II, Tangents-F,G,H	Camp Lejeune, 3,000 feet west of Browns Inlet extending westward	1.58 miles (6,000 lf)	1 mile or 5,280 linear feet	<200,000 every 2 yrs	
New River Inlet	*AIWW, New River Inlet Crossing Section II, Tangents I & J, Channel to Jax. Section III, tangents 1&2	N. Topsail Beach, 3,000 feet west of inlet extending westward to Maritime Way (Galleon Bay area)	1.5 miles (8,000 lf)	0.8 miles or 4,000 linear feet	<200,000 annually	Two areas 2,000 linear feet on either side of disposal area are routinely used.
New Topsail Inlet (Hampstead)	*AIWW, Sect. III	Topsail Island, Queens Grant	0.6 miles (2,500 lf)	0.6 miles or 2,500 lf	<50,000 every 6 yrs	
	*AIWW, Topsail Inlet Crossing & Topsail Creek	Topsail Beach, from a point 2,000 feet north of Topsail Inlet	1 mile (5,280 lf)	0.4 mi or 2,000 ft	<75,000 annually	
Wrightsville Beach	AIWW Sect. III, Tang 11&12 Mason Inlet Crossing	Shell Island (north end of Wrightsville Beach from a point 2,000 feet from Mason Inlet	0.4 miles (2,000 lf)	0.4 mi. or 2,000 lf	<100,000	Not recently required since the inlet crossing closed up. If reopened will be rescheduled if needed
	*Masonboro Sand Bypassing	At a point 9,000 feet from jetty extending southward midway of island	1.2 miles (6,000 lf)	1 mile 5,280 lf	500,000 every 4 years	Same time as Wrightsville Beach Nourishment
Carolina Beach	AIWW, Section IV, Tangent 1	Southern end of Masonboro Island at a point 2,000 linear feet from Carolina Beach Inlet extending northward to Johns Bay area	1.3 miles (7,000 lf)	0.4 miles (2,000 linear feet)	<50,000 annually	This site is used alternately with Carolina Beach Disposal Site on North end of Island
	AIWW, Section IV, Tangent 1	North end of Carolina Beach at Freeman Park				Limits for each disposal event are dependent on the quantity of material to be dredged
Caswell Beach	*Caswell Beach	Beachfront on eastern end of island	4.7 miles (25,000 lf)	4.7 miles or (25,000 linear feet)	1.1 million every 6 years	Disposal Material from Wilmington Harbor Ocean Bar Project

Bald Head	*Bald Head	Beach front on eastern and western shoreline	3.0 miles (16,000 lf)	3.0 miles or 16,000 lf	1.1 million every 2 years (except every 6th when it goes to Caswell)	Least Costly Disposal Option From Wilmington Harbor Ocean Bar Project.
Holden Beach	AIWW	Beach front on eastern end of the shoreline				Limits for each disposal event are dependent on the quantity of material to be dredged
Ocean Isle	AIWW	Beachfront on eastern end of the island within the vicinity of Shallotte Blvd				Limits for each disposal event are dependent on the quantity of material to be dredged

Table I-3 (Continued)

Other factors affecting Beach Resources: Many factors unrelated to placement of sand on the beach may affect beach resources including: benthic invertebrate resources, shorebird populations, and ocean fish stocks. The factors can be a result of natural events such as natural population cycles or as a result of favorable or negative weather conditions including droughts, floods, La Niña, El Niño, and major storms or hurricanes to name a few. A primary anthropogenic factor affecting shorebird populations is beach development resulting in a loss or disturbance of nesting habitat and invasion of domestic predators. Primary man-induced factors affecting fish stocks are over fishing and degradation of water quality due to pollution.

5. Significant Resources

Based on scoping comments from resource agencies and stakeholders, the primary concerns with the proposed dredging and beach disposal are direct and indirect impacts to macro-invertebrates, fish, shorebirds, and threatened and endangered species. Federally listed threatened or endangered species which could be present along the North Carolina coast are the blue whale, finback whale, humpback whale, North Atlantic right whale, sei whale, sperm whale, West Indian manatee, green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, shortnose sturgeon, Atlantic sturgeon, seabeach amaranth, and piping plover. Impacts to all listed species are summarized below and include, but are not limited to, mortality, reduction in prey species, habitat change, and disturbance during construction activities. Also discussed are the benefits of periodic renourishments, which are expected to enhance nesting habitat of sea turtles and to provide additional habitat for sea beach amaranth and piping plover. In relation to dredging of offshore sites for material, the primary concerns are the potential impacts to benthic organisms and fish species associated with the borrow areas. Detailed discussions of all significant resources and associated impacts considered in this assessment are included in Sections 2.0 and 7.0 of the main report.

Beach and Dune. Terrestrial habitat types within these areas include sandy or sparsely vegetated beaches and vegetated dune communities. Mammals occurring within this environment are opossums, cottontails, gray foxes, raccoons, feral house cats, shrews, moles, voles, and house mice. Common vegetation of the upper beach includes beach spurge, sea rocket and pennywort. The dunes are more heavily vegetated, and common species include American beach grass, panic grass, sea oats, broom straw, seashore elder, and salt meadow hay. Seabeach amaranth, a federally listed threatened species, is present throughout most of North Carolina. Ghost crabs are important invertebrates of the beach/dune community. The beach and dune also provide important nesting habitat for loggerhead and green sea turtles as well as habitat for a number of shorebirds and many other birds, including resident and migratory songbirds. Placement of material along the ocean beach enhances and improves important habitat for a variety of plants and animals, and restores lost habitat in the areas of most severe erosion. This is especially important for nesting loggerhead sea turtles, piping plovers, and seabeach amaranth. Historic nesting data from the study area beaches indicate that sea turtles continue to nest on disposal beaches with hatch rate successes similar to non-disposal

beaches. Furthermore, new populations of seabeach amaranth have been observed to follow sand placement on beaches where sand has been disposed by the Corps of Engineers (ex. Wrightsville Beach) (USFWS, 1996b; CSE, 2004). Individually and cumulatively, in addition to providing important habitat, beach nourishment projects protect public infrastructure, public and private property, and human lives.

Marine Waters. Along the coast of North Carolina, marine waters provide habitat for a variety of ocean fish and are important commercial and recreational fishing grounds. Kingfish, spot, bluefish, weakfish, spotted seatrout, flounder, red drum, king mackerel, and Spanish mackerel are actively fished from boats, the beach, and local piers. Offshore marine waters serve as habitat for the spawning of many estuarine dependent species. Oceanic large nekton located offshore of North Carolina are composed of a wide variety of bony fishes, sharks, and rays, as well as fewer numbers of marine mammals and reptiles. Marine mammals and sea turtles may be present in the offshore borrow sites. Dredging and placement of beach fill may create impacts in the marine water column in the immediate vicinity of the activity, potentially affecting the surf zone and nearshore ocean. These impacts may include minor and short-term suspended sediment plumes and related turbidity, as well as the release of soluble trace constituents from the sediment. Overall water quality impacts for any given project are expected to be short-term and minor. Cumulative effects of multiple simultaneous beach nourishment operations could potentially impact fishes of the surf zone. However, the high quality of the sediment selected for beach fill and the small amount of beach affected at any point in time would not suggest that this activity poses a significant threat.

Intertidal and Nearshore Zones. The intertidal zone within the proposed beach nourishment areas serves as habitat for invertebrates including mole crabs, coquina clams, amphipods, isopods, and polychaetes, which are adapted to the high energy, sandy beach environment. These species are not commercially important; however, they provide an important food source for surf-feeding fish and shore birds. The surf zone is suggested to be an important migratory area for larval/juvenile fish moving in and out of inlets and estuarine nurseries (Hackney *et al.*, 1996). Disposal operations along the beach can result in increased turbidity and mortality of intertidal macrofauna, which serves as food sources for various fish and bird species. Therefore, feeding activities of these species may be interrupted in the immediate area of beach sand placement. These mobile species are expected to temporarily relocate to other areas as the project proceeds along the beach. Though a short-term reduction in prey availability may occur in the immediate disposal area, only a small area is impacted at any given time, and once complete, organisms can recruit into the nourished area. The anticipated construction timeframes for beach projects are typically from December 1 to March 31 and would avoid a majority of the peak recruitment and abundance time period of surf zone fishes and their benthic invertebrate prey source. To summarize, the impacts of beach renourishment projects on the intertidal and nearshore zones are considered temporary, minor and reversible. Cumulative effects of multiple simultaneous beach nourishment operations could be potentially harmful to benthic invertebrates in the surf zone; however, the high quality of the sediment selected for beach fill and the small amount of

beach affected at any point in time would suggest that this activity would not pose a significant threat.

Hardbottoms. Hardbottoms are also called "live-bottoms" because they support a rich diversity of invertebrates such as corals, anemones, and sponges, which are refuges and food sources for fish and other marine life. They provide valuable habitat for reef fish such as black sea bass, red porgy, and groupers. Hardbottoms are also attractive to pelagic species such as king mackerel, amberjack, and cobia. While hardbottoms are most abundant in southern portions of North Carolina, they are located along the entire coast (USFWS, 1990). Recognizing the detailed hard bottom resource inventory completed for this project and the avoidance measures identified impacts to hard bottom communities are not anticipated from this project. Though hard bottom communities are located throughout North Carolina, recognizing the current resource inventories in place to identify and avoid hard bottom communities for dredging and beach nourishment projects, the cumulative effects are not significant.

Nearshore Zone. Beach nourishment projects introduce fill into nearshore waters out to a specified depth of closure, usually from about -20 to -25 feet NGVD. 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 fairly common where suitable habitat occurs. Many species of fish-eating birds are typically found in this area including gulls, terns, cormorants, loons, and grebes (Sections 2.04 and 7.02). Marine mammals and sea turtles also are frequently seen in this area and are discussed in detail in Section 2.0, and Appendix F. Fishes and benthic resources of this area are discussed in Sections 2.04.

Borrow Areas U, Y and the ODMDS. The borrow areas U, Y and the ODMDS are located 1-5 off the shore. Due to the length of Bogue Banks, three borrow areas roughly divided evenly along the project area. Changes in geophysical conditions associated with dredging activities may affect the resources that inhabit these areas due to changes in sediment characteristics, bathymetry, habitat complexity, etc. (Diaz *et al.*, 2004; Slacum *et al.*, 2010). Though short term bathymetric changes will occur following dredging, it is anticipated that the shoal will infill and re-establish its structure (Dibajnia and Nairn *et al.*, 2011) and post dredging surface sediments will be consistent with the adjacent and pre-dredging sediment; thus maximizing macro invertebrate recruitment and recovery. Similar to other offshore borrow sources, post dredging recovery of the benthic resources and the organisms that rely on them could take 1-4 years depending on the magnitude and duration of the perturbation and local rates of recruitment. Assuming that physical changes to the system are not significant following dredging, macro invertebrates are expected to recruit rapidly; however, reestablishment of pre-dredging species composition may take longer.

5a. Other Resources

Air Quality. The ambient air quality for all of coastal North Carolina has been determined to be in compliance with the National Ambient Air Quality Standards. All

coastal counties in North Carolina are designated as attainment areas and do not require conformity determinations.

Additionally, although ozone is not a significant problem in the coastal counties, ozone is North Carolina's most widespread air quality problem, particularly during the warmer months. High ozone levels generally occur on hot sunny days with little wind, when pollutants such as nitrogen oxides and hydrocarbons react in the air. The ozone season is April through October. Dredging with beach disposal or renourishment typically takes place during the cooler months of the year, during times of low biological activity and outside of the ozone season. Section 7 provides detailed emissions analysis of the proposed project. Based on this analysis, this project is not anticipated to create any adverse effect on the air quality of this attainment area or cumulative effect on the ambient air quality for all of coastal North Carolina.

Social and Economic. Though in the short term, the economic recession has resulted in a down real estate market, it is assumed that in the long term coastal areas of NC will continue to grow and expand both with and without beach nourishment projects. Therefore, the economic benefit analysis for the proposed project claims no increase in benefits or hurricane and storm damage due to induced development. Development of vacant lots is limited to lots buildable under the regulations set forth by CAMA, flood plain regulations, State and local ordinances, and applicable requirements of the Federal Flood Insurance Program.

IWR Report 96-PS-1, FINAL REPORT: An Analysis of the U.S. Army Corps of Engineers Shore Protection Program, June 1996 states: "Corps projects have been found to have no measurable effect on development, and it appears that Corps activity has little effect on the relocation and/or construction decisions of developers, homeowners, or housing investors."

Wave Conditions. Localized deepening of the offshore borrow area is the only potential source of impacts on wave conditions, however, these changes are not expected to be significant.

Shoreline and Sand Transport. The drivers of the littoral transport of sand both along shore and cross shore include wind, waves, and currents. For the proposed project along Bogue Banks the project will not modify these drivers. The project does not include placement of sand within the inlet complexes and it is not anticipated the small relative quantities from the project would influence the large scale physical drivers of the inlet system.

6. Resource Capacity to Withstand Stress and Regulatory Thresholds

There are no known thresholds relating to the extent of ocean bottom that can be disturbed without significant population level impacts to fisheries and benthic species. Therefore, a comparison of cumulative impacts to established thresholds is not made. However, the potential impact area of the proposed project is small relative to the area of

available similar habitat on a local, vicinity, and statewide basis and the quick recovery rate of opportunistic species. It is expected that there is a low risk that the direct and cumulative impacts of the proposed action and other known similar activities would reach a threshold with potential for population level impacts on important commercial fish stocks. In regard to physical habitat alterations it is expected that alterations in depths and bottom sediment may occur and be persistent for some borrow areas. However, site modifications would be within the range of tolerance by these species and, although man-altered, consistent with natural variations in depth and sediment within the geographic range of EFH for local commercial fish species. The Final Report, Collection of Environmental Data Within Sand Resource Areas Offshore North Carolina and The Environmental Implications of Sand Removal for Coastal and Beach Restoration (Byrnes et al. 2003) provided the following assessment of potential impacts to benthic organisms from dredging:

Because the sedimentary regime of North Carolina sand source areas is vertically uniform, recolonization of surficial sediments by later successional stages likely will proceed even if dredged shoals are not completely reestablished. Furthermore, dredging of only a small portion of the area within each of the resource areas will ensure that a supply of non-transitional, motile taxa will be available for rapid migration into dredged sites. While community composition may differ for a period of time after the last dredging, the infaunal assemblage type that exists in mined areas will be similar to naturally occurring assemblages in the study area, particularly those assemblages inhabiting inter-ridge troughs. Based on previous observations of infaunal reestablishment in dredged sites, the infaunal community in dredged sites most likely will become reestablished within 2 years, and will exhibit levels of infaunal abundance, diversity, and composition comparable to nearby non-dredged sites.

In a 1999 Environmental Report on the use of federal offshore sand resources for beach and coastal restoration, the U.S. Department of Interior, Minerals Management Service, now BOEM, (DOI 1999) provided the following assessment of potential impacts to beach fauna from beach disposal:

Because benthic organisms living in beach habitats are adapted to living in high energy environments, they are able to quickly recover to original levels following beach nourishment events; sometimes in as little as three months (Van Dolah et al. 1994; Levison and Van Dolah 1996). This is again attributed to the fact that intertidal organisms are living in high energy habitats where disturbances are common. Because of a lower diversity of species compared to other intertidal and shallow subtidal habitats (Hackney et al. 1996), the vast majority of beach habitats are recolonized by the same species that existed before nourishment (Van Dolah et al. 1992; Nelson 1985; Levison and Van Dolah 1996; Hackney et al. 1996).

While the proposed beach disposal may adversely impact benthic macrofauna, these organisms are highly resilient and any effects will be localized, short-term, and reversible.

7. Baseline Conditions

The following main report section describes the status of significant resources that may be affected by this and other similar projects that are pertinent to this analysis.

Section 2.0, Affected Environment.

8. Cause and Effect Relationships

The following main report section describes impacts of the proposed action on significant resources. Cause and effect relationships described in the report are consistent with those that would be expected for other similar projects that are pertinent to this analysis.

Section 7.0, Environmental Effects.

9. Magnitude and Significance of Resource Impacts

9a. Offshore Borrow Areas

Site Specific Impacts: Borrow areas U, Y and the ODMDS are the identified borrow sources for this project and extends between 1-5 miles offshore at depths between -40 and -57'. There are many possible sequences and methods for dredging and placing available material on the beach for the project and a site specific borrow area use plan has yet to be defined. The economic optimization of the use of the borrow areas for the life of the project will be further evaluated when the final borrow area data has been collected and fully analyzed during the Plans and Specifications (P&S) phase. Both initial construction and each nourishment interval will utilize varying components of the borrow site with a sequence of temporary impacts to benthic resources over the life of the project. Subsequent intervals of dredging within the borrow area will likely occur in portions not previously been dredged. Upon each dredging interval, recovery in adjacent areas will have already occurred; therefore, re-occurring impacts to any sub-component of a borrow area are not anticipated. Therefore, the total acreage of impact that could occur during any given dredging event is the one time impact of the surface area required to dredge the volume of sediment for initial construction or nourishment. This cyclic use of borrow areas would result in cumulative effects from space crowded perturbations on a local scale. Assuming that the borrow areas are not impacted by unusually high sedimentation rates or some other disturbance, a natural succession of species should occur, potentially restoring the area to its original levels of abundance and biomass within 1-5 years (Naqvi and Pullen, 1982; Bowen and Marsh, 1988; Johnson and Nelson, 1985; Saloman *et al.*, 1982; Van Dolah *et al.*, 1984; Van Dolah *et al.* 1992; Johnson and Nelson, 1985; Van Dolah *et al.*, 1984; and Wilber and Stern, 1992). Considering that un-impacted or recovered portions of the borrow area will likely be available during any particular dredging event, more rapid recruitment from adjacent areas is expected to expedite recovery. The impacts of this activity on benthic invertebrates are discussed in more

detail in Section 7. Cumulative impacts from space crowded perturbations could occur at the local scale resulting from the use of the borrow areas.

Statewide Impacts:

Existing and Potential Sites: Beach compatible sediment identified for all federal and non-federal nourishment projects throughout North Carolina is most often identified from: upland sites, maintenance or deepening of navigation channels, and/or offshore borrow areas (Table I-2). For the purposes of this impact assessment, only offshore borrow areas are evaluated for cumulative marine resource impacts considering that upland sources are outside of the marine environment and navigation channels are repeatedly dredged already in order to maintain navigation servitude. Of all the projects listed with offshore borrow areas in Table I-2, there is currently only one federal (Carolina Beach and Vicinity, NC Kure Beach portion) and four non-federal (Bogue banks FEMA, Bogue Banks Restoration Project – Phases 1&2, Bald Head Island Beach Nourishment, and Nags Head Beach Nourishment) offshore borrow sites that have received permits and/or authorizations and funding, and are currently in use. Other offshore borrow areas identified for projects are either under study and have not been permitted and/or authorized yet or have received permits and/or authorizations but have not been funded or constructed yet. Considering only the projects that are currently in use, significant cumulative impacts associated with time and space crowded perturbations are not expected considering that these borrow areas are spread out throughout the state and the acreage of impact for these borrow areas relative to the available un-impacted sites throughout the state is not significant. However, recognizing the potential for all of the federal and non-federal projects identified in North Carolina to occur within the reasonably foreseeable future (Table I-2), there is a potential for cumulative impacts for time and space crowded perturbations associated with the cyclic use of the offshore borrow areas throughout the state.

9b. Beach Areas

The impacts of beach disposal on North Carolina beaches are evaluated in Section 7.0 of the main report. The degree of cumulative impact would increase proportionally with the total length of beach impacted. The most likely projects to increase the length of North Carolina beach disposal are beach nourishment projects.

As shown in Table I-5 below, the North Carolina ocean beaches (320 miles) can be divided up based on the potential that a beach nourishment project will be proposed for them. The Coastal Area Management Act (CAMA) applies to all 20 North Carolina Coastal Counties. Proper beach nourishment, navigation disposal, and/or local maintenance within these counties is generally regulated under CAMA or USACE permitting authorities alone, and for this analysis, are labeled CAMA regulated. Approximately 37 percent of North Carolina beaches are in this category. Other North Carolina ocean beach areas which are less likely to be considered for beach disposal include those identified under the Coastal Barrier Resources Act (CBRA) of 1982 (PL 9-348), the Coastal Barrier Improvement Act of 1990 (PL 101-591), and National and State

park lands. CBRA restricts federal expenditures in those areas comprising the Coastal Barrier Resources System (CBRS); thus, long term federal beach nourishment projects will not occur in defined CBRA zones. However, though long term federal beach nourishment projects are restricted from CBRA zones, non-federal permitted projects may still occur (i.e. North Topsail Beach) on a short term basis. National or state park lands are the least likely to have beach nourishment projects considering that their mission is often to manage lands in their natural state and protection of infrastructure is less common. National and state parks allow highly restricted disposal under special use permits and conduct disposal only as required to protect resources, such as at Pea Island. Only about 10 percent (on National/Federal and State Parks) of all existing or projected disposal/nourishment in North Carolina are on beaches within this category.

Table I-4. North Carolina beach classifications and associated potential for beach disposal/nourishment activities.

Beach Classification	Percentage of NC Beaches	Potential for Beach Disposal/Nourishment Activities
Coastal Barrier Resource System	19	Medium
Developed and/or CAMA Regulated	37	High
National Park Lands	40	Low
State Park Lands	4	Low

Statewide Impacts

The following quantitative analyses of statewide impacts were determined based on data provided in Tables J-2 and J-3. These data represent an estimate of the percent of North Carolina beach affected by sand disposal for maintenance of federal navigation channels, and existing, proposed, or potential federal and non-federal beach nourishment projects. Table I-5 represents the total project miles for all existing and proposed federal and non-federal beach nourishment projects and the full authorized limits for beach disposal of navigation dredged material. However, assuming all of these activities were constructed to the full extent (which is very unlikely considering funding constraints, dredging needs from navigation channels, etc.) these estimates would not represent the actual extent of North Carolina ocean beach impacted because of overlapping project areas.

Table I-5. Summary of total project miles for existing and/or proposed federal and non-federal nourishment activities and federal navigation disposal.

Project Type	Total Project Miles	% NC Beach
Federal Beach Nourishment	122	38
Non-Federal Beach Nourishment	93	29
Federal Authorized Beach Disposal	41	13
TOTAL	256	80

Recognizing that many of the existing or proposed federal and non-federal beach nourishment project limits overlap and that some portions of the federal authorized beach disposal limits are within these project areas as well, Table I-6 provides an estimate of total mileage of North Carolina Ocean beach that could cumulatively be impacted by beach nourishment or navigation disposal activities without double counting the overlapping projects.

Table I-6. Summary of cumulative mileage of North Carolina Ocean beach that could be impacted by beach nourishment and/or navigation disposal activities.

Project Type	Total Miles Impacted (*w/o double counting for overlapping projects)	% NC Beach
Federal and Non-Federal Beach Nourishment	112	35
Federal Authorized Beach Disposal	19	6
TOTAL	131	41

a. Existing Beach Nourishment:

- Of the total 197 potential federal and non-federal beach nourishment project miles proposed for NC ocean beaches (Table I-5), a total of 92 (29%) have actually been constructed. However, this estimate represents actual project miles nourished and does not reflect circumstances where the projects overlap. Therefore, the total number of actual miles of beach nourished is less.

b. Proposed Beach Renourishment:

- 121 miles or 38 percent of the North Carolina ocean beaches are proposed for beach nourishment (federal and non-federal).

c. Cumulative Impacts:

- Considering all proposed and existing disposal and nourishment impacts throughout the ocean beaches of North Carolina, a significant portion of the shoreline will have beach placement activities in the foreseeable future, likely resulting in time and space crowded perturbations. However, recognizing the funding constraints to complete all authorized and/or permitted activities, the availability of dredging equipment, etc.; it is very unlikely that all of these proposed projects would ever be constructed all at once. Therefore, though time and space crowded perturbations are expected in the reasonably foreseeable future, assuming each project adheres to project related impact avoidance measures, it is likely that adjacent un-impacted and/or recovered portions of beach will be available to support dependent species (i.e. surf zone fish, shore birds, etc.) and facilitate recovery of individual project sites to pre-project conditions.

Project Level Impacts

The proposed project consists of an 119,670 ft (22.7 miles) long main beachfill, with a consistent berm profile across the entire area, and dune expansion in certain portions (approximately 5.9 miles of the project). The main beachfill is bordered on either side by a 1,000 ft tapered transition zone berm. Sand for the beachfill would be delivered from offshore borrow areas by dredge.

a. Existing Local Beach Placement:

- **Non-Federal Projects:** The Bogue Banks Restoration (BBR) Project was implemented by Carteret County as an interim measure, to go along with placement resulting from Morehead City Harbor dredging, until a full USACE Coastal Storm Damage Reduction project could be implemented. The BBR project was implemented in 3 phases and has placed approximately 4.3 million cy of material along the island since 2001.

•

b. Existing Federal Beach Placement:

- **Morehead City Section 933:** Since 2004, approximately 3.2 million cubic yards (cy) of maintenance material dredged from Morehead City Harbor has been placed in various locations in Bogue Banks as part of the Section 933 project.

- **Morehead City Harbor Maintenance:** Since 1978, about 9 million cy of material dredged during harbor maintenance has been placed on the eastern end of the island as least cost disposal.

d. Proposed Beach Nourishment:

- The proposed project consists of an 119,670 ft (22.7 miles) long main beachfill.
- Carteret County is currently in the early planning stages of a 30 year non-federal beach nourishment project that would extend along the entire length of Bogue Banks. Although this project is being planned as contingency in case the Federal project is not implemented, the actual likelihood of the longer term local plan being implemented is uncertain.
- The Corps is preparing the Morehead City DMMP which will place material from the maintenance of the Morehead City Harbor onto Bogue Banks and Shackelford Banks.

e. Cumulative Impacts:

- The proposed project beach placement activities are approximately every three years and allow for recovery between events.

Conclusion

Historically, the extent of beach nourishment activities on North Carolina beaches was limited to a few authorized federal projects including: Wrightsville Beach, Carolina and Kure Beaches, and Ocean Isle Beach. However, in the past 10 years, a significant number of federal and non-federal beach nourishment efforts were pursued to provide coastal storm damage reduction along the increasingly developed North Carolina shoreline. Additionally, the number of non-federal permitted beach nourishment projects has increased in recent years in efforts to initiate coastal storm damage reduction measures in the interim of federal projects being authorized and/or funded (i.e. Nags Head, North Topsail Beach, and Topsail Beach). Considering the extent of coastal development and subsequent vulnerability to long and short term erosion throughout the North Carolina shoreline it is likely that the proposed beach nourishment projects within the reasonably foreseeable future will be constructed. Furthermore, the frequency of beach disposal activities for protection of infrastructure will continue throughout the state resulting in cumulative time and space crowded perturbations. However, assuming projects continue to adhere to environmental commitments for the reduction of environmental impacts, and un-developed beaches throughout the state continue to remain undisturbed, it is likely that adjacent un-impacted and/or recovered portions of beach will be available to support dependent species (i.e. surf zone fish, shore birds, etc.) and facilitate recovery of individual project sites to pre-project conditions. Assuming recovery of impacted beaches and the sustainability of un-developed protected beaches (i.e. National/Federal and State Parks and Estuarine Reserves) the potential impact area

from the proposed and existing actions is small relative to the area of available similar habitat on a vicinity and statewide basis.

10. Actions to Reduce Cumulative Impacts

Appendix G includes environmental commitments and monitoring proposed to minimize project impacts. These actions will also reduce any cumulative impacts related to beach nourishment and offshore borrow activities. Several of the incrementally larger beach projects considered in this assessment including Wilmington Harbor, Bogue Banks (local nourishment project), and Dare County Beaches have conducted significant monitoring components that address beach impacts on northern, central and southern North Carolina beaches.

DRAFT

References

- Bowen, P.R. & G.A. Marsh. October 1988. Benthic Faunal Colonization of An Offshore Borrow Pit in Southeastern Florida. U.S. Army Corps of Engineers, Dredging Operations Technical Support program. Misc. Rept. D-88-5.
- Byrnes, M.R., R.M. Hammer, B.A. Vittor, S.W. Kelley, D.B. Snyder, J.M. Côté, J.S. Ramsey, T.D. Thibaut, N.W. Phillips, and J.D. Wood. 2003. Collection of Environmental Data Within Sand Resource Areas Offshore North Carolina and the Environmental Implications of Sand Removal for Coastal and Beach Restoration. U.S. Department of the Interior, Minerals Management Service, Leasing Division, Sand and Gravel Unit, Herndon, VA. OCS Report MMS 2000-056, Volume I: Main Text 256 pp. + Volume II: Appendices 69 pp.
- Cacchione D. A., D. E. Drake, W. D. Grant, and G. B. Tate. 1984. Rippled Scour Depressions on the Inner Continental Shelf Off Central California. *Journal of Sedimentary Petrology*. Vol. 54, No. 4, p. 1280-1291.
- Council on Environmental Quality (CEQ). January 1997. Considering Cumulative Effects Under the National Environmental Policy Act.
- Diaz R.J., Cutter G.R. Jr., and Hobbs C.H. III. 2004. Potential Impacts of Sand Mining Offshore of Maryland and Delaware: Part 2 – Biological Considerations. *Journal of Coastal Research*. Vol 20 (1); pgs. 61-69.
- Dibajnia, M. and R. B. Nairn. *Investigation of Dredging Guidelines to Maintain and Protect the Geomorphic Integrity of Offshore Ridge and Shoal Regimes*, U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Leasing Division, 2011. OCS Study BOEMRE 2011-025. 150 pp. + appendices.
- Hackney, C. T., M. H. Posey, S.W. Ross, and A. R. Norris. 1996. A Review and Synthesis of Data on Surf Zone Fishes and Invertebrates in the South Atlantic Bight and the Potential Impacts from Beach Nourishment. Report to the U.S. Army Corps of Engineers, Wilmington. 110 pp.
- Johnson, R.O. and W.G. Nelson. 1985. Biological Effects of Dredging in an Offshore Borrow Area. *Biological Sciences*. 48 (3): 166-188.
- Jean Beasley, pers. Comm.
- Jutte, P.C. R.F. Van Dolah, and P.T. Gayes. 2002. Recovery of Benthic Communities Following Offshore Dredging, Myrtle Beach, SC. *Shore and Beach*, Vol. 70, no: 3, pp. 25-30

- Jutte, P.C., R.F. Van Dolah, G.Y. Ojeda, and P.T. Gayes. 2001. An Environmental Monitoring Study of the Myrtle Beach Renourishment Project: Physical and Biological Assessment of Offshore Sand Borrow Site, Phase II – Cane South Borrow Area, Final Report, prepared by the South Carolina Marine Resources Research Institute, South Carolina Marine Resources Division, Charleston, SC, for the U.S. Army Engineer District Charleston, 70 pp.
- Jutte, P.C., R.F. Van Dolah, M.V. Levisen, P. Donovan-Ealy, P.T. Gayes, and W.E. Baldwin. 1999. An Environmental Monitoring Study of the Myrtle Beach Renourishment Project: Physical and biological Assessment of Offshore Sand Borrow Site, Phase I – Cherry Grove Borrow Area, Final Report, prepared by the South Carolina Marine Resources Research Institute, South Carolina Marine Resources Division, C
- McQuarrie, M.E. 1998. Geologic framework and short-term, storm-induced changes in shoreface morphology: Topsail Beach, NC. *Unpub. M.S. Thesis, Dept. of the Environment, Duke Univ., Durham.* 105p.
- Murray A. B. and E. R. Thieler. 2004. A New Hypothesis and Exploratory Model for the Formation of Large-Scale Inner-Shelf Sediment Sorting and “Rippled Scour Depressions.” *Continental Shelf Research.* 24: 295-315.
- Naqvi, S.M. & C.H. Pullen. 1982. Effects of beach nourishment and borrowing on marine organisms. U.S. Army Corps of Engineers, Coastal Engineering Research Center, Misc. Rept. 82-14.
- Posey, M.H. and T.D. Alphin. 2000. Monitoring of Benthic Faunal Responses to Sediment Removal Associated With the Carolina Beach and Vicinity – Area South Project. Final Report. CMS Report No. 01-01.
- Saloman, C. H. & S.P. Naughton. 1984. Beach restoration with offshore dredged sand: effects on nearshore macrofauna. U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, NOAA Tech. Mem. NMFS-SEF-133.
- Slacum, W. H. Jr., W.H. Burton, and E.T. Methratta. 2010. Assemblage Structure in Shoal and Flat-Bottom Habitats on the Inner Continental Shelf of the Middle Atlantic Bight, USA. *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science.* 2:277-298.
- Thieler E. R., O. H. Pilkey, Jr., W. J. Cleary, and W. C. Schwab. 2001. Modern Sedimentation on the Shoreface and Inner Continental Shelf at Wrightsville Beach, North Carolina, USA. *Journal of Sedimentary Research.* Vol. 71, No. 6, p. 958-970.

- Theiler E.R., P. T. Gayes, W. C. Schwab, and M. S. Harris. 1999. Tracing Sediment Dispersal on Nourished Beaches: Two Case Studies. *Coastal Sediments*. New York, ASCE, p. 2118-2136.
- Turbeville, D.B. and G.A. Marsh. 1982. Benthic Fauna of an offshore borrow area in Broward County, FL. US Army Corps of Engineers Coastal Engineering Research Center. Misc. Report. 82-1. pp. 1-43.
- U.S. Army Corps of Engineers (USACE), Wilmington District. 2009. Final Integrated General Reevaluation Report and Environmental Impact Statement, Shore Protection, West Onslow Beach and New River Inlet (Topsail Beach), North Carolina. February 2009 (Revised April 2009).
- U.S. Army Corps of Engineers (USACE). May 2003. Draft Evaluation Report and Environmental Assessment, Morehead City Harbor Section 933, Carteret County, North Carolina.
- U.S. Army Corps of Engineers (USACE). September 2000. Final Feasibility Report and Environmental Impact Statement on Hurricane Protection and Beach Erosion Control, Dare County Beaches (Bodie Island Portion), Dare County, North Carolina Volume I.
- U.S. Department of the Interior, Minerals Management Service (DOI). 1999. Environmental Report , Use of Federal Offshore Sand Sources for Beach and Coastal Restoration in New Jersey, Maryland, Delaware, and Virginia. OCS Study MMS 99-0036. Office of International Activities and Marine Minerals. Prepared by The Louis Berger Group, Inc. Contract Number 1435-01-98-RC30820.
- Van Dolah, R.F., P.H. Wendt, R.M. Martore, M.V. Levisen, and W.A. Roumillat. 1992. A Physical and Biological Monitoring Study of the Hilton Head Beach Nourishment Project. Marine Resources Division, South Carolina Wildlife and Marine Resources Department, Charleston, South Carolina. March 1992.
- Van Dolah, R.F., D.R. Calder, D.M. Knott. 1984. Effects of Dredging and Open-Water Disposal on Benthic Macroinvertebrates in South Carolina Estuary. *Estuaries*. 7 (1): 28-97.
- Wilber, P. and M. Stern. 1992. A Re-examination of Infaunal Studies That Accompany Beach Nourishment Projects. Proceedings of the 5th Annual National Conference on Beach Preservation Technology. 242-257.