Feasibility Report
and
Environmental Impact Statement

on

Coastal Storm Damage Reduction

SURF CITY AND NORTH TOPSAIL BEACH
NORTH CAROLINA

Appendix J

Cumulative Impact Assessment

APPENDIX J
Cumulative Impact Assessment
Surf City and North Topsail Beach, 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 Ac (Table J-1).

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

Environmental Impact Assessment Components	CEA Steps
I. Scoping	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	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	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 impacts of dredging from the proposed ocean borrow sites and impacts of placement of sand material on the beach (whether for beach nourishment or disposal of dredge maintenance material) on significant coastal shoreline resources. In making this assessment, we have reviewed the following reports:

- U.S. Department of the Interior, Minerals Management Service (MMS) report entitled "Use of Federal Offshore Sand Resources for Beach and Coastal Restoration in New Jersey, Maryland, Delaware, and Virginia," dated November 1999 (DOI 1999)
- MMS report entitled "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)
- 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.

The last three reports listed above included comprehensive assessments of state-wide cumulative impacts. 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 focus on cumulative impacts within the project area since portions of affected beaches under the current proposal have received fill in the past and the proposed action represents an approximately 3.1% increase in the area of North Carolina beaches affected by sand placement as described in the Dare County Beaches EIS (USACE, 2000), Morehead City Harbor Section 933 (USACE, 2003) and Topsail Beach (USACE, 2009) documents referenced. Additionally, this analysis will study the cumulative impacts within the project area associated with increased offshore borrow area use. The proposed project represents a new impact to the offshore benthic resources in the Topsail Island area. However, 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 borrow 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 placement of dredged material within the project area (in the vicinity of Topsail Beach) in about 1969. While historic accounts of local coastal storm damage reduction efforts including sand placement on Wrightsville Beach dating back to the mid-1930s were considered in this assessment, no attempt was made to quantify these actions since detailed data were not available. 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.

At the project vicinity scale the cumulative assessment considers past periodic beach disposal of AIWW maintenance material either annually or on a six-year basis along portions of Topsail Island. This assessment assumes continued periodic beach disposal of maintenance material along Topsail Island and construction of the West Onslow Beach and New River Inlet (Topsail Beach) and proposed beach nourishment projects. The cumulative analysis also considers the potential that future federal (i.e. Brunswick County Beaches, Bogue Banks, etc.) and non-federal (i.e. Topsail Beach, Bald Head Island, Figure Eight Island, etc.) 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, Minerals Management Service, 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 8.0 of the main report.

4a. Actions Affecting Benthic Resources

Dredging: Benthic organisms within the defined borrow areas dredged for construction and periodic nourishment will be impacted. However, 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 dredging borrow areas for beach nourishment sand, there is concern for potential cumulative impacts due to repeated dredging in a borrow area within short periods of time such that the benthic community may not have time to recover. Dredging in subsequent areas close to one another may result in impacts to potential adult organism recruitment to the dredged areas, further lengthening the time for recovery in an area (DOI 1999). However, as noted in Section 8.01.7 of the main report, considering the distance offshore and the shallow volumes of sediment within the borrow areas, it is anticipated that all dredging activities associated with initial construction and each re-nourishment interval will be conducted using a hopper dredge. Recognizing the thin volumes of sediment within each borrow area, it is anticipated that all available sediment within each dredged portion of a borrow site will be fully utilized. Therefore, re-occurring impacts to an individual portion of a borrow area are not anticipated and full recovery of each dredged site is expected prior to the next dredging event.

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, 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

The major sources of beach impacts are local beach maintenance activities (which include local beach nourishment), 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 (section 8.01.6 of the Feasibility Report/EIS), fisheries (section 8.01.3 of the Feasibility Report/EIS), shorebird (section 8.02.3 of the Feasibility Report/EIS), and sea turtle species (appendix I of the Feasibility Report/EIS) 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: Local efforts can also include beach nourishment such as that conducted along Pine Knoll Shores, Salter Path, Indian Beach, and Emerald Isle by local interests in 2001-2004. The number of locally funded beach nourishment activities has increased significantly since 2004 along other developed North Carolina beaches. 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 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 may be permitted to be nourished, include, but are not limited to: Nags Head, Bogue Banks, North Topsail Beach, Topsail Beach, Figure Eight Island, Bald Head Island, and Holden Beach (Table J-2). Individually, these projects total approximately 75 miles of beach or 23% 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, coastal storm damage reduction 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 J-2). 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 J-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 SCNTB Project Area (miles)
Federal	*Dare County Beaches, NC Bodie Island (Coastal Storm Damage Reduction)	Offshore Borrow Areas	Kitty Hawk and Nags Head Beaches	14	150
	Dare County Beaches, NC Hatteras to Ocracoke Portion	NA	Hatteras and Ocracoke Island (Hot Spots)	10	130
	Cape Lookout National Seashore -East Side of Cape Lookout Lighthouse	Channel	East Side of Cape Lookout Lighthouse	1	50
	*Beaufort Inlet Dredging - Section 933 Project (Outer Harbor)	Beaufort Inlet Outer Harbor	Indian Beach, Salter Path, and Portions of Pine Knoll Shores	7	35
	*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	40
	*Bogue Banks, NC (Coastal Storm Damage Reduction)	Offshore Borrow Areas	Communities of Bogue Banks	24	35
	Surf City and North Topsail Beach - (Coastal Storm Damage Reduction)	Offshore Borrow Areas	Surf City and North Topsail Beach	10	0
	*West Onslow Beach New River Inlet (Topsail Beach) (Coastal Storm Damage Reduction)	Offshore Borrow Areas	Topsail Beach	6	10
	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	40
	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	45
	*Brunswick County Beaches, NC - Oak Island, Caswell, and Holden Beaches (Coastal Storm Damage Reduction)	Offshore Borrow Areas - Jay Bird Shoals and Frying Pan Shoals	Caswell Beach, Yaupon Beach, Long Beach, Holden Beach	30	65
	*Wilmington Harbor Deepening (Section 933 Project) - Sand Management Plan	Wilmington Harbor Ocean Entrance Channels	Bald Head Island, Caswell Beach, Oak Island	4	65
	*Holden Beach (Section 933 Project)	Wilmington Harbor Ocean Entrance Channels	Holden Beach	2	65
	*Oak Island Section 1135 - Sea Turtle Habitat Restoration	Upland Borrow Area - Yellow Banks	Oak Island	2	65
	Ocean Isle Beach, NC (Coastal Storm Damage Reduction)	Shallotte Inlet	Ocean Isle Beach	2	70

Non-Federal	***Town of Nags Head - Beach Nourishment Project	Offshore Borrow Areas	Nags Head	10	150
	***Emerald Isle FEMA Project**	Offshore Borrow Areas - Morehead City Port Shipping Channel (ODMDS)	Emerald Isle	4	30
	***Bogue Banks FEMA Project**	Offshore Borrow Areas – Morehead City Port Shipping Channel (ODMDS)	Emerald Isle (2 segments), Indian Beach, Salter Path, Pine Knoll Shores	13	35
	***Bogue Banks Restoration Project – Phase I – Pine Knoll Shores and Indian Beach Joint Restoration**	Offshore Borrow Areas	Pine Knoll Shores and Indian Beach	7	35
	***Bogue Banks Restoration Project – Phase II – Eastern Emerald Isle**	Offshore Borrow Areas	Indian Beach and Emerald Isle	6	30
	***Bogue Banks Restoration Project – Phase III– Bogue Inlet Channel Realignment Project**	Bogue Inlet Channel	Western Emerald Isle	5	30
	***North Topsail Dune Restoration (Town of North Topsail Beach)**	Upland borrow source near Town of Wallace, NC	North Topsail Beach	NA	0
	***North Topsail Beach Shoreline Protection Project**	New River Inlet Realignment and Offshore Borrow Area	North Topsail Beach	11	0
	***Topsail Beach - Beach Nourishment Project**	New Topsail Inlet Ebb Shoal and Offshore Borrow areas	Topsail Beach	6	10
	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
	Bald Head Island Creek Project	Bald Head Creek	South Beach	0.34	55
	Bald Head Island - Beach Nourishment	Offshore Borrow Area - Jay Bird Shoals	West and South Beach of Bald Head Island	4	55
	***Holden Beach East & West**	Upland Borrow Source (Truck Haul)	Extension of 933 Project	3	65
	***Holden Beach East & West**	Upland Borrow Source (Truck Haul)	Extension of 933 Project	3	65

Federal (USACE) Navigation Beach Disposal: Maintenance material from dredging in the vicinity of Topsail Island has historically been disposed within authorized disposal limits along 1.5 miles of beach at North Topsail Beach and 1.6 miles of beach at Topsail Beach (Table J-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, to the maximum extent practicable. Placement of this sand on beaches represents return of material, which eroded from these beaches, and is, therefore, replenishment with native material. The design of beach placement sites generally extends the elevation of the natural berm seaward.

Table J-3 Summary of dredged material disposal activities on North Carolina ocean front beaches 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).

PROJECT		DISPOSAL LOCATION	APPROVED DISPOSAL LIMITS	ESTIMATED ACTUAL DISPOSAL LIMITS	ESTIMATED QUANTITY (CY)	COMMENTS
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		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 (Brandt Island)**	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 fo 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)	1mile (5,280 lf)	0.4 miles or 2,000 linear feet	<100,000 annually	
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.
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
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.

Table J-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 others, the primary concerns with the proposed dredging and beach disposal are direct and indirect impacts to hard bottom communities, macro-invertebrates, fish, shorebirds, and sea turtles. 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, seabeach amaranth, and piping plover. Impacts to all listed species are provided in Appendix I and 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. In relation to dredging of offshore sites for material, the primary concerns are the potential impacts to benthic organisms, fish species, and hard bottom habitat areas. Detailed discussions of all significant resources and associated impacts considered in this assessment are included in Sections 2.0 and 8.0 of the Feasibility Report/EIS.

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 and seabeach amaranth. Historic nesting data from Topsail Island indicate that sea turtles continue to nest on

disposal beaches with hatch rate successes similar to non-disposal beaches (Jean Beasley, pers. comm.). 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 and Bogue Banks) (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 that may be present in the offshore borrow sites are addressed in Appendix I. 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 15 November to 30 April 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). As identified in Figure J-1, there are dispersed hardbottom areas present in offshore environment and borrow areas off of Surf City and North Topsail Beach. Hardbottoms in the Surf City North Topsail Beach area and potential project related impacts are discussed in detail in Sections 2.01.10 and 8.01.8.2 of the Feasibility Report/EIS. In order to assess the potential impact of the proposed project on: (1) nearshore hard bottom habitat as a result of burial or sedimentation from the beach fill equilibration process and (2) offshore habitat from hopper dredging activities, the Corps contracted side scan sonar, multi-beam, and diver ground truth data collection. Diver ground truth verification was used to confirm the presence or absence of hard bottom within high backscatter areas identified as “potential hard bottom” from the remote sensing efforts. Diver ground truth confirmation of 8 selected areas previously identified as “potential” hard bottom, in conjunction with the sidescan interpretation, supported the conclusion that no hard bottom was identified landward of the calculated -7 m (-23 ft.) depth of closure. Additional refined analyses of the remote sensing data coupled with the (1) diver ground truth transects, (2) collected sediment samples, and (3) digital video, identified the previously defined “high backscatter anomalies” to be regions of coarse gravel and shell hash. These features identified in the nearshore environment off Surf City and North Topsail Beach are consistent with previously identified “rippled scour depressions (RSD)” (Cacchione *et al*., 1984; Thieler *et al*., 1999; Thieler *et al*., 2001), “ripple channel depressions (RCD)” (McQuarrie, 1998), or “sorted bedform”(Murray and Thieler, 2004) features identified throughout the coast of NC (Wrightsville Beach, Figure Eight Island, Topsail Island, etc.). Hard bottom of varying low (<0.5 m (1.6 ft.)) to moderate (0.5 m (1.6 ft.) to 2.0 m (6.6 ft.)) relief (i.e. large contiguous hard bottom, patchy outcroppings, and/or distinct ledges) and total area were confirmed and characterized within multiple borrow areas in the offshore (>-23 ft NGVD) environment. Sections 2.01.10 and 8.01.8.2 of the main report and Appendix R discuss the identified hard bottom resources and potential impacts in more detail. Additionally, specific project measures in order to avoid impacts to hard bottoms are provided. 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.

Figure J-1. Hard bottom resources identified within 16 borrow areas (A-T) located offshore of Topsail Island.

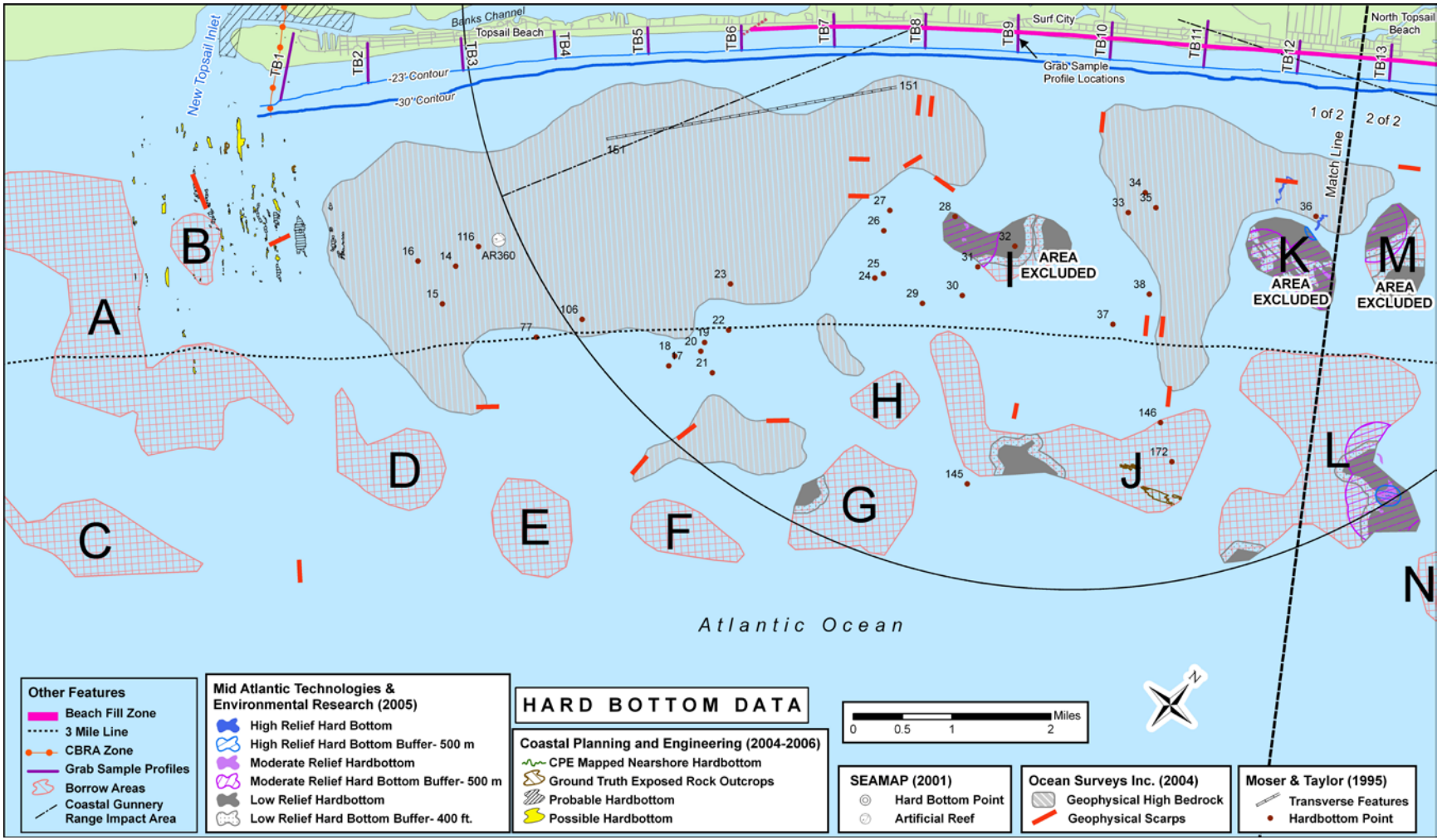
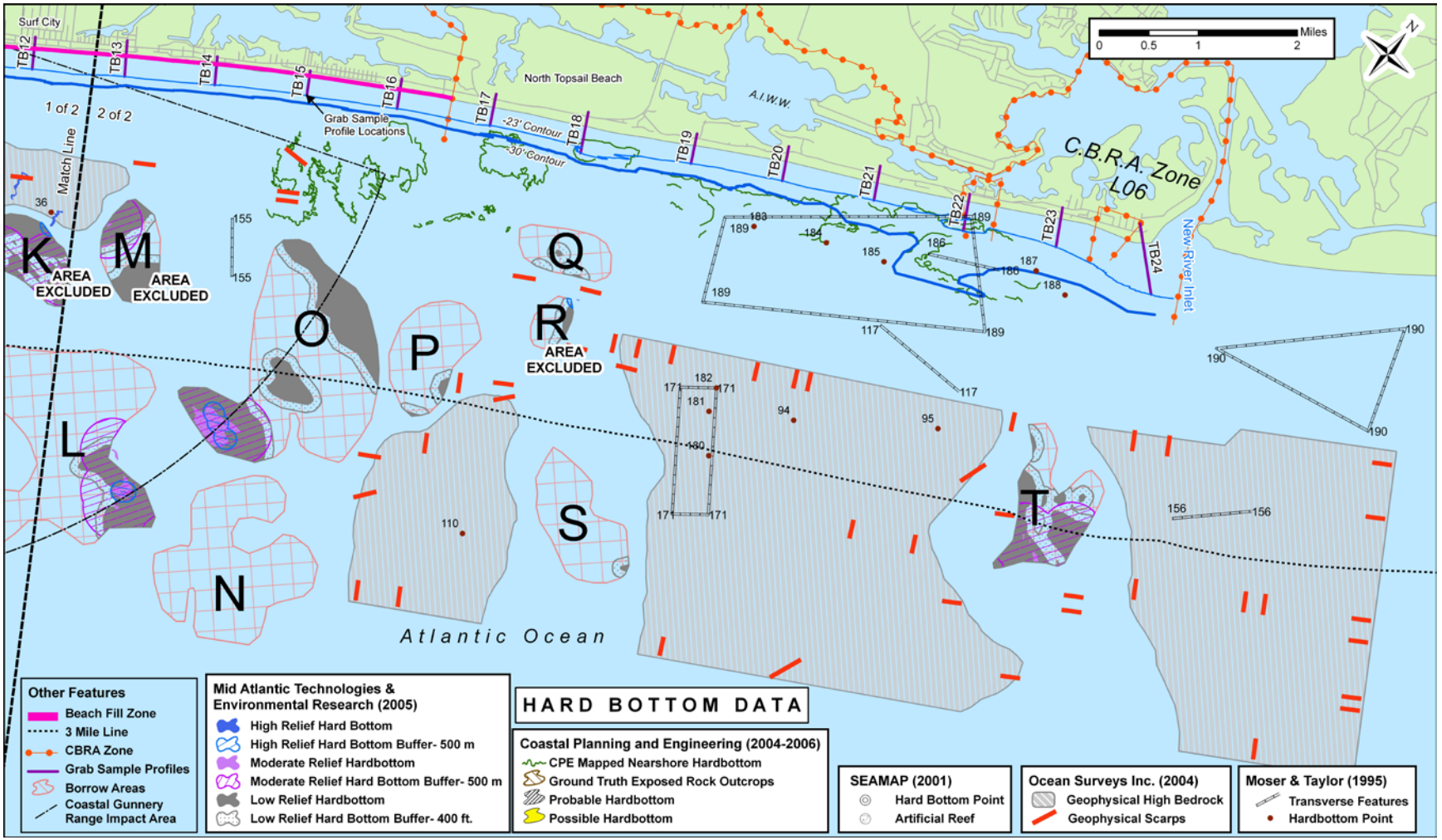


Figure J-1. (continued)



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 2.02.3 and 8.02.3). Marine mammals and sea turtles also are frequently seen in this area and are discussed in detail in Sections 2.01.7, 2.02.4, and Appendix I. Fishes and benthic resources of this area are discussed in Sections 2.01.4, 2.01.5, 2.01.8, and 2.01.9 respectively.

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 8.08.1 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. The coastal areas of North Carolina 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 offshore borrow areas is the only potential source of impacts on wave conditions, however, these changes are not expected to be significant considering the shallow nature of the proposed borrow sites. For the proposed Surf City North Topsail Beach project, the borrow area use plan identifies sixteen detached, relatively small borrow areas scattered offshore of Topsail Island.

These borrow areas include 10 identified for the Surf City/North Topsail Beach project and the excess amount from 6 borrow areas identified for the Topsail Beach Federal project (USACE, 2009). These areas are typically between 1 and 6 miles offshore and have pre-dredge bottom depths between 35 and 50 feet. This identified borrow area use plan should have less impact on wave conditions than dredging of a large, contiguous area.

Shoreline and Sand Transport. Existing water depths in offshore borrow areas are substantially deeper than the estimated active profile depths. Therefore no impacts to the active profile are expected due to borrow area dredging for this project or any other projects in the State.

Net movement of material placed on Surf City North Topsail Beach will be predominantly to the north based on transport analysis, with northerly sediment transport being roughly twice that of southerly transport on average. On a regional basis, renourishment projects add material to the longshore transport system, thus providing positive impacts. Although a regional sediment budget analysis has not been completed, it is expected that the proposed action and the combined effects of all other existing and proposed beach projects will have a minimal effect on shoreline and sand transport.

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. 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 (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 Feasibility Report/EIS 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 Feasibility Report/EIS 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 8.0, Environmental Effects.

9. Magnitude and Significance of Resource Impacts

9a. Offshore Borrow Areas

Site Specific Impacts: Sixteen borrow areas have been identified for the Surf City/North Topsail Beach Coastal Storm Damage Reduction Project. These borrow areas include 10 identified for the Surf City/North Topsail Beach project and the excess amount from 6 borrow areas identified for the Topsail Beach Federal project (Figure J-1 and Table J-4).

Table J-4. Topsail Island Borrow Area Characteristics.

Borrow Area	Total Acreage (**excluding hard bottom and buffers)	Estimated Volume (Million yd^3)	Distance Offshore (miles)	Surface Elevation (ft. MLLW)
A	2,272	*	1 to 3	-38.5 to –49.0
B	158	*	1.5 to 2.5	-42.2 to –43.2
C	598	*	4 to 5.5	-45.5 to -47.7
D	471	*	3.5 to 4.5	-43.5 to –46.9
E	406	*	4.5 to 5.5	-49 to –50
F	282	*	4.5 to 5.5	-47.2 to -48
G	574	2.41	4 to 5.5	-46.5 to -49
H	158	0.72	3.5 to 4.5	-44.4 to -45.2
J	912	3.67	3 to 4.5	-42 to -47.4
L	1298	6.13	3 to 5.5	-42.3 to -47
N	1001	5.64	4 to 6	-43.6 to -46.7
O	807	3.85	1.5 to 4	-40.6 to -43.9
P	409	2.73	2 to 3.5	-39.5 to -40.5
Q	144	0.73	1 to 1.5	-35.2 to -35.4
S	472	1.46	3.5 to 4.5	-43.8 to -44.8
T	86	0.25	2 to 4	-37.2 to -42

* - These borrow areas are planned to be used for the Topsail Beach Federal and non-Federal projects (USACE, 2009). The excess material not used for these projects is expected to be available for the Surf City/North Topsail Beach project. This amount is approximately 9.68 million cubic yards.

* * - Acreage calculations represent available area to be dredged for sediment taking into account the avoidance of hard bottom habitat and associated buffers.

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. However, for a majority of the identified borrow sites to be utilized for this project, the depths of available sediment are relatively shallow with an average range of 2.6 to 6.4 ft for borrow areas G-T located offshore of Surf City and North Topsail Beach. Under the proposed plan, initial construction would require about 11.8 mcy and each nourishment interval would require about 2.6 mcy. Both initial construction and each nourishment interval will likely utilize multiple borrow areas with a sequence of temporary impacts to benthic resources over the life of the project. Considering the shallow average thickness of the borrow areas and the associated dredging operations and production capabilities to effectively dredge the sediment, it is anticipated that individual dredged areas within each borrow area will be fully utilized and will not be dredged again at consecutive dredging events. Therefore, once the dredged site recovers from the initial dredging impact, it will likely not be impacted again as all of the available sediment would be exhausted from the dredged area. Considering that the identified borrow areas are all consistently shallow, the size of the impact area can be correlated to the volume of sediment needed. For example, initial construction will require about 11.8 mcy and will therefore have the largest acreage impact among multiple borrow areas during that one time event. Each subsequent nourishment interval will require about 2.6 mcy and will impact a reduced amount of acres at six year intervals for the duration of the project. Once all of the sand is dredged from the identified borrow areas to meet the demand for the 50 year duration of the project, a total of about 10,047 acres (SCNTB (G-T) – 5,861 acres; Topsail Beach (A-F) – 4,186 acres) could be impacted among all 16 identified borrow sites offshore of Topsail Island (Table J-4).

Subsequent intervals of dredging within an individual borrow area will likely occur in portions of the borrow area that have 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 repeatedly dredging recently used areas, 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 8.01 Feasibility/EIS titled “Marine Environment.”

Cumulative impacts from space crowded perturbations could occur at the local scale resulting from the use of borrow sites A-F for initial project construction and periodic maintenance of the Topsail Beach federal and non-federal projects as well as borrow areas G-T for the Surf City and North Topsail Beach federal and non-federal projects.

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 J-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 J-2, there is currently only one federal (Carolina Beach and Vicinity, NC Kure Beach portion) and three non-federal (Bogue banks FEMA, Bogue Banks Restoration Project – Phases 1&2, and Bald Head Island 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 J-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 8.0 of the Feasibility Report/EIS. 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 J-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 J-5. 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 J-6 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 J-6. 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	75	23
Federal Authorized Beach Disposal	41	13
TOTAL	**238**	**75**

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 J-7 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 J-7. 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 J-6), a total of 74 (23%) 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:

- 123 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
(10-mile study area)

The Surf City and North Topsail Beach study area is a berm and dune project extending along approximately 10 miles of the oceanfront. The southern limit of the project is the boundary between Topsail Beach and Surf City. The northern limit is within North Topsail Beach at the southern edge of the Coastal Barrier Resources System (Topsail Unit, L06).

a. Existing Local Maintenance:

- Under existing conditions, the entire study area (10 miles) is expected to experience frequent local maintenance, including beach scraping, bulldozing, dune restoration, beach restoration, etc.

b. Existing Disposal Activities:

- Annual disposal activities (<200,000 cy) occur within a 1.5 mile area on the north end of N. Topsail Beach, approximately 3,000 feet west of inlet extending westward to Maritime Way (Galleon Bay area).
- The placement of nourishment material along the 10-mile study area is not expected to affect the current disposal schedule.

c. Existing Beach Nourishment:

- None.

d. Proposed Beach Nourishment:

- The entire 10-mile federal study area is proposed for beach nourishment. Additionally, a non-federal study is proposed to nourish the remaining portions of North Topsail beach, including the CBRA units.

e. Cumulative Impacts:

- The currently approved navigation disposal limits are located outside of the proposed project area study area; therefore, none of the area proposed for sand deposition within the 10-mile study area has had previous beach disposal, other then small scale emergency fill events.

- For areas that have had local disturbances (i.e. beach bulldozing), it is possible that the proposed action will impact beach invertebrates in areas that have not fully recovered from past sand deposition, extending recovery time.

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

Sections 7.03.6 and 10.06.1 of the Feasibility Report/EIS include 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. The Dare County Beaches project also has a significant offshore borrow area monitoring component for both pre- and post-borrow activities.

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