# ENVIRONMENTAL ASSESSMENT

## Bald Head Island Beach Restoration Project

## Bald Head Island
## Brunswick County, North Carolina

*Prepared for:*

The Village of Bald Head Island
Bald Head Island, NC

*and*

U.S. Army Corps of Engineers
Wilmington District

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June 2008

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# 1.0 PROJECT PURPOSE

The beachfront of Bald Head Island (specifically South Beach and portions of West Beach) are in need of beach-compatible sand to offset erosional losses. The goal of the Village of Bald Head Island (Village) project is to ensure that South Beach in its entirety remains in an improved non-critically eroded condition. The proposed borrow source is located within the most seaward portion of Jay Bird Shoals. The designed project will serve as the "base" condition for future beach disposal operations by the U.S. Army Corps of Engineers (USACE) Wilmington District. The projected frequency and scope of these federal maintenance projects are identified in the Wilmington Harbor Sand Management Plan (SMP). Under current conditions, the typical federal bi-annual channel maintenance sand volume is insufficient to maintain all areas suffering erosion at Bald Head Island. With a base project in place, it is highly probable that in the future an adequately sized fill project will remain viable for a longer period of time – thereby greatly enhancing the amount of protection afforded to residential homes and island infrastructure throughout the two areas of concern. The proposed Village project, together with future federal maintenance projects as identified in the SMP, will provide for a more stable beachfront (thus mitigating the detrimental effects of shoreline erosion). The proposed project is for a one-time action of dredging and subsequent placement of material along portions of eroding beachfront.

## 1.1 Project Location

The enclosed vicinity map (Figure 1) depicts the location of the proposed borrow area and the proposed beach restoration project on Bald Head Island (Brunswick County, North Carolina). Bald Head Island is located immediately eastward of the mouth of the Cape Fear River at 33.85°N, 77.9889°W (NAD27) (Figure 2). The island forms the southern terminus of the Smith Island complex at Cape Fear Point from which Frying Pan Shoals extend over twenty miles southeastward into the Atlantic Ocean.

Bald Head Island's east and south shorelines (East Beach and South Beach, respectively) front the Atlantic Ocean. The western shoreline (a.k.a. West Beach) is located immediately adjacent to the Cape Fear River entrance. The north side of the island is bounded by the Bald Head Creek estuary. The remainder of Smith Island is composed of interior tidal creeks (including Cape Creek and Deep Creek), associated tidal marsh, Middle Island, and Bluff Island. The mouth of the Cape Fear River (over one mile in width) separates Bald Head Island from the eastern end of Oak Island (or Caswell Beach). The enclosed nautical chart (Figure 3) depicts the location of these islands relative to the Cape Fear River entrance channel and its associated shoal formations.

The beachfront ecosystem in the project footprint can be divided into three main areas including, the dune complex, the dry sand beach, and the wet beach. Common vegetation along 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 and salt meadow hay. South Beach (particularly the western portion) and West Beach (compromising both the foredune and dry sand beach system) have been experiencing chronic to severe shoreline recession since the mid 1970s. Since 2001, the Wilmington District USACE has placed over 3.80 Mcy of beach compatible sand dredged from the adjacent navigation project on portions of South Beach. That work was implemented in accordance with the Wilmington Harbor Sand Management Plan (SMP). Along the westernmost portion of South Beach in close proximity to the Cape Fear River entrance, sixteen (16) soft groins (sand filled tubes) are presently maintaining the integrity of the dune complex and dry sand beach as well protecting island infrastructure and residential homesites.

The Village has identified a viable source of beach-compatible sand via a detailed Sand Search Investigation performed by Olsen and Associates, Inc. (2007) (Appendix A). The 225-acre site evaluated near the seaward end of Jay Bird Shoals is located approximately 0.8 miles offshore of Bald Head Island and 1.6 miles offshore of Oak Island. The area designated as the project borrow site is approximately 158 acres. Seabed elevations range between -5 ft to -16 ft NGVD within the proposed borrow area (Figure 4). Another expansive shoal formation, Middle Ground, is located north of Jay Bird Shoals. This shoal consists of intertidal and subtidal soft bottom encompassing approximately 440 acres. The former federal navigational channel is located immediately to the east of the proposed Jay Bird Shoal borrow area. The entrance channel for the Cape Fear River was re-located further east (immediately adjacent to the Point of Bald Head Island) in 2000 with a portion of the re-oriented channel extending directly through Bald Head Shoal. Currents throughout the area are principally influenced by semidiurnal tidal flows within the Cape Fear River entrance. The mean tidal range is 4.9 ft at the mouth of the river.

## 2.0 PROJECT PERMITTING

The purpose of this Environmental Assessment (EA) is to provide the US Army Corps of Engineers (USACE), the North Carolina Department of Environment and Natural Resources (DENR), and associated agencies with a concise decision making tool that identifies whether the proposed beach nourishment project is of sufficient impact to require the preparation of an Environmental Impact Statement (EIS). An EIS is required only in

those circumstances where more detailed studies and research (beyond the normal scope of an EA) are needed. If an EIS is not warranted, a "Finding of No Significant Impact" (FONSI) will be issued by DENR. A CAMA Major Development Permit Application will be submitted upon completion of the Departmental Review of the EA document. It should be noted that a FONSI does not assure the issuance of a CAMA Major Permit.

Upon issuance of a FONSI, the applicant and/or their agent will submit a joint CAMA Major/Department of Army Permit Application to the respective state and federal permit coordinators. The Division of Coastal Management (DCM) coordinates state agency review of the development application, assembles comments and finalizes permit conditions. State commenting agencies include the NC Division of Water Quality (DWQ), Land Quality Section, Water Resources, Marine Fisheries (DMF), Environmental Health, Archives and History, Community Assistance as well as the Wildlife Resources Commission (WRC), the Department of Administration (DOA) and the Department of Transportation (DOT). The US Army Corps of Engineers (USACE) will also review this EA document and make a determination whether DCM can process the entire permit application as a joint state/federal review endeavor or whether a separate Federal 404 and Section 10 Permit will be required. Commenting federal agencies coordinated by the USACE include the US Environmental Protection Agency (EPA), National Marine Fisheries Service (NMFS), and the US Fish & Wildlife Service (US FWS).

## 3.0 PROJECT DESCRIPTION

The Village of Bald Head Island (Village) has elected to implement a designed beach restoration project intended to preserve the entirety of the South Beach shoreline. A portion of West Beach will likewise be included in the proposed nourishment program since it has suffered significant erosion and is not typically addressed by federal beach disposal actions. The volume of sand placed for such a project must be sufficient to both address historic beach losses and expected sediment losses between federal beach disposal events required by the SMP. Presently the design volume at the time of construction is expected to be approximately 2 Mcy (as measured in-place for payment). The gross volume excavated will be 10-25% higher than the pay volume. Approximately 5% or less of the total dredge volume would be placed on West Beach.

The proposed borrow area for the Village project is sited on the distal (seaward) end of a highly dynamic linear shoal feature bordering the western perimeter of the original navigation project entrance channel. As such it is part of the overall Jay Bird Shoal complex westward of Bald Head Island which forms much of the

present day Cape Fear River ebb tidal platform. The latter large scale morphological unit has been significantly altered in spatial configuration, volume, ambient depths, etc. due to the construction and maintenance of the Cape Fear River Entrance Channel beginning in the late 1800's. For example, a Section 933 Evaluation Report prepared by the Wilmington District (USACE, June 1990) quantified some 29.5 Mcy of accretion throughout the Jay Bird Shoal complex between 1872 and 1974 (see Figure 7). From 1923 to 1974, the shoal field west of the channel increased at an average of 253,000 cy/yr (Olsen Associates, Inc., April 1989). The overall net gain westward of the channel was .48 Mcy/yr. (1872-1974) despite the concurrent excavation of 53 Mcy of material from the entrance channel itself over that same period of time.

A recent (2006) high resolution multi-beam survey of some 27 square miles of Cape Fear Entrance bathymetry was performed by Geodynamics for the Village (see Figure 8). The fundamental justification of the work was two-fold: a.) to provide a high resolution 3-D bathymetric assessment (*i.e.,* topographic model) of natural and manmade features presently existing in the vicinity of Bald Head Island, and b.) to provide updated (and highly detailed) survey data for shoal features of interest which have never been mapped in high detail. Of specific interest were high resolution survey depictions of existing seabed conditions throughout Middle Ground and Jay Bird Shoal complex. Existing data, including currently published Nautical Charts, were deemed highly unreliable for purposes of borrow site evaluation and associated impact studies. To date, the only reliable available survey data within the channel/river gorge are obtained for purposes of ensuring safe navigation therein, or routine maintenance of the authorized project dimensions by the Wilmington District, USACE. Although the District likewise initiated a five year regional monitoring study for the Cape Fear River Entrance as a component of the Wilmington Harbor SMP, the more dynamic and shallow portions of interest of Jay Bird Shoal are not surveyed due to cost, degree of difficulty, etc. Hence, the Geodynamics survey is the only one of its type and comprehensive level of detail available for the Cape Fear River shoal system in its entirety.

The selection of the proposed Bald Head Island borrow site (by design) capitalized on the results of the Geodynamics survey. Of specific interest in the development of the borrow site were the following characteristics:

- reasonable accessibility to Bald Head Island and maximum distance from Oak Island so as to minimize conflict with future similar work by others,

- documented strata of high quality beach compatible sediment suitable for meeting both recently adopted State Standards and post-placement performance criteria acceptable to the Engineer,
- lack of significant benthic or other resources to be temporarily impacted by excavation,
- desirable constructability characteristics for purposes of sand excavation and beach fill construction by an ocean certified cutter suction dredge,
- an acceptable level of potential cultural resource avoidance necessary for dredge operational feasibility, and
- siting of the borrow area in a dynamic depositional area for purposes of ensuring substrate recovery or minimization of substrate composition modification over time. This is in contrast to a site selected upon, or within, a transgressive shoal feature.

The design depth of the proposed borrow site is such that substrate sediments exposed during project construction will continue to consist of high quality sands. Future sedimentary conditions will therefore initially be influenced by slumping of excavation perimeter side slopes (*i.e.,* sand); sand eroded from Cultural Resource buffer zones by waves and current; and deposition from sediment transport along the marginal shoal feature as presently exists today. Quantification of infilling rates is difficult due to equilibration processes between cut and uncut portions of shoal during the first few years following dredging. It is well documented however that the section of shoal in question is naturally depositional both in the modern day and the morphological sense. Regardless of future realized sediment deposition rates, the probability of sedimentation by similar sandy material (in contrast to fines, organics, clays, etc.) is excellent and is the principal post-construction borrow site characteristic desired for favoring the recovery of benthic communities (Bergquist, et.al. 2008) and minimizing potential Essential Fish Habitat (EFH) impacts.

Suitable sediment within the Jay Bird Shoals borrow site (Figure 5) will be excavated by cutter suction dredge and transported by submerged pipeline to the western end of Bald Head Island. At that point, the material will be distributed by shore pipe to either the West or South Beach shorelines. Within the borrow site, two (2) groups of magnetic anomalies and a federal tide gage structure have been identified and will be avoided by the dredge contractor via specified exclusion areas. The design depth of the borrow area will vary between -20 and -22 ft NGVD (mol). The proposed footprint of the requested area to be excavated is approximately 158 ac and is located at the distal (i.e. seaward) end of Jay Bird Shoals. Existing depths in the proposed borrow area range between –5 ft and -16 ft NGVD. All material to be excavated meets recently adopted Technical Standards for Beach Fill Projects as published in the North Carolina Administrative Code (15A

NCAC 07H .0312). Sediment and vibracore data from the most recent site evaluation have been assembled and are provided in Appendix A. Additional information pertaining to existing sediment conditions is provided in Section 6.2 of this document.

Beach quality material from this project will be placed along South Beach beginning westward of sand tube groin no. 1 and will extend approximately 16,200 lf to the west where it will taper to existing conditions westward of the Cape Fear spit. Assuming an average fill density of 100 cy/ft, the net fill volume is estimated at 1.86 Mcy, mol. West Beach will receive additional fill placement as dictated by shoreline conditions existing immediately prior to project bid. Given the steep slope of this shoreline, a maximum fill placement density of 30 cy/ft is anticipated.

The proposed beach construction project will initially impact approximately 40 acres of land above the existing mean high water and up to 200 acres of land below mean high water along South Beach and West Beach combined. There will be approximately 158 acres or less of bottom disturbance at the Jay Bird Shoals borrow site. Project design drawings and narrative are provided for reference in Appendix B. The selection of the proposed project is based upon an alternatives analysis (Section 5.0) and subsequent selection of the least damaging practicable alternative in accordance with Section 404(b)(1) guidelines.

# 4.0 PROJECT NEED

## BACKGROUND

Since about 1974, beach erosion experienced at Bald Head Island, NC has been principally manifest as chronic and severe shoreline recession along South Beach (most particularly the western portion) and a portion of West Beach. In the net, the island's erosion is the apparent result of several combined factors: (1) divergent alongshore littoral transport gradients at South Beach, (2) tidal currents and proximity to the Cape Fear River Entrance, and (3) long-term morphological changes in island configuration and offshore ebb tidal shoal formations due to both initial navigation channel construction and subsequent channel maintenance.

## 4.1 Historic Morphologic Changes to Jay Bird Shoals

The existence of both Jay Bird Shoals and Bald Head shoals in their current linear depositional configurations are a direct result of the federal navigational project and associated channel improvements over time. These shoal features are relatively modern and man-altered ebb-tide dominated formations. Prior to the maintenance of the Wilmington Harbor Navigation Project entrance channel, the original naturally occurring

ebb tidal platform was relatively broad and continuous and positioned at a much more landward location. Moreover, the shallow nature of the historical bar served to allow for the natural wave-induced bypassing of sand from the west to Bald Head Island (refer to Figure 6).

Subsequent to navigation channel construction through the outer bar in the late 1800's, and in particular, since its continual high-frequency maintenance at a significantly deepened configuration (post 1972), all natural sand bypassing to Bald Head Island has been eliminated. Until recently, most sand dredged from the entrance channel for the purpose of maintaining navigability has been transported to the Ocean Dredged Material Disposal Site (ODMDS) – thereby removing the beach quality sediment from the littoral system. The long term net result has been the deflation of the nearshore shoals seaward of Bald Head Island and a reconfiguration of the South Beach shoreline nearest the Cape Fear River. Figure 7 graphically depicts the resultant large-scale offshore accretion westward of the original channel alignment and corresponding shelf deflation seaward of Bald Head Island. The quantification of the associated impact volumes presented in Figure 7 was prepared by the Wilmington District USACE.

The Wilmington Harbor Entrance Channel, which extends seaward of Bald Head Island, is not stabilized by jetties and until channel modifications initiated in 2000, had been maintained at a single location and orientation by dredging since the late 1800's. In recent time, prior to the 2000 major modifications of the Harbor Deepening Project, maintenance of the entrance channel typically required the removal of between 500,000 – 1,000,000 cubic yards (cy) of material each year. Beginning in 2000, the federal navigation channel was deepened by four feet and widened at several locations. Since initial construction in 2000, three (3) maintenance dredging operations have been conducted within the channel. It should be noted that the seven-mile long ocean entrance segment of the channel was likewise reoriented in 2000 from its historical alignment to a more easterly location through Bald Head Shoals and directly seaward of Bald Head Island.

### 4.2 Wilmington Harbor Sand Management Plan

The *Wilmington Harbor Sand Management Plan* (SMP) was formulated as a specific action element of the 2000 deepening project for Wilmington Harbor. The Plan's acknowledged purpose was to reverse the highly impactive practice of transporting beach quality sand removed from the channel during dredging activities to offshore disposal sites outside the active littoral system. Specifically the plan called for the future placement of all dredged beach quality sand onto adjacent beaches. Over a typical six-year cycle, the initial SMP indicated that approximately 1.0 Mcy of sand would be placed on the beaches of Bald Head Island in year two

and four (after initial construction) and on Oak Island/Caswell Beach during year six. The cycle would then repeat. The six-year disposal cycle was planned for the life of the navigation project but can be altered based upon impact documentation and other relevant factors.

As an adjunct to the SMP, and as specifically addressed by the Wilmington Harbor Navigation Project Environmental Assessment, the USACE initiated a 6-year Cape Fear River Entrance monitoring program. An annual report is prepared and the associated data intended to ultimately evaluate and modify the SMP, as determined necessary (after coordination with interested parties). If the project is documented to cause significant adverse impacts on an adjacent shoreline, the SMP can be "adjusted". Should adverse effects not be resolvable through SMP modification, the USACE can seek to implement "appropriate corrective measures".

### 4.3 Prior Shore Protection Measures

Sand placement activities constructed at Bald Head Island since 1991 are summarized in Table 1. The three small scale disposal projects constructed between 1991 and 1997 were cost-shared or paid for by the Village of Bald Head Island. The 2001 disposal operation was constructed as an element of the Wilmington Harbor Deepening Project. The disposal sand was placed as a designed berm along 15,500 ft of shoreline and was performed in general conformance with the requirements of the SMP. The 2005 beach disposal project was the first "official" event (Year 2) of the scheduled disposal cycle for the SMP and was constructed between November 2004 and January 2005. A small scale non-federal West Beach sand disposal project was constructed by the Village in 2006 as a by-product of the dredging to the entrance of Bald Head Creek.

A temporary sand-filled tube groin field was constructed by the Village along the westernmost portion of South Beach. Construction began in March 1996, immediately following completion of the above referenced small-scale beach disposal project. Sixteen soft groins (sand-filled tubes) were constructed of geotextile material and sand fill to comply with the North Carolina Division of Coastal Management's rules prohibiting "hard structures" as a means of localized shoreline stabilization. The CAMA permit for the sand tubes was issued by way of a variance granted by the Coastal Resources Commission. Over time, the temporary groins had deteriorated to the point that replacement was eventually warranted in 2005. It has been relatively well documented through long-term physical monitoring that the rejuvenated groin field is successfully reducing the rate of sediment losses along the western half of South Beach. During the 7-month monitoring period (April to November 2006) immediately prior to the 2007 disposal event, sand losses within the sand tube groin

field above the Mean High Water Line (MHWL) were modest (i.e. -7,700 cy) relative to the remainder of the active profile within the limits of the groin field (to -16 ft) which lost roughly -171,200 cy. Long-term data (Olsen 2003, Olsen 2004, Olsen 2005, Olsen 2006, Olsen 2007) have indicated that the rejuvenated sand tube groin field has performed as intended by reducing sediment losses above the MHWL. This measured performance of the groin field likewise conforms with the Wilmington District's stated desire to reduce the rate of shoaling of the adjacent segment of navigation project channel (bordering the Point). Hence, the reconstruction of the sand tube groin field by the Village was a stipulated requirement of the Wilmington District prior to the initiation of the scheduled Winter of 2005 beach disposal program.

Table 1: Beach disposal activities at Bald Head Island since 1991.

| Year | Volume |
|---|---|
| 1991 | 0.35 Mcy |
| 1996 | 0.70± Mcy |
| 1997 | 0.45 Mcy |
| 2001 | 1.58± Mcy |
| 2005 | 1.2 Mcy (Est.) |
| 2006 | 47,800 cy |
| 2007 | 1 Mcy (Est.) |

## 4.4 Recent Federal Beach Disposal Actions

In the early months of 2007, the Wilmington District placed approximately 1 Mcy of beach compatible material along South Beach during the second scheduled maintenance dredging of the navigation channel. The work was performed in accordance with the terms of the SMP.

Per the terms of that SMP, sand derived from channel maintenance in 2009 will go to Oak Island. Subsequently, the Village of Bald Head Island does not expect to receive *scheduled* maintenance dredging sand from the navigation project until at least 2011 – some four (4) years after the most recent 2007 disposal operation.

### 4.5 Current Conditions

Beach monitoring performed annually by the Village indicates that since 2000, South Beach has begun to experience some *net* level of improvement due to:

- beach disposal operations routinely performed by the USACE over the last 7 years;
- the fact that the sand being placed is in a "design" configuration; and
- the reduction of beach fill end losses resulting from the rejuvenation of the sand tube groin field.

It is predicted that any major structural compromise in the integrity of the sand tube stabilizing structures, as well as a 4-year hiatus in federal beach disposal activities at Bald Head Island, will cause setbacks in the currently expanded beach widths which protect the natural dune complex, developed properties and critical infrastructure (main southern road, utilities, etc.), particularly along the western half of South Beach where erosional stress is the highest. Similarly, unless some increased level of sand placement eventually occurs along the eastern half of South Beach, recession of the beach and dune line back to, or landward of, historical eroded limits at that location will eventually occur.

During the last year of pre-fill monitoring by the Village (i.e., April 05 to April 06), South Beach lost some 300,000 to 350,000 cy of sand – which is below (less than) historical maximum levels. If one includes the Point, the maximum volume of sand lost approaches 425,000 cy. As a result, annualized sediment losses are *almost equal* to present day federal sand disposal volumes (i.e., approximately 1 Mcy every two (2) years). With a four-year hiatus following the placement of federal navigation project sand in April, 2007, some form of additional (i.e., outside) sand source will be necessary to both maintain current beach conditions and prevent probable storm damage to island infrastructure, including residential homesites, roadways, etc. Additionally, nourishment efforts are necessary to maintain the integrity of the natural dune complex and dry sand beach which serves as habitat for threatened and endangered species.

## 5.0 ALTERNATIVES ANALYSIS

The following analysis considers alternate forms of potential beach stabilization and/or alternate sources of sand. The preferred alternative (dredging and beach nourishment) is considered the least environmentally damaging practicable alternative to meet the stated project purpose and need.

### 5.1 No-Action Alternative

The no-action alternative would submit the shoreline of South Beach to a predictable renewed highly eroded condition. That is to say, the beach would remain unimproved until the next scheduled beach disposal event some four years, or more into the future. Low-altitude aerial photography of the beachfront depicts the April 2003 shoreline in a highly eroded condition prior to the federal beach disposal actions in 2005 (Appendix C). Without the establishment and maintenance of a stable, baseline beach profile, there will continue to be large scale cumulative losses of material from the subject beachfront. In its current condition, but without action, major island infrastructure and single-family residences will again be threatened by future erosion just as they were in 2003. As such, it is projected that planned federal disposal projects (four years into the future) will not be able to keep pace with, or adequately offset the effects of continuing erosion along the South Beach shoreline without the proposed locally constructed beach fill project. For example, the Village sponsored comprehensive annual monitoring studies for Bald Head Island document typical annual sand losses of approximately 350,000 cy/yr between federal beach disposal events. Most of this loss occurs along the western half of South Beach between the center of the Island and the Point. This net loss includes the beneficial effects of the 16 structure sand tube groinfield. Accordingly, over the anticipated 4-year (minimum) window between beach disposal events, as dictated by the Wilmington Harbor Sand Management Plan, some 1.4 Mcy of sand will be lost from this section of shorefront alone. All of this loss occurs in the region of previously damaged roadway and infrastructure. The no-action alternative is therefore not considered practicable due to the large scale projected damage to existing island infrastructure and residences, as well as the documented fact that a resumption of beach disposal actions pursuant to the tenets of the Wilmington Harbor SMP will be insufficient to provide for a full recovery to today's conditions.

### 5.2 Shoreline Armoring

The implementation of any level of conventional shoreline armoring, seawalls or other protective structural measures sufficient to reduce or eliminate shoreline recession at Bald Head Island is not permittable in accordance with the State of North Carolina regulatory mandates. Shoreline armoring is therefore determined not be practicable.

### 5.3 Abandonment or Modification of the Federal Navigation Project

The cessation of all dredge and fill activities associated with the ocean entrance channel to Wilmington Harbor would result in the eventual recovery of the ebb tidal shoal feature which historically served to naturally bypass sand to Bald Head Island. The morphological recovery of the ebb tidal shoal would take

many decades (and perhaps a century) and would therefore provide negligible physical near term benefit to Bald Head Island. It is therefore determined not to be a practicable alternative.

Modification to existing navigation project features such as channel realignment, construction of a channel widener or a terminal groin near the Point could provide future shore protection benefits to Bald Head Island. However, the level of study and requisite authorizations would take substantial time. Accordingly, navigation project modification is determined not to be practicable at this time.

### 5.4 Brunswick County Shore Stabilization Project

The Wilmington District USACE is presently performing continuing study and design analyses intended to lead to the eventual funding and construction of a countywide shore stabilization project predicated on beach restoration. The timing and feasibility of including Bald Head Island in that plan are not practicable to meet the Village's near term shore protection requirements. (The updated draft EIS is not expected to be completed until 2010.) The Brunswick County project would require subsequent permitting and Congressional authorizations. Thus, any potential benefit derived from this project would not satisfy the immediate, short-term needs for protection. Moreover, the type and level of project being proposed by the Village of Bald Head Island would be identical to that proposed for construction at predominately federal expense. The one exception is that the proposed project by the Village would be constructed at no cost to the federal government. The Village project is presently conceived as a one-time operation with future maintenance provided by the Wilmington Harbor SMP. Inclusion of Bald Head Island into a future countywide shore stabilization project continues to be an option. It is likewise reasonable to assume that Bald Head Island and the other Brunswick County shorelines will be the recipients of beach quality sediment derived from any future navigation project improvements or Port development related activities in the vicinity of the Wilmington Harbor entrance channel.

### 5.5 Beach Nourishment with Terminal Groin Installation

A project design incorporating both reduced restoration of the beachfront and the installation of a permanent terminal structure to limit the loss of fill material would be an effective means for shoreline protection over the long-term – particularly at South Beach in proximity to the navigation channel. The placement of beach quality sand with concurrent installation of a groin or permanent groin field would retain (or greatly reduce) the volume of material otherwise lost via long-shore drift, tidal currents, channel impacts, etc. However, due to existing state regulations, 'hardened' methods of beach stabilization are not permitted. Therefore,

nourishment *with* groin or groin field construction is not considered a permittable alternative without a variance. Such an option may be permittable without a variance in order to maintain the federal navigation project channel dimension and the west end of South Beach (i.e. the 'Point') by reducing shoaling; however, this option is not within the control of the Village.

### 5.6 Dredging and Beach Nourishment (Applicant's Proposed and Preferred Alternative)

The proposed borrow site footprint to be dredged represents an approximate 158-ac area of subtidal habitat located near the distal portion of Jay Bird Shoals. Initial conceptual designs included a more expansive footprint area extending more westward into Jay Bird Shoals. Due to potential adverse impacts to intertidal habitat, the footprint area to be affected by excavation was reduced to the current, proposed extent. The proposed dredge area maximizes the quantity of suitable beach nourishment material while both protecting cultural resources and minimizing the spatial extent of impacts to soft bottom habitat. The footprint is located over subtidal bottom ranging in depth from approximately -5 ft NGVD to -16 ft NGVD. Benthic and fisheries resources of Jay Bird Shoals and its vicinity are discussed in Section 6.12 of this document. Magnetometer and side-scan sonar surveys (conducted by Tidewater Atlantic Research, Inc.) indicated two groups of magnetic anomalies exhibiting characteristics consistent with potential shipwreck material and/or significant cultural resources (refer to Appendix D for the archaeological remote sensing survey and target assessment for Jay Bird Shoal). During dredging operations, a 200-ft buffer will be maintained to avoid dredging impacts and secondary effects of erosion per coordination with the State Historic Preservation Office (SHPO).

The entire shoreline of South Beach is designated by permit as a federal beach disposal area for beach quality material excavated from the Cape Fear River entrance channel (as authorized under the Wilmington Harbor Navigation Project). In addition, CAMA Major Permit #9-95 (issued to the Village of Bald Head Island) authorizes placement of material for beach nourishment. Beach quality material from this project will be placed along South Beach beginning westward of sand tube groin no. 1 and extending approximately 16,200 lf to the east. Assuming an average fill density of 100 cy/ft, net fill volume is estimated at 1.86 Mcy, mol. West Beach will receive additional fill placement as dictated by shoreline conditions existing immediately prior to project bid. Given the steep slope of this shoreline, a maximum fill placement density of 30 cy/ft at that location is anticipated.

In light of various design modifications and measures to be employed to minimize potential disturbance to environmental and cultural resources, it is considered that the proposed project represents the least environmentally damaging, practicable alternative to achieve stated project goals and objectives.

## 5.7 Alternate Borrow Areas

Areas considered as potential sources of material for beach nourishment have been evaluated in the context of the project requirements (both in terms of sand quality and quantity). Any potential sand source area must consist of sediments satisfying minimum standards for beach fill projects as required through the North Carolina Administrative Code (15A NCAC 07H .0312). The applicant must also consider the proximity of the source area relative to the area of beach being nourished due to transport logistics, project duration, constructability, and cost constraints. All dredging and beach filling operations must be confined to a relatively narrow window of time to minimize potential adverse effects to environmental resources. In light of these considerations, the most desirable potential sources are identified in the general vicinity of West Beach and South Beach on Bald Head Island.

The following source sites have been considered for the purpose of providing a sufficient quantity of sand for the proposed beach nourishment: (1) areas westward of the former federal channel alignment; (2) the EPA designated Wilmington Ocean Dredged Material Disposal Site (ODMDS); (3) confined disposal facilities (CDFs) along the upper reaches of the Cape Fear River; and (4) near-shore ebb tidal shoals (outside of the proposed dredge footprint).

### 5.7.1 Areas West of Former Federal Channel

Offshore sediment data acquired from areas situated immediately adjacent to the former federal channel alignment at the mouth of the Cape Fear River indicate a high content of fine sediments generally considered unsuitable for beach nourishment (see Appendix A). Due to the nature of this material and the technical standards for beach placement, this alternative is determined not to be practicable and is therefore eliminated from further consideration.

### 5.7.2 Offshore ODMDS

The offshore ODMDS has been used for the disposal of dredged materials from the Wilmington Harbor Federal navigation project and the Military Ocean Terminal at Sunny Point (MOTSU) for many years. MOTSU is a military port facility located on the west bank of the Cape Fear River approximately 10 miles upstream

from the river's mouth. Both the Federal navigation project and MOTSU require some level of annual maintenance dredging. Reaches of the Federal project maintenance extend from the ocean bar channel at the mouth of the Cape Fear River to a point just north of Smith Creek on the Northeast Cape Fear River (north of Wilmington, NC). The Wilmington Harbor Dredged Material Management Plan (DMMP) provides specific information as to the historical and present-day use of the ODMDS including documentation of the quantity and character of material placed within. In addition, an evaluation of potential beneficial uses of material dredged from the Federal navigation project is required as part of the DMMP. This requirement served as the premise for the establishment of the 2000 Wilmington Harbor Sand Management Plan (SMP) which specifically provides for the return of littoral material to the beachfront. According to the SMP, beach-compatible dredged material (sands) dredged from the ocean bar or river navigation channel should be placed on nearby beaches or within the active littoral system when it is economically and environmentally acceptable to do so.

The DMMP clearly documents conditions of the two ODMDS sites (both the old site used until 2002 and the new site used for current dredged material disposal). Specific volume totals of dredged materials placed within the former ODMDS site are available from 1976 through 1999 (Table 2). Since 1987, the date of the site designation, approximately 27.6 Mcy of dredged materials have been placed within the ODMDS. The source of the material is divided into three general zones within the Cape Fear River: (1) the Wilmington Harbor Federal navigation project, ocean bar channels (WH-OB); (2) the Wilmington Harbor navigation channel to Wilmington, excluding the ocean bar and portions above the Lower Brunswick channel (WH-NAV); and (3) the MOTSU channel. Of the total material disposed in the ODMDS, approximately 15.5 Mcy (56%) of the material has come from WH-NAV and the MOTSU channels. As identified in Table 3, the mid-project reaches of WH-NAV and MOTSU exhibit significantly higher silt and clay components not compatible with beach placement. MOTSU dredged material alone (accounting for 12 Mcy or 43% of the total material placed in the ODMDS since 1987) is characterized as silty riverine sediments consisting of 70% silt and clay. Additionally, it is commonly reported that the ODMDS consists of woody debris associated with prior dredging of river bottom. In light of these documented conditions, this alternative has been determined to be not practicable and has been eliminated from further consideration in the following analysis of potential actions.

### 5.7.3 Confined Disposal Facilities (CDFs)

Over the years, maintenance for the Wilmington Harbor project has resulted in the creation of disposal sites along channelized reaches of the Cape Fear River Estuary. The 1989 Environmental Impact Statement (EIS)

for the long-term maintenance of Wilmington Harbor (USACE 1989) identified eighteen (18) disposal sites extending from Snow Marsh Channel (north of Southport) to near the upstream limit of the federal project on the Northeast Cape Fear River (just north of the mouth of Smith Creek). The disposal areas were originally formed from pumping material to unconfined areas along maintained channel reaches. Over time, the federal project included the construction of upland dikes to contain the dredged material. Most of these diked upland facilities have since been abandoned by the USACE (Owens, pers. comm.). These areas

Table 2. Dredged Material Quantities from Wilmington Harbor Project 1976-1999.

| DREDGED MATERIAL QUANTITY – CUBIC YARDS | | | | |
|---|---|---|---|---|
| YEAR | WH-OB | WH-NAV | MOTSU | YEAR TOTAL |
| 1976 | 1,157,161 | 0 | 0 | 1,157,161 |
| 1977 | 218,624 | 0 | 0 | 218,624 |
| 1978 | 523,803 | 0 | 0 | 523,803 |
| 1979 | 138,817 | 0 | 0 | 138,817 |
| 1980 | 951,935 | 0 | 0 | 951,935 |
| 1981 | 376,942 | 0 | 0 | 376,942 |
| 1982 | 850,621 | 0 | 0 | 850,621 |
| 1983 | 1,018,839 | 0 | 0 | 1,018,839 |
| 1984 | 1,297,202 | 0 | 0 | 1,297,202 |
| 1985 | 190,633 | 0 | 0 | 190,633 |
| 1986 | 756,423 | 0 | 0 | 756,423 |
| 1987 | 1,571,976 | 0 | 983,250 | 2,555,226 |
| 1988 | 0 | 597,568 | 0 | 597,568 |
| 1989 | 1,124,408 | 0 | 1,255,134 | 2,379,542 |
| 1990 | 524,267 | 0 | 1,047,290 | 1,571,557 |
| 1991 | 427,176 | 466,349 | 0 | 893,525 |
| 1992 | 1,051,328 | 0 | 773,950 | 1,825,278 |
| 1993 | 749,800 | 0 | 945,255 | 1,695,055 |
| 1994 | 1,040,600 | 0 | 549,770 | 1,590,370 |
| 1995 | 1,594,295 | 1,633,852 | 398,111 | 3,626,258 |
| 1996 | 1,000,000 | 345,430 | 3,683,330 | 5,028,760 |
| 1997 | 1,444,000 | 217,294 | 132,914 | 1,794,208 |
| 1998 | 901,988 | 196,442 | 1,473,582 | 2,572,012 |
| 1999 | 675,549 | 0 | 825,000 | 1,500,549 |
| 1976-1999 | 19,586,387 | 3,456,935 | 12,067,586 | 35,110,908 |
| 1987-1999 | 12,105,387 | 3,456,935 | 12,067,586 | 27,629,908 |
| Note: WH-OB – Baldhead Shoal through Battery Island Channels, inclusive. | | | | |
| WH-NAV – Lower Swash through portions of Lower Brunswick channels. | | | | |
| MOTSU – Materials associated with MOTSU only. | | | | |
| Material Management Plan (DMMP) Wilmington Harbor, North Carolina, June 1996. U. S. Army Corps of Engineers, Wilmington District – Ocean Disposal Database and Contract Dregding Records. | | | | |

Table 3. Sediment Composition of Dredged Material – Wilmington Harbor Project

| Channel | %Gravel | % Sand | % Silt & Clay | Sediment Grouping |
|---|---|---|---|---|
| Bald Head Shoal | | | | |
| Offshore Reaches | 0.0 | 73.2 | 26.8 | Silty Offshore |
| Inlet Reaches | 0.0 | 98.7 | 1.3 | Sandy Lower Project Reaches |
| Smith Island | 7.9 | 92.0 | 0.1 | |
| Caswell-Southport | 18.0 | 80.5 | 1.5 | |
| Southport | 12.5 | 85.5 | 2.0 | |
| Battery Island | 38.0 | 61.0 | 1.0 | |
| Lower Swash | 27.0 | 70.0 | 3.0 | |
| Horsheshoe Shoal | 0.0 | 98.0 | 2.0 | |
| Reaves Point | 0.0 | 99.0 | 1.0 | |
| Lower Midnight | 0.0 | 76.0 | 24.0 | Varied Mid-Project Reaches |
| Upper Midnight | 0.0 | 82.5 | 17.5 | |
| Lower Lilliput | 0.0 | 56.5 | 46.5 | |
| Upper Lilliput | 0.0 | 98.0 | 2.0 | |
| Keg Island | 0.0 | 63.0 | 37.0 | |
| Upper and Lower Big Island | 2.0 | 94.0 | 3.0 | |
| Lower Brunswick | 0.0 | 92.7 | 7.3 | |
| Upper Brunswick | 0.0 | 57.0 | 43.0 | |
| Fourth East and Between | 0.0 | 80.0 | 20.0 | |
| Anchorage Basin | 0.0 | 6.0 | 94.0 | Silty Upper – Project Reaches |
| Between Memorial & Hilton Railroad Bridges | 10.0 | 55.0 | 35.0 | |
| Above Hilton Railroad Bridge | 0.0 | 58.0 | 42.0 | |
| MOTSU* | 0.0 | 30.0 | 70.0 | Silty Riverine |

Note: Gravel – grain size larger than 5.0 mm
Sand – grain size between 0.07 and .5 mm
Silt and Clay – grain size smaller that 0.07 mm
Source: USACE 1996 except for * which is USACE 1993

range in size with all but one site (Area 15 on Eagles Island) less than 50 acres. Many of the sites have eroding dikes and have been subsequently overgrown by *Phragmies australis* and wetland plant species. Based upon the location of these areas, many of the sites consist of mixed material with higher content of fine-grained sediments. Only two sites (Area 3 and Area 4) are still maintained by the USACE as CDFs. Area 3 (29 ac) has mixed sediment content (Owens, pers. communication) and would likely not be a suitable source candidate for beach quality material. Area 4 (25 ac) consists predominantly of beach-compatible sand. However, sand from this island is dedicated for the federally-authorized Kure Beach project in New Hanover County (NC).

Based upon documentation of existing disposal areas of the Wilmington Harbor project, use of any single CDF as a source of beach-compatible sand is not viable. All but one of these sites consists of mixed sediment content deemed unsuitable for beach placement. The one CDF (Area 4) that contains higher percent sand content is dedicated as a sand source for the federally-authorized Kure Beach project. Given the quantity of sand required for nourishment on Bald Head Island, the State technical standards the material must meet, and issues associated with constructability, CDFs are not considered a practicable sand source alternative.

### 5.7.4 Alternate Borrow Areas of Nearshore Coastal Zone

Ebb tidal shoals near the mouth of the Cape Fear River include Bald Head Shoal, Jay Bird Shoals, and Middle Ground. These depositional features generally exhibit high sand content in sufficient quantities to provide the necessary amount of nourishment to offset sand losses on West Beach and South Beach. However, these shoals play an important role in the dissipation of storm wave energy affecting the beaches along Oak Island and Bald Head Island. In addition, the shoals provide intertidal and subtidal habitat supporting estuarine and marine fauna. Dredging from Bald Head Shoal is considered potentially detrimental considering ongoing changes at the nearshore location due to the navigation channel reorientation, as wells as the proximity and beneficial sheltering effects of this depositional feature to the currently eroding Bald Head Island beaches. In a similar fashion, major nearshore modifications to Middle Ground could affect littoral processes at Oak Island. Middle Ground is the most practicable sand source for cost-effective future beach restoration on Oak Island even though it is not considered a high probability sediment source for work at Bald Head Island. Removal of material from these two areas to facilitate Bald Head Island would provide temporary benefits at best with the likelihood of reducing beneficial effects in their lee. Jay Bird Shoals, on the other hand, is located substantially farther from the Oak Island beachfront. A comprehensive geotechnical investigation of this area was conducted to identify the least environmentally damaging, practicable alternative for dredging (refer to Appendix A for Sand Search Report). Based upon baseline evaluations of this shoal, a specific area near the distal end of the shoal platform has been identified to provide the quantity and quality of sand necessary to achieve project objectives while concurrently mitigating potentially adverse effects to environmental and cultural resources.

# 6.0 EXISTING ENVIRONMENTAL CHARACTERISTICS

## 6.1 Topography

The proposed borrow area consists of subtidal bottom habitat. According to a bathymetric survey conducted by Geodynamics, Inc., existing depths range between -5 ft and -16 ft NGVD within the proposed borrow site. North of this location, Jay Bird Shoals tends to become much more shallow, with some portions of the shoal platform exposed at low tide. Sediment cores collected throughout the shoal environs indicated relatively high percent sand content (see Appendix A).

The placement of borrow sediments will occur primarily along the south facing shoreline (South Beach) of Bald Head Island. This area commonly receives beach quality fill material as a result of the maintenance of the federal navigation project (refer to Table 1 for a list of recent beach disposal activities). Furthermore, the current SMP identifies the schedule for future beach disposal events associated with bi-annual channel maintenance. Current elevations of the beachfront and nearshore littoral zone affected by the proposed work range between -12 ft to +8 ft NGVD. This area experiences significant and abrupt erosion losses generally following federal channel dredging operations conducted in close proximity to the Point. Long-term changes originate with the overall reorientation of the seven-mile long segment of the ocean entrance channel through the adjacent Bald Head Shoal formation. The subject beach profile has experienced fill placement almost bi-annually since the initiation of the Wilmington Harbor Deepening Project in 2000.

## 6.2 Soils

Soils for the proposed beach placement are identified as Newhan fine sand (refer to Figure 9). This soil unit consists of excessively drained sandy material with medium to coarse-grained sand and shell fragments. The percent organic material and fine-textured sand fraction is relatively low (i.e. < 2%).

The proposed borrow site sediments are characterized as SP sands under the Unified Soil Classification System and defined as poorly graded sands-gravelly sands with little to no fine sand components. Thirty-one Vibracore samples were collected within the proposed Jaybird Shoals borrow area to identify sediment compatibility relative to the native beach fill placement sites. Borrow site Vibracores were taken to an average depth of -30 ft. (NGVD29). SP sands were found to an average depth of -25 ft. where a thin clay layer was found to exist. Composites of the Vibracores (to the design depth excavation) were then compared to composite sediment samples taken from 5 cross-shore transects along Bald Head Island beaches (i.e. 3

transects from East Beach and 2 transects from South Beach). Due to the disturbed nature of South and West Beaches resulting from previous fill projects, profiles were taken on South Beach eastward of areas being affected by ongoing beach disposal activities in 2007. The three samples on East Beach were requested by the State (for future scientific purposes) even though it is not a recipient beach for this project. The attached Sand Search Investigation (Olsen Associates, Inc. 2007) (Appendix A) provides more specific information related to the existing sediment composition of the borrow area.

The State of North Carolina has established grain size standards for beach fill projects. For the purpose of these standards, four grain size categories are defined by the State as the following:

Gravel – sediment grain sizes greater than 4.76mm and less than 76mm
Granular – sediment grain sizes 2mm and greater and less than 4.76mm
Sand - sediment grain sizes .0625mm and greater and less than 2mm, and
Fines – sediment grain sizes less than .0625mm (i.e. passing a no. 230 sieve).

Specific criteria related to the revised sediment criteria rules are identified in 15A NCAC 07H .0312. The project engineer (Olsen Associates, Inc.) has coordinated with NC DCM prior to, and throughout the course of, the sand search investigation for the project to ensure that the evaluation was consistent with the recently adopted sampling protocol. Data were forwarded to the State for review and concurrence. Through this coordinated effort, the State has provided a preliminary indication that the applicant has met the requirements of the testing and sampling protocol and that the resultant data appear to meet the new State standards.

### 6.3 Land Use

The Village of Bald Head Island is an incorporated municipality. The island is accessible to the public by means of a passenger ferry which operates between Southport, NC and Bald Head Island Marina. Though remaining under the general planning authority of the Brunswick County Land Use Plan, the Village has adopted its own policies regarding planning and resource management. Bald Head Island policies have been incorporated into the Brunswick County Land Use Plan. These policies promote natural resource protection and management and guide responsible development. The Village supports state and federal laws designed to manage development in Ocean Hazard Areas of Environmental Concern and Estuarine Shoreline Areas of Environmental Concern (AEC's).

The proposed beach restoration project area is located within an AEC, and is therefore considered to be within the conservation land class. According to the Brunswick County Land Use Plan:

> *The purpose of the Conservation class is to provide for the effective long-term management and protection of significant, limited, or irreplaceable areas. Management is needed due to the natural, cultural, recreational, scenic or natural productive values of both local and more than local concern. As such, the Conservation class should be applied to areas that should be either not developed at all (preserved), or if developed, done so in a very limited manner characterized by careful planning and cautious attention to the conservation of environmental features.*

### 6.4 Wetlands

There are no jurisdictional wetlands (as regulated under Section 404 of the Clean Water Act or the North Carolina Coastal Area Management Act) within the project area. Rather expansive tidal marsh habitat is located along interior tidal creeks of Bald Head Island. This tidal marsh complex is characteristic of estuarine environments of the southeastern coastal plain. Smooth cordgrass (*Spartina alterniflora*) dominates the upper half of the intertidal zone. High coastal marsh exhibits a more diverse vegetative assemblage that includes such species as salt meadow cordgrass (*S. patens*), giant cordgrass (*S. cynosuroides*), black needlerush (*Juncus romerianus*), and sea oxeye (*Borrichia frutescens*). Coastal marshes have been demonstrated to provide valuable refuge and feeding habitat for resident and migratory fauna and are critical for detrital export that sustains higher trophic levels of the estuarine ecosystem. All wetlands are located well outside the vicinity of the proposed project area.

### 6.5 Prime or Unique Agricultural Lands

No agricultural land exists within the boundaries of the project area.

### 6.6 Public Lands and Scenic, Recreational, and State Natural Areas

According to NC Administrative Code 15A NCAC 07H .0207, public trust areas include all waters of the "Atlantic Ocean and the lands thereunder from the mean high water (MHW) mark to the seaward limit of state jurisdiction" (approx. 3 miles offshore). The position of the MHW boundary is continually altered by physical processes influencing the deposition and/or loss of material in the nearshore zone. The proposed dredge operations will occur in submerged public lands. A portion of the beach fill placement in the littoral zone will also be located below MHW tapering to a depth of -12 ft NGVD.

In addition, the state's position regarding beach ownership is that although state ownership ends at the mean high water line, the public has always enjoyed the right to use the dry sand beach sand located above the normal high water line until the growth of vegetation or dune line occurs.

### 6.7 Areas of Archaeological or Historical Value

The Cape Fear River is recognized as one the most significant and historically important waterways of the Carolinas. The attached cultural resources report (Appendix D) provides a brief history of the Cape Fear River from the earliest Spanish explorers in 1526 through the present. The Lower Cape Fear in particular has served as a commercially important navigational artery for over three hundred years. Numerous shipwrecks are known and identified within this section of the river.

Due to the well-documented maritime history, the Village contracted with Tidewater Atlantic Research, Inc. to perform an archaeological survey and assessment of the Jay Bird Shoals borrow area. The contractor conducted a magnetometer and side-scan survey of the proposed borrow area in March 2007. Analysis of this data indicated a total of 49 magnetic anomalies. None of these anomalies had an associated acoustic signature. All but seven of these targets appear to have been generated by modern debris such as fish and crab traps, pipes, cable, chain, small boat anchors, etc. The remaining seven targets were investigated via diver reconnaissance. Five of these anomalies were associated with modern debris as well. The remaining two anomalies could not be located or identified by probing depths of up to 15 ft below the bottom surface. The signatures of these anomalies however are consistent with potential shipwreck material, and therefore, will be avoided. Please refer to the enclosed report detailing the findings of this archaeological assessment (Appendix D). This work has been coordinated through, and reviewed by, SHPO.

### 6.8 Air Quality

The Wilmington Regional Office of the NCDENR has jurisdiction over the air quality in this location. It has been determined that the ambient air quality for Bald Head Island is in compliance with the National Ambient Air Quality Standards.

### 6.9 Noise Levels

Ambient noise levels within and adjacent to the project area are relatively low. No industrial properties are located near the project site. Some commercial properties are located adjacent to the Bald Head Island Marina. Short-term elevations in noise levels may be attributed to ferry and boat traffic near the marina basin

and residential construction activity. In general, the predominant low-impact land use of the island equates to low ambient noise levels.

## 6.10 Water Resources (Surface Water and Groundwater)

### 6.10.1 Surface Water

According to the NC Division of Water Quality's (DWQ) classification of waterbodies, the lower section of the river, from Federal Point to the Atlantic Ocean, is designated as Class "SA". The waters of the Atlantic Ocean in the vicinity of the mouth of the Cape Fear Rive are designated "SB". "SB" waters are suitable for primary recreational uses as well as all uses identified for "SC" waters (e.g. fishing, fish and wildlife propagation, and secondary recreation). "SA" waters are suitable for marketable shellfishing and all uses identified under the "SC" and "SB" classes (15 NC AC 2B .0311).

Water flow is principally directed by semidiurnal tides in the area, with the mean tidal range of approximately 4.9 ft near the mouth of the river. Physiochemical parameters (including salinity and dissolved oxygen) are affected by freshwater river flow, tides, and wind forces. The salinity of waters in the proposed project area are generally near 35 ppt, but may be lower during ebb tide conditions and associated freshwater outflow. The average flow rater of the Cape Fear River at its mouth is 9,700 cubic feet per second (USACE 2000).

### 6.10.2 Groundwater

Groundwater of the area is generally supplied from the shallow semi-confined water table aquifer and the deeper Castle Hayne limestone aquifer. Recently potable water supplied to Bald Head Island has been through a series of 16 ground water supply wells scattered across the inland portion of the island. The water supply wells are situated at an average depth of 55 feet below the ground surface in the shallow semi-confined aquifer. The well water is treated with a reverse osmosis filter. Peak water usage averages 270,000 gallons per day in July and August. The minimum water usage occurs in February, which averages 68,000 gallons per day. The Village of Bald Head Island recently constructed a ten inch (10") water main from mainland Brunswick County to Bald Head Island (the subaqueous portion having an eight inch (8") diameter). County water is now mixed with well water to provide water to the Island. The well system has become the secondary source of water while the newly constructed water main will provide primary water resources.

## 6.11 Forest Resources

The project site consists of open water habitat (subtidal), beachfront, and littoral zones. There are no forested areas within the project boundaries.

## 6.12 Shellfish or Fish and Their Habitats

### 6.12.1 Benthos

Benthic organisms are an important link between primary production and consumers in estuarine ecosystems. Several factors influence the composition, abundance and diversity of the benthic assemblage in an area. Sediment type and percent organic matter, tidal dynamics, and physiochemical parameters of the overlying water column (e.g. nutrient composition and dissolved oxygen levels) all contribute to the abundance and distribution of benthic organisms in near-shore environments (Posey et al. 1996).

*Soft Bottom - Ebb Tidal Shoals:* Benthic organisms tend to be more abundant within small tidal creeks and coastal marsh areas away from the more rapid tidal currents near mouths of creeks and rivers. High water velocities and shifting sand shoals within higher energy areas (e.g. ebb tide deltas of creek and river mouths) present a largely prohibitive environment for most bottom-dwellers (Posey et al. 1996). Representative infauna include polychaete worms (e.g. *Nereis* species), nematodes, amphipods, and isopods. Common epibenthic fauna include blue crabs (*Callinectides sapidus*) and echinoderms (sand dollars). Given that these soft bottom areas are regularly affected by shifting sands, the dominant taxa are opportunistic in nature and thus are adapted to relatively rapid colonization and recovery (Posey and Alphin 2001).

According to Peterson and Peterson (1979), the most numerous meiofaunal taxon occurring on intertidal flats of North Carolina are the nematodes. Other meiofaunal taxa of these systems may include harpacticoid copepods, gastrotrichs, and turbellarians (Peterson and Peterson, 1979). Benthic sampling conducted by Lawler, Matusky, & Skelly Engineers (1975) at six stations south the Military Ocean Terminal at Sunny Point (MOTSU) indicated that polychaetes were the most dominant benthic faunal group in the lower Cape Fear River. Other investigations by Birkhead et al. (1979) also indicated the abundance of polychaete worms in samples collected from the nearshore ocean at the mouth of the Cape Fear River. Representative polychaete worms included *Spiophanes bombyx, Magelona* sp., *Heteromastus filiformis*, and *Paraprionospio pinnata*. Additional taxa identified included the sea pansy (*Renilla reniformis*), the sand dollar (*Mellita quinquiesperforata*) and brittlestar (amphiurid). Relatively small, opportunistic species of polychaetes and amphipods tend to be the numerically dominant benthic macrofauna of intertidal and subtidal flats. Species

abundances and diversity tend to decrease within higher intertidal areas and within areas of increased physical energy (e.g. on rapidly accreting shoals).

Blue crabs are commonly found in all sounds and estuaries of North Carolina. However, during winter blue crabs tend to migrate to deeper waters to ameliorate the effects of cold temperatures in shallow intertidal and subtidal areas. According to Peterson and Peterson (1979), blue crabs are rarely present along intertidal flats from mid December to mid March (i.e. during the proposed dredging activity). Other common intertidal epifauna, such as the American oyster (*Crassostrea virginica*) do not occur within or immediately adjacent to the dredge area.

Benthic sampling was conducted in August and September of 2007 on Jay Bird Shoals, Middle Ground, and Bald Head Shoals. A total of 120 samples were collected via the use of a 'petite' ponar grab. Samples have been sorted and identified by the University of North Carolina at Wilmington Benthic Ecology Lab. UNC-Wilmington is currently in the process of conducting statistical analyses and a report of findings for this sampling effort.

*Beachfront:* Ocean beachfront environments are typically characterized by high wave energy and relatively low primary productivity (Steele, 1968). The foreshore and nearshore zones of Bald Head Island consist of exposed bars and spits with sandy subtidal and intertidal substrates. As documented for similar barrier island complexes, percent organic matter of beachfront sediments is low relative to the sediments of protected, back-barrier sandflats. In addition, relative species diversity and abundance tends to be less than backwater habitats (Hackney, et. el., 1996). Benthic species along the ocean beachfront are adapted to coarser-grained substrates and high-energy environments. Representative fauna include mole crabs, coquina clams, polychaete worms, ghost crabs and amphipods. According to Posey, et al. (1996), mole crabs and coquinas represent the largest component of the total macrofaunal biomass of North Carolina intertidal beaches. Van Dolah and Knott (1984) reported coquina clams and polychaetes as the most abundant benthic organisms of the foreshore and nearshore, respectively, in Myrtle Beach, South Carolina. Collectively, the benthic assemblage represents an important food source for many shore birds and important recreational fish species such as flounders, pompanos, mullets, and kingfish. While meiofaunal assemblages are rather diverse, the larger macrofaunal community in the swash zone is generally characterized by low density and abundance due to dynamic and active wave conditions (Posey et al. 1996).

### 6.12.1 Nekton

The estuarine system of the Cape Fear River provides a multi-use habitat for migratory and resident nekton species. Depending on individual tolerances to environmental conditions, different zones of this system (i.e. coastal marsh, tidal flats, channels) are inhabited by faunal species at various life stages (Weinstein 1979). The river itself is a corridor for species migrating to and from spawning, nursery, and feeding areas.

Some of the more common fish species known to inhabit the waters of the mouth of the Cape Fear River (including subtidal soft bottom of the ebb tide delta) include red drum (*Sciaenops ocellatus*), bluefish (*Pomatomus saltatrix*), and summer flounder (*Paralichthys dentatus*). Other estuarine-dependent species including croakers (Family Sciaenidae), spot (*Leiostomus xanthurus*), Atlantic menhaden (*Brevoortia tyrannus*) and striped mullet (*Mugil cephalus*) that serve as prey for fisheries managed species (e.g. snappers, groupers, tuna, and sharks) are common in these waters. Blue crab (*Callinectes sapidus*), brown shrimp (*Penaeus aztecus*), pink shrimp (*Farfantepeneaus duorarum*), and white shrimp (*Farfantepeneaus setiferus*) are common crustacean species that utilize the intertidal and open water habitat within and adjacent to the project area. Appendix F (Essential Fish Habitat Report) provides more detailed information regarding habitat of commercially important fisheries. A comprehensive list of species identified during sampling of the shoal platforms in September and October 2007 are included in Table 4.

*Primary Nursery Areas:* There are no designated Primary Nursery Areas (PNAs) for the mouth of the Cape Fear River and near-shore shoals. The dynamic nature of the ebb tidal platform at the mouth of the river does not provide favorable nursery habitat for nekton species. PNA has been designated for interior creeks of Smith Island and within the river estuary north of Federal Point. These areas are generally characterized by shallow intertidal and subtidal waters underlain by fine-textured bottom sediments with relatively high percent organic matter (Weinstein 1979). The project area and its vicinity do not provide for such conditions.

*Hard Bottoms:* Hard bottom habitat in the South Atlantic Bight generally consists of exposed rock or consolidated sediments in near-shore or off-shore marine waters. Exposed hard bottom provides the substrate surface area for colonization by invertebrates and algae. In turn, these areas serve as an important food source to a variety of invertebrate and fish species. Community structure varies widely with depth, location, and season.

Table 4. Species List (September 5th and November 12th 2007 Sampling)[1]

| Common Name | Scientific Name | Number |
|---|---|---|
| Jay Bird Shoal | | |
| Pinfish | *Lagodon rhomboides* | 4 |
| Black drum | *Pogonias cromis* | 1 |
| Southern kingfish | *Menticirrhus americanus* | 2 |
| Bay anchovy | *Anchoa mitchilli* | 17 |
| Southern flounder | *Paralichthys lethostigma* | 1 |
| Spotfin mojarra | *Eucinostomus argenteus* | 1 |
| Inshore lizardfish | *Synodus foetens* | 1 |
| Middle Ground | | |
| Inshore lizardfish | *Synodus foetens* | 2 |
| Pinfish | *Lagodon rhomboides* | 1 |
| Spotfin mojarra | *Eucinostomus argenteus* | 1 |
| Bald Head Shoal | | |
| Spotfin mojarra | *Eucinostomus argenteus* | 1 |
| Bay anchovy | *Anchoa mitchilli* | 2 |
| Spot | *Leiostomus xanthurus* | 1 |

These habitats are characterized by a rich diversity of invertebrates (e.g. sponges, corals, anemones, tunicates, and mollusks) and reef fish (NC DENR 2005) and are thus commonly referred to as "live bottoms". The majority of hard bottom sites occur greater than three nautical miles from the shore (SEAMAP-SA 2001). Other hard bottom sites may be subject to covering by storm-induced shifting sands and therefore may not be readily identified. According to the North Carolina Coastal Habitat Protection Plan (CHPP), northern Long Bay consists of a number of hard bottom sites occurring generally greater than one mile from shore.

There are no known hard bottoms occurring in the vicinity of the proposed borrow area to be dredged. An evaluation of Jay Bird Shoals and its immediate vicinity did not indicate the presence of hard bottoms. In addition, ocean-bottom surveys conducted by the USACE in the vicinity of the new channel alignment for the

[1] Trawl sampling conducted at ten stations on September 5 and November 12 (2007) using 12-ft and 30-ft otter trawls, respectively.

Wilmington Harbor Navigation Project did not indicate the presence of hard bottoms within or near its path (USACE 2000). Hard bottoms have, however, been identified near the seaward limit of the former federal navigation channel (approximately five miles offshore). The presence of this hard bottom during the design of the last Harbor deepening project ultimately prompted the re-orientation of the channel alignment to avoid dredging impacts to this type of biological community. Other hard bottom points have been identified greater than three miles west of Jay Bird Shoals (NC DENR 2005).

*Surf-Zone*: Distribution and abundance of surf zone fishes may vary widely by season and year. The surf zone provides foraging habitat for many resident and seasonal migrant fish species, including summer flounder, bluefish, bay anchovy, rough silverside, Spanish mackerel, and spiny dogfish. Other species (e.g. Florida pompano, Gulf kingfish, and white mullet) utilize this area as nursery habitat during juvenile development. Offshore spawning produces young that migrate into the surf zone for protection and feeding. The surf zone also provides temporal habitat for estuarine-dependent species migrating to and from tidal creeks.

### 6.12.2 Submerged Aquatic Vegetation

Based upon site visits and recorded observations in this region, no submerged aquatic vegetation (SAV) beds exist within or adjacent to the project area. *Zostera marina* (eelgrass), *Halodule wrightii* (shoalgrass), and *Ruppia maritima* (widgen grass), three dominant coastal SAV species, appear to occur only north of the New Hanover/Pender County line.

## 6.13 Wildlife and Natural Vegetation

The presence of any plant or animal species is determined by the availability and abundance of suitable habitat. The project area contains open water habitat (subtidal), beachfront, and littoral zones.

Vegetation within the open water habitat type is minimal. No submerged aquatic vegetation (SAV) beds exist within or adjacent to the project area. This section of Cape Fear River and the Atlantic Ocean provides habitat for a variety of marine animals including whales, dolphins, the West Indian manatee, sea turtles, and fish (see Section 6.12).

Common vegetation of the upper beach includes beach spurge (*Euphorbia polygonifolia*), sea rocket (*Cakile edentula*) and pennywort (*Hydrocotyle bonariensis*). The dunes are more heavily vegetated, and common species include American beach grass (*Ammophila breviligulata*), panic grass (*Panicum amarum*), sea oats (*Uniola paniculata*), broom straw (*Andropogon virginicus*), and salt meadow hay (*Spartina patens*). A variety of shorebirds and waterbirds utilize the beachfront of Bald Head Island. Least terns, American oystercatchers, and Wilson's plovers have been observed nesting within the project area (S. Cameron, WRC). In addition, the shoreline is used by migrating and foraging shorebirds such as sanderlings and willets. The NC Natural Heritage Program has designated the project area as the Bald Head Island Natural Heritage Priority Site because of the existence of several rare plant species, animal species, and/or community types within that particular area. Furthermore, the southwestern point of the beach has been identified as a colonial waterbird nesting site by the NC Natural Heritage Program. It is known to provide nesting habitat for gulls, least terns, and skimmers.

Table 5 contains a list of plants and animals that are Federally-listed, Candidate Species, and Federal Species of Concern which could be present in the area of the proposed project. Listed species that could potentially be located within the project area during the proposed action are the humpback whale, right whale, West Indian manatee, piping plover, green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, shortnose sturgeon, and seabeach amaranth. A biological assessment is being prepared and coordinated with the USFWS and the NMFS, pursuant to Section 7 of the Endangered Species Act of 1973, as amended.

Table 5. Species List and Presence near Project Area

| Common Name | Scientific Name | Status | Habitat present? | Known observation* |
|---|---|---|---|---|
| Mammals | | | | |
| Eastern cougar | *Puma concolor couguar* | E | no | no |
| Finback whale | *Balaenoptera physalus* | E | no | no |
| Humpback whale | *Megaptera novaeangliae* | E | yes | yes** |
| Right whale | *Eubalaena glacialis* | E | yes | yes** |
| Sei whale | *Balaenoptera borealis* | E | no | no |
| Sperm whale | *Physeter catodon* | E | no | no |
| West Indian manatee | *Trichechus manatus* | E | yes | no |
| Birds | | | | |
| Bald eagle | *Halieaetus leucocephalus* | *** | no | no |
| Piping plover | *Charadrius melodus* | T | yes | yes |
| Red-cockaded woodpecker | *Picoides borealis* | E | no | no |
| Wood stork | *Mycteria americana* | E | no | no |
| Reptiles | | | | |
| American alligator | *Alligator mississippiensis* | T(S/A) | no | no |
| Green sea turtle | *Chelonia mydas* | T | yes | yes |
| Hawksbill sea turtle | *Eretmochelys imbricata* | E | yes | yes** |
| Kemp's ridley sea turtle | *Lepidochelys kempii* | E | yes | yes** |
| Leatherback sea turtle | *Dermochelys coriacea* | E | yes | yes** |
| Loggerhead sea turtle | *Caretta caretta* | T | yes | yes |
| Fish | | | | |
| Shortnose sturgeon | *Acipenser brevirostrum* | E | yes | no |
| Plants | | | | |
| Cooley's meadowrue | *Thalictrum cooleyi* | E | no | no |
| Rough-leaf loosestrife | *Lysimachia asperulaefolia* | E | no | no |
| Seabeach amaranth | *Amaranthus pumilus* | T | yes | yes |

KEY:

E A taxon "in danger of extinction throughout all or a significant portion of its range."

T A taxon "likely to become endangered within the foreseeable future throughout all or a significant portion of its range."

T(S/A) Threatened due to similarity of appearance - a species that is threatened due to similarity of appearance with other rare species and is listed for its protection. These species are not biologically endangered or threatened and are not subject to Section 7 consultation.

* According to NC Natural Heritage Program, NC Wildlife Resource Commission, Bald Head Island Conservancy data, and observations of LMG staff.

** Species known to migrate along the coast of NC (Wynne, 1999).

*** Species protected by the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act.

# 7.0 PREDICTED ENVIRONMENTAL EFFECTS

## 7.1 Topography

Project activities will have an immediate effect on the bathymetry within the proposed dredge area as well as the proposed beach fill area. Post-dredging bottom contours will range from –20 ft to -22 ft NGVD. As a result, approximately 158 ac of subtidal shoal will be converted to deeper bottom habitat. The proposed dredging and placement of material on the down-drift shoreline of Bald Head Island represents a form of sand by-passing deemed beneficial in light of the interruption of littoral transport by the presence and continued maintenance of the federal navigation channel.

Removal of sediment from open water shoals can potentially alter local wave heights and propagation via wave refraction and wave diffraction effects. While the alteration of wave climate in the immediate vicinity of a borrow site is not in itself particularly problematic, the potential 'shadow' effect of the alteration can under certain conditions extend shoreward, thereby altering the littoral transport regime at the shoreline.

To assess the potential for impact of the proposed excavated borrow area on the local wave climate, the STWAVE refraction/diffraction model was applied to the bathymetry offshore of Bald Head Island, Oak Island, and the Cape Fear River Entrance both with and without the excavated borrow site. Changes in the wave climate due to the proposed site were then computed by comparing the differences between the simulations. The STWAVE model (Smith and Resio, 2001) is a numerical, finite-difference model intended to describe the steady-state wind-growth and propagation of water waves in the nearshore environment.

Forty-seven (47) wave cases were simulated for both pre- and post-dredge conditions. Comparison of the pre- and post-dredge wave transformation patterns for the 47 wave cases reveals only minor changes in wave height and direction at the shoreline for average annual wave conditions. Along the Oak Island and Bald Head Island shorelines, the maximum wave increases were 0.2 ft (0.06 m) and 0.3 ft (0.09 m), respectively. As a result, no significant changes in average annual wave conditions were predicted. Based upon the results of this analysis, together with findings of similarly designed projects, it is not expected that the excavation of the project borrow site will have any significant impact on the Oak Island and Bald Head Island shorelines. An analysis of the potential effect of the proposed borrow site to the local wave climate is provided in detail in Appendix E).

Dredged material will be transported via hydraulic pumping to South Beach for permanent disposal within an authorized beach fill footprint. The South Beach fill berm will maintain an average elevation of +8 ft NGVD which is consistent with prior beach disposal berms constructed by the Wilmington District USACE. The berm profile will slope gradually (approximate 20:1 slope) waterward, tapering to -12 ft NGVD. The average fill density is anticipated to be 100 cy/ft, mol.

Placement of sand on West Beach will be subject to conditions of that shoreline immediately prior to project bid. The placement berm is expected to reach an elevation of +8.5 ft NGVD and taper to -12 ft NGVD. Due to overly deep nearshore beach profile slopes, a maximum fill placement density of 30 ft/cy is anticipated at that location.

Post-construction profiles are to be relatively consistent with previous federal beach disposal projects on Bald Head Island. Hence, post-construction equilibration processes will be similar to those observed by monitoring over the last six (6) or more years. The initially filled profile will extend seaward but is not anticipated to have any significant effect on wave energy. Upland topography will be affected in providing for a wider, more stable beachfront. Biological impacts associated with such activity are discussed in Sections 7.12 and 7.13 of this document.

## 7.2 Soils

As stated in Section 6.2 of this document, the area of Jay Bird Shoals targeted for borrow material has been investigated for sediment texture and compatibility. Based upon sediment core data collected during the summer of 2007, it is apparent that the proposed borrow area consists predominantly of sand (i.e. >90% sand). This material is compatible with soils of the adjacent beachfront and therefore is considered suitable for beach nourishment. It is not anticipated that the composition and texture of the existing beachfront (both South Beach and West Beach) will not be significantly altered by the disposal of dredged material. An on-site inspector will monitor the type and quality of material being deposited on the beachfront during disposal. Additional monitoring subsequent to beach placement will document sediment color (via Munsell chart) to ensure sand that is light colored and color-compatible with existing beach substrate.

Upon completion of nourishment activities, beach compaction will be monitored. Beach compaction (i.e. hardness or compaction) is a term used to characterize the resistance of the beach substrate to probing, digging or penetration. This condition is considered particularly important to the success of nesting sea turtles

since it directly affects nest excavation and incubation environment. The nourished beach will not automatically be subject to annual tilling after construction. Sand compaction monitoring will be initiated concurrent with nourishment completion and will continue on an annual basis for three years. Monitoring results will identify the need and required locations for tilling. Tilling operation, if needed, will be coordinated with appropriate resource agencies prior to the initiation of each tilling event. In addition, beach foreshore escarpments will be identified and re-graded before May 1 of each year (ahead of the sea turtle nesting period).

### 7.3 Land Use

The proposed project complies with all land classifications and will not require any zoning or land use changes. The proposed project will meet both local and state long term planning objectives established for the site. In addition, a conservation easement will prohibit the potential for additional development within the beach disposal area. Therefore, the project will not adversely impact land use.

### 7.4 Wetlands

Since there are no jurisdictional wetlands that exist within, or adjacent to, the project boundaries, no impacts (direct or otherwise) to wetlands will occur.

### 7.5 Prime or Unique Agricultural Lands

Since no agricultural lands exist within the project boundaries, no impacts will occur.

### 7.6 Public Lands and Scenic, Recreational and State Natural Areas

Subtidal public lands will be dredged and converted to deeper bottom habitat. However, this activity is not anticipated to measurably affect public lands.

As previously mentioned, the State's position regarding beach ownership is that the public has always enjoyed the right to use the dry sand beach located above the normal high water line until the growth of vegetation or dune line occurs. In addition to protecting critical road and utility infrastructure and residential housing in the vicinity of the beach fill template, the primary purpose of the project is to protect and restore valuable beach recreational area. The project area, located at the confluence of the Cape Fear River and Atlantic Ocean, is public and provides unique and important public beach resources and access, as do all of Bald Head Island's beaches. There is good, regular public ferry service to Bald Head Island operated by Bald

Head Island Transportation, Inc. Additionally, the Village has constructed and maintained numerous beach accesses, including approximately nine (9) in the vicinity of the beach fill project. The fact that Bald Head Island is an island makes it a very attractive destination. There are two bed and breakfasts and hundreds of rental homes, timeshares and fractional ownership dwellings. Bald Head Island indeed serves the public, including residents of North Carolina and many other States and Countries, with its pristine beach being among its principal draws. As testament to its public usage and appeal, there are only approximately 220 full time residents but are approximately 5,000 or more visitors on a summer weekend day.

Further, the dire consequences of failing to perform the proposed private sand placement must be considered in evaluating the project. The dramatic erosion presently experienced is greatly harming the public's use and enjoyment of the beach and threatens numerous homes and key roads (S. Bald Head Wynd, which washed out in 2004) and utility infrastructure. Many people walk, fish, sunbathe, bird watch, ship watch and otherwise recreate on the beach daily. At its greatest erosion in late 2004, vast sections of the beach (and adjacent homes) were underwater, impassible and unusable. Without private placement, damage equal to or exceeding that in 2004 may be expected to occur, as Bald Head Island is not expected to receive beach nourishment until 2010, at the earliest and subject to Federal funds availability.

## 7.7 Areas of Archaeological or Historical Value

Two groupings of magnetic anomalies exhibiting characteristics consistent with shipwreck material have been identified within the proposed borrow area. Other magnetic anomalies within Jay Bird Shoals have been confirmed to be modern equipment (i.e. fish/crab traps, pipes, cable, and/or small anchors). The two targets of potential cultural significance will be avoided by the dredging contractor. A 200-ft buffer area will be maintained in an effort to keep these targets intact. There are no other known archaeological or historical resources located within or immediately adjacent to the project area. Based upon (1) the archaeological assessment performed; (2) the subsequent identification of two groupings of magnetic anomalies; and (3) proposed mitigative measures to avoid these areas; it is anticipated that there will not be any adverse impact to areas of archeological or historical value. All work to date has been conducted in close coordination with the SHPO.

## 7.8 Air Quality

Any air quality impacts from the operation of construction equipment will be short-term and minor. Elevation of airborne pollutants should be insignificant and would represent the level of a small on-going construction site elsewhere.

## 7.9 Noise Levels

The proposed project is not anticipated to elevate noise levels above general ambient conditions. The dredging and filling operations will result in some increased noise, but should not exceed noise levels of a small construction project or passing ferry.

## 7.10 Water Resources (Surface Water and Groundwater)

### 7.10.1 Surface Water

Dredging and disposal activities will result in short-term elevations in turbidity and suspended sediment concentrations within the immediate project area. Elevations in turbidity are expected to rapidly diminish through mixing and dilution processes (USACE 2001). Refer to Section 7.12 and Appendix F (Essential Fish Habitat) for more detailed information regarding potential effects of increased turbidity. Since the dredged material consists predominantly of sand material (i.e. less than 2% fines), turbidity levels should remain low (i.e. less than 25 NTUs). Any impacts to the water column due to turbidity are thus predicted to be temporally and spatially insignificant.

### 7.10.2 Groundwater

The specified dredging depth will be to a maximum of –22' NGVD. Dredging will not interject saline waters into shallow coastal aquifers. The dredging project will not affect the fresh groundwater lens beneath Bald Head Island. Therefore, project activities will not affect groundwater resources or water supplies of nearby communities.

## 7.11 Forest Resources

No forested habitat exists within the project boundaries. The project will not affect any forest resources.

## 7.12 Shellfish or Fish and Their Habitats

Project activities will affect three principal habitat categories utilized by fish and shellfish species: (1) unvegetated intertidal sand (associated nourishment of the beachfront); (2) subtidal soft bottom; and (3) water

column. Resident and migratory fish and shellfish may be directly or indirectly affected via habitat conversion, dredge entrainment, localized elevation of turbidity levels, and/or direct burial associated with beachfront fill placement. Each of these potential impacts is discussed in greater detail in Appendix F – Essential Fish Habitat Report. The following environmental effects analysis evaluates potential impacts based upon a one-time excavation and beach sand placement event. Incremental impacts associated with other past, present, reasonably foreseeable future actions are evaluated in Appendix H (Cumulative Impacts).

7.12.1 Benthos

*Borrow Area:* The area of the proposed excavation consists predominantly of subtidal bottom habitat ranging in depth from -5 ft to -16 ft NGVD. As stated earlier, the proposed borrow site footprint occurs within a dynamic and depositional, geologically modern shoal formation located westward of the former Wilmington Harbor entrance channel alignment. Shallow subtidal areas near creek and river mouths tend to be rigorous environments for estuarine/marine organisms with physical stressors affecting benthic populations (Peterson and Peterson, 1979). The faunal community is a function of the substrate and energy regime of the area and varies naturally through time in response to physical changes of the shoal (Hobbs 2002). Given that these soft bottom areas are regularly affected by shifting sands, the dominant taxa are opportunistic in nature and thus are adapted to relatively rapid colonization and recovery (Posey and Alphin 2001).

Jay Bird Shoals consists of expansive intertidal and subtidal sand bottom habitat comprising over 440 acres. Of the entire shoal platform, approximately 158 acres (equivalent to approximately 36% of the shoal area) will be affected by the proposed borrow site footprint. The area to be dredged consists entirely of subtidal sand bottom located near the distal end of the shoal platform. The ebb shoal complex of the Cape Fear River entrance also includes Bald Head Shoals and Middle Ground. Middle Ground consists of approximately 540 acres of shallow subtidal and intertidal habitat. There are an additional 250 acres of intertidal and subtidal shoal habitat associated with Bald Head Shoals. More expansive flood tide shoals occur within the river west of Smith Island. Cumulatively, there are approximately 2,000 acres of intertidal and shallow subtidal habitat associated with the tidal delta. Of this total acreage, approximately 8% will be affected by the proposed excavation. Expansive, undisturbed shoal habitat (as part of Frying Pan Shoals) also exists east of the project area. Frying Pan Shoals extend southeastward from Cape Fear approximately 20 miles into the Atlantic Ocean.

Benthic infauna (e.g. polychaete worms, amphipods, and mollusks) will be subject to immediate impact

associated with the dredging of the shoal. Removal of sediments will result in reduced abundance, diversity, and biomass of infaunal and non-motile epibenthic organisms. In certain instances, sand excavation can result in a significant change in underlying sediment structure and composition, thus altering its suitability for larval settlement and recruitment. In high energy, sandy environments (e.g. tidal deltas) the effects of alteration are often minimized. Adverse effects are further mitigated by the presence of similar substrate subsequent to dredging. Sediment core data indicate that post-dredging surficial sediments will consist of coarse-grained sands of similar composition to that of the existing sediment interface (refer to Appendix A - Sand Search Investigation). Jay Bird Shoals is accretional in nature and thus subject to rather rapid infilling and sediment recovery. The area is characterized by moderate to high wave energy with source sediments consisting predominantly of sand and low organic content.

Many studies have indicated relatively rapid recolonization and species recovery of benthos subsequent to dredging operations (Pullen and Navqi 1983; National Research Council 1995; Hackney et al. 1996; Schaffner et al. 1996). Posey and Alphin (2002) concluded that the rapid infilling of a borrow site (resulting from strong water currents and dynamic sand movement) contributed to a relatively quick species recovery. Based upon the results of this study, interannual variability contributed more to the observed differences in species abundance than the sediment removal effects (Posey and Alphin 2002). Saloman *et al.* (1982) concluded that faunal abundance of a dredge site recovered within three months subsequent to dredging. The authors also determined that species diversity and faunal composition had returned to pre-dredge conditions within nine months.

Another study evaluated the effects of sand mining on benthic communities of Thimble Shoal in the lower Chesapeake Bay. The shoal is located 2.5 km offshore of Buckroe Beach near Hampton Roads, Virginia. Due to the beach-quality material identified within the shoal, the City of Hampton designated it as a sand source for restoration of Buckroe Beach. Pre- and post-dredging monitoring results indicated “no significant negative impacts of the mining operation on benthic community health and positive effects on overwintering blue crab populations” (Schaffner et al. 1996). Faunal recolonization was rapid as evidenced by macrobenthic organisms being abundant within the borrow area less than one month after dredging. No significant differences in biomass were observed between the borrow site and the control area. The depth distribution of macrobenthos (an indication of availability to fish and crustacean predators) showed no changes that could be attributed to dredging activity. Although there was an observed shift in species composition, the Benthic Index of Biological Integrity indicated that the borrow site habitat was comparable to

other healthy benthic habitats of lower Chesapeake Bay. The authors noted that an important prey item of spot (*Leiostomus xanthurus*) was more abundant in the borrow area subsequent to dredging. The study concluded that the dredging activity did not have negative impacts on benthic resource value. Conversely, some enhancement was apparent through the provision of habitat for the blue crab (Schaffner et al. 1996).

Repopulation of a disturbed area will vary depending upon the magnitude of the disturbance, the character of the new sediment interface, duration and timing of the dredging, the type of equipment used to extract the sediment, life history characteristics of colonizing species, water quality, and rate of sediment recovery (Pullen and Naqvi 1983; Van Dolah *et al*. 1992). Faunal recovery may take more time if the excavation significantly alters the character of the sediment interface or if poor water quality ensues due to low wave energy and high organic matter. Though species abundances may return to pre-dredging conditions rather quickly, species composition and diversity indices may remained altered for a period of time subsequent to excavation (Jutte and Van Dolah 1999). However, most studies suggest the benthic infaunal populations are restored rather quickly provided that the post-dredging environment is favorable for colonization (i.e. dynamic, accreting sandy shoals with low percent organic content) (Berquist et al. 2008) and that peak periods of larval recruitment are avoided (National Research Council 1995; Hackney et al. 1996). Other studies have indicated that the inclusion of small undisturbed islands or 'refuge patches' within a dredged area serves as a source of recolonization via migration and larval transport. Inclusion of these areas contributes to more rapid infaunal recovery and species composition similar to that of the pre-dredged condition (Hobbs 2002).

High densities and fecundity of infaunal species and the relatively small area of impact proposed, would preclude significant long-term adverse effects on benthos. In addition, the location and physical nature of the proposed borrow area favors sediment recovery and benthic infaunal recruitment. Given its proximity to the deep entrance of the federal channel, the borrow site is less prone to deposition of fine, organic-laden sediments. Changes in sediment character and resultant anoxic/hypoxic conditions are cited as principle causal factors restricting benthic re-population (National Research Council 1995). Additionally, timing of the dredging is important in light of peak recruitment periods and adult activity. Avoiding these peak periods of biological activity (i.e. dredging late fall through winter) will facilitate post-dredging recovery since larval recruitment and adult migration are the primary recolonization mechanisms (Herbich 1992). The proposed dredge footprint leaves substantial undisturbed shoal habitat intact. At the same time, undisturbed exclusion zones in the vicinity of potential historical resources (magnetic anomalies consistent with shipwreck material) and a federal tide gage will serve as sources of colonizing infauna. In light of all of these considerations, it is

anticipated that impacts to benthos associated with sediment excavation are short-term and localized.

*Beachfront:* Beachfront disposal of excavated material will result in the burial of benthic organisms. Studies have indicated that larger, more mobile species burrow through new sand or avoid disturbance through migration. Impacts from burial are most evident among small, relatively immobile species. However, these species tend to have wider areas of dispersal and exhibit relatively high reproductive rates – characteristics favoring rapid recolonization and species recovery (USACE 2001).

In general, beachfront fill placement results in short-term declines in species abundance, biomass, and taxa richness. However, most studies have indicated that assemblages recover within 2 to 7 months of project completion provided that the fill material is beach suitable (i.e. greater than 90% sand) (Hackney et al. 1996, Nelson 1993, USACE 2001). This component of the proposed project is not unlike any other permitted activity conducted through federal beach disposal projects along South Beach at Bald Head Island. Please refer to Table 1 for a list of recent nourishment projects occurring on South Beach.

It should be noted that the beach plan form of the proposed beach fill area fluctuates significantly in elevation and spatial extent. The final fill profile footprint is located in an area susceptible to recent erosion. All of South Beach is a designated beach disposal area for sand placement resulting from entrance channel maintenance dredging by the USACE. In 2001, approximately 1.6 M cy of sand was placed at this location. The location of the beach restoration footprint is intended to mitigate the current and historical erosion problems experienced along this portion of the beachfront. Beach project construction will be conducted during the period of reduced biological activity, and the fill placement footprint will be reduced to limit impacts to benthos. Therefore, long-term impacts to intertidal or nearshore infaunal assemblages are not expected.

### 7.12.2 Nekton

*Borrow Area:* Impacts to nekton may be the result of direct mortality via entrainment or through indirect effects associated with elevation of suspended sediment in the water column and physical changes to subtidal bottom (manifesting in changes in water flow patterns and habitat availability). Many studies have demonstrated that the effects of dredging to free-swimming organisms are minor or non-existent given the mobility of these type of species and the size of the dredge area (relative to the geographic range of a particular species) (Van Dolah *et al.* 1992; Hammer et al. 1993; Hackney *et al.* 1996; Hobbs 2002).

Increasingly more focus has been placed on the cumulative effects of dredging particularly with respect to the aerial extent of habitat affected by multiple projects occurring within a region. Cumulative effects are addressed in Appendix H of this document. The following information pertains to the potential impact from a single dredge event such as that proposed for this project.

Mortality of organisms lacking the ability to escape the suction field of an operating dredge and subsequent entrainment in the flow of water and sediment passing through its pumping equipment is likely. However, previous USACE studies have demonstrated that only an extremely small percentage (a fraction of 1%) of marine and estuarine larvae are subject to entrainment based upon the amount of water that a dredge can pump (USACE 2001). Van Dolah et al. (1992) concluded that the entrainment mortality to post-larval shrimp to be inconsequential given the number of eggs produced per spawn and the abundance of post-larval individuals. Dredge entrainment impacts to bottom-dwelling fish, crabs and free-swimming larval organisms is anticipated to approximate those of other authorized inlet projects. It is generally believed that impacts of a single project are minimal given the wide-ranging area that most fish utilize for foraging. In addition, the dredge areas typically represent a fraction of the large geographic range of transitory fish. It is for these reasons that many studies have concluded that dredge projects have only minimal, if any, adverse effects on resident and migratory fish species (Hammer et al. 1993; Musick 1998; Hobbs 2002).

Pullen and Naqvi (1983) found that motile animals were the least affected by dredging of an offshore shoal. These researchers concluded that fish utilization likely depends upon water quality of the dredge area. Provided the dredge area does not form an anaerobic pit of organic-laden sediment, biological communities may be restored rather quickly. In addition, multiple studies have indicated rapid recovery of benthic populations and fish utilization at locations with high water and sediment dynamics such as tidal channels (Pullen and Naqvi 1983; Van Der Veer *et al.* 1985; Musick 1998; Schaffer *et al.* 1996).

Study of a federal dredging project at Asbury Park/Manasquan Inlet, New Jersey found that fish species assemblages and abundances post-dredging were similar to that of a previous study of the area. In addition, the researches concluded that feeding habits of winter flounder and summer flounder remain unaltered post-dredging (USACE 2001). Van Dolah *et al.* (1994) found that changes in species composition between pre- and post-dredging monitoring were attributed to normal seasonal and yearly variability rather than from the effects of dredging. Van Dolah *et al*. (1992) evaluated effects of dredging on recreationally important fish species based upon changes in the abundance of prey species. Findings of this particular study indicated

that there were no appreciable differences subsequent to dredging. Other studies have actually demonstrated an increase in fish utilization subsequent to dredging. Fish may be attracted to a dredged area due to suspended nutrients and infauna in the water column and as a haven from cold surface water in the winter (Saloman 1974; Courtenay *et al*. 1980; Pullen and Naqvi 1983; Nelson and Collins 1987). Schaffner et al. (1996) concluded that a dredged borrow area in the lower Chesapeake Bay provided more favorable habitat for the blue crab. No changes in the within-sediment depth distributions of macrobenthos (an indication of availability to fish and crustacean predators) were observed subsequent to dredging. The authors concluded that it was "unlikely that the resource value of benthos in trophic support of fisheries was negatively impacted" (Schaffner et al. 1996).

While dredging has been demonstrated to have minimal effects in most instances, it is important to consider habitat type relative to life stages of the organism potentially affected. Seasonality of the proposed dredging is important in consideration of species presence during various life stages. Since most species spawn offshore, this portion of the life cycle would not be affected by dredging activities near shore. Post-larval development occurring within interior estuarine shallow soft-bottom area will also remain unaffected. Generally, the shoal is used for resting and feeding habitat of juvenile and adult prey species. Thus, these species may be indirectly affected by excavation of the substrate. Given the mobility of these species and the expansive shallow subtidal habitat of Bald Head Shoal, Middle Ground, and undisturbed areas of Jay Bird Shoals, the area of disturbance is likely not to have significant adverse effects to prey species. In addition, rapid infilling of the borrow area is anticipated. Therefore, adverse effects are considered temporal and relatively minor. No significant impact to benthic or fish species is expected at local or regional population levels.

*Beachfront:* Beach nourishment impacts to resident or migratory fish within the surf zone are generally attributed to burial of benthic habitat, physical disturbance influencing distribution patterns, and/or elevated turbidity levels influencing physiology or feeding behavior. There is little evidence documenting direct impacts of beach nourishment to resident and/or migratory fish species (Hackney et al. 1996, USACE 2001). Subtle responses to beach nourishment activities have been evidenced through small-scale (both temporally and geographically) dietary shifts (USACE 2001). According to the USACE Final Report (2001) for biological monitoring of nourished beaches of New Jersey, surf zone fishes did not exhibit any significant deleterious effects from disposal activities.

Effects of elevated turbidity levels also appear to be limited both temporally and spatially. Turbidity levels

tend to decrease rapidly subsequent to dredging and disposal through simple mixing and dilution processes (associated with longshore and tidal currents, wind, and surf). Indeed, storm events can produce equally high levels of suspended sediments. Increased turbidity associated with beachfront disposal is minimized through dewatering of material behind upland dikes. The nature of the material dredged (i.e. less than 2% fines) will serve to minimize turbidity problems. In general, the spatial scale of elevated turbidity related to dredging and beachfront disposal is very small (USACE 2001).

*Hard Bottom:* There are no known hard bottoms within, adjacent to, or within the vicinity of, the proposed borrow area. Based upon previous mapping efforts, identified hard bottoms points are located to the south (beyond the seaward limit of the former federal channel entrance) and to the west (seaward of Long Beach). Each of these mapped locations is greater than 4 miles from the proposed borrow area. In addition, the USACE did not identify any hard bottom in the vicinity of the new entrance channel alignment (USACE 2000). Excavation of soft bottom and subsequent changes to shoaling patterns could potentially result in secondary effects to hard bottom communities. Hard bottoms may become covered by thin layers of sand (as is more often observed through storm-induced shoaling). Given the lack of observed hard bottoms near the project area, it is anticipated that excavation activities and subsequent material transport to the beachfront will not adversely affect hard bottoms in the area of Cape Fear nor seaward of the Brunswick County beaches.

### 7.13 Wildlife and Their Habitats

Nourishment activities along the project shoreline may temporarily impact foraging habitat of shorebirds and waterbirds. In light of the dynamic nature of this type of habitat, it is expected that birds utilizing these areas can readily move to adjacent shoals or shorelines located immediately outside the project area. In addition, nourishment is scheduled to occur during the winter months, when biological activity is low. This will reduce impacts to food sources. All construction activities will occur outside of the waterbird and shorebird nesting season. Therefore, project activities are not expected to affect any nesting habitat of resident or migratory avifauna.

Dredging and disposal activities will occur during periods of reduced biological activity (i.e. during the approved dredging window). Therefore, the occurrence of whales, manatees, or sea turtles within the project area is unlikely. Beach fill construction will seek to avoid the sea turtle nesting season. In addition, the

beachfront in its current condition is eroding and the proposed project will ultimately serve to improve sea turtle nesting habitat.

Since dredging of the borrow areas will be performed offshore, no impacts to seabeach amaranth plants will occur from this action. However, the beach nourishment that is to take place along the coast of Bald Head Island may bury existing seeds and could negatively affect the amaranth population in later seasons. To reduce these potential impacts, beach nourishment will occur in winter months, when amaranth exists as seeds. Furthermore, the proposed project will occur on areas suffering from potential plant loss through erosion and should ultimately expand the back berm width which is potential habitat for the plant species.

A Biological Assessment (BA) is being prepared and coordinated with the USFWS and the NMFS, pursuant to Section 7 of the Endangered Species Act of 1973, as amended (Appendix G). This assessment determined that the proposed action may affect but will not likely adversely affect the piping plover and the seabeach amaranth. Due to the timing of the project and precautions taken during its implementation, other federally listed endangered or threatened species should not be affected. Section 7 coordination will be completed prior to the initiation of the proposed work.

### 7.14 Introduction of Toxic Substances

In light of the substrate composition and the physical processes of the mouth of the Cape Fear River, it is unlikely that bottom sediments have accumulated any toxic or hazardous substances as regulated by CERCLA (1980) or RCRA (1976). Contaminants tend to bind more readily to the surfaces of fine-grained sediments uncharacteristic of the substrate of the project area. In addition, there have been no known sources of contamination (i.e. spillage, treatment, or storage of toxic substances) within or near the project area. Therefore, it is unlikely that a composite bottom sample would yield contaminant levels exceeding EPA standards.

## 8.0 MITIGATIVE MEASURES

The timing and sequencing of project activities will help mitigate any potential adverse impacts to natural resources. Dredging and beachfront sand placement operations will avoid periods of peak biological activity. Over the course of the last few years, the applicant has evaluated numerous alternatives and implemented various measures in an effort to mitigate environmental impacts potentially resulting from project activities.

The following is a brief summary of some of the mitigative measures to be implemented by the applicant. Additional measures may be implemented by the Village if deemed necessary by permitting agencies.

Construction activities will be generally confined to the period of the year between November 15th and April 1st. All construction and de-mobilization will be completed no later than April 30th. Beach nourishment will be initiated along the western end of South Beach. Fill placement will progress in a relatively continuous and uniform manner toward the east. This beach fill sequencing will help ameliorate any potential disturbances to over-wintering piping plover foraging near the Point. Moreover, all project-related activities including equipment movements, pipeline storage, etc. will contractually be precluded from occurring within 1000 ft from the center of the Cape Fear spit feature. Hence, both the expansive Cape Fear emergent beaches and spit, as well as the entirety of East Beach shoreline will serve as potential habitat for birds potentially displaced during the period of construction.

The footprint of the proposed borrow area has been reduced in spatial extent and refined to avoid and minimize disturbance to potential cultural and environmental resources. A 200-ft buffer will be maintained around the two groupings of magnetic anomalies exhibiting signatures consistent with potential shipwreck material. In addition, dredging will occur at the distal end of the shoal formation (unconsolidated subtidal bottom) and will avoid any intertidal sand habitat. Potential adverse effects to benthos are further minimized by keeping areas of the shoal intact and thus maintaining source areas for benthic recolonization. As evidenced in the Sand Search Investigation Report (Appendix A), design depths will ensure consistency of sediment type pre- and post-dredging. Dredging and nourishment activities will occur during periods of reduced biological activity and prior to peak recruitment periods. The proposed window of operation will also minimize potential adverse effects to the West Indian manatee and migrating sea turtle species.

Upon completion of nourishment activities, beach compaction will be monitored. The nourished beach will not automatically be subject to annual tilling after construction. Sand compaction monitoring will be initiated concurrent with nourishment completion and will continue on an annual basis for three years. Monitoring results will identify the need and required locations for tilling. In addition, beach foreshore escarpments will be identified and re-graded before May 1 of each year (ahead of the sea turtle nesting period).

Portions of the South Beach shoreline have been routinely vegetated by the applicant subsequent to prior beach disposal activities by the USACE. Back-beach sand fencing programs likewise have been

implemented to foster natural dune growth. The net result has been the creation of a natural backshore dune environment conducive for faunal use. Without the reconstruction of an enhanced beach profile and berm, these back-beach resources will be lost prior to the next federal beach disposal operation tentatively scheduled for 2011. Moreover, the anticipated fill volume derived solely from channel maintenance will be substantially less than that required to maintain the existing beach/dune system at that time. The comprehensive beach restoration project proposed by the Village of Bald Head Island will seek to both protect the existing duneline from construction impacts and will replace any sand lost to erosion prior to project completion.

## 9.0 CUMULATIVE IMPACTS

Cumulative impacts have been evaluated in considered of past, present, and reasonably foreseeable future projects. The analysis is provided as an attached appendix (Appendix H).

## 10.0 FINDINGS

The project is not expected to significantly affect the quality of the environment. Since direct and secondary impacts to the environment are short-term and relatively minor, the preparation of an Environmental Impact Statement (EIS) is not warranted. Following satisfaction of the requirements of the NCEPA, the Division of Coastal Management may take action on the CAMA Major Permit application.

## 11.0 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

***Federal.*** Review of the CAMA Major Permit application by federal agencies is coordinated by the U.S. Army Corps of Engineers (USACE). The USACE will review the application for compliance with section 10 of the Rivers and Harbors Act of 1899 which covers construction, dredging, filling, and other work in navigable waters. The USACE will also review the application for compliance with Section 404 of the Clean Water Act, which covers the discharge of dredged or fill material into any waters or wetlands.

Distribution of applications is handled by the COE to the Environmental Protection Agency (EPA), the National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (USFWS) for their review and comment. Comments from these agencies are received and considered by the COE prior to any permit issuance. All comments and permit conditions are then forwarded to the North Carolina Division of Coastal Management (NCDCM).

*State.* NCDCM coordinates the review process for all relevant state agencies. State authorizations include the Coastal Area Management Act; Dredge and Fill Act; Water Quality Certification; and Easement in Public Trust Areas. Application copies are distributed by NCDCM to the state agencies for comment prior to any permit issuance.

*North Carolina Environmental Policy Act.* The proposed project involves the use of public lands below mean high water and therefore requires compliance with the NCEPA. This EA is being submitted as documentation for such compliance. Based on the assessment of impacts by the proposed project, a FONSI will be issued or preparation and review of an EIS will be required prior to permit action.

As required, the applicant will apply for and receive an easement in the state-owned, Submerged Land Section from the Department of Administration State Property Office as required under NCGS 146-12(e).

## 12.0 NOTIFICATION

*Public Notice.* The USACE Wilmington District will issue a formal Public Notice upon review and initial comments on the draft EA document. NCDCM will issue a notice of application for a CAMA Major Permit in the local newspaper as part of their review process.

*Environmental Assessment Submittal.* This EA is being submitted to Mr. Doug Huggett of the NCDCM office in Morehead City, N.C. for circulation to commenting state agencies. In addition, the document is being submitted to Mr. Keith Harris of the USACE Wilmington District for distribution to commenting federal agencies.

*Application Submittal.* The CAMA Major Permit application will be submitted to Mr. Steve Everhart of the NCDCM field office in Wilmington, N.C. and to Mr. David Timpy of the COE Regulatory Branch at the District office in Wilmington, N.C.

## 13.0 POINT OF CONTACT

Any comments or questions regarding this EA should be directed to Christian Preziosi, Land Management Group, Inc., P.O. Box 2522, Wilmington, N.C. 28402. Telephone contact is (910) 452-0001.

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