

SECTION 6.0 – AVOIDANCE, MINIMIZATION AND MITIGATIVE MEASURES

CEQ regulations (40 CFR 1508.20) define mitigation to include: (1) avoiding the impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (3) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the lifetime of the action; and (5) compensating for the impact by replacing or providing substitute resources or environments.

The following section describes the avoidance, minimization and mitigation measures related to terminal groin design, construction, monitoring, threatened and endangered species, and cultural resources. The Applicant has completed an Inlet Management Plan (IMP) that provides detailed information regarding required plan components including: (1) determination and type of data to define the baseline condition; (2) post-construction monitoring to compare baseline data and assess potential adverse impacts; (3) timeframes for post-construction monitoring; (4) identification of thresholds for implementation of mitigation measures; and (5) mitigation measures that may be implemented. The complete IMP (Appendix B) has been determined to be compliant with SB 151 per NCDCM review and concurrence. Elements of this plan are discussed in Section 6.3 below.

6.1 TERMINAL GROIN DESIGN

The Applicant's engineer (Olsen Associates, Inc.) considered and evaluated several design parameters influencing structure performance while concurrently minimizing potential adverse effects to resources of the project area. Varying options related to structure template (length and width), elevation, and permeability have been evaluated to determine the level of performance relative to the design goals (see Appendix I and Engineering Report – Olsen 2013). Design goals relevant to reducing adverse effects included, but were not limited to, the following: (1) reduce sediment transport rates from the westernmost segment of South Beach to the Cape Fear River and thus avoid potential navigation impacts associated with increased shoaling; (2) minimize the potential for adverse impacts to a downdrift shoreline (e.g. West Beach); (3) preclude impacts to other coastal barrier islands; (4) minimize or reduce future maintenance requirements for portions of an existing sand tube groinfield located along South Beach; (5) reduce the need for future dredge and fill projects by extending the effective life and benefit level of federal disposal and Village-sponsored nourishment.

In order to achieve the design goals as outlined above, the following design precepts were considered and evaluated:

(1) Porosity – the structure should be sufficiently permeable (or “leaky”) as to limit its effectiveness in the long-term impoundment of sand.

(2) Template (length and width) – the direct, as well as synergistic effects of the groin structure should provide an equilibrated profile or template for the stabilization of the updrift South Beach shoreline sufficient to last between federal beach disposal events, *i.e.*, nominally two to three years. The beach profile is expected to progressively reduce in size between sand placement events.

(3) Elevation – portions of the groin should be sufficiently low such that wave overtopping and resultant sediment transport can occur past the structure during periods of energetic wave conditions.

(4) Settlement – the structure should have a foundation designed to be highly resistant to long-term settlement so as to substantially reduce future maintenance requirements.

(5) Adjustment – the structure should be capable of post-construction “tuning” if deemed necessary to refine performance characteristics.

(6) Constructability – the structure should be adequately robust so as to resist damage during low probability storm events, but at the same time sufficiently straight forward in design to assure cost-effective constructability in a highly energetic and dynamic environment.

The precepts above have been used by the applicant’s engineer to develop a structural design that meets the applicant’s goals regarding optimal performance while concurrently reducing potential adverse effects to both natural resources and the human environment. The design process itself considers various structural characteristics that ultimately define performance relative to the design goals. Evaluations of design characteristics such as permeability and length are described in Appendix I and the Engineering Report (Olsen 2013).

The engineer has identified a 1,900 lf terminal groin as the most appropriate length offering an apparent acceptable balance between maintaining the updrift objective of the structure while minimizing the possibility of downdrift impacts (Olsen 2012). In contrast to conventional groin or jetty structures which are typically designed to be sand-tight, the proposed terminal groin is relatively permeable, or leaky, allowing some level of sand and water transport over and through the structure. The mid-length structure coupled with a semi-permeable design would avoid any potential adverse effects to active and passage migration of surf zone fishes and larvae and minimize potential erosion to downdrift beaches. In addition, the Applicant proposes to construct the groin in two phases, with the

Phase I structure being approximately 1,300 lf in length. The phased construction approach is discussed further below as well as in Section 3.2.5.

6.2 CONSTRUCTION METHODS AND SEQUENCING

It is the intent of the applicant to utilize sand from the next Wilmington Harbor maintenance event as the principal source to meet the sand fillet requirement of SB 151. Doing so would potentially avoid, or at least minimize disturbance to other potential sand source sites and would make use of a disposal event that will occur irrespective of the Village's Shoreline Protection Project. Maintenance dredging of the Wilmington Harbor navigation project and associated disposal is conducted in accordance with environmental commitments identified in the Environmental Assessment (EA) for preconstruction modifications of the authorized improvements to Wilmington Harbor (USACE 2000). In addition, federal disposal would allow retention of material within the littoral system and thus likewise ensure the placement of beach-compatible sand on recipient sites.

In the event that the Village is unable to make use of, or is required to supplement a SMP disposal event for the sand fillet, four prospective sand source sites have been identified (as described in prior sections of this EIS). All of the borrow sites are depositional features containing sediments of high sand content (>90%). As such, the site conditions are more favorable for both physical recovery (through infilling of sediments of similar texture) and biological recovery (through recruitment of benthic infauna of adjacent undisturbed areas) (Pullen and Naqvi 1983; Posey and Alphin 2002). Site-specific geotechnical data is available for the Jay Bird Shoals, Bald Head Creek Shoals, and the Wilmington Harbor Entrance Channels (see Section 4.0). In addition, geotechnical evaluations of sediments within Frying Pan Shoals were conducted by the USACE as part of the General Reevaluation Report (GRR) for this 50-year project. The findings of these analyses were reported in the Brunswick County Beaches Renourishment Study (Catlin 2010). Based on compatibility analysis criteria

for percent silt content, percent shell content, mean grain size and standard deviation from sediment sampling within Frying Pan Shoals, the material from the borrow area identified in the GRR is largely compatible with the native beach material (Catlin 2010)¹. Post-dredging physical monitoring for any of the shoal sand source sites would also be performed to evaluate physical recovery rate of the dredged site.

All beach fill material would comply with the State of North Carolina Technical Standards for Beach Fill Projects (15A NCAC 07H .0312). The Technical Standards require the characterization of sediments from the recipient beach and the proposed borrow sites. Sediment characteristics that are considered include percent weight of fine-grained sediment, percent weight of granular sediment, percent weight of gravel, and percent weight of calcium carbonate. Temporary shore-parallel dikes would be constructed in the immediate construction area as needed to control the effluent, decrease turbidity levels in the water, and maximize the settling of sediments from the discharge before entering the ocean.

The timing and sequencing of nourishment actions for both the initial required fillet and for subsequent adaptive management would reduce potential adverse impacts to natural resources. Federal disposal operations are generally confined to the period of the year between November 15th and April 1st. The proposed groin construction would occur immediately subsequent to the federal disposal of sand on South Beach. Based upon coordination with the USACE Wilmington District Navigation Branch, the Village will not perform any groin construction activities on South Beach until the USACE dredging contractor has completed the federal channel maintenance disposal project and has demobilized all equipment and pipeline from that location. As a result, actual groin construction is expected to begin April 2015 and continue for four to six months (pending

¹ The Village would be required to collect sufficient site-specific geotechnical data to ensure compatibility of the dredge sediments with the recipient beaches and to comply with state sediment criteria.

weather conditions and the specific method of construction employed by the contractor). The start of groin construction immediately following federal disposal will theoretically allow for sand to be transported westward toward the structure and will help minimize its lee side effects. Supplemental sand that may be needed for fillet formation is anticipated to be obtained from the Jay Bird Shoals borrow site, since the Federal channel will have been recently dredged to authorized dimensions and will therefore be unavailable as a borrow source. Based upon the anticipated schedule for groin construction, any supplemental nourishment action (for fillet enhancement) would occur during the following winter.

Specific construction practices will be employed to minimize the potential adverse effects of construction activities on the beachfront and nearshore waters during the late spring and summer months. These include: (1) phased construction of the terminal groin (as described in more detail below); (2) utilization of high quality beach compatible material for the fillet; (3) utilization of a foundation mattress that will reduce the rock volume in the water and minimize maintenance actions; (4) individual placement of armor stone (rather than dumping of stone which would otherwise introduce debris into the water); and (5) restricting work to daylight hours. In addition, the Applicant has coordinated with the USFWS and NMFS (in accordance with ESA Section 7 consultation requirements) for specific conservation measures and reasonable and prudent measures (RPMs) to be employed to minimize potential adverse effects to endangered species (including sea turtles). These measures are described further in Section 6.5 below. A list of all USFWS conservation measures, RPMs, and terms and conditions are provided in the project Biological Opinion (BO) in Appendix S.

The Applicant proposes to construct the groin in two phases, with Phase I consisting of the installation of an approximate 1,300 lf structure. The phased approach would reduce the sand volume requirement for the fillet and thus minimize the need for any supplemental sand from the proposed sand source sites for the initial construction. The Phase I structure

would require considerably less rock and therefore would reduce the time necessary for construction. This, in turn, would help to limit the period of work performed during the bird and turtle nesting seasons. Phasing would also promote more rapid activation of sand bypassing and limit any potential downdrift effects to West Beach. Lastly, the Phase I structure would provide the opportunity for monitoring to determine the timing and physical extent of the Phase II structure (which would not exceed a combined 1,900 lf).

The Applicant has identified the proposed limits of work including the proposed material staging area, transport corridor, and work limits for the fillet formation (see Figure 3.3). All project-related construction activities would remain within the established construction area to minimize impacts to environmental resources. The terminal groin and fillet work area would be limited to the westernmost 2,500 lf of South Beach (an area of documented chronic erosion). This constitutes less than 12% of the total West Beach and South Beach shoreline length.

If supplemental sand is necessary for the fillet, all construction pipes that would be placed on the beach would be located as far landward as possible without compromising the integrity of the dune system. The Applicant would seek to perform any dredging associated with the terminal groin fillet construction or maintenance, outside of the sea turtle moratorium – unless necessitated by an emergency condition. The Applicant would also limit all terminal groin construction activities to daylight hours only. Specific construction practices intended to avoid and minimize potential adverse effects to threatened and endangered species are provided in Appendix S.

6.3 INLET MANAGEMENT PLAN

In accordance with the requirements of SB 151, the Village formulated an Inlet Management Plan (IMP) for management and monitoring of the inlet, estuarine and ocean shorelines immediately adjacent to and under the influence of the inlet. The IMP (Appendix B) details the following monitoring and mitigation actions:

1. Describes the post-construction activities that the applicant will undertake to monitor the impacts on coastal resources;
2. Defines the baseline for assessing any adverse impacts and the thresholds for when the adverse impacts must be mitigated;
3. Provides for mitigation measures to be implemented if adverse impacts reach the thresholds defined in the plan; and
4. Provides for modification or removal of the terminal groin if the adverse impacts cannot be mitigated.

6.3.1 Post-Construction Physical Monitoring

The Village of Bald Head Island, NC (Village) has performed comprehensive beach monitoring of South Beach, The Point and West Beach since 1999. Prior to that date, less formal surveys of the “dry” beach (only) were also accomplished at varying dates in time. In 2008, East Beach was added to the current monitoring plan. Elements of the present day survey program under the SMP include the nearshore portions of Bald Head Shoal and the abutting federal navigation project. Borrow sites are likewise monitored for a typical three-year period post-excavation. Post-construction monitoring (both biological and physical) has been conducted by the Village for prior nourishment projects that utilized sand from Jay Bird Shoals and from the shoals of Bald Head Creek. More complete information regarding the existing survey work performed by both the Village and the USACE (for the Wilmington Harbor Deepening Project) is provided in the IMP.

6.3.1.1 Beach Surveys

Bald Head Island

The Applicant will continue to perform comprehensive annual beach monitoring as carried out over the past thirteen (13) years at Bald Head Island. The survey baseline for this work is depicted by Figure 1 of the IMP. Several additional profile lines will be added to the existing survey program in the vicinity of the terminal structure (see Figure 2 of IMP). In addition, the project surveyor will be required to annually perform an approximate MHWL survey between Sta. 0+00 and 75+00 (see Figure 3 of IMP). Each survey will be compared to prior surveys and utilized for trend analysis. Digitally controlled aerial photography taken at approximate 6-month intervals will likewise be used to supplement analysis of the post-terminal groin shoreline condition.

According to the plan, the first post-construction MHWL survey will be performed within 30 days of the completion of the proposed terminal groin and updrift beach fill, thereby documenting the as-built shoreline condition. The entire island-wide monitoring surveys will be performed on a six-month basis at the same approximate time as previous seasonal survey program addressed by the existing (pre-terminal groin) comprehensive island-wide beach monitoring program.

Oak Island

For approximately the past 12 years, the Wilmington District, USACE has performed comprehensive physical monitoring which included both the Oak Island and Bald Head Island shorelines. As a result, a comprehensive data base has been developed which portrays shoreline changes at both locations for over a decade. For purposes of assessing post-construction oceanfront shoreline conditions on the eastern end of Oak Island, the Village's coastal engineering consultant will utilize publicly available survey data acquired by the Wilmington District, USACE (see Figure 4 of IMP). Similarly, the consultant will access and utilize relevant federal aerial photography of the Oak Island area of interest.

Should the USACE terminate the annual acquisition of survey data on Oak Island, the Village will survey annually the east end of the island from Sta. 60 through Sta. 30, including half stations. The number of beach profiles surveyed is not anticipated to exceed seven (7). That data would be added to the database of information acquired by the Wilmington District beginning in 2000.

The Village proposes that its responsibility for analysis of post-groin physical surveying on Oak Island would terminate if six (6) years of monitoring subsequent to terminal groin structure completion fails to indicate a cause and effect relationship between structure installation, or borrow-site utilization, and oceanfront shoreline change at the eastern end of Oak Island immediately adjacent to and under the influence of the inlet.

6.3.1.2 Borrow Site Monitoring Surveys

The previously authorized borrow area located on Jay Bird Shoals was surveyed both immediately prior to and after construction of the 2009/10 Village-sponsored 1.8 Mcy beach restoration project. Subsequent surveys are being performed at 12-, 24- and 36-months and biennially thereafter. The area surveyed includes a minimum of 500-ft. of coverage outside the permit limits of the borrow site. Subsequent to a Post-Irene emergency dredging project at South and West Beach constructed in 2011/12, a Bald Head Creek borrow site is subject to annual surveys beginning in January 2013.

Subsequent to sand placements which may be required by the construction of the terminal groin based upon the borrowing of sand from within the unexcavated portion of the Jay Bird Shoal borrow site (previously authorized in 2009); the northward expansion of the borrow site at the entrance to Bald Head Creek; the Smith Island Range of the federal navigation channel, or any other permitted site, annual monitoring of that site will be performed pursuant to the terms of the associated Permit(s). Monitoring results will be addressed in each subsequent Village annual monitoring report.

6.3.1.3 Aerial Photography

The Village of Bald Head Island will continue to perform controlled (color) rectified digital aerial photography of the island shoreline(s) twice a year – usually coincident with the timing of each seasonal beach survey. The present minimum areas of coverage are the West Beach, South Beach and East Beach shorelines. Oblique low altitude photography is likewise performed periodically as required to document the occurrences of any storm, or man-made event of interest.

6.3.2 Mitigation Thresholds

6.3.2.1 West Beach

According to the Applicant’s engineer, it is anticipated (and supported by in-depth modeling) that a portion of the West Beach shorefront will potentially require beach disposal on a 3-year basis – *with or without* terminal structure implementation. The proposed principal borrow source for interim small scale sand placement at that location (if necessary) will be the expanded Bald Head Creek borrow site. The assignment of “impact” on West Beach due to a terminal structure will therefore need to weigh the following site specific factors potentially affecting shoreline conditions downdrift of the groin:

- Interval between sand placement projects?
- Have average annual shoreline recession rates (volumes and MHWL location) increased by over 50%? Has beach fill equilibration been accounted for? Is the duneline being impacted?
- Can a documented cause and effect relationship be assigned to downdrift shoreline reconfiguration, or is any newly developed “hot spot” isolated and therefore not the result of a quantifiable trend?
- Do numerical modeling results support or refute the observed shoreline erosion trends?
- Can extraordinary meteorological conditions be defined as a cause of accelerated erosion?

- Have navigation channel maintenance operations changed in frequency or scope?

The baseline for action along West Beach (Sta 0+00 – Sta 24+00 by definition) will be determined by analysis of historical surveys along this reach acquired on almost a 6-month basis since 2000. Over this 14 year period, either the Village or the USACE have placed sand when the limit of erosion reached “critical” condition portions (in most cases where the limit of erosion was located at/or within the primary dune). All such landward limits of erosion locations are well documented by survey. Therefore, the “baseline” for remedial actions by the Village along West Beach will be the point at which the limit of upland erosion reaches its historical worst case condition – as documented by survey since 2000 – or is projected to reach such a condition in the next 6 months.

6.3.2.2 Oak Island (Fort Caswell)

According to the Applicant’s engineer, in depth numerical modeling analyses of Oak Island predict no quantifiable impact to littoral transport patterns or rates and associated shoreline change at that location due to either terminal groin construction or the continued use of the Jay Bird Shoal borrow area (to the limits of excavation permitted in 2009). Nonetheless, the Village proposes a “baseline” for the initiation of “mitigation” pursuant to SB 151 from Sta. 60 to Sta. 30, the oceanfront shoreline immediately adjacent to and under the influence of the inlet. The Village has committed to delivering annually to DCM a report of its monitoring results. In the event the monitoring results disclose any potential shoreline change exceeding a baseline trigger, the Applicant proposes that a Technical Advisory Committee (TAC) be consulted. The proposed TAC would be comprised of a NC licensed professional engineer with substantial expertise and employment experience in coastal engineering from the Village, Oak Island Stakeholders and DCM (one from each, for three (3) total engineers) to review the results of the monitoring and analyses and to consider whether there is any terminal groin related impact on shoreline change exceeding the

baseline trigger. The TAC is proposed to be formally established prior to the completion of construction of the terminal groin project.

According to the Applicant's proposal, if the majority of the TAC finds that a shoreline impact exists because of the terminal groin, and not because of other causes, the Village would work with the TAC and affected interests at Fort Caswell to determine and implement appropriate adaptive response measures, consistent with the reasonableness and cost-benefit precepts of SB 151, or subsequent law.

The Applicant proposes that, should annual computed shoreline recession rates exceed by 50%, or more, the maximum measured annual recession rate (since 2000) at one or more of the designated survey locations, the TAC will be requested to evaluate and determine the source of the additional erosion. Similarly, if the updated long term trend rate varies by 50%, or more from its last published value, the TAC will be requested to evaluate and determine the source of the additional erosion or reduction in accretion (since 2000). In either event, a specific determination will be made, and a report submitted to DCM, regarding any expectation that the causation of additional erosion is related to the terminal groin project.

6.3.3 Mitigation

6.3.3.1 West Beach

Priority for any required mitigation on West Beach would be alongshore sand placement sufficient to protect endangered residential structures and the total loss of protective dune formations. The timing of a mitigative sand placement, however, may be adversely affected by factors such as design document formulation, dredge availability, and public project bid requirements. As a result, the following interim actions may likewise need to be considered: (1) sand bag revetment construction along the section of shorefront where threatened structures exist; (2) temporary borrowing of sand mechanically from the updrift

impoundment fillet of the terminal groin and placement along the affected shorefront; or (3) both actions.

Structure modification would also be considered as part of any remedial action plan. In most instances, such an action would consist of rock removal from the structure crest sufficient to increase its transmissivity to sand transport. That is to say, its permeability (or “leakiness”) would be increased. Such an action would not be expected to result in immediate benefits. Hence, it should be considered to be a secondary response in the hierarchy of remedial actions. Note that terminal structure alteration is summarized briefly below and in more detail within the Applicant’s IMP (Appendix B).

6.3.3.2 Oak Island (Fort Caswell)

According to the Applicant’s engineer, comprehensive numerical modeling analyses indicate no probability of shoreline change at Oak Island as a result of the proposed action. As a result, the Applicant has proposed the use of a TAC which would be authorized to make a shoreline impact determination in lieu of just the Applicant (or its engineer). Any recorded increase in erosion on the eastern section of Oak Island that exceeds the baseline and is determined by the TAC to be caused by the Bald Head Island Shoreline Protection Project would most likely need to be mitigated through direct sand placement. The Applicant’s hope is that mitigation could occur through a reapportionment of some portion of the federal disposal sand to that hot spot, rather than placement of the sand at a more stable or accreting location on Oak Island to the west of Fort Caswell. The USACE has not committed to, or considered, such a potential response. If the altered USACE disposal alternative is not available, the Village may consider, in consultation with the TAC, other measures to address the erosion, such as a sand push, sand stockpiling of disposal sand, sandbag or other revetment, sand placement redesign of the federal disposal project limits of fill, or, in an extreme circumstance and absent more reasonable, cost-effective alternatives, reduction in size or removal of the terminal groin.

6.3.3.3 Terminal Structure Alteration

As discussed in Section 3.0 and 5.0 of the FEIS, the proposed terminal groin is to be constructed as a “leaky” structure with some level of reduced sediment transport continuing to occur either through and/or over the structure crest. As a rubble mound structure, sand permeability can be physically increased through the removal of stones. Any reduction in effective structural elevation will increase sediment transport across the groin. Increased transport would be conducive to spit or dry beach growth on the downdrift side of the structure which, in effect, would be expected to increase sediment transport to West Beach. Such “tuning” of a permeable structure is often desirable even if mitigation is not required. Normally, tuning would not occur without the benefit of significant post-construction monitoring, since the transmissivity of such a structure varies over time – dependent upon the condition (*i.e.* size and elevation) of the updrift sand fillet, seasonal wave climatology, storm effects and other site specific factors. In an extreme circumstance, and absent more reasonable, cost-effective alternatives, effective “removal” or major dismantling of the structure may be required.

6.4 NATURAL RESOURCE MONITORING

The Applicant and USACE have coordinated with both NMFS and USFWS for Section 7 ESA consultation. As a result of the consultation process, a number of conservation measures have been developed in an effort to avoid and minimize potential adverse effects to listed species. Conservation measures, reasonable and prudent measures (RPM’s) and terms and conditions of the USFWS Biological Opinion (BO) are provided in Appendix S.

The following is the summary of proposed natural resource monitoring (both during and after project construction). Additional mitigative measures are outlined in Section 6.5.

6.4.1 Sea Turtles

Intensive sea turtle nest monitoring will be performed by qualified personnel of the Bald Head Island Conservancy (Conservancy) within and immediately adjacent to the project area (including western South Beach and the Point). The monitoring will be performed throughout the portion of the construction time period occurring between May 1 and November 30 and will include the following elements:

- a. Monitoring within the work areas will be performed at night in a regular, routine fashion by qualified sea turtle monitoring personnel;
- b. Any nesting sea turtle encountered by Conservancy personnel will be tagged per standard operating procedures for the organization's Sea Turtle Protection Program as permitted by the NC Wildlife Resources Commission. BHI Conservancy will relocate all nests in the project area to eastern South Beach or to East Beach within two to three hours of nesting. Note that it is likely that these nests would have been relocated regardless of the project's timeline because of severe erosion in this area. These nests will be relocated to more stable, suitable nesting habitat located further east to ensure that no sea turtle nests are impacted from construction activities;
- c. For any nests that have not been relocated, monitoring for emerging nests or hatchlings shall be conducted prior to initiating work and regularly thereafter;
- d. If nest or hatchlings are within an area obstructed by equipment or nourishment activities, hatchlings will be transported by qualified Conservancy personnel to an area outside of the work boundaries. The hatchlings will be released at least 15 feet above the current water line and allowed to crawl into the ocean.

Immediately after completion of this project and prior to May 1 for three subsequent years, sand compaction will be monitored in the area of restoration in accordance with a protocol agreed to by the Service, the State regulatory agency, and Bald Head Island. If required, the area will be tilled to a depth of 36 inches. All tilling activity shall be completed prior to May 1. A report on the results of compaction monitoring will be submitted to the Service prior to

any tilling actions being taken. An annual summary of compaction assessments and the actions taken will be submitted to the USFWS. This condition will be evaluated annually and may be modified if necessary to address sand compaction problems identified during the previous year.

Visual surveys for escarpments along the project area shall be made immediately after completion of the beach nourishment project and prior to May 1 for three subsequent years. Results of the surveys will be submitted to the USFWS prior to any action being taken. Escarpments that interfere with sea turtle nesting or that exceed 18 inches in height for a distance of 100 feet will be leveled to the natural beach contour by May 1. The USFWS will be contacted immediately if subsequent reformation of escarpments that interfere with sea turtle nesting or that exceed 18 inches in height for a distance of 100 feet occurs during the nesting and hatching season to determine the appropriate action to be taken. If it is determined that escarpment leveling is required during the nesting or hatching season, the Service will provide a brief written authorization that describes methods to be used to reduce the likelihood of impacting existing nests. An annual summary of escarpment surveys and actions taken will be submitted to the USFWS.

The sand-filled geotubes within the project area will be monitored to determine the depth at which each geotube lies beneath the sand, and the potential impacts to nesting sea turtles. Prior to May 1 each year, the Applicant will monitor the location and depth of each sand-filled geotube located within 2,500 lf of either side of the groin field. The depth from the top of the sand vertically to the top of the sand-geotube shall be measured at two locations for each geotube: the landward end and near the center (125-175 feet from the landward end, depending on the length of the geotube).

Sand tubes demonstrated to be non-functional via long-term burial, and as verified through a minimum of three years of monitoring, may be removed.

6.4.2 Shorebirds and Colonial Waterbirds

A bird monitoring plan will be developed to monitor piping plover, red knot, waterbirds, colonial waterbirds and other shorebirds during and after construction. Bald Head Island Conservancy (Conservancy) performs monitoring of the beaches and the Point during shorebird nesting season. The Applicant will coordinate with the Conservancy to ensure that bird monitoring is compliant with the terms and conditions of the USFWS Biological Opinion (BO). Monitoring will be conducted for a minimum of three (3) full years past the completion of both phases of groin construction, or until the end of the shorebird nesting season (August 31) of the third year after construction, whichever is later. Post-construction monitoring will only be ceased after the review of at least three years' worth of data and approval by the USACE, USFWS, NCDCCM, and NCWRC.

During construction of both phases, bird monitoring will be conducted weekly. Between construction phases and for at least three years after construction is completed, bimonthly (twice-monthly) bird surveys will be conducted in all intertidal and shoreline areas along South Beach and West Beach. Field observations will be conducted during daylight hours, and primarily during high tide. Specific monitoring protocol is provided in the attached conservation measures, RPMs, and terms and conditions of the USFWS' BO (Appendix S).

6.5 ADDITIONAL MITIGATIVE MEASURES

As described above, the Applicant and USACE have coordinated with NMFS and USFWS through Section 7 ESA consultation. By way of this consultation, several conservation measures, RPMs, and terms and conditions have been identified to avoid and minimize potential adverse effects to threatened and endangered species. The following is a list of some of the measures drafted (organized by listed species). The list below is additive to the natural resource monitoring described above. For a complete list of conservation measures, RPMs, and terms and conditions, refer to Appendix S.

6.5.1 Loggerhead and Green Sea Turtles

- Only beach quality sand suitable for sea turtle nesting, successful incubation, and hatchling emergence shall be used for beach nourishment at the project site. Furthermore, sand of similar grain size and composition to that of the existing beach will be used to reduce any changes in physical characteristics of the beach that may affect nest survival. This material will meet the Technical Standards for Beach Fill Projects as published in the North Carolina Administrative Code (15A NCAC 07H .0312).
- Channel maintenance and beach disposal associated with the federal Sand Management Plan (SMP) are planned to be completed by April 30th.
- Staging areas for construction equipment will be located primarily on the northern and western riverfront shorelines (and not on South Beach). All construction materials that are placed on the beach will be located as far landward as possible without compromising the integrity of the dune system. Temporary storage of construction materials on the beach will be in such a manner so as not to compromise the integrity of the dune systems.
- To the maximum extent practicable, all excavations and temporary alteration of beach topography resulting from groin construction will be filled or leveled to the natural beach profile prior to dusk each day. During any periods when excavated trenches must remain on the beach at night, a barrier (e.g., hay bales, silt fencing) sufficient to prevent adult and hatchling sea turtles from accessing excavated trenches, etc., would be placed around the footprint of each groin segment above MHW.
- The Applicant will seek to perform any dredging associated with the terminal groin fillet construction or maintenance, outside of the sea turtle moratorium – unless necessitated by an emergency condition.

- The Applicant will limit all terminal groin construction activities to daylight hours only.

6.5.2 Manatees

- Proposed excavation work would be performed with a cutter suction dredge with sand pumped by submerged pipeline to the western end of Bald Head Island.

- Groin construction would be spatially constrained to reduce the possibility of a collision.

- The majority of the dredging would occur during fall and winter months when populations of manatees are lower.

- The contractor will follow the USFWS' *Guidelines for Avoiding Impacts to the West Indian Manatee: Precautionary Measures for Construction Activities in North Carolina Waters*. Minimization and avoidance efforts identified in these guidelines include actions such as; educating personnel on manatee identification and observance, avoidance and civil penalties for harming, harassing or killing manatees under the Marine Mammal Protection Act and the Endangered Species Act. These guidelines also detail specific actions required in the event that a manatee is identified in the project area and resultant documentation regarding sightings, construction related collisions and/or injuries.

6.5.3 Sturgeon

Avoidance and minimization efforts for impacts to Atlantic and shortnose sturgeon are mainly related to minimization of impacts to foraging habitat. Beach quality sand with similar grain size and composition to that of the existing beach will be utilized for nourishment efforts reducing impacts to potential prey species and facilitating recovery of the benthos. Additional conservation measures including the use of temporary dikes to control effluent would further reduce foraging impacts. Maintaining slow speeds during

mobilization to the dredge site and during active dredging would also minimize the likelihood of collision.

6.5.4 Piping Plover and Red Knot

- All construction equipment would be prohibited from entering upland beaches associated with the Cape Fear spit feature as well as East Beach. Additionally, a specific construction corridor for the terminal groin would be established along the Point on dry beach between the dune line and MHW. These actions would provide readily available substitute habitat areas for any birds displaced by construction activities. Note that the proposed work area, including the material staging area, rock transport corridor, and fillet work area are depicted in Figure 3.3.

- To reduce changes in physical characteristics of the beach that may affect nourishment impacts on invertebrates, sand of similar grain size to the existing beach will be used.

- Although the direct footprint of the terminal groin may result in a permanent loss of foraging habitat, beach nourishment and groin construction would occur within highly eroded areas and would ultimately increase foraging habitat within the project area.

6.5.5 Seabeach Amaranth

- Beach disposal associated with the federal SMP would take place after November 15th, after amaranth plants have already released seeds.

- Seabeach amaranth surveys will be conducted in the project area, including at least 2,500 lf on each side of the groin along South Beach and West Beach, for a minimum of three years after completion of groin construction. Habitat known to support this species, including the upper edges of the beach, lower foredunes, and overwash flats will be visually surveyed for

the plant. Annual reports should include numbers of plants, latitude/longitude, and habitat type.

6.6 CULTURAL RESOURCE AVOIDANCE

A 2012 marine remote-sensing survey identified the remains of a 160 to 190 ft sailing vessel within the VBHI Shoreline Protection Project Study area. The groin structure is designed to create a minimum of 150 ft of clearance from the identified vessel remains. During construction, the contractor will be made aware of the location of the wreck and be required to maintain a minimum 150 ft buffer to the wreck, as required by the NC SHPO. The groin structure, as proposed, will result in accretion of sediment along the southwestern shoreline of Bald Head Island. Burial of the remains will offer protection from further degradation thereby resulting in a positive impact to the archeological site. Post-construction monitoring of the shoreline updrift of the groin would identify if any of the shipwreck remains were to become exposed at any point in the future. If this were to occur, the Village would contact SHPO and the USACE to identify appropriate protective measures.

In addition to the archaeological investigations of the proposed terminal groin site, TAR has completed surveys of both the Jay Bird Shoals and the Bald Head Creek Shoals sand source sites. The investigation of the Jay Bird Shoals site was completed as part of the Bald Head Island Beach Nourishment Project authorized in 2009 and constructed in 2010. The findings of this investigation were presented within the project EA (LMG 2008). Magnetometer and side-scan sonar surveys (conducted by TAR) indicated two groups of magnetic anomalies exhibiting characteristics consistent with potential shipwreck material and/or significant cultural resources. As a result, a 200-ft buffer will be maintained to avoid dredging impacts and secondary effects of erosion.

More recently, TAR completed an investigation of the Bald Head Creek Shoals site (including the 37.6-acre proposed expansion to the north). Based upon the historical and remote sensing survey data collected as part of this effort, no NRHP eligible submerged cultural resources were identified in the 2014 survey area. The shallow area north of the mouth of Bald Head Creek is reported to have been the location of a number of channel range markers. TAR recommended that in the event that dredging exposes the remains of one or more range beacons, the NC Underwater Archaeology Branch (UAB) at Fort Fisher should be informed so that an assessment of the structures' historical significance can be assessed and its remains documented.