

APPENDIX 1 SCOPE OF SERVICES
(Digital Copy Only)

SCOPE OF PROFESSIONAL SERVICES OUTER BANKS, NORTH CAROLINA COMPREHENSIVE SAND SEARCH PERMITTING AND ENGINEERING SUPPORT FOR BEACH NOURISHMENT

In order to obtain a state permit from the NC DCM, geotechnical and geophysical investigations of both the native beach and borrow area must be conducted to determine if the source is compatible with the beach. The State Technical Standards for Beach Fill Projects (15A NCAC 07H.0312) defines the requirements of data collection and the procedure in which compatibility will be determined. CPE-NC will conduct preliminary and design level geophysical and geotechnical surveys, data processing and interpretation, borrow area design, compatibility analysis, and production of a final geotechnical report.

Field investigations associated with the Marine Sand Search Investigation include a preliminary joint seismic reflection profiling, sidescan sonar, bathymetric and magnetometer survey of four (4) investigation areas which are located in both state and federal waters. The working survey plan consists of approximately 112 miles of planned survey lines. CPE-NC will attempt to collect all 112 miles of geophysical data during the survey, however, conditions may not allow for collection of all planned lines. On-the-fly interpretations will be made during the survey to allow CPE-NC to prioritize areas and sub-sections of areas in the event that data cannot be collected along all of the planned survey lines. Following the preliminary geophysical survey, forty (40) vibracores will be collected within the investigation areas. On-the-fly interpretations of the vibracores will be made to determine which areas to target with additional vibracore surveys. Upon collecting the first forty (40) vibracores, CPE-NC will move into the design level vibracore surveys, which will entail the collection of an additional sixty (60) vibracores. After the collection and analysis of the vibracores, a design level geophysical survey will be conducted. The layout of the joint seismic reflection profiling, sidescan sonar, bathymetric and magnetometer survey will be determined based on the results of the preliminary geophysical survey as well as the vibracore investigations.

A detailed description of each task associated with this scope of professional services is provided below.

Bureau of Ocean Energy Management (BOEM) Authorizations

Portions of three (3) of the four (4) survey areas shown on Figure 1 are located seaward of state waters, falling under the jurisdiction of the Bureau of Ocean Energy Management (BOEM). The offshore surveys (geophysical and geotechnical) will require authorization from BOEM. CPE-NC will prepare and submit BOEM Authorization applications and respond to any requests for additional information. CPE-NC will coordinate with BOEM and incorporate reasonable protocol necessary to adhere to conditions of the authorizations in order to conduct the surveys. CPE-NC will also provide status updates and final deliverables to BOEM as required in the authorizations.

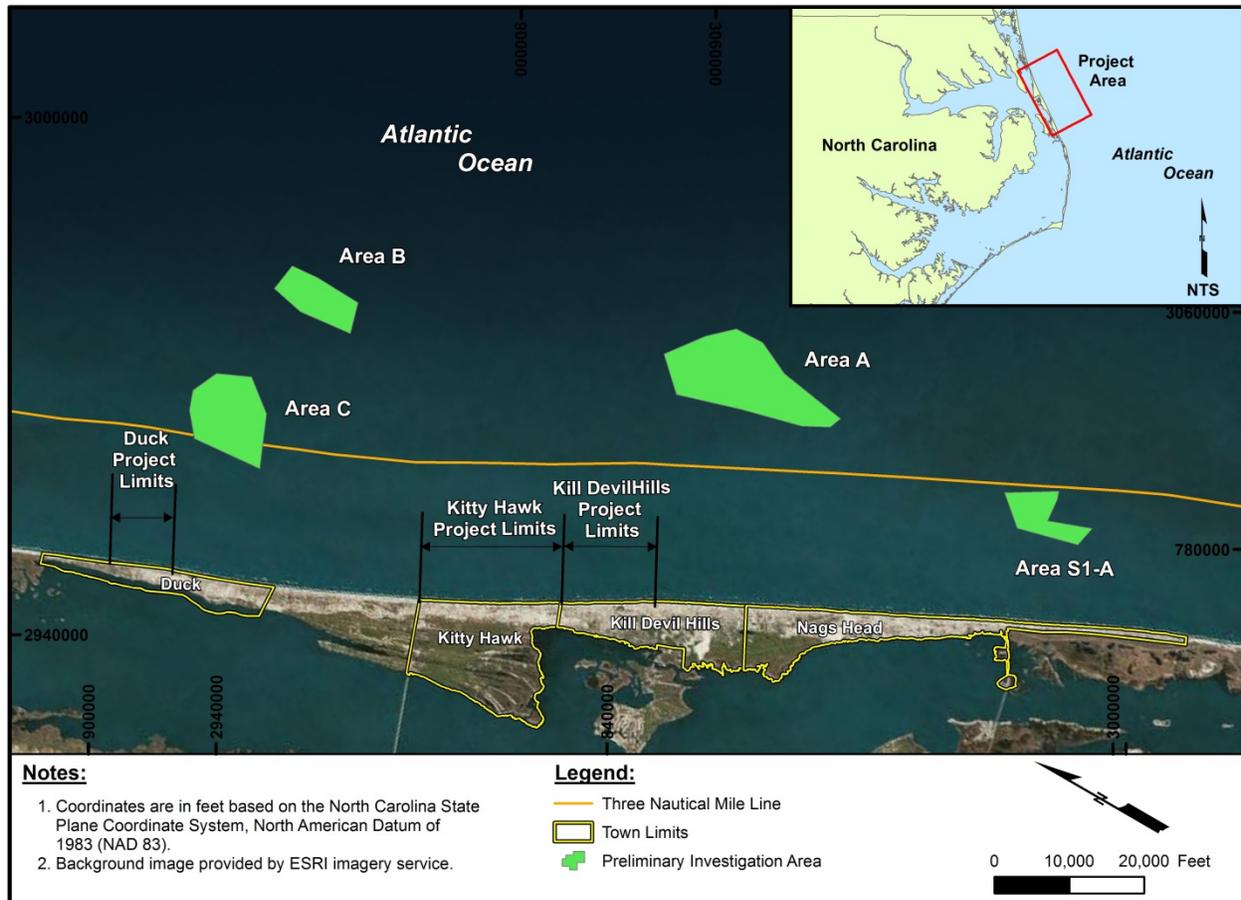


Figure 1 Preliminary Investigation Areas.

Preliminary Geophysical Survey

The geophysical survey includes subbottom profiling using the EdgeTech X-Star SB-512i “chirp sonar system”, a sidescan sonar survey utilizing the EdgeTech 4200 HFL chirp sidescan system (or equivalent), a magnetometer and a fathometer. Approximately 112 line miles of geophysical data will be collected during the preliminary geophysical survey.

The survey control and accuracy standards will be consistent with the North Carolina Division of Coastal Management’s Technical Standards for Beach Fill Projects (15A NCAC 07H .0312). A report from the surveyor will be submitted certifying that the survey meets the technical standards.

Geophysical Survey Equipment

Navigation System: A Real Time Kinematic Global Positioning (RTK GPS) system with dual frequency receivers will be used on board the survey vessel to provide high-precision navigation and instantaneous tide corrections. In order to maintain the vessel navigation along the profile lines Hypack Inc.’s hydrographic system Hypack 2013® (or equivalent) will be used. This software merges RTK GPS vertical and horizontal positioning with the sounding data, allowing real time review of the profile data in plan view or cross section format. It also provides navigation to the helm to control the deviation from the online azimuth.

Seismic Reflection Profile Surveys: An EdgeTech X-STAR 512i seismic sub-bottom system will be used to conduct the seismic reflection profile surveys. The X-STAR SB-512i Full Spectrum Sonar is a

versatile wideband FM sub-bottom profiler that collects digital normal incidence reflection data over many frequency ranges. This instrumentation generates cross-sectional images of the seabed (to a depth of up to 50 ft.). The X-STAR SB-512i transmits an FM pulse that is linearly swept over a full spectrum frequency range (also called a “chirp pulse”). The tapered waveform spectrum results in images that have virtually constant resolution with depth.

Throughout the offshore seismic reflection survey, selection of the chirp pulse will be modified in real time to obtain the best possible resolution of geological features and the sequence stratigraphy (*i.e.* vertical sequence and lateral distribution of sediment bodies comprised by different grain sizes and sediment composition) that in turn optimizes data quality and enhances subsequent interpretation. High frequency and/or short duration pulses are, for example, used to obtain highest resolution (clearest reflector image) in near surface situations; low frequency or longer duration pulses are used where deeper penetration is required.

Bathymetric Survey: The Odom Hydrographic Systems, Inc.’s Hydrotrac, a single frequency portable hydrographic echo sounder (or equivalent) will be used to perform the bathymetric survey. The Hydrotrac operates a frequency of 210 kHz and is a digital, survey-grade sounder. The sounder will be calibrated using an Odom Hydrographic Systems, Inc.’s Digital Pro® speed-of-sound velocity meter. Speed of sound through water and other selected parameters will be adjusted to accurately reflect physical water conditions in the survey area. A bar check will be performed at the beginning and end of each survey session.

Sidescan Sonar Survey: An EdgeTech 4200-HFL sidescan sonar system (or equivalent) will be used to collect sidescan sonar data. The 4200-HFL uses full-spectrum chirp technology to deliver wide-band, high-energy pulses coupled with high resolution and superb signal to noise ratio echo data. The portable sidescan package includes a laptop computer running the Discover® acquisition software and a 300/600 kHz dual frequency towfish running in high definition mode.

Magnetometer Survey: A Geometrics G-882 Digital Cesium Marine Magnetometer (or equivalent) will be used to perform a cursory investigation of magnetic anomalies within the potential sediment sources. The purpose of the magnetometer survey is to establish the presence, and subsequent exclusion zones around any potential underwater wrecks, submerged hazards, or any other features that would affect borrow area delineation and dredging activities. The Hypack 2013® software will record magnetic anomalies directly from the Geometrics magnetometer.

Geophysical Data Analysis

The EdgeTech Discover data acquisition system collects and stores geophysical survey data in a digital format. EdgeTech’s Discover is a modular acquisition and processing software package that is compatible with all of EdgeTech’s systems. It serves as the digital image processing, display, storage, and surface control station for the EdgeTech 512i sub-bottom profiler (chirp sonar system). This data acquisition system digitizes, stores, and processes seismic signals and combines the seismic imagery with navigational inputs to georeference data in real-time. Hardcopy records will be produced during data acquisition.

The digital sidescan data will be merged with positioning data (RTK GPS via HYPACK 2013®), video displayed, and recorded to the acquisition computer’s hard disk for post processing and/or replay. The position of the sensor relative to the RTK GPS antenna will be documented to ensure proper positioning of the data.

All sidescan sonar and seismic reflection data will be processed using the SonarWiz.MAP software package developed by Chesapeake Technologies Inc. This software package allows for advanced processing, interpretation, and digital mosaic output and can produce georeferenced HTML's viewable in generic web-browser software programs. SonarWiz.MAP also produces digital geographic information for both sub-bottom and sidescan data that are exportable for incorporation into a GIS database. All sidescan sonar, sub-bottom profile, magnetometer and bathymetric data collected during the course of the preliminary geophysical survey will be processed and interpreted by CPE-NC personnel. In addition, the magnetometer data will be reviewed by a qualified archaeologist for cultural resource interpretation.

Vibracore Survey

A vibracore survey plan will be developed based on the results of the preliminary geophysical survey. The survey includes vibracoring to investigate promising locations identified during the preliminary geophysical survey. Forty (40) vibracores will be collected during the initial investigation of the potential sand sources. Based on field interpretations of these forty (40) vibracores, an additional sixty (60) vibracores (total of 100) will be collected in order to delineate the most promising sand deposits and satisfy the 1000-foot spacing requirements required by the State Technical Standards.

Vibracore Survey Equipment

A 271B Alpine Pneumatic vibracore, configured to collect undisturbed sediment cores up to 20 ft. in length, will be used for this investigation. This self-contained, free-standing pneumatic vibracore unit contains an air-driven vibratory hammer assembly, an aluminum H-beam which acts as the vertical beam upright on the seafloor, 20-ft long steel tubes measuring 4" in diameter (with a plastic core liner) and a drilling bit with a cutting edge. An air hose array provides compressed air from the compressor on deck to drive the vibracore. If recovery is less than 85% of the expected total penetration, the sampled portion will be removed from the pipe, a new core pipe attached, and a jet pump hose will be attached just below the vibracore head. After lowering the rig to the bottom and jetting to two (2) feet above the recovery depth, the jet will be turned off and the vibrator turned on in order to attempt to collect the remaining core. The vibracore unit will be crane deployed from a sufficiently large vessel to adequately deploy and retrieve the unit.

At each core location a vibracore will be taken. If field measurements indicate that less than 85% recovery has been achieved, then up to two (2) additional cores will be taken, or a hydraulic jetting technique will be used to facilitate sampling below previously retained material. In the event a jet is used, the recovery of the original vibracore and additional vibracore sections will be combined to determine total recovery. Should the above procedures not result in 85% or more recovery, then this drilling effort will be considered a completed core for purposes of payment under this contract.

Geotechnical Data Analysis

Vibracore Logging During Field Operations: After retrieval, each core will be split in half and each core will be field logged to verify the most promising areas for continued vibracoring. Splitting the vibracores during field investigations provides an opportunity for immediate visual evaluation of the core and real time optimization of the vibracoring plan (the sampling program may be modified based on what is observed in the recovered materials). This flexibility in the field is important to allow the geologist to focus on potential sand resources. Other advantages of core splitting and logging in the field are realized when it can be immediately determined whether shorter than expected cores are due to loss of sediment or compaction, or whether there are other abnormalities such as coarse materials plugging the core causing gaps in sediment retrieval, etc.

Sediment Sample Analysis: Upon completion of field operations, all vibracores will be transported to CPE-NC's office in Wilmington, NC. There, the vibracores will be logged in greater detail by describing sedimentary properties by layer in terms of layer thickness, color, texture (grain size), composition and presence of clay, silt, gravel, or any other identifying features. The vibracores will be photographed in 2.0

ft. intervals. Sediment samples will be extracted from the vibracores at irregular intervals based on distinct stratigraphic layers in the sediment sequence. The vibracores will then be wrapped and archived. Cores will be stored for a period of up to one (1) year. After this time, cores may either be relinquished to the client or stored for an additional annual cost of \$25 per core.

Mechanical Sieve Analysis: The sediment samples will be analyzed to determine color and grain size distribution. During sieve analysis, the wet, dry and washed Munsell colors will be noted. Sieve analysis of the sediment samples will be performed in accordance with the American Society for Testing and Materials (ASTM) Standard Methods Designation D 422-63 for particle size analysis of soils. This method covers the quantitative determination of the distribution of sand size particles. For sediment finer than the No. 230 sieve (4.0 phi) the ASTM Standard Test Method, Designation D 1140-00 will be followed. Weights retained on each sieve will be recorded cumulatively. Grain size results will be entered into the gINT® software program, which computes the mean and median grain size, sorting, silt/clay percentages for each sample using the moment method.

Carbonate Testing: Samples will also be tested for carbonate content. Carbonate content will be determined by percent weight using the acid leaching methodology described in Twenhofel, W.H. and Tyler, S.A., 1941. *Methods of Study of Sediments*. New York: McGraw-Hill, 183p.

Design Level Geophysical Survey/Cultural Resource Survey

The geophysical survey includes subbottom profiling using the EdgeTech X-Star SB-512i “chirp sonar system”, a sidescan sonar survey utilizing the EdgeTech 4200 HFL chirp sidescan system (or equivalent), a magnetometer and a fathometer. Line miles will be dependent on the extent of the areas delineated based on the results of the preliminary geophysical survey and the vibracore survey. The specifications of the equipment to be used and the data processing methodology are the same as those listed under Sub-Task B. We anticipate approximately 270 line miles will be surveyed during the design level geophysical survey. The purpose of this survey is primarily to satisfy cultural resource requirements set forth by the State of North Carolina and BOEM. This investigation will supplement the data acquired during the preliminary geophysical investigation in order to obtain the 30 meter line spacing required to perform the cultural resource assessment.

A cultural resources report will be prepared by a qualified marine archeologist under the direction of CPE-NC and sent to the State Historic Preservation Office (SHPO) and BOEM for review and approval. The report will include a historical review of the region as well as interpretations of the survey data collected during the preliminary and design level geophysical surveys and the vibracore surveys.

This scope of work does not include diver verification of any resources such as hardbottom, sea grass, cultural resources, etc., that may be identified during the course of the preliminary or design level geophysical surveys. If during the investigations CPE-NC finds evidence of such resources that would impact borrow area design, CPE-NC will immediately notify the TOWN. At that time, pending TOWN approval, CPE-NC will develop a cost proposal for diver verification of potential environmental resources.

Native Beach Samples

The state sediment criteria requires a total of thirteen (13) samples from specifically defined locations along at least five (5) profiles within the project area (15A NCAC 07H.0312)(1)(c and d). Required sample distribution along the profile includes six (6) samples landward and six (6) samples seaward of the mean low water (MLW) contour and one (1) additional sample at the MLW line for a total of thirteen (13). During the course of the Feasibility Study for the federal Dare County Storm Damage Reduction Project, the USACE collected samples along four (4) profiles within the project area. However, the

sampling regiment used by the USACE is not consistent with the State Technical Standards. CPE-NC will collect three (3) additional samples along the four (4) profiles previously sampled by the USACE to meet the state requirements. In addition, CPE-NC will collect thirteen (13) samples along one (1) additional profile within the proposed project area to meet the minimum five (5) profiles required by the State Technical Standards.

Towns of Duck, Kill Devil Hills, and Kitty Hawk

- A. On October 15, 2013; CPE-NC collected beach samples and nearshore sediment samples along five (5) profiles in the Duck project area (D-03, D-08, D-13, D-18, D-24). A total of 65 new samples were collected.
- B. On September 14 and 15, 2014; CPE-NC collected beach samples and nearshore sediment samples along five (5) profiles in Kill Devil Hills (KDH160, KDH210, KDH260, KDH290, KDH320). A total of 28 new samples were collected to complement existing beach samples collected by the USACE in 1996.
- C. On April, 26 2014 CPE-NC collected beach samples and nearshore sediment samples along five (5) profiles (KH0+00, KH50+00, KH75+00, KH110+00, KH160+00). A total of 26 new samples were collected to complement existing beach samples collected by the USACE in 1993.

Mechanical sieve analysis will be conducted on each sample using the methodology described in detail under the Geotechnical Analysis section. A composite grain size will be calculated for each profile. A composite sample for the complete profile sampled by CPE-NC will be prepared by mixing equal parts of samples from each sample location along a profile. Likewise, a composite sample of the three (3) additional samples collected along the four (4) partial profiles sampled by CPE-NC will be prepared by mixing equal parts of samples from each location along the profile. The composite samples generated for each profile will be analysed for calcium carbonate content using the same methodology described in detail under the Geotechnical Analysis section.

In addition to grain size and calcium carbonate content analysis, a survey will be performed (as required by the state rule) of a 50,000 ft² representative shoreline portion of the project area to quantify the number of clasts > 3 inches in diameter present within the survey area. This survey serves as a baseline and will be duplicated upon completion of a beach nourishment project. This proposal includes the baseline survey to quantify clasts > 3 inches in diameter and does not include any post-construction surveys.

Compatibility Analysis, Product and Report Development

A compatibility analysis will be conducted to match the borrow area(s) and beach for optimum project performance and to satisfy the State Technical Standards. Composite values for mean grain size, percent silt, percent gravel, and percent carbonate will be calculated for the sediment contained in each borrow area designed. These composite values for the borrow areas will be compared to composite values for the same sediment characteristics calculated from the native beach sampling. The results of the analysis of both borrow area and native beach samples will be included along with the results of the compatibility analysis as part of the final geotechnical report.

A preliminary draft geotechnical report will be prepared and submitted to the TOWN in both digital and hardcopy format for review and comment. This report will include project results, including bathymetric and isopach (sediment thickness) maps, sub-bottom (seismic) survey profiles, vibracore logs, vibracore photographs, granulometric reports and grain size distribution curves. The TOWN will identify any revisions that may be necessary and provide recommendations for the final draft report. The final draft report will be submitted along with the draft EA to state and federal resource agencies. In the event that comments are provided by the resource agencies, CPE-NC will amend the draft report to address those comments. Addressing comments does not include the collection of additional field data. In the event that additional field data is required, CPE-NC will submit a separate proposal for the work.

A final report summarizing the results of the geotechnical investigation will be prepared and submitted to the TOWN and state and federal resource agencies as an addendum to the Final EA.

Additional Vibracore Surveys (Contingency)

This scope proposes the collection of 100 vibracores to develop borrow areas for the project. There may be a need for additional vibracores, depending on the thickness of the deposits targeted for borrow area development. CPE-NC proposes the collection of up to fifty (50) additional vibracores as a contingency item. The use of this contingency would require an additional written approval by the TOWN in the event that it is recommended by CPE-NC in the course of completing the Geotechnical Analysis. The same method of collection and analysis described in the Geotechnical Analysis section will be used.

CAVEATS

CPE-NC proposes to perform the marine sand search to the industry standard of care and will coordinate the investigations with federal and state regulatory agencies as required. Even though the regulatory agencies may agree with the scope of the investigations, beach compatible sand may not be located, regulatory agencies may not approve the sand source(s) we locate, or regulatory agencies may impose a sand placement QA/QC requirement that would be difficult to meet. If any of these events occur, it may be necessary to locate additional beach compatible sand sources at additional cost. CPE-NC will also make reasonable attempts to determine if other entities are exploring the same sand sources or have a permit to use the same sand we intend to investigate. Despite these efforts, it is possible that others may claim the sand that we find, and negotiations and/or further exploration may be required if that occurs. Lastly, cultural or environmental resources may exist in or near the investigated borrow area that would limit or preclude a portion or all of its use.

CPE-NC will attempt to avoid these problems and restrictions, but there may be adverse circumstances that cannot be avoided or mitigated. All of the listed potential outcomes may be beyond the control of CPE-NC and may result in the need for additional services. The TOWN herein recognizes the above referenced risks and agrees to work with CPE-NC to complete the work, which may include contracting for additional services for sand investigations as needed.