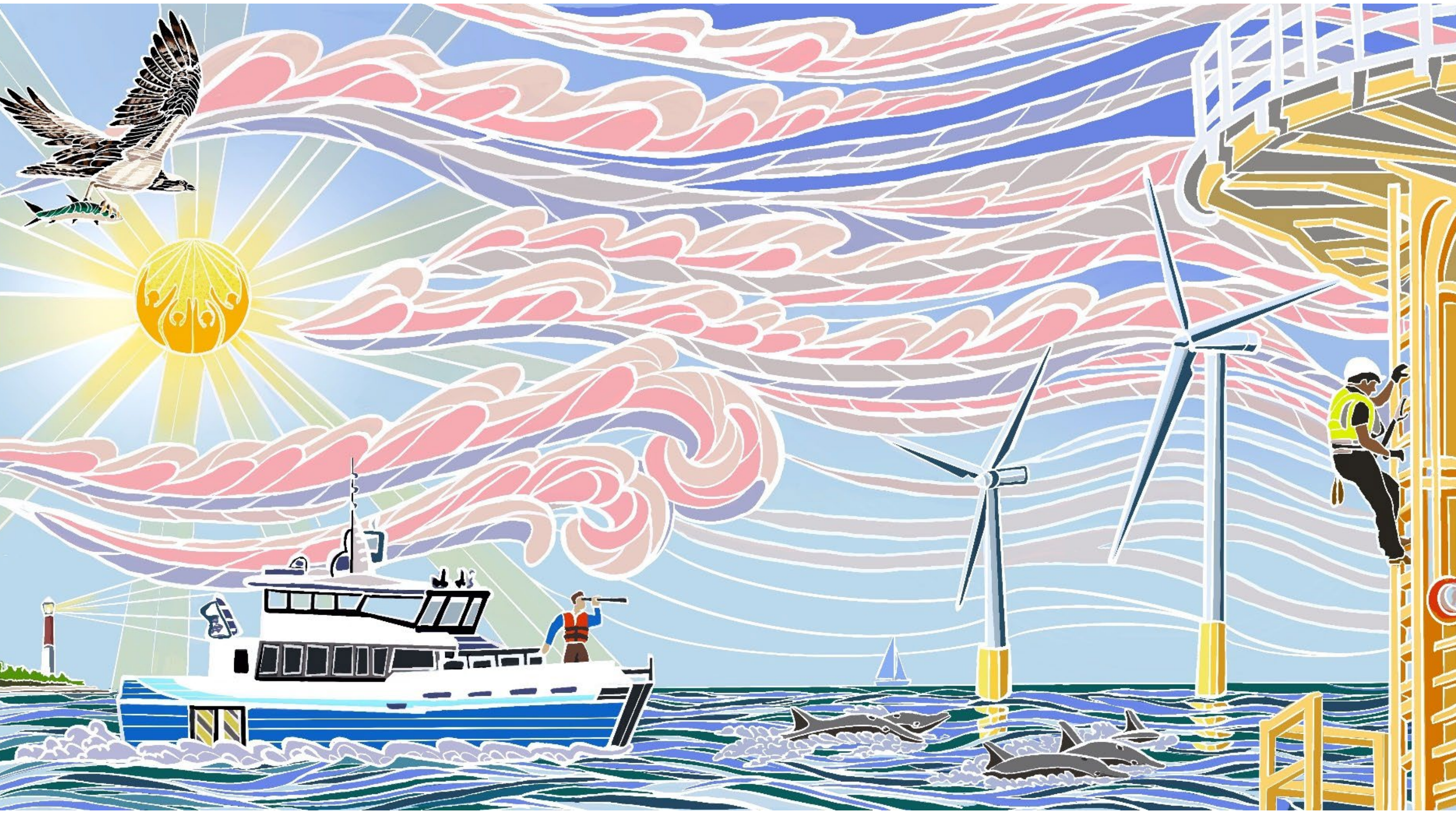

Appendix II-Q

Marine Archaeological Resource Assessment (MARA) –
Public Summary

March 2024

Marine Archaeological Resources Assessment – Public Summary

Atlantic Shores North Offshore Wind Project

Atlantic Outer Continental Shelf

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March 2024

Note: Atlantic Shores has updated the Project Design Envelope to include the following landfall sites: Monmouth Landfall Site, Asbury Landfall Site, Kingsley Landfall Site, Lemon Creek Landfall Site, Wolfe's Pond Landfall Site, and Fort Hamilton Landfall Site. The information included in this report demonstrates the completeness of Atlantic Shores' multi-year development efforts and should be considered representative for the Project. For additional information regarding the layout of the Project, please refer to COP Volume I Project Information, Sections 1.0 Introduction and 4.7 Landfall Sites, as well as Figure 1.1-2 Project Overview.

1.0 INTRODUCTION

Atlantic Shores Offshore Wind, LLC (Atlantic Shores) is a 50/50 joint venture between EDF-RE Offshore Development, LLC (a wholly owned subsidiary of EDF Renewables, Inc. [EDF Renewables]) and Shell New Energies US, LLC (Shell). Atlantic Shores is proposing to develop offshore wind energy generation facilities within Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0549 (Lease Area). The Lease Area covers approximately 81,129-acre (328.3-square kilometer [km^2]) located in federal waters on the Atlantic Outer Continental Shelf (OCS) within the New Jersey Wind Energy Area (NJWEA). The facilities to install within the Lease Area will include a maximum of up to 157 wind turbine generators; up to eight small, four medium, or three large offshore substations; inter-array and/or inter-link cables connecting the wind turbine generators and offshore substations; and up to one permanent meteorological tower. The two Export Cable Corridors (ECCs), referred to as the Monmouth ECC and Northern ECC, will traverse federal, New Jersey, and/or New York State waters to landfall sites on the New Jersey and/or New York coastlines. A full description of Project and associated plans for construction, operations and maintenance (O&M), and decommissioning can be found in Volume I (Project Information) of the Atlantic Shores Construction and Operations Plan (COP) for the Project (EDR, 2022).

SEARCH, Inc. (SEARCH) conducted a marine archaeological resources assessment (MARA) designed and produced to assist BOEM in complying with the implementing regulations for Section 106 of the Historic Preservation Act (NHPA) (36 CFR Part 800), the National Environmental Policy Act (NEPA) (Title 42 U.S.C. § 4321 et seq.), and other applicable laws and regulations. The full MARA is included as Appendix II-Q1 of the Project's COP. All phases of work were designed, directed, and managed by professional cultural resource specialists who meet the professional qualification standards in the Secretary of the Interior's *Standards and Guidelines for Archeology and Historic Preservation*. The MARA has been developed in accordance with 30 CFR Part 585 and the stipulations in Atlantic Shores' Lease Agreement OCS-A 0549.

1.1 Purpose of the Investigation

The Project constitutes a federal undertaking with the potential to cause effects to submerged historic properties, and it is therefore subject to consultation under Section 106 of the NHPA (Title 54 U.S.C. 306108). SEARCH provided technical expertise to Atlantic Shores' marine survey contractor (MSC), Fugro USA Marine, Inc. (Fugro), pursuant to 30 CFR 585, which established BOEM procedures for the issuance and administration of offshore renewable energy leases. The purpose of Atlantic Shores multi-year marine survey campaign and associated assessments were to support the identification and characterization of potential submerged historic properties within the Marine Physical Effects Preliminary Area of Potential Effects (hereafter, PAPE). Atlantic Shores conducted a set of comprehensive desktop, geotechnical, and geophysical assessments of the Offshore Project Area to identify known archaeological sites as well as to characterize the potential for the WTA and ECCs to include marine archaeological sites. These surveys were conducted in accordance with approved Marine High-Resolution Geophysical (HRG) Survey Plans (ASOW 2020, 2021, 2022).

Working with experts in Tribal history, marine archaeology, geology, and maritime history, Atlantic Shores designed surveys to identify potentially sensitive submerged cultural sites and landscapes and took appropriate action (as well as planned future actions) to avoid potential effects to cultural resources. Submerged historic properties include pre-contact ("prehistoric") and historic period archaeological sites, objects, districts, or structures (including shipwrecks) that are listed in or eligible for listing in the NRHP maintained by the Secretary of the Interior or have been designated as National Historic Landmarks (NHLs) by the Secretary of the Interior (30 CFR Part 585, Subpart F).

SEARCH, in the role of Qualified Marine Archaeologist (QMA) for the Projects, created a pre-contact and historical context for the region, assembled a geologic and paleoenvironmental background, generated a reconstructed paleolandscape model, reviewed previous archaeological investigations conducted in the vicinity, and identified submerged cultural resources reported in the vicinity of the Projects to supplement and guide data analysis. The MARA presents this research and data analysis, as well as a discussion of survey and data processing technologies and methodologies and the archaeological findings and recommendations. The intent is to assess the presence/absence of potential submerged cultural resources that may be adversely affected by seafloor-disturbing activities (horizontal and vertical) associated with the Projects' installation, operation, and decommissioning. In general, since the identification of a target's source(s) is not always possible through HRG survey data, nor is the assessment of a target's integrity, significance, or eligibility for listing in the National Register of Historic Places (NRHP; i.e., historic property designation), SEARCH recommends avoidance buffers in lieu of additional archaeological investigation.

1.2 Overview of the Projects

Atlantic Shores' Lease Area is located on the OCS within the NJWEA, which was identified by BOEM as suitable for offshore renewable energy development through a multi-year, public environmental review process. The Project will be located in Lease Area OCS-A 0549, which is 81,129 acres (328.3 km^2) in area (see Figure 1). Lease Area OCS-A 0549 is located north of and is adjacent to Atlantic Shores' Lease Area OCS-A 0499. At its closest point, the Lease Area is approximately 8.3 miles (mi.; 13.5 kilometers [km]) from the New Jersey coastline. The facilities to be installed within the Lease Area will include:

- a maximum of 157 wind turbine generators (WTGs);

- up to eight small, four medium, or three large offshore substations (OSSs);
- inter-array and/or inter-link cables connecting the WTGs and OSSs;
- up to one permanent meteorological (met) tower; and
- up to two temporary meteorological and oceanographic (metocean) buoys.

The Lease Area layout is designed to maximize offshore renewable wind energy production while minimizing effects on existing marine uses. The structures will be aligned in a uniform grid allowing straight transit through the Lease Area. Given the proximity to and shared border between the two Atlantic Shores lease areas, the layouts of both lease areas form a continuous regular grid. In developing the layout, existing vessel traffic patterns and feedback from agencies and consulting parties (including the U.S. Coast Guard [USCG] and commercial and recreational fishers) were considered.

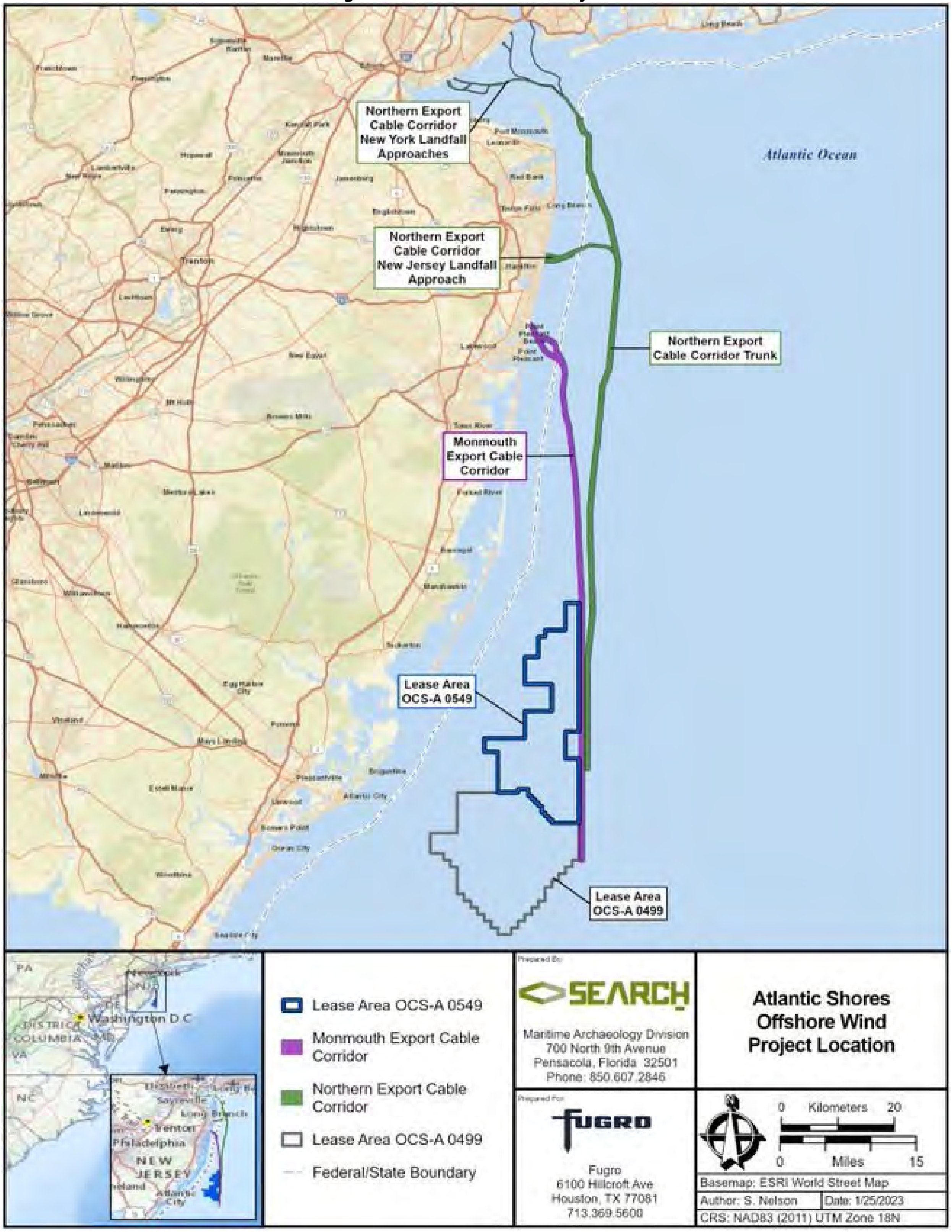
Within the Lease Area, the WTGs and OSSs will be connected by inter-array cables and/or inter-link cables. Energy from the OSSs will be delivered to shore by buried export cables that will travel within designated ECCs from the Lease Area through Federal as well as New Jersey State and/or New York State waters to landfall sites on the New Jersey and/or New York coastlines.

The Monmouth ECC extends from south to north along the eastern side of the Lease Area. It then continues north prior to turning west to a terminus at a single potential landfall site in southern Monmouth County, New Jersey. The total length of the Monmouth ECC associated with the Project from the Lease Area to the furthest potential landfall location is approximately 61 mi. (97.5 km).

The maximum length of the Northern ECC from the Lease Area to the furthest potential landfall location is approximately 90.4 mi (145.5 km). The Northern ECC extends north from the Lease Area to a point where it branches off into New Jersey waters (the Asbury Branch of the Northern ECC) and continues further north to a point where it branches to three possible landfall locations in New York. The Asbury Branch of the Northern ECC extends westward from the Northern ECC approximately 8.6 mi (13.9 km) to the potential Asbury Landfall Sites in northern Monmouth County, New Jersey.

In New York State waters, the Northern ECC branches to the Lemon Creek and Wolfe’s Pond Landfall Sites on southwest Staten Island in Richmond County, New York and the Fort Hamilton Landfall Site in Brooklyn in Kings County, New York.

Figure 1. Overview of the Projects[a]



a. Note that the Atlantic Shores Project Location and Preliminary APE are inclusive of project components no longer part of the PDE. This MARA Public Summary demonstrates multi-year development and survey efforts completed. Please see the PDE as defined in the COP Volume I Project Information.

1.3 Potential Project Impacts

The Projects may impact potential submerged cultural resources during Project construction and installation, operations and maintenance, and decommissioning. Potential impacts are assessed through the identification and definition of "Impact Producing Factors" (IPFs). Relevant BOEM guidance characterizes IPFs as defining the particular ways in which an action or activity affects a resource, identifying the cause-and-effect relationships between actions (e.g., the construction, operation, and decommissioning of the proposed Project) and relevant physical, biological, economic, or cultural resources (BOEM, 2019). For the purposes of this study, IPFs are defined as specific project activities or actions that could either positively or negatively impact cultural resources. IPFs can define direct impacts caused by Project actions or activities or indirect impacts which are reasonably foreseeable impacts that occur later in time or are removed in distance from project actions or activities. IPFs are also characterized in terms of the duration of the potential impact, whether they are temporary, short term, long-term, or permanent.

For the Atlantic Shores Project, the following IPFs in Table 1 have been identified for marine cultural resources. These two IPFs have the potential to negatively impact submerged cultural resources during the construction and installation, operations and maintenance, and decommissioning phases of the Projects.

Table 1. Impact Producing Factors during Project Phases

Impact Producing Factors	Construction & Installation	Operations & Maintenance	Decommissioning
Anchoring and jack-up vessels	●	●	●
Installation and maintenance of new structures and cables	●	●	●

1.3.1 Anchoring and Jack-up Vessels

Anchored or jack-up vessels may be utilized to facilitate construction and installation of the Projects. Jack-up vessels have legs that lower into the seabed and brace the vessel as it elevates above sea level, where it can safely perform operations in a stable, elevated position. Anchoring impacts can occur at the locations where anchors are placed on the seabed, within sediments disturbed or compressed beneath the seafloor as the anchor settles, and the seafloor disturbance from anchor chains being dragged across seafloor during anchor deployment, collection, or vessel movement (referred to as anchor sweep). The vertical extent of seafloor impacts from vessel anchoring and jack-up vessels is anticipated to range from 3.3 to 16.4 feet (ft.) (1.0 to 5.0 meters [m]). The maximum anchoring area of disturbance for both the Monmouth and Northerns ECCs is estimated to be 0.1 square miles ($mi.^2$; 0.26 km^2). Any anchoring activities during WTG or OSS installation will occur within the disturbance areas presented for each foundation type. The use of anchored and jack-up of vessels would result in seabed disturbance and therefore could affect cultural resources if present in the area.

1.3.2 Installation and Maintenance of New Structures

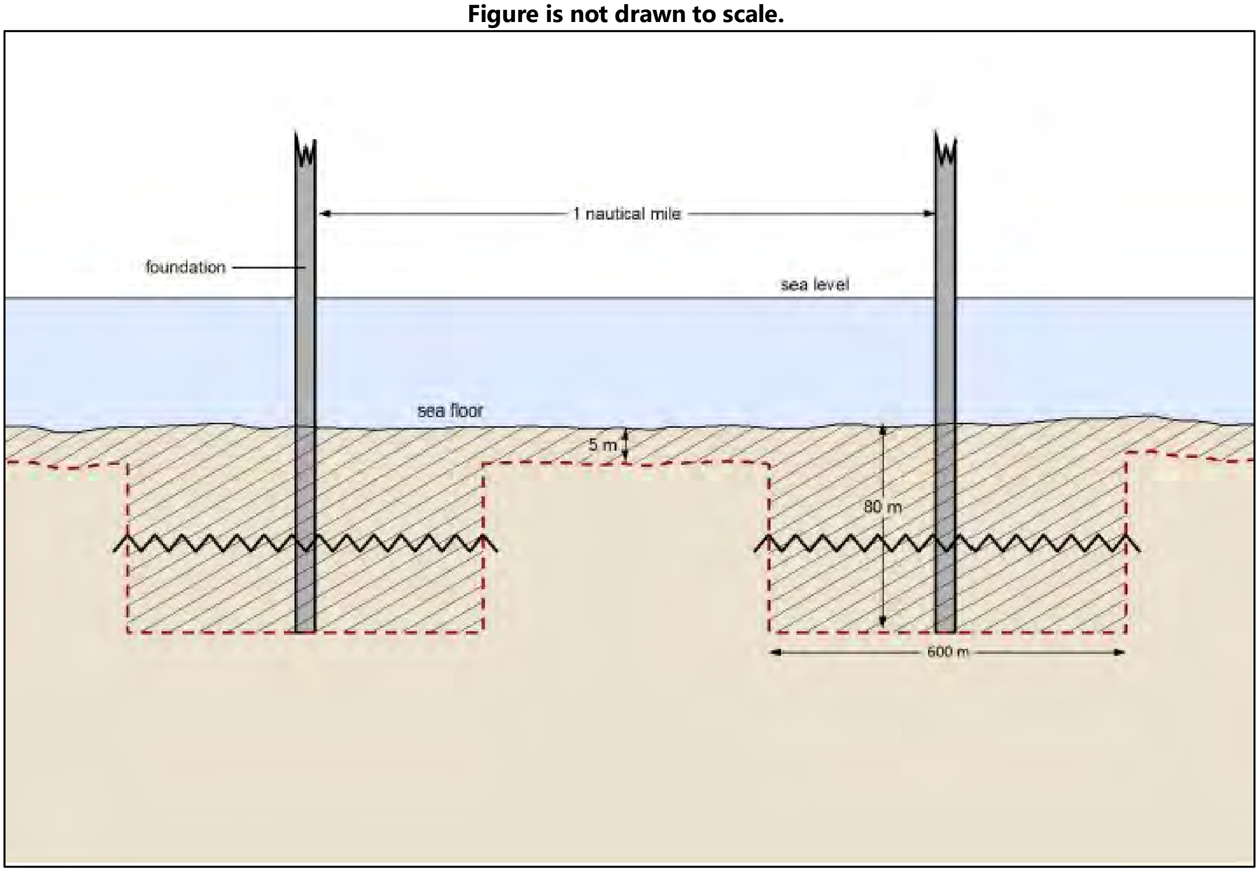
The installation and maintenance of new structures and cables will disturb sediments on the ocean floor and therefore could affect archaeological resources (if present). Seafloor-disturbing activities during construction of the WTG, OSS, and meteorological tower foundations and installations of metocean buoys could include seabed preparation for certain foundation types, foundation placement, and scour protection installation. Seafloor-disturbing activities during installation of the offshore cables include pre-installation activities (sand wave clearing, boulder relocation, pre-lay grapnel run, etc.), offshore cable installation, cable protection where needed, and excavation at the horizontal directional drilling (HDD pit). The impacts associated with the installation and maintenance of new structures will occur within the areas surveyed by the MSC and subsequently analyzed by SEARCH.

1.4 Description of Preliminary Area of Potential Effects (PAPE)

The PAPE defines the geographic scope of potential impacts to submerged historic properties based on Atlantic Shores analyses. In accordance with the Section 106 regulations, the formal Area of Potential Effects (APE) will be determined by BOEM through on-going consultations. The Marine Physical Effects PAPE is defined as the combination of the approximately 81,129-acre (328.3-km^2) WTA and both proposed ECCs (including the 25,600-acre [103.6-km^2] Monmouth ECC and the 36,480-acre [147.6-km^2] Northern ECC) (Figure 1). Construction activities are expected to affect a small percentage of the seabed encompassed by the Marine Physical Effects PAPE, which includes the locations of the following specific facilities:

- **WTG foundations:** the PAPE represents the maximum disturbance associated with the Project Design Envelope (PDE) for WTG foundations. The PDE for WTG foundations includes piled, suction bucket, and gravity foundations, as described in Section 4.2 of COP Volume I (EDR, 2022). For each WTG foundation, SEARCH assessed an area possessing a 262 ft. (80 m) below seabed (bsb) vertical limit with a 1,969 ft. (600 m) diameter horizontal limit centered on each proposed WTG foundation (Figure 2).

Figure 2. Diagram depicting the vertical depths of impacts associated with the WTG and OSS foundations. Figure is not drawn to scale.



- **OSS foundations:** the PAPE represents the maximum disturbance associated with the PDE for OSS foundations. The PDE for OSS foundations includes piled, suction bucket, and gravity foundations, as described in Section 4.4 of COP Volume I (EDR, 2022). For each OSS foundation, SEARCH assessed an area possessing a 230 ft. (70 m) bsb vertical limit with a 1,969 ft. (600 m) diameter horizontal limit centered on each proposed OSS foundation.

- **Offshore cables:** the PAPE represents the maximum disturbance associated with the PDE for offshore cables. The PDE includes export, inter-array, and interlink cables, as described in Section 4.5 of COP Volume I (EDR, 2022). For the offshore cables, SEARCH assessed a 16 ft. (5.0 m) bsb vertical limit in all areas of the PAPE apart from the 1,969 ft. (600 m) buffer surrounding proposed WTG and OSS foundation locations.

- **Meteorological (Met) towers and buoys:** the PAPE represents the maximum disturbance associated with the PDE for met towers and buoys, as described in Section 4.6 of COP Volume I (EDR, 2022). For the meteorological tower foundation, SEARCH assessed an area possessing a 262 ft. (80 m) bsb vertical limit with a 1,969 ft. (600 m) diameter horizontal limit centered on the foundation. For the buoys, SEARCH assumed a maximum vertical limit of 3.3 ft. (1.0 m), which would be accommodated by the 16 ft. (5.0 m) maximum depth of impact limit throughout the majority of the PAPE.

- **Vessel anchoring and jack-up vessels:** As described above and in Section 4.10 of COP Volume I (EDR, 2022), vessel anchoring, and jack-up vessels are minimally intrusive to the seabed and the depth of disturbance for these activities range from 3.3 to 16.4 ft. (1.0 to 5.0 m). These activities are anticipated to occur within the rows and corridors defined for installation of the WTGs and cables. SEARCH assessed a 16 ft. (5.0 m) bsb vertical limit in all areas of the PAPE to accommodate potential impacts from vessel anchoring and jack-up vessels.

For the purposes of the MARA, SEARCH assumed a maximum vertical depth of disturbance of 262 ft. (80 m) bsb within a 1,969 ft. (600 m) diameter centered on each WTG and OSS location, which corresponds to the maximum embedment depth for the deepest foundation type. The 1,969 ft. (600 m) diameter horizontal limit is designed to afford the developer flexibility in its Project design through allowances for micro-siting of the foundations, as well as to accommodate the maximum extent of potential impacts during construction, O&M, and decommissioning of the WTG and OSS foundations. It should be noted that the area of actual impacts associated with the WTG and OSS foundations will be significantly smaller. In the IAC areas, ECCs, and areas of the WTG rows not falling within the 1,969 ft. (600 m) diameter surrounding the WTG and OSS foundations, the maximum vertical depth of impact is 16 ft. (5.0 m) bsb.

Impacts associated with the construction and installation, O&M, and decommissioning of the infrastructure will be constrained within the horizontal boundaries of the Project. The final PAPE will be determined through BOEM consultation with NJHPO. The MARA presents information regarding the potential submerged cultural resources that may be adversely affected by seabeddisturbing (horizontal and vertical) activities within the PAPE. A QMA reviewed HRG data and the results of the geotechnical campaign to its full extent including areas beyond the PAPE; however, recommended targets are limited only to those targets or their avoidance buffers that overlap with the PAPE.

2.0 BACKGROUND RESEARCH

2.1 Environmental and Cultural Context

The natural environment of the PAPE must be considered prior to analyzing the marine remote-sensing data for preserved geomorphic features representing ancient submerged landforms. Archaeologists apply the knowledge that pre-contact people showed a preference for specific landscape features for various subsistence, social, ritual, and cultural tasks to help determine the likelihood of encountering archaeological sites in a particular region. Using local cultural history for the region, submerged ancient landforms, i.e., geomorphic features possessing archaeological interest, include, but are not limited to, floodplains adjacent to river systems, due to their proximity to fresh water, as well as areas of higher elevation, which are ideal vantage points with dry soils.

The potential for site preservation is highest in areas such as flood plains where overlying deposits may have protected site integrity during marine transgression. Resource procurement areas such as tool stone outcrops and estuaries for shell fishing are also features of interest. Evaluating the submerged coastal plains for these landscape features and lithic resources includes a review of regional climate, crustal geophysical shifts, sea-level changes, shoreline migration, and sediment typology.

2.1.1 Geologic Setting and Sea Level

The modern New Jersey outer continental shelf (NJ OCS) is situated between the Hudson canyon to the north and Delaware Shelf Valley to the south and measures approximately 75 to 93 mi. (120 to 150 km) wide with an area of roughly 25,000 km^2 (Carey et al., 2005).

The northeast continental shelf generally breaks into a steep downward slope toward the Atlantic abyssal plain at depths ranging from 328 to 426 ft. (100 to 130 m). However, the eastern extents of the shelf are extended by the Hudson Apron, an additional 10 to 12 mi. (15 to 20 km). The shelf is considered a mature, passive continental platform with low subsidence and sediment influx rates (Nordfjord et al., 2006). The shelf is associated with a storm-dominated, mixed energy shoreline, with a tidal range of 1.0 to 2.0 m and mean wave height of roughly 1.0 m (Carey et al., 2005).

Sea-level rise is the most prominent driver for sedimentation on the NJ OCS. Interpreting seismic reflectors requires an understanding of sea-level history and chronological sampling from borehole samples. Sediment packages within the Offshore Project Area extend back to the Cenozoic era (66 million years ago). Although these ancient sediments are not archaeologically relevant, more recent sediment packages laid above are relevant. The NJ OCS has three high sea-level stands throughout the Late Pleistocene/Holocene, where sediment was deposited. Much of the sediment was supplied from the paleo-Hudson River and redistributed by coastal currents. In the millennia leading up to the Last Glacial Maximum (LGM; 29,000- 22,000 calibrated years before present [cal BP]) the shelf was subaerially exposed and regional fluvial incisions were cut within the NJ OCS (Clark et al., 1999; Glasser et al., 2011). This was a period of soil development, non-deposition, and erosion throughout the Atlantic Shores Offshore Project Area. Incised channels cut into sediments on the coastal plains.

2.1.2 Cultural Context

The full MARA includes a detailed pre-contact Native American cultural context summarizing the information from numerous publications about the Paleoindian, Archaic, Woodland, and Contact periods. The potential exists for archaeological sites from the Paleoindian, Archaic, and Woodland culture periods on the now submerged landscape (Engelhart et al., 2011). This context informed the identification and assessment of Ancient Submerged Landform Features (ASLFs) identified on the OCS with the potential to contain possibly intact, culturally relevant sediment deposits.

The full MARA also includes historic context summarizing the historical development of maritime trade and associated infrastructure in the region, including a discussion of historic maritime cultural trends, including significant ports, vessel types, and causes for marine losses, which provide further detail regarding the types of historic-period marine archaeological resources that could be present within the Offshore Project Area. Given the intensity and longevity of maritime activity in this region, navigation charts show numerous vessel wrecks, obstructions, and other navigational hazards within the Offshore Project Area. As a result of the intensive use of these shipping lanes in the region and as evidenced by the density of charted shipwrecks, there is a moderate to high probability of encountering charted maritime cultural resources within the WTA and ECCs. The historic context informed the assessment of the range of potential historic period submerged historic properties that could be located within the PAPE and how specific shipwrecks may relate to documented patterns in local history.

In addition, offshore waters located in proximity to life-saving stations and lighthouses, typically have a higher likelihood of hazardous nearshore areas and therefore shipwrecks, as do nearshore environments due to the dynamic conditions. Additional shipwrecks are likely to exist on the seabed than have been accounted for in historic and contemporary literature (Pearson et al., 2003). The potential for submerged cultural resources should be considered moderate to high within the ECCs where shallower waters led to more hazardous conditions. However, the dynamic ocean conditions decrease the potential for preservation of shipwrecks.

2.2 Previously Recorded Archaeological Sites and Surveys

SEARCH conducted a review of previous maritime archaeological investigations to determine whether submerged NRHP eligible or listed historic properties have been documented within or adjacent to the Lease Area and ECCs. SEARCH contacted the BOEM Office of Renewable Energy Programs during its research for the Atlantic Shores Site Assessment Plan and confirmed at the time that no archaeological surveys had been conducted within the PAPE; however, it has been reported that a geophysical survey occurred within portions of the PAPE.

At the time background research was undertaken for this investigation, the COVID-19 pandemic resulted in safety measures that prevented physical access to many local repositories, including the New Jersey Historic Preservation Office (NJHPO) in Trenton. During this time, background research through NJHPO was not possible. Therefore, background research relied heavily on digital libraries (including NJ HPO’s LUCY Cultural Resources Geographic Information System [GIS] Online Map Viewer) to aid the development of the Project research design and to help inform interpretation the remote-sensing data. An additional request to conduct background research through the NJHPO was made in February 2023; as of March 2023, NJHPO has not responded to this request.

Background research for cultural resource studies and environmental assessments conducted in the portion of the Project area in New York State waters was conducted through state and local sources including New York’s Cultural Resource Information System (CRIS). SEARCH’s review identified 12 previous maritime investigations conducted in New York State waters that intersect or are within the PAPE or within the 1.0-mi. (1.6-km) buffer zone.

SEARCH reviewed databases of reported shipwrecks and other submerged archaeological sites to identify reported submerged cultural resources within or adjacent to the project PAPE. Several desktop reviews, cultural resources reconnaissance studies, and environmental assessments also have addressed the potential for submerged cultural resources within the Offshore Project Area (e.g., TRC, 2012). The database sources include:

- BOEM’s Archaeological Resource Information Database;
- Global GIS Data Services, LLC, Global Maritime Wrecks Database (GMWD);
- National Oceanic and Atmospheric Administration (NOAA) Wrecks and Obstructions Database including the Automated Wreck and Obstruction Information System (AWOIS);
- NOAA Electronic Navigation Charts Database (ENC); and
- New Jersey Maritime Museum Shipwreck Database (NJMM).

SEARCH’s review identified 276 reported shipwrecks within 1.6 km (1.0 mi) of the PAPE. It is important to note that position accuracy for historic shipwrecks is tentative at best in most instances and shipwrecks are generally plotted based on contemporary records, maps, or oral histories. Many shipwreck databases provide a range of position accuracy or an accuracy reliability scale. It must be assumed, therefore, that the 276 reported wrecks do not constitute an exhaustive list of shipwrecks potentially within the 1.0-mi. (1.6-km) buffer zone, nor can it be assumed that every shipwreck truly resides where it is described/depicted. Approximately 20 of the shipwrecks reported within 1.6 km (1.0 mi) of the Lease Area are associated with Garden State North Fish Haven, an artificial reef intentionally built by the State of New Jersey. These artificial reefs are constructed with derelict vessels to promote marine life. The vessels documented at this location are well defined.

2.3 Potential for Submerged Cultural Resources

Given the pre-contact occupation on the once-exposed OCS and the maritime context of the area, there is a potential for pre-contact and historic submerged cultural resources to exist within the PAPE (TRC, 2012). The preservation potential for submerged archaeological resources within the PAPE varies and is highly dependent on the duration of exposure and resource composition. Marine transgression and seafloor sedimentation are the main environmental factors affecting preservation (TRC, 2012).

The best chance of preserved materials for such submerged cultural resources exists if the resources were buried within marine sediment. Burial is possible in instances of quick, large-scale flooding resulting in rapid sediment accumulation (Uchupi et al., 2001). Additionally, geologic features that may be associated with ancient submerged sites, such as relict channels and associated paleolandscapes, can be preserved and recognized beneath the seafloor via a sub-bottom profiler. These areas have been highlighted and recommended for avoidance from disturbance or mitigation during all construction and decommissioning phases of Atlantic Shores. Submerged pre-contact sites that were on the surface or buried shallowly on the OCS before the transgression likely suffered from erosion, deflation, or complete relocation from high-energy marine processes.

Archaeologists expect a progressively higher preservation potential for historic submerged cultural resources, as shipbuilding began utilizing materials with a lower susceptibility for deterioration in maritime environments. Early European exploration that may have crossed the PAPE employed small, wooden-hull sailing vessels. The twentieth-century workboat is another category of shipwreck that should be expected in the region. The magnetic anomaly of an iron or steel vessel propelled with a steam or gasoline engine would be relatively large and intense, with a much higher amplitude gradient than other types of historic vessels. The hull and machinery are more likely to have survived in some form above the sea floor and be detectable as acoustic contacts.

3.0 FIELD SURVEY AND DATA PROCESSING

3.1 HRG Survey

The intent of the MARA is to assess the presence/absence of potential submerged cultural resources that may be adversely affected by seafloor-disturbing activities (horizontal and vertical) associated with Project installation, operation, and decommissioning. The first step in protecting submerged cultural resources is to locate them, which requires detection and recognition in the HRG survey record. SEARCH assisted Atlantic Shores with completing the HRG Survey Plan and worked with their survey consultant to design a survey that captured data needed for a MARA and met guidelines recommended in BOEM's archaeological guidelines (BOEM, 2020a). The 2020/2021 revised survey plan was submitted on February 24, 2020 and was approved by BOEM in April 2020. A revised amendment to the survey plan covering activities proposed for the 2021 campaign was submitted on January 10, 2021.

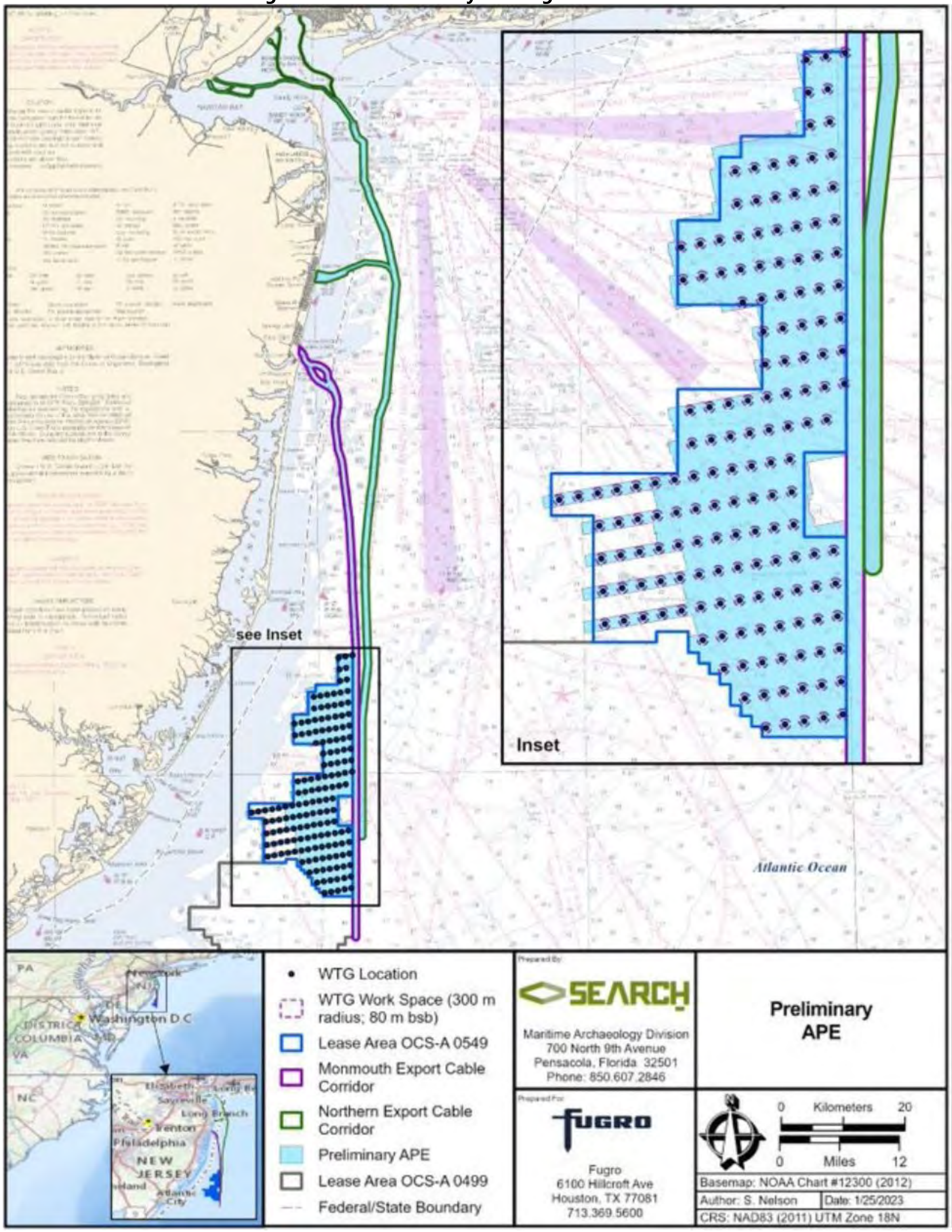
3.1.1 Methods

Fugro conducted HRG survey during the 2020-2022 campaigns from Research Vessel (R/V) *Fugro Enterprise*, R/V *Fugro Brasilis*, and Driving Support Vessel (DSV) *Aqueos Splash*. Fugro also utilized the DSV *Aqueous Splash* for Monmouth Survey, while R/V *Fugro Enterprise* and Motor Vessel (M/V) *Bella Marie* were employed for Northern ECC and New York and New Jersey Landfall approaches. A nearshore geophysical survey off Atlantic City was performed by S.T. Hudson utilizing the survey vessel M/V *Yeti* in August 2021. The survey design incorporated parallel survey lines spaced 98 ft. (30 m) apart with perpendicular tie lines spaced 1,640 ft. (500 m) apart. In the shallower areas near proposed cable landfall, 49 ft. (15 m) line spacing was used to achieve full multibeam echosounder and side scan sonar coverage. In addition to all necessary safety equipment, each vessel was equipped with a suite of HRG equipment meeting or exceeding the survey instrumentation guidelines presented by BOEM (2020a, 2020b):

- Guidance and Navigation equipment including Primary Global Navigation Satellite System (GNSS)
- Magnetometers, which were mounted on a fixed-frame gradiometer and towed in a transverse gradiometer configuration
- Side-scan sonar
- Shallow penetration sub-bottom profiler
- Single-channel ultra high-resolution seismic system
- Ultra high-resolution multichannel seismic system
- Multibeam Echosounder

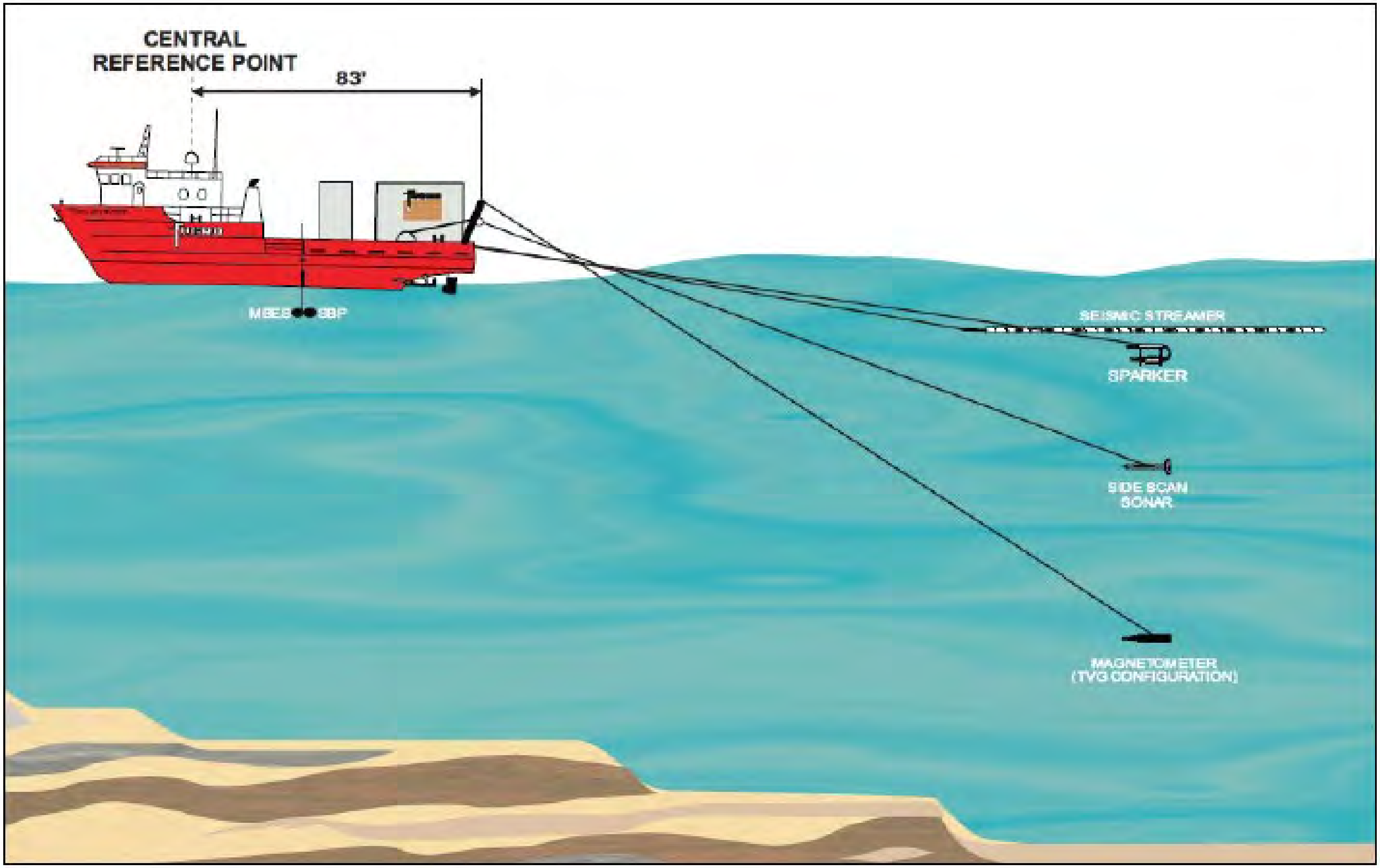
The survey coverage extents are depicted in Figure 3. Antenna positions, tow point positions, and tow cable lengths were recorded and updated throughout the survey for accurate data collection in order to maintain accurate instrument laybacks (Figure 4).

Figure 3. Extent of Survey Coverage in WTA and ECCs[a]



a. Note that the Atlantic Shores Project Location and Preliminary APE are inclusive of project components no longer part of the PDE. This MARA Public Summary demonstrates multi-year development and survey efforts completed. Please see the PDE as defined in the COP Volume I Project Information.

Figure 4. Example of Equipment Towing Configuration for Fugro Enterprise (for illustrative purposes only; diagram not to scale)



a. Note in the depiction of the Magnetometer, "TVG Configuration" refers to Transverse Gradiometer, which is useful for eliminating signal interference.

3.1.2 Survey Equipment and Example Imagery

A side scan sonar (SSS) utilizes acoustic energy to image the seabed and any objects protruding above it (Figure 5). The resulting image is ideal for detecting and recognizing submerged cultural resources exposed above the sediment. A multibeam echosounder (MBES) produces similar imagery to side scan sonars but illustrates exposed acoustic contacts in three dimensions at a lower, vertical, resolution (Figure 6). A sub-bottom profiler (SBP) utilizes soundwaves to penetrate the seabed in an effort to illustrate what is buried below the seabed (Figure 7). The imagery produced is an archaeologist's best resource for detecting density changes potentially indicative of geomorphic features of archaeological interest.

The gradiometer/magnetometer detects anomalies in the Earth's magnetic field produced by ferrous and magnetic objects. A gradiometer/magnetometer is best for detecting buried submerged cultural resources not visible in the SSS record (Figure 8). The copious amount of iron utilized in the construction and operation of historic vessels affords the magnetometer the opportunity to detect most shipwrecks, if the methodology is designed in a way to capture the optimized potential for discovery of cultural resources in a maritime environment.

Figure 5. Example Side Scan Sonar Acoustic Imagery of Potential Shipwreck

Figure 6. Example Multibeam Echosounder (MBES) Bathymetry of Potential Shipwreck

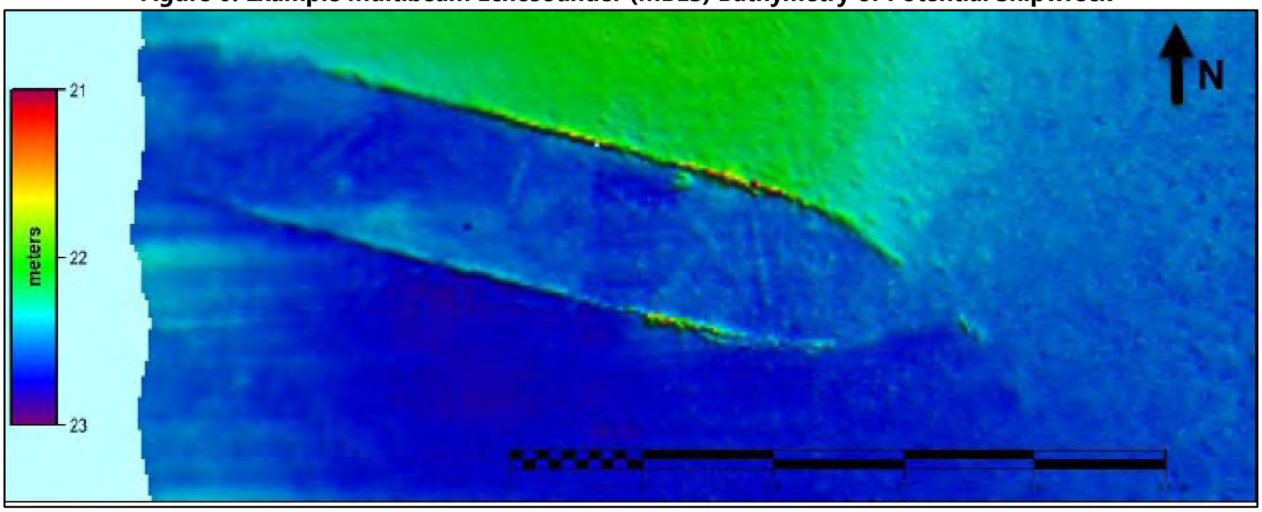


Figure 7. Example Sub-Bottom Profiler (SBP) Imagery of a Potential ASLF

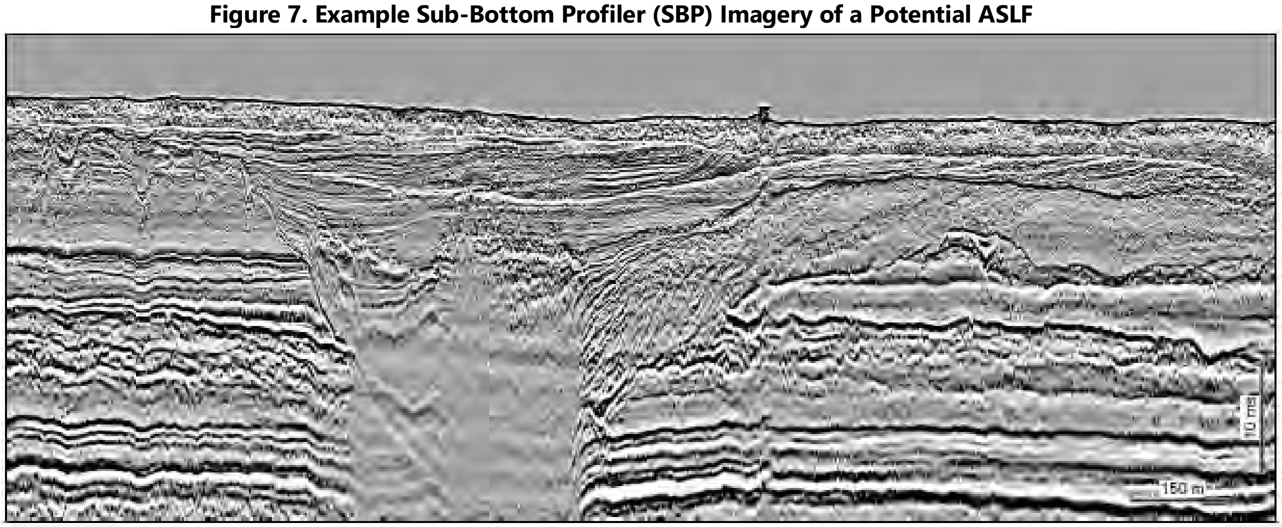
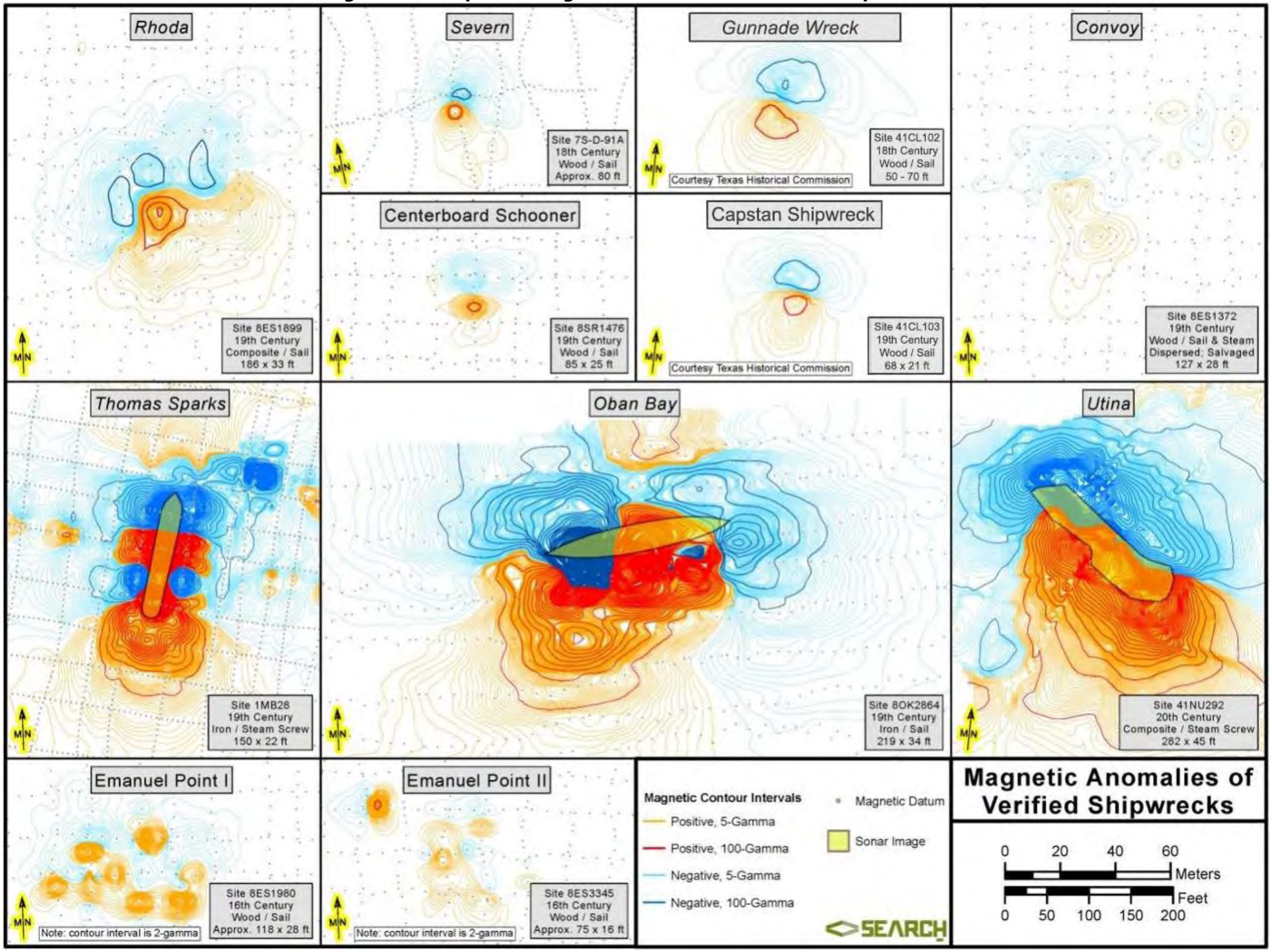


Figure 8. Examples of Magnetic Anomalies of Verified Shipwrecks.



3.1.3 Results

SEARCH was provided with a complete HRG dataset for the Projects, including SSS, SBP, MBES, gradiometer/magnetometer, and seismic data collected over multiple survey campaigns between 2020 and 2022. SEARCH reviewed raw and processed acoustic and magnetic data and a geologic ground model of the PAPE. The surveys were non-intrusive, and no potential submerged cultural resources were impacted during data collection. HRG data were processed, and SEARCH applied knowledge gained from the historical and pre-contact research when interpreting the survey results.

In total, SEARCH identified 173 targets within the HRG data in the WTA and ECC routes. Of the 173 total targets, 40 potential submerged cultural resources were identified within the PAPE that could represent historic properties (shipwrecks and debris fields). SEARCH also identified 133 potential ASLFs. Prior research and consultation between BOEM and federally recognized Tribal Nations have resulted in the determination that ASLFs similar to the 133 potential ASLFs identified by SEARCH are Traditional Cultural Properties (TCPs; BOEM, 2021, 2022).

SEARCH recommends a resource specific 164 ft. (50 m) avoidance buffer around the 40 potential historic properties to prevent project impacts. SEARCH calculated each recommended avoidance buffer as a radius from a circular polygon delineated from the perimeter of the magnetic anomaly. The recommended avoidance buffer, therefore, is designed to account for sensor positional errors, contouring that is accurate to approximately half the survey transects spacing in the cross-track direction, and potential buried non-ferrous debris, as well as expected types of seafloor impacts. Additionally, SEARCH recommends avoidance of each ASLF with a horizontal buffer of 82 ft. (25 m) to address potential errors from sub-bottom interpretation and spatial mapping. This buffer is included in each target’s outer boundary.

3.2 Marine Archaeology Geotechnical Campaign

A marine archaeological geotechnical campaign, which recovered samples of sediments from the seabed, was conducted by Fugro and R. Christopher Goodwin & Associates (RCG&A) in 2021. Details of this campaign are contained in a report (RCG&A, 2021) located in Appendix K of the MARA for Lease Area OCS-A 0499 (SEARCH, 2022) The results from the processing and analysis of the marine archaeological geotechnical campaign includes the vibracores first reported on in RCG&A (2021) and the boreholes collected by Fugro during its geotechnical campaign supporting characterization of the PAPE (Fugro, 2022a, 2022b, 2023a, 2023b, 2023c). The processing of the collected cultural vibracores (VC) took place in three phases.

3.2.1 Methods

In the first phase of processing, RCG&A cut nine VC cores, photographed the core sections, and collected samples for analysis, including 81 subsamples for future radiocarbon analysis. RCG&A took notes on a single core (VC 6). Four cores processed by RCG&A are located within Lease Area 0549 and the Monmouth ECC.

The second phase of processing took place in the summer of 2021. SEARCH processed the subsamples for radiocarbon material. The subsamples were processed at the Fugro lab in Houston, Texas. Subsamples were emptied on a tray to inspect for radiocarbon samples. Photographs were taken of the subsamples, and a general description of sediment texture, potential depositional environment, and inclusions were noted. If organic material was not immediately observable, the subsamples were wet sieved through a geologic particle size sieve with 4000, 2000, 500, 250, 125, and 63-micron mesh. Samples were also taken for zooarchaeological purposes to assist in the identification of environmental conditions.

The third and final stage of core analysis occurred in August 2022. SEARCH collaborated with Fugro and Atlantic Shores to process and analyze an additional 32 vibracores collected in the Northern ECC and the New York Landfall locations. Fugro processed 22 of the cores for geotechnical processes, after which SEARCH staff detailed the core stratigraphy and collected 22 radiocarbon samples for processing. Atlantic Shores selected an additional 10 vibracore locations for paleolandscape investigations and analyses. Fugro cut the vibracores, after which SEARCH staff processed and analyzed the core sediments and stratigraphy for preserved subaerial landscapes. SEARCH collected 35 sediment and organic samples for radiocarbon analysis and dating. SEARCH streamed and recorded video and audio of the core processing and sampling procedures for select Atlantic Shores and Fugro staff. The recorded videos were subsequently downloaded and stored on an internal cloud storing service devoted to data and research conducted within the 0549 Lease area and associated cable corridors. SEARCH shared video recordings with the Atlantic Shores team for downloading and later review.

In total, 36 vibracore locations were assessed in association with Lease Area 0549 and the associated cable corridors. RCG&A subsampled four vibracore locations (RCG&A 2021), and SEARCH processed the subsamples. SEARCH processed 32 vibracore locations. In total, SEARCH collected 92 samples from Lease Area 0549 and the associated cable corridors: 86 radiocarbon samples and six species identification samples.

3.2.2 Species Identification

A mix of eight species of gastropods and bivalves were identified from shell material recovered from the geotechnical samples. By identifying the species type, inferences can be made on the depositional environment such as near shore, freshwater, estuaries, or lagoons. Areas such as these have a higher potential for containing submerged pre-contact sites. All samples were collected from the top U0 horizon (subsequently discussed in Section 3.2.4) with date ranges from 640 to 40,280 cal BP.

3.2.3 Paleolandscape Reconstruction

Approximating the distribution of submerged archaeological sites on the continental shelf requires an accurate estimate of the elevation of the shoreline through time. The data collected both during the background research and the geotechnical campaign have been compiled to create the most accurate sea-level curve for the PAPE. These data are used to recreate the paleolandscape and to develop archaeological probability models (Joy, 2020).

During the LGM, sea levels were as low as 426 ft. (130 m) below sea level (bsl). This would have been the time of maximum extent of exposed coastal plains on the continental shelf, exceeding 84 mi. (137 km) from the modern shoreline. From 14,500 to 13,000 cal BP, sea levels increased from 295 to 213 ft. (90 to 65 m) bsl. During the Younger Dryas (12,900 to 11,700 cal BP), sea level slowly continued to rise from 229 to 196 ft. (70 to 60 m) bsl. At the end of the Younger Dryas the coastline was 55 mi. (98 km). Sea levels continued to increase steadily throughout the beginning of the Holocene. By 8,000 cal BP, sea levels were 59 ft. (18 m) bsl. The paleocoastline at this time was approximately 6.7 mi. (10.9 km) from the modern coast and the seas would have nearly fully submerged the Offshore Project Area. By 6,000 cal BP, sea levels were 26 ft. (8 m) bsl and the paleocoastline was roughly 1.95 mi. (3 km) from the modern shoreline. By 2,000 cal BP sea-level began to stabilize to modern levels (Table 2).

Table 2. Sea-level Depths and Approximate Coastline Locations after the LGM based on Modern Bathymetry

Age (cal BP)	Depth	Distance to Modern Coast
3,000	-9.8 ft. (-3 m)	0.5 mi. (0.81 km)
6,000	-23 ft. (-17 m)	1.95 mi. (3 km)
8,000	-59 ft. (-18 m)	6.7 mi. (10.9 km)
11,500	-190 ft. (-58 m)	60 mi. (97 km)
13,000	-213 ft. (-65 m)	65 mi. (105 km)
15,000	-311 ft. (-95 m)	80 mi. (129 km)
21,000	-426 ft. (-130 m)	84 mi. (137 km)

3.2.4 Subsurface Stratigraphy and Ground Model

The transportation and deposition of sediment requires a catalyst. In many cases, wind and water energy act as the catalyst to move sediments and redeposit them in other locations. Sea-level rise plays a significant role in the deposition of sediments on the coastal plain. Within the PAPE, sea-level fluctuation over the last 135,000 years has created multiple horizons, and their inclusions contain the chronostratigraphic, biostratigraphic, and geologic context needed to develop the paleoenvironmental and landscape reconstructions for modelling the potential for submerged pre-contact sites within the PAPE.

The subsurface stratigraphy across the PAPE can be divided into four main groups: Holocene marine deposits (U0), Holocene to Late Pleistocene transgressive channel deposits (TCG), Late Pleistocene, and Coastal Plains Deposits (Table 3). The Late Pleistocene deposits have been subdivided into 3 units that represent at least 3 different episodes of sea-level fluctuations (U1, U2 and U3). Approximate ages of the stratigraphic groups are inferred from site specific radiocarbon dating of recent geotechnical samples and correlation with regional stratigraphic studies to the north, northeast and south of the Offshore Project Area.

Table 3. Regional Stratigraphic Ages and Interpreted Horizons within the PAPE

Period	Epoch (with approximate age[a])	Unit/Key Bounding Horizons
Quaternary	Holocene (7,400 cal BP to Present)	U0 Horizon 000 (Base of U0)
	Early Holocene (~12,000-7,400 cal BP) Upper Late Pleistocene (~28,000-12,000 cal BP)	TCG (Transgressive Channel Group) Erosional unconformity at base of TCG)
	Late Pleistocene (35,000-28,000 cal BP) Late Pleistocene (39,000-35,000 cal BP)	U1 H005-H000 (Upper U1) H020-H0005 (Lower U1) Base of U1 is defined by H020
	Late Pleistocene (52,000-42,000 cal BP)	U2 Channel 20 sequence (Upper U2) Base of U2 is defined by combined horizons 50-80-85
	Late Pleistocene (129,000-52,000 cal BP)	U3 Base of U3 is defined by H100
Tertiary	Coastal Plains Deposits (Pre-Quaternary age – Miocene to Pliocene)	CP

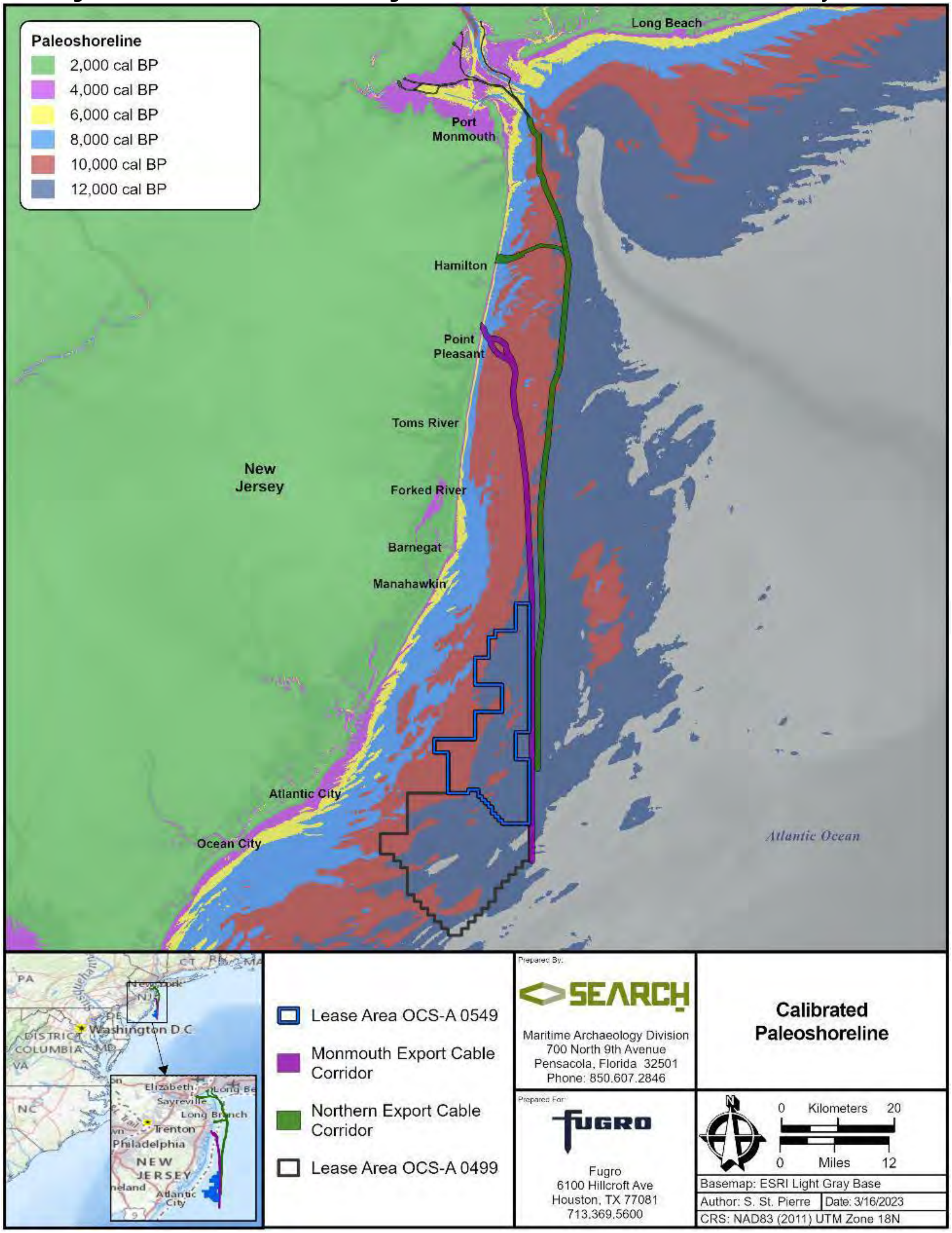
a) Approximate ages inferred from recent radiocarbon dating of geotechnical samples within the Lease Area and correlation to regional stratigraphic studies.

The Holocene marine deposits, Holocene-Late Pleistocene transgressive channel sequence, and upper Late Pleistocene sequence contain the highest potential for archaeological material. Holocene (U0) sediments were deposited after marine transgression; there is a low probability for pre-contact archaeological material in primary context, however, there is a high probability for post-contact maritime artifacts and pre-contact archaeological material in secondary context based on the local archaeological record. The transgressive channel group deposits (TCGs) include substantial paleo-channel sequences. The channels incised deeply across the subaerially exposed shelf into the older sediments of U1, U2 and U3 during the LGM. Radiocarbon dates taken from geotechnical samples in the upper portion of the TCGs define an age range between 7,490 and 10,030 cal BP. The age at the base of the TCGs is conservatively estimated to be no older than 28,000 cal BP. Pleistocene (U1) represents the late Pleistocene from about 40,000 to 28,000 cal BP.

3.3 Ground Model

Based on analysis of the HRG survey data, and the samples recovered from the ten VC and nine borehole core locations, a robust ground model of the seabed was generated. This ground model was used to determine the paleoshoreline during different time periods (Figure 9) and informed the identification of possibly preserved and once subaerially exposed soils that can contain archaeological sites.

Figure 9. Calibrated Paleoshoreline Migration Model of the Atlantic Shores Offshore Project Area[a]



a. Note that the Atlantic Shores Project Location and Preliminary APE are inclusive of project components no longer part of the PDE. This MARA Public Summary demonstrates multi-year development and survey efforts completed. Please see the PDE as defined in the COP Volume I Project Information.

4.0 SUMMARY AND CONCLUSIONS

SEARCH served as the Projects' QMA to assist BOEM with its obligation to Section 106 of the NHPA by identifying the presence/absence of potential submerged cultural resources within the PAPE. SEARCH conducted a MARA of HRG survey data, consisting of bathymetry, MAG, MBES, SSS, and SBP datasets, collected during a non-intrusive survey campaign within the PAPE by a third-party MSC. This assessment was conducted in preparation of seafloor impacts, which could include direct and indirect impacts related to infrastructure installation, maintenance, and decommissioning, as well as vessel work zones, anchoring/ spudding, and ingress/egress. As part of the MARA, SEARCH also reviewed HRG data prior to geotechnical investigations to ensure that associated seabed impacts would not affect potential submerged cultural resources. SEARCH utilized these geotechnical investigations for archaeological analyses to inform the MARA and verify the geologic ground model.

The HRG data record displays a relatively uniform sand seafloor, as well as some natural features (i.e., hard bottom) and items of modern anthropogenic origin (e.g., tires, commercial fishing equipment, and flotsam/jetsam from passing vessels). SEARCH identified 40 targets, consisting of magnetic anomalies, acoustic contacts, and/or buried reflectors within the HRG survey data that could represent potential submerged, historic-period cultural resources. SEARCH also identified 133 ASLFs within the PAPE through interpretation of the SBP and seismic data. These ASLFs have potential to contain significant archaeological evidence of precontact activities and of ancient Native American populations on the now-submerged OCS. These targets also contain preserved elements such as intact margins and fluvial downcuts that may represent culturally significant TCPs.

SEARCH recommends avoidance of each potential submerged cultural resource by a minimum distance of a 3.2 ft. (1 m) vertical buffer (ASLF and shipwrecks/debris fields), a horizontal buffer of 82 ft. (25 m) from all ASLFs, and a buffer of 164 ft. (50 m) from the extent of the outer edge of the magnetic anomalies or acoustic contacts (shipwrecks and debris fields). SEARCH has identified the paleolandscape features within the Project Areas and recommends refining engineering plans to minimization impacts and/or avoidance measures to identified ancient submerged landforms and targets. ASOW will compile a list of targets that cannot be avoided. The data collected and a mitigation framework will be presented to Tribal Nations. Then, a mitigation plan will involve consulting parties and subject matter experts to develop a treatment plan to address targets where impacts cannot be avoided.

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