Empire Offshore Wind LLC and EW Offshore Wind Transport Corporation

Empire Wind 2 Project

Article VII Application

Appendix E

Benthic Resource Characterization Reports

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ACRONYMS AND ABBREVIATIONS

Alpine	Alpine Ocean Seismic Survey, Inc.
BOEM	U.S. Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
Empire or the Applicant	Empire Offshore Wind LLC and EW Offshore Wind Transport Corporation
EW 2	Empire Wind 2
ft	foot
Lease Area	BOEM-designated Renewable Energy Lease Area OCS-A 0512
m	meter
NYSPSC or Commission	New York Public Service Commission
NY Project	portions of the EW 2 Project transmission system located within the State of New York
PSL	New York Public Service Law
SPI	sediment profile imagery

E.1 INTRODUCTION

Empire Offshore Wind LLC and EW Offshore Wind Transport Corporation (collectively, Empire or the Applicant) propose to construct and operate the Empire Wind 2 (EW 2) Project as one of two separate offshore wind projects to be located within the Bureau of Ocean Energy Management (BOEM) designated Renewable Energy Lease Area OCS-A 0512 (Lease Area). This assessment is being submitted to the New York Public Service Commission (NYPSC or Commission) for the portions of the EW 2 Project transmission system located within the State of New York (collectively the NY Project) pursuant to Article VII of the New York Public Service Law (PSL).

E.2 BENTHIC SURVEY REPORTS

This Appendix to the EW 2 Project Article VII Application presents complete reports of benthic surveys conducted by Empire and its contractors to support the characterization of benthic resources in the submarine export cable corridor in the State of New York (NY Project Area). Note that survey reports cover a larger area than the NY Project Area. As the concept of the EW 2 Project has evolved, survey reports may reflect routing that has subsequently been modified. The 2019 benthic survey report is included as **Attachment E-1, Benthic Assessment Survey of Proposed Export Cable Routes in Support of the Equinor Wind OCS-A 0512 Offshore Wind Farm Project** (Empire[1]/Inspire 2019). The report for benthic surveys conducted in 2021 is included as **Attachment E-2, Empire Wind 2021 Surveys Environmental Campaign – EW2 RV Shearwater**.

Benthic surveys were conducted in accordance with the following guidelines:

- BOEM's site characterization requirements in 30 Code of Federal Regulations (CFR) § 585.626;
- BOEM's *Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585* (BOEM 2019a);
- BOEM's *Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585* (BOEM 2019b); and
- The National Oceanic and Atmospheric Administration National Marine Fisheries Service Greater Atlantic Regional Fisheries Office's *Recommendations for Mapping Fish Habitat* (NOAA Fisheries 2020)[2].

The characterization of benthic resources in the Benthic Characterization Study Area depicted in **Figure E-1** incorporated data from Empire's site-specific surveys; publicly-available databases (e.g., NOAA Fisheries 2019, Northeast Regional Ocean Council 2019, Mid-Atlantic Regional Ocean Council 2019); regional surveys; resource reports (e.g., NYSERDA 2017, NEFMC 2017, NOAA Fisheries 2017, MAFMC 2016 and 2017); and relevant peer-reviewed literature. Empire's project-specific survey is summarized in **Table E-1** and briefly described below.

Empire contracted Inspire, LLC to conduct benthic sampling along the proposed submarine export cable siting corridor in spring 2019 using sediment profile imagery (SPI) and grab samples to characterize benthic habitats (**Attachment E-1)**. The interpretation of benthic substrate indicated by backscatter was well-correlated with SPI results. Grain size distribution was analyzed in six sediment grab samples to ground-truth the SPI results;

[1] Empire is a direct, wholly owned subsidiary of Empire Offshore Wind Holdings LLC ("Empire HoldCo"). Empire HoldCo is jointly owned by (1) an indirect, wholly owned subsidiary of Equinor ASA (collectively, "Equinor"); and (2) an indirect, wholly owned subsidiary of BP Wind Energy North America Inc. ("BP"). BP acquired ownership interest in Empire HoldCo in a transaction that closed on January 29, 2021.
[2] This guidance was released in May 2020 and is referenced in the 2020 and 2021 survey reports.

no infauna or epifauna were sampled (see **Table E-1**). Full survey reports are included in this appendix. Digital imagery is available upon request.

To augment the 2019 survey data and characterize previously unsurveyed portions of the EW 2 submarine export cable siting corridor, Empire conducted additional benthic surveys in April and May 2021. Empire contracted Alpine Ocean Seismic Survey, Inc. (Alpine) to perform a geophysical and environmental survey along the EW 2 export cable corridor to ground-truth the results of geophysical data, characterize surficial sediment conditions, and provide benthic habitat classification as per BOEM guidelines and NOAA Fisheries recommendations (**Attachment E-2**). Empire also contracted Alpine to perform an additional high-resolution geophysical survey at the EW 2 landfall. The survey spanned April to May 2021 and employed multi-beam echosounder; ultra-short baseline; sound velocity profiler; modified Van Veen grab; shallower water camera system; and water quality profiler data. The surveys corroborated characterizations of softbottom habitat in previously surveyed portions of the EW 2 submarine export cable siting corridor and detected novel hardbottom (e.g., cobbles, boulders) in previously unsurveyed portions of the corridor.

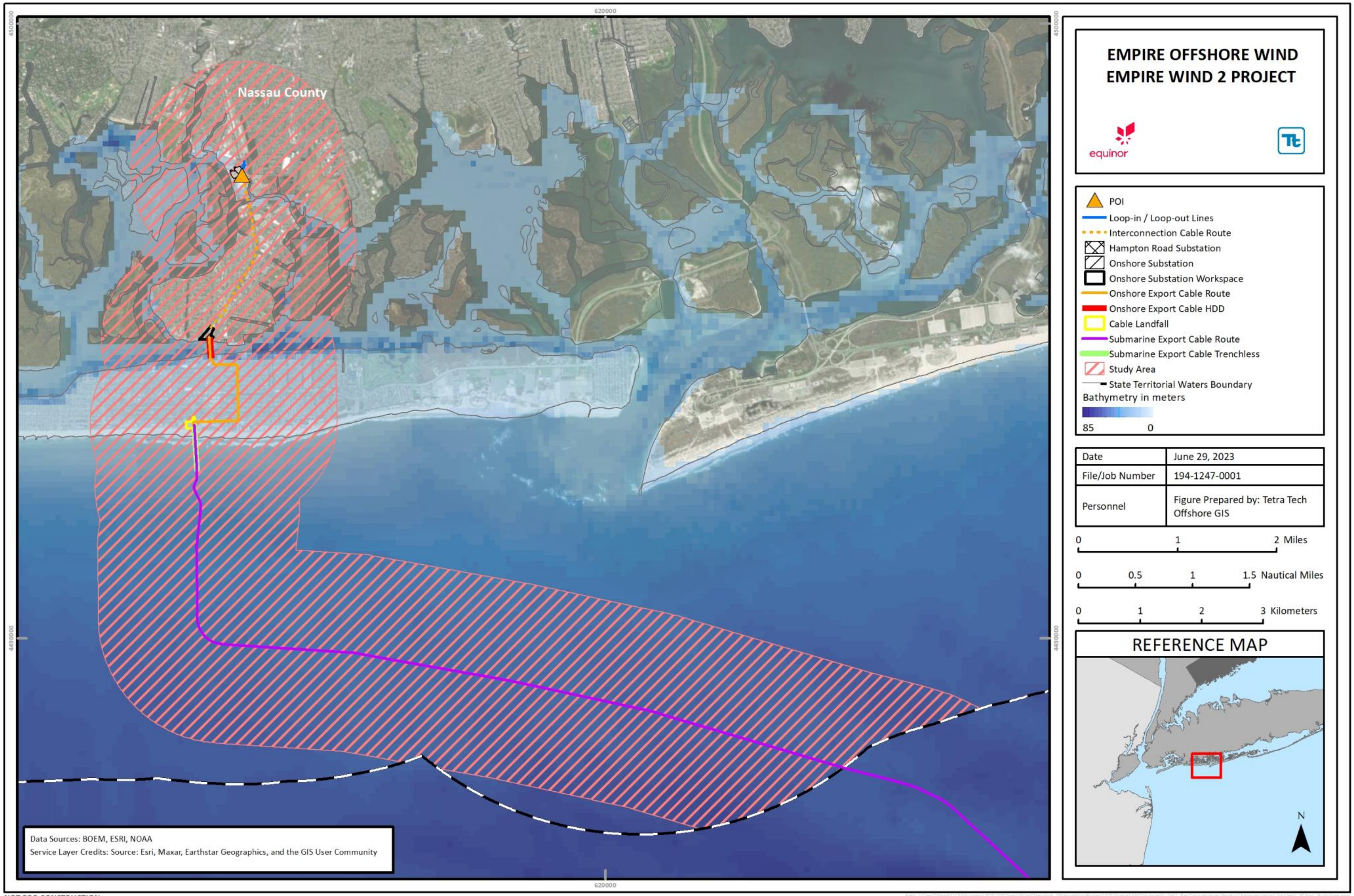

Figure E-1 Benthic Characterization Study Area

Table E-1 Project-Specific Benthic Surveys in EW 2 Project Area

Project Subarea	Sediment Grabs (Grain Size)	Sediment Grabs (Benthic Infauna)		Benthic Imagery		Description of Survey	
		Method a/	Sample Number	Method	Sample Number	Sample Dates	Surveyor
Benthic Assessment Survey Report (EW 1 and EW 2) (**Attachment E-1**) b/	16	no organisms collected		SPI/PV	172	2019 July	Inspire
Habitat Characterization Report (EW 2) (**Attachment E-2**)	37	Modified Day Grab/Van Veen	37	Drop-down still images and 600-m towed video transects	15 transects; 1,683 still images and 227 video snapshots)	2020 Nov-Dec	Gardline

Notes:
a/ Total sample number, including additional samples outside the NY Project area.
MBES = Multibeam echo sounder
SPI/PV = Sediment profile image/plan view image
SSS = Side-scan sonar

E.3 REFERENCES

BOEM (Bureau of Ocean Energy Management). 2019a. *Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585*. June 2019. Available online: https://www.boem.gov/sites/default/files/renewable-energy-program/Regulatory-Information/BOEM-Renewable-Benthic-Habitat-Guidelines.pdf Last accessed December 11, 2019.

BOEM. 2019b. *Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR 585*. Fisheries Study Guidelines. Available online: https://www.boem.gov/Fishery-Survey-Guidelines/. Last accessed July 11, 2019.

MAFMC (Mid Atlantic Fishery Management Council). 2016. Ecosystem Approach to Fisheries Management Guidance Document: 68 pages. Available online: https://static1.squarespace.com/static/511cdc7fe4b00307a2628ac6/t/589a2b61d2b8575c64fe05ff/1486498674225/EAFM_Guidance+Doc_2017-02-07.pdf. Accessed February 4, 2019.

MAMFC. 2017. Unmanaged Forage Omnibus Amendment: Including an Environmental Assessment, Regulatory Impact Review, and Regulatory Flexibility Act Analysis. Dover, DE: 223 pages.

Mid-Atlantic Regional Ocean Council. 2019. https://portal.midatlanticocean.org/

NEFMC (New England Fishery Management Council). 2017. Omnibus Essential Fish Habitat Amendment 2, Including a Final Environmental Impact Statement. Available online: https://www.nefmc.org/library/omnibus-habitat-amendment-2. Accessed February 4, 2019.

NOAA Fisheries (National Oceanic and Atmospheric Administration National Marine Fisheries Service). 2017. Final Amendment 10 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery

Management Plan: Essential Fish Habitat. Office of Sustainable Fisheries and Atlantic Highly Migratory Species Management Division. Silver Spring, Maryland: 442.

NOAA Fisheries. 2019. "Essential Fish Habitat Mapper." Available online: https://www.fisheries.noaa.gov/resource/map/essential-fish-habitat-mapper. Accessed 10 December 2019.

NOAA Fisheries. 2020. Recommendations for Mapping Fish Habitat. Greater Atlantic Regional Fisheries Office, Habitat Conservation and Ecosystem Services Division. May 2020.

Northeast Regional Ocean Council. 2019. Maps and Data for Ocean Planning in the northeastern United States, Available from https://www.northeastoceandata.org/. Accessed December 11, 2019.

NYSERDA (New York State Energy Research and Development Authority). 2017. New York State Offshore Wind Master Plan: Fish and Fisheries Study Final Report: 202 pages.

ATTACHMENT E-1
BENTHIC ASSESSMENT SURVEY OF PROPOSED EXPORT CABLE ROUTES

Benthic Assessment Survey of Proposed Export Cable Routes in Support of the Equinor Wind OCS-A 0512 Offshore Wind Farm Project

DATA REPORT

Survey Conducted 10-15 July 2019

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REVISION HISTORY

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LIST OF ACRONYMS

aRPD	apparent Redox Potential Discontinuity
BOEM	Bureau of Ocean Energy Management
CMECS	Coastal and Marine Ecological Classification Standard
COP	Construction and Operations Plan
DSLR	Digital single-lens reflex
Equinor	Equinor Wind US, LLC
FGDC	Federal Geographic Data Committee
G&G	Geological and Geophysical Survey
GPS	Global Positioning System
INSPIRE	INSPIRE Environmental, LLC
LIECR	Long Island Export Cable Route
NEF	Nikon Electronic Format
NJECR	New Jersey Export Cable Route
NYHECR	New York Harbor Export Cable Route
OCS	Outer Continental Shelf
PEP	Project Execution Plan
PSD	Photoshop Document
PV	Plan View
SOD	Sediment oxygen demand
SOP	Standard operating procedure
SPI	Sediment Profile Imaging

EXECUTIVE SUMMARY

INSPIRE Environmental conducted a combined Sediment Profile and Plan View Imaging (SPI/PV) survey at stations along the proposed potential Equinor Wind Export Cable Routes and at reference stations. The SPI/PV survey was conducted as part of a benthic assessment of Equinor Wind Offshore Lease Area OCS-A 0512 and provides an interpretive assessment of discrete sampling stations to characterize and delineate the benthic habitat.

The Equinor lease area OCS-A 0512 is located in the federal waters of the New York Bight. The proposed cable routes transit much of the NY Bight in federal waters, but portions also extend into NY and NJ state waters as well. To conduct a benthic assessment of the proposed area that met the Bureau of Ocean Energy Management (BOEM) guidelines, INSPIRE designed a 157-station SPI/PV survey along the cable route and 15 stations at pre-determined reference stations for a total of 172 stations surveyed. Sixteen sediment grabs were also collected to ground-truth the SPI/PV data.

Sediment type along the proposed cable routes varied at large but not small scales. Surficial sediments across the surveyed area were spatially heterogenous at the inter-station scale (i.e., sediment type varied by station) and mostly homogenous at the intra-station scale (i.e., most replicates at a station were similar in sediment type). This trend was true at the reference stations. Despite the spatial variations in sediment types, most of the sediment found along the cable routes and at the reference stations were varying sizes of mobile sand or mobile sand mixed with gravel, with a few instances of silt-clay and cobbles/boulders. The sediment types documented during the SPI/PV survey were used to ground-truth USGS backscatter data. The SPI/PV data corresponded well with the backscatter data along the cable routes and at the reference stations. Extrapolating bottom type in the area using the SPI/PV and USGS backscatter data is appropriate given the ground-truth verification. Grain-size deduced from sediment grabs was generally in agreement with the sediment types designated with SPI/PV. Disagreement between the grab and SPI/PV data can be attributed to the sediment grabs collecting only a single replicate of a relatively small area of the seafloor and not capturing the intra-station heterogeneity present at the surveyed areas.

The sediment types documented along the proposed cable routes corresponded to the designated Habitat Types. Habitat Types were defined based on the physical habitat structure and mobility, as well as the dominant CMECS Biotic Subclass and CMECS Biotic Group. Three broad habitat types were identified at the surveyed area, Sand Sheets, Sand with Mobile Gravel, and Patchy, Cobbles, Boulders on Sand. Stations were predominantly Sand Sheet habitat, and the Hudson Shelf Valley appeared to be the primary delineation of Habitat Type in the surveyed area. The transition from a seafloor habitat of Sand Sheet to one of Sand with Mobile Gravel occurred right at the Hudson Shelf Valley for both the reference stations and stations along the proposed cable routes. Stations east of the submarine valley were Sand Sheet habitat, and stations west of the submarine valley were a habitat of Sand with Mobile Gravel. Patchy, Cobbles, Boulders on Sand were documented at Station 050 situated on Cholera Bank, and along the NJECR at Station 010 in the Hudson Shelf Valley. Cobbles and boulders tend to be predominantly stationary allowing for attached fauna to settle and grow, whereas sand and gravel are particles that are small enough that the average hydrodynamic forcing on the bottom can mobilize and transport them; mobilized grains makes the presence and subsistence of attached fauna unlikely.

Soft Sediment Fauna was the dominant Biotic Subclass observed across the surveyed area. The predominance of Soft Sediment Fauna corresponded to the predominant Sediment Types and Habitat Types observed along the proposed cable routes. There were a few instances of Attached Fauna present (12 of the 157 station samples), and Mussel Beds made-up the majority of observations (7 of the 12 stations). At the remaining stations, one station had trace coverage of barnacles (Station 133), and the other instances were sparse coverage of sponges, hydroids, and mussels at Stations 010, 046, and 068, respectively. Station 050 was an exception with dense cover of diverse attached fauna (corals, sponges, barnacles, hydroids). The reference stations were exclusively composed of Soft Sediment Fauna.

Along the proposed cable routes Biotic Group was observed to be spatial heterogenous, with a high diversity of Biotic Groups documented. Sand dollar beds and both Small and Larger Tube-Building Fauna were the predominant Biotic Groups that were observed, with much of the tube-building activity the product of the polychaete *Diopatra cuprea. D. cuprea* produce tubes reinforced with shell fragments and tiny pebbles which are cemented in the style of an overlapping mosaic giving these tubes a distinct appearance. The high variability in dominant Biotic Groups along the proposed cable routes highlights the diversity of benthic fauna on the seafloor in the NY Bight.

Sensitive taxa were only documented at one station, Station 050, where the Northern Star Coral *Astrangia* spp. was observed in all replicates. *Astrangia* is a stony coral that attaches to hard substrate instead of building its own structure like those corals commonly observed in tropical reefs. The polyps are translucent, and the colony has a furry appearance when they are expanded. These sensitive taxa were observed in conjunction with other non-sensitive attached fauna (sponges, hydroids, barnacles).

The results and images from this survey will allow accurate characterization and delineation of the benthic environment and establish a baseline of both large- and small-scale biological features along the potential proposed cable routes and at the three reference areas. The results will also allow Equinor to broadly communicate the results of the survey using seafloor images of predevelopment conditions. Contributions from this survey will provide valuable information to address BOEM guidelines and regulations.

1.0 INTRODUCTION

1.1 Project Background

Equinor Wind US, LLC (Equinor) and the U.S. Department of Interior's Bureau of Ocean Energy Management (BOEM) executed a commercial lease for the development of a wind energy facility on the Outer Continental Shelf (OCS) offshore New York in Lease OCS-A-512, (referred to in this report as the "Lease Area"), effective April 1, 2017. Equinor awarded INSPIRE Environmental (INSPIRE) the benthic assessment investigation of the proposed potential cable routes to support spatial planning decisions, reduce uncertainty associated with baseline conditions, and inform future approaches to quantify changes in the benthic community associated with proposed Project activities.

The Equinor lease area is in the federal waters of the New York Bight, an average of 20 miles south of Long Island, east of the Rockaways. The Equinor Wind site extends 14 to 30 miles southeast of Long Island and covers water depths between 20 to 40 meters (65 to 131 feet); the bulk of the work will take place in the shelf waters adjacent New York (NY) and New Jersey (NJ), which range in depth from approximately 5 to 63 meters (16 to 206 ft) (Figure 1-1). The proposed cable routes transit much of the NY Bight in federal waters, but portions also extend into NY and NJ state waters as well.

The continental shelf within the NY Bight region is characterized primarily by ridge and swale topography, isolated and shore-attached linear sand shoals and ridges, and localized artificial topographic highs (Figure 1-2, Byrnes et al. 2004). The most prominent sea floor feature in this area is the 170-km-long submarine Hudson River Shelf Valley which extends southeasterly across the continental shelf offshore New York City toward the shelf break until it connects with the Hudson Canyon (Rona et al. 2015 Figure 1-2). Northeast of the Hudson River Shelf Valley is a prominent northeast-southwest trending shoal. It is referred to as Cholera Banks and is characterized as an eastward extension of one or more coastal plain strata (Williams and Duane 1974). It has been suggested that this area was an emergent headland covered by coastal plain strata during the early Holocene (Schwab et al. 2000).

INSPIRE Environmental conducted a benthic assessment survey along the proposed cable routes for Equinor's lease area utilizing combined Sediment Profile and Plan View Imaging (SPI/PV). The survey was conducted at stations along the cable route and at pre-determined reference stations.

1.2 Objectives

The overall objective of this project was to conduct a benthic assessment survey along proposed export cable routes, specifically:

1. Identify and confirm dominant benthic macrofaunal and macrofloral communities and substrata in the potential Export Cable Corridors from the Lease Area to landfalls in NY and NJ associated with development of offshore wind energy within BOEM's Lease Area OCS-A-512;

- Dominant and Co-Occurring Coastal and Marine Ecological Classification Standard (CMECS) Biotic Subclasses and Groups
- Observed flora and fauna and evidence of their presence (i.e., tracks, burrows, tubes)
- Infaunal successional stage (functional indicator of benthic community)

2. Prepare for the design of a pre-construction baseline study that will be established later to assess whether detectable changes occurred in post-construction benthic habitat associated with proposed operations;
    - Statistically sound sampling density and arrangement that meets BOEM requirements of stations spaced at a distance of 1.9 km.
3. Collect information aimed at supporting spatial planning decisions;
    - Statistically sound sampling density and arrangement
    - Identification of benthic habitat types and potentially sensitive habitats
4. Collect information aimed at reducing uncertainty associated with baseline conditions and/or to inform the interpretation of survey results; and
    - Use of regional data. For example, INSPIRE contributed data collected for the New York State Energy Development Authority (NYSERDA) to NOAA to improve a regional grain size prediction model (Poti et al. 2012)
5. Inform development of an approach to quantify substantial changes in the benthic community composition associated with proposed Project activities.
    - Collection of data at reference stations for comparison

BOEM has produced regulations and guidelines for conducting a site characterization for the proposed development of all offshore wind projects in U.S. federal waters. The SPI/PV benthic assessment was conducted to provide Equinor with data contributing to:

- Guidelines for Information Requirements for a Renewable Energy Construction and Operation Plan (COP) (BOEM 2016),
- Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585 (BOEM 2015),
- Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585, prepared by BOEM July 2015 and March 2017 (BOEM 2017), and;
- Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 (BOEM 2019).

SPI/PV parameters collected as part of this survey were ‘mapped’ to corresponding BOEM Site Characterization guidelines for benthic assessment (BOEM 2019). This allows for a clear representation of how data collected as part of this survey satisfies BOEM recommended guidelines.

2.0 METHODS

2.1 Sediment Profile and Plan View Imaging

Sediment profile and plan view (SPI/PV) imaging is a monitoring technique used to provide data on the physical characteristics of the seafloor and the status of the benthic biological community (Germano et al. 2011). SPI/PV imaging has been shown to be a powerful reconnaissance tool that can efficiently map gradients in sediment type, biological communities, or disturbances from physical forces, anthropogenic input, or organic enrichment. Results and interpretations from SPI/PV data are about dynamic processes that have been deduced from imaged structures; as such, they should be considered hypotheses available for further testing/confirmation.

A 172–station SPI/PV survey was conducted by scientists from INSPIRE Environmental 10-15 July 2019 aboard the utility vessel *Northstar Commander*, along the proposed export cable routes for the Equinor Wind lease area, and at three pre-determined reference areas (Figure 2-1). The Equinor lease area is in federal waters on the continental shelf adjacent NY and NJY, and the proposed cable routes transit federal as well as NY and NJ state waters. Per BOEM guidelines stations were spaced at a distance of 1.9 km along the proposed cable routes, and reference locations were determined based on USGS backscatter data of the New York Bight (Figure 2-2).

SPI/PV station locations are provided in Appendix A. The methodology for data acquisition and analysis for these images was consistent with the sampling methods described in detail in the Project Execution Plan (PEP) for this project (INSPIRE 2019a) and INSPIRE standard operating procedures (INSPIRE 2019b).

2.1.1 Sediment Profile Imaging

The SPI technique involves deploying an underwater camera system to photograph a cross-section of the sediment–water interface. High-resolution SPI images were acquired using a Nikon® D7200 digital single-lens reflex (DSLR) camera mounted inside an Ocean Imaging® Model 3731 pressure housing. The pressure housing sat atop a wedge-shaped steel prism with a plexiglass front faceplate and a back mirror, that was mounted at a 45° angle. The camera lens looked down at the mirror, which reflected the image from the faceplate. The prism had an internal strobe mounted inside at the back of the wedge to provide illumination for the image; this chamber was filled with distilled water, so the camera always had an optically clear path. The descent of the prism into the sediment was controlled by a hydraulic piston. As the prism penetrated the seafloor, a trigger activated a time-delayed circuit that fired the internal strobe to obtain a cross-sectional image of the upper 15–20 cm of the sediment column (Figure 2-3). The camera remained on the seafloor for approximately 20 seconds to ensure that successful images were obtained.

Test exposures of a Color Calibration Target were made on deck at the beginning of the survey to verify that all internal electronic systems were working to design specifications and to provide a color standard against which final images could be checked for proper white balance. Test images were also captured to confirm proper camera settings for site conditions. For this survey, the ISO-equivalent was set at 640, shutter speed was 1/250s, and the f-stop was f11. Images were stored in compressed raw Nikon Electronic Format (NEF) files (approximately 30 MB each). Images were checked periodically throughout the survey to confirm that the initial camera settings were still resulting in the highest quality images possible. All camera settings and any setting changes were recorded in the field log (Appendix B). Details of the camera settings for each digital image also are available in the associated parameters file embedded in each electronic image file.

Whenever the camera was brought back on board (typically after every third to fifth station), the frame counter was checked to ensure that the requisite number of replicates had been obtained. In addition, a prism penetration depth indicator on the camera frame was checked to verify that the optical prism had penetrated the bottom to a sufficient depth. If images were missed or the penetration depth was insufficient, the camera frame stop collars were adjusted and/or weights were added or removed, and additional replicate images were taken. Frame counts, time of image acquisition, water depth, frame stop-collar position, and the number of weights used were recorded in the field log for each replicate image (Appendix B). If mud doors were needed, their use was also recorded in the field log. Visual checks and hand tightening checks of all nuts and bolts on the SPI/PV camera frame were conducted periodically to make sure nothing vibrated loose during the survey.

Prior to field operations, the internal clock in the digital SPI system was synchronized with the vessel's navigation. Each image was assigned a unique time stamp in the digital file attributes by the camera's data logger and cross-checked with the time stamp in the navigational system's computer data file. Images were downloaded periodically to verify successful sample acquisition and/or to assess the type(s) of sediment and other relevant features present at a given station. Digital image files were renamed with the appropriate station names immediately after downloading as a further quality assurance step.

2.1.2 Plan View Imaging

An Ocean Imaging® Model DSC24000 plan view underwater camera system with two Ocean Imaging® Model 400-37 Deep Sea Scaling lasers was attached to the sediment profile camera frame and used to collect plan view images of the seafloor surface. Both SPI and PV images were collected during each "drop" of the system. The PV system consisted of a Nikon® D7200 DSLR camera encased in a pressure housing, a 24 VDC autonomous power pack, a 500 W strobe, and a bounce trigger. A weight was attached to the bounce trigger with a stainless-steel cable so that the weight hung below the camera frame; the scaling lasers projected two red dots that were separated by a constant distance (26 cm) regardless of the field of view of the PV system. The field of view can be varied by increasing or decreasing the length of the trigger wire and, thereby, the camera height above the bottom when the picture is taken. As the SPI/PV camera system was lowered to the seafloor, the weight attached to the bounce trigger contacted the seafloor prior to the camera frame reaching the seafloor and triggered the PV camera (Figure 2-3).

During set-up and testing of the PV camera, the positions of lasers on the PV camera were checked and calibrated to ensure separation of 26 cm. Test images were also captured to confirm proper camera settings for site conditions. For this survey, the ISO-equivalent was set at 800, shutter speed was 1/15s and the f-stop was f8. Images were stored in compressed raw Nikon Electronic Format (NEF) files (approximately 30 MB each). Images were checked periodically throughout the survey to confirm that the initial camera settings were still resulting in the highest quality images possible. The ISO setting was changed to 640 and the f-stop setting was changed to f10 after reviewing images from the first station. The f-stop was adjusted again to f16 after the first images were taken on the second day of the survey. All camera settings and any setting changes were recorded in the field log (Appendix B). Details of the camera settings for each digital image also are available in the associated parameters file embedded in each electronic image file.

Prior to field operations, the internal clock in the digital PV system was synchronized with the vessel's navigation system and the SPI camera. Each image was assigned a unique time stamp in the digital file attributes by the camera's data logger and cross-checked with the time stamp in the navigational system's computer data file. In addition, the field crew kept redundant written sample logs (Appendix B). Throughout the survey, PV images were downloaded at the same time as SPI images and were evaluated for successful image acquisition and image clarity. Digital image files were renamed with the appropriate station names immediately after downloading as a further quality assurance step.

The ability of the PV system to collect usable images is dependent on the clarity of the water column. Initially the trigger wire was set to 1.8 m and most of the stations furthest offshore were sampled at this trigger wire distance. As stations became shallower and moved more in-shore, increased turbidity resulted in adjusting the trigger wire to 1.2 m for the majority of the survey, resulting in a mean image width of 1.2 m and a mean field of view of 1.1 m^2.

2.1.3 SPI and PV Data Collection

The SPI/PV survey was conducted at Equinor Wind Offshore Wind Farm Project area from 10 July to 14 July aboard the utility vessel *Northstar Commander*. At each station, the vessel was positioned at the target coordinates and the camera was deployed within a defined station radius tolerance of 7.5 m. Four replicate SPI and PV images were collected at each station (Appendix B). The three replicate images with the best quality (adequate prism penetration, no or minimal sampling artifacts) at each station were selected for analysis (Appendices C and D).

Vessel positioning was carried out by INSPIRE. A Hemisphere vector V102 GPS compass was used to accurately record vessel heading and differential position accuracy to within a meter. During mobilization the navigator conducted a positional accuracy check on the system by placing the antenna on a known GPS point and ensuring the antenna's position fell within a meter of the known coordinates. During operations HYPACK Ultralite software was used to receive positional data and direct the vessel to sampling stations. When the vessel was within a 7.5-meter radius of the target location, the SPI/PV camera system was deployed to the seafloor.

As soon as the camera system made contact with the seafloor, the navigator recorded the time and position of the camera electronically in HYPACK and the written field log. This process was repeated for five SPI/PV replicate "drops" of the SPI/PV camera system at each sampling station. After all stations were surveyed the navigator exported all recorded positional data into an Excel sheet. The Excel sheet included the station name, replicate number, date, time, depth, and position of every SPI/PV replicate.

2.1.4 Image Conversion and Calibration

Following completion of field operations, quality control checks were conducted of filenames, date/time stamps, and the field log. After these procedures, the NEF raw image files were color calibrated in Adobe Camera Raw® by synchronizing the raw color profiles to the Color Calibration Target that was photographed prior to field operations with the SPI camera. The raw SPI and PV images were then converted to high-resolution Photoshop Document (PSD) format files, using a lossless conversion file process and maintaining an Adobe RGB (1998) color profile. The PSD images were then calibrated and analyzed in Adobe Photoshop®. Length and area measurements were recorded as number of pixels and converted to scientific units using the calibration information.

2.1.5 SPI and PV Data Analysis

Computer-aided analysis of SPI/PV images provided a set of standard measurements to allow for comparisons among different areas of interest. Parameters measured from SPI/PV image analysis directly correspond to BOEM Benthic Site Characterization Requirements and Guidelines (Table 2-1). Measured parameters for SPI and PV images were recorded in Microsoft Excel© spreadsheets. These data were subsequently checked by one of INSPIRE's senior scientists as an independent quality assurance/quality control review before final interpretation was performed. Spatial distributions of SPI/PV parameters were mapped using ESRI ArcGIS 10.5.

2.1.5.1 Sediment Profile Image Analysis Parameters

The parameters discussed below were assessed and/or measured and recorded for each replicate SPI image selected for analysis (Appendix C). Descriptive comments were also recorded for each. Many variables can be seen and annotated in context in SPI images from soft bottom coastal and estuarine environments (Figure 2-4).

2.1.5.1.1 Sediment Type

The sediment grain size major mode and range were visually estimated from the color images by overlaying a grain size comparator that was at the same scale. This comparator was prepared by photographing a series of Udden-Wentworth size classes (equal to or less than coarse silt up to granule and larger sizes) with the SPI camera: silt–clay (>4 phi), very fine sand (4 to 3 phi), fine sand (3 to 2 phi), medium sand (2 to 1 phi), coarse sand (1 to 0 phi), very coarse sand (0 to -1 phi), and granule and larger (<-1 phi). The lower limit of optical resolution of the photographic system is about 62 microns, allowing recognition of grain sizes equal to, or greater than, coarse silt (≥4 phi). The accuracy of this method has been documented by comparing SPI estimates with grain size statistics determined from laboratory sieve analyses (Germano et al. 2011).

The comparison of the SPI images with Udden-Wentworth sediment standards photographed through the SPI optical system was also used to map near-surface stratigraphy such as sand-over-mud and mud-over-sand, where observed. When mapped on a local scale, this stratigraphy can provide information on relative transport magnitude and frequency.

2.1.5.1.2 Prism Penetration Depth

The SPI prism penetration depth was measured from the bottom of the image to the sediment–water interface. The area of the entire cross-sectional sedimentary portion of the image was digitized; the number of pixels within this area was divided by the calibrated linear width of the image to determine the mean penetration depth. Linear maximum and minimum depths of penetration were also measured. All three measurements (maximum, minimum, and mean penetration depths) were recorded in the data file.

If the stop collar settings and the number of weights used in the camera frame are held constant throughout the survey, the camera functions as a static-load penetrometer. Comparative penetration values from sites of similar grain size give an indication of the relative water content of the sediment. Highly bioturbated sediments and rapidly accumulating sediments tend to have the highest water contents and greatest prism penetration depths.

The depth of penetration also reflects the bearing capacity and shear strength of the sediments. Over-consolidated or relic sediments and shell-bearing sands resist camera penetration. Highly bioturbated, sulfidic, or methanogenic muds are the least consolidated and deep penetration is typical. Seasonal changes in camera prism penetration have been observed at the same station in other studies and are related to the control of sediment geotechnical properties by bioturbation (Rhoads and Boyer 1982). The effect of water temperature on bioturbation rates appears to be important in controlling both biogenic surface relief and prism penetration depth (Rhoads and Germano 1982).

2.1.5.1.3 Small-Scale Surface Boundary Roughness

Surface boundary roughness was determined by measuring the vertical distance between the highest and lowest points of the sediment–water interface. The camera must be level to record accurate boundary roughness measurements. The surface boundary roughness (sediment surface relief) measured over the width of sediment profile images typically ranges from 0 to 4 cm and may be related to either physical structures (ripples, rip-up structures) or biogenic features (burrow openings, fecal mounds, foraging depressions). Biogenic roughness typically changes seasonally and is related to the interaction of bottom turbulence and bioturbation.

In sandy sediments, boundary roughness can be a measure of sand wave height. On silt–clay bottoms, boundary roughness values often reflect biogenic features such as fecal mounds or surface burrows. The size and scale of boundary roughness values can have dramatic effects on both sediment erodibility and localized oxygen penetration into subsurface sediments (Huettel et al. 1996).

2.1.5.1.4 Apparent Redox Potential Discontinuity Depth

Aerobic near-surface marine sediments typically have higher reflectance relative to underlying hypoxic or anoxic sediments. Surface sands washed free of mud also have higher optical reflectance than underlying muddy sands. These differences in optical reflectance are apparent in SPI images; oxidized surface sediments contain particles coated with ferric hydroxide (an olive or tan color when associated with particles) and reduced and muddy sediments below this oxygenated layer are darker, generally gray to black (Fenchel 1969; Lyle 1983; Sturdivant and Shimizu 2017). The boundary between colored ferric hydroxide surface sediments and underlying gray to black sediments is called the apparent redox potential discontinuity (aRPD).

The depth of the aRPD in the sediment column is an important time integrator of dissolved oxygen conditions within sediment porewaters. In the absence of bioturbation, this high reflectance layer (in muds) will typically reach a thickness of 2 mm below the sediment–water interface (Rhoads 1974). This depth is related to the supply rate of molecular oxygen by diffusion into subsurface sediments and the consumption of that oxygen by the sediment and associated microflora. In sediments that have very high sediment oxygen demand (SOD), the sediment may lack a high reflectance layer even when the overlying water column is aerobic. In the presence of bioturbating macrofauna, the thickness of the high reflectance layer may be several centimeters.

The relationship between the thickness of the high reflectance layer and the presence or absence of free molecular oxygen in the associated porewaters must be considered with caution. The actual RPD is the boundary or horizon that separates the positive Eh region of the sediment column from the underlying negative Eh region. The exact location of this Eh = 0 boundary can be determined accurately only with microelectrodes; hence, the relationship between the change in optical reflectance, as imaged with the SPI camera, and the actual RPD can be determined only by making *in situ* Eh measurements. For this reason, the optical reflectance boundary, as imaged, is described in this study as the “apparent” RPD (aRPD) and was measured as a mean value. The mean aRPD measured in SPI has been shown to be a suitable proxy for the RPD with the depth of the actual Eh = 0 horizon generally either equal to or slightly shallower than the depth of the optical reflectance boundary (Rosenberg et al. 2001; Simone and Grant 2017). There is a lag time between when Eh reaches 0 mV and the precipitation of darker sulfidic sediments (Jorgensen and Fenchel 1974) under reducing conditions and, therefore, the related color reflectance change used to indicate the aRPD may be slightly deeper than the RPD. Additionally, bioturbating organisms can mix ferric hydroxide-coated particles downward below the Eh = 0 horizon; with active ventilation, burrows have been shown to extend below the aRPD (Sturdivant et al. 2012; Sturdivant and Shimizu 2017). Because bioturbating organisms are not uniformly distributed in the sediment matrix, the depth of the aRPD can vary across the width of a SPI image (approximately 14–15 cm). As a result, the mean aRPD depth serves as a valuable estimate of the depth of porewater exchange, usually through porewater irrigation (bioturbation).

The rate of depression of the aRPD within the sediment is relatively slow in organic-rich muds, on the order of 200 to 300 micrometers per day; therefore, this parameter has a long time constant (Germano and Rhoads 1984). The rebound in the aRPD is also slow (Germano 1983). Measurable changes in the aRPD depth using the SPI optical technique can be detected over periods of 1 or 2 months. This parameter is used effectively to document changes (or gradients) that develop over seasonal or yearly cycles related to seasonal hypoxia, SOD, water temperature effects on bioturbation rates, and infaunal recruitment. For example, the aRPD has been shown to be a sensitive and specific indicator of hypoxic conditions experienced over the preceding 1 day to 4 weeks (Shumchenia and King 2010), and to be correlated to concurrent *in situ* dissolved oxygen concentrations (Sturdivant et al. 2012). Time-series aRPD measurements following a disturbance can be a critical diagnostic element in monitoring the degree of recolonization in an area by the ambient benthos (Rhoads and Germano 1986).

The mean aRPD depth also can be affected by local erosion. Scouring can wash away fines and shell or gravel lag deposits and can result in a very thin surface oxidized layer. During storm periods, erosion may completely remove any evidence of the aRPD (Fredette et al. 1988).

Another important characteristic of the aRPD is the contrast in reflectance at this boundary. This contrast is related to the interactions among the degree of organic loading, the bioturbation activity in the sediment, and the concentrations of bottom-water dissolved oxygen in an area. High inputs of labile organic material increase SOD and, subsequently, sulfate reduction rates and the associated abundance of sulfide end products. This results in more highly reduced, lower-reflectance sediments at depth and high contrasts between these sediments and the overlying oxidized sediments, i.e., high aRPD contrasts. In a region where there is generally more uniform reflectance across the sediment column, i.e., low aRPD contrasts, images with high aRPD contrasts indicate localized sites of relatively large inputs of organic-rich material such as phytoplankton, other naturally occurring organic detritus, dredged material, or sewage sludge.

Because the determination of the aRPD requires discrimination of optical contrast between oxidized and reduced particles, it is difficult, if not impossible, to determine the depth of the aRPD in well-sorted sands of any size that have little to no silt or organic matter in them. When using SPI technology on sand bottoms, little information other than grain size, prism penetration depth, and boundary roughness values can be measured; while oxygen has penetrated the sand beneath the sediment–water interface due to physical forcing factors acting on surface roughness elements (Ziebis et al. 1996; Huettel et al. 1998), estimates of the mean aRPD depths in these types of sediments are indeterminate with conventional white light photography.

2.1.5.1.5 Organic Enrichment, Sedimentary Methane, and Thiophilic Bacteria

Sediment oxygen demand (SOD) represents the overall rate of oxygen consumption, biologically and chemically, by the sediment column. Organic loading to a system results in increased SOD and reduced sediments. The relative amount of organic enrichment is indicated by sediment color; darker coloration indicates that sediment is more reduced and has greater organic loading (Fenchel 1969; Rhoads 1974; Lyle 1983; Bull and Williamson 2001; Sturdivant and Shimizu 2017). SOD levels (i.e., none, low, medium, and high) were assessed for all images. Images in which dark-gray or black reduced sediments were in contact with the water column across the entire length of the sediment–water interface were recorded as having low dissolved oxygen conditions. If organic loading is extremely high, porewater sulfate is depleted and methanogenesis occurs. The process of methanogenesis is indicated by the appearance of methane bubbles in the sediment column. These gas-filled voids are readily discernable in SPI images because of their irregular, generally circular aspect and glassy texture (due to the reflection of the strobe off the gas bubble). The presence of subsurface methane bubbles were noted.

A primary diagnostic feature indicating an area is suffering from hypoxic conditions due to organic enrichment is the presence of *Beggiatoa* or *Beggiatoa*-like colonies. (Note: while it cannot be determined with certainty that any bacterial colonies seen in profile images are the genus *Beggiatoa* without microscopic identification, these bacteria are known to be in the same family of sulfur-oxidizing bacteria that only appear in hypoxic or anoxic conditions). These colonies have diagnostic morphology that has been documented in numerous other sediment profile imaging surveys (Nilsson and Rosenberg 1997; Rosenberg et al. 2001; Karakassis et al. 2002; Germano et al. 2011). The presence of sulfur-oxidizing bacterial colonies indicates hypoxic dissolved oxygen concentrations in the water column at the benthic boundary layer (Rosenberg and Diaz 1993; Sturdivant et al. 2012). The presence and extent (e.g., threads, trace, patches, mat) of *Beggiatoa* or *Beggiatoa*-like colonies were noted.

2.1.5.1.6 Infaunal Successional Stage

The mapping of infaunal successional stages is readily accomplished with SPI technology. These stages are recognized in SPI images by the presence of dense assemblages of near-surface polychaetes and/or the presence of subsurface feeding voids; both may be present in the same image. Mapping of successional stages is based on the theory that organism–sediment interactions in fine-grained sediments follow a predictable sequence after a major seafloor perturbation. This theory states that primary succession results in “the predictable appearance of macrobenthic invertebrates belonging to specific functional types following a benthic disturbance. These invertebrates interact with sediment in specific ways. Because functional types are the biological units of interest, our definition does not demand a sequential appearance of particular invertebrate species or genera” (Rhoads and Boyer 1982). This theory is presented in Pearson and Rosenberg (1978) and further developed in Rhoads and Germano (1982) and Rhoads and Boyer (1982).

This continuum of change in animal communities after a disturbance (primary succession) has been divided subjectively into four stages: Stage 0, indicative of a sediment column that is largely devoid of macrofauna, occurs immediately following a physical disturbance or in close proximity to an organic enrichment source; Stage 1 is the initial community of tiny, densely populated polychaete assemblages; Stage 2 is the start of the transition to head-down deposit feeders; and Stage 3 is the mature, equilibrium community of deep-dwelling, head-down deposit feeders (Figure 2-5).

The first invertebrate assemblage (Stage 1) appears within days after an area of bottom is disturbed by natural or anthropogenic events. Stage 1 consists of assemblages of tiny tube-dwelling marine polychaetes that reach population densities of 10^4 to 10^6 individuals per m^2. These animals feed at or near the sediment–water interface and physically stabilize or bind the sediment surface by producing a mucous “glue” that they use to build their tubes. Sometimes deposited dredged material layers contain Stage 1 tubes still attached to mud clasts from their location of origin; these transported individuals are considered as part of the *in situ* fauna in our assignment of successional stages.

If there are no repeated disturbances to the newly colonized area, then these initial tube-dwelling suspension or surface-deposit-feeding taxa are followed by burrowing, head-down deposit-feeders that rework the sediment deeper and deeper over time and mix oxygen from the overlying water into the sediment. The animals in these later-appearing communities (Stage 2 or 3) are larger, have lower overall population densities (10 to 100 individuals per m^2), and can rework the sediments to depths of 3 to 20 cm or more. These animals “loosen” the sedimentary fabric and increase the water content in the sediment, thereby lowering the sediment shear strength, and actively recycle nutrients because of the high exchange rate with the overlying waters resulting from their burrowing and feeding activities.

In dynamic environments, it is simplistic to assume that benthic communities always progress completely and sequentially through all four stages in accordance with the idealized conceptual model depicted in Figure 2-5. Various combinations of these basic successional stages are possible. For example, secondary succession can occur (Horn 1974) in response to additional labile carbon input to surface sediments, with surface-dwelling Stage 1 or 2 organisms coexisting at the same time and place with Stage 3, resulting in the assignment of a “Stage 1 on 3” or “Stage 2 on 3” designation. If both Stage 1 and Stage 2 organisms exist in an image with Stage 3 fauna, the Stage 1 on 3 designation is used because it is more important to document the presence of recruiting organisms than intermediate Stage 2 fauna.

While the successional dynamics of invertebrate communities in fine-grained sediments have been well documented, the successional dynamics of invertebrate communities in sand and coarser sediments are not well known. Consequently, the insights gained from sediment profile imaging technology regarding biological community structure and dynamics in sandy and coarse-grained bottoms can be limited highlighting the importance of combining SPI with PV.

2.1.5.2 Plan View Image Analysis

Plan view images provide a much larger field of view than SPI images and provide valuable information about the landscape ecology and sediment topography in the area where the pinpoint "optical core" of the sediment profile was taken (Figure 2-6). Unusual surface sediment layers, textures, or structures detected in any of the sediment profile images can be interpreted by considering the larger context of surface sediment features; i.e., whether a surface layer or topographic feature is a regularly occurring feature and typical of the seafloor in this general vicinity or an isolated anomaly. The scale information provided by the underwater lasers allows accurate density counts of attached epifaunal colonies, sediment burrow openings, or larger macrofauna or fish which may have been missed in the sediment profile cross-section, as well as measurements of the percent cover of *Beggiatoa* colonies and other features of interest. Information on sediment transport dynamics and bedform wavelength is also available from PV image analysis. The parameters discussed below were assessed and/or measured and recorded for each replicate PV image selected for analysis (Appendix D).

2.1.5.2.1 Field-of-View

For each replicate PV image, the field-of-view area was measured. The scale information provided by the underwater lasers allows accurate density counts of attached epifaunal colonies, sediment burrow openings, or larger macrofauna or fish which may not have been captured in the sediment profile cross-section, as well as measurements of features of interest observed in the image.

2.1.5.2.2 CMECS Biotic Subclass and CMECS Biotic Group

The Biotic Component of CMECS is a classification of the living organisms of the seabed and water column together with their physical associations at a variety of spatial scales. The Biotic Component is organized into a branched hierarchy of five nested levels: Biotic Setting, Biotic Class, Biotic Subclass, Biotic Group, and Biotic Community. The Biotic Subclass is a key CMECS classifier that presents valuable information about the surveyed area in terms of physical habitat and the potential presence of sensitive taxa; therefore, it was identified as a parameter for PV image analysis. Biotic Component classifications are defined by the dominance of life forms, taxa, or other classifiers in the observation. In the case of PV images dominance is assigned to the taxa with the greatest percent cover in the observational footprint (Federal Geographic Data Committee [FGDC] 2012).

Biotic Subclasses describe dominant biota at a coarse level. Within the Benthic/Attached Biota Biotic Component setting, there are eight classes, of which the Faunal Bed class is of most relevance to the OCS. Three subclasses fall under the Faunal Bed hierarchy: Attached Fauna, Soft Sediment Fauna, and Inferred Fauna. Inferred Fauna (e.g., tracks and trails, egg masses) are often present, but in this study, were primarily used to inform or confirm the selection of either the Attached or Soft Sediment Fauna subclass. Although the Biotic Subclass is not directly based on sediment grain size distributions, it reflects them at the scale of relevance to the dominant fauna present, thus serving as an integrator of physical and biological characteristics of the seafloor. CMECS expressly states that "substrate type is such a defining aspect of the Faunal Bed class that CMECS Faunal Bed subclasses are assigned as physical-biological associations involving both biota and substrate (FGDC 2012)."

Plan view images were assigned one of three Biotic Subclasses (definitions from FGDC 2012):

- Attached Fauna – "Areas characterized by rock substrates, gravel substrates, other hard substrates, or mixed substrates that are dominated by fauna which maintain contact with the substrate surface, including firmly attached, crawling, resting, interstitial, or clinging fauna. Fauna may be found on, between, or under rocks or other hard substrates or substrate mixes. These fauna use pedal discs, cement, byssal threads, feet, claws, appendages, spines, suction, negative density, or other means to stay in contact with the (generally) hard substratum and may or may not be capable of slow movement over the substratum. Many attached fauna are suspension feeders and feed from the water column. Other attached fauna are benthic feeders, including herbivores, predators, detritivores, and omnivores."

- Soft Sediment Fauna – "Areas that are characterized by fine unconsolidated substrates (sand, mud) and that are dominated in percent cover or in estimated biomass by infauna, sessile epifauna, mobile epifauna, mobile fauna that create semi-permanent burrows as homes, or by structures or evidence associated with these fauna (e.g., tilefish burrows, lobster burrows). These animals may tunnel freely within the sediment or embed themselves wholly or partially in the sediment. In many cases, they will regularly leave their burrows, and may move rapidly or swim actively after doing so, but any animal that creates a semi-permanent home in the sediment can be classified as Soft Sediment Fauna. These animals may also move slowly over the sediment surface but are not capable of moving outside of the boundaries of the classification unit within one day. Most of these fauna possess specialized organs for burrowing, digging, embedding, tube-building, anchoring, or locomotory activities in soft substrates."

- IND – an indeterminate Biotic Subclass

The Biotic Component subclasses of Attached and Soft Sediment Fauna are excellent broad-brush tools for screening-level assessments of seafloor habitats for offshore wind development. Mapping proposed development areas with this CMECS classifier can highlight locations, that from a benthic habitat perspective, might be considered suitable for offshore wind development (Soft Sediment Fauna) and those that may be unsuitable or require further detailed study to determine suitability (Attached Fauna). Depending on the results and scale of reconnaissance surveys, additional studies would likely be needed as specific siting alternatives are examined.

Attached Fauna habitats are also referred to in some documents as "live bottom." These hard bottom habitats that support "live bottom" are considered potentially valuable and sensitive resources for regionally important taxa. Additionally, cobbles and boulders can provide habitat for a diverse range of taxa and serve as valuable habitat for corals and as a place for squid to lay their eggs. Soft coral habitats also may play a role in creating or enhancing habitat for black sea bass (*Centropristis striata*), a species of concern for the SJWF and SJEC areas (Guida et al. 2017). Hard bottom habitats are limited in distribution along the Mid-Atlantic and Northeast portions of the OCS relative to sandy and soft bottom habitats (Guida et al. 2017; USGS 2018).

While Biotic Subclasses describe major biological characteristics at a fairly coarse level, Biotic Groups are descriptive terms based on finer distinctions of taxonomy, structure, position, environment, and salinity levels (FGDC 2012). CMECS provides definitions and descriptions of dozens of Biotic Groups. Only a subset of these Biotic Groups could potentially occur in the surveyed area (based on water depth, latitude, depth, etc.). The full set of defined Biotic Groups are available in the CMECS document (FGDC 2012) and a subset of Biotic Groups observed within the surveyed area are found in Table 2-2.

2.1.5.2.3 Sensitive Taxa and Species of Concern

While Geological and Geophysical (G&G) multibeam echosounder and side scan sonar data provide high quality remote imaging of the seafloor, they do not provide adequate resolution for the identification of sensitive taxa. The image resolution of the SPI/PV survey allows for the identification of sensitive taxa. Sensitive seafloor habitats include corals, submerged aquatic vegetation beds, and valuable cobble and boulder habitat (BOEM 2019). Cobble and boulder habitat can serve as structure for hard and soft corals, nursery ground for juvenile lobster, and as preferable benthic habitat for squid to deposit their eggs. Taxa considered sensitive for this survey included corals, seagrasses, squid eggs, and American lobster. Species of concern for this area included black sea bass, Atlantic cod, sea scallops, and ocean quahog (Guida et al. 2017). Presence/absence of each sensitive taxa or species of concern was noted for each replicate SPI and PV image.

2.1.5.2.4 Invasive Taxa

The introduction of invasive species to the water column and benthic habitat is an important concern related to offshore development. The utilization of vessels originating from many different ports can lead to the introduction of invasive species through fouled hulls and contaminated ballast water. The introduction of new structures, such as scour protection, turbine structure, transmission cable, and concrete mattresses, to the water column and seafloor during construction may also lead to the introduction of invasive species. The SPI/PV survey collected baseline presence/absence data for marine invasive species within the surveyed area. A list of potential invasive species was derived from the Northeastern Aquatic Nuisance Species Panel (https://www.northeastans.org/) and a Pennsylvania Sea Grant report (https://seagrant.psu.edu/sites/default/files/MidAtlantic%20AIS%20Field%20Guide_Web.pdf).

2.2 Sediment Grabs

2.2.1 Sediment Acquisition

A double, 0.1m^2 Ted Young Modified Van Veen grab sampler was used to collect surficial sediment samples following procedures outlined in the SOP for Sediment Grab Sampling

(INSPIRE 2019c). Sediments were retained from a total of 16 stations sampled along the proposed export cable routes (Figure 2-1).

Once the boat was positioned to within 25 m of the planned sampling station, the sampler was lowered vertically through the water column until it came into contact with the sediment surface. Once on the bottom, the jaws closed and the line went slack, indicating that a sample had been collected. Position data were collected, and the grab was raised to the surface and retrieved on deck.

Upon recovery of the sample, the sediment within the grab bucket was inspected to assess whether the sample was acceptable (i.e., had not been subject to partial washout during retrieval, and was of sufficient volume). If the sample was not acceptable, two additional attempts were made at the target station. If, after three attempts, a successful grab was not collected, the vessel moved off station in an attempt to find suitable bottom.

Each grab attempted was logged. Once a sample was deemed acceptable, a photograph of the undisturbed grab was obtained. The station name, latitude/longitude, and time of collection and descriptive features were recorded on the Sediment Sample Log Form (Appendix E).

2.2.2 Sediment Processing

After the grab was photographed and logged, a subsample was collected for grain size analysis. Surficial samples for grain size analyses were collected from the top 10 cm from one of the buckets. Before subsamples of the surficial sediments were taken, any overlying water was removed by slowly siphoning off the overlying water near one side of the sampler. A ruler was placed in the center of the grab (deepest section) and the top 10 cm of sediment was removed and transferred to a clean glass bowl for homogenization. Following homogenization, approximately 500 grams of sediment was placed in a zip top bag, sealed and labelled with StationID, date and time. Samples were stored at 4°C prior to analysis (samples may be held for up to 6 months before analysis). Samples were not frozen or dried prior to analysis. A Chain of custody form (Appendix F) was prepared in the field and accompanied the samples when shipped to the laboratory for analysis.

Aqua Survey, Inc. (ASI) performed the Grain Size Distribution analysis for this project. Sixteen sediment samples were delivered to ASI on July 15, 2019, under chain of custody procedures. Upon arrival, all samples were assigned unique ASI sample numbers. The samples containing mostly sand were analyzed by the sieve method (ASTM D6910-04), while the samples containing sand and silt were analyzed with the combined sieve and hydrometer method (ASTM D798-17). See Table 2-3 for sample identification and for which method was used for each sample. The appendices contain all supporting documentation including sample use forms (Appendix E) and chains of custody (Appendix F).

The particle size of the sediments was analyzed in the laboratory using ASTM Methods D6913/D7928, sieve/hydrometer methods (these methods supersede ASTM D422).

2.3 Data Quality Assurance and Quality Control

Measures were taken both during field data collection and during post-collection analysis for data quality assurance and control in alignment with the PEP for this project (INSPIRE 2019a).

Prior to survey mobilization, the camera electronics were “bench-tested” to ensure the cameras were focused and firing properly, the lasers were aligned properly, and the strobe was operational. The positions of lasers on the PV camera were checked and calibrated to ensure separation of 26 cm. Spare camera parts, fully charged battery packs, and spare cables were carried in the field to ensure uninterrupted sample acquisition. At the beginning of the survey, the times on the digital SPI and PV cameras were synchronized with the navigation system clock. Each SPI and PV station replicate is identified by the time stamp recorded as part of the digital image file and the corresponding time and position recorded by the navigation system. Redundant written sample logs were kept by the field crew (Appendix B). Test shots were fired on deck at the beginning of each field day to verify all internal electronic systems were working according to specifications. These test shots included taking pictures of standard color cards to ensure proper color balance of the digital images during collection and to verify the calibration of the image analysis system during processing.

At regular intervals during each survey day, the frame counter on the SPI camera was checked to make sure the desired number of replicates had been taken. In addition, both the SPI and PV images were downloaded at regular intervals (typically every 3 to 5 stations) using external USB ports. These images then were viewed to confirm the settings on the digital cameras were optimal for the conditions in the survey area. These settings were adjusted if necessary and changes noted in the field log (Appendix B). In addition, if images were missed or penetration depth was insufficient, proper adjustments were made (e.g., weight added to the frame) and additional replicates taken. Digital image files were renamed with the appropriate station names immediately after downloading as a further quality assurance step. Visual checks and hand tightening checks of all nuts and bolts on the SPI/PV camera frame were conducted periodically to make sure nothing vibrated loose during the survey.

A quality assurance review of all data and results presented in this report was performed in accordance with the PEP for this project (INSPIRE 2019a).

Table 2-1. SPI/PV Survey Parameters with Corresponding BOEM Site Characterization Requirements and Guidelines

	SPI/PV	**BOEM Guideline (BOEM 2019)**
Analysis Parameters	Sensitive Taxa (SPI/PV)	• Identification of potentially sensitive seafloor habitat
	Invasive Taxa (SPI/PV)	• Identification of invasive taxa
	Attached Flora/Fauna (PV)	• Identification of potentially sensitive seafloor habitat • Classification to CMECS Biotic Subclass • Classification to CMECS Biotic Group
	Soft Sediment Infauna Community (SPI/PV)	• Identification of potentially sensitive seafloor habitat • Characterization of macrofaunal community • Identification of taxa diversity • Classification to CMECS Biotic Subclass • Classification to CMECS Biotic Group
	Dominant and Co-occurring Biotic Subclasses & Groups	• Identification of potentially sensitive seafloor habitat • Classification to CMECS Biotic Subclass • Classification to CMECS Biotic Group
	Mobile Epifauna (SPI/PV)	• Characterization of macrofaunal community • Identification of taxa diversity
	Fish (PV)	• Characterization of macrofaunal community
	Burrows/Tubes/Tracks (PV)	• Characterization of macrofaunal community
	Flora (PV)	• Characterization of macrofloral community
	Apparent Redox Potential Discontinuity (SPI)	• Characterization of benthic habitat attributes
	Sediment Oxygen Demand (SPI)	• Characterization of benthic habitat attributes
	Successional Stage (SPI)	• Characterization of benthic habitat attributes
	Low Dissolved Oxygen Presence (SPI)	• Characterization of benthic habitat attributes
	Methane Presence (SPI)	• Characterization of benthic habitat attributes

Table 2-2. CMECS Classification Levels Used in Analysis and Classifications for the Equinor Wind Survey

CMECS Term	Scale of Classification	Classifications
Geoform Component		
Tectonic Setting	Site	Passive Continental Margin
Physiographic Setting	Site	Continental Shelf
Geoform Origin	Site	Geologic
Substrata Component		
Substrate Origin	Site	Geologic Substrate
Substrate Class	SPI/PV	Unconsolidated Mineral Substrate
+Substrata Subclass	SPI/PV	Fine Unconsolidated Substrate; Coarse Unconsolidated Substrate
+Substrata Group	PV	Sandy Mud; Muddy Sand; Sand; Slightly Gravelly; Gravelly Sand; Sandy Gravel; Boulder
+Substrata Subgroup	SPI	Silt-Clay; Very Fine Sand; Fine Sand; Medium Sand; Coarse Sand; Very Coarse Sand; Granule; Pebble; Cobble
Biotic Component		
Biotic Setting	SPI/PV	Benthic/Attached Biota
Biotic Class	SPI/PV	Faunal Bed
+Biotic Subclass	SPI/PV	**Soft Sediment Fauna**; Attached Fauna; Inferred Fauna
+Biotic Group	SPI/PV	**Larger Tube-Building Fauna;** Tracks and Trails; Sand Dollar Bed; Attached Corals; Attached Hydroids; Burrowing Anemones; Mobile Crustaceans on Hard or Mixed Substrates; Mobile Crustaceans on Soft Sediments; Diverse Soft Sediment Epifauna; Small Tube-Building Fauna; Attached Bryozoans; Larger Deep-Burrowing Fauna; Mobile Mollusks on Soft Sediments; Mobile Mollusks on Hard or Mixed Substrates; Barnacles

+ Indicates variability within the surveyed area at this level of the hierarchy
Bold text indicates an overwhelming dominant classification across the surveyed area

Table 2-3. Sediment Grab Sample Identification

Station ID	ASI ID	Grain Size Analysis Method
003	20190565	ASTM D6913-04
006	20190566	ASTM D6913-04
010	20190567	ASTM D7928-17
011	20190568	ASTM D7928-17
147	20190569	ASTM D6913-04
157	20190570	ASTM D6913-04
020	20190571	ASTM D6913-04
038	20190572	ASTM D6913-04
060	20190573	ASTM D7928-17
076	20190574	ASTM D7928-17
091	20190575	ASTM D6913-04
095	20190576	ASTM D6913-04
100	20190577	ASTM D7928-17
057	20190578	ASTM D7928-17
133	20190579	ASTM D6913-04
136	20190580	ASTM D6913-04

3.0 RESULTS

A complete set of all the data measured and assessed from each analyzed SPI image is presented in Appendix C; data measured and assessed from each PV image are in Appendix D. Station summary data was grouped by proposed cable route of interest for ease of interpretation (Long Island Cable Routes, New Jersey Cable Routes, New York Harbor Cable Routes, and reference stations; Figure 3-1) and are presented in Tables 3-1 through 3-4. Section 3.1 summarizes results for the entire surveyed area. Section 3.2 reports results from the Long Island Cable Routes, Section 3.3 reports results from the New Jersey Cable Routes, Section 3.4 reports results from the New York Harbor Cable Routes, and Section 3.5 reports results from the reference stations.

3.1 Site Overview

3.1.1 Physical Features

Surface sediment types observed in both the SPI and PV images across the surveyed areas were diverse and spatially variable (Figures 3-2, 3-3, 3-4, 3-5). Sediments ranged from: fine sediments of silt/clay and very fine sand; to larger sand sizes; to coarser material of granules and pebbles; and larger cobbles and boulders (Figures 3-2, 3-3, 3-4, and 3-6). Surficial sediments (up to 20 cm below the sediment–water interface) were assessed from SPI images and assigned phi size classes for the grain size major mode parameter (Appendix C). Many sediments imaged exhibited a surface layer of coarse sediment over a range of finer grain size classes. For interpretive purposes, these images have been aggregated into “over sand/finer sediment” groupings, such as “pebble over finer sediment”, “granule over sand”, and “very coarse sand over sand” (Tables 3-1a, 3-2a, 3-3a, 3-4a, 3-5; Figures 3-3, 3-7).

The combination of the PV images and SPI provided context on the composition of surface sediments, which were mixed in distribution (Figures 3-2, 3-3) with instances of small- and large-scale spatial heterogeneity driven by hydrodynamic forcing on the seabed. Small-scale (intra-station) heterogeneity was represented by two or three replicate images for a station being classified into two or three different sediment types (Figure 3-2,3-3). E.g., Station 51 contained three gravel sediment types (granule, pebble, pebble over fine sediment) with coarser grains oriented in the troughs of the seabed by fluid dynamics (Figure 3-8). Intra-station heterogeneity was predominantly observed at stations along the New Jersey cable route, stations in the state waters of the Long Island cable route, and stations along and adjacent Cholera Bank (Figures 3-3, 3-4, 3-5). At stations where the predominant sediment type was consistent across replicates there were still occasions where hydrodynamics influenced grain orientation, e.g., Station 40 (Figure 3-9). Larger grains were located within the trough of asymmetric sand ripples formed via bedload transport. Spatial heterogeneity in surface sediments was also observed at a larger scale (inter-station). For example, Stations 009 and 010 had different sediment types despite their close spatial proximity (Figure 3-2). Station 010 was located within a submarine valley along the edge and was composed of fine sand over silt-clay (Figure 3-10A), whereas Station 009 was situated just outside of the valley and was composed of coarse granules (Figure 3-10B); deeper valleys or basins are noted for the reduced fluid shear force on the seabed found in these areas, compared to adjacent shallower areas. Subsequently finer material can be found in these relatively deeper locations; Station 011 located directly in the submarine valley was composed of silt-clay (Figure 3-6A). The observations of sediment types in the profile and plan view images corresponded to the USGS backscatter data (Figure 2-2), ground-truthing this information and providing a level of confidence in areas of backscatter return where SPI/PV data was not collected. There was a sharp spatial contrast in backscatter returns either side of the Hudson River Shelf Valley, and this difference in backscatter was also observed in the sediment types documented.

The prism penetration measurement provides additional information about the bearing capacity and shear strength of sediments sampled. The camera frame stops and weights were mostly held constant throughout the survey with a few notable exceptions (Appendix B). The weights are the key adjustment to hold constant in order to use prism penetration to assess relative sediment shear strength. During the survey, weights were constant at every station except Station 030. There was some adjustment to the stops, but the stops rarely had any influence on penetration as most stations contained shallow to medium penetration that rarely reached the maximum stop height. Prism penetration is therefore useful as a barometer of relative sediment shear strength and load-bearing capacity. Penetration values across the surveyed areas ranged from 2.0 cm to 19.8 cm, with a mean of 6.0 cm (SD±2.3) (Tables 3-1a, 3-2a, 3-3a, 3-4a). Nearly two-thirds of all stations were characterized by medium to high load-bearing strength reflected in the relatively shallow prism penetration depths observed (<6 cm) (Figures 3-11 and 3-12). Approximately one-third of all stations had low to medium bearing capacity reflected in prism penetration values between 6 and 20 cm (Figures 3-11 and 3-12 B and C). Station 128 had the lowest shear strength of any station sampled, with the prism over-penetrating and exceeding the field of view of the face plate (Figure 3-13), as a result this station was not included as part of the assessment for prism penetration values.

Small-scale surface boundary roughness measured in SPI images can indicate physical shaping activity related to bedforms and hydrodynamics as well as biological activities such as infaunal burrowing and fish foraging. Station mean boundary roughness across the surveyed area averaged 1.3 cm (SD±0.5), with a range of 0.5 to 3.2 cm (Tables 3-1a, 3-2a, 3-3a and 3-4a; Figure 3-14). Physical forcing was the primary driver shaping small-scale boundary roughness for the majority of the SPI images analyzed (Appendix C).

3.1.2 Biological Features and Habitat

The CMECS Biotic Subclass of Soft Sediment Fauna was the dominant Biotic Subclass observed across the surveyed areas (Tables 3-1b, 3-2b, 3-3b, 3-4b; Figure 3-15). This subclass is defined as “Areas that are characterized by fine unconsolidated substrates (sand, mud) and that are dominated in percent cover or in estimated biomass by infauna, sessile epifauna, mobile epifauna, mobile fauna that create semi-permanent burrows as homes, or by structures or evidence associated with these fauna (e.g., tilefish burrows, lobster burrows)” (See Section 2.1.5.2.2 for a full definition). Observations of the Soft Sediment Fauna Subclass typically were present in the form of infaunal tubes and burrows at the sediment–water interface and sand dollars on the sediment surface (Tables 3-1b, 3-2b, 3-3b, 3-4b; Figure 3-16). Epifaunal tracks were present across much of the surveyed areas and were created by small epifauna, such as snails and hermit crabs (Figure 3-17A) and by larger epifauna, such as cancer crabs and sea stars (Figures 3-10A, 3-17B).

The CMECS Biotic Subclass of Attached Fauna was infrequently observed as either the dominant Subclass or as the Co-occurring Biotic Subclass in the surveyed areas (Tables 3-1b, 3-2b, 3-3b, 3-4b; Figure 3-18). Attached fauna were documented: in the state waters along the planned path of the New York Export Cable where mussel beds were observed amongst shell fragments overlying silt-clay (Figure 3-19); at stations located on Cholera Bank where a diverse assemblage of attached fauna was observed (hydroids, sponges, corals; Figure 3-20); and at one station along the proposed NJ cable route (Figure 3-10A). This subclass is defined as "Areas characterized by rock substrates, gravel substrates, other hard substrates, or mixed substrates that are dominated by fauna which maintain contact with the substrate surface, including firmly attached, crawling, resting, interstitial, or clinging fauna" (See Section 2.1.5.2.2 for a full definition). When present, the percent cover of attached fauna was dense (Figure 3-21), as highlighted by the mussel beds observed along the New York Export Cable route (Figure 3-19) and the diverse attached fauna at Station 050 on Cholera Bank (Figure 3-20B); moderate, sparse and trace (Stations 095, 068, 010 respectively).

The CMECS Biotic Group of Small Tube-Building Fauna was the most common Dominant Biotic Group observed across the surveyed areas (Tables 3-1b, 3-2b, 3-3b, 3-4b; Figures 3-22 and 3-23). This group is defined as "Soft sediment areas dominated by tube-building annelids (e.g., spionids, sabellids), amphipods, small phoronids, or other small, surface-dwelling, tube-building fauna. These animals have a small tube width (< 2 millimeters), and the tubes often occur in dense mats. The animal itself may reside above or below the sediment surface within the constructed tube, which may be composed of a variety of materials (e.g., glued sediments, calcium carbonate, mucus, chitin, proteins)." Other frequently occurring Dominant CMECS Biotic Groups observed across the surveyed areas included Larger Tube Building Fauna (Figure 3-24A), Sand Dollar Beds (Figure 3-24B), Small Surface-Burrowing Fauna (Figure 3-24C), Mussel Beds (Figure 3-24D), and Burrowing Anemones (Figure 3-24E). The Dominant Co-occurring Biotic Group was variable across the surveyed area with no predominant group (Figure 3-25), highlighting the diversity of seafloor taxa in the surveyed area. Definitions of all CMECS Biotic Groups can be found in the Classification Standard (FGDC 2012).

The majority of the biological features observed at the surveyed area were driven by the seafloor habitat. The predominant habitat was Sand Sheets with numerous instances of Sand with Mobile Gravel, and a couple of stations where a habitat of Patchy Cobbles and Boulders on Sand was observed (Figures 3-2, 3-26, 3-27). Cobbles and boulders can provide habitat for a diverse range of taxa and serve as valuable habitat for corals and as a place for squid to lay their eggs (Guida et al. 2017). Sensitive taxa (Section 2.1.5.2.3) were only observed in SPI/PV imagery at one station (Tables 3-1b, 3-2b, 3-3b, 3-4b; Figure 3-28). At Station 50 the non-reef building Northern Star coral, *Astrangia* spp., was observed in all replicates (Figures 3-6E, 3-

20B, 3-29). *Astrangia* is a stony coral that attaches to hard substrate instead of building its own structure dissimilar from those corals commonly observed in tropical reefs. The polyps are translucent, and the colony has a furry appearance when they are expanded (Figure 3-29 inset). These sensitive taxa were observed in conjunction with other non-sensitive attached fauna (sponges, hydroids, barnacles) (Figure 3-20). In addition to those associated with sensitive habitats, species of concern known to occur in the area are black sea bass (warmer months), Atlantic cod (colder months), sea scallops, surf clams, and ocean quahog (Guida et al. 2017); sea scallops and the ocean quahog were the only species of concern observed during the SPI/PV survey (Figures 3-30, 3-31).

3.2 Long Island Export Cable Route (LIECR)

Fifty-six SPI/PV stations were sampled along the portion of the proposed route that was defined as the Long Island Export Cable Route (LIECR, Figure 3-1). The LIECR encompassed Stations 030-042, 79-80, 82-88, 98-106, and 116-130

3.2.1 Physical Features

Surficial sediment types varied along the LIECR with observed grain size classes ranging from silt-clay to granules and pebbles (Tables 3-1a, 3-5; Figures 3-2, 3-3, 3-6D, and 3-13). Stations located furthest offshore (Stations 030-045) were predominantly composed of medium sand (Figure 3-32) with a few instances of fine and coarse sand (Figures 3-2, 3-7C). Stations closer to shore were predominantly very fine sand or fine sand (Figures 3-3, 3-33) with a few stations composed of granules or pebbles (Figures 3-3, 3-6D). While there was inter-station spatial heterogeneity in sediment type along the LIECR, intra-station heterogeneity, i.e. two or three replicate images with different grain size categories, of primary sediments was minimal (Figures 3-2, 3-3, and 3-5). Low intra-station heterogeneity provided the ability to more accurately and finely categorize sediment types. Stations exhibiting sediment types with medium or high intra-station heterogeneity, were observed to be haphazardly distributed along the LIECR (Figure 3-5). No boulders were observed along the LIECR (Figure 3-4).

Station mean prism penetration values along the LIECR ranged from 3.6 to 13.8 cm, with a mean of 5.4 cm (SD±1.6) (Table 3-1a). Approximately 80% of the stations along the LIECR contained medium to high load-bearing strength reflected in the relatively low prism penetration depths observed (<6 cm) while the remaining predominantly had low to medium bearing capacity reflected in prism penetration values between 6 and 15 cm (Figure 3-11). Station 128 had extremely low bearing capacity and was over-penetrated (Figures 3-11, 3-13); this station was not included in the statistical assessment of prism penetration along the LIECR. There was no discernible spatial trend in sediment load-bearing capacity along the LIECR (Figure 3-11).

Station mean boundary roughness along the LIECR averaged 1.3 cm (SD±0.5), with a range of 0.5 to 2.8 cm (Table 3-1a; Figure 3-14). Well-formed and irregular ripples were the predominant bedform observed along the LIECR. Higher boundary roughness values (>1.5 cm) were primarily present at stations with larger more pronounced ripples which occurred at the stations closer to shore (Figures 3-14, 3-34A). Stations further from shore were generally characterized by smaller ripples or contained no evident bedforms and generally had lower boundary roughness (<1.5 cm) (Figures 3-14, 3-34B). Physical forcing was the primary influence shaping small-scale boundary roughness for the majority of images (Appendix C). As is common in mobile sands, larger grains settled into the trough of the sand ripples (Figure 3-34).

3.2.2 Biological Features and Habitat

The dominant CMECS Biotic Subclass observed along the LIECR was Soft Sediment Fauna (Table 3-1b; Figure 3-15) with every station containing soft sediment fauna as the dominant Biotic Subclass. One station, Station 046, contained Attached Fauna as the Co-occurring Biotic Subclass (Figure 3-18); at Station 046 hydroids were observed in one replicated attached to pieces of gravel (Table 3-1b, Figure 3-20A). No other biotic subclasses were observed along the LIECR.

Biotic group was variable along the LIECR (Figure 3-22). Starting offshore and moving inshore, Stations 030-042 were determined to have Sand Dollar Beds as the dominant biotic group (Figure 3-32), with a few stations (Stations 030, 037, 040, 042) along this stretch of the proposed cable route composed of Small Surface-Burrowing or Small Tube-Building Fauna (Table 3-1b, Figures 3-24C, 3-31A). The next stretch of the LIECR (Stations 029, 043-047, 081, 078) had the dominant Biotic Group predominantly classified as Small Tube-Building Fauna (Figures 3-22, 3-35). Stations 046 and 047 were the exception, with dominant biotic groups at these stations classified as Small Surface-Burrowing Fauna and Sand Dollar Beds, respectively (Table 3-1b, Figure 3-22). The stations closest to shore, the portion of the LIECR that branches into state waters, had a variety of dominant biotic groups (Figure 3-22). Tube-Building Fauna, both small and large, were the most common Biotic Groups observed along this portion of the proposed route, while Tracks and Trails, Mobile Crustaceans on Soft Sediments, and Mobile Crustaceans on Hard or Mixed Substrates were also prevalent, amongst a few other occurring Biotic Groups not mentioned (Table 3-1b, Figure 3-22). The dominant Co-occurring Biotic Group was spatially variable along the LIECR (Figure 3-25) highlighting the diversity of taxa found on the seafloor along the LIECR.

The aRPD was often not measurable at stations along LIECR, with more than half the stations (32 out of 56) having aRPDs that were classified as IND (Figure 3-36). When determinable, mean aRPD depths ranged from 0.5 to 5.9 cm with an area mean of 3.1 cm (SD±1.2) (Table 3-1b; Figure 3-37). In mobile sandy sediments, the aRPD depth is based more on diffusion through sand grains and sediment mixing by fluid dynamics, and less on organic inputs and bioturbation of deposit-feeding infauna. Low organic inputs make optical distinction of the aRPD difficult. Similarly, with low deposition of organic materials, the sediment oxygen demand at stations along the LIECR was predominantly low (Table 3-1b, Figures, 3-37B, 3-38). Only a few stations showed evidence of elevated SOD (Figure 3-37A). No indications of low water column dissolved oxygen was observed (Table 3-1b), but the presence of methane was documented at station 128 (Table 3-1b, Figure 3-13).

The predominant state of infauna succession observed along the LIECR was Stage 2 (Table 3-1b, Figures 3-39, 3-40), an intermediate successional state. Stage 2 taxa were evidenced by the presence of polychaete tubes at the sediment–water interface (Figure 3-41), including the specialized shell tubes created by the polychaete *Diopatra cuprea* (Figure 3-41B). The presence of Stage 2 fauna along the LIECR reflects the dynamic nature of this mobile sand environment; frequent bedload transport through fluid dynamics creates an environment with regular disturbance. Due to the dynamic nature of these sandy environments and the very low organic loads found in medium and coarse sands intermediate Stage 2 taxa predominate. There were a few stations that were designated as being in transition from Stage 1 to 2 with a Stage 1 -> 2 designation (Figures 3-39, 3-40). These stations often had indications of substantial hydrodynamic forcing on the bottom, evidenced by the presence of distinct sand ripples (Figure 3-42). The small tubes present at the sediment–water interface were often located in the trough of the sand ripples (Figure 3-42B). Stage 1 -> 2 designations predominantly occurred along the LIECR between Station 116 to 123 (Figure 3-40). There were a few stations along the LIECR with advanced successional taxa indicated by Stage 2 -> 3 and Stage 3 designations (Figures 3-39, 3-40). Evidence of the presence of Stage 3 fauna included deep subsurface burrows and/or feeding voids that were both open and infilled and are the products of infaunal deposit feeder activity (Figure 3-43A). The replicates designated as being in transition from Stage 2 to 3 with a Stage 2 -> 3 designation, indicated that features (e.g., burrows in PV image pair, deep burrowing textures) were visible that indicated that Stage 3 taxa may be present but specific evidence (feeding voids) were not imaged (Figure 3-43B).

There were no sensitive taxa identified along the LIECR (Table 3-1b; Figure 3-28) and species of concern in the form of the Ocean quahog were observed at Stations 030 and 034 (Table 3-1b; Figures 3-30, 3-31A). When the Ocean quahog was observed it was in low densities as a single individual in a plan view image replicate.

The predominant habitat observed along the LIECR was Sand Sheets, with a few instances of Sand with Mobile Gravel (Figures 3-26, 3-27). Instances of habitat composed of Sand with Mobile Gravel predominantly occurred in the stations closest to shore that were in or adjacent NY state waters (Figures 3-6D, 3-26, 3-27); a couple of stations with this habitat were located further offshore (Stations 037 and 046; Figures 3-7C, 3-20A, 3-31A).

Epifauna observed with SPI and PV imagery along the LIECR was dominated by the presence of anemones, gastropods, hermit crabs, and sand dollars, among others (Table 3-1b, Figure 3-44). Epifauna were documented by PV and/or SPI at 52 of the 56 stations. Station 046 contained attached epifauna, and the percent coverage of the attached fauna at this station was sparse (1 to <30% coverage) (Table 3-1b; Figures 3-20A, 3-21).

Fish were rarely documented at stations along the LIECR; skate were documented at two stations, Stations 032 and 033 (Table 3-1b; Figure 3-45). Macroflora were not observed at any stations along the LIECR.

3.3 New Jersey Export Cable Route (NJECR)

Forty-three SPI/PV stations were sampled along the NJECR (Figure 3-1). The NJECR were the southernmost stations, and encompassed those stations extending from the Equinor lease area into NJ state waters. The NJECR included Stations 001-027 and 141-157.

3.3.1 Types of Sediment and Bedforms Observed

Similar to the LIECR surficial sediment types varied along the NJECR with observed sediment types ranging from silt-clay, to very fine sand, to sediments as large as granules (Tables 3-2a, 3-5; Figures 3-2, 3-6A, 3-6B, 3-10B). The majority of stations along the NJECR, especially those stations located east of the Hudson River Shelf Valley (Stations 012-027, 141-157), were predominantly composed of fine and medium sand (Figures 3-2, 3-23B) with a few instances of very fine sand at Stations 019 and 020 (Figures 3-2, 3-46). Station 011, located directly in the shelf valley, was composed of silt-clay (Figure 3-6A), reflecting the reduced hydrodynamics in this deeper portion of the survey area. Stations 010 and 012, located in the shelf valley but near the edge (possibly on the slopes of the valley), were composed of fine sand and very fine sand, respectively (Figure 3-10A). West of the shelf valley, moving into shallower waters and the NJ state boundaries, the sediment type was variable, with fine sand and granules the predominant sediment types (Figures 3-2, 3-7B, 3-10B, 3-12A). Intra-station sediment heterogeneity, i.e. two or three replicate images with different grain size categories, was generally low along the NJECR (Figure 3-5). A few stations had medium sediment type heterogeneity, but there was not spatial trend to the location of those stations. Boulders were present at one station along the NJECR (Table 3-2a; Figure 3-4). Station 010, located along the slope of a submarine valley, contained a boulder in one replicate (Figure 3-23A).

Station mean prism penetration values along the NJECR ranged from 2.0 to 19.8 cm, with a mean of 5.9 cm (SD±2.5) (Table 3-2a). Approximately 70% of the stations along the NJECR contained medium to high load-bearing strength reflected in the relatively low prism penetration depths observed (<6 cm), while the remaining predominantly had low to medium bearing capacity reflected in prism penetration values between 6 and 15 cm (Figure 3-11). Station 011 had extremely low load-bearing capacity with prism penetration >15 cm; this station was uniquely situated in the center of the Hudson River Shelf Valley and composed of silt-clay (Figures 3-6A, 3-11). There was no discernible spatial trend in sediment load-bearing capacity along the NJECR (Figure 3-11).

Station mean boundary roughness along the NJECR averaged 1.3 cm (SD±0.6), with a range of 0.6 to 3.2 cm (Table 3-2a; Figure 3-14). Boundary roughness was influenced by biological processes, from both infauna and epifauna activity (Table 3-2a; Figures 3-6A, 3-16B; Appendix C), and physical forcing from hydrodynamic movement of sand occasionally creating bedforms on the seafloor. When present bedforms were well-formed or uneven sand ripples (Figure 3-47). Well-formed sand ripples were oriented with larger particles in the trough of the ripple (Figure 3-47B), a common observation in mobile sands.

3.3.2 Type of Biota and Habitat Observed

The dominant CMECS Biotic Subclass along the NJECR was Soft Sediment Fauna (Table 3-2b; Figure 3-15) with every station composed of soft sediment fauna as the dominant Biotic Subclass. Most stations did not have a Co-occurring Biotic Subclass (Figure 3-18), except Stations 004 and 010 which were documented with Inferred Fauna and Attached Fauna, respectively (Table 3-2b; Figures 3-10A, 3-48).

Along the NJECR the dominant Biotic Group was variable (Table 3-2b; Figure 3-22). There was no discernible spatial trend, but Sand Dollar Beds and Small Tube-Building Fauna were the most prevalent dominant Biotic Groups observed (Figures 3-22, 3-23B, 3-46). Other biotic groups observed along the NJECR were Mobile Crustaceans on Hard or Mixed Substrates, Larger-Tube Building Fauna, Small Surface-Burrowing Fauna, and Diverse Soft Sediment Epifauna (Table 3-2b; Figure 3-22). The dominant Co-occurring Biotic Group was spatially highly variable along the NJECR with numerous Co-occurring Biotic Groups, and no particular group dominant (Figure 3-25), highlighting the diversity of taxa found on the seafloor along the NJECR.

The aRPD was often not measurable at stations along NJECR, with approximately half the stations (22 out of 43) having aRPDs that were classified as IND (Figure 3-36). When determinable, mean aRPD depths ranged from 1.5 to 4.8 cm with a mean of 3.3 cm (SD±0.8) (Table 3-2b; Figure 3-49). In mobile sandy sediments, the aRPD depth can be influenced by diffusion through sand grains during sediment mixing, and less on organic inputs and bioturbation of deposit-feeding infauna. Though at times both processes can contribute to the depth of the aRPD (Figure 3-50). Along the NJECR, when detectable, the aRPDs were generally well-mixed deep into the sediment column by both physical forcing and biological activity (Figures 3-36, 3-49, 3-50). Low organic inputs make optical distinction of the aRPD difficult, this resulted in the high number of stations with aRPDs that were indeterminate (Figure 3-36). Similarly, with low deposition of organic materials, the sediment oxygen demand at stations along the NJECR was predominantly low (Table 3-2b, Figures, 3-49B, 3-50). Only a few stations showed evidence of elevated SOD (Figure 3-49A). No indications of low water column dissolved oxygen or methane presence was observed at any stations along the NJECR (Table 3-2b).

The predominant state of infauna succession observed along the NJECR was Stage 2 (Table 3-2b, Figure 3-39). Stage 2 taxa were evidenced by the presence of polychaetae tubes at the sediment–water interface and shallow burrowing (Figures 3-49, 3-50), including tubes created by the polychaete *Diopatra cuprea*. (Figure 3-50). *D. cuprea* often incorporate shell fragments when forming their tubes (Figure 3-16A) providing the tubes with a unique appearance. Along the NJECR we observed *D. cuprea* tubes observed without shells present due to the lack of shell hash at some stations. The presence of Stage 2 fauna along the NJECR reflects the dynamic nature of this mobile sand environment. There were a few instances where the successional stage was designated as being in transition from Stage 1 to 2 with a Stage 1 -> 2 designation (Table 3-2b; Figure 3-39). These occurrences were at Stations located offshore

(Stations 150, 153, 157) and were indicated by small tubes present at the sediment–water interface. Advanced succession was documented at Stations 010, 011, and 012; each station was located in the Hudson Shelf Valley (Figure 3-39). Stage 3 fauna were evidenced by the presence of deep subsurface burrows and/or feeding voids, the products of head-down deposit feeders (Figures 3-6A, 3-49A, 3-51). There were a few stations along the NJECR with replicates designated as being in transition from Stage 2 to 3 with a Stage 2 -> 3 designation (Figure 3-39).

There were no sensitive taxa identified along the NJECR (Table 3-2b; Figure 3-28) and species of concern in the form of the ocean quahog and sea scallop were observed at Stations 024 and Station 005, 010, respectively (Table 3-2b; Figures 3-10A, 3-30). Both the ocean quahog and sea scallop were observed in low densities of one to two individuals in a plan view image replicate.

Along the NJECR habitat type varied on either side of the Hudson Shelf Valley (Table 3-2b; Figure 3-26). Stations located east of the shelf valley were exclusive composed of Sand Sheet habitat (Figure 3-23B), and stations located west of the shelf valley were predominantly a habitat of Sand with Mobile Gravel (Figure 3-10B) with some instances of Sand Sheets (Figure 3-48) and one occurrence of Patchy Cobbles, Boulders on Sand (Figure 3-23A). The habitat types observed along the NJECR corresponded to the backscatter data collected by USGS (2-2). Stronger backscatter returns indicate coarser sediments, and weaker returns indicate finer material. Areas with stronger returns were located west of the submarine valley, which coincided with the coarser habitat of Sand with Mobile Gravel and Cobbles observed in this area (Figures 2-2, 3-26).

Epifauna observed with SPI and PV imagery along the NJECR was dominated by the presence of hermit crabs and sand dollars, among others (Table 3-2b; Figure 3-46,) though crabs, sea stars and other diverse fauna were also observed (Figures 3-10A, 3-17B). Epifauna were documented by PV and/or SPI at every station along the NJECR except Station 14 (Table 3-2b), which had a seafloor covered in polychaete tubes (Figure 3-52).

Fish were infrequently observed at stations along the NJECR, with the sea robin and skate as the only taxa documented (Table 3-2b; Figure 3-53). Macroflora were not observed at any stations along the NJECR. (Table 3-2b).

3.4 New York Harbor Export Cable Route (NYHECR)

Fifty-eight SPI/PV stations were sampled along the NYHECR (Figure 3-1). The NYHECR passes over Cholera Bank, extends into NY state waters and traverses the narrows between Staten Island and Brooklyn. The NYHECR included Stations 048-077, 089-097, 107-115 and 131-140.

3.4.1 Types of Sediment and Bedforms Observed

Surficial sediment types varied along the NYHECR with observed grain size classes ranging from silt-clay to granules and pebbles (Tables 3-3a, 3-5; Figures 3-2, 3-19, 3-8A, 3-8B), with boulders present at one station, Station 050 (Figures 3-4, 3-20B). The majority of stations along the NYHECR were predominantly composed of very fine and fine sand (Table 3-3a; Figures 3-2, 3-16A, 3-54). All of the silt-clay sediments observed along the NYHECR were located in NY state waters and were frequently associated with overlying mussel beds (Table 3-3a, Table 3-3b; Figures 3-2, 3-19). Stations with coarser sediment types were primarily located on and adjacent to Cholera Bank (Stations 050-054, 068-071, and 131-138) where coarse and very coarse sand, pebbles and granules, and boulders were observed (Figures 3-8, 3-20B, 3-55). Cholera Bank is a known shoal, and the presence of coarse grains in this area was expected. The sediment types observed along the NYHECR corresponded to the backscatter results from the USGS (Figures 2-2, 3-2). Intra-station sediment heterogeneity, i.e. two or three replicate images with different grain size categories, was generally low along the NYHECR (Figure 3-5). A few stations had medium heterogeneity in sediment type, but there was no spatial trend to the location of these stations. One station, Station 051, had high heterogeneity with each replicate containing a different sediment type (Table 3-3a; Figure 3-8). Boulders were present at one station, Station 050, located on Cholera Bank (Table 3-3a; Figure 3-4). Every replicate at Station 050 had documented boulders (Table 3-3a; Figures 3-6E, 3-20B, 3-29).

Station mean prism penetration values along the NYHECR ranged from 2.3 to 18.9 cm, with a mean of 6.5 cm (SD±2.8) (Table 3-3a). Approximately 50% of the stations (31 out of 58) along the NYHECR contained medium to high load-bearing strength reflected in the relatively low prism penetration depths observed (<6 cm), while the remaining predominantly had low to medium bearing capacity reflected in prism penetration values between 6 and 15 cm (Figure 3-11). Station 115 had extremely low load-bearing capacity with prism penetration >15 cm. Station 115 was located in NY harbor and composed of silt-clay sediments; fine sediments commonly found in harbor settings have low load-bearing capacity (Figures 3-11, 3-56). Stations with low load bearing capacity were predominantly located at the shallower stations in NY state waters and corresponded with those stations containing silt-clay or very fine sand sediment types (Figures 3-2, 3-11, 3-19, 3-56).

Station mean boundary roughness along the NYHECR averaged 1.2 cm (SD±0.5), with a range of 0.5 to 2.8 cm (Table 3-3a; Figure 3-14). Boundary roughness was influenced by biological processes, from both infauna and epifauna activity (Table 3-3a; Figures 3-19, 3-56; Appendix C), and physical forcing from hydrodynamic movement of sand occasionally creating bedforms on the seafloor (Figure 3-55). When present bedforms were well-formed or uneven sand ripples (Table 3-3a).

3.4.2 Type of Biota and Habitat Observed

The predominant CMECS Biotic Subclass along the NYHECR was Soft Sediment Fauna (Table 3-3b; Figure 3-15) with most station designated with this Biotic Subclass. The Attached Fauna Biotic Subclass was found at: Station 050 located on Cholera Bank, which was composed of boulders (Figures 3-4, 3-6E, 3-20B, 3-29); Station 068 where Soft Sediment and Attached Fauna were both designated as the dominant Biotic Subclass due to the presence of mussels along with tube building fauna (Figure 3-57); and Stations 107-110 located in NY state waters, the seafloor at these stations was covered in shell material with numerous mussels situated in the interstitial spaces of the shell assemblage (Figure 3-19). Co-occurring Biotic Subclass was patchily distributed along the NYHECR (Figure 3-18). When designated, Attached Fauna or Soft Sediment Fauna were the Co-occurring Biotic Subclass (Table 3-3b). The percent cover of Attached Fauna was variable along the NYHECR (Figure 3-21). Station 050 was the only location where Attached Fauna were assessed to be densely covering the bottom (Figures 3-6E, 3-20B, 3-29). Most of the stations containing Mussel Beds (Station 095, 096, 107-110) contained moderate coverage, though some stations had sparse coverage (Figures 3-19, 3-24D).

Along the NYHECR biotic group was variable (Table 3-3b; Figure 3-22). There was no specific spatial trend, but Tube-Building Fauna (both small and larger) were the most prevalent biotic groups observed (Figures 3-22, 3-17A, 3-54). Mussel Beds and Attached Mussels were prevalent at the stations in NY state waters just before the "Narrows" (Figures 3-19, 3-22, 3-24D). Other biotic groups observed along the NYHECR were Mobile Crustaceans on Hard or Mixed Substrates, Burrowing Anemones, and Sand Dollar Beds among a few others (Table 3-3b; Figure 3-22). The dominant Co-occurring Biotic Group was spatially variable along the NYHECR with numerous co-occurring groups and no particular group dominant (Figure 3-25), highlighting the diversity of taxa found on the seafloor along the NYHECR. The diversity of Co-occurring biotic groups was similarly observed at other portions of the cable route (LIECR, NJECR).

The aRPD was often not measurable at stations along NYHECR, with approximately half the stations (26 out of 58) having aRPDs that were classified as IND (Figure 3-36). When determinable, mean aRPD depths ranged from 0.1 to 5.3 cm with a mean of 2.3 cm (SD±1.1) (Table 3-3b; Figure 3-58). Many of the NYHECR stations in federal waters were composed of mobile sands (Table 3-3a; Figure 3-2) resulting in an aRPD depth that was influenced by diffusion through sediment mixing, and less on organic inputs and bioturbation of deposit-feeding infauna (Figures 3-54, 3-57). In NY state waters the sediment became finer and the closer proximity to land increased the influence of organic input; sediment oxygen demand was much higher at NYHECR stations located in state waters (Figures 3-38, 3-57, 3-58). The aRPD at stations located in NY state waters were influenced by biological activity and organic input (Figures 3-19, 3-58). Many of the stations located on or adjacent Cholera Bank had aRPDs that were indeterminate (Figure 3-36); the aRPD can be difficult to impossible to discern in the coarse grains prevalent at stations in this location. There were no indications of low water column dissolved oxygen or methane presence was observed at any stations along the NJECR (Table 3-3b).

The infauna succession observed along the NYHECR was variable (Table 3-3b, Figure 3-39). Stations located in NY state waters had successional designations that were often either Indeterminate or advanced Stage 2->3 or Stage 3 succession; there were also a few instances of stations with Stage 2 succession. Advanced succession was evidenced by the presence of feeding voids in the sediment column (Figure 3-19). Intermediate Stage 2 succession was evidence by shallow burrowing and tubes at the sediment–water interface (Figure 3-59A). In federal waters the predominant state of infauna succession was Stage 2, evidenced by tubes at the sediment water interface (Figure 3-59B). Stage 2 succession is a common state in mobile sand environments; mobile sands were frequently observed along the portion of the NYHECR that was situated in federal waters (Figures 3-2, 3-26). While Stage 2 taxa was the predominant state of succession of the portion of the NYHECR in federal waters, advanced succession (Stage 2->3, Stage 3) was documented between Stations 056 to 062 and 089 (Figure 3-39) evidenced by large burrowing fauna (Figure 3-59C). Replicates at a few stations were designated as being in transition from Stage 1 to 2 with a Stage 1 -> 2 designation (Table 3-3b; Figure 3-39).

Along the NYHECR sensitive taxa were identified at Station 050 (Table 3-3b; Figure 3-28). At Station 050 the non-reef building Northern Star coral, *Astrangia* spp., was observed in all replicates (Figures 3-6E, 3-20B, 3-29). Species of concern, in the form of sea scallops, were observed only at station along the NYHECR in federal waters: Stations 057, 058, and 091 (Table 3-3b; Figures 3-30, 3-60A). At each station sea scallops were observed in low densities of one individual per image replicate.

The predominant habitat observed along the NYHECR was sand sheets, and the portion of NYHECR transiting Cholera Bank was composed of Sand with Mobile Gravel habitat (Table 3-3b; Figure 3-26). One station, Station 050, was composed of Patchy, Cobbles, Boulders on Sand habitat (Figures 3-6E, 3-20B, 3-29). The habitat trends observed along the NYHECR corresponded with USGS backscatter data (Figure 2-2).

Epifauna observed with SPI and PV imagery along the NYHECR was dominated by the presence of anemones, gastropods, and hermit crabs, among others (Table 3-3b; Figure 3-60). Epifauna were documented by PV and/or SPI at every station along the NYHECR except Station 74 (Table 3-3b), which had a seafloor covered in *D. cuprea*. polychaete tubes (Figure 3-61).

Fish were only observed at Stations 131 and 132 with the sea robin identified as the taxa (Table 3-3b). Macroflora were not observed at any stations along the NYHECR. (Table 3-3b).

3.5 Reference Area Stations

Fifteen reference stations were surveyed, divided into three areas with five stations in each area. Locations for the reference areas were selected to provide a representation of the breadth of seafloor covered by the proposed export cable routes. Backscatter data from the USGS (Figure 2-2) was used to define reference locations. Reference A was selected in an area of stronger backscatter return, Reference C was selected in an area of lower backscatter return, and Reference C was selected in and around the prominent shoal Cholera Bank.

3.5.1 Types of Sediment and Bedforms Observed

Surficial sediment types varied amongst the reference areas (Table 3-4a; Figure 3-2). The predominant sediment type at Reference A was composed of granules and pebbles (Figure 3-

62A), Reference B had predominant sediment types of medium sand over fine sand, (Figure 3-62B) and Reference C had predominant sediment types of medium sand (Figure 3-62C). The sediment types observed in the reference areas corresponded to the backscatter results from the USGS (Figures 2-2, 3-2). Intra-station sediment heterogeneity was generally low with each reference area having approximately similar sediment types amongst its stations (Figure 3-2).

Station mean prism penetration values at the reference areas ranged from 4.4 to 8.0 cm, with a mean of 6.2 cm (SD±1.1) (Table 3-4a). Approximately 50% of the reference stations (6 out of 15) contained medium to high load-bearing strength reflected in the relatively low prism penetration depths observed (<6 cm), while the remaining stations predominantly had low to medium bearing capacity reflected in prism penetration values between 6 and 15 cm (Figure 3-11). Stations at Reference A had the highest load bearing capacity; Reference A had the largest sediment type of the three reference areas (Figure 3-2).

Station mean boundary roughness at the reference areas averaged 1.5 cm (SD±0.5), with a range of 0.6 to 2.3 cm (Table 3-4a; Figure 3-14). Boundary roughness at the reference stations was predominantly influenced by physical processes given the prevalence of mobile sand and gravel at the three reference areas (Table 3-4a; Figures 3-60, 3-56; Appendices C and D), and physical forcing from hydrodynamic movement of sand occasionally creating bedforms on the seafloor (Figure 3-55). When present bedforms were well-formed or uneven sand ripples (Table 3-4a).

3.5.2 Type of Biota and Habitat Observed

The dominant CMECS Biotic Subclass at the reference areas was Soft Sediment Fauna (Table 3-4b; Figure 3-15) with every station in each of the three reference areas composed of soft sediment fauna as the dominant Biotic Subclass. None of the reference stations had a Co-occurring Biotic Subclass (Table 3-4b; Figure 3-18).

Biotic Group was variable between the three reference areas (Table 3-4b; Figure 3-22). The dominant Biotic Group for all stations at Reference A was Burrowing Anemones (Figures 3-63A). Reference B was a mix of dominant biotic groups, with Diverse Soft Sediment Epifauna and Larger Tube-Building Fauna the predominant groups (Figure 3-64). All of the stations at Reference C had Larger Tube-Building Fauna designated as the dominant Biotic Group (Figure 3-63B). The dominant Co-occurring Biotic Group was variable at the reference stations with numerous co-occurring groups and no particular group dominant (Figure 3-25), highlighting the diversity of taxa found on the seafloor at the reference stations. The diversity of Co-occurring biotic groups was similarly observed along the proposed cable routes (LIECR, NJECR, NYHECR).

The aRPD was often not measurable at the reference stations, with approximately half the stations (7 out of 15) having aRPDs that were classified as IND (Figure 3-36). When determinable, mean aRPD depths ranged from 2.8 to 6.8 cm with a mean of 4.4 cm (SD±1.3) (Table 3-4b; Figure 3-65). No stations showed evidence of elevated sediment oxygen demand

(Figure 3-38), and there were no indications of low water column dissolved oxygen or methane presence any of the reference stations (Table 3-4b).

Infauna succession observed at the reference stations was predominantly Stage 2 (Table 3-4b, Figure 3-39). Stage 2 succession was primarily evidenced by tubes at the sediment–water interface (Figure 3-65A). A few stations contained advanced Stage 2->3 succession, evidenced by the presence of large burrowing fauna but no feeding voids (Figure 3-65B). Reference station REFB_05 was designated as being in transition from Stage 1 to 2 with a Stage 1 -> 2 designation (Table 3-4b; Figure 3-39).

The predominant habitat observed at the reference stations was variable (Figure 3-26). Reference A was exclusively composed of Sand with Mobile Gravel habitat (Figure 3-63A). Reference B and C were exclusively composed of Sand Sheet habitat (Figures 3-63B, 3-64B). The habitat trends observed at the reference stations corresponded with USGS backscatter data (Figure 2-2), which was used to delineate the locations of the reference areas.

There were no sensitive taxa or species of concern identified at the reference stations (Table 3-4b; Figures 3-28, 3-30). Epifauna observed with SPI and PV imagery at the reference stations was dominated by the presence of anemones at Reference A (Table 3-4b; Figure 3-63A), gastropods, hermit crabs and sand dollars at Reference B (Table 3-4b; Figure 3-64B) and a few sea stars at Reference C (Table 3-4b; Figure 3-63B).

Fish were only observed at three stations, Stations REFA_01, REFA_05, and REFB01, with sea robin, flounder and skate identified as the taxa (Table 3-4b). Macroflora were not observed at any reference stations. (Table 3-4b).

3.6 Sediment Grabs

Grain size distribution analysis were completed for sixteen sediment samples. The Grain Size Distribution results are shown in Table 3-6. Sediment grab results were approximately similar to sediment types determined by SPI/PV (Table 3-6; Figures 3-2, 3-3). Sediment grab grain size analysis determined stations to be predominantly sand, which was the predominant sediment type observed in SPI/PV imagery. At Stations 010 and 011 the grain size analysis delineated the change in sediment type from fine sand over silt-clay at Station 010 to predominantly silt-clay at Station 011 located in the center of the submarine valley. The grain-size analysis for Station 010 included approximately 40% gravel. Observations of the replicate SPI/PV images for Station 010 noted that gravel was present in small patches but was not a substantial component of the sediment type at this station. The ambiguity between the grab and SPI/PV data can be attributed to the sediment grabs collecting only a single replicate of a relatively small area of the seafloor and not capturing the intra-station heterogeneity. There was general agreement between the SPI/PV and sediment grab data, but fine scales differences in the data were attributed to the limited capability for the sediment grab approach to capture intra-station sediment heterogeneity.

Table 3-1a. Summary of Plan View Image Analysis Results at the Long Island Export Cable Route Stations

Long Island Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	SPI Sediment Type (by replicate)			PV Replicate (n)	Gravel Mode (mm)	Dominant CMECS Substrate Group	Dominant CMECS Substrate Subgroup	Boulder Presence	Bedforms (by replicate)			Bedform Size Measurement (cm)	Debris	Habitat Type
027	30	3	4.1	0.9	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
028	27	3	4.7	1.2	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
029	27	3	4.6	0.8	Fine sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
030	37	3	5.7	1.2	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	Uneven Ripples	Uneven Ripples	IND	Shell Hash	Sand Sheet
031	36	3	6.0	1.0	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	Uneven Ripples	Uneven Ripples	IND	Shell Hash	Sand Sheet
032	36	3	5.9	0.8	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
033	34	3	5.9	0.8	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
034	33	3	5.6	0.7	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
035	34	3	6.1	1.0	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
036	30	3	6.3	0.7	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	Ripples	Ripples	39.4	Shell Hash	Sand Sheet
037	32	3	6.0	0.6	Very coarse sand over sand	Very coarse sand over sand	Very coarse sand over sand	3	3.0	Gravelly	Gravelly Sand	No	None	None	IND	-	Shell Hash	Sand with Mobile Gravel
038	30	3	6.4	0.5	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
039	30	3	5.4	0.9	Fine sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	Ripples	Ripples	41.4	Shell Hash	Sand Sheet
040	30	3	6.3	1.4	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
041	29	3	5.9	0.6	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
042	29	3	8.4	1.6	Very fine sand	Very fine sand	Very fine sand over silt/clay	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
043	27	3	4.3	1.2	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet

Long Island Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	SPI Sediment Type (by replicate)			PV Replicate (n)	Gravel Mode (mm)	Dominant CMECS Substrate Group	Dominant CMECS Substrate Subgroup	Boulder Presence	Bedforms (by replicate)			Bedform Size Measurement (cm)	Debris	Habitat Type
044	27	3	5.0	0.9	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
045	25	3	4.4	1.5	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	Ripples	4.5	Shell Hash	Sand Sheet
046	26	3	4.3	1.0	Medium sand	Medium sand	Pebble over finer sediment	3	12.5	Gravelly	Gravelly Sand	No	None	None	None	-	None	Sand with Mobile Gravel
047	25	3	4.4	1.0	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
078	23	3	4.8	1.3	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
079	24	3	4.1	1.5	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
080	21	3	5.2	0.9	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
081	25	3	6.7	1.0	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	Uneven Ripples	IND	None	Sand Sheet
082	23	3	5.3	1.0	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
083	23	3	8.0	1.0	Very fine sand over silt/clay	Very fine sand over silt/clay	Very fine sand over silt/clay	1	IND	Sand	Sand or Finer	No	None	-	-	-	None	Sand Sheet
084	19	3	4.2	0.8	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	Uneven Ripples	IND	None	Sand Sheet
085	20	3	5.7	0.8	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
086	16	3	5.0	0.8	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	Uneven Ripples	Uneven Ripples	IND	Shell Hash	Sand Sheet
087	13	3	3.8	2.5	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	21.1	Shell Hash	Sand Sheet
088	11	3	5.8	2.8	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	Ripples	Ripples	-	Shell Hash	Sand Sheet
098	18	3	4.2	1.0	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	Uneven Ripples	Uneven Ripples	Uneven Ripples	IND	Shell Hash	Sand Sheet
099	18	3	4.8	1.1	Fine sand	Medium sand over finer sediment	Medium sand over finer sediment	3	2.0	Slightly Gravelly	Slightly Gravelly Sand	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel
100	15	3	4.5	1.4	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	11.1	None	Sand Sheet

Long Island Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	SPI Sediment Type (by replicate)			PV Replicate (n)	Gravel Mode (mm)	Dominant CMECS Substrate Group	Dominant CMECS Substrate Subgroup	Boulder Presence	Bedforms (by replicate)			Bedform Size Measurement (cm)	Debris	Habitat Type
101	15	3	3.8	1.7	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	16.9	Shell Hash	Sand Sheet
102	17	3	5.6	1.2	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
103	17	3	3.6	1.3	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	8.6	Shell Hash	Sand Sheet
104	14	3	4.6	2.2	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	13.6	Shell Hash	Sand Sheet
105	11	3	3.6	1.4	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	29.3	Shell Hash	Sand Sheet
106	10	3	5.6	2.0	Medium sand	Medium sand	Medium sand over finer sediment	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	IND	Shell Hash	Sand Sheet
116	14	3	5.4	1.2	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	8.2	Shell Hash	Sand Sheet
117	14	3	4.2	1.3	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	12.4	Shell Hash	Sand Sheet
118	14	3	4.7	1.7	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	9.0	None	Sand Sheet
119	14	3	4.9	1.2	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
120	11	3	4.0	2.4	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	Ripples	-	None	Sand Sheet
121	8	3	5.6	0.7	Very fine sand	Very fine sand	Very fine sand	0	-	-	-	-	-	-	-	-	-	-
122	13	3	4.5	2.1	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	10.5	Shell Hash	Sand Sheet
123	14	3	5.3	1.8	Medium sand	Medium sand	Medium sand	3	2.1	Slightly Gravelly	Slightly Gravelly Sand	No	Ripples	Ripples	Uneven Ripples	12.0	Shell Hash	Sand with Mobile Gravel
124	12	3	5.6	1.6	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	19.9	Shell Hash	Sand Sheet
125	13	3	5.3	2.0	Fine sand over very fine sand	Fine sand over very fine sand	Fine sand over very fine sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	16.0	None	Sand Sheet
126	11	3	6.3	1.3	Pebble over finer sediment	Pebble over finer sediment	Pebble over finer sediment	3	IND	Gravel Mixes	Sandy Gravel	No	None	None	None	-	None	Sand with Mobile Gravel

Long Island Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	SPI Sediment Type (by replicate)			PV Replicate (n)	Gravel Mode (mm)	Dominant CMECS Substrate Group	Dominant CMECS Substrate Subgroup	Boulder Presence	Bedforms (by replicate)			Bedform Size Measurement (cm)	Debris	Habitat Type
127	13	3	5.9	1.1	Granule over sand	Pebble over finer sediment	Pebble over finer sediment	3	6.0	Gravelly	Gravelly Sand	No	None	None	Ripples	15.4	None	Sand with Mobile Gravel
128	13	3	IND	IND	Silt/clay	Silt/clay	Silt/clay	2	IND	Sand	Sand or Finer	No	Ripples	Ripples	-	11.5	None	Sand Sheet
129	12	3	13.8	1.3	Silt/clay over sand	Silt/clay over sand	Very fine sand over silt/clay	0	-	-	-	-	-	-	-	-	-	-
130	9	3	5.5	1.0	Pebble over finer sediment	Pebble over finer sediment	Pebble over finer sediment	3	IND	Gravel Mixes	Sandy Gravel	No	None	None	None	-	None	Sand with Mobile Gravel
n = SPI-56, PV-54																		
Max	**37**		**13.8**	**2.8**					**12.5**							**41.4**		
Min	**8**		**3.6**	**0.5**					**2.0**							**4.5**		
Mean	**21**		**5.4**	**1.3**					**5.1**							**16.7**		
Standard Deviation			**1.6**	**0.5**					**4.4**							**10.3**		

IND=Indeterminate
"-" Replicate image not analyzed

Table 3-1b. Summary of Sediment Profile Image Analysis Results at the Long Island Export Cable Route Stations

Long Island Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent Cover Modifier)	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
027	30	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Sand Dollar Bed	None	Yes	Yes	None	Yes	Anemone(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
028	27	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Sand Dollar Bed	None	Yes	Yes	None	Yes	Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
029	27	3	0.5	Low	No	2	2	2 -> 3	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Sand Dollar Bed	None	Yes	Yes	None	Yes	Sand Dollar(s)	No	No	None	None	Sand Sheet
030	37	3	4.0	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Sand Dollar Bed	None	Yes	Yes	None	Yes	Gastropods, Hermit Crab(s), Ocean Quahog, Sand Dollar(s)	No	No	None	Ocean Quahog	Sand Sheet
031	36	3	IND	Low	No	IND	IND	IND	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Diverse Soft Sediment Epifauna	None	No	Yes	None	Yes	Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
032	36	3	3.8	Low	No	1 -> 2	2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Small Tube-Building Fauna	None	No	Yes	Skate	Yes	Sand Dollar(s)	No	No	None	None	Sand Sheet
033	34	3	IND	Low	No	IND	1 -> 2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Diverse Soft Sediment Epifauna; Small Tube-Building Fauna	None	No	No	Skate	Yes	Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
034	33	3	4.0	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Small Tube-Building Fauna	None	Yes	No	None	Yes	Ocean Quahog, Sand Dollar(s)	No	No	None	Ocean Quahog	Sand Sheet
035	34	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Diverse Soft Sediment Epifauna; Small Tube-Building Fauna	None	Yes	No	None	Yes	Caprellid, Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
036	30	3	IND	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Diverse Soft Sediment Epifauna; Sand Dollar Bed	None	No	No	None	Yes	Crab, Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
037	32	3	3.9	Low	No	IND	2 -> 3	2 -> 3	3	No	Soft Sediment Fauna	None	Small Surface-Burrowing Fauna	Burrowing Anemones	None	Yes	Yes	None	Yes	Anemone(s), Hermit Crab(s), Sand Dollars	No	No	None	None	Sand with Mobile Gravel
038	30	3	IND	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Diverse Soft Sediment Epifauna	None	No	Yes	None	Yes	Gastropod(s), Sand Dollar(s), Sea Stars	No	No	None	None	Sand Sheet
039	30	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Larger Tube-Building Fauna; Sand Dollar Bed	None	No	No	None	Yes	Hermit Crab, Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet

Long Island Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent Cover Modifier)	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
040	30	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Surface-Burrowing Fauna	Small Tube-Building Fauna	None	Yes	No	None	Yes	Sand Dollar(s)	No	No	None	None	Sand Sheet
041	29	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Sand Dollar Bed; Small Surface-Burrowing Fauna	None	No	No	None	Yes	Sand Dollar(s)	No	No	None	None	Sand Sheet
042	29	3	2.9	Medium	No	2	2 -> 3	2 on 3	3	No	Soft Sediment Fauna	None	Small Surface-Burrowing Fauna	Tracks and Trails	None	Yes	Yes	None	Yes	Anemone(s), Caprellid(s), Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
043	27	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Sand Dollar Bed; Tracks and Trails	None	Yes	Yes	None	Yes	Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
044	27	3	IND	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Varies	None	Yes	Yes	None	Yes	Anemone(s), Crab, Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
045	25	3	IND	Low	No	IND	1 -> 2	2 -> 3	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Small Surface-Burrowing Fauna	None	Yes	No	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
046	26	3	IND	Low	No	IND	2	3	3	Yes	Soft Sediment Fauna	Attached Fauna (1)	Small Surface-Burrowing Fauna	Attached Hydroids	Sparse (1 to <30%)	No	Yes	None	No	Caprellid(s), Hydroids	No	No	None	None	Sand with Mobile Gravel
047	25	3	IND	Low	No	IND	IND	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Larger Tube-Building Fauna; Sand Dollar Bed	None	Yes	Yes	None	Yes	Anemone, Hydroids, Sand Dollar(s)	No	No	None	None	Sand Sheet
078	23	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Burrowing Anemones; Diverse Soft Sediment Epifauna	None	No	Yes	None	Yes	Anemones, Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
079	24	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna	None	Yes	Yes	None	Yes	Anemone(s), Gastropod(s), Hermit Crab(s), Sand Dollars, Urchin	No	No	None	None	Sand Sheet
080	21	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Mobile Crustaceans on Soft Sediments	None	Yes	Yes	None	Yes	Anemone(s), Gastropod, Hermit Crab(s), Sponge	No	No	None	None	Sand Sheet
081	25	3	2.4	Low	No	2 -> 3	2 -> 3	2 -> 3	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Varies	None	Yes	Yes	None	Yes	Anemone(s), Gastropod(s), Hermit Crab(s)	No	No	None	None	Sand Sheet
082	23	3	IND	Low	No	IND	IND	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Larger Tube-Building Fauna; Sand Dollar Bed	None	Yes	Yes	None	Yes	Anemone, Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
083	23	3	1.1	Medium	No	2 -> 3	2 -> 3	2 on 3	1	No	Soft Sediment Fauna	None	Burrowing Anemones	Small Surface-Burrowing Fauna	None	Yes	No	None	Yes	Anemone(s)	No	No	None	None	Sand Sheet

Long Island Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent Cover Modifier)	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
084	19	3	IND	Low	No	IND	IND	IND	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Burrowing Anemones; Mobile Crustaceans on Soft Sediments	None	Yes	Yes	None	Yes	Anemone(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
085	20	3	IND	Low	No	IND	1 -> 2	1 -> 2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna; Small Surface-Burrowing Fauna	None	Yes	Yes	None	Yes	Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
086	16	3	IND	Low	No	2	2	2 -> 3	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Diverse Soft Sediment Epifauna; Mobile Crustaceans on Soft Sediments	None	Yes	No	None	Yes	Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
087	13	3	3.8	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Small Tube-Building Fauna	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
088	11	3	IND	Low	No	IND	IND	IND	3	No	IND	IND	Mobile Crustaceans on Soft Sediments	IND	None	IND	IND	None	No	None	No	No	None	IND	Sand Sheet
098	18	3	3.0	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Varies	None	Yes	Yes	None	Yes	Anemone(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
099	18	3	4.2	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna; Mobile Crustaceans on Soft Sediments	None	Yes	No	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s), Sponges	No	No	None	None	Sand with Mobile Gravel
100	15	3	2.9	Low	No	2 -> 3	2 -> 3	2 -> 3	3	No	Soft Sediment Fauna	None	Small Surface-Burrowing Fauna	Mobile Crustaceans on Soft Sediments; Small Tube-Building Fauna	None	Yes	No	None	Yes	Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
101	15	3	3.3	Low	No	IND	2 -> 3	2 -> 3	3	No	Soft Sediment Fauna	None	Diverse Soft Sediment Epifauna	Diverse Soft Sediment Epifauna; Small Surface-Burrowing Fauna	None	Yes	No	None	Yes	Anemone(s), Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
102	17	3	3.1	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna	None	Yes	Yes	None	Yes	Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
103	17	3	2.2	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna; Sand Dollar Bed	None	Yes	Yes	None	Yes	Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
104	14	3	IND	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Tracks and Trails	Diverse Soft Sediment Epifauna	None	Yes	No	None	Yes	Anemone(s), Hermit Crab(s), Sand Dollars	No	No	None	None	Sand Sheet
105	11	3	IND	Low	No	IND	IND	2	3	No	Soft Sediment Fauna	None	Mobile Crustaceans on Soft Sediments	Larger Tube-Building Fauna	None	Yes	No	None	Yes	Hermit Crab(s)	No	No	None	None	Sand Sheet

Long Island Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent Cover Modifier)	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
106	10	3	3.2	Low	No	IND	1 -> 2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Mobile Crustaceans on Soft Sediments	None	No	No	None	Yes	Hermit Crab	No	No	None	None	Sand Sheet
116	14	3	3.8	Low	No	IND	1 -> 2	1 -> 2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Mobile Crustaceans on Soft Sediments; Tracks and Trails	None	Yes	Yes	None	Yes	Hermit Crab(s)	No	No	None	None	Sand Sheet
117	14	3	2.6	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Diverse Soft Sediment Epifauna; Small Surface-Burrowing Fauna	None	Yes	No	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
118	14	3	IND	Low	No	1 -> 2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Mobile Crustaceans on Soft Sediments	None	Yes	No	None	Yes	Hermit Crab(s)	No	No	None	None	Sand Sheet
119	14	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Mobile Crustaceans on Soft Sediments	None	Yes	No	None	Yes	Hermit Crab(s)	No	No	None	None	Sand Sheet
120	11	3	3.0	Low	No	IND	IND	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Mobile Crustaceans on Soft Sediments	None	Yes	No	None	Yes	Hermit Crab(s)	No	No	None	None	Sand Sheet
121	8	3	5.9	Low	No	IND	2	2 -> 3	0	-	-	-	-	-	-	-	-	-	Yes	IND	IND	IND	IND	IND	-
122	13	3	2.6	Low	No	1 -> 2	1 -> 2	1 -> 2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Varies	None	Yes	No	None	Yes	Hermit Crab(s)	No	No	None	None	Sand Sheet
123	14	3	3.5	Low	No	1 -> 2	1 -> 2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Larger Tube-Building Fauna; Mobile Crustaceans on Soft Sediments	None	Yes	No	None	Yes	Hermit Crab(s)	No	No	None	None	Sand with Mobile Gravel
124	12	3	3.4	Low	No	IND	1 -> 2	2	3	No	Soft Sediment Fauna	None	Mobile Crustaceans on Soft Sediments	Mobile Crustaceans on Soft Sediments; Small Surface-Burrowing Fauna	None	Yes	No	None	Yes	Gastropod(s), Hermit Crab(s), Mollusc	No	No	None	None	Sand Sheet
125	13	3	IND	Low	No	IND	1 -> 2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Mobile Crustaceans on Soft Sediments; Small Surface-Burrowing Fauna	None	Yes	No	None	Yes	Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
126	11	3	IND	Low	No	IND	2	2 -> 3	3	No	Soft Sediment Fauna	IND	Mobile Crustaceans on Hard or Mixed Substrates	IND	None	No	No	None	No	Hermit Crab(s), Hydroids	No	No	None	None	Sand with Mobile Gravel
127	13	3	IND	Low	No	IND	IND	IND	3	No	Soft Sediment Fauna	None	Mobile Crustaceans on Hard or Mixed Substrates	Larger Tube-Building Fauna	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s)	No	No	None	None	Sand with Mobile Gravel
128	13	3	IND	High	Yes	IND	IND	3	2	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Mobile Crustaceans on Soft Sediments	None	Yes	No	None	Yes	Gastropod(s), Hermit Crab(s)	No	No	None	None	Sand Sheet

Long Island Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent Cover Modifier)	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
129	12	3	0.5	Medium	No	2	2	2 -> 3	0	-	-	-	-	-	-	-	-	-	Yes	IND	IND	IND	IND	IND	-
130	9	3	IND	Low	No	IND	IND	IND	3	No	IND	IND	IND	IND	None	IND	IND	None	No	None	No	No	None	None	Sand with Mobile Gravel
n = SPI-56, PV-54																									
Max	**37**		**5.9**																						
Min	**21**		**0.5**																						
Mean	**29**		**3.1**																						
Standard Deviation			**1.2**																						

IND=Indeterminate
"-" Replicate image not analyzed
[1]Variable determined from combined SPI and PV analysis

Table 3-2a. Summary of Plan View Image Analysis Results at the New Jersey Export Cable Route Stations

New Jersey Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	SPI Sediment Type (by replicate)			PV Replicate (n)	Gravel Mode (mm)	Dominant CMECS Substrate Group	Dominant CMECS Substrate Subgroup	Boulder Presence	Bedforms (by replicate)			Bedform Size Measurement (cm)	Debris	Habitat Type
001	16	3	2.0	1.5	Fine sand	Fine sand	Fine sand	3	15.6	Gravelly	Gravelly Sand	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel
002	20	3	5.6	1.2	Granule over sand	Granule over sand	Granule over sand	3	16.0	Gravel Mixes	Sandy Gravel	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel
003	21	3	5.4	1.0	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
004	22	3	6.2	1.5	Fine sand	Fine sand	Fine sand over silt/clay	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
005	23	3	7.3	2.0	Granule over sand	Granule over sand	Medium sand	3	6.1	Gravelly	Gravelly Sand	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel
006	21	3	6.6	1.0	Granule over sand	Granule over sand	Medium sand	3	2.1	Gravelly	Gravelly Sand	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel
007	23	3	5.7	1.7	IND	IND	IND	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
008	26	3	6.3	1.2	Medium sand	Medium sand	Medium sand	3	2.0	Gravelly	Gravelly Sand	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel
009	29	3	6.7	1.3	Granule over sand	Granule over sand	Granule over sand	3	16.1	Gravel Mixes	Sandy Gravel	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel
010	35	3	6.4	1.9	Fine sand over silt/clay	Fine sand over silt/clay	Fine sand over silt/clay	3	14.1	Gravelly	Gravelly Muddy Sand	Yes	None	None	None	-	Shell Hash	Patchy Cobbles & Boulders on Sand
011	68	3	19.8	1.0	Silt/clay	Silt/clay	Silt/clay	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet

New Jersey Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	SPI Sediment Type (by replicate)			PV Replicate (n)	Gravel Mode (mm)	Dominant CMECS Substrate Group	Dominant CMECS Substrate Subgroup	Boulder Presence	Bedforms (by replicate)			Bedform Size Measurement (cm)	Debris	Habitat Type
012	39	3	9.1	2.4	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
013	34	3	6.9	2.4	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	44.4	Shell Hash	Sand Sheet
014	36	3	6.5	2.3	Medium sand	Medium sand	Medium sand over finer sediment	3	IND	Sand	Sand or Finer	No	None	Ripples	Ripples	25.2	Shell Hash	Sand Sheet
015	33	3	6.4	2.4	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
016	29	3	4.3	0.9	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
017	28	3	5.4	0.7	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
018	27	3	4.9	0.7	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	Ripples	23.2	Shell Hash	Sand Sheet
019	30	3	8.7	1.1	Very fine sand	Very fine sand	Very fine sand over finer sediment	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
020	28	3	3.9	2.1	Very fine sand over finer sediment	Very fine sand over finer sediment	Very fine sand over finer sediment	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
021	30	3	5.3	0.9	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	48.9	Shell Hash	Sand Sheet
022	29	3	4.7	3.2	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
023	28	3	5.4	1.6	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	Uneven Ripples	Uneven Ripples	Uneven Ripples	IND	Shell Hash	Sand Sheet
024	30	3	5.1	1.0	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
025	31	3	5.3	0.9	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
026	30	3	4.8	1.1	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
141	29	3	6.6	1.5	Very fine sand	Very fine sand	Very fine sand	1	IND	Sand	Sand or Finer	No	None	-	-	-	None	Sand Sheet
142	29	3	4.6	1.2	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet

New Jersey Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	SPI Sediment Type (by replicate)			PV Replicate (n)	Gravel Mode (mm)	Dominant CMECS Substrate Group	Dominant CMECS Substrate Subgroup	Boulder Presence	Bedforms (by replicate)			Bedform Size Measurement (cm)	Debris	Habitat Type
143	28	3	4.3	0.6	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
144	29	3	4.2	0.7	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
145	30	3	5.5	0.6	Very fine sand	Very fine sand	Very fine sand	2	IND	Sand	Sand or Finer	No	None	None	-	-	None	Sand Sheet
146	30	3	4.3	0.6	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
147	31	3	4.6	1.3	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
148	35	3	5.2	1.4	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	Ripples	Ripples	39.1	Shell Hash	Sand Sheet
149	34	3	6.0	0.9	Fine sand	Fine sand	Fine sand	2	IND	Sand	Sand or Finer	No	None	None	-	-	Shell Hash	Sand Sheet
150	34	3	5.4	0.6	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
151	34	3	4.8	0.9	Fine sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	31.8	Shell Hash	Sand Sheet
152	34	3	5.6	1.1	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
153	36	3	5.6	1.4	Fine sand	Fine sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
154	37	3	5.6	1.9	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
155	37	3	5.8	1.1	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
156	36	3	5.2	0.9	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
157	37	3	6.2	1.2	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	Ripples	Ripples	30.9	Shell Hash	Sand Sheet
n = 43																		
Max	**68**		**19.8**	**3.2**					**16.1**							**48.9**		
Min	**16**		**2.0**	**0.6**					**2.0**							**23.2**		
Mean	**31**		**5.9**	**1.3**					**10.3**							**34.8**		
Standard Deviation			**2.5**	**0.6**					**6.6**							**9.7**		

IND=Indeterminate
"-" Replicate image not analyzed

Table 3-2b. Summary of Sediment Profile Image Analysis Results at the New Jersey Export Cable Route Stations

New Jersey Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent Cover Modifier)	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
001	16	3	IND	Low	No	IND	IND	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Small Tube-Building Fauna	None	No	No	None	Yes	Crab	No	No	None	None	Sand with Mobile Gravel
002	20	3	IND	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Mobile Crustaceans on Hard or Mixed Substrates	Burrowing Anemones	None	No	No	Sea Robin	Yes	Anemone(s), Hermit Crab(s)	No	No	None	None	Sand with Mobile Gravel
003	21	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	IND	Small Tube-Building Fauna	Burrowing Anemones	None	No	Yes	None	Yes	Anemone(s), Gastropod(s)	No	No	None	None	Sand Sheet
004	22	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	Inferred Fauna (1)	Small Tube-Building Fauna	Burrowing Anemones	None	No	Yes	None	Yes	Anemone, Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
005	23	3	IND	Low	No	IND	IND	IND	3	No	Soft Sediment Fauna	None	Mobile Crustaceans on Hard or Mixed Substrates	Sand Dollar Bed	None	No	No	Sea Robin	No	Crabs, Hermit Crab(s), Sand Dollar(s), Scallop	No	No	None	Sea Scallop	Sand with Mobile Gravel
006	21	3	IND	Low	No	IND	IND	2	3	No	Soft Sediment Fauna	None	Mobile Crustaceans on Hard or Mixed Substrates	Burrowing Anemones	None	No	No	None	Yes	Anemone(s), Gastropod(s), Hermit Crab(s)	No	No	None	None	Sand with Mobile Gravel
007	23	3	IND	IND	No	IND	IND	IND	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Sand Dollar Bed; Small Tube-Building Fauna	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
008	26	3	IND	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Mobile Crustaceans on Hard or Mixed Substrates; Sand Dollar Bed	None	Yes	No	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand with Mobile Gravel
009	29	3	IND	Low	No	IND	IND	IND	3	No	Soft Sediment Fauna	None	Small Surface-Burrowing Fauna	Burrowing Anemones; Egg Masses	None	No	No	None	No	Anemone(s)	No	No	None	None	Sand with Mobile Gravel
010	35	3	3.2	Low	No	2	2 on 3	2 on 3	3	Yes	Soft Sediment Fauna	Attached Fauna (2)	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna	Sparse (1 to <30%)	Yes	No	None	Yes	Caprellid(s), Crab, Hermit Crab, Scallop(s), Sponge	No	No	None	Sea Scallop	Patchy Cobbles & Boulders on Sand
011	68	3	1.5	High	No	2 on 3	2 on 3	2 on 3	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Small Surface-Burrowing Fauna	None	Yes	Yes	None	Yes	Anemone(s)	No	No	None	None	Sand Sheet

New Jersey Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent Cover Modifier)	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
012	39	3	3.5	Low	No	2	2 on 3	2 on 3	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Small Surface-Burrowing Fauna	None	Yes	No	None	Yes	Crab, Penaeid Shrimp	No	No	None	None	Sand Sheet
013	34	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Varies	None	No	No	None	Yes	Anemone, Caprellid(s), Gastropod, Crab, Urchin	No	No	None	None	Sand Sheet
014	36	3	3.7	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Small Surface-Burrowing Fauna	None	No	No	None	Yes	None	No	No	None	None	Sand Sheet
015	33	3	3.5	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Varies	None	Yes	Yes	None	Yes	Caprellid(s), Crab, Gastropod(s)	No	No	None	None	Sand Sheet
016	29	3	3.6	Low	No	2	2	2 on 3	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Small Tube-Building Fauna	None	Yes	No	None	Yes	Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
017	28	3	4.5	Low	No	2	2	2 on 3	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna; Sand Dollar Bed	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s), Sea Star	No	No	None	None	Sand Sheet
018	27	3	2.5	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna	None	Yes	Yes	Unknown	Yes	Crab, Gastropod(s), Hermit Crab(s), Sand Dollar(s), Sea Star	No	No	None	None	Sand Sheet
019	30	3	4.8	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Small Surface-Burrowing Fauna	None	Yes	No	None	Yes	Crab, Gastropod(s)	No	No	None	None	Sand Sheet
020	28	3	3.5	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Larger Tube-Building Fauna	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
021	30	3	IND	Low	No	IND	IND	IND	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Diverse Soft Sediment Epifauna	None	No	No	None	Yes	Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
022	29	3	3.8	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna; Small Surface-Burrowing Fauna	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
023	28	3	IND	Low	No	IND	IND	IND	3	No	Soft Sediment Fauna	None	Diverse Soft Sediment Epifauna	Larger Tube-Building Fauna; Small Tube-Building Fauna	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
024	30	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Diverse Soft Sediment Epifauna; Sand Dollar Bed	None	No	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	Ocean Quahog	Sand Sheet
025	31	3	2.2	Low	No	2	2	2	3	No	Soft Sediment Fauna	IND	Sand Dollar Bed	IND	None	No	No	None	Yes	Hermit Crab, Sand Dollar(s)	No	No	None	None	Sand Sheet

New Jersey Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent Cover Modifier)	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
026	30	3	IND	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Sand Dollar Bed	None	Yes	Yes	None	Yes	Sand Dollar(s)	No	No	None	None	Sand Sheet
141	29	3	3.6	Low	No	2	2	2	1	No	Soft Sediment Fauna	None	Sand Dollar Bed	Larger Deep-Burrowing Fauna	None	Yes	No	None	Yes	Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
142	29	3	3.3	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna; Larger Deep-Burrowing Fauna	None	Yes	Yes	None	Yes	Gastropod(s), Sand Dollar(s), Sea Stars	No	No	None	None	Sand Sheet
143	28	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Diverse Soft Sediment Epifauna; Larger Deep-Burrowing Fauna	None	Yes	Yes	None	Yes	Anemones, Caprellid(s), Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
144	29	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Sand Dollar Bed	None	Yes	No	None	Yes	Gastropod(s), Hermit Crab, Sand Dollar(s)	No	No	None	None	Sand Sheet
145	30	3	2.4	Low	No	2	2 -> 3	2 -> 3	2	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Sand Dollar Bed	None	Yes	Yes	Skate	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
146	30	3	2.2	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Larger Deep-Burrowing Fauna; Larger Tube-Building Fauna	None	Yes	Yes	None	Yes	Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
147	31	3	IND	Low	No	IND	IND	IND	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Mobile Mollusks on Soft Sediments; Small Tube-Building Fauna	None	Yes	Yes	None	Yes	Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
148	35	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Small Surface-Burrowing Fauna	None	Yes	Yes	None	Yes	Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
149	34	3	IND	Low	No	2	2	2	2	No	Soft Sediment Fauna	None	Sand Dollar Bed	Mobile Mollusks on Soft Sediments	None	Yes	No	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
150	34	3	3.6	Low	No	IND	1 -> 2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Mobile Mollusks on Soft Sediments; Small Tube-Building Fauna	None	Yes	Yes	None	Yes	Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet

New Jersey Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent Cover Modifier)	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
151	34	3	IND	Low	No	IND	2	2 -> 3	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Larger Deep-Burrowing Fauna; Small Tube-Building Fauna	None	Yes	No	None	Yes	Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
152	34	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Surface-Burrowing Fauna	Diverse Soft Sediment Epifauna	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
153	36	3	IND	Low	No	1 -> 2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna; Sand Dollar Bed	None	Yes	Yes	None	Yes	Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
154	37	3	3.9	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Varies	None	Yes	Yes	None	Yes	Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
155	37	3	3.2	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna; Larger Deep-Burrowing Fauna	None	Yes	Yes	None	Yes	Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
156	36	3	3.0	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna; Sand Dollar Bed	None	Yes	Yes	None	Yes	Gastropod(s), Sand Dollar(s), Unknown Organism	No	No	None	None	Sand Sheet
157	37	3	IND	Low	No	1 -> 2	1 -> 2	1 -> 2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Varies	None	Yes	Yes	None	Yes	Anemone, Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
n = 43																									
Max	**68**		**4.8**																						
Min	**16**		**1.5**																						
Mean	**31**		**3.3**																						
Standard Deviation			**0.8**																						

IND=Indeterminate
"-" Replicate image not analyzed
[1]Variable determined from combined SPI and PV analysis

Table 3-3a. Summary of Plan View Image Analysis Results at the New York Harbor Export Cable Route Stations

New York Harbor Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	SPI Sediment Type (by replicate)			PV Replicate (n)	Gravel Mode (mm)	Dominant CMECS Substrate Group	Dominant CMECS Substrate Subgroup	Boulder Presence	Bedforms (by replicate)			Bedform Size Measurement (cm)	Debris	Habitat Type
048	23	3	3.9	0.9	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
049	27	3	10.4	0.9	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
050	27	3	2.3	1.0	Fine sand	IND	IND	3	195.8	Gravel Mixes	Sandy Gravel	Yes	None	None	None	-	Shell Hash	Patchy Cobbles & Boulders on Sand
051	26	3	7.9	1.1	Granule	Pebble	Pebble over finer sediment	3	4.4	Gravel Mixes	Sandy Gravel	No	None	None	None	-	None	Sand with Mobile Gravel
052	23	3	4.8	0.7	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
053	22	3	4.7	1.1	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
054	22	3	4.5	1.1	Coarse sand	Coarse sand	Coarse sand over finer sediment	3	1.9	Slightly Gravelly	Slightly Gravelly Sand	No	None	None	None	-	None	Sand with Mobile Gravel
055	22	3	5.7	1.2	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
056	25	3	5.7	1.1	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
057	26	3	7.3	0.8	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
058	28	3	7.2	1.7	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
059	29	3	9.1	1.1	Very fine sand over silt/clay	Very fine sand over silt/clay	Very fine sand over silt/clay	1	IND	Sand	Sand or Finer	No	None	-	-	-	None	Sand Sheet
060	29	3	7.2	1.7	Very fine sand	Very fine sand over silt/clay	Very fine sand over silt/clay	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
061	28	3	8.5	1.4	Very fine sand over silt/clay	Very fine sand over silt/clay	Very fine sand over silt/clay	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
062	27	3	6.2	2.7	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	IND	-	None	Sand Sheet

New York Harbor Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	SPI Sediment Type (by replicate)			PV Replicate (n)	Gravel Mode (mm)	Dominant CMECS Substrate Group	Dominant CMECS Substrate Subgroup	Boulder Presence	Bedforms (by replicate)			Bedform Size Measurement (cm)	Debris	Habitat Type
063	23	3	3.7	0.7	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
064	22	3	3.4	0.6	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
065	23	3	4.3	0.8	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	IND	-	None	Sand Sheet
066	25	3	3.7	0.9	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
067	23	3	5.3	0.8	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
068	21	3	6.6	1.2	Pebble over finer sediment	Pebble over finer sediment	Very coarse sand over sand	3	8.6	Gravel Mixes	Sandy Gravel	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel
069	21	3	5.4	0.9	Coarse sand	Very coarse sand over sand	Very coarse sand over sand	3	2.5	Slightly Gravelly	Slightly Gravelly Sand	No	None	None	Ripples	54.4	Shell Hash	Sand with Mobile Gravel
070	23	3	5.3	1.2	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
071	22	3	6.0	1.3	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	Uneven Ripples	IND	None	Sand Sheet
072	23	3	3.4	1.4	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	Uneven Ripples	IND	None	Sand Sheet
073	25	3	4.6	0.9	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
074	26	3	5.8	0.9	Fine sand	Fine sand	Fine sand	1	IND	Sand	Sand or Finer	No	None	-	-	-	None	Sand Sheet
075	28	3	10.5	0.7	Very fine sand over silt/clay	Very fine sand over silt/clay	Very fine sand over silt/clay	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
076	27	3	5.4	1.3	Fine sand	Fine sand	Fine sand over silt/clay	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
077	26	3	9.1	1.1	Very fine sand over silt/clay	Very fine sand over silt/clay	Very fine sand over silt/clay	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
089	24	3	6.7	1.8	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
090	21	3	5.3	1.1	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
091	18	3	4.4	1.3	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet

New York Harbor Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	SPI Sediment Type (by replicate)			PV Replicate (n)	Gravel Mode (mm)	Dominant CMECS Substrate Group	Dominant CMECS Substrate Subgroup	Boulder Presence	Bedforms (by replicate)			Bedform Size Measurement (cm)	Debris	Habitat Type
092	17	3	3.5	1.1	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	Uneven Ripples	Uneven Ripples	Uneven Ripples	IND	Shell Hash	Sand Sheet
093	13	3	3.7	1.8	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	15.4	Shell Hash	Sand Sheet
094	13	3	4.5	2.3	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	Uneven Ripples	Uneven Ripples	Uneven Ripples	IND	None	Sand Sheet
095	9	3	6.1	1.3	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	Ripples	Ripples	Ripples	14.4	None	Sand Sheet
096	7	3	5.2	2.0	Very coarse sand over sand	Very coarse sand over sand	Very coarse sand over sand	3	2.1	Gravelly	Gravelly Sand	No	None	None	Ripples	18.0	Shell Hash	Sand with Mobile Gravel
097	10	3	5.0	2.1	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	Uneven Ripples	Uneven Ripples	Uneven Ripples	IND	Shell Hash	Sand Sheet
107	16	3	7.0	1.4	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
108	15	3	10.0	2.8	Silt/clay	Silt/clay	Silt/clay	3	IND	IND	IND	No	None	None	None	-	Shell Hash	IND
109	11	3	10.1	1.6	Silt/clay	Silt/clay	Silt/clay	3	IND	IND	IND	No	None	None	None	-	Shell Hash	IND
110	16	3	12.4	2.6	Silt/clay	Silt/clay	Silt/clay	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
111	26	3	8.1	0.9	Very fine sand	Very fine sand	Very fine sand over silt/clay	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
112	20	3	6.1	2.3	Very fine sand	Very fine sand	Very fine sand	3	IND	IND	IND	No	None	None	None	-	Shell Hash	IND
113	14	3	6.4	1.5	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	Uneven Ripples	Uneven Ripples	Uneven Ripples	IND	None	Sand Sheet
114	15	3	14.3	1.1	Very fine sand over silt/clay	Very fine sand over silt/clay	Very fine sand over silt/clay	0	-	-	-	-	-	-	-	-	-	-
115	13	3	18.9	1.1	Silt/clay	Silt/clay	Silt/clay	0	-	-	-	-	-	-	-	-	-	-
131	21	3	6.1	0.9	Granule over sand	Pebble over finer sediment	Pebble over finer sediment	3	5.1	Gravelly	Gravelly Sand	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel
132	23	3	6.1	0.9	Granule over sand	Pebble over finer sediment	Pebble over finer sediment	3	8.9	Gravelly	Gravelly Sand	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel

New York Harbor Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	SPI Sediment Type (by replicate)			PV Replicate (n)	Gravel Mode (mm)	Dominant CMECS Substrate Group	Dominant CMECS Substrate Subgroup	Boulder Presence	Bedforms (by replicate)			Bedform Size Measurement (cm)	Debris	Habitat Type
133	24	3	6.7	0.7	Granule over sand	Granule over sand	Granule over sand	3	2.9	Gravelly	Gravelly Sand	No	None	None	None	-	None	Sand with Mobile Gravel
134	24	3	8.4	0.9	Very coarse sand over sand	Very coarse sand over sand	Very coarse sand over sand	3	5.6	Gravel Mixes	Sandy Gravel	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel
135	23	3	5.6	0.9	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
136	25	3	6.5	1.1	Medium sand	Medium sand	Pebble over finer sediment	3	4.1	Gravelly	Gravelly Sand	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel
137	28	3	4.6	1.2	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
138	27	3	4.9	0.5	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
139	27	3	4.3	0.6	Very fine sand	Very fine sand	Very fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
140	28	3	5.9	0.7	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
n = SPI-58, PV-56																		
Max	**29**		**18.9**	**2.8**					**195.8**							**54.4**		
Min	**7**		**2.3**	**0.5**					**1.9**							**14.4**		
Mean	**22**		**6.5**	**1.2**					**22.0**							**25.5**		
Standard Deviation			**2.8**	**0.5**					**57.7**							**19.3**		

IND=Indeterminate
"-" Replicate image not analyzed

Table 3-3b. Summary of Sediment Profile Image Analysis Results at the New York Harbor Export Cable Route Stations

New York Harbor Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent Cover Modifier)	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
048	23	3	IND	Low	No	IND	IND	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Diverse Soft Sediment Epifauna; Sand Dollar Bed	None	Yes	Yes	None	Yes	Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
049	27	3	2.7	High	No	2 -> 3	2 -> 3	2 on 3	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Small Surface-Burrowing Fauna	None	Yes	No	None	Yes	Anemone(s), Caprellid(s), Hermit Crab(s)	No	No	None	None	Sand Sheet
050	27	3	IND	Low	No	IND	IND	2	3	Yes	Attached Fauna	Soft Sediment Fauna (1)	Attached Hydroids	Attached Bryozoans; Attached Sponges	Dense (70 to < 90%)	No	No	None	Yes	Corals, Hydroids, Sea Star, Sponges	No	Yes	Non-Reef Building Hard Coral	None	Patchy Cobbles & Boulders on Sand
051	26	3	IND	Low	No	IND	IND	IND	3	No	IND	IND	Mobile Crustaceans on Hard or Mixed Substrates	Burrowing Anemones	None	No	No	None	No	Anemone(s), Hermit Crab(s)	No	No	None	None	Sand with Mobile Gravel
052	23	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Mobile Crustaceans on Soft Sediments; Sand Dollar Bed	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
053	22	3	IND	Low	No	1 -> 2	1 -> 2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Diverse Soft Sediment Epifauna; Mobile Crustaceans on Soft Sediments	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
054	22	3	IND	Low	No	IND	IND	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna; Small Tube-Building Fauna	None	Yes	No	None	Yes	Gastropod(s), Hermit Crab(s)	No	No	None	None	Sand with Mobile Gravel
055	22	3	3.3	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Small Surface-Burrowing Fauna	None	No	No	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
056	25	3	1.7	Low	No	2 -> 3	2 -> 3	2 -> 3	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Small Surface-Burrowing Fauna	None	No	Yes	None	Yes	Crab, Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
057	26	3	2.8	Low	No	2 -> 3	2 -> 3	2 -> 3	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Diverse Soft Sediment Epifauna; Small Surface-Burrowing Fauna	None	Yes	Yes	None	Yes	Caprellid(s), Gastropod(s), Hermit Crab(s), Sea Scallop	No	No	None	Sea Scallop	Sand Sheet
058	28	3	2.7	Low	No	2	2 -> 3	2 -> 3	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Varies	None	Yes	Yes	None	Yes	Aphrodita, Caprellid, Gastropod(s), Hermit Crab(s), Sand Dollar(s), Sea Scallop	No	No	None	Sea Scallop	Sand Sheet
059	29	3	1.9	Low	No	2 -> 3	2 -> 3	2 on 3	1	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Small Surface-Burrowing Fauna	None	Yes	Yes	None	Yes	Anemones, Gastropod(s), Hermit Crab(s)	No	No	None	None	Sand Sheet

New York Harbor Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent Cover Modifier)	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
060	29	3	1.3	Low	No	2 -> 3	2 -> 3	2 -> 3	3	No	Soft Sediment Fauna	None	Burrowing Anemones	Burrowing Anemones; Small Surface-Burrowing Fauna	None	Yes	Yes	None	Yes	Anemone(s), Aphrodita, Clams, Gastropod(s), Hermit Crab(s)	No	No	None	None	Sand Sheet
061	28	3	1.7	Low	No	2	2 -> 3	2 -> 3	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Small Surface-Burrowing Fauna	None	Yes	No	None	Yes	Anemone(s), Gastropod(s)	No	No	None	None	Sand Sheet
062	27	3	2.1	Low	No	2 -> 3	2 -> 3	2 -> 3	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Small Surface-Burrowing Fauna	None	Yes	No	None	Yes	Anemone(s), Gastropod(s)	No	No	None	None	Sand Sheet
063	23	3	IND	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Diverse Soft Sediment Epifauna	Small Surface-Burrowing Fauna; Small Tube-Building Fauna	None	Yes	Yes	None	Yes	Anemone, Gastropod(s), Hermit Crab, Sand Dollar(s)	No	No	None	None	Sand Sheet
064	22	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Varies	None	Yes	Yes	None	Yes	Anemone, Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
065	23	3	3.0	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Surface-Burrowing Fauna	Small Surface-Burrowing Fauna; Tracks and Trails	None	Yes	Yes	None	Yes	Anemones, Gastropod(s), Hermit Crab, Sand Dollars	No	No	None	None	Sand Sheet
066	25	3	IND	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Sand Dollar Bed	None	Yes	No	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
067	23	3	IND	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Larger Tube-Building Fauna	None	Yes	No	None	Yes	Sand Dollar(s)	No	No	None	None	Sand Sheet
068	21	3	3.1	Low	No	IND	IND	IND	3	No	Soft Sediment Fauna	Attached Fauna (2)	Mobile Crustaceans on Hard or Mixed Substrates	Attached Mussels; Diverse Soft Sediment Epifauna	Sparse (1 to <30%)	No	No	None	Yes	Hermit Crab(s), Mussels, Sand Dollars	No	No	None	None	Sand with Mobile Gravel
069	21	3	IND	Low	No	IND	IND	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Mobile Crustaceans on Hard or Mixed Substrates; Small Surface-Burrowing Fauna	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand with Mobile Gravel
070	23	3	3.4	Low	No	1 -> 2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Burrowing Anemones; Small Surface-Burrowing Fauna	None	Yes	Yes	None	Yes	Anemone(s), Gastropod(s), Hermit Crab(s)	No	No	None	None	Sand Sheet
071	22	3	3.0	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Larger Tube-Building Fauna; Small Tube-Building Fauna	None	No	Yes	None	Yes	Gastropod(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
072	23	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Small Surface-Burrowing Fauna; Tracks and Trails	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet

New York Harbor Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent Cover Modifier)	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
073	25	3	2.0	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna; Mobile Mollusks on Soft Sediments	None	Yes	Yes	Unknown	Yes	Anemones, Gastropod(s), Hermit Crab(s)	No	No	None	None	Sand Sheet
074	26	3	IND	Low	No	2	2	2 -> 3	1	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Small Surface-Burrowing Fauna	None	Yes	No	None	Yes	None	No	No	None	None	Sand Sheet
075	28	3	1.8	Medium	No	2	2	2 -> 3	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Burrowing Anemones	None	Yes	Yes	None	Yes	Anemone(s), Gastropod(s), Hermit Crab(s), Unknown Organism	No	No	None	None	Sand Sheet
076	27	3	1.3	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Diverse Soft Sediment Epifauna	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
077	26	3	1.7	Medium	No	2	2	2 on 3	3	No	Soft Sediment Fauna	None	Burrowing Anemones	Small Tube-Building Fauna	None	Yes	Yes	None	Yes	Anemone(s), Gastropod(s)	No	No	None	None	Sand Sheet
089	24	3	1.4	Medium	No	2	2 -> 3	2 -> 3	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Small Surface-Burrowing Fauna; Small Tube-Building Fauna	None	Yes	No	None	Yes	Anemone(s), Hermit Crab(s)	No	No	None	None	Sand Sheet
090	21	3	2.4	Medium	No	2	2	2 -> 3	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Small Surface-Burrowing Fauna	None	Yes	No	None	Yes	Anemone(s), Gastropod(s)	No	No	None	None	Sand Sheet
091	18	3	IND	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Sand Dollar Bed; Small Surface-Burrowing Fauna	None	Yes	Yes	None	Yes	Moon Snail, Sand Dollar(s), Sea Scallop	No	No	None	Sea Scallop	Sand Sheet
092	17	3	3.3	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Mobile Mollusks on Soft Sediments	None	Yes	No	None	Yes	Anemone(s), Gastropod(s), Hermit Crab(s)	No	No	None	None	Sand Sheet
093	13	3	2.9	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Small Surface-Burrowing Fauna; Small Tube-Building Fauna	None	Yes	No	None	Yes	Unknown Organism	No	No	None	None	Sand Sheet
094	13	3	IND	Low	No	IND	2	2 -> 3	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Varies	None	Yes	No	None	Yes	Anemone(s), Gastropod(s), Hermit Crab(s), Moon Snail, Sand Dollar	No	No	None	None	Sand Sheet
095	9	3	IND	Low	No	IND	IND	IND	3	No	Soft Sediment Fauna	Attached Fauna (3)	Attached Mussels	Attached Mussels; Tracks and Trails	Moderate (30 to < 70%)	Yes	Yes	None	Yes	Hermit Crab(s), Mussels	No	No	None	None	Sand Sheet
096	7	3	IND	Low	No	IND	IND	IND	3	No	Soft Sediment Fauna	Attached Fauna (2)	Attached Mussels	None	Trace (<1%)	Yes	No	None	Yes	Mussels	No	No	None	None	Sand with Mobile Gravel
097	10	3	IND	Low	No	IND	IND	IND	3	No	Soft Sediment Fauna	None	Tracks and Trails	Mobile Crustaceans on Soft Sediments	None	Yes	No	None	Yes	None	No	No	None	None	Sand Sheet

New York Harbor Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent Cover Modifier)	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
107	16	3	5.3	Low	No	IND	IND	IND	3	No	Attached Fauna	Soft Sediment Fauna (3)	Mussel Bed	Mobile Crustaceans on Soft Sediments	Moderate (30 to < 70%)	Yes	No	None	Yes	Hermit Crab, Mussels	No	No	None	None	Sand Sheet
108	15	3	0.3	High	No	IND	2 on 3	2 on 3	3	No	Attached Fauna	None	Mussel Bed	Attached Hydroids; Attached Sea Urchins	Sparse (1 to <30%)	IND	IND	None	Yes	Hydroids, Spider Crab(s), Sea Urchin(s)	No	No	None	None	IND
109	11	3	0.1	High	No	IND	2 on 3	2 on 3	3	No	Attached Fauna	IND	Mussel Bed	Attached Hydroids	Moderate (30 to < 70%)	IND	IND	None	Yes	Hydroids, Mussels	No	No	None	None	IND
110	16	3	0.1	High	No	2 on 3	2 on 3	2 on 3	3	No	Attached Fauna	Soft Sediment Fauna (1)	Mussel Bed	Attached Hydroids	Moderate (30 to < 70%)	Yes	No	None	Yes	Hydroids	No	No	None	None	Sand Sheet
111	26	3	2.8	Medium	No	IND	IND	IND	3	No	Soft Sediment Fauna	Attached Fauna (1)	Mobile Crustaceans on Soft Sediments	Attached Hydroids	Sparse (1 to <30%)	Yes	No	None	Yes	Hermit Crabs, Hydroids	No	No	None	None	Sand Sheet
112	20	3	IND	Low	No	2	2	2	3	No	IND	IND	IND	IND	None	IND	IND	IND	Yes	Hermit Crab	IND	None	None	IND	IND
113	14	3	2.4	Low	No	IND	2	2	3	No	IND	IND	IND	IND	None	IND	IND	IND	No	IND	IND	None	None	IND	Sand Sheet
114	15	3	1.7	High	No	2 -> 3	2 on 3	2 on 3	0	-	-	-	-	-	-	-	-	-	Yes	IND	IND	IND	IND	IND	-
115	13	3	1.9	High	No	2 on 3	2 on 3	2 on 3	0	-	-	-	-	-	-	-	-	-	Yes	IND	IND	IND	IND	IND	-
131	21	3	IND	Low	No	IND	1 -> 2	1 -> 2	3	No	Soft Sediment Fauna	None	Small Surface-Burrowing Fauna	Larger Tube-Building Fauna	None	Yes	No	Sea Robin	Yes	Gastropod(s), Hermit Crab	No	No	None	None	Sand with Mobile Gravel
132	23	3	IND	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Small Tube-Building Fauna	Varies	None	Yes	No	Sea Robin	Yes	Barnacles	No	No	None	None	Sand with Mobile Gravel
133	24	3	IND	Low	No	IND	2	2	3	No	Soft Sediment Fauna	Attached Fauna (1)	Small Tube-Building Fauna	Diverse Soft Sediment Epifauna; Mobile Crustaceans on Hard or Mixed Substrates	Trace (<1%)	Yes	Yes	None	Yes	Anemones, Barnacles, Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand with Mobile Gravel
134	24	3	IND	Low	No	IND	IND	IND	3	No	Soft Sediment Fauna	None	Mobile Crustaceans on Hard or Mixed Substrates	Burrowing Anemones; Mobile Crustaceans on Hard or Mixed Substrates	None	Yes	No	None	Yes	Anemone(s), Hermit Crab(s)	No	No	None	None	Sand with Mobile Gravel
135	23	3	2.8	Low	No	IND	1 -> 2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Sand Dollar Bed	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
136	25	3	IND	Low	No	1 -> 2	2	2	3	No	Soft Sediment Fauna	None	Burrowing Anemones	Burrowing Anemones; Mobile Crustaceans on Soft Sediments	None	Yes	No	None	Yes	Anemone(s), Gastropod(s), Hermit Crab(s)	No	No	None	None	Sand with Mobile Gravel
137	28	3	2.4	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Larger Tube-Building Fauna; Sand Dollar Bed	None	Yes	Yes	None	Yes	Anemone(s), Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
138	27	3	IND	Low	No	IND	IND	2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Larger Tube-Building Fauna; Small Tube-Building Fauna	None	Yes	Yes	None	Yes	Sand Dollar(s)	No	No	None	None	Sand Sheet

New York Harbor Export Cable Route Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent Cover Modifier)	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
139	27	3	IND	Low	No	2	2	2 -> 3	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Larger Tube-Building Fauna	None	Yes	Yes	None	Yes	Anemones, Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
140	28	3	3.4	Low	No	2	2	2 -> 3	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Small Tube-Building Fauna	None	Yes	Yes	None	Yes	Anemone, Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
n = SPI-58, PV-56																									
Max	**29**		**5.3**																						
Min	**7**		**0.1**																						
Mean	**22**		**2.3**																						
Standard Deviation			**1.1**																						

IND=Indeterminate
"-" Replicate image not analyzed
[1]Variable determined from combined SPI and PV analysis

Table 3-4a. Summary of Plan View Image Analysis Results at the Reference Stations

Reference Station	Water Depth (m)	SPI Replicate (n)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	SPI Sediment Type (by replicate)			PV Replicate (n)	Gravel Mode (mm)	Dominant CMECS Substrate Group	Dominant CMECS Substrate Subgroup	Boulder Presence	Bedforms (by replicate)			Bedform Size Measurement (cm)	Debris	Habitat Type
REFA_01	29	3	6.5	1.7	Pebble over finer sediment	Pebble over finer sediment	Pebble over finer sediment	3	10.6	Gravel Mixes	Sandy Gravel	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel
REFA_02	32	3	7.1	1.9	Granule over sand	Granule over sand	Granule over sand	3	6.6	Gravel Mixes	Sandy Gravel	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel
REFA_03	31	3	7.2	2.1	Pebble over finer sediment	Pebble over finer sediment	Pebble over finer sediment	3	8.7	Gravel Mixes	Sandy Gravel	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel
REFA_04	30	3	8.0	1.8	Granule over sand	Pebble over finer sediment	Pebble over finer sediment	3	8.9	Gravel Mixes	Sandy Gravel	No	None	None	None	-	Shell Hash	Sand with Mobile Gravel
REFA_05	33	3	7.3	2.1	Coarse sand over finer sediment	Pebble over finer sediment	Pebble over finer sediment	3	8.3	Gravel Mixes	Sandy Gravel	No	None	None	None	-	None	Sand with Mobile Gravel
REFB_01	23	3	5.6	0.9	Medium sand over finer sediment	Medium sand over finer sediment	Medium sand over finer sediment	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
REFB_02	23	3	6.2	0.6	Medium sand over finer sediment	Medium sand over finer sediment	Medium sand over finer sediment	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
REFB_03	23	3	6.1	1.8	Medium sand over finer sediment	Medium sand over finer sediment	Medium sand over finer sediment	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
REFB_04	23	3	4.4	0.9	Medium sand over finer sediment	Medium sand over finer sediment	Medium sand over finer sediment	3	IND	Sand	Sand or Finer	No	None	None	Uneven Ripples	IND	Shell Hash	Sand Sheet
REFB_05	24	3	4.4	0.9	Fine sand	Fine sand	Fine sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
REFC_01	36	3	5.3	1.1	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
REFC_02	36	3	5.8	1.4	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	Shell Hash	Sand Sheet
REFC_03	36	3	5.1	1.3	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet

Reference Station	Water Depth (m)	SPI Replicate (n)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	SPI Sediment Type (by replicate)			PV Replicate (n)	Gravel Mode (mm)	Dominant CMECS Substrate Group	Dominant CMECS Substrate Subgroup	Boulder Presence	Bedforms (by replicate)			Bedform Size Measurement (cm)	Debris	Habitat Type
REFC_04	35	3	7.4	1.1	Medium sand	Medium sand	Medium sand over finer sediment	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
REFC_05	35	3	6.9	2.3	Medium sand	Medium sand	Medium sand	3	IND	Sand	Sand or Finer	No	None	None	None	-	None	Sand Sheet
n = 15																		
Max	**36**		**8.0**	**2.3**					**10.6**									
Min	**23**		**4.4**	**0.6**					**6.6**									
Mean	**30**		**6.2**	**1.5**					**8.6**									
Standard Deviation			**1.1**	**0.5**					**1.5**									

IND=Indeterminate
"-" Replicate image not analyzed

Table 3-4b. Summary of Sediment Profile Image Analysis Results at the Reference Stations

Reference Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
REFA_01	29	3	IND	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Burrowing Anemones	None	None	Yes	No	Sea Robin	Yes	Anemone(s)	No	No	None	None	Sand with Mobile Gravel
REFA_02	32	3	3.9	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Burrowing Anemones	Small Tube-Building Fauna	None	Yes	No	None	Yes	Anemone(s)	No	No	None	None	Sand with Mobile Gravel
REFA_03	31	3	3.4	Low	No	2	2	2 -> 3	3	No	Soft Sediment Fauna	None	Burrowing Anemones	Mobile Crustaceans on Hard or Mixed Substrates; Small Tube-Building Fauna	None	Yes	No	None	Yes	Anemone(s), Hermit Crab(s)	No	No	None	None	Sand with Mobile Gravel
REFA_04	30	3	5.5	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Burrowing Anemones	Mobile Crustaceans on Hard or Mixed Substrates	None	Yes	No	None	Yes	Anemone(s), Hermit Crab(s)	No	No	None	None	Sand with Mobile Gravel
REFA_05	33	3	2.8	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Burrowing Anemones	Mobile Crustaceans on Hard or Mixed Substrates; Small Tube-Building Fauna	None	Yes	No	Flounder; Skate	Yes	Anemone(s), Hermit Crab(s)	No	No	None	None	Sand with Mobile Gravel
REFB_01	23	3	4.1	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Diverse Soft Sediment Epifauna	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
REFB_02	23	3	IND	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Diverse Soft Sediment Epifauna	None	Yes	Yes	Flounder	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
REFB_03	23	3	3.5	Low	No	IND	2	2	3	No	Soft Sediment Fauna	None	Diverse Soft Sediment Epifauna	Diverse Soft Sediment Epifauna; Larger Tube-Building Fauna	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
REFB_04	23	3	IND	Low	No	IND	IND	2	3	No	Soft Sediment Fauna	None	Diverse Soft Sediment Epifauna	Larger Tube-Building Fauna; Mobile Crustaceans on Soft Sediments	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Hydroids, Sand Dollar(s)	No	No	None	None	Sand Sheet
REFB_05	24	3	IND	Low	No	1 -> 2	1 -> 2	1 -> 2	3	No	Soft Sediment Fauna	None	Sand Dollar Bed	Varies	None	Yes	Yes	None	Yes	Gastropod(s), Hermit Crab(s), Sand Dollar(s)	No	No	None	None	Sand Sheet
REFC_01	36	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Mobile Crustaceans on Soft Sediments	None	Yes	No	None	Yes	Caprellid(s), Shrimp	No	No	None	None	Sand Sheet
REFC_02	36	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Mobile Crustaceans on Soft Sediments	None	Yes	No	None	Yes	Shrimp	No	No	None	None	Sand Sheet
REFC_03	36	3	IND	Low	No	2	2	2	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Varies	None	Yes	No	None	Yes	Sea Star(s)	No	No	None	None	Sand Sheet
REFC_04	35	3	4.8	Low	No	2	2	2 -> 3	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Diverse Soft Sediment Epifauna; Mobile Crustaceans on Soft Sediments	None	Yes	No	None	Yes	Sea Star(s), Shrimp	No	No	None	None	Sand Sheet
REFC_05	35	3	6.8	Low	No	2	2	2 -> 3	3	No	Soft Sediment Fauna	None	Larger Tube-Building Fauna	Diverse Soft Sediment Epifauna; Mobile Crustaceans on Soft Sediments	None	Yes	No	None	Yes	Clam, Gastropod, Sea Star(s), Shrimp	No	No	None	None	Sand Sheet
n = 15																									
Max	**36**		**6.8**																						
Min	**23**		**2.8**																						
Mean	**30**		**4.4**																						

Reference Station	Water Depth (m)	SPI Replicate (n)	Mean aRPD Depth (cm)	Sediment Oxygen Demand Level	Methane Presence	Successional Stage (by replicate)			PV Replicate (n)	Possible Habitat of Interest	Dominant CMECS Biotic Subclass	Dominant CMECS Co-occurring Biotic Subclasses (# of reps)	Dominant CMECS Biotic Group	Dominant CMECS Co-occurring Biotic Group	Maximum Attached Fauna Percent Cover (CMECS Percent	Burrow Presence	Tracks Presence	Fish Present[1]	Presence of Tubes[1]	Epifauna Present[1]	Invasive Taxa Present[1]	Sensitive Taxa Present[1]	Sensitive Taxa[1]	Species of Concern[1]	Habitat Type
Standard Deviation			**1.3**																						

IND=Indeterminate
"-" Replicate image not analyzed
[1]Variable determined from combined SPI and PV analysis

Table 3-5. SPI Sediment Type to Grain Size (phi)

SPI Sediment Type	Grain Size Major Mode (phi)
Cobble & Cobble over sand	<-8
	<-8 / 3 to 2
Pebble	-4 to -5
	-3 to -4
	-2 to -3
Pebble over finer sediment	-4 to -5 / 0 to -1
	-3 to -4 / 0 to -1
	-3 to -4 / 1 to 0
	-3 to -4 / >4
	-2 to -3 / 1 to 0
	-2 to -3 / 3 to 2
	1 to 0 / -2 to -3*
Granule	-1 to -2
Granule over sand	-1 to -2 / 1 to 0
	-1 to -2 / 2 to 1
	-1 to -2 / 3 to 2
Very coarse sand	0 to -1
Very coarse sand over sand	0 to -1 / 1 to 0
	0 to -1 / 2 to 1
Coarse sand	1 to 0
Coarse sand over finer sediment	1 to 0 / 2 to 1
	1 to 0 / 3 to 2
	1 to 0 / >4
Medium sand	2 to 1
Medium sand over silt/clay	2 to 1 / >4
Fine sand	3 to 2
Very fine sand	4 to 3
Very fine sand over silt/clay	4 to 3/>4
Silt/clay & Silt/clay over sand	>4
	>4 / -1 to -2
	>4 / 0 to -1
	>4 / 1 to 0
	>4 / 2 to 1
	>4 / 3 to 2
	>4 / 4 to 3
Indeterminate	IND

*designation used for a near even distribution of these grain size classes throughout the sediment column

Table 3-6. Sediment Grabs Grain Size Distribution (USCS Classification)

<table>
<tr><th>Station</th><th>ASI #</th><th>% Coarse Gravel</th><th>% Fine Gravel</th><th>Total Gravel</th><th>% Coarse Sand</th><th>% Medium Sand</th><th>% Fine Sand</th><th>Total Sand</th><th>% Silt</th><th>% Clay</th><th>Total Fines</th></tr>
<tr><td>003</td><td>20190565</td><td>0.0</td><td>0.0</td><td>0.0</td><td>0.0</td><td>2.2</td><td>97.8</td><td>100</td><td colspan="3">0.0</td></tr>
<tr><td>006</td><td>20190566</td><td>0.1</td><td>0.5</td><td>0.6</td><td>8.5</td><td>74.3</td><td>16.6</td><td>99.4</td><td>0.0</td><td>0.0</td><td>0.0</td></tr>
<tr><td>010</td><td>20190567</td><td>0.1</td><td>38.4</td><td>38.5</td><td>17.2</td><td>23.5</td><td>15.4</td><td>56.1</td><td>1.8</td><td>3.6</td><td>5.4</td></tr>
<tr><td>011</td><td>20190568</td><td>0.0</td><td>0.0</td><td>0.0</td><td>0.0</td><td>11.9</td><td>9.0</td><td>20.9</td><td>48.1</td><td>31.0</td><td>79.1</td></tr>
<tr><td>147</td><td>20190569</td><td>0.0</td><td>0.0</td><td>0.0</td><td>0.4</td><td>35.2</td><td>64.3</td><td>99.9</td><td colspan="3">0.1</td></tr>
<tr><td>157</td><td>20190570</td><td>0.0</td><td>0.3</td><td>0.3</td><td>0.5</td><td>42.0</td><td>57.2</td><td>99.7</td><td colspan="3">0.0</td></tr>
<tr><td>020</td><td>20190571</td><td>0.0</td><td>0.0</td><td>0.0</td><td>0.1</td><td>1.1</td><td>98.7</td><td>99.9</td><td colspan="3">0.1</td></tr>
<tr><td>038</td><td>20190572</td><td>0.0</td><td>0.0</td><td>0.0</td><td>1.2</td><td>53.6</td><td>45.2</td><td>100</td><td colspan="3">0.0</td></tr>
<tr><td>060</td><td>20190573</td><td>0.0</td><td>0.6</td><td>0.6</td><td>0.2</td><td>20.6</td><td>53.5</td><td>74.3</td><td>16.2</td><td>8.9</td><td>25.1</td></tr>
<tr><td>076</td><td>20190574</td><td>0.0</td><td>0.6</td><td>0.6</td><td>0.1</td><td>36.6</td><td>48.0</td><td>84.7</td><td>7.7</td><td>7.0</td><td>14.7</td></tr>
<tr><td>091</td><td>20190575</td><td>0.0</td><td>0.0</td><td>0.0</td><td>0.8</td><td>8.7</td><td>90.3</td><td>99.8</td><td colspan="3">0.2</td></tr>
<tr><td>095</td><td>20190576</td><td>0.0</td><td>0.0</td><td>0.0</td><td>0.0</td><td>51.2</td><td>48.8</td><td>100</td><td colspan="3">0.0</td></tr>
<tr><td>100</td><td>20190577</td><td>0.2</td><td>6.5</td><td>6.7</td><td>2.2</td><td>29.3</td><td>33.5</td><td>65.0</td><td>13.5</td><td>14.8</td><td>28.3</td></tr>
<tr><td>057</td><td>20190578</td><td>0.0</td><td>0.1</td><td>0.1</td><td>0.1</td><td>39.4</td><td>47.1</td><td>86.6</td><td>8.2</td><td>5.1</td><td>13.3</td></tr>
<tr><td>133</td><td>20190579</td><td>1.3</td><td>6.3</td><td>7.6</td><td>17.0</td><td>56.9</td><td>18.5</td><td>92.4</td><td colspan="3">0.0</td></tr>
<tr><td>136</td><td>20190580</td><td>1.5</td><td>7.4</td><td>8.9</td><td>13.3</td><td>39.9</td><td>37.9</td><td>91.1</td><td>0.0</td><td>0.0</td><td>0.0</td></tr>
</table>

4.0 SUMMARY

The purpose of the SPI/PV survey was to provide data about surficial sediments and characterize benthic habitats along the proposed export cable routes for the Equinor Wind Offshore lease area OCS-A 0512. Results from the SPI/PV survey are intended to support spatial planning decisions, reduce uncertainty associated with baseline conditions, and inform future approaches. This SPI/PV study provides a secondary line of data for the assessment of the physical, geological, and biological conditions of the surficial sediments within the surveyed area. This study also carefully considered all BOEM regulations and guideline recommendations; SPI and PV images provide important data pertaining to several of these regulations and guidelines (Table 4-1). The data from this study was collected and interpreted in consideration of these regulations and guidelines so Equinor can provide federal regulators have the best available information for review. The SPI and PV images were useful in mapping physical, geological, and biological properties of the surface sediments and helped to document and characterize processes structuring surface sediments along the proposed cable routes and at the reference stations.

Surficial sediments were heterogenous across the surveyed area at an inter-station scale; intra-station sediment heterogeneity was largely low (most replicates were similar in sediment type), but there were a few instances of high variability. These results highlight that sediment type along the export cable routes varied at large but not small scales; this trend was true at the reference stations. Despite the spatial variations in sediment types, most of the sediment found along the cable routes and at the reference stations were varying sizes of mobile sand. There were a few distinct locations where the sediment type varied from sand: silt-clay was documented in the submarine valley (the Hudson Shelf Valley) traversing the NJECR and at the stations located near the "Narrows" along the NYHECR; granules and pebbles were observed at stations located on Cholera Bank, at stations west of the submarine valley (including at Reference A), and at some of the shallow stations near Long Island; and boulders were documented at a few stations, most notably Station 050 on Cholera Bank. The sediment types documented during the SPI/PV survey were used to ground truth USGS backscatter data. The SPI/PV data corresponded well with the backscatter data, and it is appropriate to extrapolate bottom type in the area using the SPI/PV and USGS backscatter data.

The sediment type observed across the surveyed area corresponded to the Habitat Types documented. Three broad habitat types were identified at the surveyed area, Sand Sheets, Sand with Mobile Gravel, and Patchy, Cobbles, Boulders on Sand. These Habitat Types were defined based on their physical habitat structure and mobility, as well as their dominant CMECS Biotic Subclass and CMECS Biotic Group. Sand Sheets were the overwhelming habitat observed. Habitats such as Sand with Mobile Gravel and Patchy, Cobbles, Boulders on Sand were observed in distinct locations. Sand with Mobile Gravel was documented in the shallow portions of the NJECR just west of the Hudson Shelf Valley, along Cholera Bank, and in the most western portion of the LIECR in NY state waters. Patchy, Cobbles, Boulders on Sand were documented at Station 050 situated on Cholera Bank, and along the NJECR at Station 010 in the Hudson Shelf Valley. Cobbles and boulders can provide habitat for a diverse range of taxa and serve as valuable habitat for juvenile fauna. Similar habitat observations were made at the reference stations. Sand Sheets were the predominant habitat and exclusive to Reference B (adjacent Cholera Bank) and Reference C (just east of the Hudson Shelf Valley). Sand with Mobile Gravel was exclusively observed at Reference A just west of the Hudson Shelf Valley. There did appear to be a spatial orientation to the presence of Sand with Mobile Gravel. The transition from a seafloor habitat of Sand Sheet to one of Sand with Mobile Gravel occurred right at the Hudson Shelf Valley for both the reference stations and stations along the proposed cable routes. Stations east of the submarine valley were Sand Sheet habitat, and stations west of the submarine valley were a habitat of Sand with Mobile Gravel.

The vast majority of stations (nearly two-thirds) were characterized by medium to high load-bearing strength reflected in the relatively shallow prism penetration depths (<6 cm) observed along the proposed cable routes. There was a similar trend at the reference stations where approximately half of the reference stations were characterized by medium to high load-bearing strength. Sediment load-bearing capacity, indicated by prism penetration depth, is related to grain size, and prism penetration values correlated well with sediment composition across the surveyed area. Stations with a higher prevalence of gravel, including boulders, had the highest bearing capacities (<4 cm prism penetration) or prism penetration was refused when the camera system landed directly on large boulders (e.g., Station 050). Penetration depth range is not strictly controlled by grain size but can also be influenced by compaction/porosity, as well as infaunal bioturbation. There were no discernible trends in prism penetration and bioturbation observed at the surveyed area.

Ripples indicate frequent and persistent hydrodynamic forcing at the surface of the seafloor. Ripples of varying amplitude and wavelength were the predominant bedform across the sandy and gravelly sandy portions of the surveyed area, the predominant habitat types along the proposed cable routes. Often larger particles were oriented in the trough of the sand ripples. Smaller ripples and an absence of rippling were observed at some stations haphazardly dispersed along the proposed cable routes and in a few distinct locations: the deeper stations located in the submarine valley; the stations near the Narrows where the seafloor was “armored” with bivalves; and stations where boulders were present (Stations 010 and 050). Mean small-scale surface boundary roughness measured from SPI images followed a similar spatial pattern, with higher values coincident with larger scale ripples. In addition, thin surface layers of coarse sediment over fine sediment (e.g., pebbles over finer sediment, coarse sand over fine sand) were observed throughout the surveyed area and indicated coarse sediments that were subject to frequent hydrodynamic activity over finer base sediments. The size of any larger bedforms present in the area exceeded the field-of-view of the SPI and PV images and would need to be measured in multibeam and side-scan sonar data.

The dominant Biotic Subclass across the surveyed area was Soft Sediment Fauna. The dominance of Soft Sediment Fauna corresponded with the predominant Sediment and Habitat Types observed. Attached Fauna were present as the CMECS Biotic Subclass or Co-occurring

Biotic Subclass at 12 of the 157 stations sampled across the surveyed area. Mussels in dense Mussel Beds were the Attached fauna observed in the state waters along the NYHECR; stations with Mussel Beds accounted for more than half (7 of the 12 stations) of the observations of Attached Fauna documented. At the remaining stations, one station had trace coverage of barnacles (Station 133), and the other instances were sparse coverage of sponges, hydroids, and mussels at Stations 010, 046, and 068, respectively. Station 050 was an exception with dense cover of diverse attached fauna (corals, sponges, barnacles, hydroids). The reference stations reflected what was observed along the proposed cable routes, with Soft Sediment Fauna the predominant Biotic Subclass. There were no observations of Attached Fauna at any of the reference stations.

While dominant Biotic Subclass was somewhat homogeneous across the surveyed area, Biotic Group was much more heterogeneous. Sand dollar beds and both Small and Larger Tube-Building Fauna were the predominant Biotic Groups that were observed. Tubes at the sediment–water interface were often the result of polychaetae activity, but amphipod tubes were also observed. Many tubes were formed by the polychaetae *Diopatra cuprea*, a polychaete that regularly incorporates shell particles into its tube construction giving these tubes a distinct appearance. The variability in dominant Biotic and Co-Occurring Biotic Groups along the proposed cable routes highlights the benthic diversity of the seafloor in the surveyed area. Dominant Biotic groups at the reference areas was a bit more homogeneous. The dominant Biotic Group at Reference A and Reference C was exclusively Burrowing Anemones and Larger Tube-Building Fauna, respectively. The dominant Biotic Group at Reference B was more diverse with 3 different Biotic Groups represented (Diverse Soft Sediment Epifauna, Larger Tube-Building Fauna, Sand Dollar Bed). The reference areas were generally more homogeneous with the biotic groups observed in each area because the reference areas represented a relatively small area, whereas the proposed cable routes cover vast swaths of the NY Bight.

Sensitive taxa were only documented at one station, Station 050, where the Northern Star Coral *Astrangia* spp. was observed. *Astrangia* spp. is not a reef forming coral but enhances the value of hard substratum toward attracting other fauna when it occurs (Guida et al. 2017). This taxon is found in hard bottom habitats attached to cobbles and boulders; Station 050, where *Astrangia* spp. was observed, had a habitat of cobble and boulders. *Astrangia* spp. has a broad geographical distribution, and its low relief and non-reef building life history strategy provides a population level resiliency to disturbance. *Astrangia* spp. is also not documented to provide essential fish habitat (Dimond and Carrington 2007). Any impacts to the star coral from cable construction should be minimal, localized, and recovery should be rapid (Aronson et al. 2008). No sensitive taxa were documented at the reference stations.

Throughout the surveyed area, successional taxa were overwhelmingly designated as Stage 2, with only a few stations documented to contain some other successional designation. In many cases, the Stage 2 determination was based on the presence of *D. cuprea* tubes; specialized shell tubes. Due to the dynamic nature of these sandy environments and the very low organic loads found in medium and coarse sands, Stage 3 head-down deposit feeders would not be expected in these habitats. In instances where more advanced successional taxa were observed, the sediment grain-size was finer which can correlate with a higher organic content to support advanced successional taxa (Pearson and Rosenberg 1978). The aRPD was not determinable at many of the stations, often because it was not optically determinable. This is a common occurrence in mobile, well-washed sands with high porewater content. In coarser sandy sediments, the oxidation depth is based more on diffusion through sand grains and less on organic inputs and bioturbation of deposit-feeding infauna. The result is that the vast majority of stations also had low sediment oxygen demand, and there were no signs of bottom water hypoxia or methanogenesis.

The results and images from this survey will provide an accurate characterization and delineation of benthic habitats and establish a baseline of both large- and small-scale biological features along the proposed cable routes and at the reference areas. The results will also allow Equinor to broadly communicate the results of the survey using seafloor images of predevelopment conditions. Contributions from this survey will provide valuable information to address the BOEM guidelines and regulations, as well as stakeholder concerns.

Table 4-1. BOEM Guidelines, SPI Survey Approaches and Results

Guideline	SPI/PV Survey Approach and/or Parameter(s)	Results
Identify and confirm benthic flora and fauna	Epifauna, Infauna, Tracks, Burrows, Flora, CMECS Biotic Subclass and Group	No living flora observed
		Soft Sediment Fauna dominated with patchy presence of Attached Fauna
Establish a pre-construction baseline	Epifauna, Infauna, Tracks, Burrows, Flora, CMECS Biotic Subclass and Group	Sample density along the potential Equinor Wind Export Cable Routes establishes a baseline benthic characterization
Collect data to reduce uncertainty associated with baseline estimates and to inform interpretation of survey results	Epifauna, Infauna, Tracks, Burrows, Flora, CMECS Biotic Subclass and Group	Results from the SPI/PV survey may be integrated and analyzed with regional data to reduce uncertainty in existing datasets
Identify communities of sessile and slow-moving marine invertebrates	Epifauna, Infauna, CMECS Biotic Subclass and Group	Habitat Types
		Lists of observed species and CMECS Biotic Groups
Identify sensitive benthic habitats	Sensitive Taxa; CMECS Substrate Group; CMECS Biotic Subclass (dominant and co-occurring)	Sensitive taxa types recorded
		Attached Fauna presence/coverage
		Habitat Types
		*best to integrate with G&G data for full picture
Characterize seasonal and inter-annual variability of benthic community	Sampled in Summer during biologically active period (July)	Communities seen in proposed project (nearshore sands, shelf sands and cobble) not subject to substantial inter-annual variability
Identify areas to serve as baseline reference	Sampled 5 stations in three representative reference areas	Reference areas identified and baseline assessment at reference areas conducted
Characterize and delineate hard bottom gradients and rock outcroppings	Mapped presence of boulders, Sediment type assessment.	Habitat Types
		Spatial assessment of features completed
Characterize surficial sediments	Sediment Types mapped	Comprehensive assessment of surficial sediments completed as part of SPI/PV survey, including presence of boulders.

5.0 REFERENCES

Aronson, R., A. Bruckner, J. Moore, B. Precht, and E. Weil. 2008. *Astrangia poculata*. *The IUCN Red List of Threatened Species* 2008: e.T133446A3749524. http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T133446A3749524.en. Downloaded on 21 March 2019.

Bureau of Ocean Energy Management (BOEM) Office of Renewable Energy Programs. 2019. Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585. June 2019.

Bull, D.C. and R.B. Williamson. 2001. Prediction of principal metal-binding solid phases in estuarine sediments from color image analysis. Environ. Sci. Tech. 35: 1658-1662.

Byrnes, M.R., R.M. Hammer, S.W. Kelley, J.L. Baker, D.B. Snyder, T.D. Thibaut, S.A Zichichi, L.M. Lagera, S.T. Viada, B.A. Vittor, J.S. Ramsey, and J.D. Germano. 2004. Environmental Surveys of Potential Borrow Areas Offshore Northern New Jersey and Southern New York and the Environmental Implications of Sand Removal for Coastal and Beach Restoration. U.S. Department of the Interior, Minerals Management Service, Leasing Division, Marine Minerals Branch, Herndon, VA. OCS Report MMS 2004-044, Volume I: Main Text 264 pp. + Volume II: Appendices 194 pp.

Byrnes, M.R., R.M. Hammer, and T.D. Thibaut, 2004. Effects of sand mining on physical processes and biological communities offshore New Jersey. Journal of Coastal Research, 20(1): 25-43.

Federal Geographic Data Committee (FGDC). 2012. Coastal and Marine Ecological Classification Standard. FGDC-STD-018-2012. Marine and Coastal Spatial Data Subcommittee. June 2012. 343 pp. Reston, VA.

Fenchel, T. 1969. The ecology of marine macrobenthos IV. Structure and function of the benthic ecosystem, its chemical and physical factors and the microfauna communities with special reference to the ciliated protozoa. Ophelia 6: 1-182.

Fredette, T.J., W.F. Bohlen, D.C. Rhoads, and R.W. Morton. 1988. Erosion and resuspension effects of Hurricane Gloria at Long Island Sound dredged material disposal sites. In: Willey, R.G., editor. Water Quality ’88, Seminar Proceedings; 1988 Feb 20–23; Charleston, SC. Davis (CA): U.S. Army Corps of Engineers, Hydraulic Engineering Center. p. 323-334.

Germano, J.D. 1983. Infaunal succession in Long Island Sound: animal sediment interactions and the effects of predation [dissertation]. New Haven (CT): Yale University.

Germano, J.D. and D.C. Rhoads. 1984. REMOTS sediment profiling at the Field Verification Program (FVP) Disposal Site. In: Montgomery, R.L. and J.W. Leach, editors. Dredging and dredged material disposal proceedings, Vol. 1. New York (NY): American Society of Civil Engineers. p. 536-544.

Germano, J.D., D.C. Rhoads, R.M. Valente, D. Carey, and M. Solan. 2011. The use of Sediment Profile Imaging (SPI) for environmental impact assessments and monitoring studies: lessons learned from the past four decades. Oceanogr. Mar. Biol. 49: 247-310.

Guida, V., A. Drohan, H. Welch, J. McHenry, D. Johnson, V. Kentner, J. Brink, D. Timmons, E. Estela-Gomez. 2017. Habitat Mapping and Assessment of Northeast Wind Energy Areas. Sterling, VA: US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-088. 312 p.

Horn, H.S. 1974. The ecology of secondary succession. Annu. Rev. Ecol. Systemat. 5: 25-37.

Huettel, M., W. Ziebis, and S. Forster. 1996. Flow-induced uptake of particulate matter in permeable sediments. Limnol. Oceanogr. 41: 309-322.

Huettel, M., W. Ziebis, S. Forster, and G.W. Luther III. 1998. Advective transport affecting metal and nutrient distributions and interfacial fluxes in permeable sediments. Geochim. Cosmochim. Acta 62: 613-631.

INSPIRE Environmental. 2019a. Project Execution Plan (PEP) for the Empire Wind Export Cable Route Benthic Survey, NY/NJ USA. Prepared by INSPIRE Environmental, June 2019.

INSPIRE Environmental. 2019b. Standard operating procedure for sediment profile and plan view imaging sample collection and image analysis. Prepared by INSPIRE Environmental, March 2019.

INSPIRE Environmental. 2019c. Standard operating procedure for sediment grab sampling. Prepared by INSPIRE Environmental, Newport, RI. May 2019.

Jorgensen, B.B. and T. Fenchel. 1974. The sulfur cycles of a marine sediment model system. Mar. Biol. 24: 189-201.

Karakassis, I., M. Tsapakis, C.J. Smith, and H. Rumohr. 2002. Fish farming impacts in the Mediterranean studied through sediment profiling imagery. Mar. Ecol. Progr. 227: 125-133.

Lyle, M. 1983. The brown-green colour transition in marine sediments: a marker of the Fe (III) – Fe (II) redox boundary. Limnol. Oceanogr. 28: 1026-1033.

Nilsson, H.C. and R. Rosenberg. 1997. Benthic habitat quality assessment of an oxygen stressed fjord by surface and sediment profile images. J. Mar. Syst. 11: 249-264.

Pearson, T.H. and R. Rosenberg. 1978. Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. Oceanogr. Mar. Biol. 16: 229-311.

Poti, Matthew, Brian Kinlan, and Charles Menza. 2012. “Chapter 3: Surficial Sediments.” In *A Biogeographic Assessment of Seabirds, Deep Sea Corals and Ocean Habitats of the New York Bight: Science to Support Offshore Spatial Planning NOAA Technical Memorandum NOS NCCOS 141*, edited by Charles Menza, Brian P. Kinlan, Dan S. Dorfman, Matthew Poti and Chris Caldow, 33–56. Silver Spring, MD.

Rhoads, D.C. 1974. Organism-sediment relations on the muddy seafloor. Oceanogr. Mar. Biol. 12: 263-300.

Rhoads, D.C. and L.F. Boyer. 1982. The effects of marine benthos on physical properties of sediments. In: McCall, P.L. and M.J.S. Tevesz, editors. Animal-sediment relations. New York (NY): Plenum Press. p. 3-52.

Rhoads, D.C. and J.D. Germano. 1982. Characterization of organism-sediment relations using sediment profile imaging: an efficient method of remote ecological monitoring of the seafloor (REMOTS System). Mar. Ecol. Progr. 8: 115-128.

Rhoads, D.C. and J.D. Germano. 1986. Interpreting long-term changes in benthic community structure: a new protocol. Hydrobiologia. 142:291-308.

Rona, P. V. Guida, M.Scranton, D. Gong, L. Macelloni, M. Pierdomenico, A-R. Diercks, V. Asper, S. Haag. 2015. Hudson submarine canyon head offshore New York and New Jersey: A physical and geochemical investigation. Deep-Sea Research Part II, Volume 121, p. 213-232.

Rosenberg, R. and R.J. Diaz. 1993. Sulfur bacteria (*Beggiatoa* spp.) mats indicate hypoxic conditions in the inner Stockholm Archipelago. Ambio 22: 32-36.

Rosenberg, R., H.C. Nilsson, and R.J. Diaz. 2001. Response of benthic fauna and changing sediment redox profiles over a hypoxic gradient. Estuar. Coast. Shelf Sci. 53: 343-350.

Schwab, W.C., Denny, J.F., Butman, B., Danforth, W.W., Foster, D.S., Swift, B.A., Lotto, L.L., Allison, M.A., and Thieler, E.R.. 2000. Seafloor Characterization Offshore of the NewYork-New Jersey Metropolitan Area using Sidescan-Sonar: U.S. Geological Survey Open-File Report 00-295Shumchenia, E. and J. King. 2010. Evaluation of sediment profile imagery as a tool for assessing water quality in Greenwich Bay, Rhode Island, USA. Ecol. Indic. 10: 818-825.

Simone, M. and J. Grant. 2017. Visual assessment of redoxcline compared to electron potential in coastal marine sediments. Estuar. Coast. Shelf Sci. 188: 156-162.

Sturdivant, S.K., R.J. Díaz., and G.R. Cutter. 2012. Bioturbation in a declining oxygen environment, in situ observations from Wormcam. PLoS ONE 7(4): e34539.

Sturdivant, S.K. and M.S. Shimizu. 2017. In situ organism-sediment interactions: bioturbation and biogeochemistry in a highly depositional estuary. PLoS ONE 12(11): e0187800.

USGS. 2018. usSEABED: Coastal and Marine Geology Program. https://walrus.wr.usgs.gov/usseabed/ Accessed: 11/15/2018

Williams, S.J. and D.B. Duane, 1974. Geomorphology and Sediments of the Inner New York Bight Continental Shelf. U.S. Army Engineer Coastal Engineering Research Center, Technical Memorandum No. 76-2, Fort Belvoir, VA.

Ziebis, W., M. Huettel, and S. Forster. 1996. Impact of biogenic sediment topography on oxygen fluxes in permeable seabeds. Mar. Ecol. Progr. 1409: 227-237.

Benthic Assessment Survey of Proposed Export Cable Routes in Support of the Equinor Wind OCS-A-0512 Offshore Wind Farm Project

DATA REPORT

Survey Conducted 08-15 July 2019

FIGURES

Prepared for:

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18 November 2019

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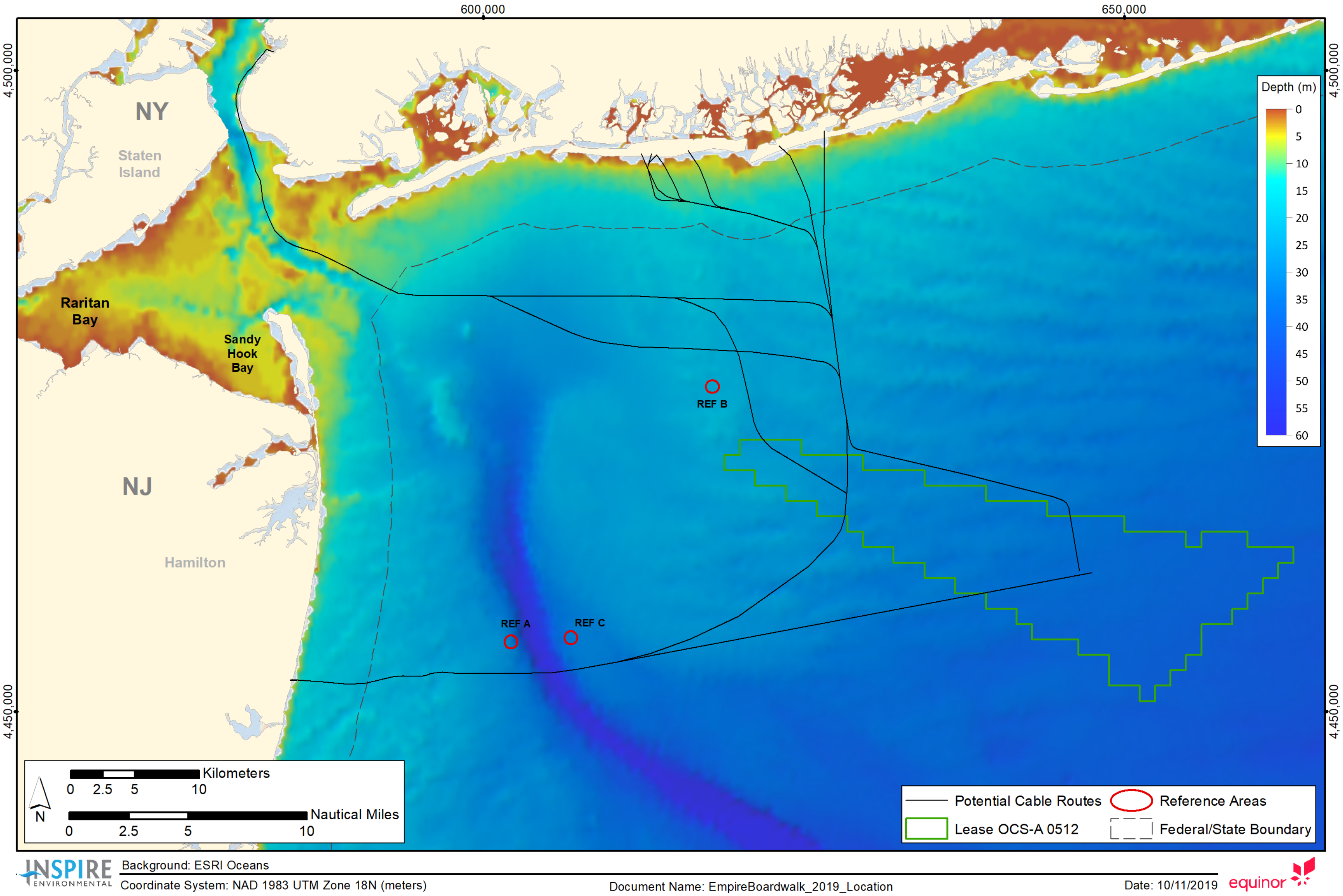


Figure 1-1. Location of the Equinor Wind export cable survey area including the lease area and proposed cable routes

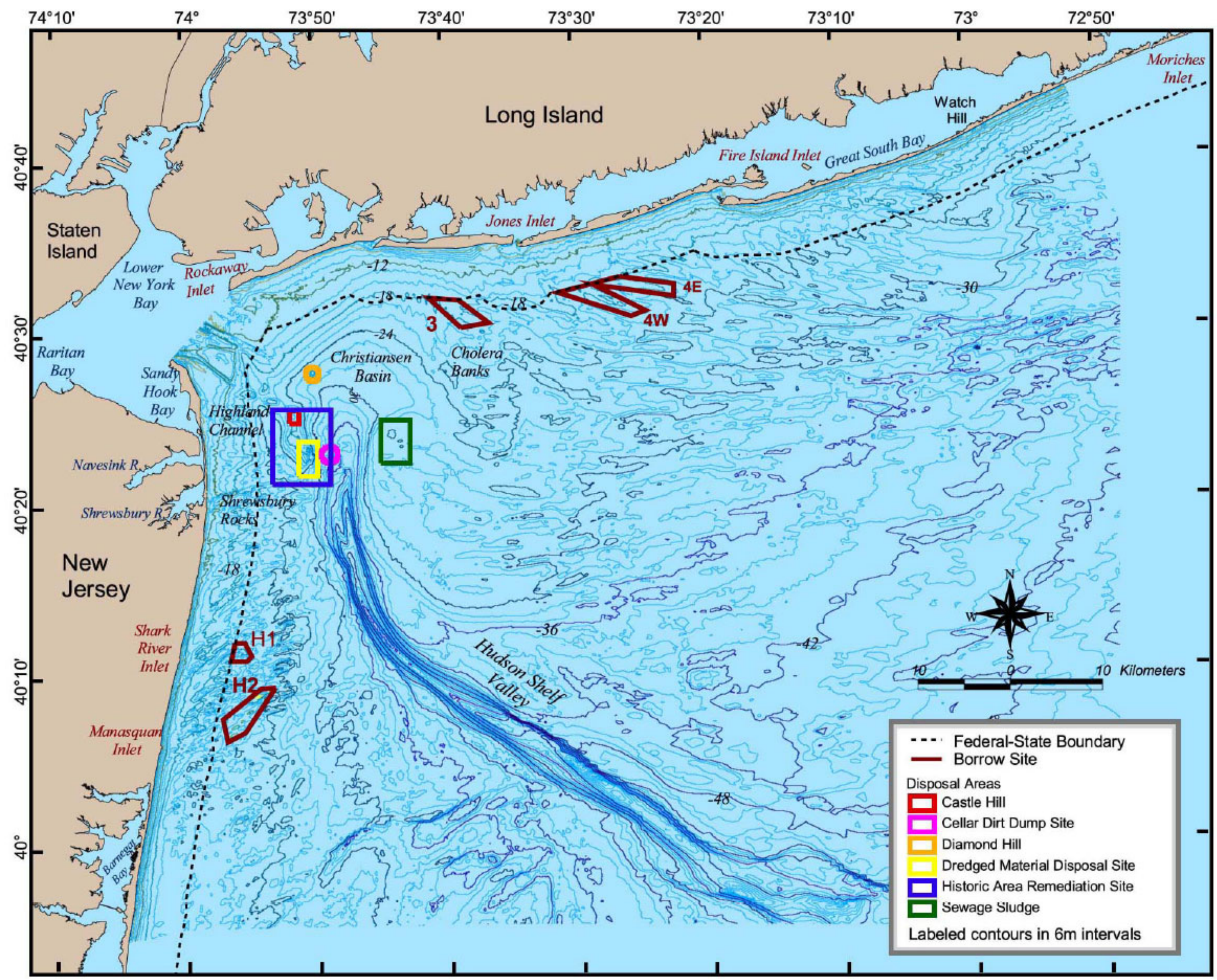


Figure 1-2. Prominent geomorphic features of the New York Bight continental shelf (adapted from Byrnes et al. 2004)

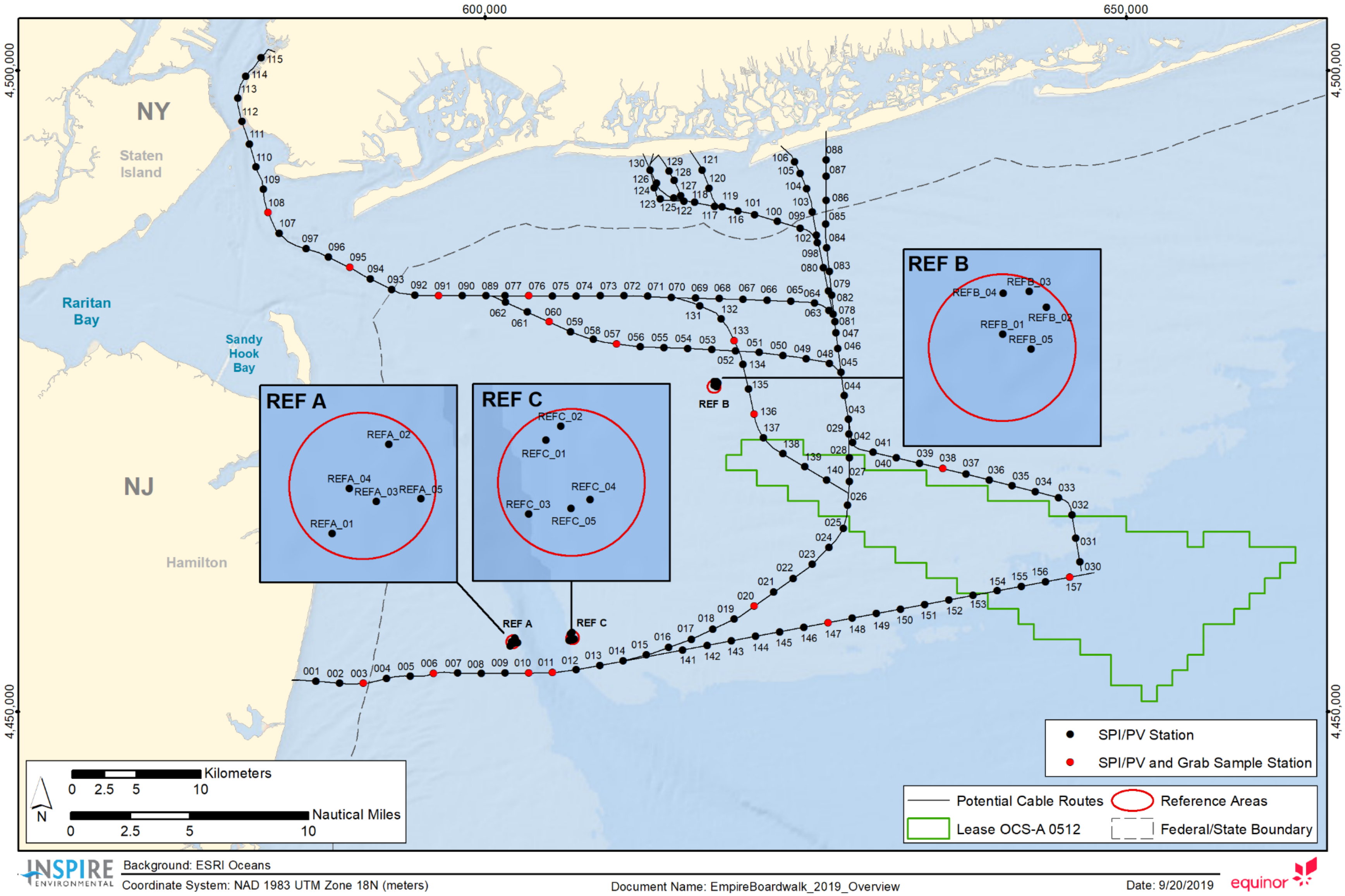


Figure 2-1. Station locations sampled for SPI, PV, and grabs along the proposed export cable routes at the Equinor Wind Offshore Wind Farm Project

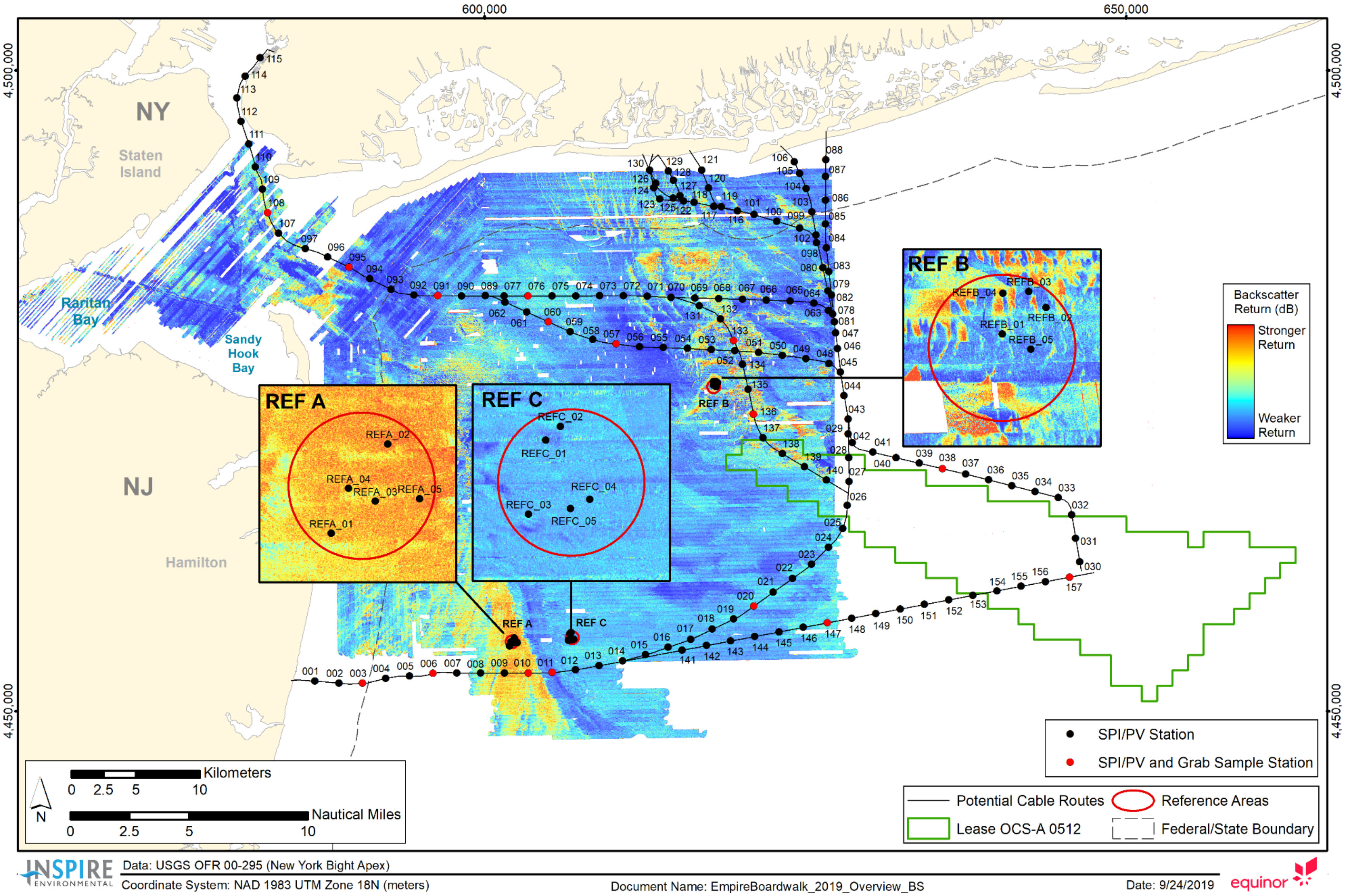


Figure 2-2. ***Station locations sampled for SPI, PV, and grabs over USGS Backscatter data along the proposed export cable routes at the Equinor Wind Offshore Wind Farm Project***

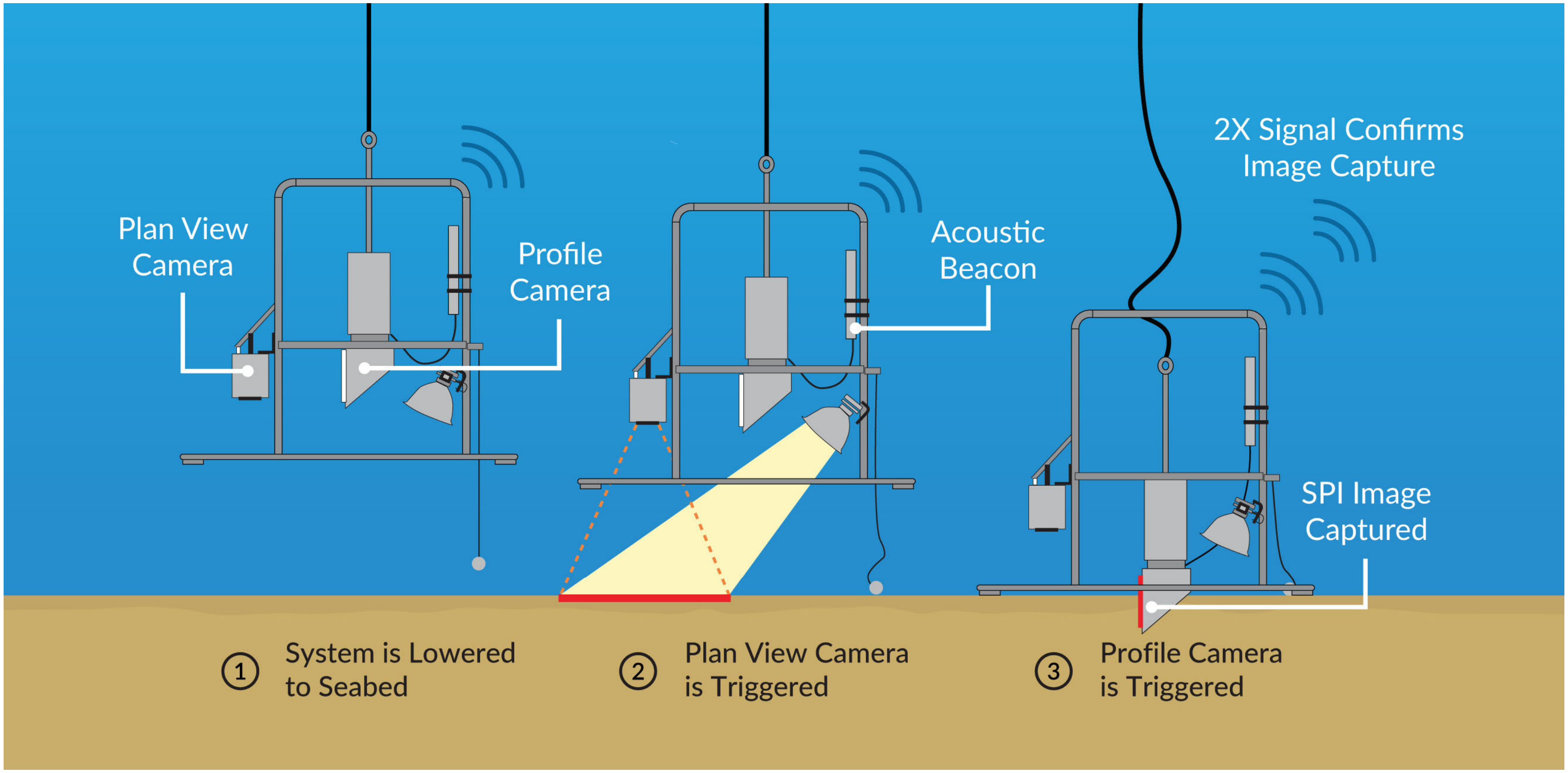


Figure 2-3. Schematic diagram of the operation of the sediment profile and plan view camera imaging system

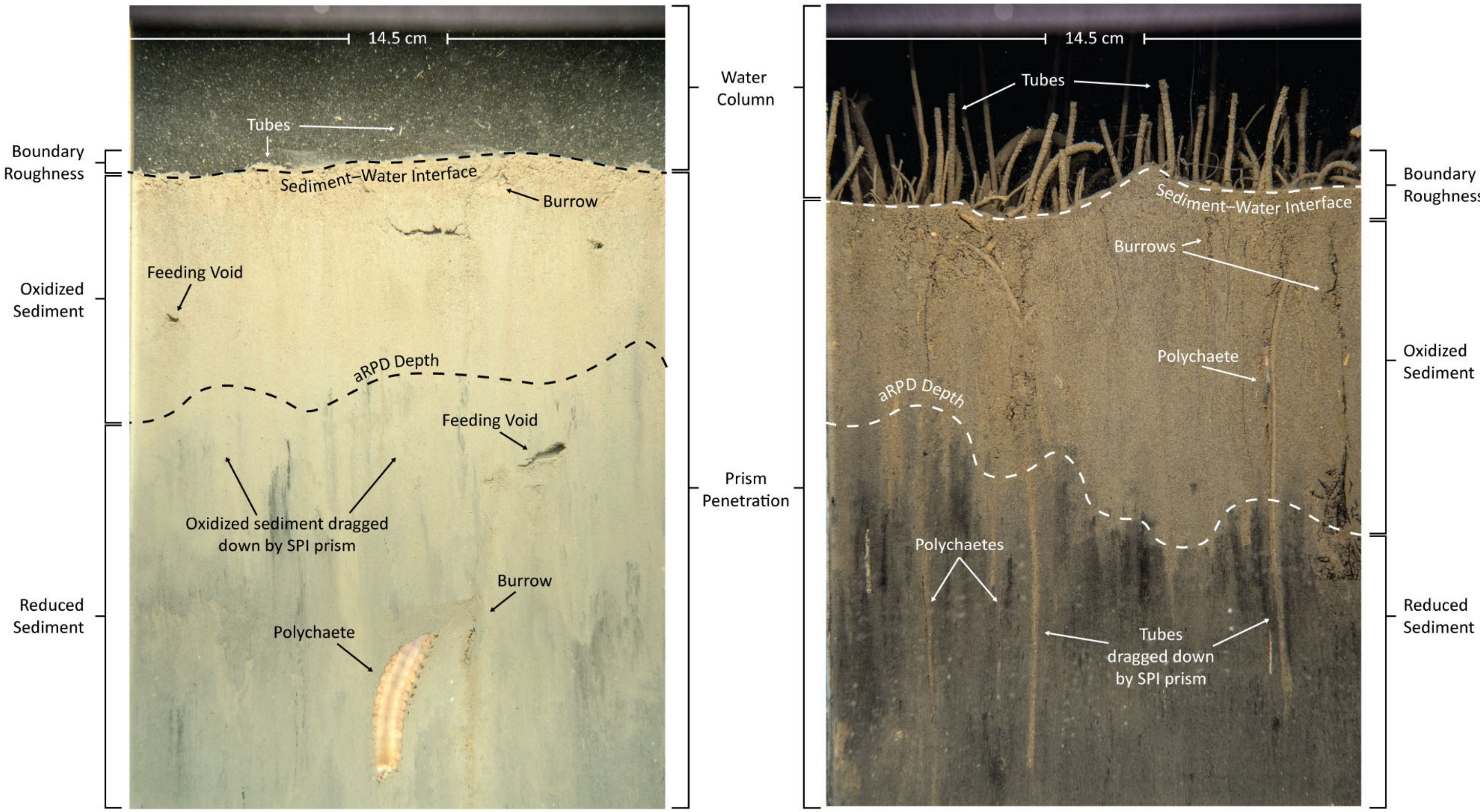


Figure 2-4. SPI images from soft bottom coastal and estuarine environments annotated with many standard variables derived from SPI images. The water column, depth of prism penetration, boundary roughness of the sediment–water interface, and zones of oxidized and reduced sediment are denoted with brackets. The apparent redox potential discontinuity (aRPD), the boundary between oxidized and reduced sediments, is marked with a dashed line. Infauna and related structures (tubes, burrows, feeding voids) are noted with arrows.

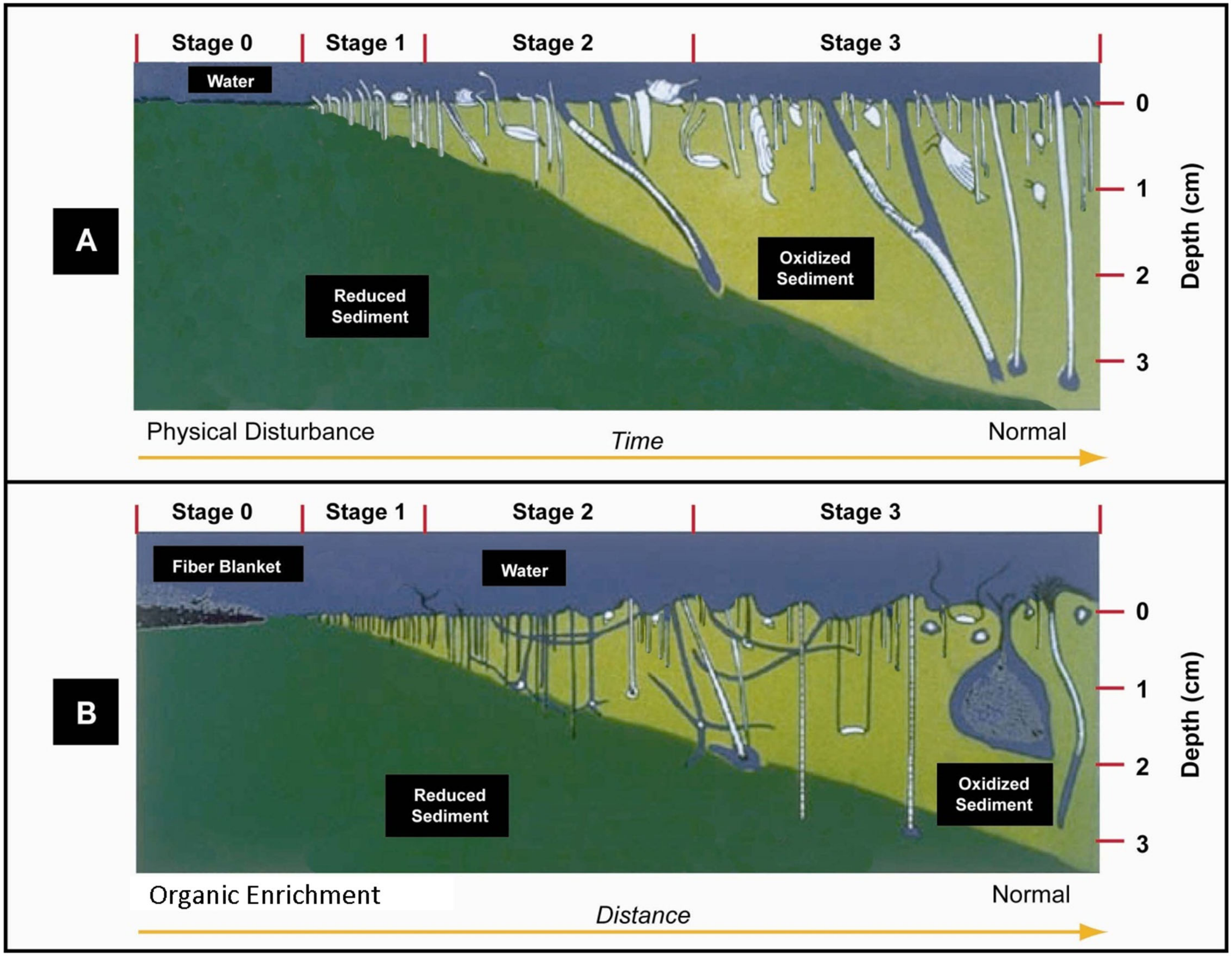


Figure 2-5. ***The stages of infaunal succession as a response of soft-bottom benthic communities to (A) physical disturbance or (B) organic enrichment; from Rhoads and Germano (1982)***

Figure 2-6. ***This representative plan view image shows the sampling relationship between plan view and sediment profile images. Note: plan view images differ between surveys and stations and the area covered by each plan view image may vary slightly between images and stations.***

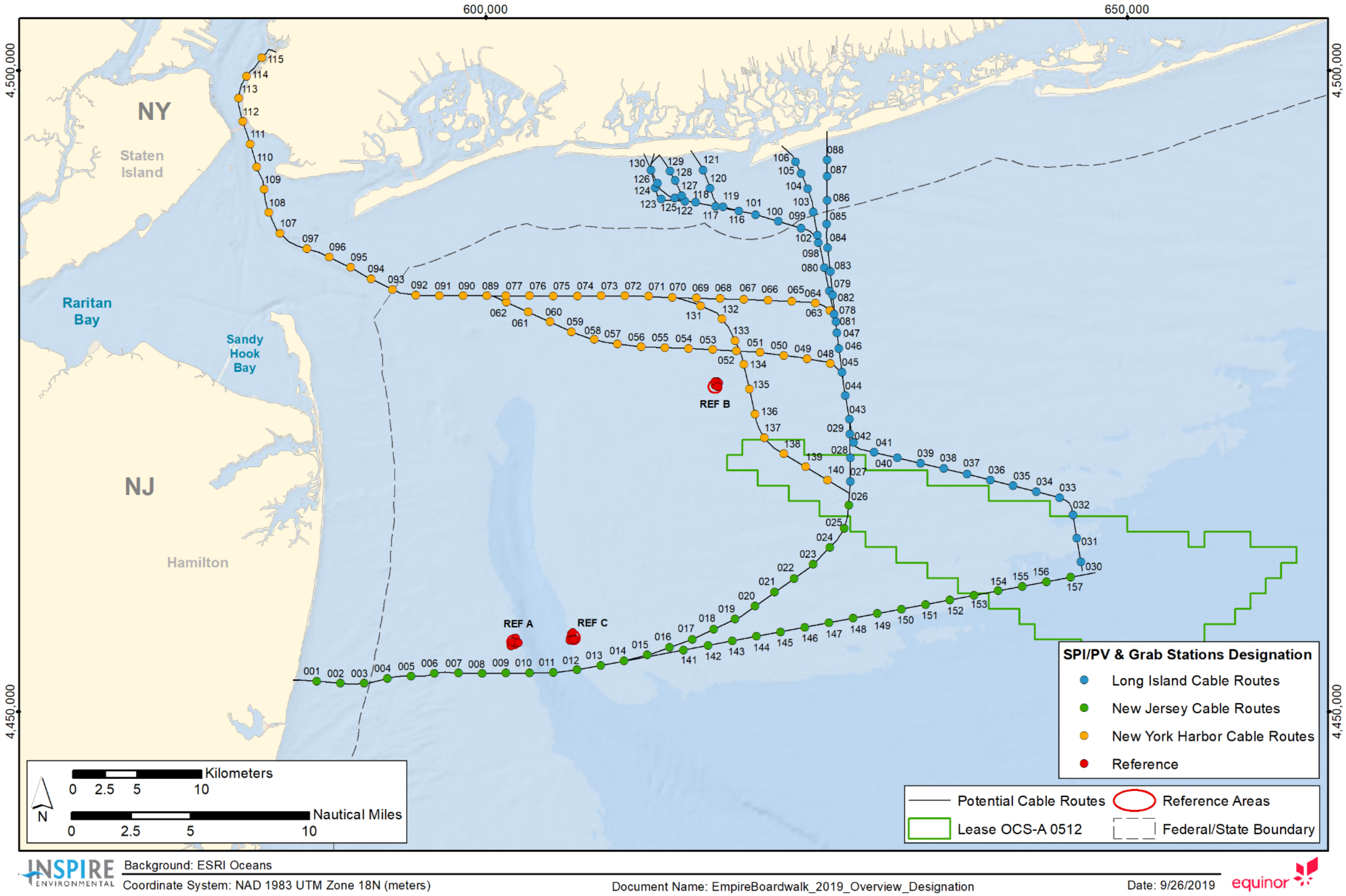


Figure 3-1. Delineation of survey area by cable route

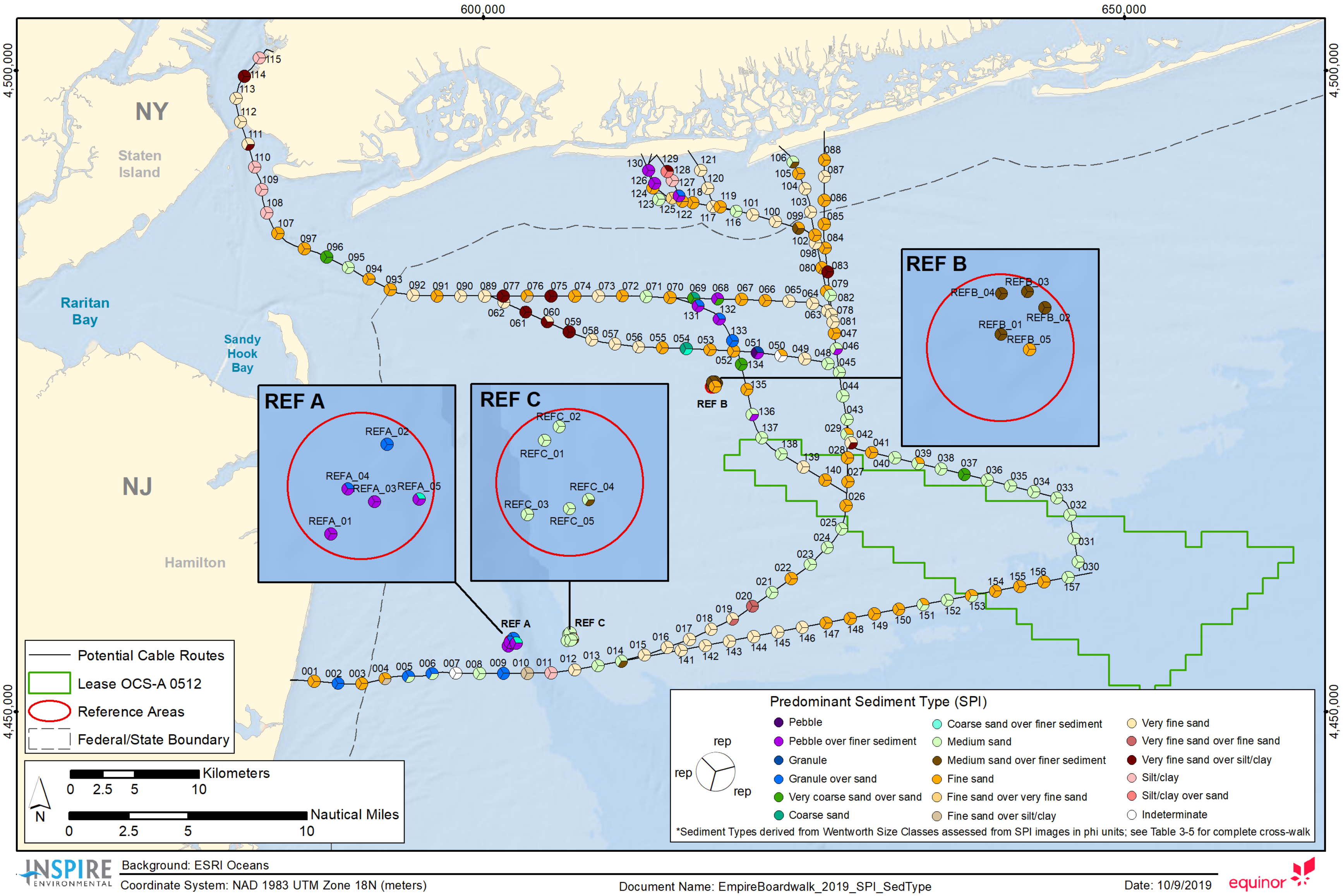


Figure 3-2. Predominant sediment types aggregated from grain size major mode (phi units) derived from SPI images across the surveyed area

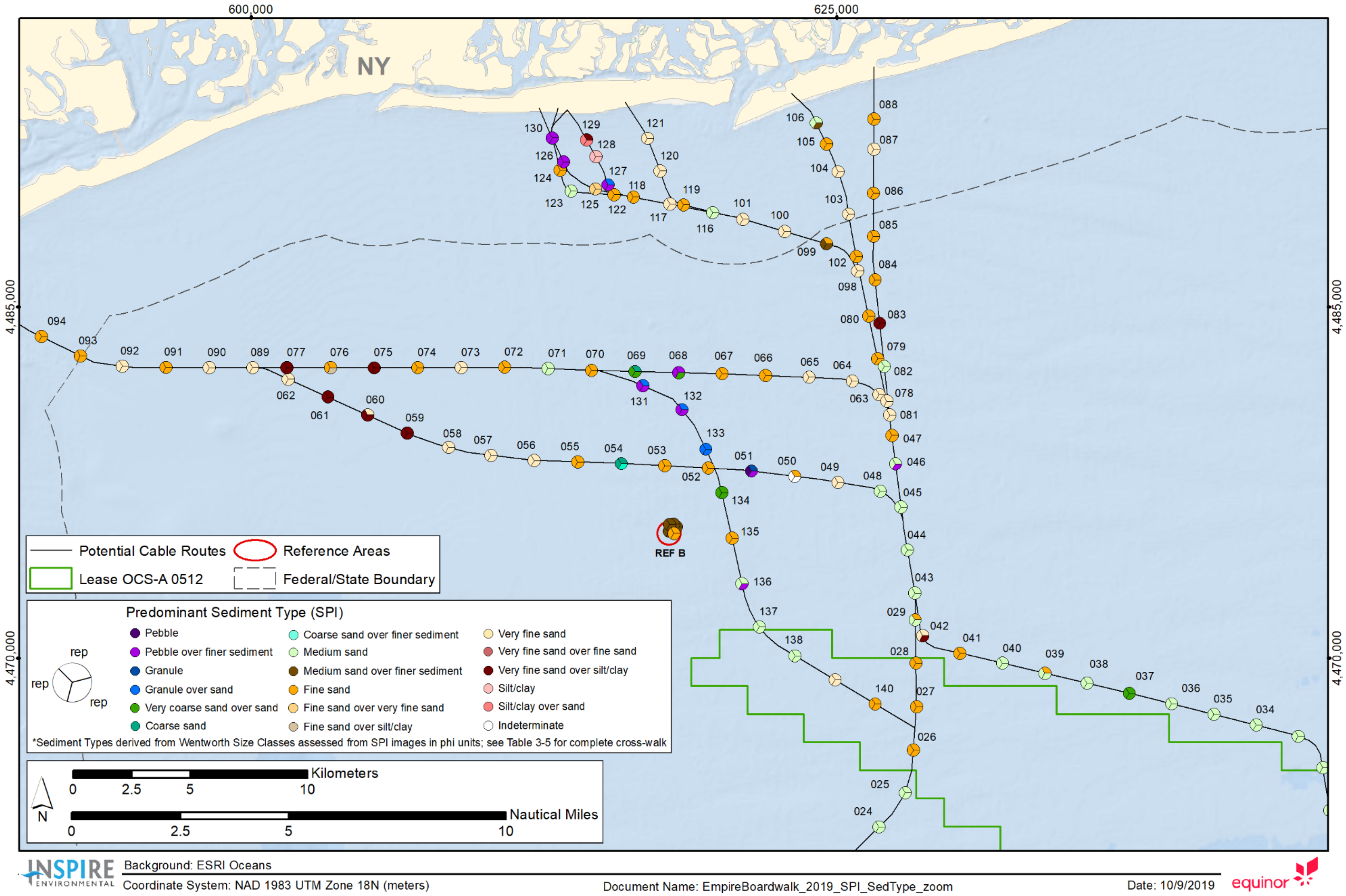


Figure 3-3. ***Zoom-in of the Long Island export cable route. Predominant sediment types aggregated from grain size major mode (phi units) derived from SPI images across the surveyed area.***

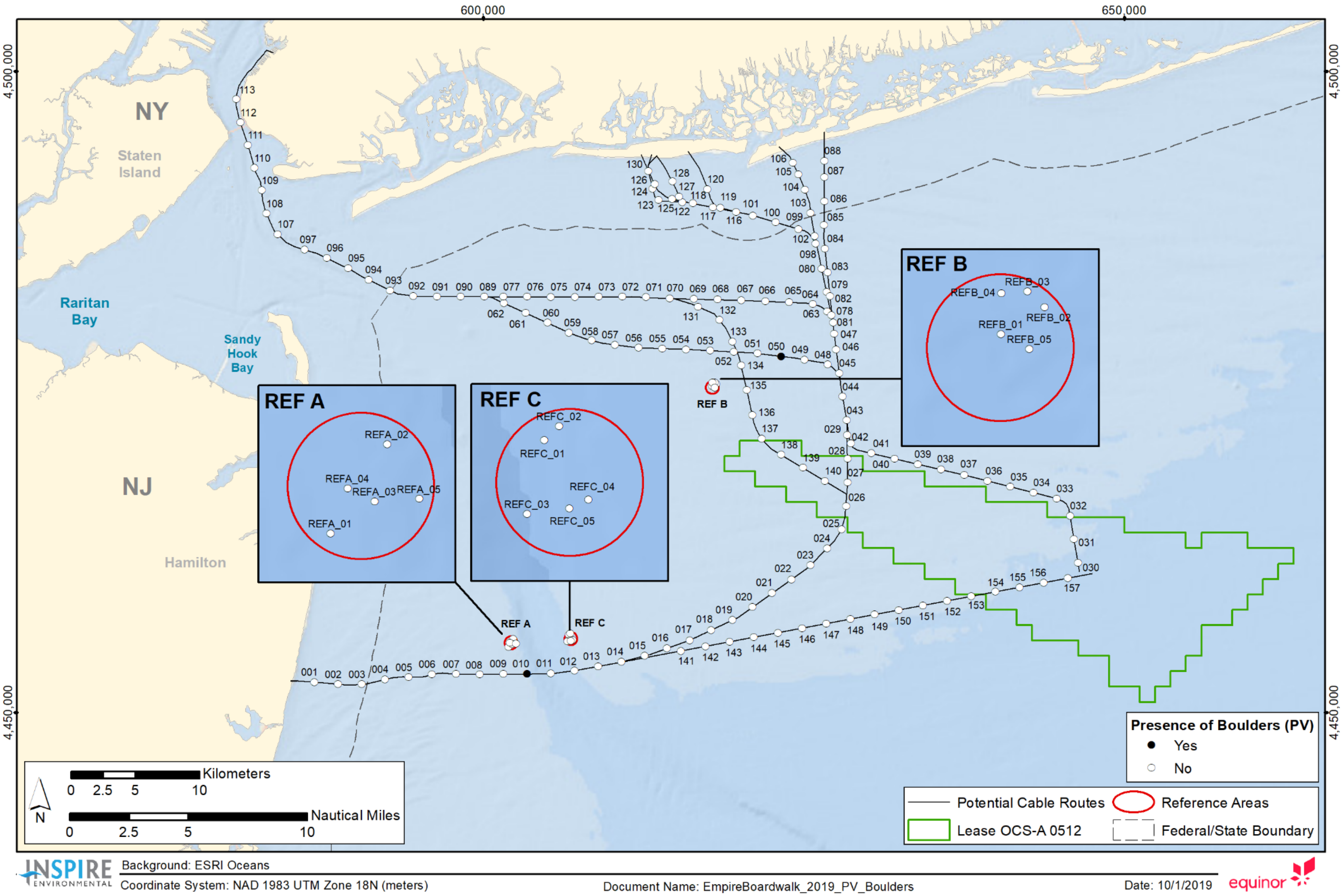


Figure 3-4. Presence/absence of boulders across the surveyed area

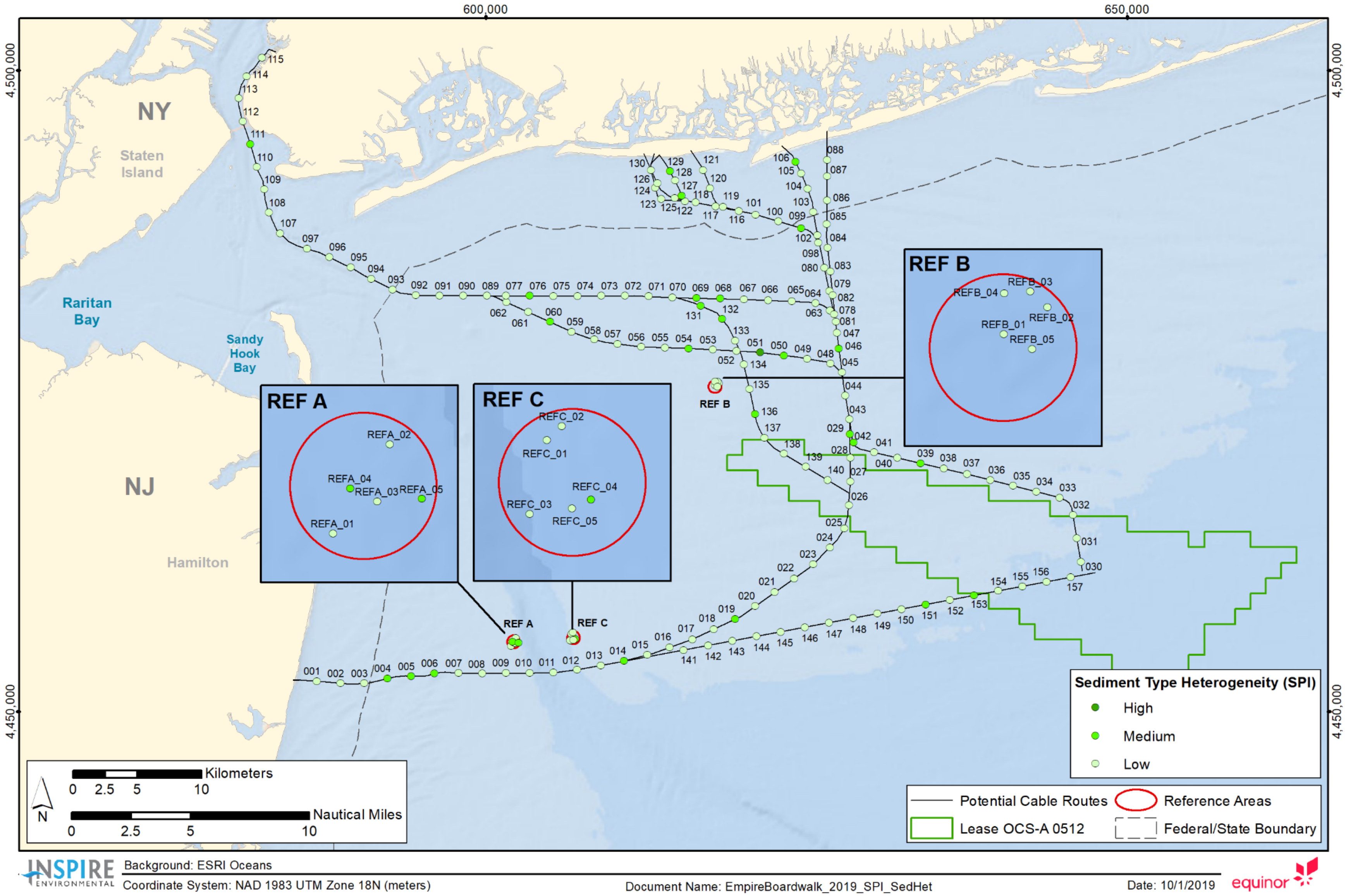


Figure 3-5. Intra-station sediment type heterogeneity determined from SPI images across the surveyed area

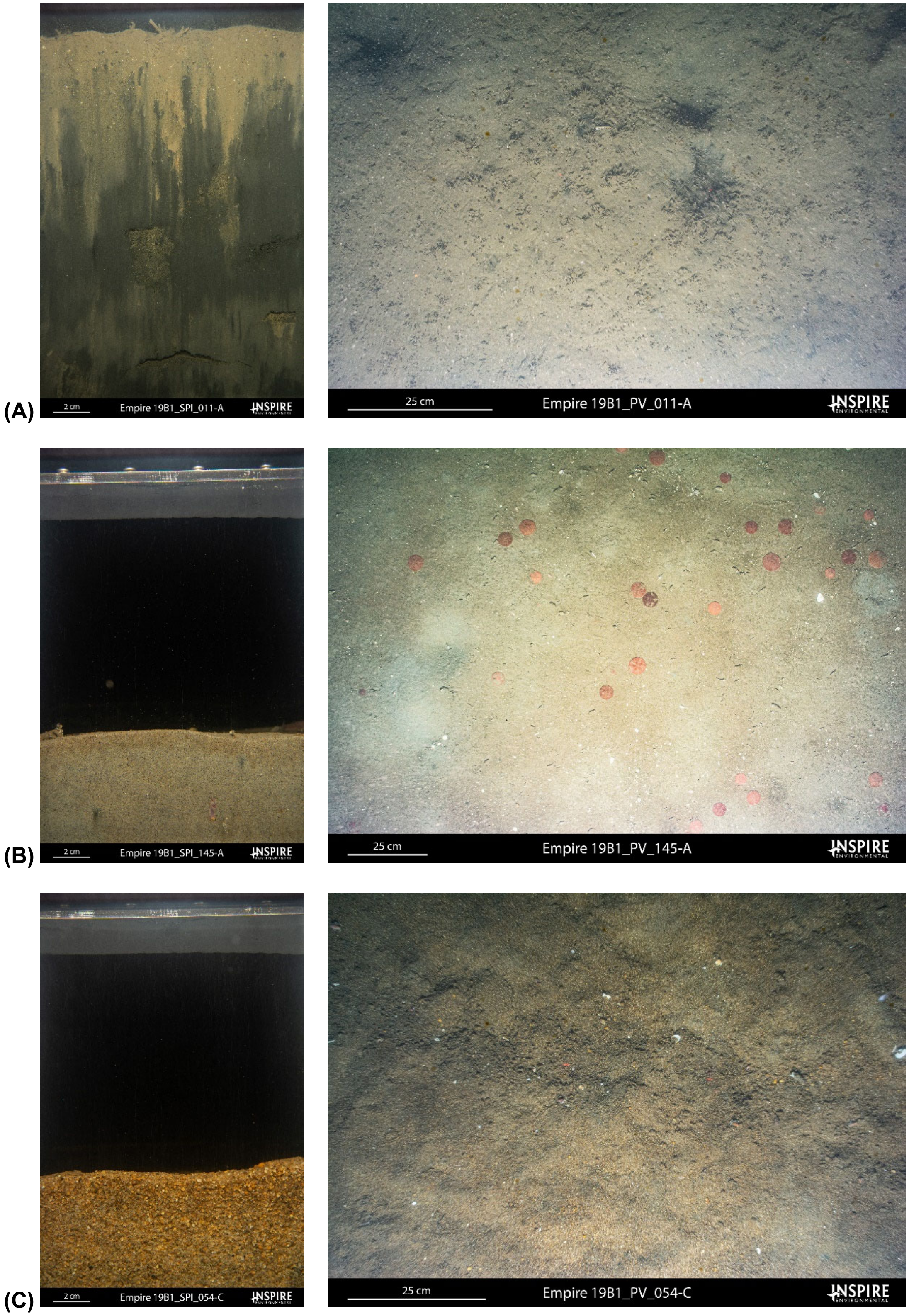
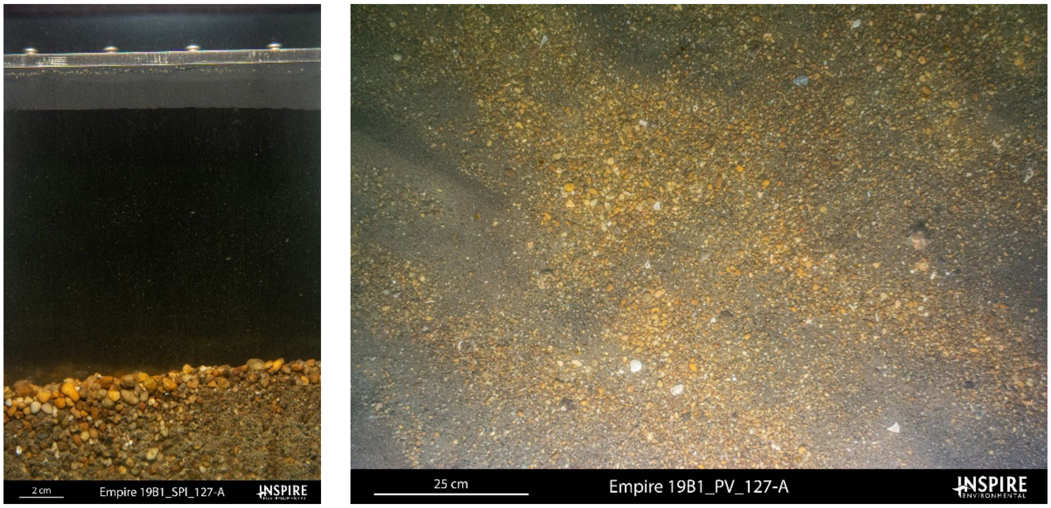
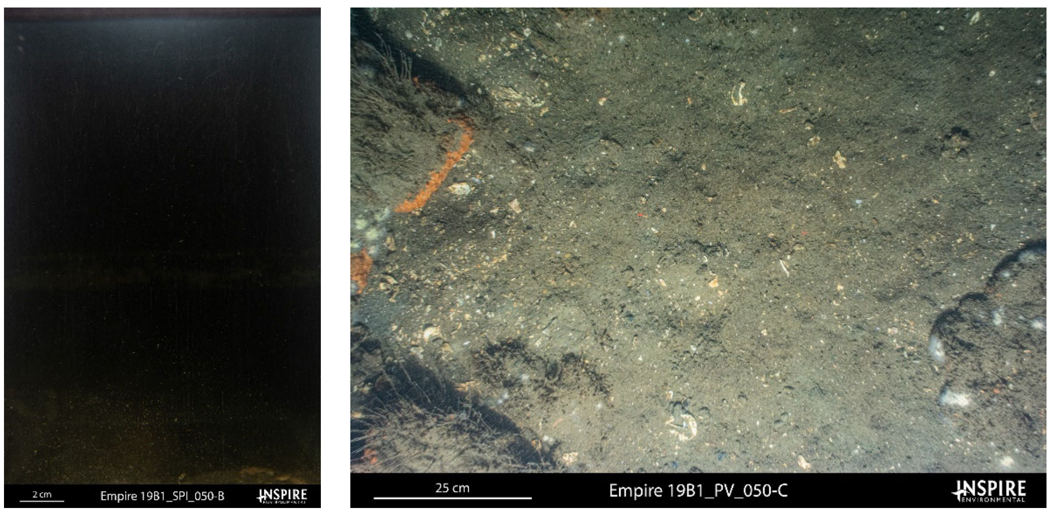


Figure 3-6. Representative SPI and PV images depicting the range of sediment types across the surveyed area; (A) silt-clay; (B) very fine sand; (C) medium to coarse sand; (D) small gravel (granule and pebble); and (E) large gravel (cobbles and small boulders)

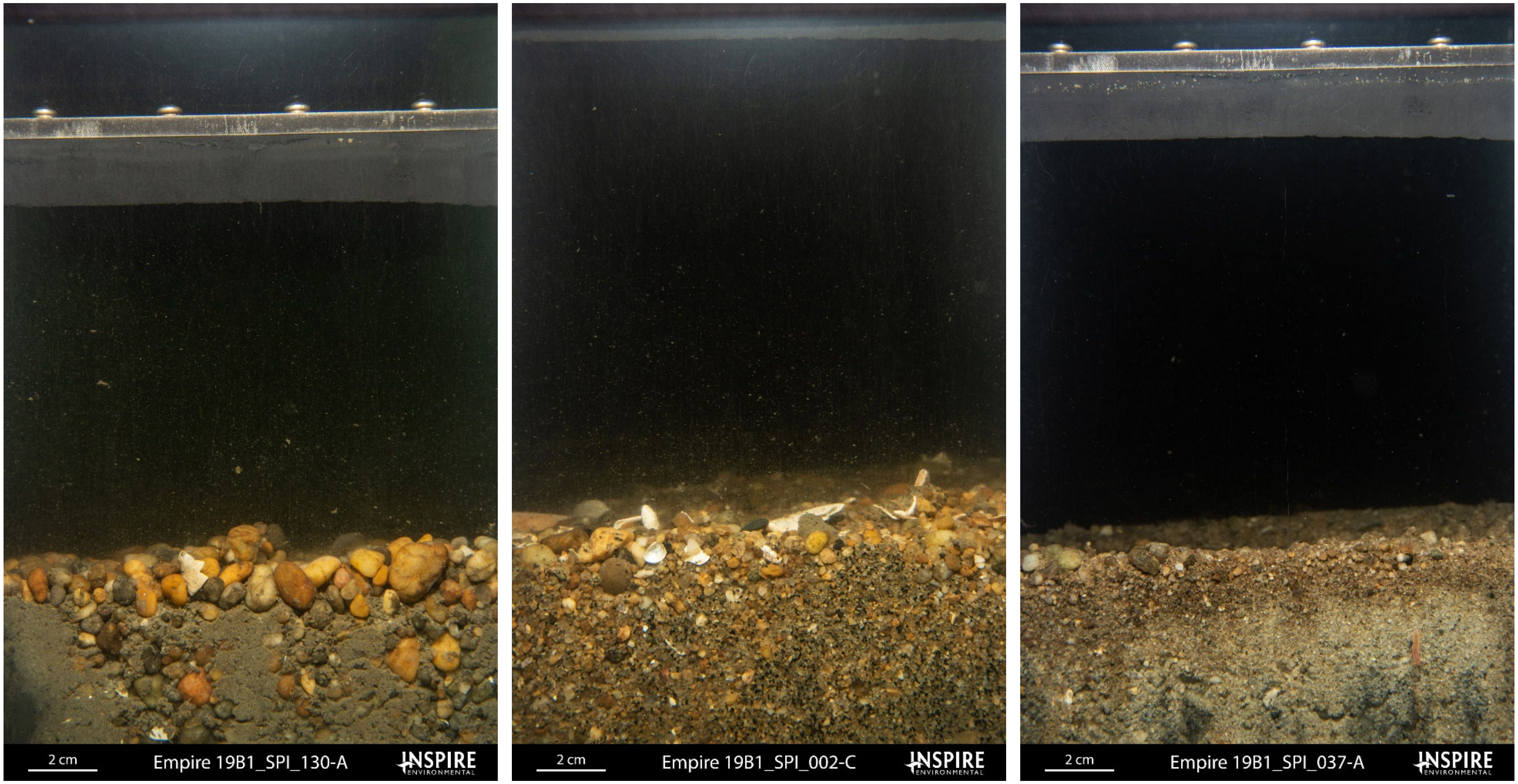


(D)



(E)

Figure 3-6. continued ***Representative SPI and PV images depicting the range of sediment types across the surveyed area; (A) silt-clay; (B) very fine sand; (C) medium to coarse sand; (D) small gravel (granule and pebble); and (E) large gravel (cobbles and small boulders)***



(A) (B) (C)

Figure 3-7. Representative SPI images showing layering of coarse material over sand; (A) pebble over sand; (B) granule over sand; and (C) very coarse sand over sand

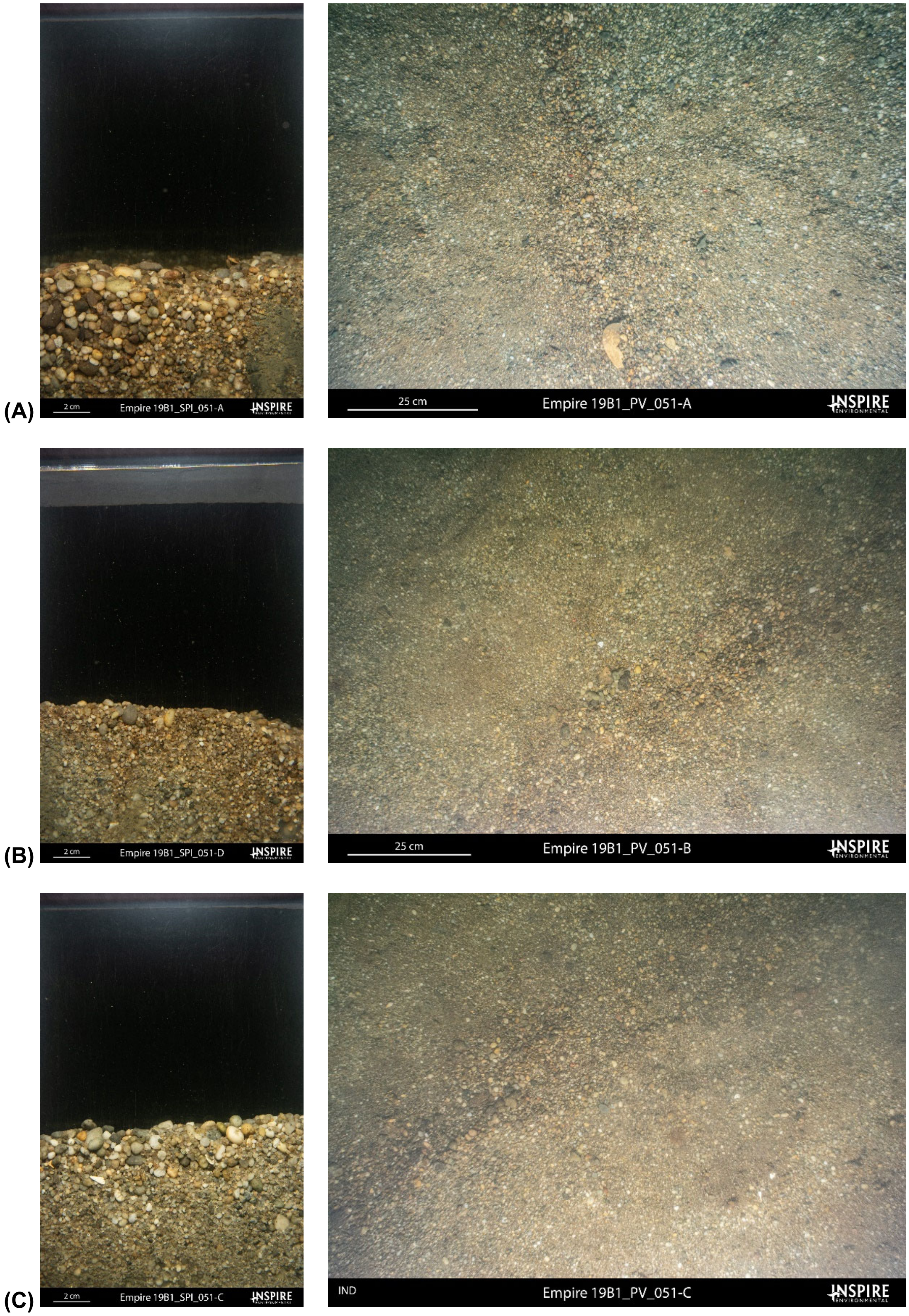


Figure 3-8. Representative SPI and PV images showing intra-station heterogeneity in sediment type at Station 051 with the following predominant sediment types characterized: (A) granule; (B) pebble; and (C) pebble over finer sediment. Small, long-period, low relief asymmetric bedforms were present amongst the gravel.

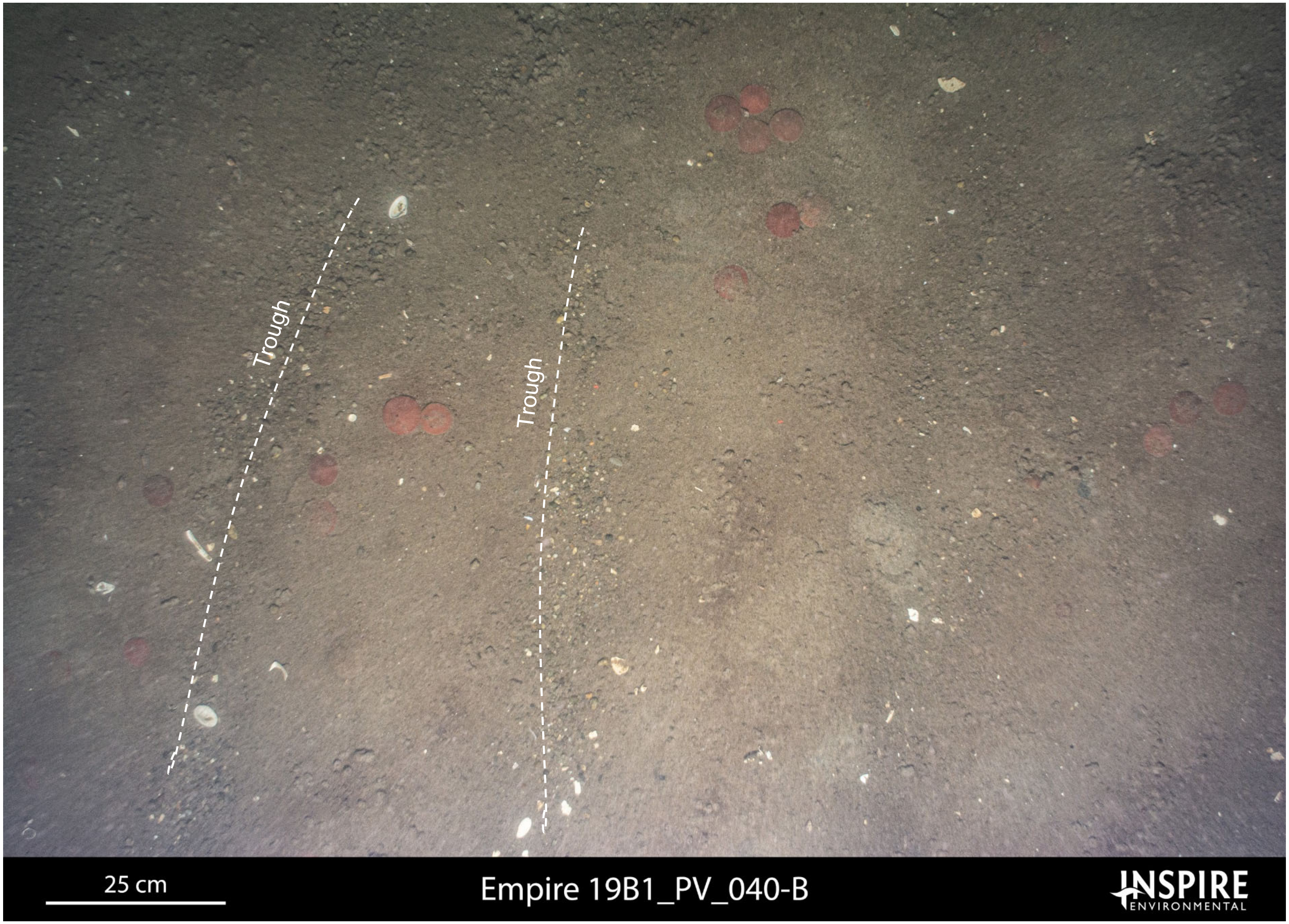


Figure 3-9. ***Plan view image depicting a small long-period asymmetric bedform with a semi-distinct sand ridge with granules and pebbles in the trough***

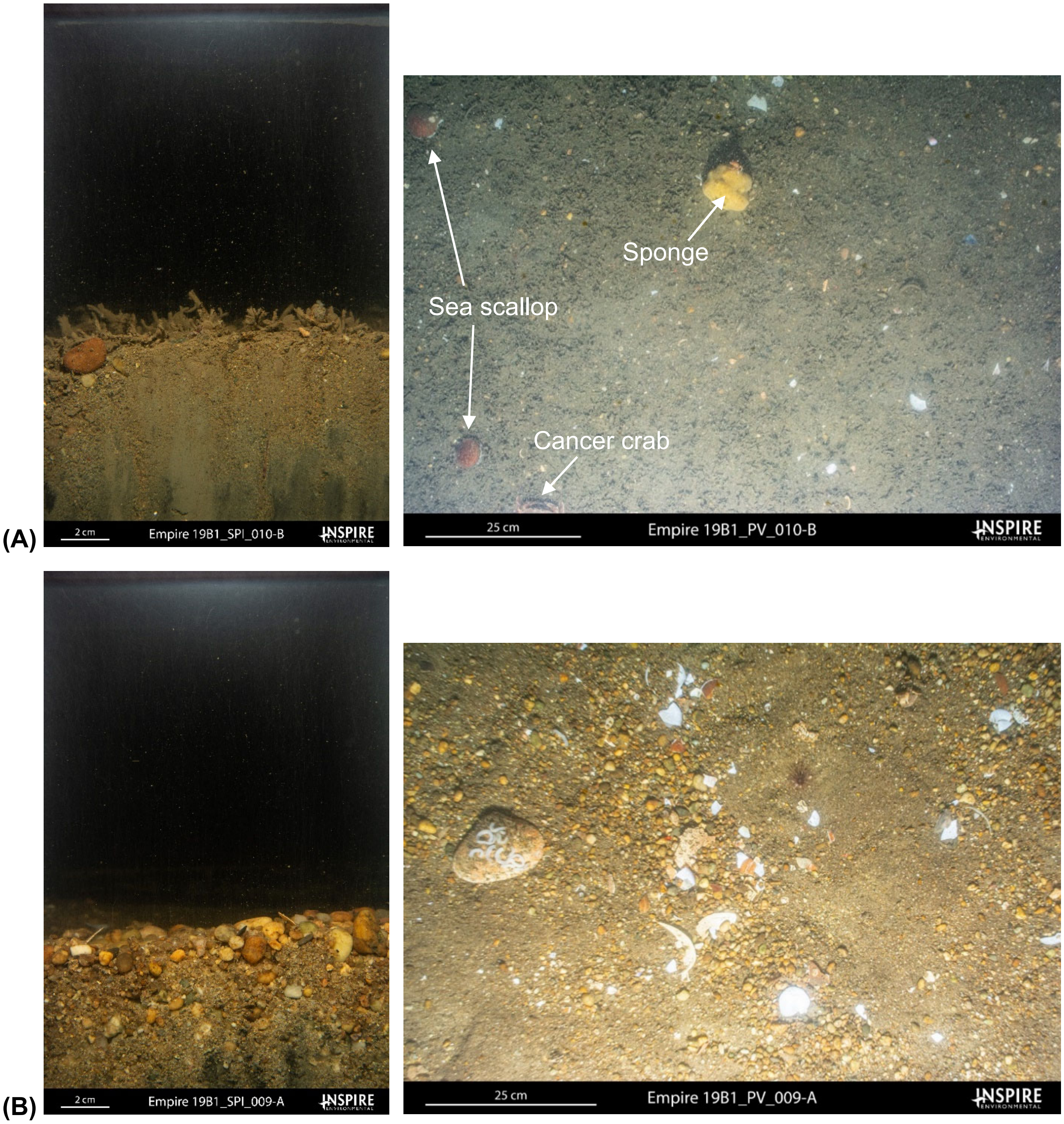


Figure 3-10. Profile and plan view images contrasting sediment type at two adjacent stations: (A) Station 010 located in a submarine channel (at the edge of the channel) was composed of very fine sand over silt-clay with sparse coverage of sponges present as Attached Fauna and sea scallops and a Cancer crab present; and (B) Station 009 located just outside of the channel composed of granule over sand

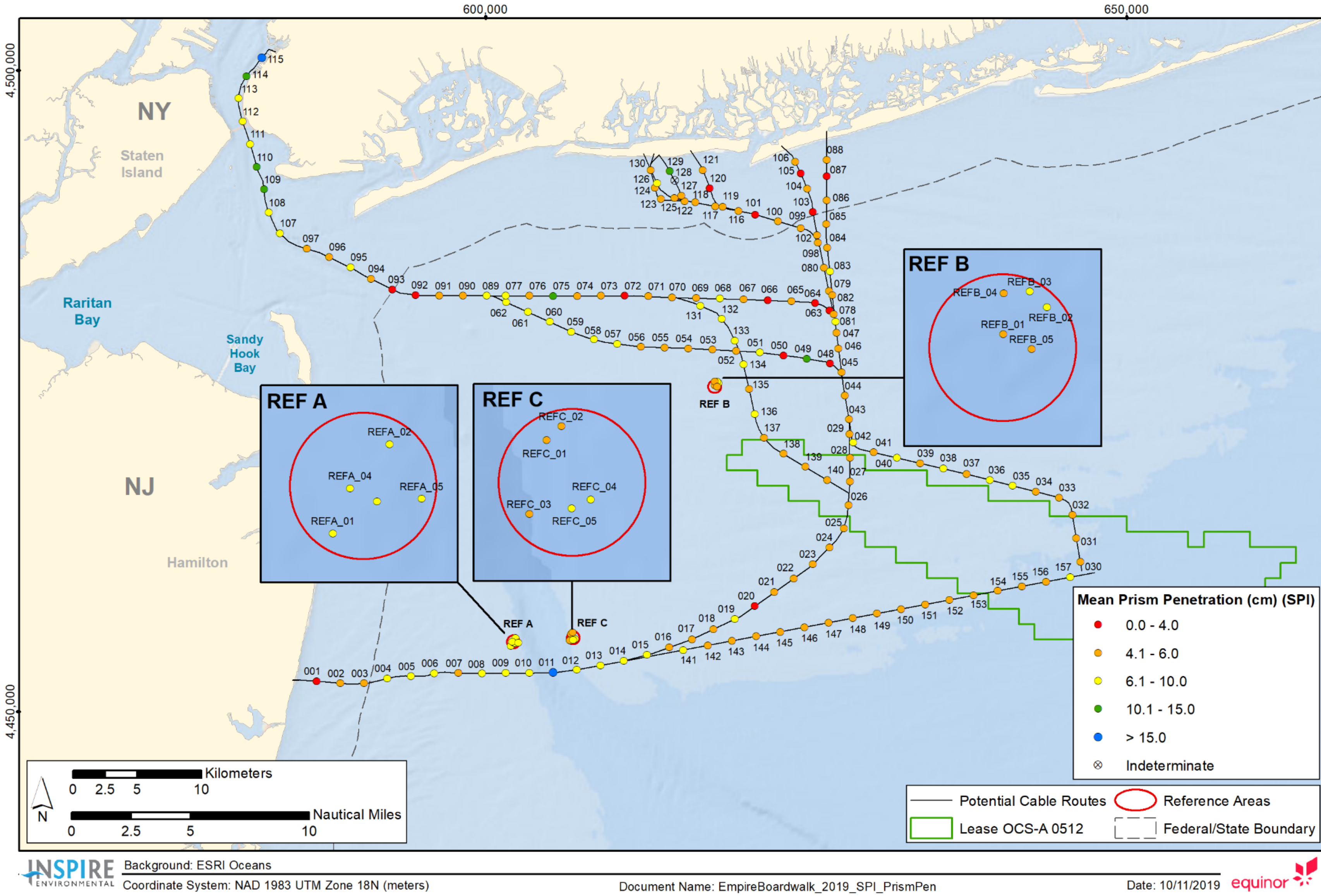
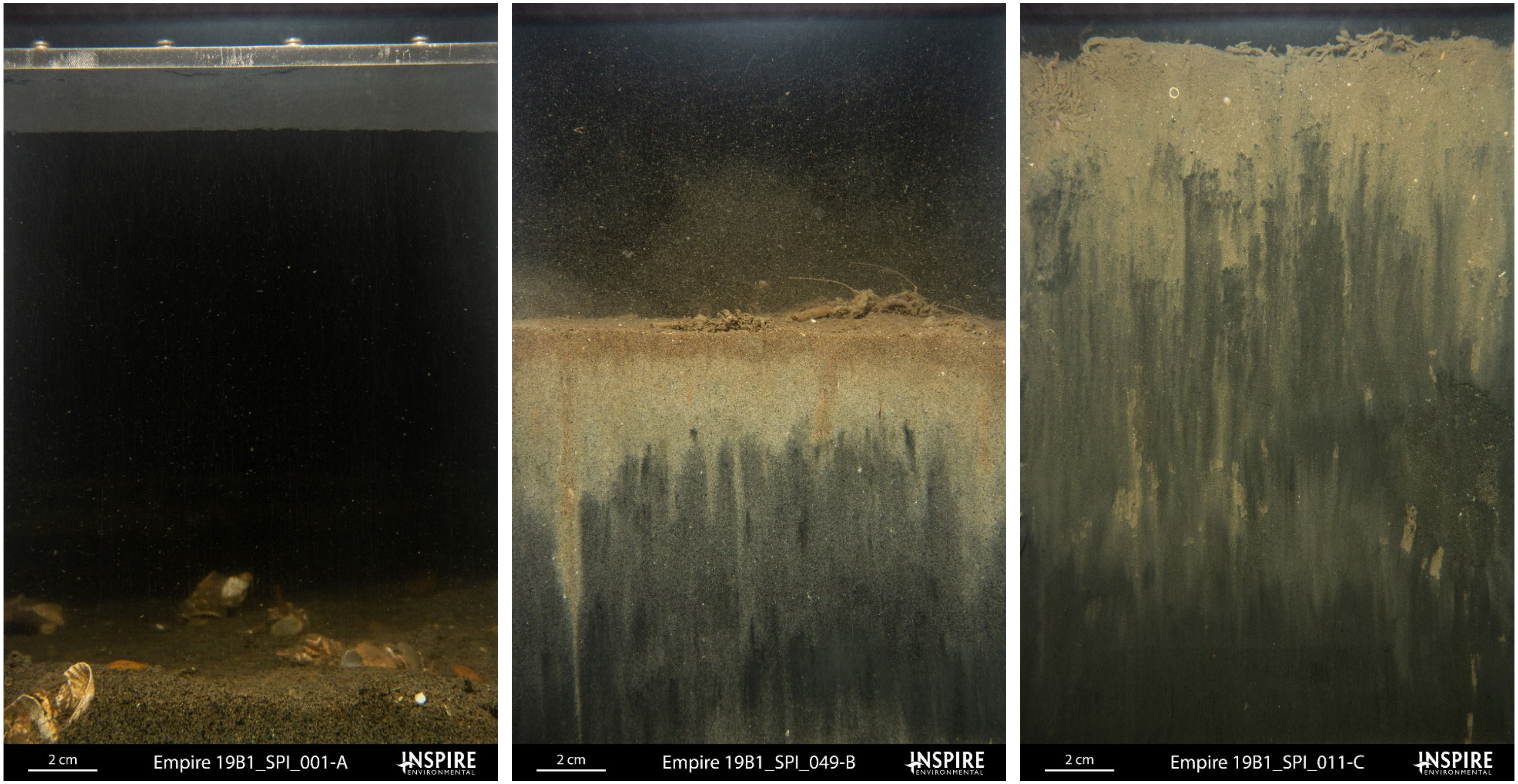


Figure 3-11. Mean station camera prism penetration depths (cm) at the Equinor Wind survey area



(A) **(B)** **(C)**

Figure 3-12. Representative SPI images showing sediments with; (A) low; (B) medium; and (C) high prism penetration values, corresponding to high, medium, and low load-bearing strength, respectively

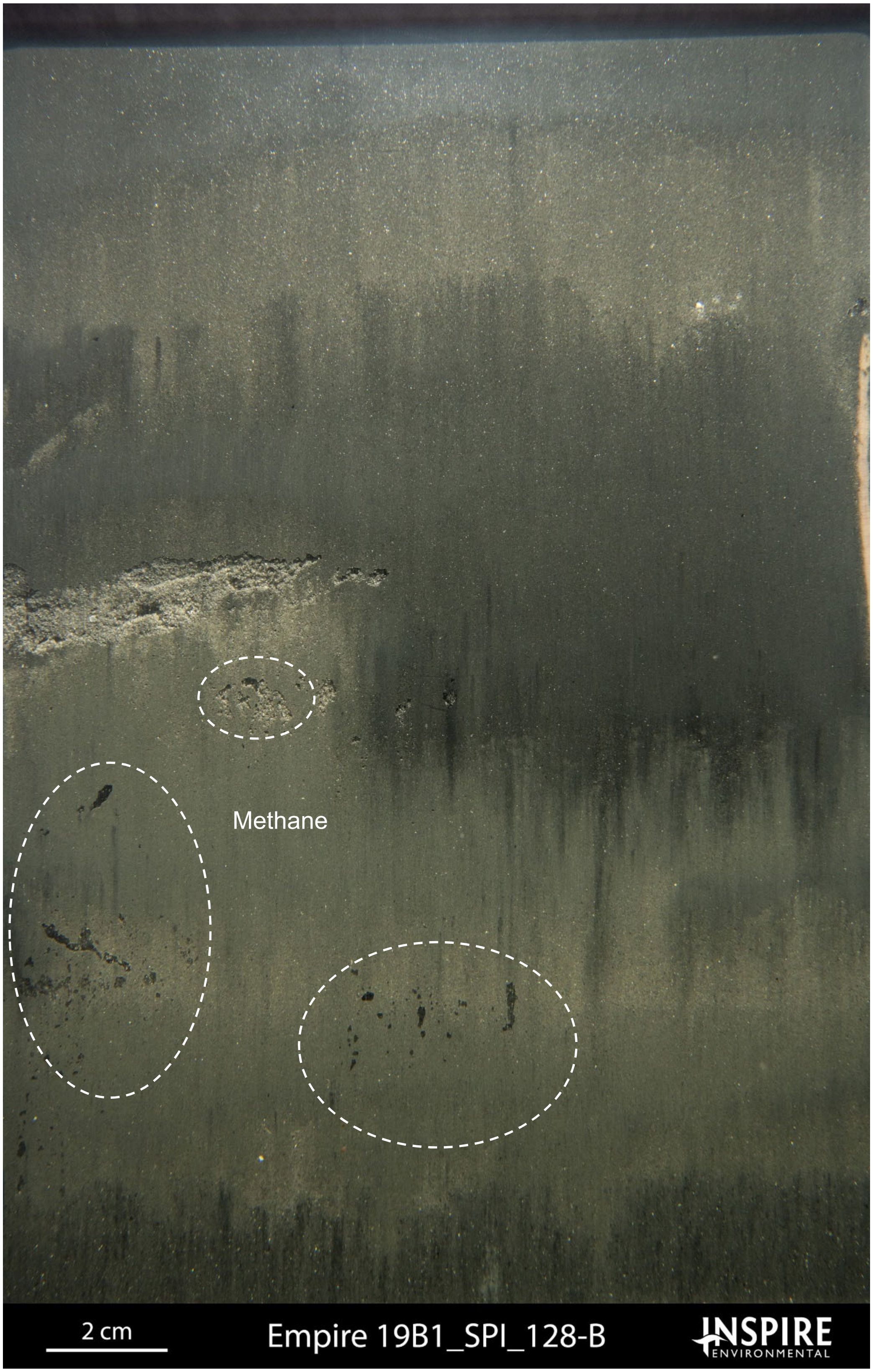


Figure 3-13. Profile image of Station 128 depicting over penetration in silt-clay sediment with low shear strength, and the presence of methane vesicles in the sediment column

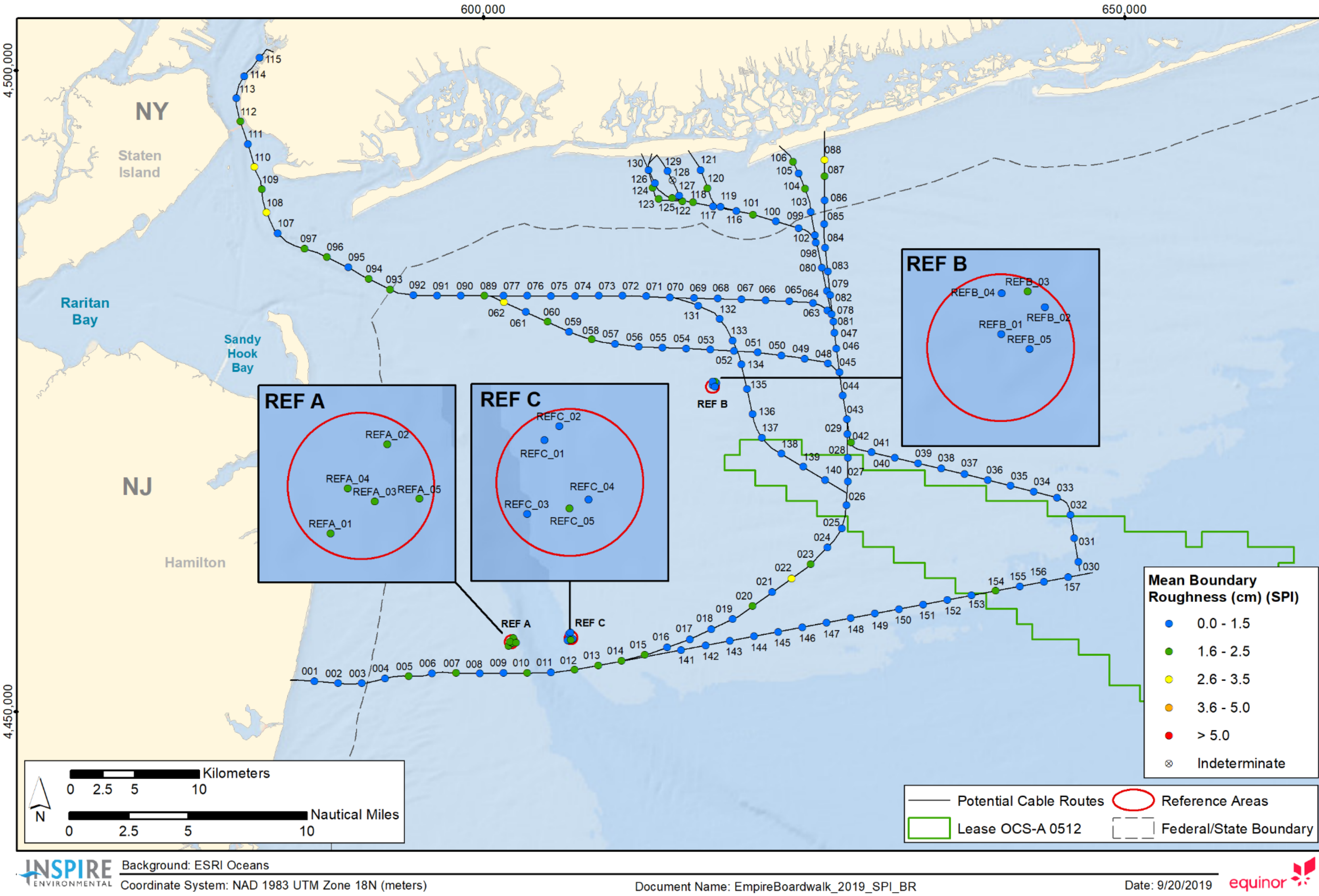


Figure 3-14. Mean station small-scale boundary roughness (cm) at the Equinor Wind survey area

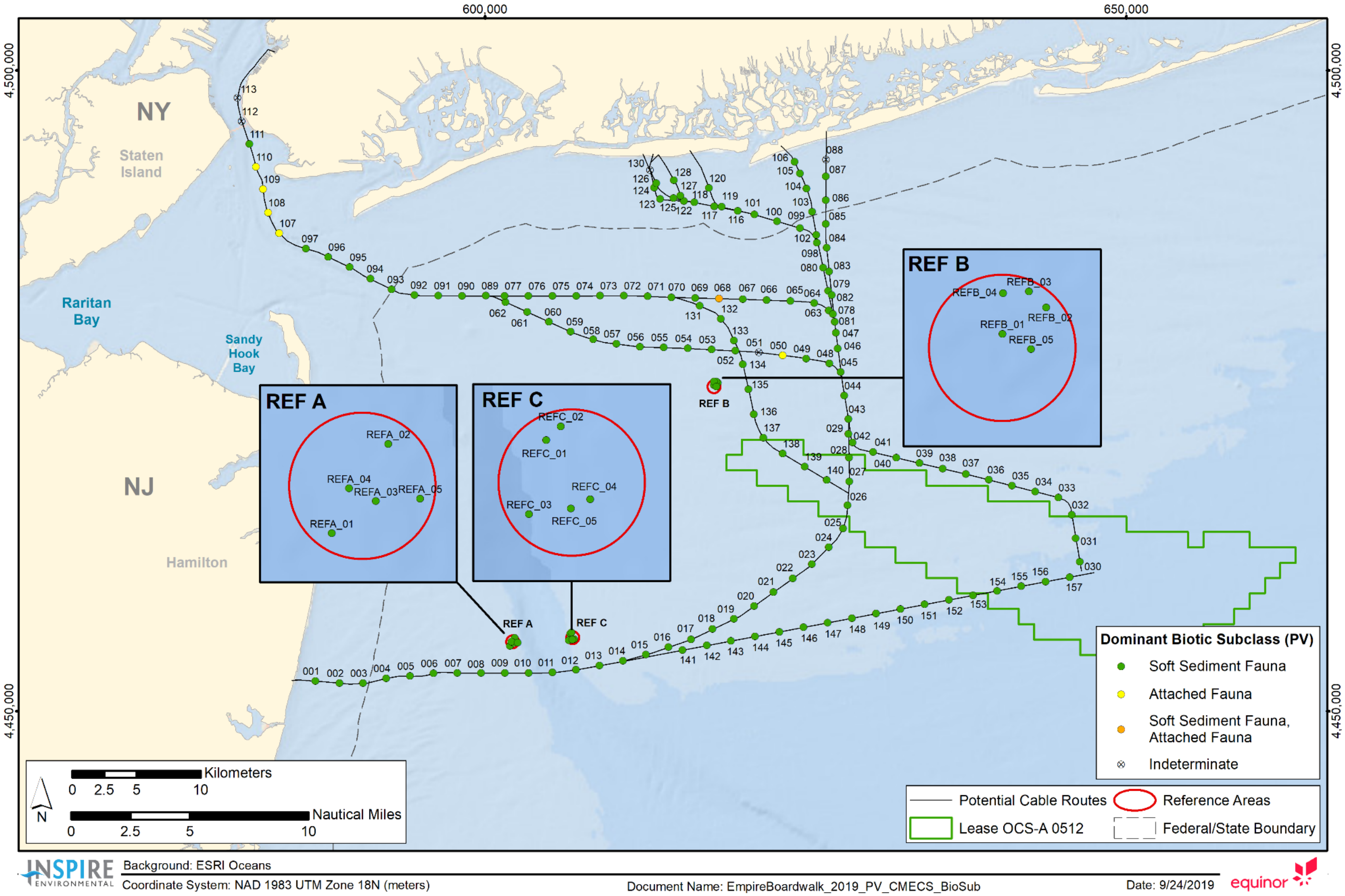
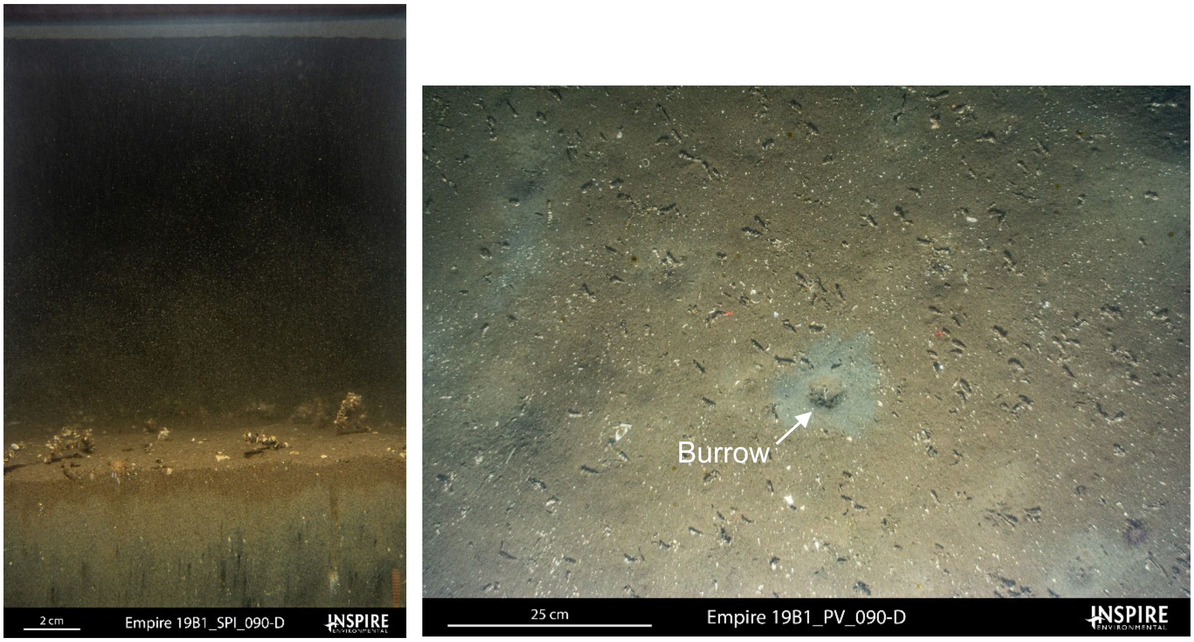


Figure 3-15. Dominant CMECS Biotic Subclass at the Equinor Wind survey area

(A)



(B)

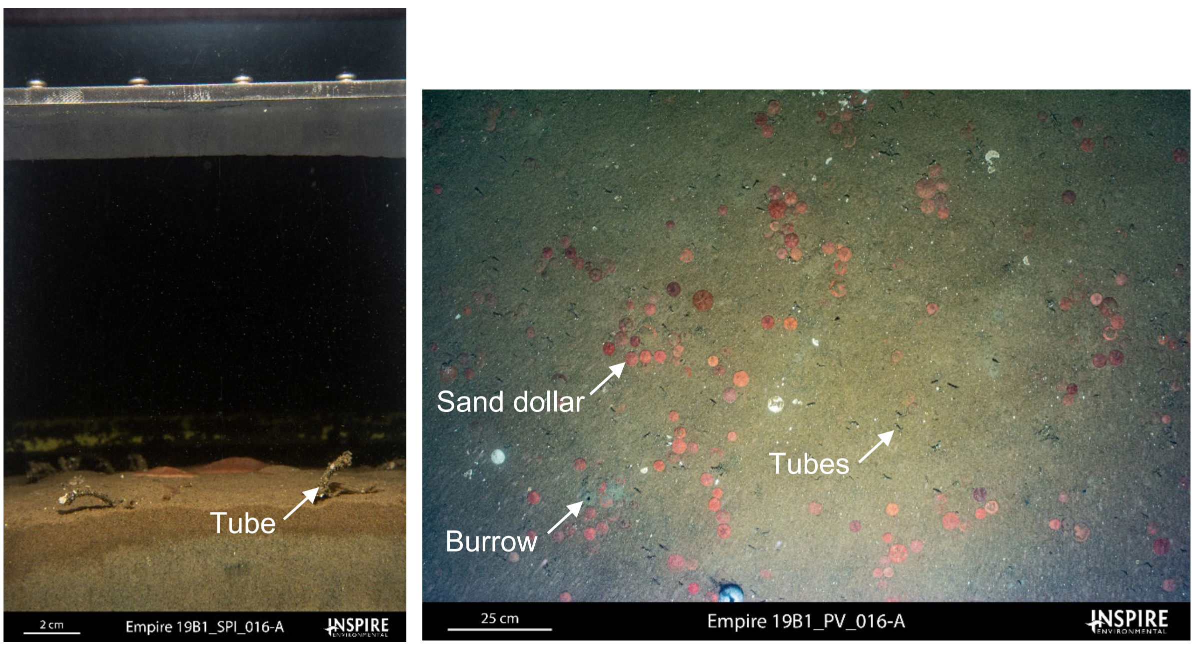
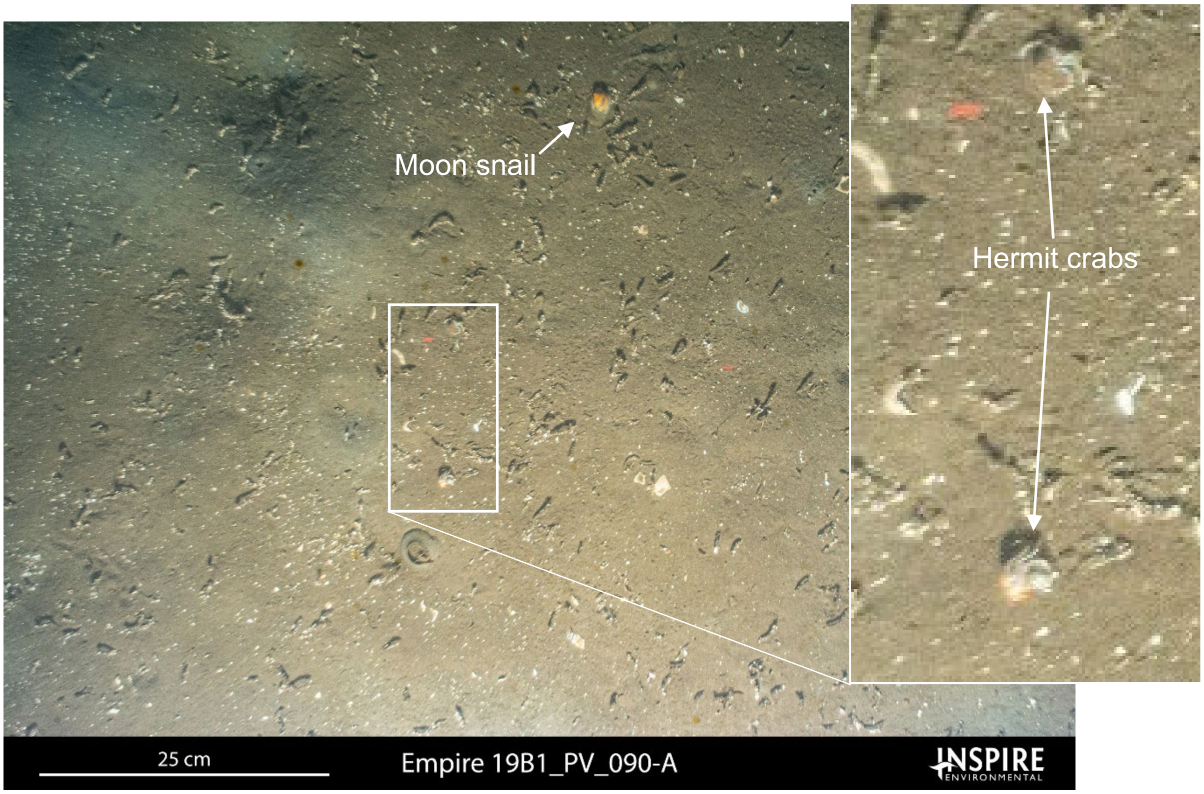
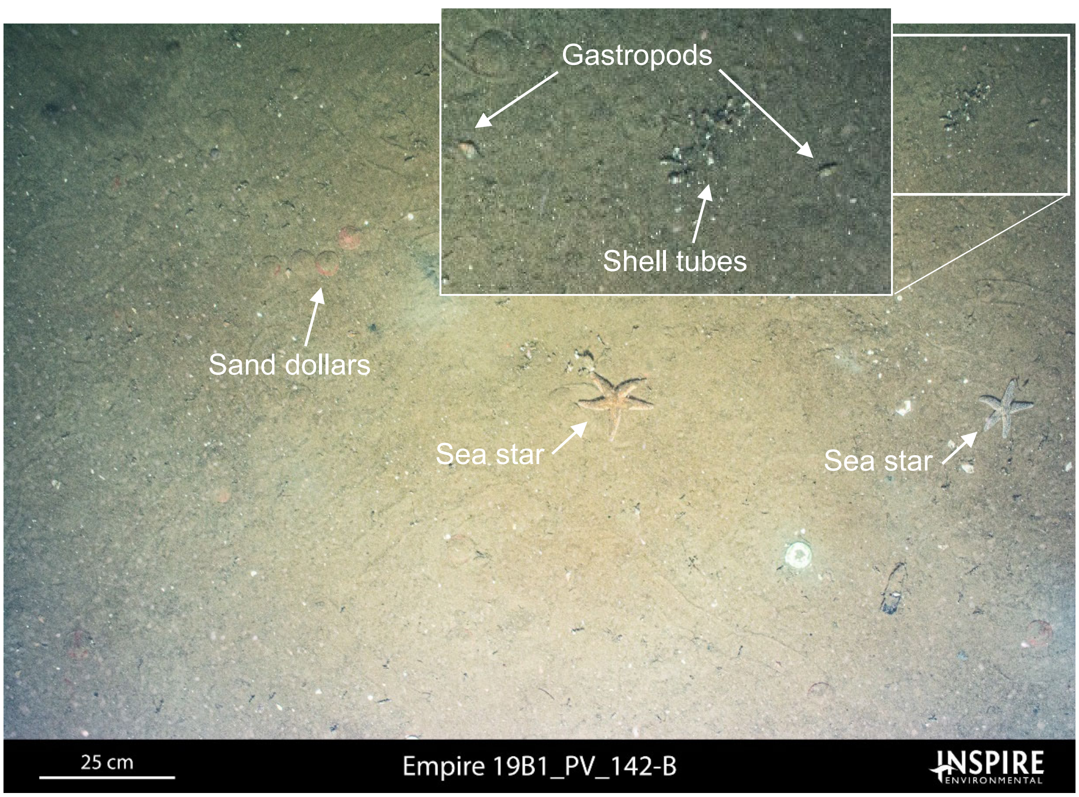


Figure 3-16. Representative SPI and PV images showing evidence of the CMECS Soft Sediment Fauna Biotic Subclass at (A) Station 090 composed of very fine sand depicting tubes and evidence of burrowing at the sediment-water interface; and (B) Station 016 depicting sand dollars, tubes and burrows on the seafloor, fauna driving seafloor boundary roughness



(A)



(B)

Figure 3-17. Representative PV images depicting epifauna activity on the seafloor at (A) Station 090 with hermit crabs and a moon snail present amongst numerous Diopatra cuprea tubes; and (B) Station 142 with sea stars, gastropods, hermit crabs, and sand dollars present amongst the distinct shell tubes formed by Diopatra cuprea worms.

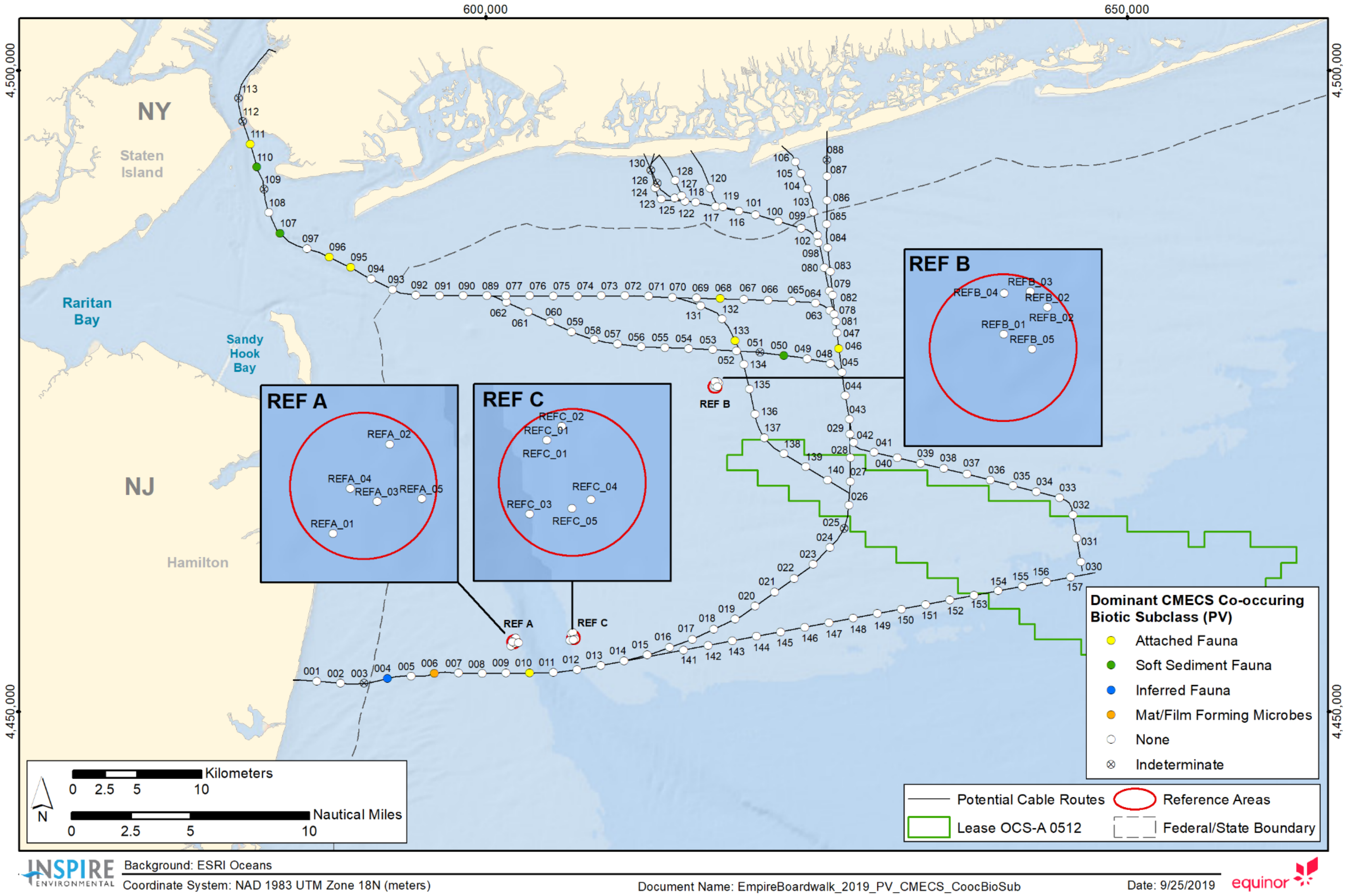


Figure 3-18. Dominant CMECS Co-occurring Biotic Subclass at the Equinor Wind survey area

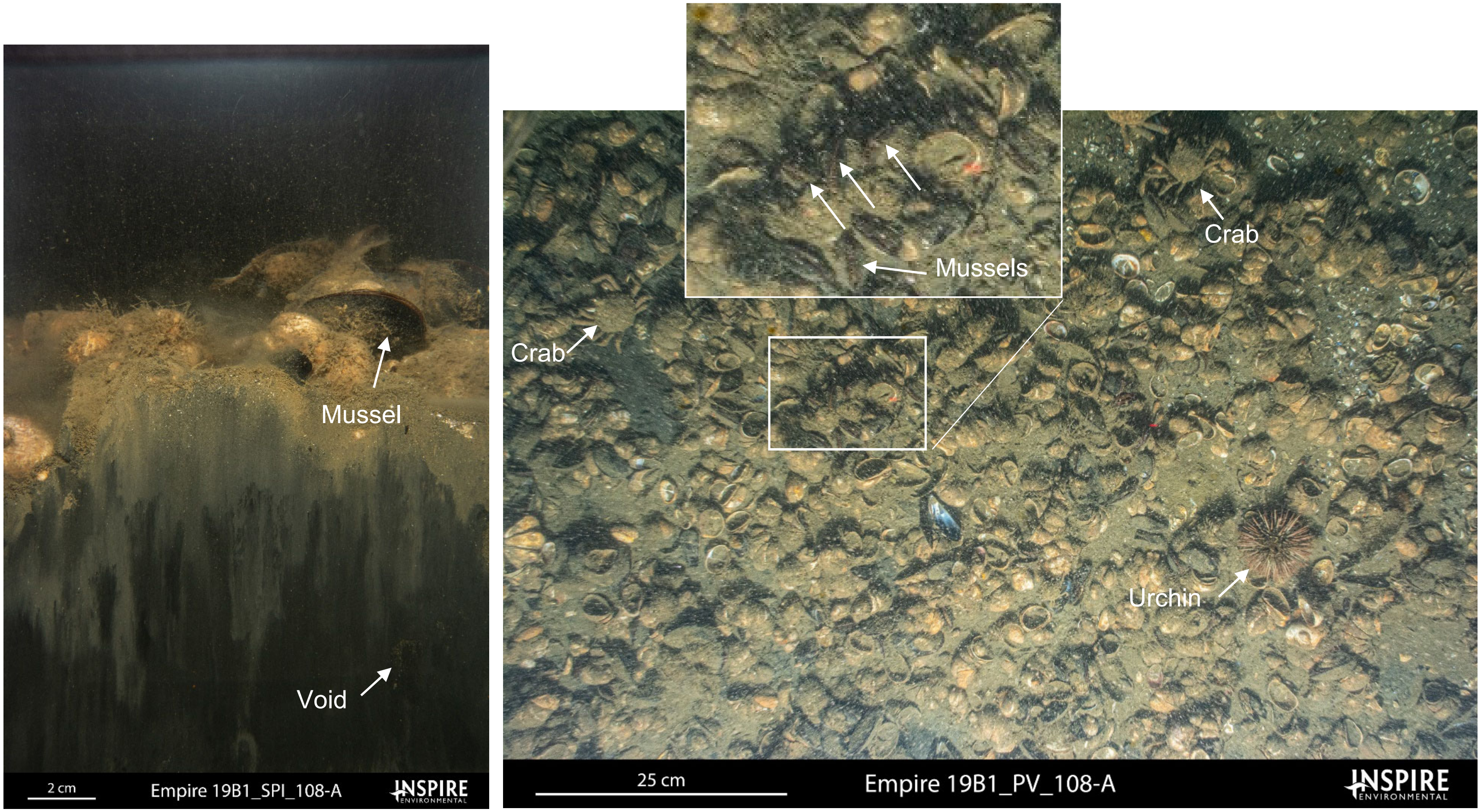
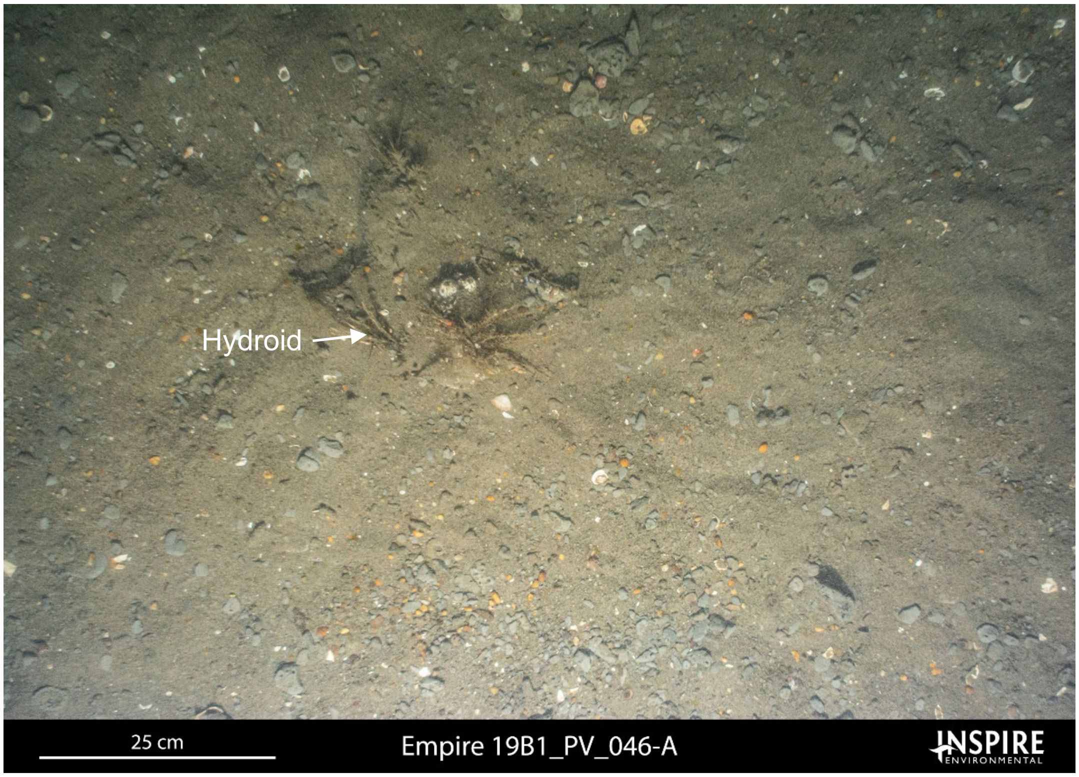
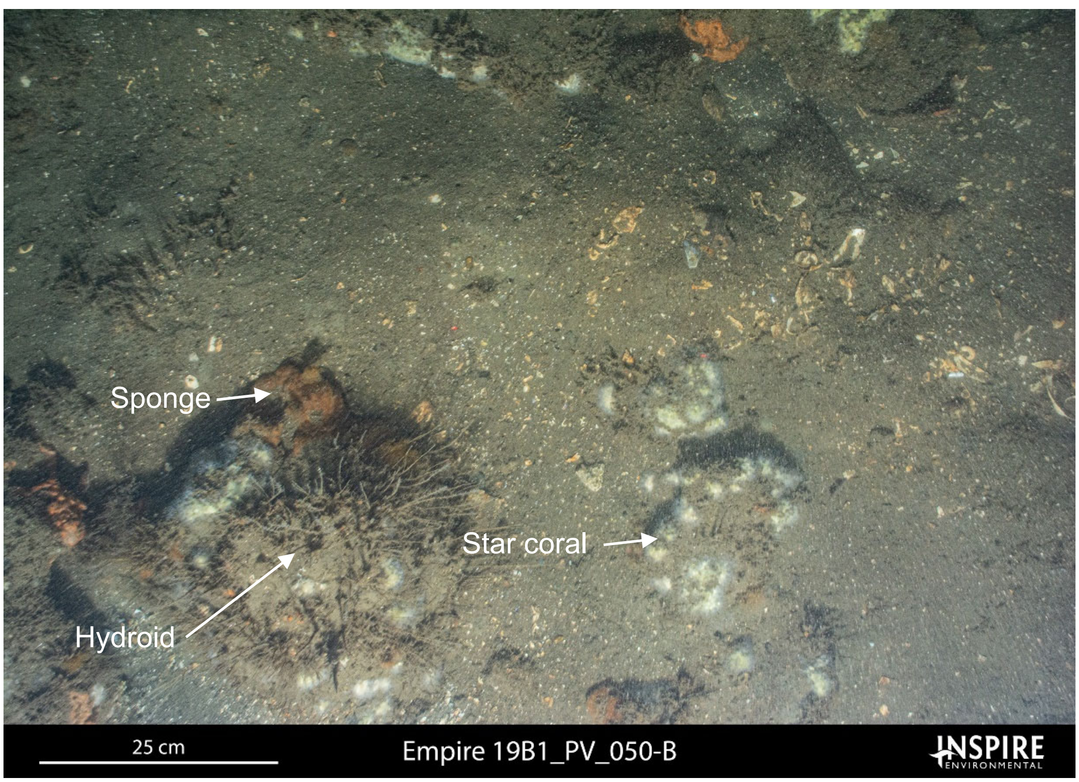


Figure 3-19.** **Representative SPI and PV images at Station 108 composed of silt-clay with dense mussel bed coverage on the seafloor and crabs, urchins and other interstitial fauna. Infilled feeding void from Stage 3 fauna visible in profile image.



(A)



(B)

Figure 3-20. Representative PV images showing attached fauna at (A) Station 046 with the presence of hydroids; and (B) Station 050 with the presence of hydroids, sponges, and the star coral Astrangia spp., which is defined as sensitive taxa

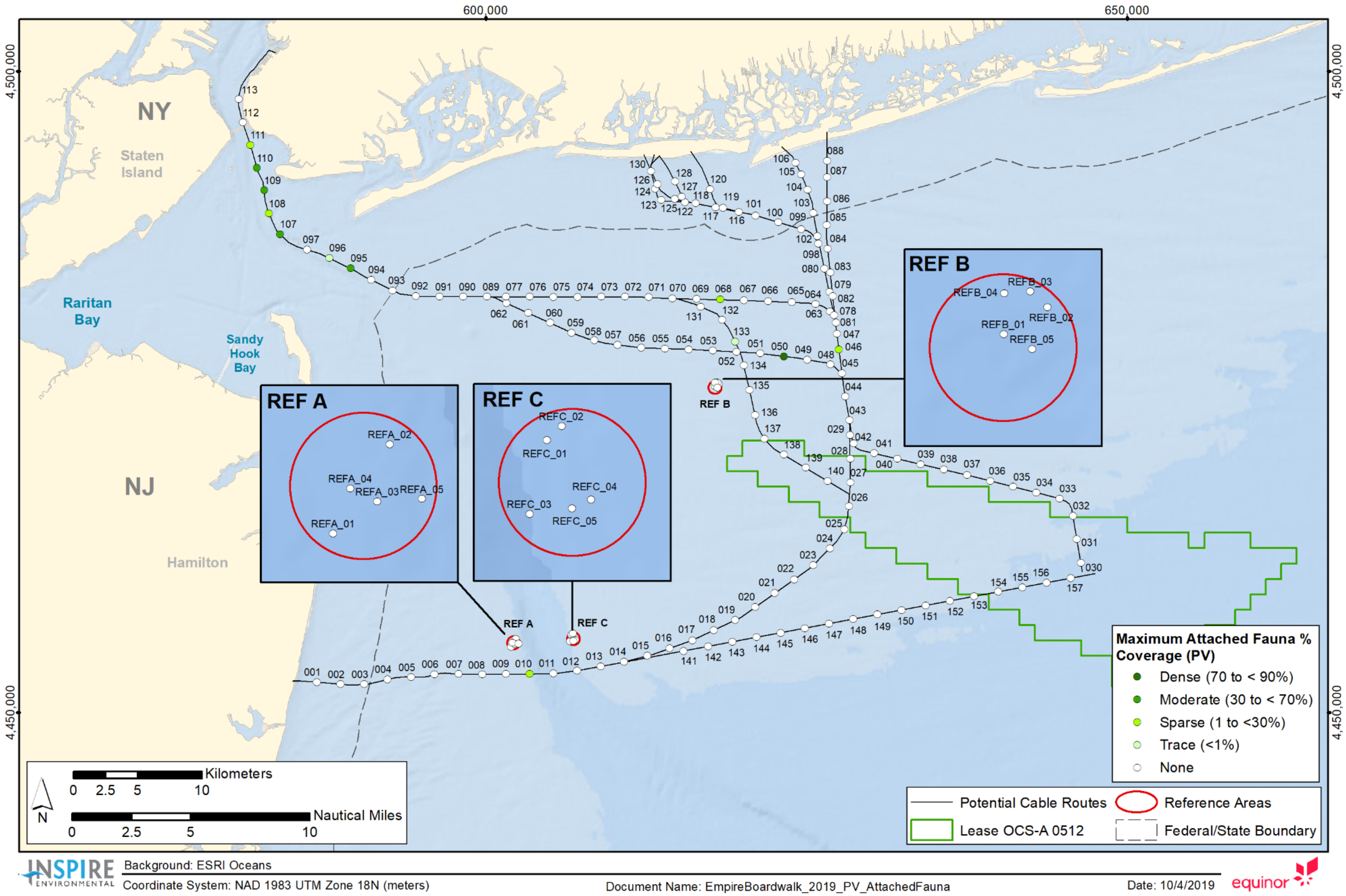


Figure 3-21. Maximum Attached Fauna Percent Cover (CMES Percent Cover Modifier) at the Equinor Wind survey area

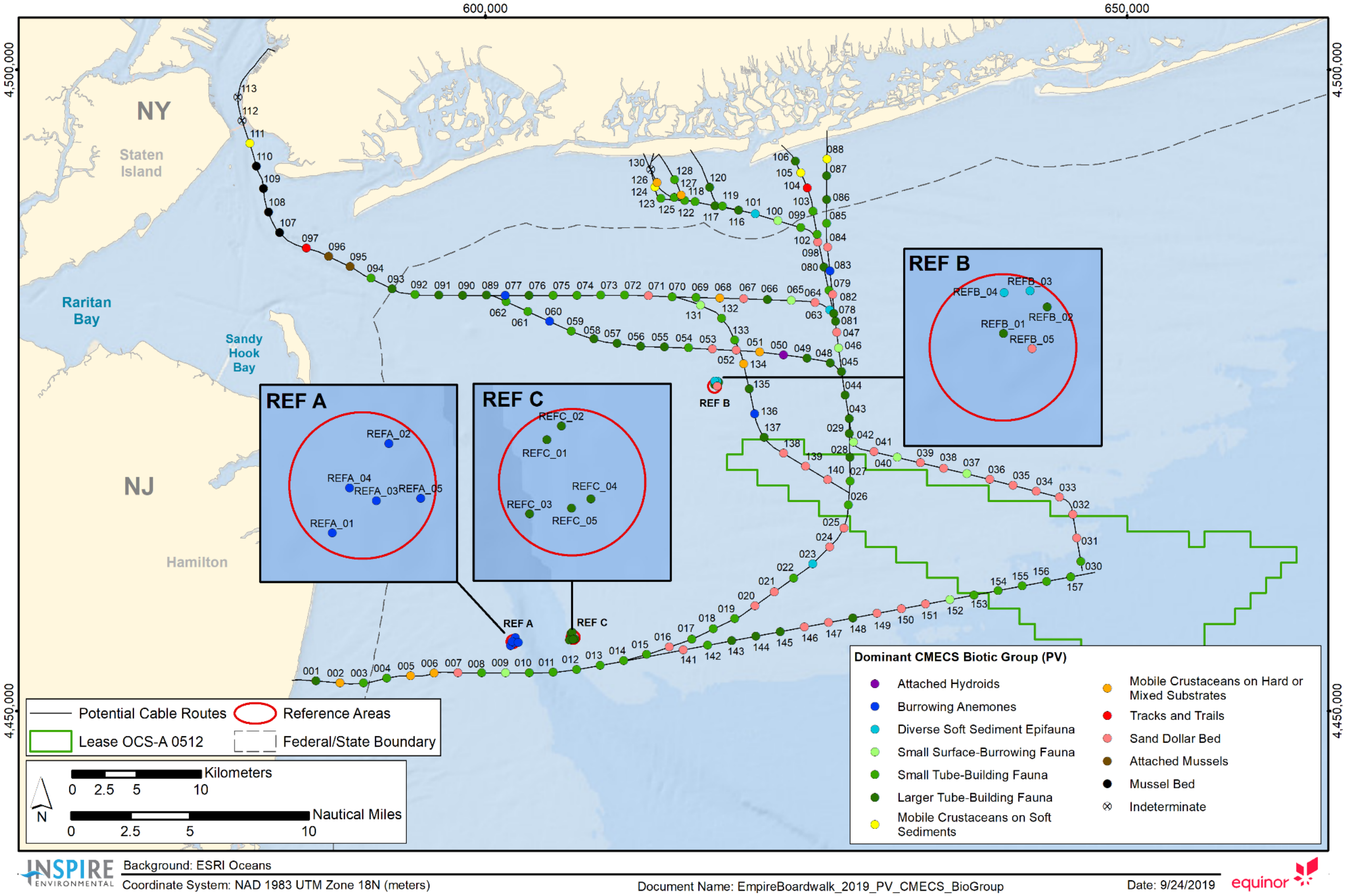


Figure 3-22. Dominant CMECS Biotic Group at the Equinor Wind survey area