OCS Study
BOEM 2018-029

Field Observations During Wind Turbine Foundation Installation at the Block Island Wind Farm, Rhode Island

Appendix E1: Seafloor Monitoring Survey 1 Report

US Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs

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May 2018

Authors (in alphabetical order):
Jennifer L. Amaral, Robin Beard, R.J. Barham, A.G. Collett, James Elliot, Adam S. Frankel, Dennis Gallien, Carl Hager, Anwar A. Khan, Ying-Tsong Lin, Timothy Mason, James H. Miller, Arthur E. Newhall, Gopu R. Potty, Kevin Smith, and Kathleen J. Vigness-Raposa

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By
HDR
9781 S Meridian Boulevard, Suite 400
Englewood, CO 80112

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Seafloor Disturbance and Recovery Monitoring Program
Survey No. 1 May 2016
Block Island Wind Farm, USA

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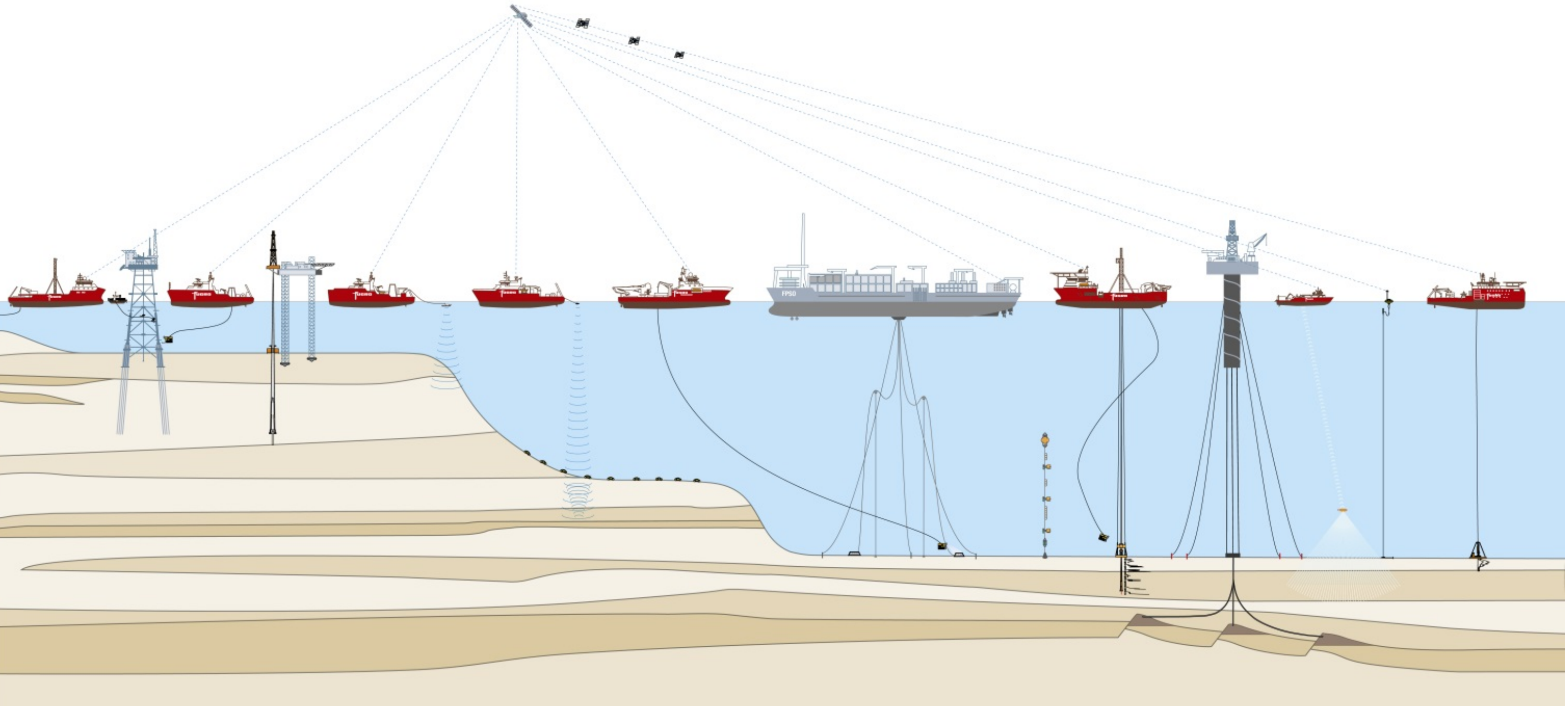

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Prepared for: HDR
300 North Madison Street
Athens, Alabama 35611
USA

01	Draft	Dean Gresham	Kevin Smith	Kevin Smith	September 7, 2016
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1. INTRODUCTION

1.1 Real-Time Opportunity for Development Environmental Observations (RODEO) Program

The United States (U.S.) Department of Interior's Bureau of Ocean Energy Management (BOEM) is responsible for managing the exploration and development of the nation's offshore energy resources. The BOEM conducts environmental reviews, including National Environmental Policy Act (NEPA) analyses, for each major stage (leasing, site assessment, construction, operations, and decommissioning) of proposed offshore energy development projects. Through these reviews and analyses, the BOEM evaluates potential environmental impacts from the proposed offshore activities on the human, coastal, and marine environments. The NEPA analysis is used to inform the decision-making process for whether and/or how to proceed with the approval of the offshore energy development.

To conduct the required analyses and effectively analyze the potential environmental impacts under NEPA, the BOEM requires data on impact-producing factors (stressors) and their effects on ecosystems and individual receptors. Development of offshore wind energy is new to the U.S.; therefore, data necessary for assessment of environmental impacts are not readily available. As a result, the BOEM has initiated the Real-Time Opportunity for Development Environmental Observations (RODEO) Program. The purpose of this program is to make direct, real-time measurements of the nature, intensity, and duration of potential stressors during the construction and/or initial operations of selected proposed offshore wind facilities.

Data collected under the RODEO Program may be used as input to analyses or models that are employed to evaluate effects or impacts from future offshore activities. The first facility to be part of the RODEO Program monitoring is the Block Island Wind Farm (BIWF) Project, which is located off the coast of Rhode Island.

1.2 Seafloor Disturbance and Recovery Monitoring

The seafloor can be disturbed by various activities during the construction and operational phases of a wind farm development. During construction, vessel anchoring activities and spud can penetrations may result in depressions in the seafloor. In addition, while a lift boat is positioned on site, scour can develop around the legs that penetrate the seafloor. Evidence of those impacts on the environment can disappear as sediment is reworked and transported due to natural processes after construction equipment is removed from the seafloor. The recovery rate from a seafloor disturbance primarily depends on sediment type, bottom current flow conditions (e.g. speed, duration, direction, etc.), and size of the disturbance feature.

The objective of repeated bathymetric surveys is to acquire multibeam data for use as a multi-temporal analysis tool to monitor for disturbance and recovery of the seafloor. This report summarizes the conditions observed during the first survey performed following the completion of the 2015 construction season. Additional bathymetric surveys are proposed for continued monitoring of the Block Island wind turbine construction area.

1.3 Block Island Wind Farm

Deepwater Wind (DW) recently constructed the BIWF located approximately five kilometers (km) southeast of Block Island, Rhode Island. The BIWF is comprised of five wind turbine generators with a name-plate capacity of 30 megawatts (MW). Figure 1 presents the location of the BIWF and survey area.

During the 2015 construction season, DW installed the foundations of the five WTGs. Installation of the export cable, inter-array cables, WTG towers, nacelles, and blades were installed during the summer of 2016. Installation of the five WTGs was performed by several lift boats and jack-up barges. In addition, a variety of other support vessels were used to support construction activities. The lift boats used to install the WTG foundations were the L/B *Robert*, L/B *Lacie Eymard*, and the L/B *Michael Eymard*. Based on the layout and physical dimensions of each lift boat (listed in Appendix B), seafloor disturbance features and their patterns were correlated to lift boats. A timeline of vessel movements (provided by DW), was then used to determine the timing of the specific seafloor disturbance at each location.

1.4 Purpose and Scope

This report presents the findings of the hydrographic survey conducted on May 11 and 12, 2016. WTG foundation construction works were completed in December 2016 and this survey represents the first post-construction survey. Hydrographic data collected during this survey were used to interpret seafloor disturbance features created during the foundation installation of the five wind turbines. Specifically, this seafloor monitoring will focus on:

- Sediment disturbances that may have resulted from construction vessel anchoring. Disturbed locations on the seafloor were mapped using high resolution multibeam. The depth and spatial extent of each disturbed location was also to be determined.
- Periodic multibeam surveys will be conducted to monitor seafloor recovery rates.
- Determining the amount of scour around the jacket foundations as well as surficial sediment movement and healing that has occurred since the end of the installation at each WTG location.

1.5 Authorization

Authorization for this work was provided by HDR Master Service Agreement No. MSA2015-1165, under task order TO 003, 0000023102, between HDR and Fugro, dated July 24, 2015.

2. DATA COLLECTION, PROCESSING, AND INTERPRETATION METHODS

2.1 Survey Overview

On May 11 and 12, 2016 Fugro conducted a hydrographic survey of the project area surrounding the Block Island wind turbine foundations that were installed during 2015. Foundation installation activities were completed in December 2015. Figure 1 and Chart 1 present the extent of the hydrographic survey. A detailed description of the survey vessel and instrument offsets can be found in Appendix A of this report.

All data in this report were projected in meters with the Universal Transverse Mercator (UTM) Zone 19 North coordinate system, using the World Geographic System of 1984 (WGS84) geodetic datum. The real-time navigation and position data were used as the geodetic control, receiving differential global navigation satellite system (GNSS) corrections in real-time via a G2 subscription to Fugro's OmniStar service. All real-time positioning data were converted to WGS84 (g1150) using an Applanix POS MV positioning system. This real-time positioning was used to process the multibeam survey lines. Horizontal positioning error at the vessel's CRP is estimated to be less than one meter (during optimal conditions).

Bathymetric data were reduced to mean lower low water (MLLW) based on the National Oceanic and Atmospheric Administration (NOAA) VDatum model (http://vdatum.noaa.gov). This model provides separation values from the GNSS ellipsoid down to the chart datum of MLLW for the survey area. These values were then applied to the bathymetry using the CARIS HIPS Compute GPS Tide routine. For a more detailed description of survey methods and calibration, refer to Appendix A.

2.2 Hydrographic Survey

The hydrographic survey was conducted using the chartered vessel R/V *Jamie Hanna.* The R/V *Jamie Hanna* is a 55-foot long purpose-built ocean-going vessel with a draft of seven feet. The vessel was equipped with a side mount for the echosounder transducer (Appendix A, Figure A-1). The hydrographic survey was conducted using a Reson SeaBat 7125 ultra-high resolution multibeam echosounder, designed to operate in water depths ranging from 0.5 meters to 300 meters. Reson states the vertical resolution of this instrument to be six millimeters; however, the nominal vertical resolution of post-processed data is likely to be closer to 10 centimeters (depending on sea state, tidal error, seafloor gradient, sounding position along track, and other factors).

Multibeam data were collected in WinFrog software and were visually monitored during the survey for quality assurance. The WinFrog *.s7k files were then brought into CARIS for bathymetric processing. Subsequently, corrections for vessel offsets, patch test calibration, and static draft measurements were input into the software. Sound Velocity Profiles (SVP) were then used to correct the bathymetric data for sound refraction or ray bending.

After each line was examined and cleaned in CARIS' Swath Editor, the tide corrections were loaded and the lines were merged. The merged dataset was then examined to identify tidal discrepancies, sound velocity errors, motion errors, and data gaps. Once all processing was completed, a digital terrain model (DTM) was generated with CARIS at a 0.5 meter bin size. The ASCII XYZ grid file of easting, northing, and depth values in meters was then output from CARIS for charting.

3. MULTI-TEMPORAL ANALYSIS OF SEAFLOOR CHANGE

Survey data collected after the first season of construction are used to interpret the locations and extents of the seafloor disturbance. The survey extent encompassed the area denoted by DW as the "Work Area." The Work Area was the primary area where construction vessels were positioned during construction. During our evaluation of the bathymetric data, we identified a few disturbance features that appeared to partially recover. To augment our evaluation of the data and assist in identifying areas of dynamic seafloor conditions, we incorporated available bathymetric data renderings from a survey conducted of the site in 2012. A report of a 2012 bathymetry survey performed by Ocean Surveys Incorporated (OSI) was provided to Fugro by DW to supplement this portion of the study. The raw and/or processed bathymetry data were not available; however, a bathymetry rendering was extracted from the report and georeferenced for a qualitative comparison with Fugro's May 2016 bathymetry survey.

This section of the report describes the interpreted seafloor disturbances, preliminary assessment of seafloor conditions and dynamics, and a discussion of areas already exhibiting recovery.

3.1 Seafloor Disturbance Features

On May 11 and 12, 2016 Fugro conducted a post-construction hydrographic survey to assess the seafloor conditions at the Block Island Wind Farm using a multibeam echosounder. The hydrographic survey was used to measure water depths in the BIWF Work Area and to determine the presence and extent of seafloor disturbance created by WTG construction vessels. Seafloor disturbance features were observable in the hydrographic survey data in the Work Area and were concentrated around each of the five WTG locations (Figure 2b and Charts 2 and 3). Figure 2b and Chart 2 presents the interpreted extents and classifications of the different types of seafloor disturbance features. The different types of disturbance features are classified based on the following:

- Spud: Circular depressions arranged in a pattern that match one of the lift boats and are generally located near a WTG. Likely created when a lift boat was on position during installation of a foundation or performing construction works (e.g. welding, painting, etc.) at the foundation.
- Circular Depression: Circular depression not associated with a geometric pattern that would have been created when a lift boat was on position and had all 3 or 4 legs deployed. Circular depression was generally located away from WTG position and may be related to a spud depression or anchor drop.
- Drag Mark: Elongated or linear disturbance feature likely created from the dragging of a spud leg or anchor.
- Scour: Scour feature that formed around the leg of the jacket foundation.

We interpreted 160 seafloor disturbance features that comprise an area of approximately 11,570 m^2. Circular depressions comprise the largest number of features, however, drag marks comprise the largest total area of the five different categories of features. Table 3.1 summarizes the number, area, and relative percentage of the Work Area that each category of feature comprised.

Table C-1 (Appendix C) describes each disturbance feature including size, depth, and attributed vessel if known.

Table 3.1: Summary of Seafloor Disturbance Features

Area and Interpreted Features	Area (m^2)	Percentage of Work Area	Percentage of Disturbed Area	Number of Features
Work Area	7,277,390	100%	N/A	160
Total Disturbed Area	11,570	0.16%	100%	N/A
Spud	870	0.01%	8%	22
Circular Depressions	2,803	0.04%	23%	69
Drag Marks	6,414	0.09%	56%	44
Scour	1,483	0.02%	13%	25

By attempting to correlate seafloor disturbance features with the vessels that created them, a timeline of vessel movements and locations has been assembled from the Daily Briefings to Mariners reports on Figures 3a through 3c (as summarized below):

- Figure 3a: Vessel movements and locations for construction activities between July and September of 2015
- Figure 3b: Vessel movements and locations for construction activities between October and December of 2015
- Figure 3c: Vessel movements and locations for construction activities between April and May of 2016

3.1.1 Wind Turbine Generator 1

Wind Turbine Generator 1 is located in the northeastern-most section of the study area and is associated with the most well-resolved seafloor disturbances. Figures 4a and 4b present the local bathymetry and three interpreted types of seafloor disturbance: linear features, circular features, and scour depressions. The circular depressions are likely spud leg impressions from the L/B *Robert* which last worked on the site on November 3, 2015 (Figure 3a). Rectangular depressions are likely the footprint of the mud mats from the L/B *Michael Eymard* which worked on the site from April 26 through 30, 2016. These probable spud leg depressions range in depth from approximately ten to 40 centimeters and cover an area about 9 meters long and 6 meters wide. In addition to vessel activity, circular depressions identified as probable scour holes have developed around the legs of the WTG foundation. These 9 to 11-meterwide circular depressions range in depth from approximately five to ten centimeters. A relatively linear feature is also present at WTG 1 that could be attributed to a dragged spud leg.

3.1.2 Wind Turbine Generator 2

Wind Turbine Generator 2 is located in the northeastern section of the study area and displays very well-resolved seafloor disturbances. Figures 5a and 5b present the local bathymetry and two interpreted types of seafloor disturbance: circular depressions from vessel activities and scour depressions. Two different vessels appear to have left spud depressions at WTG 2. A smaller triangle of three-spud set of depressions appears to be the L/B *Michael Eymard* (whose depressions are approximately ten centimeters in depth). The other set of triangular spread three-spud depressions appears larger in dimension and could be the L/B *Robert*. Localized scour within a 9 to 12-meterradius of each foundation leg can be observed at WTG 2; these depressions range from five to ten centimeters deep.

3.1.3 Wind Turbine Generator 3

Wind Turbine Generator 3 is located in the central section of the study area. Very few seafloor disturbances were observed in the vicinity of WTG 3. Figures 6a and 6b display the local bathymetry and the legs of a lift boat (most likely the L/B *Lacie Eymard*) working at the site during the survey, as well as scour holes around the legs of the lift boat and WTG foundation legs. Scour around WTG 3 is estimated to be less than ten centimeters in depth. WTG 3 is located in a slightly deeper channelized area of the seafloor where ripple bedforms are observed on the seafloor. This area could experience higher bottom current speeds, which maybe the reason that seafloor disturbances from the installation vessels aren't as apparent at this location.

3.1.4 Wind Turbine Generator 4

Wind Turbine Generator 4 is located in the southwestern section of the study area. Very few seafloor disturbances were observed at this location. Figures 7a and 7b display the local bathymetry and two types of seafloor disturbance at WTG 4. The first type of disturbance are irregularly shaped scour holes around each of the foundation legs and the legs of a lift boat (L/B *Michael Eymard*) which was on location during the survey. These irregular patterns show some scour tails that trend from southeast to northwest, indicating a possible current direction from the southeast. The deepest of these scour holes is approximately 20 to 25 centimeters. The second type of seafloor disturbance observed at WTG 4 were linear marks. Four relatively long linear disturbances were mapped; three of which trend northeast-southwest and one that trends southeast-northwest. The height of the wave ripples around WTG 4 range from five to ten centimeters; however, the linear features near the site are approximately ten centimeters deep. Although the linear scars are analogous with the depth of the wave ripples, they cross-cut the wave ripples and are readily apparent in the bathymetry data, indicating that they are anthropogenic disturbances.

3.1.5 Wind Turbine Generator 5

Wind Turbine Generator 5 is located in the southwestern-most section of the study area. Very few seafloor disturbances were delineated at this location. Figures 8a and 8b show the local bathymetry, no significant scour around the WTG foundation legs, and a few apparent linear features that are interpreted to represent acquisition artifacts in the bathymetry dataset. WTG 5 is located at a water depth of 23 meters, which is the shallowest of the locations. The high-energy environment associated with this water depth may prevent the preservation of seafloor disturbance features.

3.1.6 Seafloor Disturbance between WTG Locations

Additional seafloor disturbance features can be observed between the WTG locations, which are spaced approximately 0.8 km apart. The most notable of these features are linear drag marks ranging from approximately 150 to 200 meters in length (Figure 9 and Chart 2). Chart 2 shows the locations of some of these linear features around WTG 4, between WTG 1 and 2, and to the southeast of WTG 2. The location and orientation of these features are indicative of their origin. The features found along the proposed inter array cable route that are oriented northeast to southwest are most likely from vessels working during the installation of the BIWF. Although the drag marks were only ten to 20 centimeters in depth at the time of the survey, the depth of the features when they were created could have been up to 40 centimeters (Panel A, Figure 9). Panel A on Figure 8 presents the most well-defined spud/mud mat depressions observed in the bathymetry data. These features are attributed to the L/B *Michael Eymard*, which was last on location at WTG 1 on April 30, 2016 (Figure 3c).

Other interpreted seafloor disturbance features (as seen on Figure 9, Panel C and Chart 2) that are not associated with a WTG location cannot be positively identified as belonging to either of the lift boats used during the installation. None of the features match the three-leg triangle pattern from the three lift boats working in the area and none of the depressions are wide enough to match the mud mat diameter of the lift boats. The shape and size of the features could have been modified by mobile sediment infilling; however, due to the lack of additional evidence, no positive vessel identity could be established. It is possible that these smaller features can be attributed to a spud crane barge (similar to the Weeks No. 526 barge that was active in the area during late 2015).

3.2 Seafloor Disturbance Recovery

The rate of recovery from the initial disturbance back to a natural seafloor is dependent on a variety of factors. Some of the main influences on seafloor recovery are bottom current speeds, surficial sediment mobility, and the influence of large storm events (which can drastically alter the normal flow conditions at a site). Seafloor features identified in the May 11 and 12, 2016 bathymetric survey represent the initial survey from which future bathymetric surveys will be compared to evaluate seafloor recovery and rates in the study area.

Seafloor morphology and bedforms develop in response to the interaction between bottom currents and seafloor sediments. Bedform type (e.g. ripple or dune) and size are dependent on the bottom current speed, flow direction(s), and sediment type. Stow et al. (2009) and Ashley (1990) have developed interrelationships between sediment type, current speeds, and bedforms. Furthermore, Van Rijn (1993) and Allen (1982) present relationships between bedforms, mobility, and sedimentary environments. As a first step in this study, we evaluate sediment mobility and sedimentary environments based on the bedforms observed in the May 2016 survey, available sediment type data, and a comparison with a survey conducted in 2012 of the area. Rates of seafloor recovery are anticipated to be directly related to sediment mobility. The following section describes the interpreted sediment mobility and sedimentary environments. Future surveys will be used to refine our evaluation sediment mobility and recovery rates.

3.2.1 Surficial Sediment Mobility

Seafloor recovery after a disturbance is partially dependent on the mobility of the surficial sediments. Within the BIWF area, bedforms of varying scale were observed in the multibeam data. The profile view on Figure 10 presents some of the smaller wave ripples (on the order of five to ten centimeters in height) and Figure 11 presents some of the larger features (up to 0.5 meters in height). Movement of these 0.5-meter-high bedforms was observed between the 2012 bathymetric survey by OSI and the May 2016 Fugro survey. Figures 12 and 13 depict the same location at an identical scale to highlight the shift in bedforms between the two surveys. Panel A on Figures 12 and 13 present one of the larger examples of seabed mobility with a northwestward shift of a ridge form by approximately 15 meters and another (smaller) northwestward shift of eight meters on a proximal ridge. Panel A is located in the northern portion of the survey area and in slightly deeper water. Panel B, which is in slightly shallower water, shows approximately 13 meters of geographic shift to the northwest on one of the ridge features that can be seen in both 2012 and 2016 datasets.

Based on these observations of bedform migration, the project area was classified into zones by bedform size and relative mobility rates. Some inferences were made as to the grain size of the surficial material in each zone. Figure 14 and Chart 4 illustrate the three different zones and two subzones; in addition, they are summarized below:

- Zone 1: High mobility sand ridges or shoal features that are approximately 0.5 meters high (compared to the surrounding lows of Zone 2). Interpreted to be comprised of fine sand. These sand ridge or shoal type features can be seen to shift between the 2012 and 2016 bathymetric data sets; however, the outline of each feature remains close and discernable in both datasets.
    - Zone 1a: Slightly higher mobility sand dune features located within Zone 1 that are approximately 1.0 meters in relief (compared to the surrounding lows of Zone 2). These sand dune features are interpreted to be composed of fine sand and are observed in both the 2012 and 2016 datasets; however, correlating each feature between the datasets is difficult due to the relatively high rate of change in position and shape.
- Zone 2: Moderate mobility areas which are interpreted to be comprised of medium to coarse sand size particles. These areas are seen in both the 2012 and 2016 datasets; however, due to the fact that they are relatively featureless, the boundaries cannot be correlated well in both datasets.
    - Zone 2a: Wave ripple fields which are moderately mobile and are comprised of medium to coarse sand particles. These wave ripple fields can be seen in both 2012 and 2016 datasets; however, the low resolution of the 2012 dataset precludes the use of these features in more detailed studies of the sediment mobility rates.
- Zone 3: Low Mobility glacial moraine area which is interpreted to include mainly coarse gravel and cobbles. This glacial moraine area is seen in both 2012 and 2016 datasets and was not observed to shift between the two.

3.2.2 Seafloor Recovery

In addition to variable sediment mobility rates across the study area, differential sediment recovery can be observed in some areas around the BIWF. Linear seafloor features near WTG 4 (interpreted to be drag marks from a spud leg) were observed to cross multiple seafloor textures (Figure 15). The long, linear features located to the west of WTG 4 were observed to cross from a wave ripple field (Zone 2a) to a sand ridge (Zone 1) and then back into a wave ripple field (Zone 2a); this differential recovery is characteristic of Zones 1 and 2a. The sand ridge along the center section of the drag mark shows very little evidence of the drag mark; however, the beginning and end of the drag mark can be connected from the wave ripples on the western side to the eastern side of the sand ridge. This suggests that the areas with different seafloor textures appear to represent areas of different seabed mobility and rates of recovery.

Although additional multibeam surveys at are needed to estimate rates of bedform migration, seafloor disturbance features and the changes seen between the 2012 and 2016 datasets can help to assess the relative levels of mobility for the different seafloor textures seen in the project area.

4. SUMMARY

Based on our assessment of the seafloor through an analysis of high-resolution multibeam data, we conclude the following:

- During the work season of 2015, jacket foundations were installed for the five wind turbines. Construction was ended in December of 2015. Wind turbine towers, blades, and nacelles and the transmission cables were installed during 2016. This report describes the results from a survey conducted in May 2016, prior to the start of the 2016 construction season.
- Water depths within the survey area range from approximately El. -20 to -30 meters MLLW. The regional bathymetry slopes to the northeast at an average gradient of 0.5 degrees.
- The Block Island Wind Farm project contains five existing WTG locations and is located on (and adjacent to) a moraine feature composed primarily of sand, gravel, cobbles, and potential boulders. Wind turbines were installed in areas where the seafloor sediments are predominantly fine- and medium-grained sand.
- Although water depths are relatively constant, variable sediment composition and metocean conditions exist over the survey area. This is evident due to a variety of bedforms of different scale (such as dunes and ripples) that were observed in the bathymetry data. Natural reworking of the seafloor and significant bedform migration is a dynamic process that is interpreted to be occurring within certain portions of the study area. This process was observed by comparing 2012 and 2016 bathymetric survey data.
- Several types of construction-related seafloor disturbances were imaged in the multibeam data in the vicinity of the WTG locations, including spud leg depressions, scour holes, spud leg drag marks, and anchor drag marks. In addition, these types of features are observable in the areas between the WTG locations. All seafloor disturbances were mapped and catalogued during this study; some were able to be correlated with specific WTG construction lift boats based on dimensions and reported vessel times on location.
- Seafloor disturbance activities were group into the following categories:
  - Spud: Circular depressions arranged in a pattern that match one of the lift boats and are generally located near a WTG. Likely created when a lift boat was on position during installation of a foundation or performing construction works (e.g. welding, painting, etc.) at the foundation.
  - Circular Depression: Circular depression not associated with a geometric pattern that would have been created when a lift boat was on position and had all 3 or 4 legs deployed. Circular depression was generally located away from WTG position and may be related to a spud depression or anchor drop.
  - Drag Mark: Elongated or linear disturbance feature likely created from the dragging of a spud leg or anchor.
  - Scour: Scour feature that formed around the leg of the jacket foundation.
- We interpreted 160 seafloor disturbance features that comprise an area of approximately 11,570 m^2. Circular depressions comprise the largest number of features, however, drag marks comprise the largest total area of the five different categories of features. Some features displayed evidence or recovery.
- Seafloor mobility within the survey area was classified into three zones (Zone 1–Zone 3) and two subzones (Zone 1a and Zone 2a) based on bedform shifts observed in the 2012 and 2016 bathymetry surveys. Seafloor mobility is highest within Zone 1, moderate in Zone 2, and low in Zone 3. In general, zones of higher seafloor mobility correlate with higher sediment infill/seafloor disturbance recovery rates. Geophysical evidence exists that indicates seafloor disturbances will

recover more rapidly (up to five centimeters per month) over areas of higher water column energy, shallower bathymetry, smaller particle size, faster current speeds, and/or higher sediment mobility. Therefore, seafloor disturbances within Zone 1 are likely to recover faster than those observed in Zones 2 or 3.

- Future bathymetric surveys will be used to update the seafloor mobility zones and evaluate recovery from seafloor disturbances.

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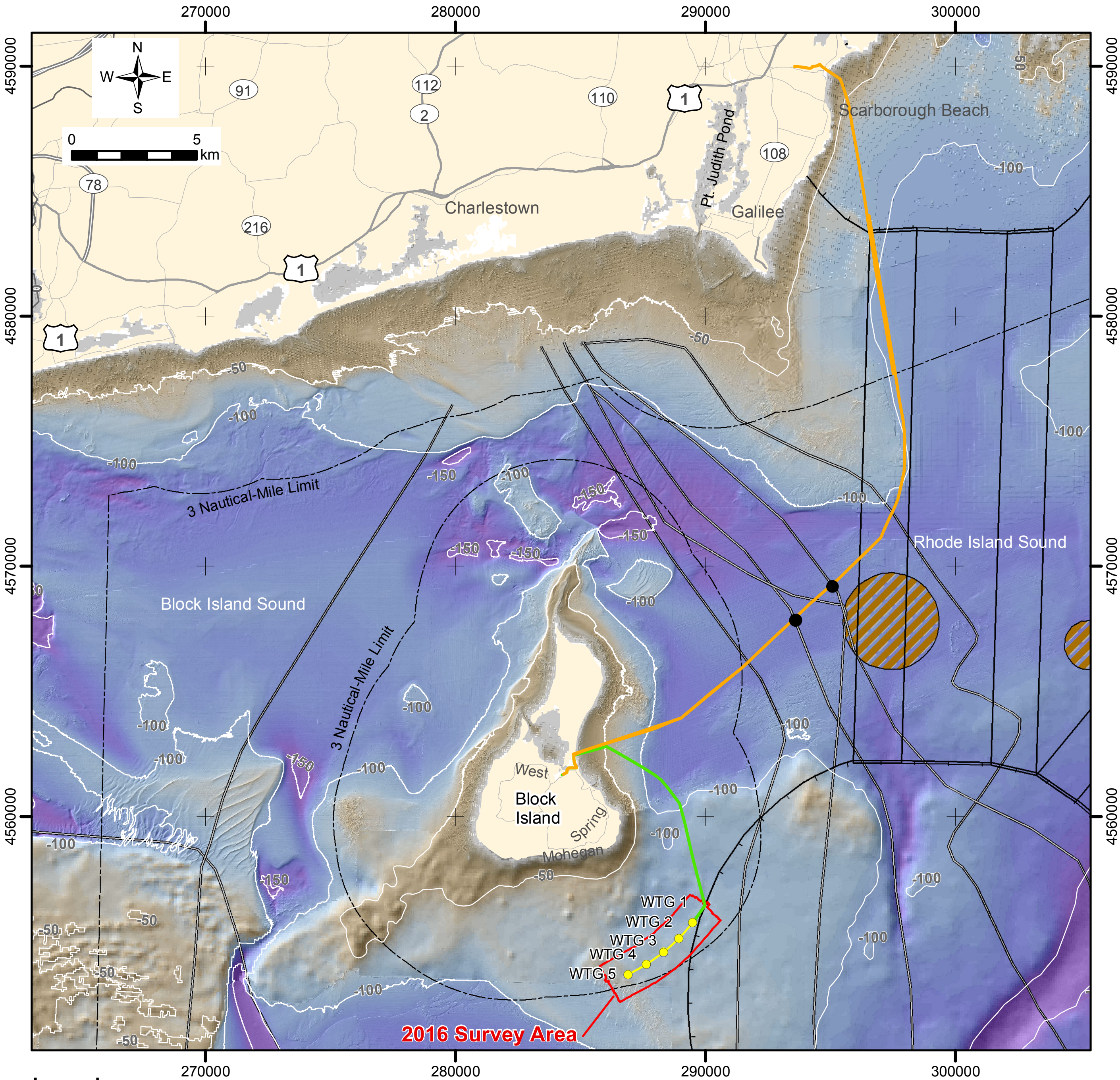
FIGURES



Legend

Block Island Wind Farm

- Turbine
- Active Cable Crossing
- BITS Alternative 1
- Export Cable
- Inter Array Cable

Bathymetry (MLLW, ft)
Source: compiled NOAA survey data

Contour interval is 50 ft.

High : 0

Low : -220

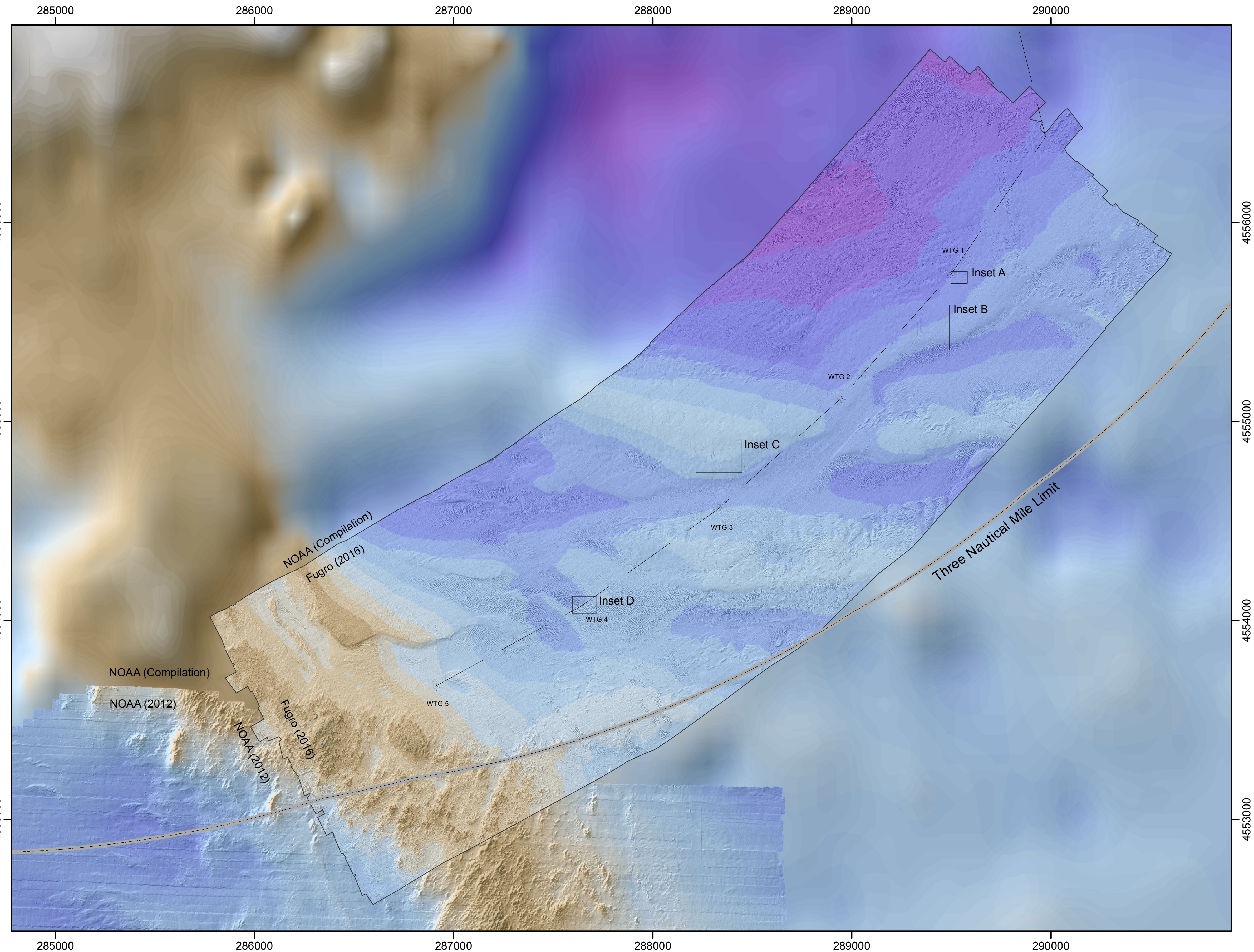
Base Map

- Submarine Cable
- 3 Nautical Mile State Limit
- Precautionary Area
- Traffic Separation Scheme Lane
- Dumping Ground Area
- Coordinate Grid: UTM Zone 19N, NAD83, Meters

STUDY AREA
Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 1

N:\Projects\04_2015\04_8115_0001_BOEM_RODEO\BlockIsland_RI\Outputs\Post_Con_Survey_1\MXD\Fig-1_Study_Area.mxd, 8/5/2016, wcupples



Legend

Export Cable/Inter Array Cable

Three Nautical Mile State Limit

Bathymetry (Meter, MLLW)

- Lower than -30
- -29 to -30
- -28 to -29
- -27 to -28
- -26 to -27
- -25 to -26
- -24 to -25
- -23 to -24
- -22 to -23
- -21 to -22
- -20 to -21
- -19 to -20
- -18 to -19
- -17 to -18
- -16 to -17

Contour interval is 5 meters.
Contour interval is 1 meter.

Notes:

1. Fugro 2016 multibeam bathymetry was collected on May 11 through 12, 2016.

2. NOAA (2012) multibeam bathymetric data is from the National Oceanic and Atmospheric Administration's (NOAA) hydrographic survey of Block Island Sound, New York. This survey was conducted August 25 through August 29, 2012.

3. Bathymetric data is a compilation of NOAA sounding files in the area that were collected between 1938 to 1979.

4. Insets are in reference to Figure 9.

N
W
E
S

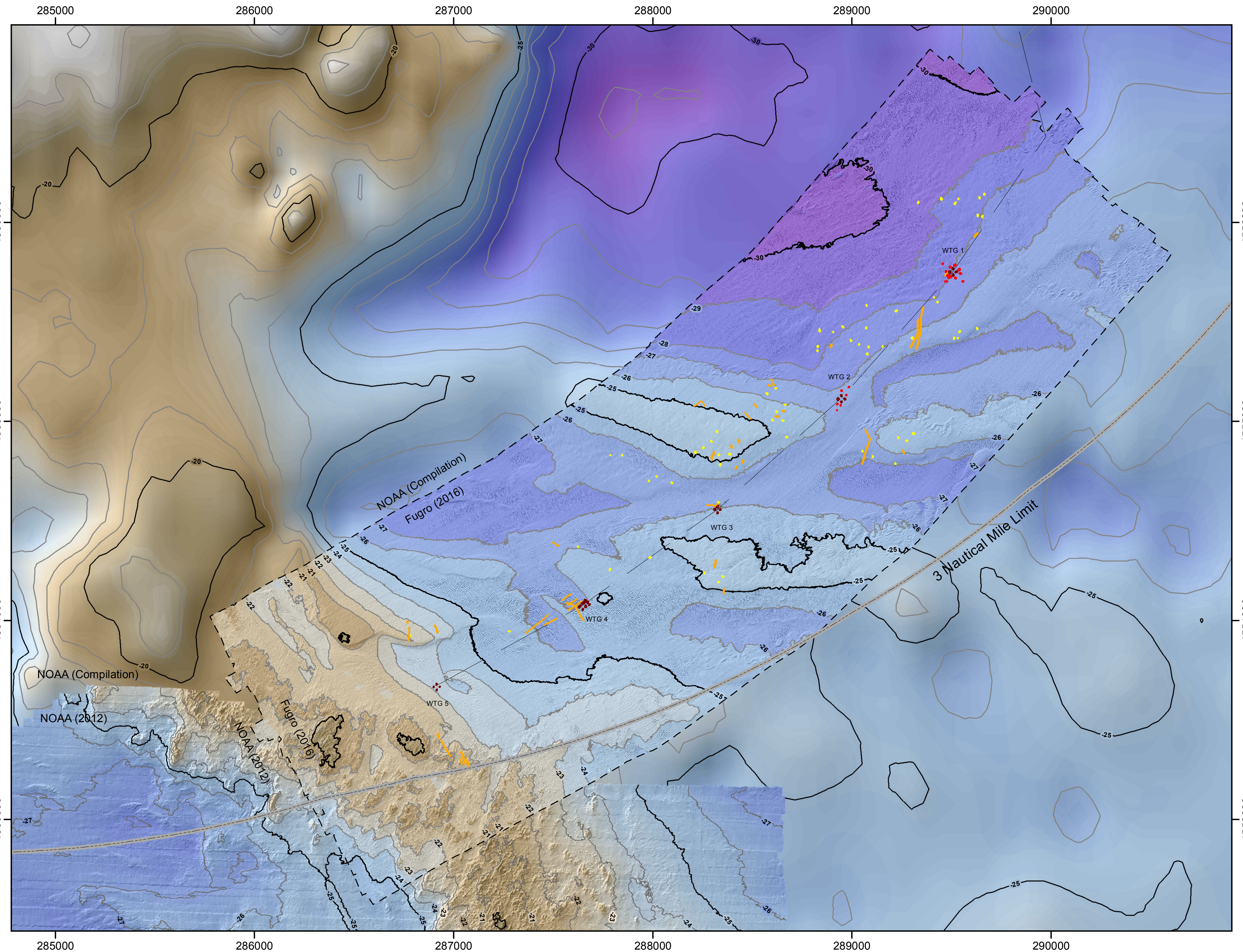
0 200 400 800
Meters

Coordinate System: UTM 19N, NAD83, Meter

FUGRO 2016 BATHYMETRY
Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 2a

N:\Projects\04_2015\04_8115_0001_BOEM_RODEO\BlockIsland_RI\Outputs\Post_Con_Survey_1\MXD\Fig-2a_Distribution_of_Mapped_Seafloor_Disturbance_no_Interp.mxd, 2/23/2017, greenwoodm



Legend

Export Cable/Inter Array Cable

Three Nautical Mile State Limit

Bathymetry (Meter, MLLW)

- Lower than -30
- -29 to -30
- -28 to -29
- -27 to -28
- -26 to -27
- -25 to -26
- -24 to -25
- -23 to -24
- -22 to -23
- -21 to -22
- -20 to -21
- -19 to -20
- -18 to -19
- -17 to -18
- -16 to -17

Contour interval is 5 meters.
Contour interval is 1 meter.

Interpreted Seafloor Disturbance Features

- Spud Location
- Scour
- Linear Feature (Possible Drag Mark)
- Unknown

Notes:

1. Fugro 2016 multibeam bathymetry was collected on May 11 through 12, 2016.

2. NOAA (2012) multibeam bathymetric data is from the National Oceanic and Atmospheric Administration's (NOAA) hydrographic survey of Block Island Sound, New York. This survey was conducted August 25 through August 29, 2012.

3. Bathymetric data is a compilation of NOAA sounding files in the area that were collected between 1938 to 1979.

N
W E
S

0 200 400 800 Meters

Coordinate System: UTM 19N, NAD83, Meter

INTERPRETED SEAFLOOR DISTURBANCE FEATURES

Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 2b

N:\Projects\04_2015\04_8115_0001_BOEM_RODEO\BlockIsland_RI\Outputs\Post_Con_Survey_1\MXD\Fig-2b_Distribution_of_Mapped_Seafloor_Disturbance_Interp.mxd, 8/5/2016, wcupples

Table 1

			Jul-15														Aug-15																															Sep-15																													
Vessel Name	Vessel Type	Site	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
W533	Derrick Crane Barge	WTG1		x	x	x	x	x	x	x	x	x	x	x							x	x	x	x	x	x	x																																					x	x	x												
		WTG2																										x	x	x	x	x	x	x	x										x	x	x	x	x	x	x	x	x																								
		WTG3																																	x	x	x	x	x	x	x			x	x	x	x	x	x	x																											
		WTG4																																								x																										x	x											
		WTG5																																																	x	x	x	x			x	x	x			x	x														
W526	Derrick Crane Barge	WTG1																																																																									
		WTG2																																		x	x	x	x	x	x	x																	x	x	x						x												
		WTG3																																								x							x		x	x	x	x	x	x																					
		WTG4																																																																									
		WTG5																																																																x	x	x										
W297	Cargo Barge	WTG1				x	x			x	x	x	x	x							x	x	x	x																																									x	x													
		WTG2																													x	x	x			x																																												
		WTG3																																			x	x	x	x	x								x		x	x	x	x	x	x																					
		WTG4																																																																									
		WTG5																																																								x	x	x			x	x														
JMC300	Cargo Barge	WTG1			x	x	x	x	x	x	x	x	x	x							x	x	x	x	x	x	x																																					x	x													
		WTG2																										x	x	x	x																														x	x				x														
		WTG3																																																																									
		WTG4																																																																									
		WTG5																																																																									
JMC304	Cargo Barge	WTG1																																																																									
		WTG2																																																																									
		WTG3																																	x																																													
		WTG4																																						x	x	x																									x	x											
		WTG5																																																																									
Marmac300	Cargo Barge	WTG1																																																																									
		WTG2																																																																									
		WTG3																																																																									
		WTG4																																																																									
		WTG5																																														x		x	x	x	x	x	x	x	x							x	x											
L/B Robert	Lift Boat	WTG1																																																																x	x											
		WTG2																																																																		x	x									
		WTG3																																																													x														
		WTG4																																																																		x	x							x		
		WTG5																																																														x	x												
Wotan	Derrick Crane Barge	WTG1																																																																									
		WTG2																																																																									
		WTG3																																																																									
		WTG4																																																																									
		WTG5																																																																									
L/B Michael Eymard	Lift Boat	WTG1																																																																									
		WTG2																																																																									
		WTG3																																																																									
		WTG4																																																																									
		WTG5																																																																									
L/B Lacie Eymard	Lift Boat	WTG1																																																																									
		WTG2																																																																									
		WTG3																																																																									
		WTG4																																																																									
		WTG5																																																																									

Notes:

1. Vessel names and locations are based on DWW Daily Briefings for Mariners posted by DWW on the BIWF website.
2. Refer to Appendix B for vessel specifications.

APPROXIMATE VESSEL LOCATIONS
JULY TO SEPTEMBER 2015
Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 3a

Table 2

			Oct-15																														
Vessel Name	Vessel Type	Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
W533	Derrick Crane Barge	WTG1																															
		WTG2										x	x	x																			
		WTG3																															
		WTG4												x	x	x	x																
		WTG5								x	x	x																					
W526	Derrick Crane Barge	WTG1									x	x	x	x	x	x	x	x	x	x	x	x											
		WTG2																															
		WTG3																															
		WTG4																							x	x	x	x	x				
		WTG5																															
W297	Cargo Barge	WTG1									x	x	x								x												
		WTG2																															
		WTG3																															
		WTG4																															
		WTG5																															
JMC300	Cargo Barge	WTG1																															
		WTG2																															
		WTG3																															
		WTG4																															
		WTG5																															
JMC304	Cargo Barge	WTG1																															
		WTG2																															
		WTG3																															
		WTG4														x	x	x							x	x	x	x	x	x	x	x
		WTG5																															
Marmac300	Cargo Barge	WTG1																															
		WTG2																															
		WTG3																															
		WTG4																															
		WTG5																															
L/B Robert	Lift Boat	WTG1											x	x	x	x	x	x	x	x	x	x	x	x	x	x							x
		WTG2																															
		WTG3																															
		WTG4									x	x	x	x											x	x	x	x	x				
		WTG5																															
Wotan	Derrick Crane Barge	WTG1																															
		WTG2																															
		WTG3																															
		WTG4																			x	x	x	x									
		WTG5																															
L/B Michael Eymard	Lift Boat	WTG1																															
		WTG2																															
		WTG3																															
		WTG4																															
		WTG5																															
L/B Lacie Eymard	Lift Boat	WTG1																															
		WTG2																															
		WTG3																															
		WTG4																															
		WTG5																															

			Nov-15																													
Vessel Name	Vessel Type	Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
W533	Derrick Crane Barge	WTG1																														
		WTG2																														
		WTG3																														
		WTG4																														
		WTG5																														
W526	Derrick Crane Barge	WTG1	x	x	x	x											x	x	x							x	x					
		WTG2				x	x																								x	x
		WTG3																x	x	x	x											
		WTG4								x	x	x																				
		WTG5																					x	x	x							
W297	Cargo Barge	WTG1																														
		WTG2																														
		WTG3																														
		WTG4																														
		WTG5																														
JMC300	Cargo Barge	WTG1																														
		WTG2																														
		WTG3																														
		WTG4																														
		WTG5																														
JMC304	Cargo Barge	WTG1	x	x	x																											
		WTG2				x	x																									
		WTG3																														
		WTG4																														
		WTG5																														
Marmac300	Cargo Barge	WTG1																														
		WTG2																														
		WTG3															x	x	x													
		WTG4									x																					
		WTG5																														
L/B Robert	Lift Boat	WTG1	x	x																												
		WTG2			x	x	x	x	x	x																						
		WTG3														x	x	x	x													
		WTG4								x	x	x	x	x	x	x																
		WTG5																		x	x	x	x	x	x	x						
Wotan	Derrick Crane Barge	WTG1																														
		WTG2																														
		WTG3																														
		WTG4																														
		WTG5																														
L/B Michael Eymard	Lift Boat	WTG1																														
		WTG2																														
		WTG3																														
		WTG4																														
		WTG5																														
L/B Lacie Eymard	Lift Boat	WTG1																														
		WTG2																														
		WTG3																														
		WTG4																														
		WTG5																														

			Dec-15						
Vessel Name	Vessel Type	Site	1	2	3	4	5	6	7
W533	Derrick Crane Barge	WTG1							
		WTG2							
		WTG3							
		WTG4							
		WTG5							
W526	Derrick Crane Barge	WTG1							
		WTG2	x	x					
		WTG3							
		WTG4				x	x		
		WTG5							
W297	Cargo Barge	WTG1							
		WTG2							
		WTG3							
		WTG4							
		WTG5							
JMC300	Cargo Barge	WTG1							
		WTG2							
		WTG3							
		WTG4							
		WTG5							
JMC304	Cargo Barge	WTG1							
		WTG2							
		WTG3							
		WTG4							
		WTG5							
Marmac300	Cargo Barge	WTG1							
		WTG2							
		WTG3							
		WTG4							
		WTG5							
L/B Robert	Lift Boat	WTG1							
		WTG2							
		WTG3							
		WTG4							
		WTG5							
Wotan	Derrick Crane Barge	WTG1							
		WTG2							
		WTG3							
		WTG4							
		WTG5							
L/B Michael Eymard	Lift Boat	WTG1							
		WTG2							
		WTG3							
		WTG4							
		WTG5							
L/B Lacie Eymard	Lift Boat	WTG1							
		WTG2							
		WTG3							
		WTG4							
		WTG5							

Notes:
1. Vessel names and locations are based on DWW Daily Briefings for Mariners posted by DWW on the BIWF website.
2. Refer to Appendix B for vessel specifications.

APPROXIMATE VESSEL LOCATIONS
OCTOBER TO DECEMBER 2015
Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 3b

Table 3

			Apr-16							May-16																													
Vessel Name	Vessel Type	Site	25	26	27	28	29	30		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
W533	Derrick Crane	WTG1																																					
	Barge	WTG2																																					
		WTG3																																					
		WTG4																																					
		WTG5																																					
W526	Derrick Crane	WTG1																																					
	Barge	WTG2																																					
		WTG3																																					
		WTG4																																					
		WTG5																																					
W297	Cargo Barge	WTG1																																					
		WTG2																																					
		WTG3																																					
		WTG4																																					
		WTG5																																					
JMC300	Cargo Barge	WTG1																																					
		WTG2																																					
		WTG3																																					
		WTG4																																					
		WTG5																																					
JMC304	Cargo Barge	WTG1																																					
		WTG2																																					
		WTG3																																					
		WTG4																																					
		WTG5																																					
Marmac300	Cargo Barge	WTG1																																					
		WTG2																																					
		WTG3																																					
		WTG4																																					
		WTG5																																					
L/B *Robert*	Lift Boat	WTG1																																					
		WTG2																																					
		WTG3																																					
		WTG4																																					
		WTG5																																					
Wotan	Derrick Crane	WTG1																																					
	Barge	WTG2																																					
		WTG3																																					
		WTG4																																					
		WTG5																																					
L/B *Michael*	Lift Boat	WTG1		x	x	x	x	x		x																	x	x	x										
Eymard		WTG2									x																			x									
		WTG3																													x	x	x	x	x	x	x	x	x
		WTG4																			x	x																	
		WTG5																					x	x	x	x	x												
L/B *Lacie*	Lift Boat	WTG1																																			x	x	
Eymard		WTG2																																x	x	x	x			x
		WTG3																		x	x	x	x																
		WTG4																							x	x	x	x	x	x	x								
		WTG5																													x	x	x							

Note:
1. Vessel names and locations are based on DWW Daily Briefings for Mariners posted by DWW on the BIWF website.
2. Refer to Appendix B for vessel specifications.

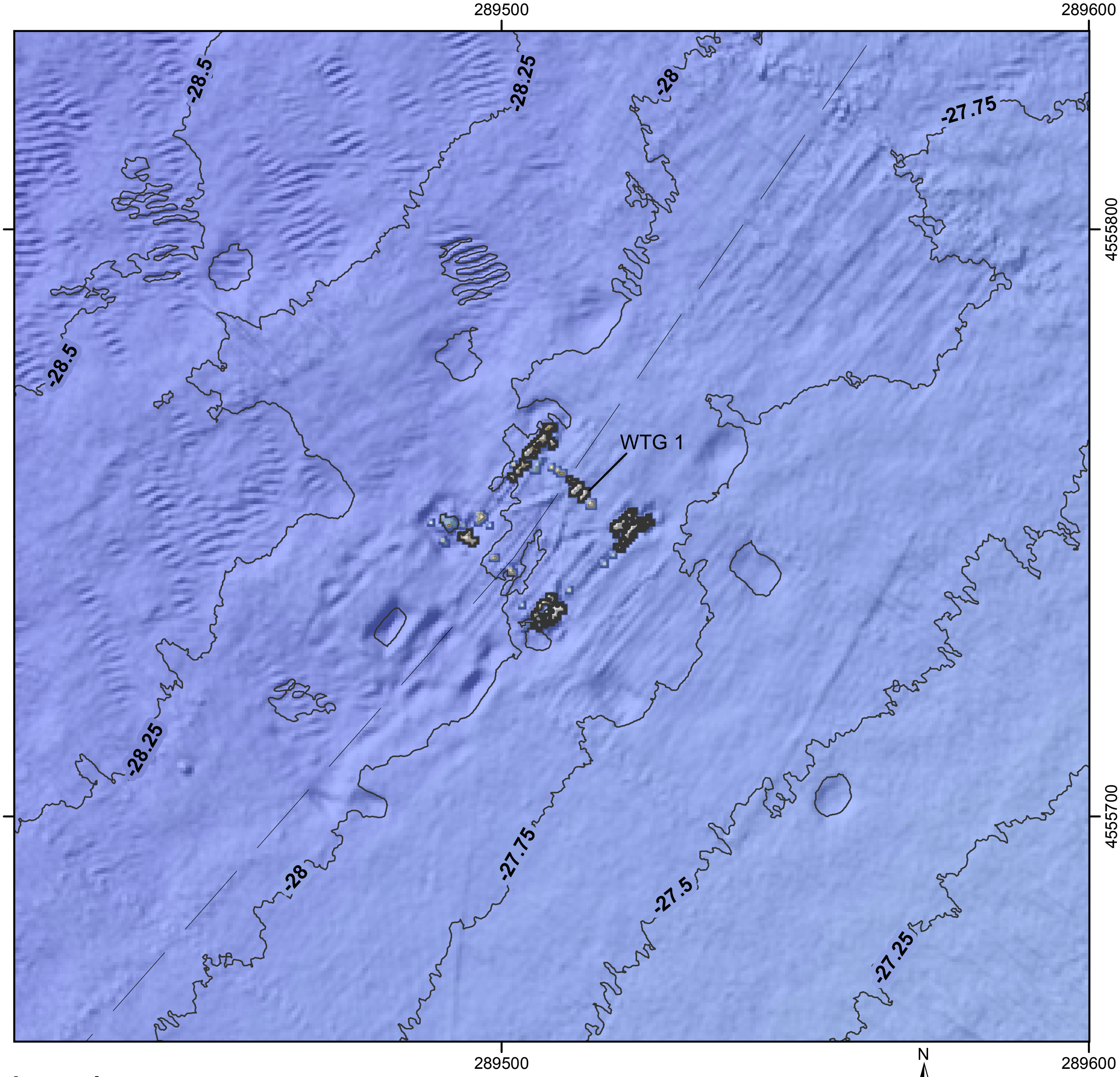
APPROXIMATE VESSEL LOCATIONS APRIL THROUGH MAY 2016

Seafloor Monitoring Study

Block Island Wind Farm and Transmission Project

Offshore Rhode Island

FIGURE 3c



Legend

Export Cable/Inter Array Cable

2016 Fugro Bathymetry (Meter, MLLW)

High : -17

Low : -31

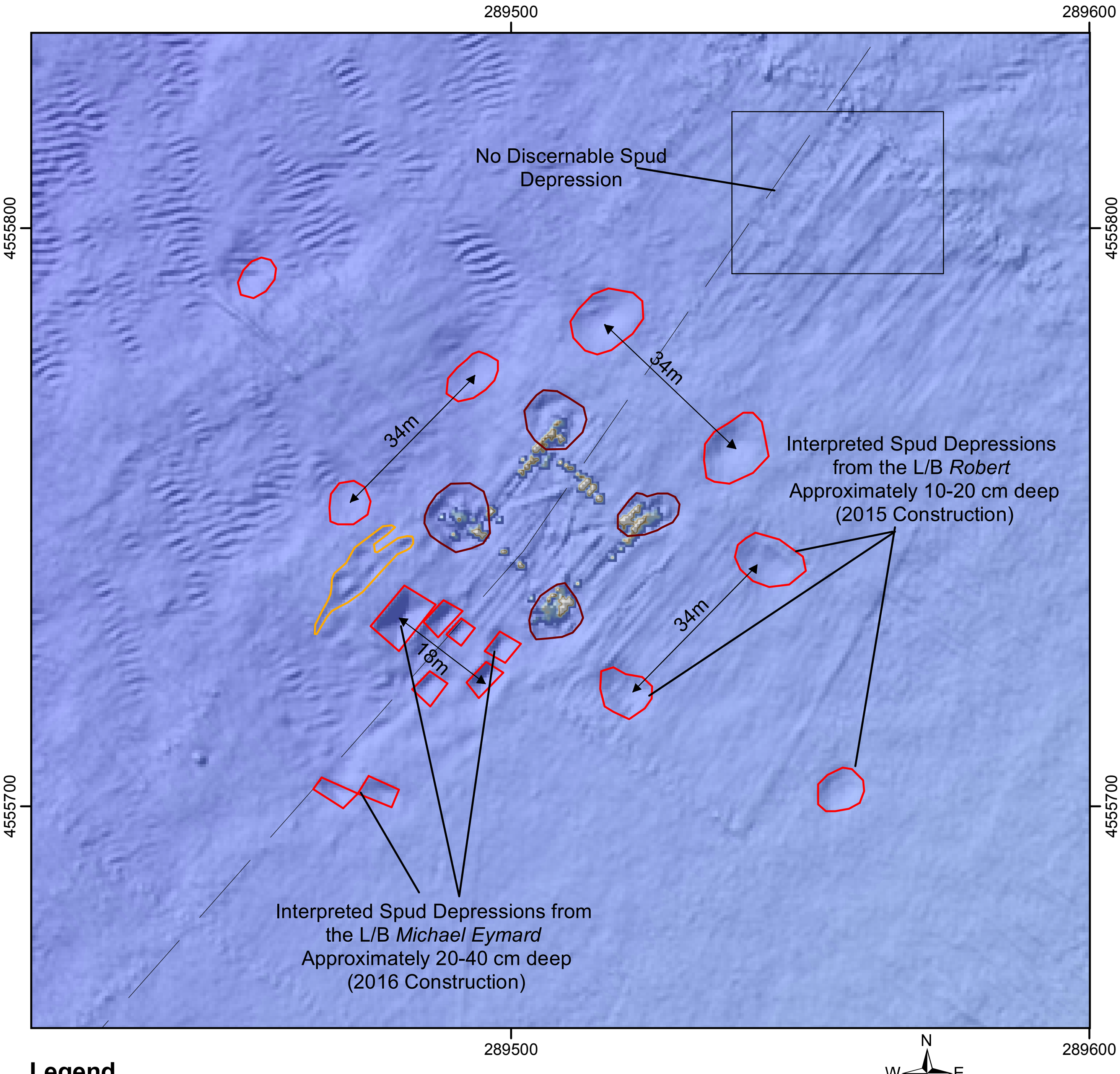
Contour interval is 0.25 meters

0 10 20 40
Meters

Coordinate System: UTM 19N, NAD83, Meter

WIND TURBINE GENERATOR NO. 1 BATHYMETRY
Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 4a



Legend

Export Cable/Inter Array Cable

Interpreted Seafloor Disturbance Features

- Spud
- Scour
- Drag Mark

2016 Fugro Bathymetry (Meter, MLLW)

High : -17

Low : -31

0 10 20 40 Meters

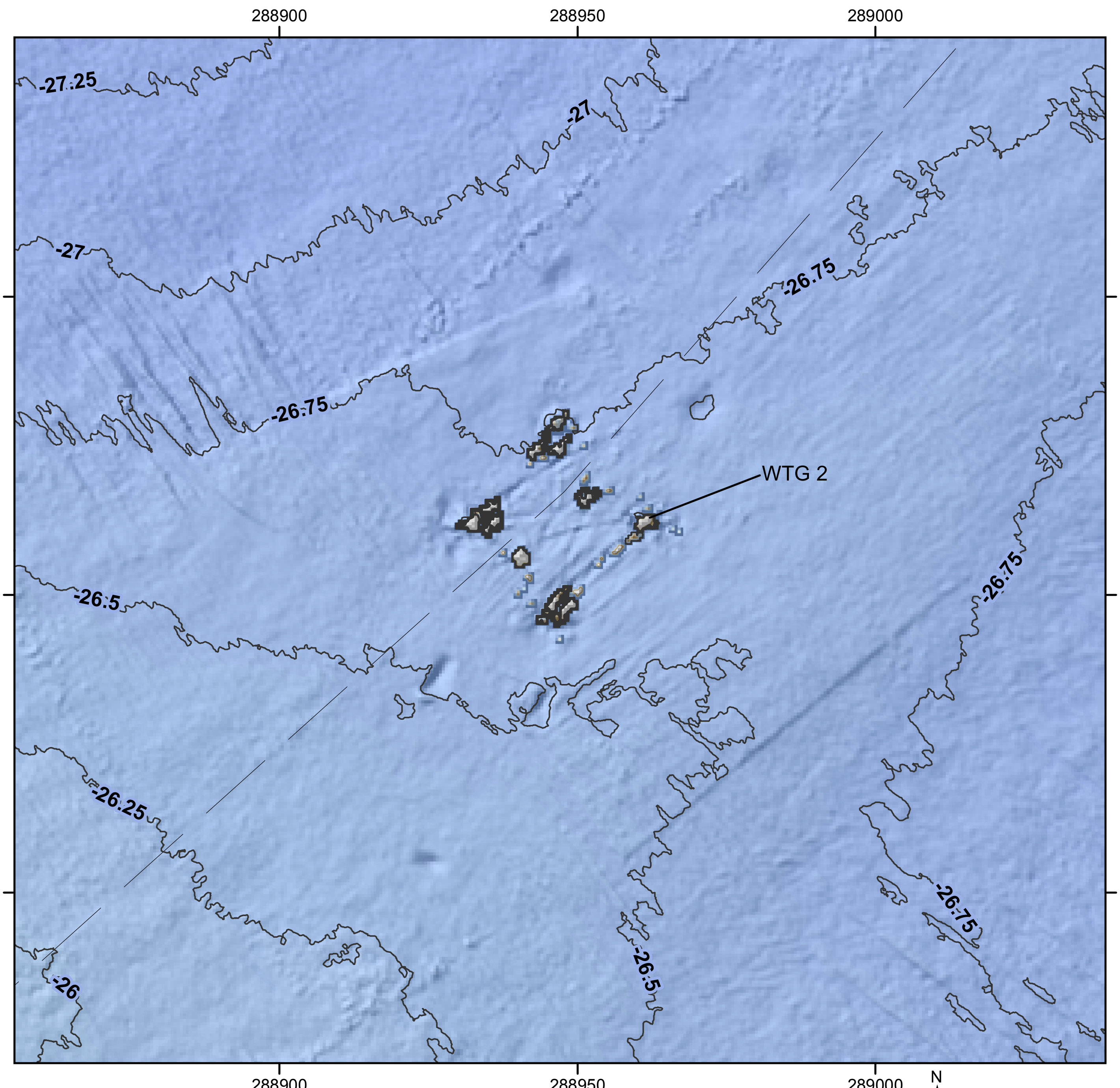
Coordinate System: UTM 19N, NAD83, Meter

WIND TURBINE GENERATOR NO. 1
INTERPRETED SEAFLOOR DISTURBANCE

Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 4b

N:\Projects\04_2015\04_8115_0001_BOEM_RODEO\BlockIsland_RI\Outputs\Post_Con_Survey_1\MXD\Fig-4b_WTG1_Bathymetry_with_Interp.mxd, 2/20/2017, greenwoodm



Legend

Export Cable/Inter Array Cable

2016 Fugro Bathymetry (Meter, MLLW)

High : -17

Low : -31

Contour interval is 0.25 meters

0 10 20 40 Meters

Coordinate System: UTM 19N, NAD83, Meter

WIND TURBINE GENERATOR NO. 2 BATHYMETRY

Seafloor Monitoring Study

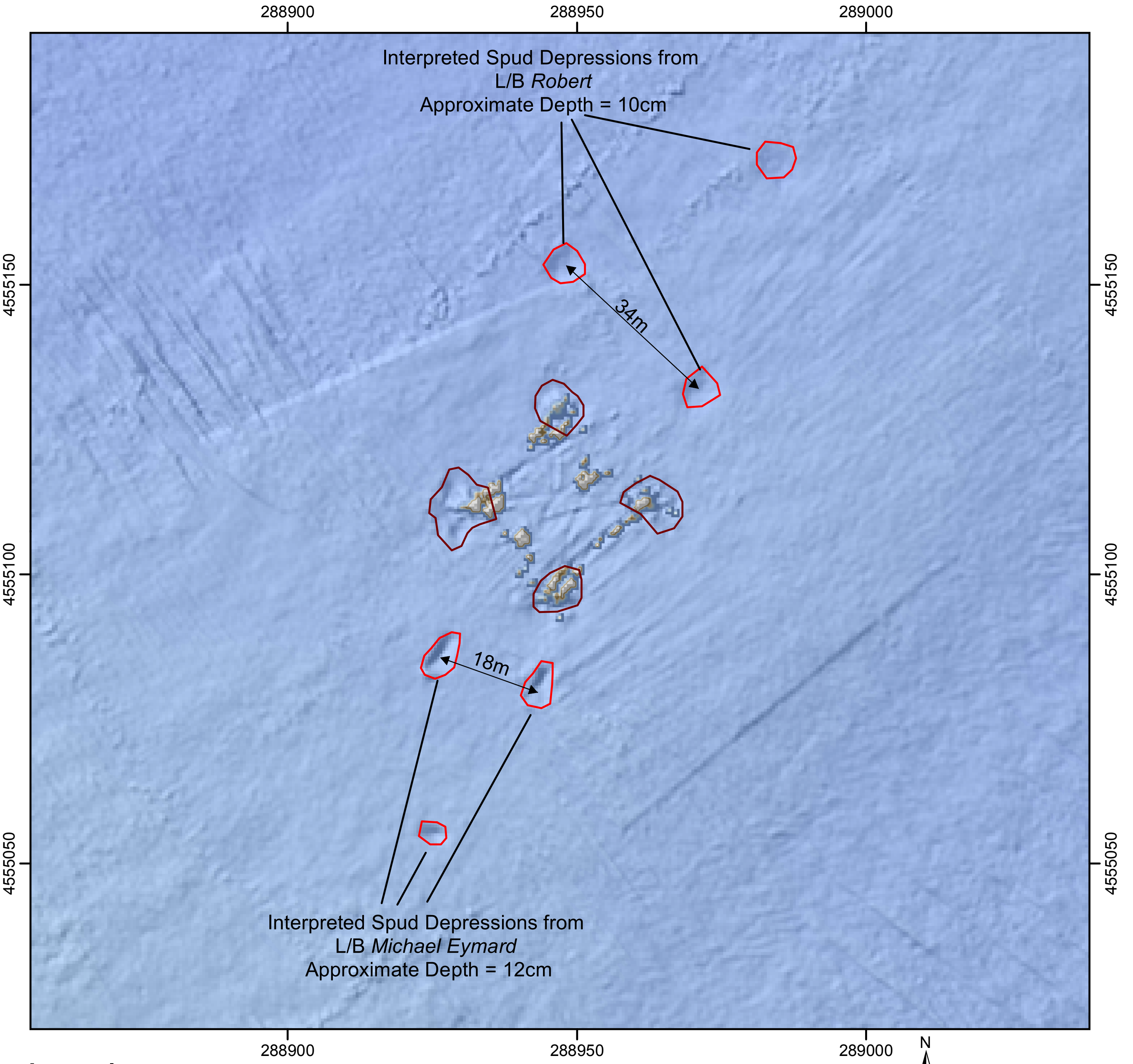
Block Island Wind Farm and Transmission Project

Offshore Rhode Island

FIGURE 5a

N:\Projects\04_2015\04_8115_0001_BOEM_RODEO\BlockIsland_RI\Outputs\Post_Con_Survey_1\MXD\Fig-5a_WTG2_Bathymetry_with_Contours.mxd, 2/17/2017, greenwoodm

BOEM
Project No. 04.81150001



Legend

Export Cable/Inter Array Cable

Interpreted Seafloor Disturbance Features

Spud

Scour

2016 Fugro Bathymetry (Meter, MLLW)

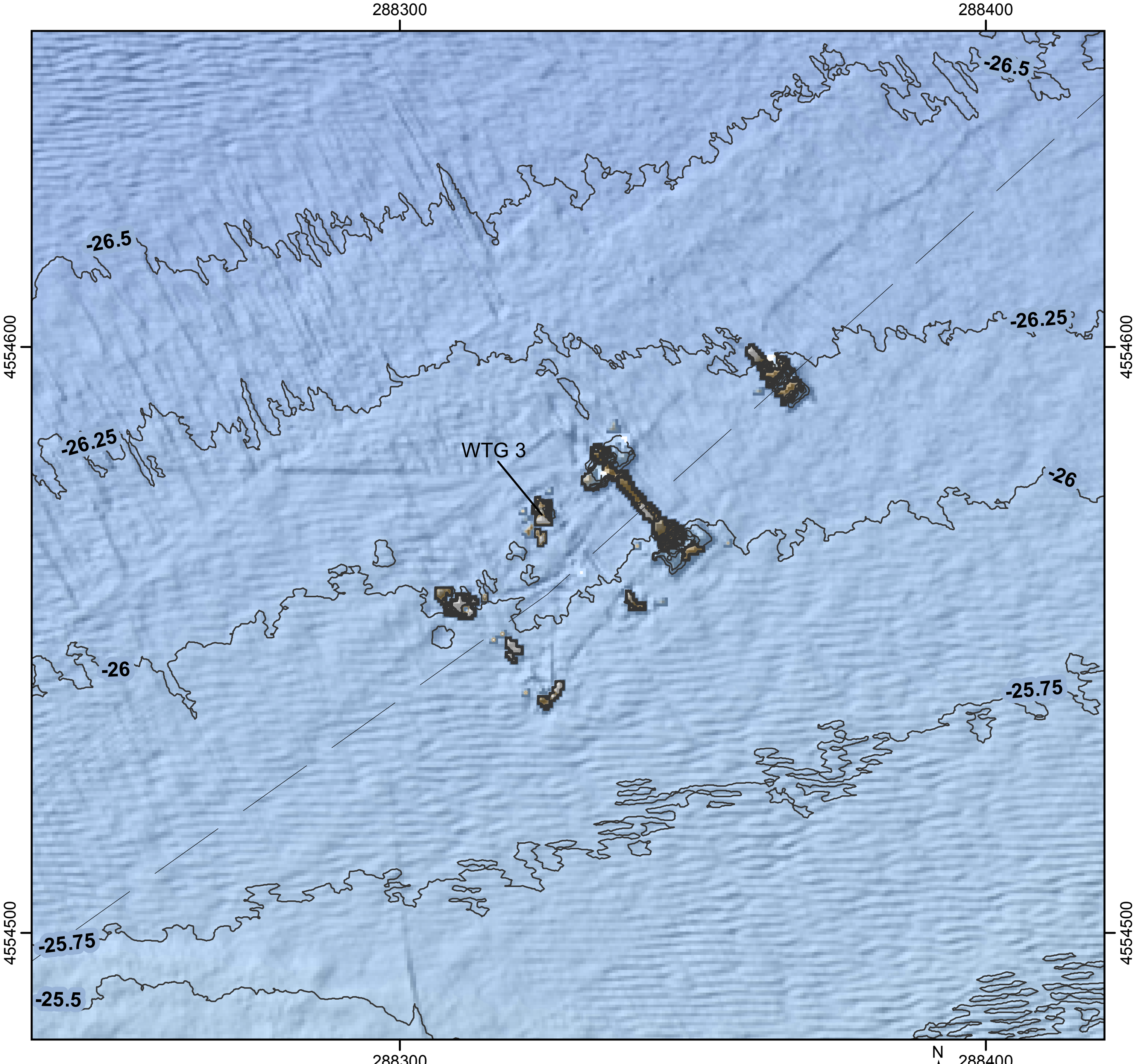
High : -17

Low : -31

WIND TURBINE GENERATOR NO. 2
INTERPRETED SEAFLOOR DISTURBANCE
Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 5b

N:\Projects\04_2015\04_8115_0001_BOEM_RODEO\BlockIsland_RI\Outputs\Post_Con_Survey_1\MXD\Fig-5b_WTG2_Bathymetry_with_Interp.mxd, 2/20/2017, greenwoodm



Legend

Export Cable/Inter Array Cable

2016 Fugro Bathymetry (Meter, MLLW)

High : -17

Low : -31

Contour interval is 0.25 meters

0 10 20 40 Meters

Coordinate System: UTM 19N, NAD83, Meter

WIND TURBINE GENERATOR NO. 3 BATHYMETRY

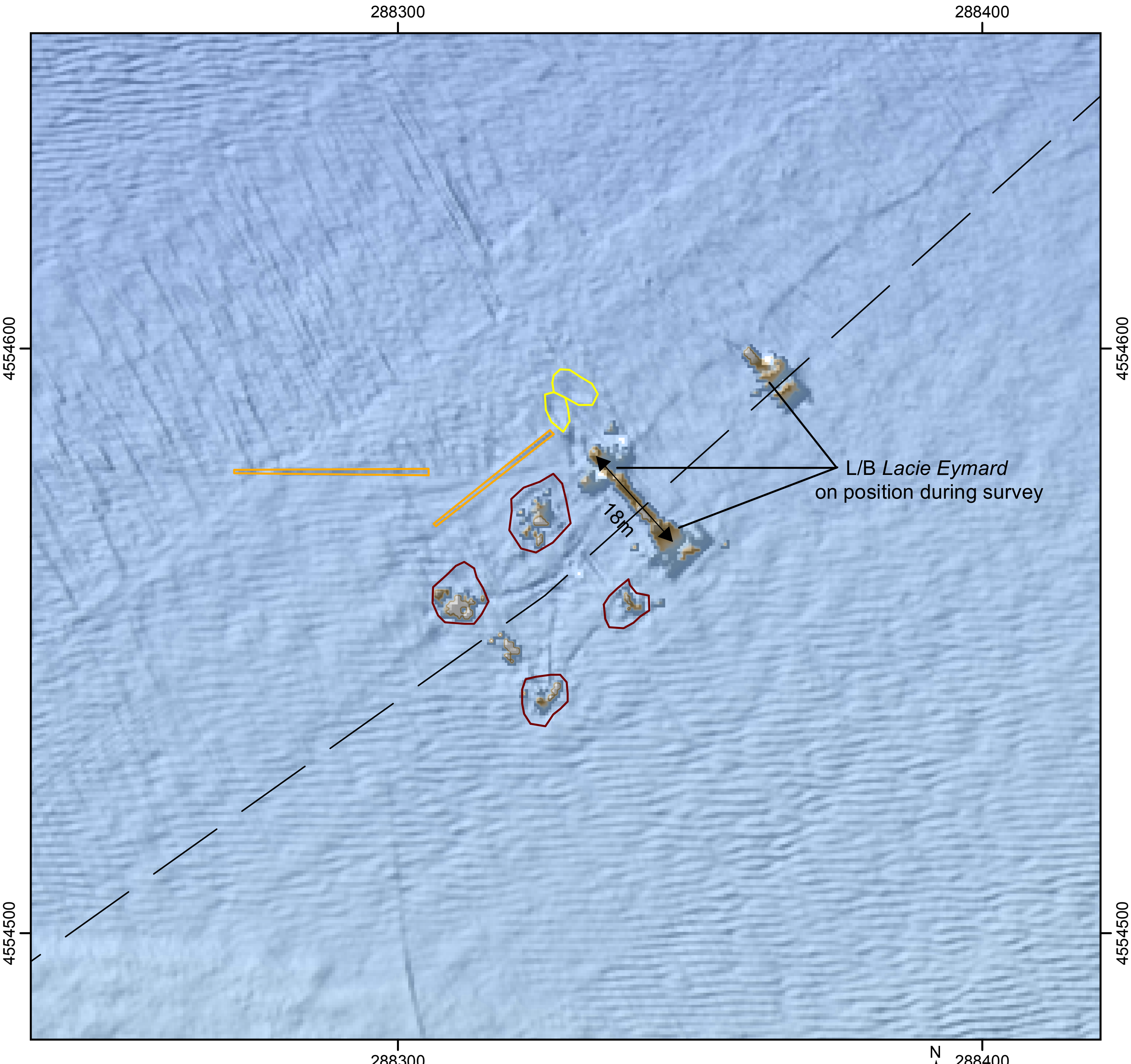
Seafloor Monitoring Study

Block Island Wind Farm and Transmission Project

Offshore Rhode Island

FIGURE 6a

N:\Projects\04_2015\04_8115_0001_BOEM_RODEO\BlockIsland_RI\Outputs\Post_Con_Survey_1\MXD\Fig-6a_WTG3_Bathymetry_with_Contours.mxd, 2/17/2017, greenwoodm



Legend

Export Cable/Inter Array Cable

Interpreted Seafloor Disturbance Features

Scour

Drag Mark

Circular Depression

2016 Fugro Bathymetry (Meter, MLLW)

High : -17

Low : -31

0 10 20 40 Meters

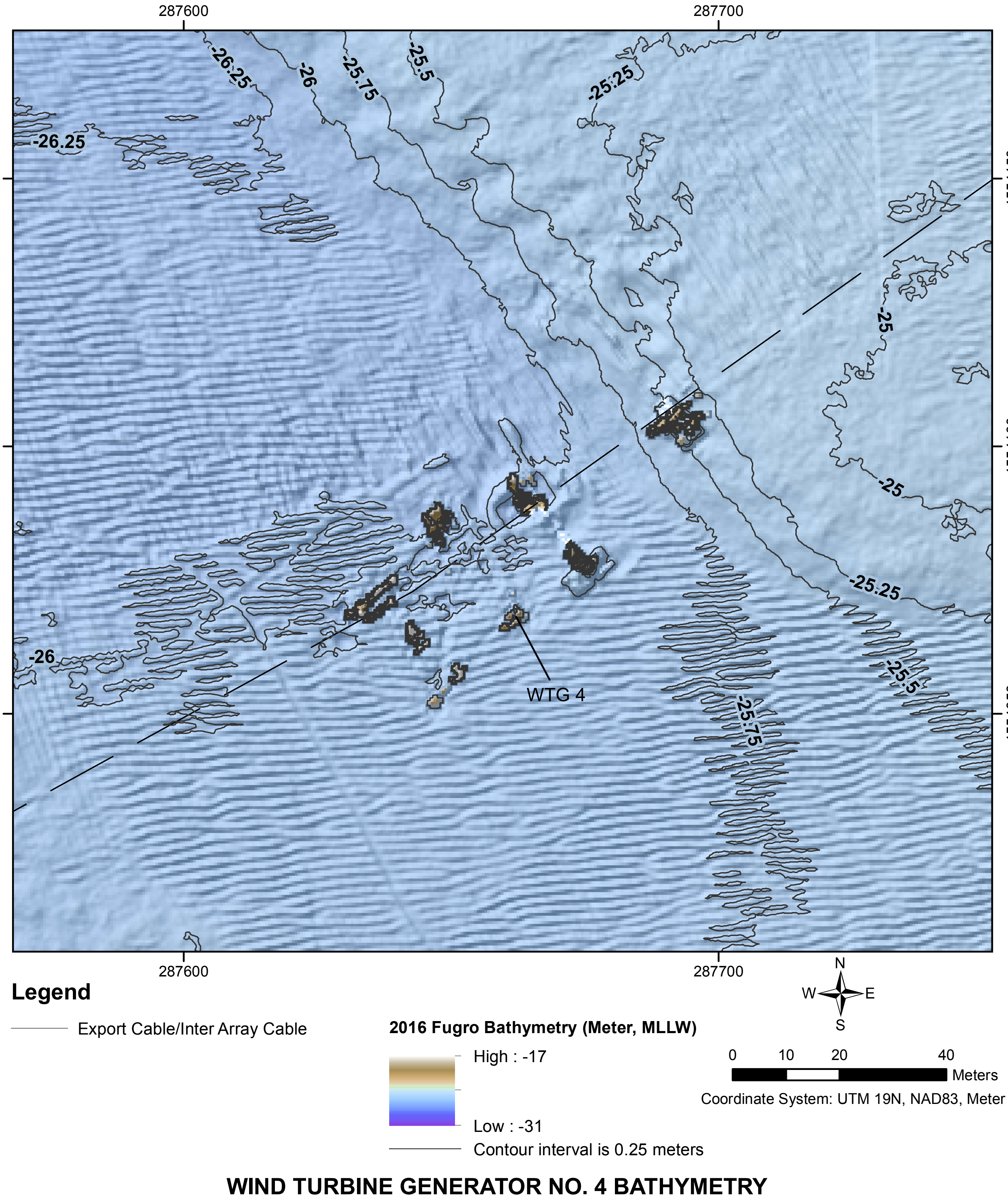
Coordinate System: UTM 19N, NAD83, Meter

WIND TURBINE GENERATOR NO. 3
INTERPRETED SEAFLOOR DISTURBANCE

Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 6b

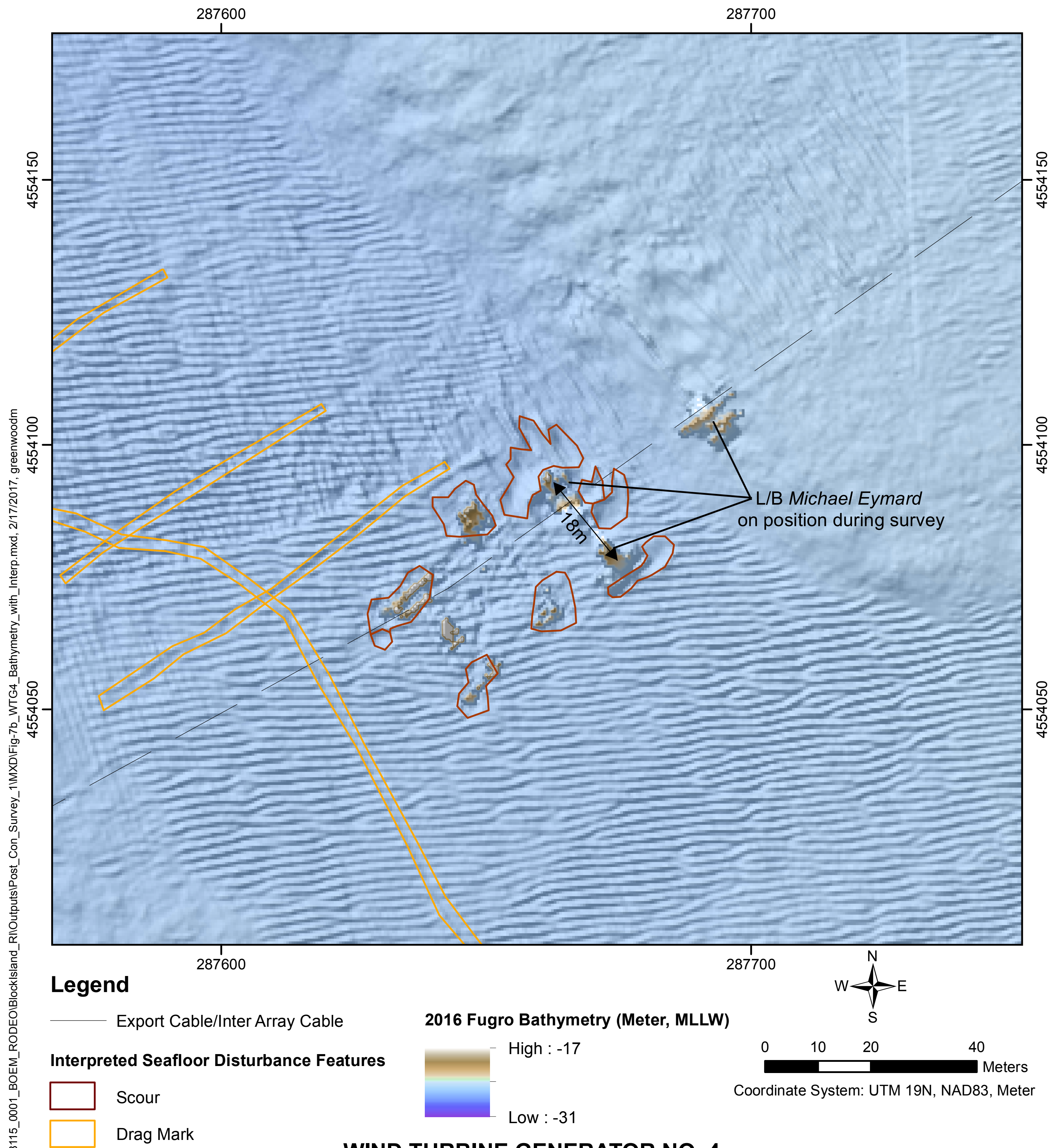
N:\Projects\04_2015\04_8115_0001_BOEM_RODEO\BlockIsland_RI\Outputs\Post_Con_Survey_1\MXD\Fig-6b_WTG3_Bathymetry_with_Interp.mxd, 2/17/2017, greenwoodm



WIND TURBINE GENERATOR NO. 4 BATHYMETRY
Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 7a

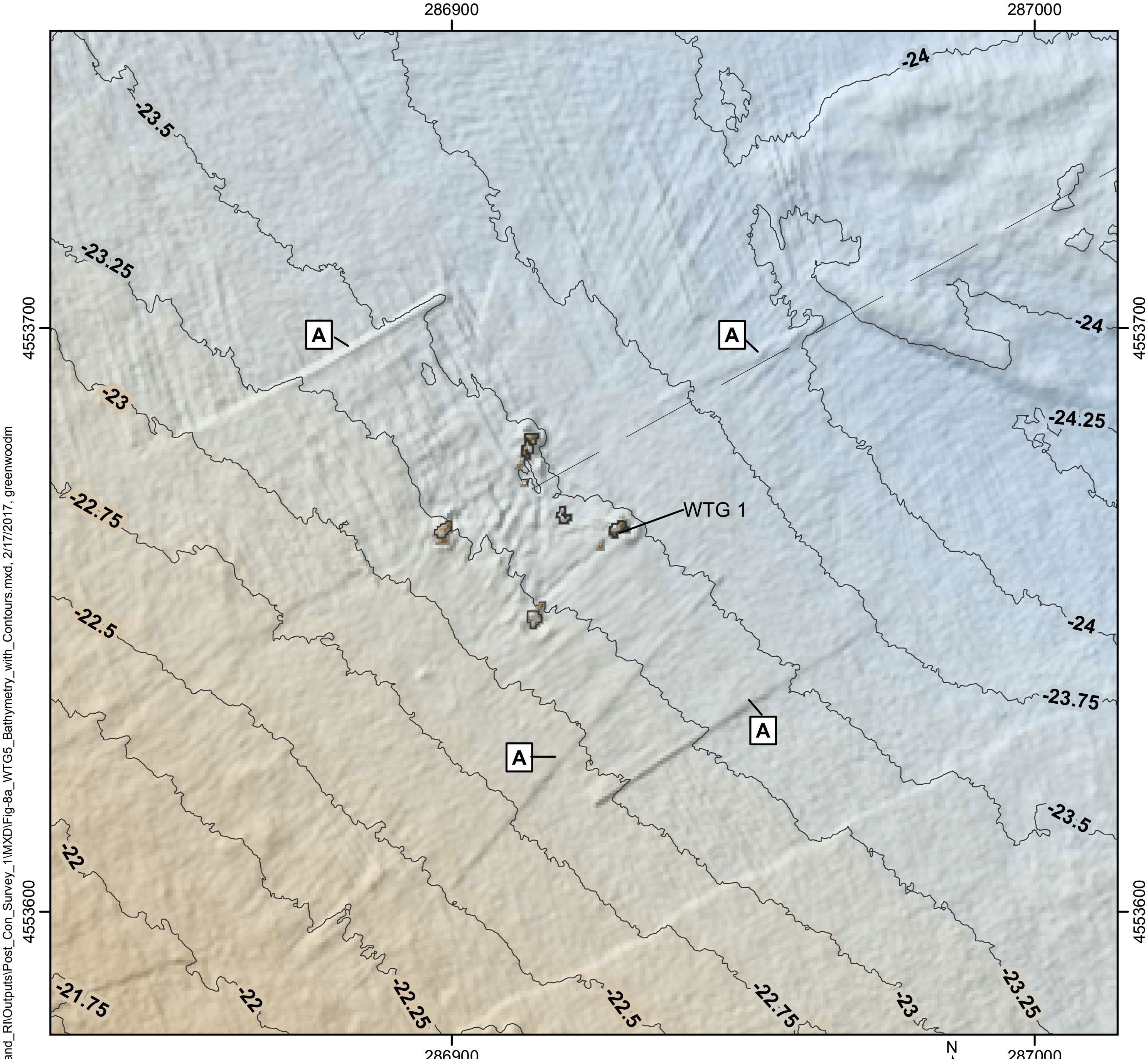
N:\Projects\04_2015\04_8115_0001_BOEM_RODEO\BlockIsland_RI\Outputs\Post_Con_Survey_1\MXD\Fig-7a_WTG4_Bathymetry_with_Contours.mxd, 2/17/2017, greenwoodm



N:\Projects\04_2015\04_8115_0001_BOEM_RODEO\BlockIsland_RI\Outputs\Post_Con_Survey_1\MXD\Fig-7b_WTG4_Bathymetry_with_Interp.mxd, 2/17/2017, greenwoodm

WIND TURBINE GENERATOR NO. 4
INTERPRETED SEAFLOOR DISTURBANCE
Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 7b



Legend

Export Cable/Inter Array Cable

A Data Artifact

2016 Fugro Bathymetry (Meter, MLLW)

High : -17

Low : -31

Contour interval is 0.25 meters

0 10 20 40 Meters

Coordinate System: UTM 19N, NAD83, Meter

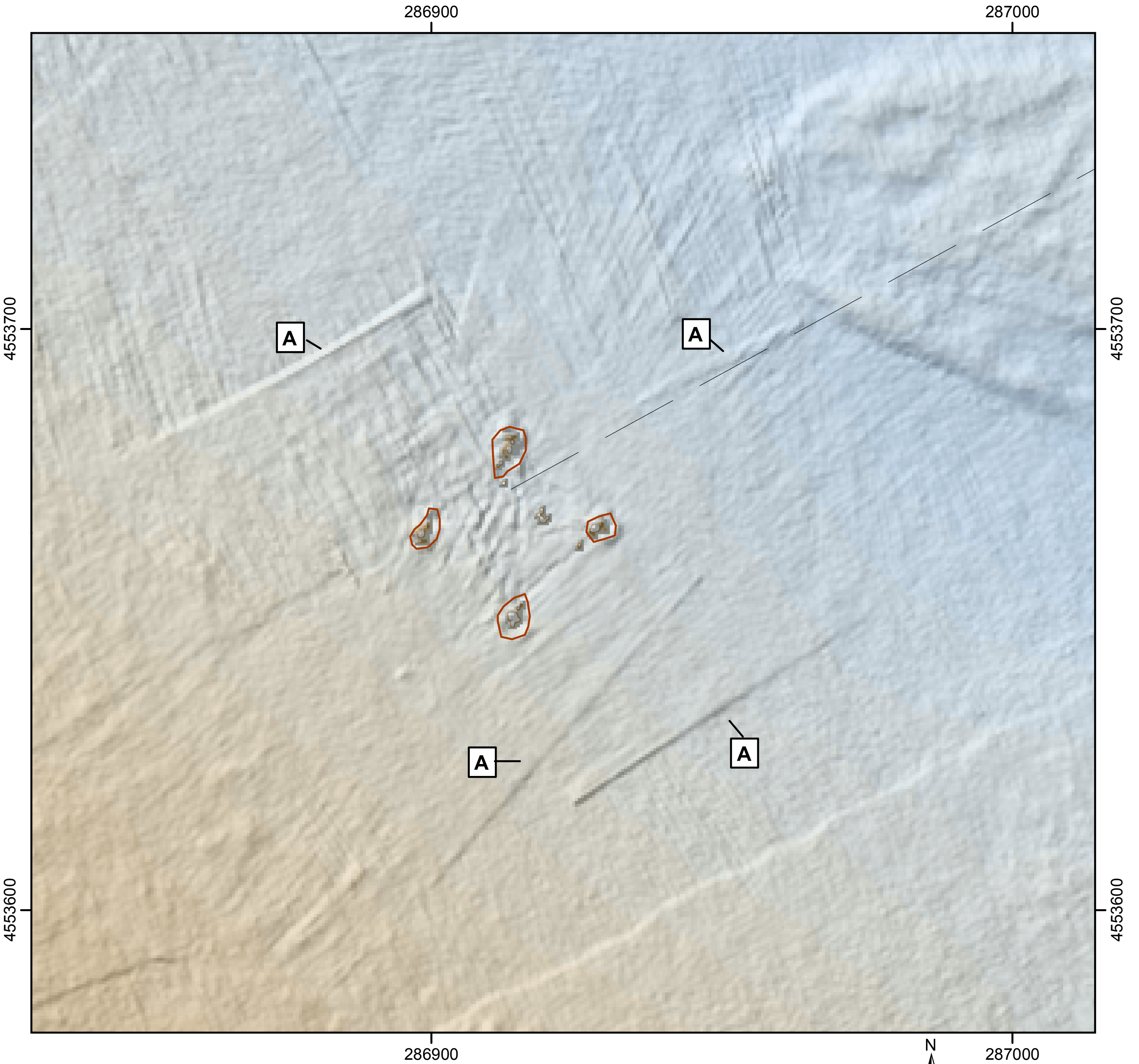
WIND TURBINE GENERATOR NO. 5 BATHYMETRY

Seafloor Monitoring Study

Block Island Wind Farm and Transmission Project

Offshore Rhode Island

FIGURE 8a



Legend

Export Cable/Inter Array Cable

A Data Artifact

Interpreted Seafloor Disturbance Features

Scour

2016 Fugro Bathymetry (Meter, MLLW)

High : -17

Low : -31

0 10 20 40 Meters

Coordinate System: UTM 19N, NAD83, Meter

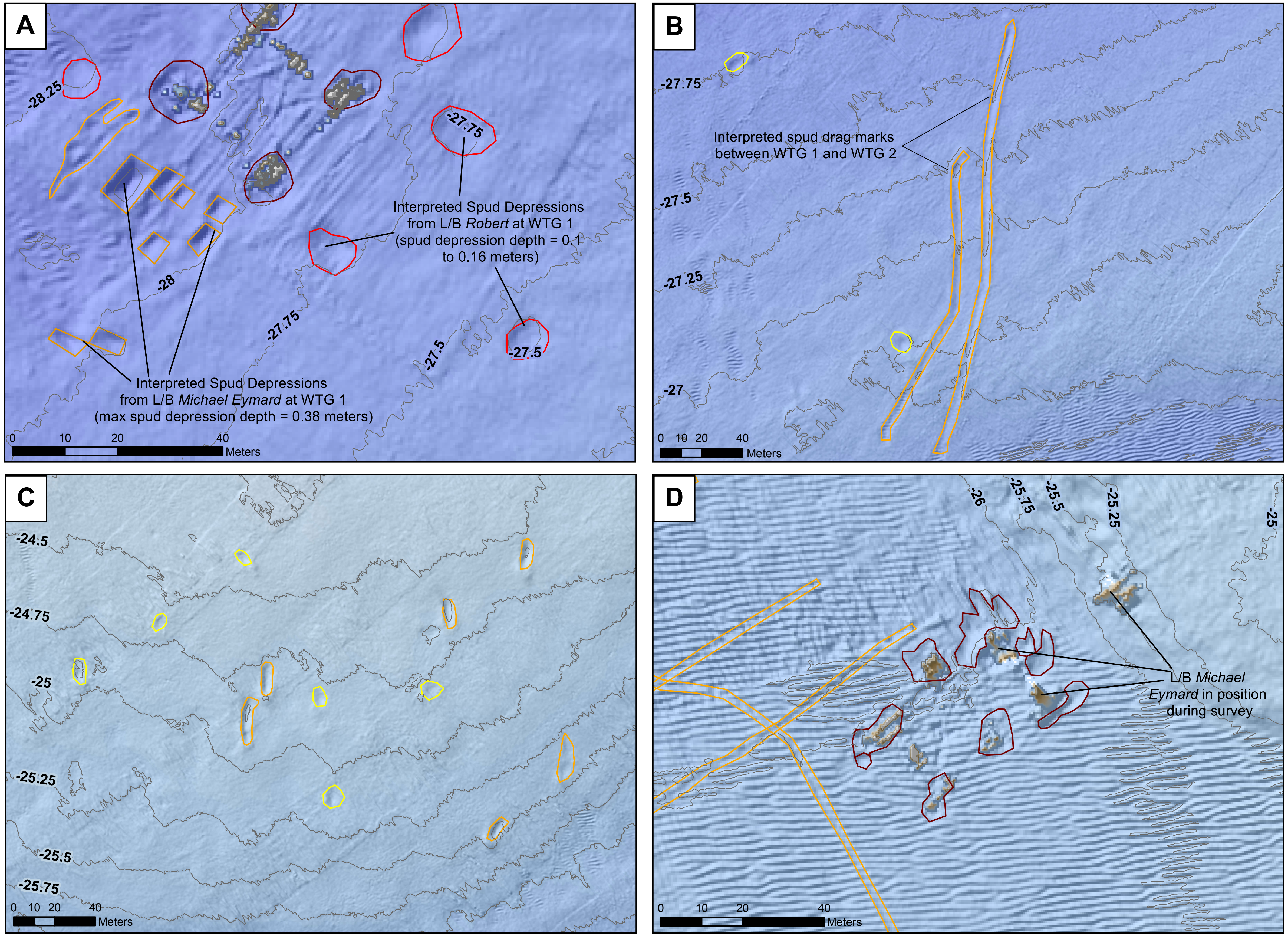
WIND TURBINE GENERATOR NO. 5
INTERPRETED SEAFLOOR DISTURBANCE

Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 8b

N:\Projects\04_2015\04_8115_0001_BOEM_RODEO\BlockIsland_RI\Outputs\Post_Con_Survey_1\MXD\Fig-8b_WTG5_Bathymetry_with_Interp.mxd, 8/5/2016, wcupples

FUGRO



Legend

2016 Fugro Bathymetry (Meter, MLLW)

High : -17

Low : -31

Interpreted Seafloor Disturbance Features

- Spud Location
- Scour
- Drag Mark
- Circular Depression

Notes:

1. Refer to Figure 2 for location of images.
2. Inset A: Probable spud locations around WTG 1 from L/B *Roberts*. Each depression has an average diameter of 7 m with an average depth of approximately 0.13 m.
3. Inset B: Two drag marks with lengths of 152 m (left) and 215 m (right), Each drag mark has an average width of 4 m and an approximate maximum depth of 0.12 m.
4. Inset C: Series of circular depressions or drag marks from vessels at wind turbine. Depressions range in depth from 0.08-0.22 in depth.
5. Inset D: Scour depressions located around WTG 4. Predominately elongated in the northwest direction. Have an average maximum depth of 0.09 m.

N
W E
S

Coordinate System: UTM 19N, NAD83, Meter

SELECTED SEAFLOOR DISTURBANCE FEATURES

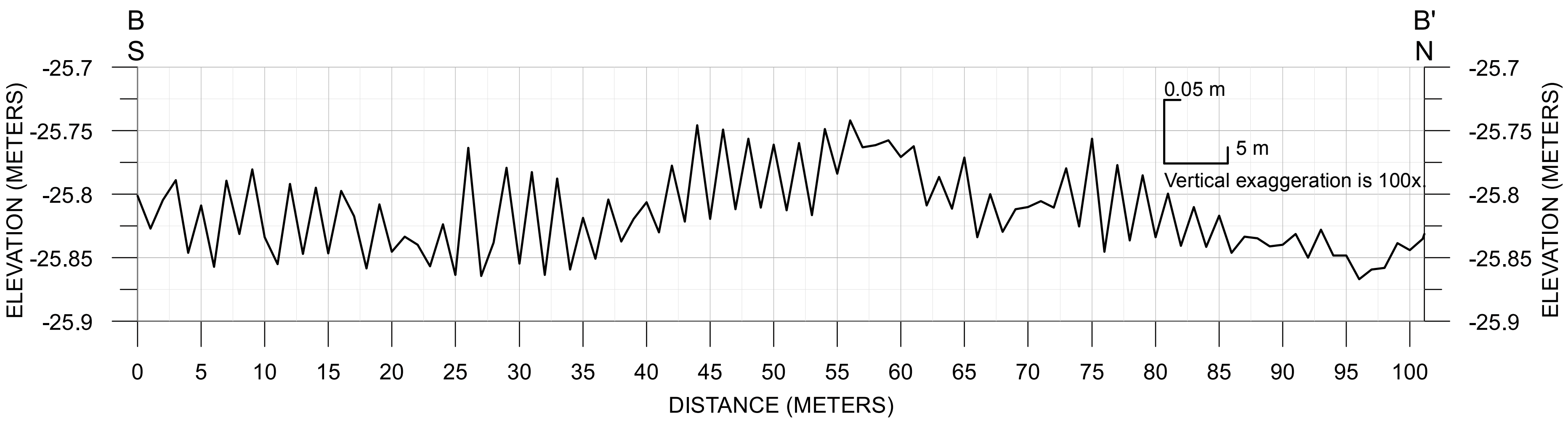
Seafloor Monitoring Study

Block Island Wind Farm and Transmission Project

Offshore Rhode Island

FIGURE 9

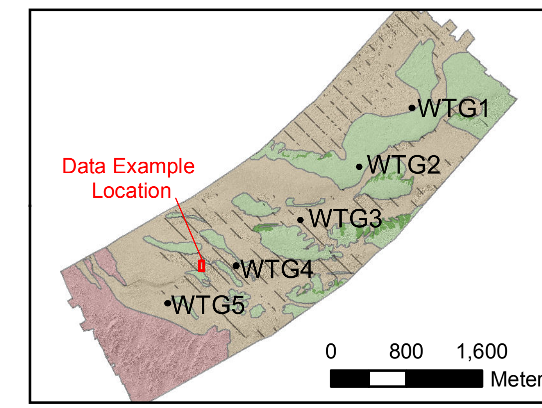
N:\Projects\04_2015\04_8115_0001_BOEM_RODEO\BlockIsland_RI\Outputs\Post_Con_Survey_1\MXD\Fig-8_Other_Seafloor_Dist_Features.mxd, 2/20/2017, greenwoodm



Legend

Interpreted Sediment Mobility Zones
(based on particle size, morphology, and comparison between 2012 and 2016 surveys)

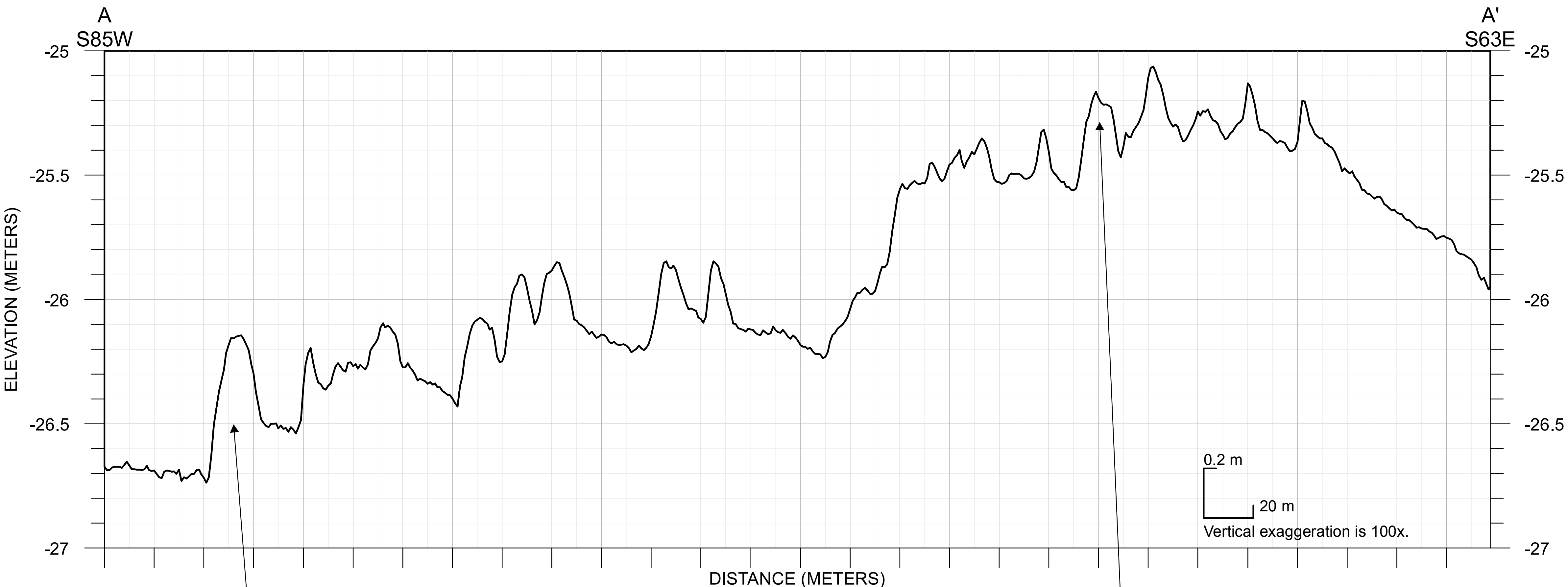
- 1 High Mobility Ridges or Shoals (Fine Sand)
  - 1a Higher Mobility Sand Dunes
- 2 Moderate Mobility (Medium-Coarse Sand)
  - 2a Sand Ripple Area
- 3 Low Mobility Morraine Ridges (Gravel, Cobbles, and Boulders)

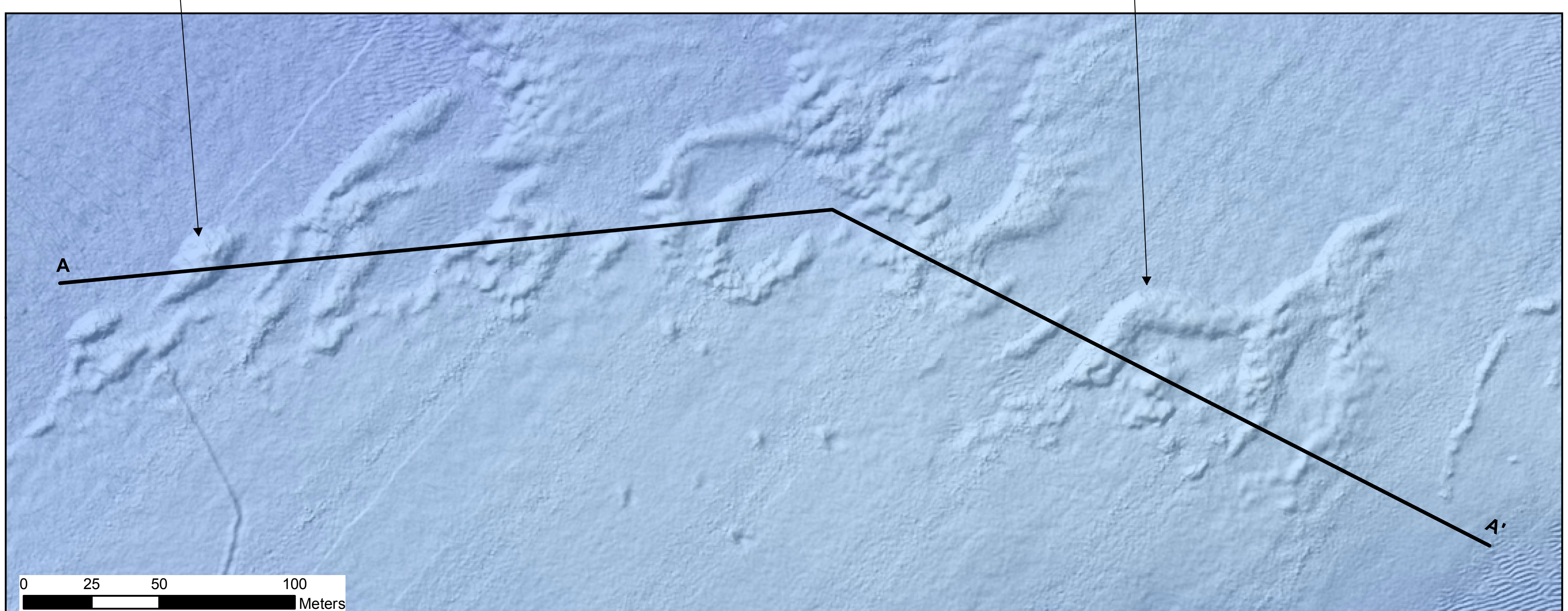


Coordinate System: UTM 19N, NAD83, Meter

EXAMPLE OF RIPPLE BEDFORMS
Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 10

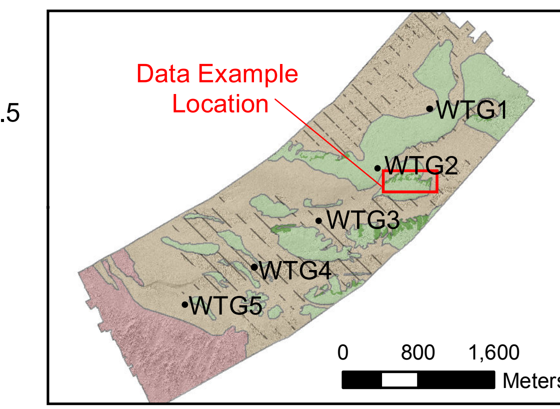




Legend

Interpreted Sediment Mobility Zones
(based on particle size, morphology, and comparison between 2012 and 2016 surveys)

- 1 High Mobility Ridges or Shoals (Fine Sand)
- 1a Higher Mobility Sand Dunes
- 2 Moderate Mobility (Medium-Coarse Sand)
- 2a Sand Ripple Area
- 3 Low Mobility Morraine Ridges (Gravel, Cobbles, and Boulders)

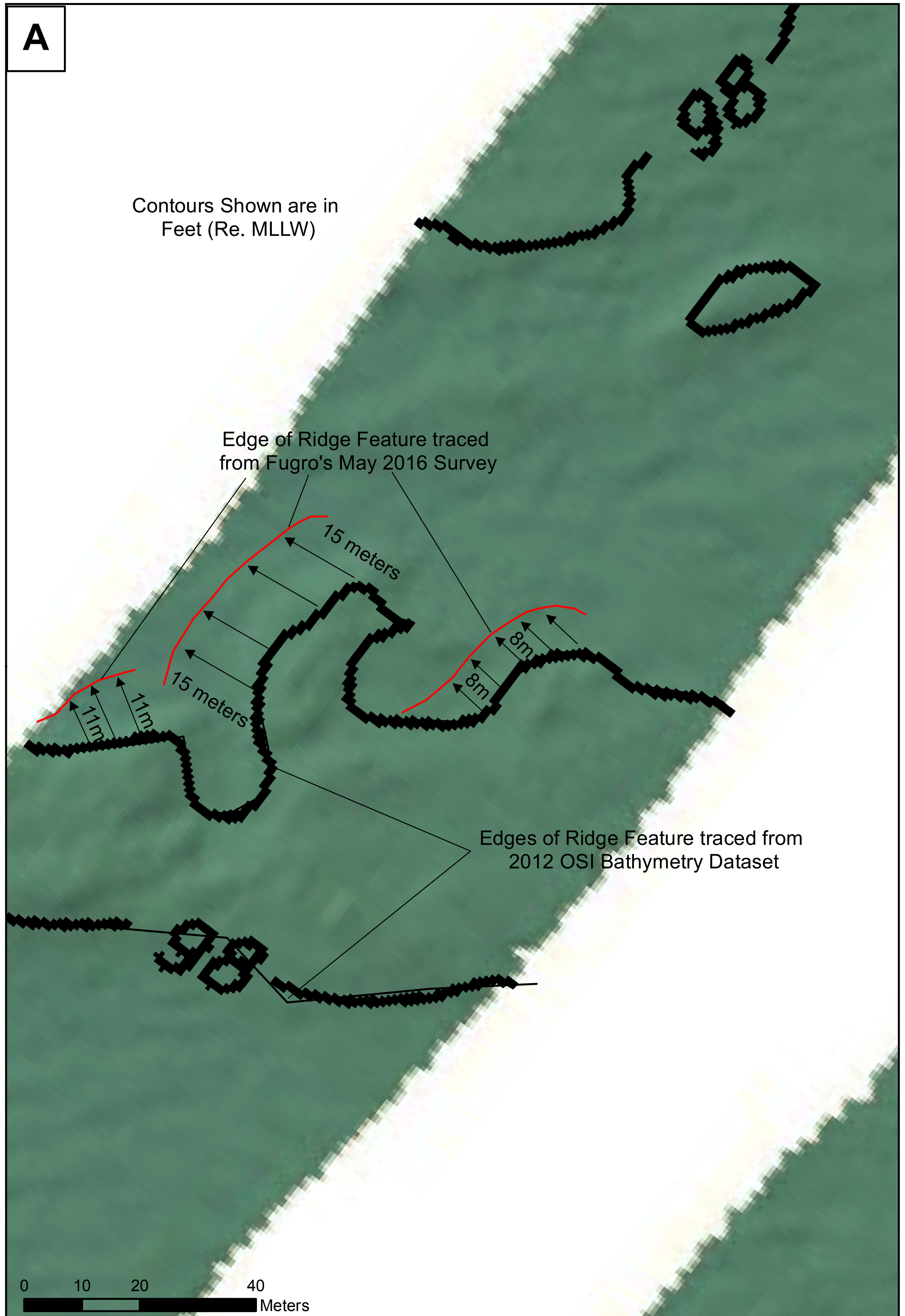


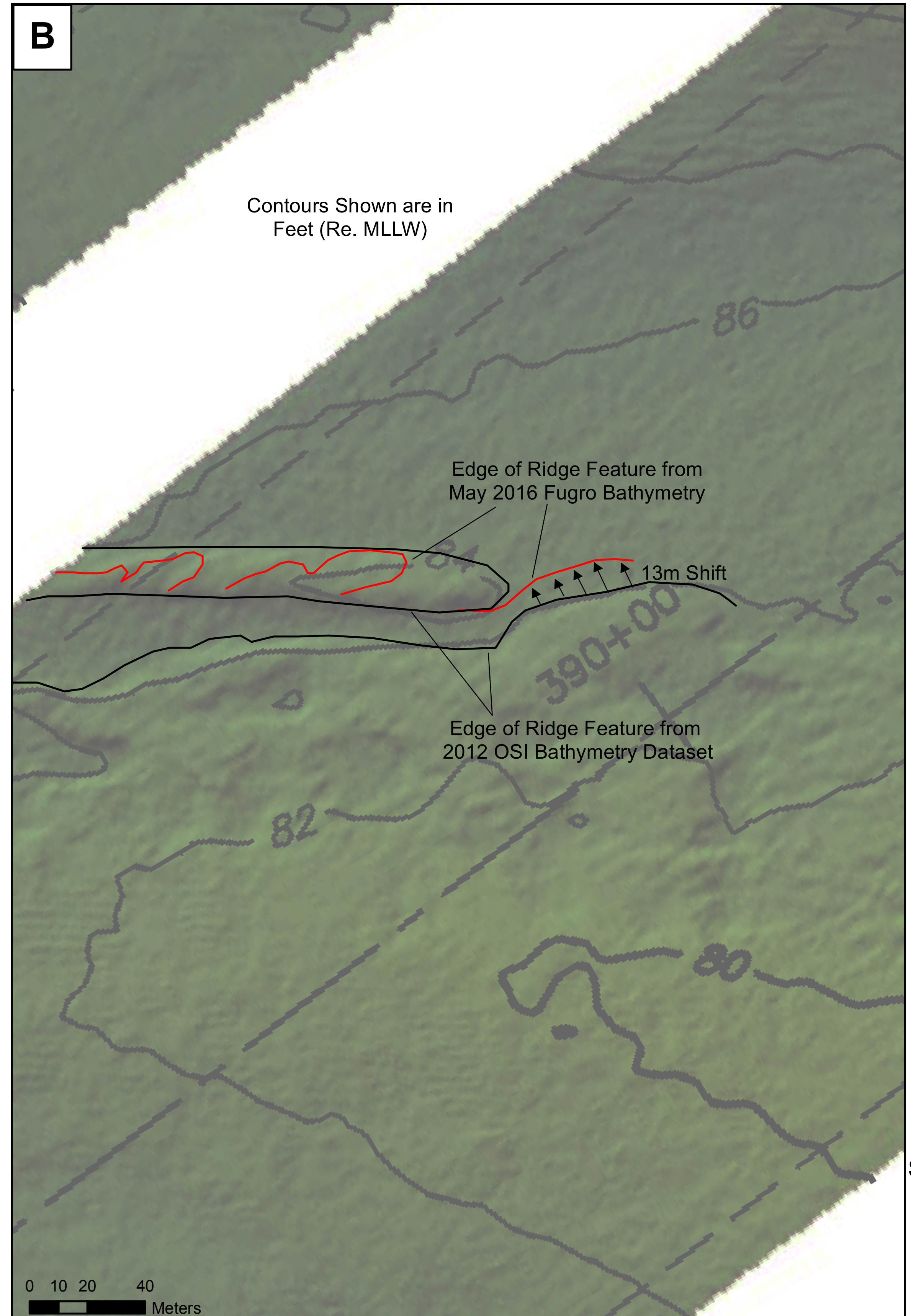
N
W E
S

Coordinate System: UTM 19N, NAD83, Meter

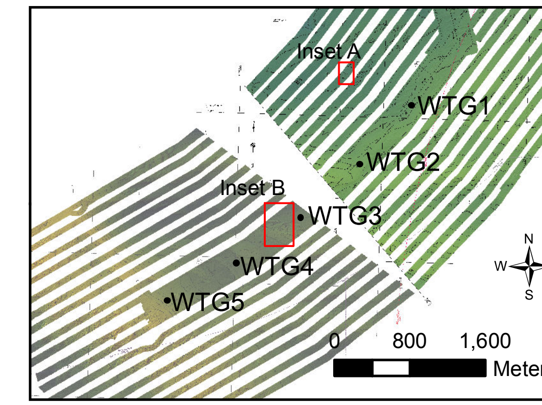
EXAMPLE OF DUNE BEDFORMS
Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 11





Inset Map Locations



Notes:

1. 2012 bathymetry was collected by Ocean Surveys Inc. (OSI) from January 11 to September 19, 2012 using a multibeam echosounder.

2. 2016 bathymetry was collected by Fugro from May 11 to 12, 2016 using a multibeam echosounder.

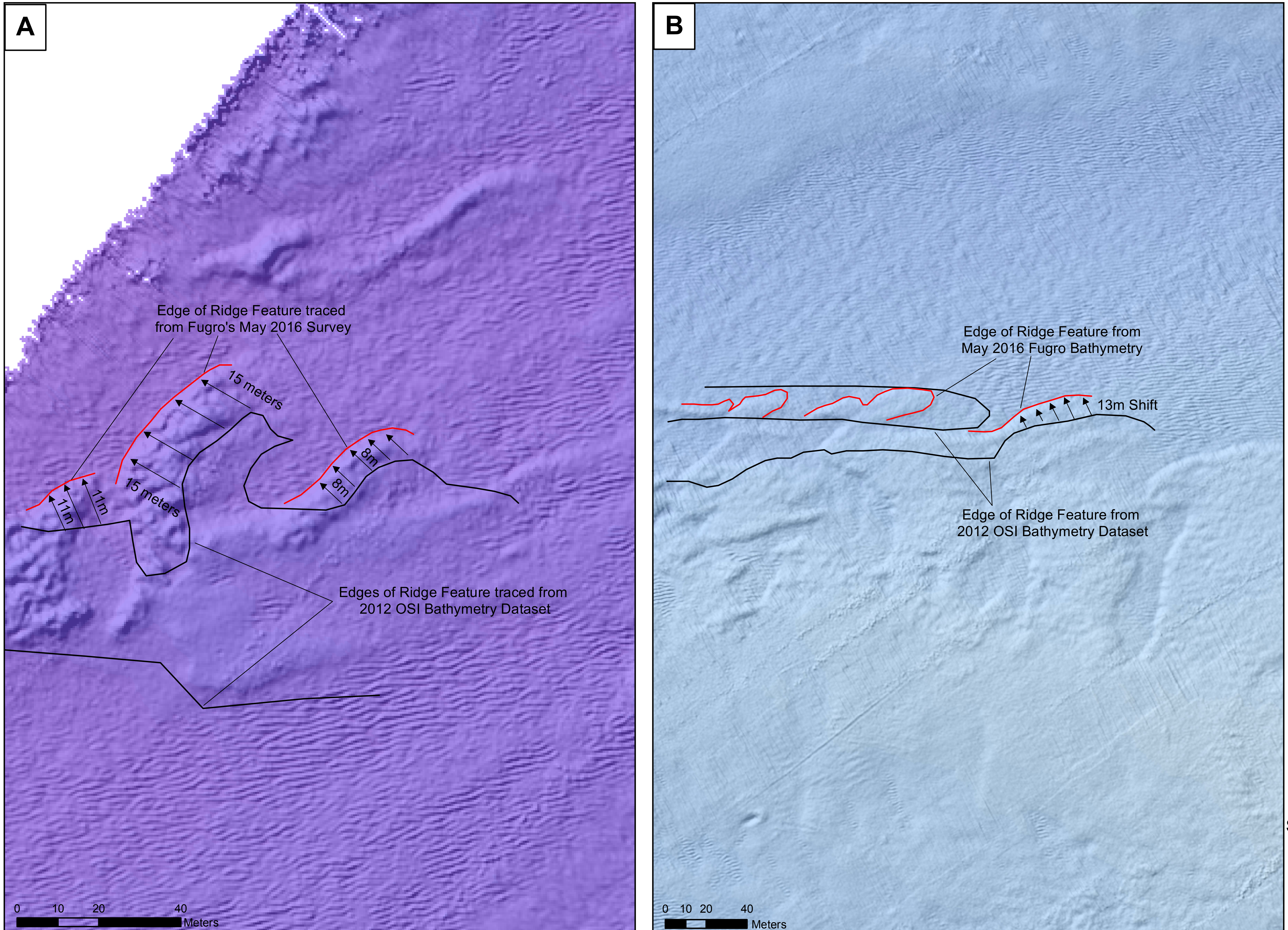
N W E S

Coordinate System: UTM 19N, NAD83, Meter

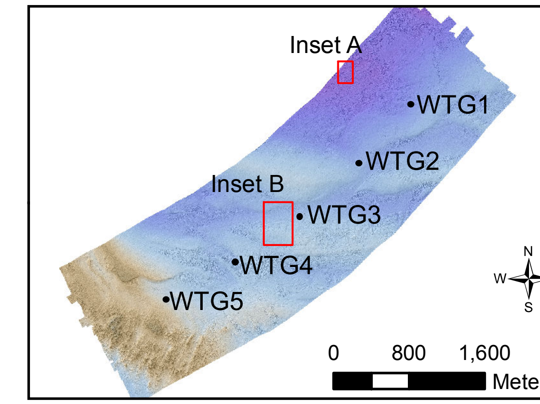
SURFICIAL SEDIMENT MOBILITY COMPARISON SHOWING 2012 BATHYMETRY

Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 12



Inset Map Locations



Notes:

1. 2012 bathymetry was collected by Ocean Surveys Inc. (OSI) from January 11 to September 19, 2012 using a multibeam echosounder.

2. 2016 bathymetry was collected by Fugro from May 11 to 12, 2016 using a multibeam echosounder.

N
W E
S

Coordinate System: UTM 19N, NAD83, Meter

SURFICIAL SEDIMENT MOBILITY COMPARISON SHOWING 2016 BATHYMETRY
Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 13

BOEM
Project No. 04.81150001

Legend

Interpreted Sediment Mobility Zones
(based on particle size, morphology, and comparison between 2012 and 2016 surveys)

- 1 High Mobility Ridges or Shoals (Fine Sand)
  - 1a Higher Mobility Sand Dunes
- 2 Moderate Mobility (Medium-Coarse Sand)
  - 2a Sand Ripple Area
- 3 Low Mobility Morraine Ridges (Gravel, Cobbles, and Boulders)

Interpreted Seafloor Disturbance Features

- Spud Location
- Scour
- Linear Feature Location
- Other Seafloor Disturbance

Note: See Chart 4 for detailed interpreted sedimentary environments.

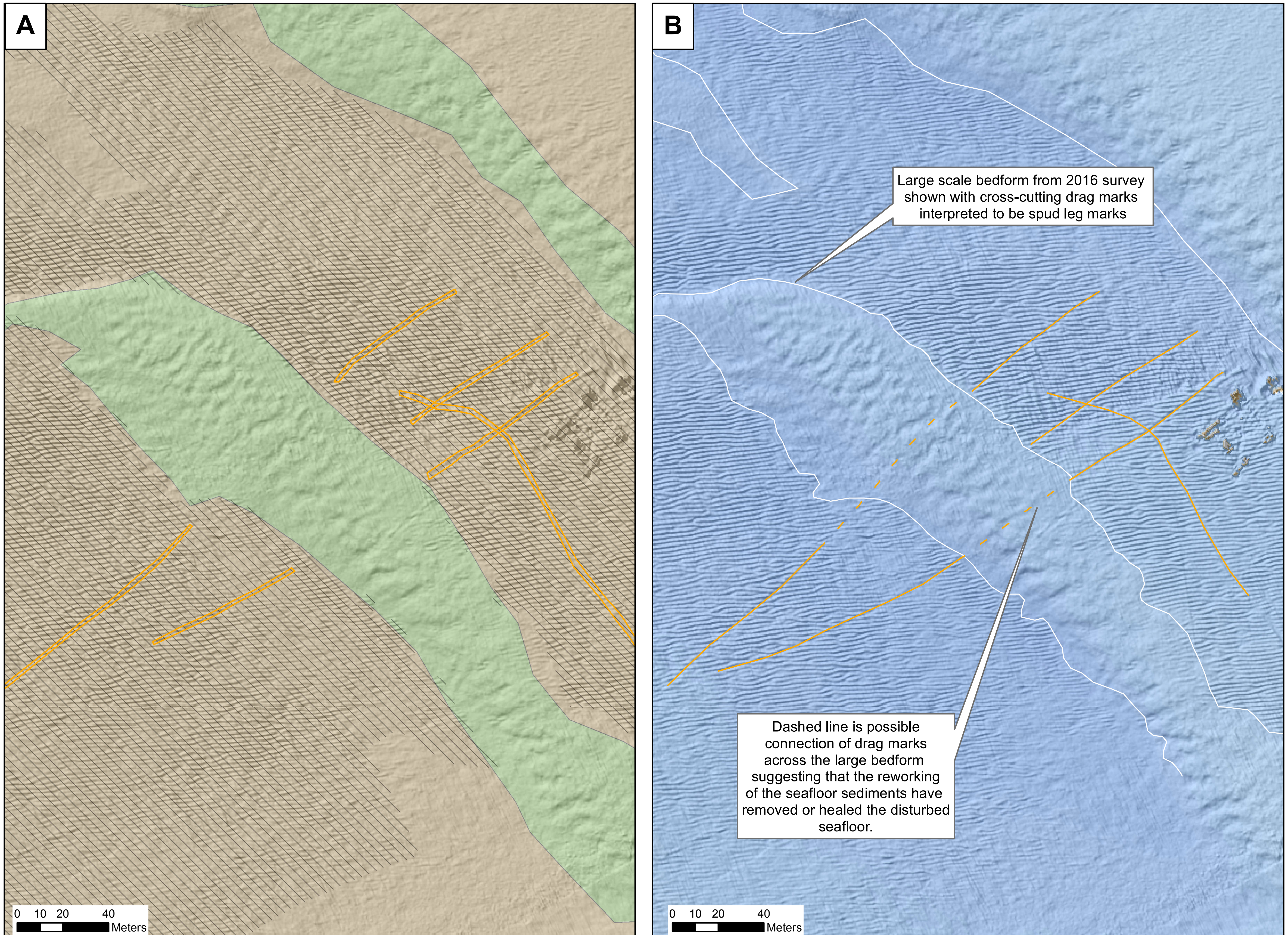
N
W E
S

0 400 800
Meters

Coordinate System: UTM 19N, NAD83, Meter

INTERPRETED SEDIMENTARY ENVIRONMENTS
Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 14



Legend

Drag Marks (dashed where inferred)

Bedform Feature Outline

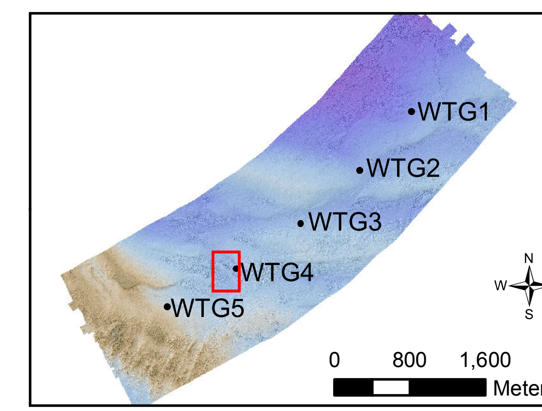
Interpreted Sediment Mobility Zones
(based on particle size, morphology, and comparison between 2012 and 2016 surveys)

1 High Mobility Ridges or Shoals (Fine Sand)

2 Moderate Mobility (Medium-Coarse Sand)

2a Sand Ripple Area

Inset Map Locations



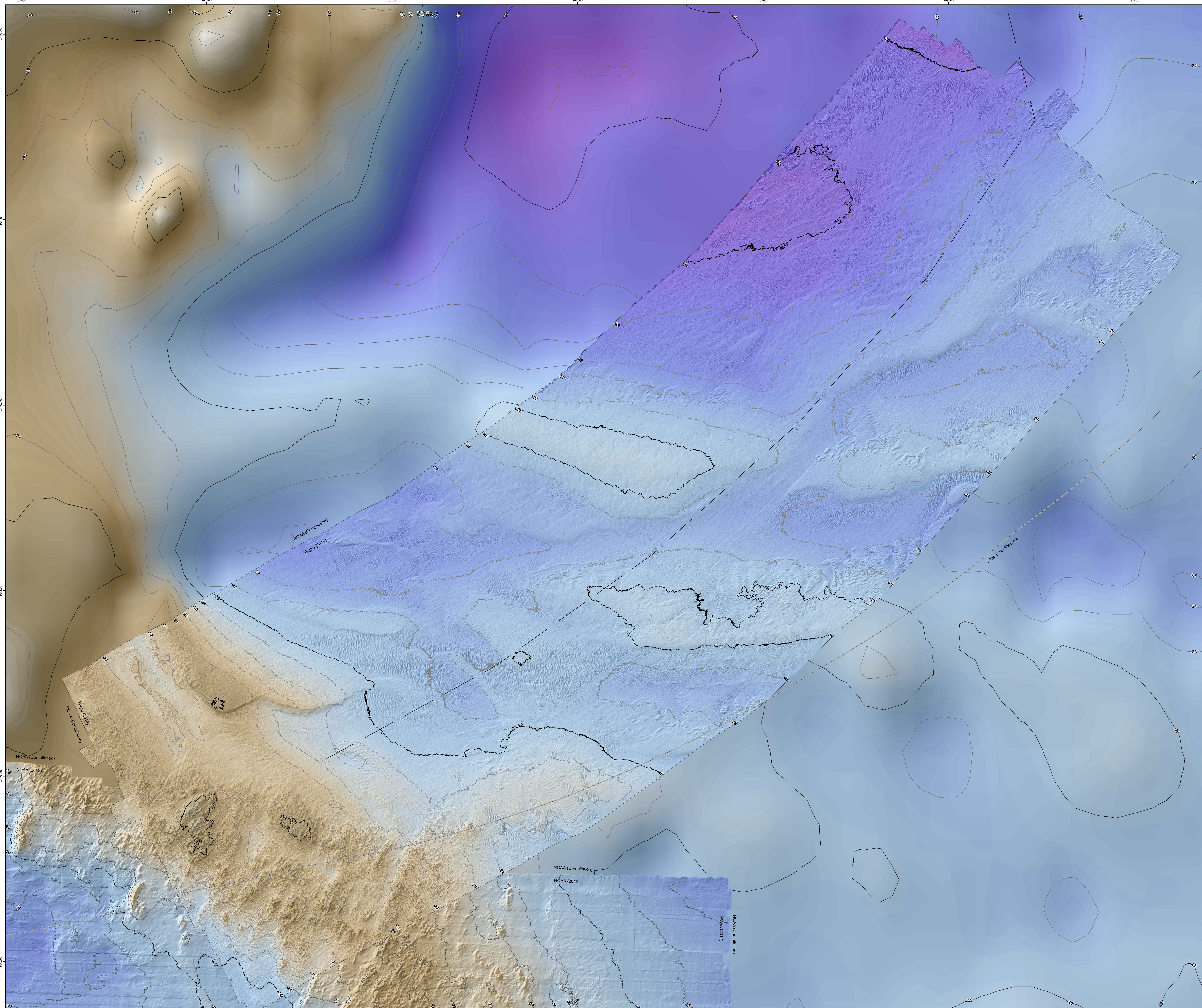
N W E S

Coordinate System: UTM 19N, NAD83, Meter

INFERRED SEAFLOOR RECOVERY EXAMPLE
Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE 15

CHARTS



LEGEND

- - - Export Cable/Inter Array Cable

3 Nautical Mile Limit

Bathymetry (Meters, MLLW)

-16.9 to -16	-24.9 to -24
-17.9 to -17	-25.9 to -25
-18.9 to -18	-26.9 to -26
-19.9 to -19	-27.9 to -27
-20.9 to -20	-28.9 to -28
-21.9 to -21	-29.9 to -29
-22.9 to -22	-30.8 to -30
-23.9 to -23	

Major Contour is 5 meters

Minor Contour is 1 meter

Notes:

1. Fugro marine survey data were collected from May 11 through May 13, 2016 onboard the R/V Jamie Hanna using a high-resolution integrated multibeam bathymetric survey system.

2. Differential Global Positioning System (DGPS) corrections were obtained from Fugro's OmniStar GNSS in real-time via a G2 subscription.

3. Survey equipment utilized for data collection included the following systems:
-Reson SeaBat 7125 SV2 Multibeam Echosounder (MBES)
-Applanix POS MV 320 (v4) Motion Reference Unit & Positioning System
-Applied Microsystems Limited (AML) SmartProbe for Sound Velocity Profiles
-FPI's WinFrog (v3.10.49) navigation and data acquistion software

4. NOAA (2012) Multibeam bathymetric data is from the National Oceanic and Atmospheric Administration's (NOAA) hydrographic survey of Block Island Sound, New York. This survey was conducted August 25 through August 29, 2012.

5. NOAA Compiled: Bathymetric data is a compilation of NOAA sounding files in the area that were collected between 1938 to 1979.

GEODETIC INFORMATION

SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.0000
SEMI-MINOR AXIS:	6,356,752.3141
INVERSE FLATTENING:	298.257222101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 19 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0

N W E S

Coordinate Grid is UTM Zone 19N, NAD 1983, Meters

FUGRO CONSULTANTS, INC.
World Trade Center, Suite 350
101 West Main Street
Norfolk, Virginia 23510
Tel: (757) 625-3350,
Fax: (757) 625-3352
www.fugroconsultants.com

N W E S

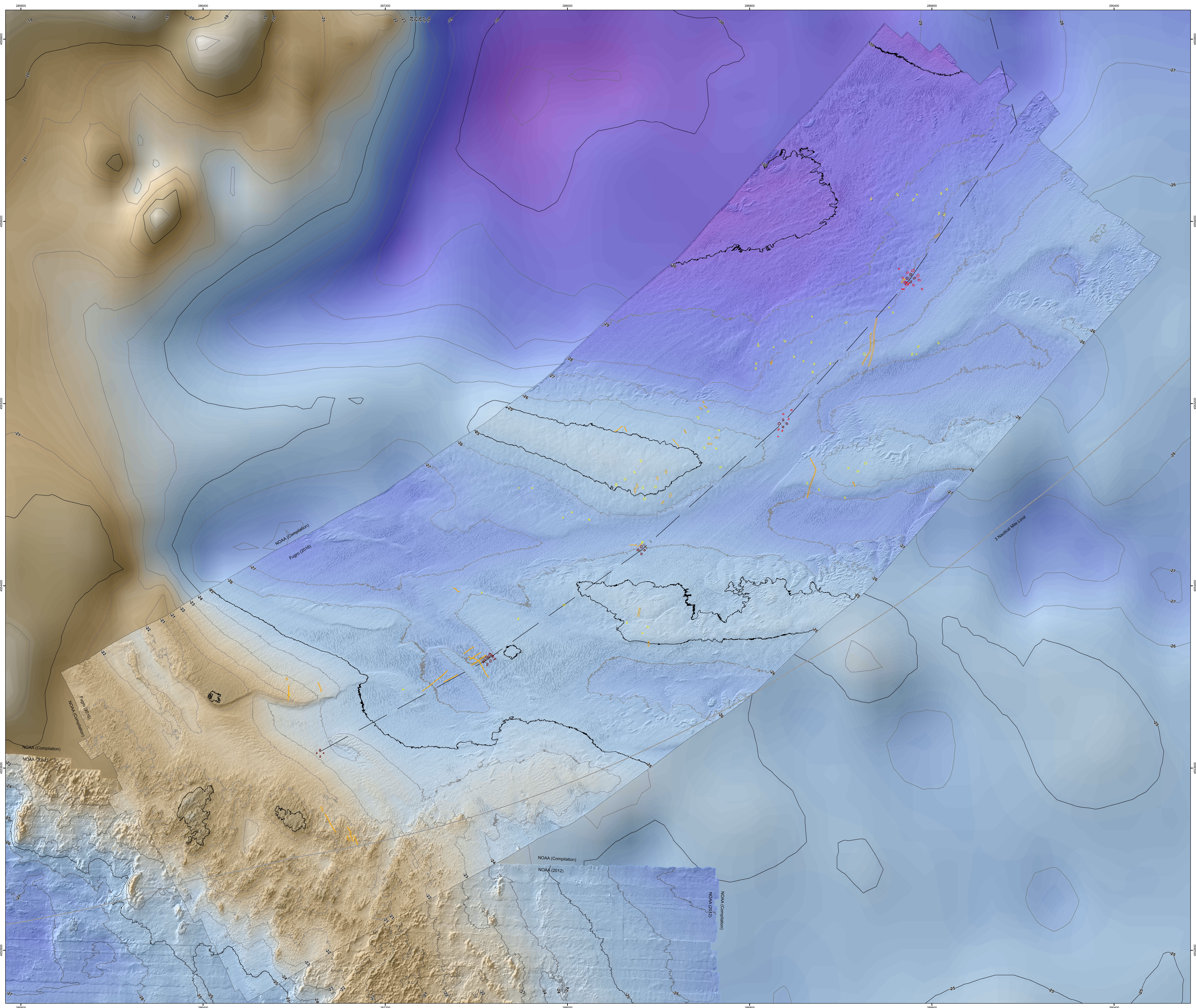
FUGRO 2016 BATHYMETRIC SURVEY
Sediment Disturbance and Recovery Field Plan
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

0 0.25 0.5 Kilometers

0 0.125 0.25 Nautical Miles

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	Aug. 2016	Fugro 2016 Bathymetry	MLG	WBC	KRS
2					
3					

JOB NUMBER: 04.81150001 CHART NO.: 1



LEGEND

Export Cable/Inter Array Cable

3 Nautical Mile Limit

Bathymetry (Meters, MLLW)

-16.9 to -16	-24.9 to -24
-17.9 to -17	-25.9 to -25
-18.9 to -18	-26.9 to -26
-19.9 to -19	-27.9 to -27
-20.9 to -20	-28.9 to -28
-21.9 to -21	-29.9 to -29
-22.9 to -22	-30.8 to -30
-23.9 to -23	

Major Contour is 5 meters

Minor Contour is 1 meter

Interpreted Seafloor Disturbance Features

Spud Location

Scour

Linear Feature

Other Seafloor Disturbance

Notes:

1. Fugro marine survey data were collected from May 11 through May 13, 2016 onboard the R/V Jamie Hanna using a high-resolution integrated multibeam bathymetric survey system.

2. Differential Global Positioning System (DGPS) corrections were obtained from Fugro's OmniStar GNSS in real-time via a G2 subscription.

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-Applied Microsystems Limited (AML) SmartProbe for Sound Velocity Profiles
-FPI's WinFrog (v3.10.49) navigation and data acquistion software

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5. NOAA Compiled: Bathymetric data is a compilation of NOAA sounding files in the area that were collected between 1938 to 1979.

GEODETIC INFORMATION

SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.0000
SEMI-MINOR AXIS:	6,356,752.3141
INVERSE FLATTENING:	298.257222101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 19 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0

N W E S

Coordinate Grid is UTM Zone 19N, NAD 1983, Meters

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World Trade Center, Suite 350
101 West Main Street
Norfolk, Virginia 23510
Tel: (757) 625-3350,
Fax: (757) 625-3352
www.fugroconsultants.com

N W E S

INTERPRETED SEAFLOOR DISTURBANCE FEATURES FROM 2016 FUGRO BATHYMETRY

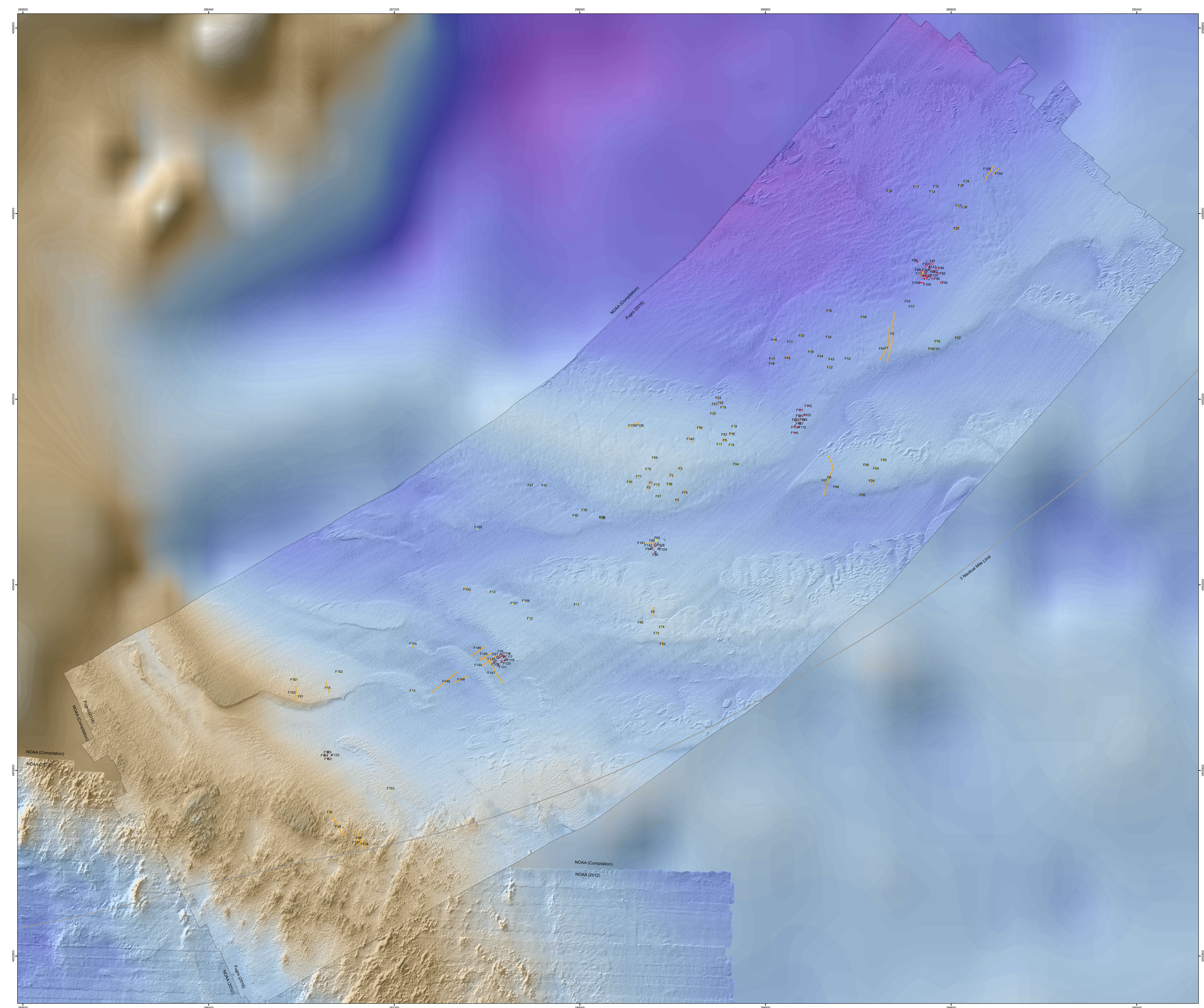
Sediment Disturbance and Recovery Field Plan
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

0 0.25 0.5 Kilometers

0 0.125 0.25 Nautical Miles

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	Aug. 2016	Fugro 2016 Bathymetry	MLG	WBC	KRS
2					
3					

JOB NUMBER: 04.81150001 CHART NO.: 2



LEGEND

- - - Export Cable/Inter Array Cable

3 Nautical Mile Limit

Bathymetry (Meters, MLLW)

-16.9 to -16	-24.9 to -24
-17.9 to -17	-25.9 to -25
-18.9 to -18	-26.9 to -26
-19.9 to -19	-27.9 to -27
-20.9 to -20	-28.9 to -28
-21.9 to -21	-29.9 to -29
-22.9 to -22	-30.8 to -30
-23.9 to -23	

Interpreted Seafloor Disturbance Features

Spud Location

Scour

Linear Feature

Other Seafloor Disturbance

Notes:

1. Fugro marine survey data were collected from May 11 through May 13, 2016 onboard the R/V Jamie Hanna using a high-resolution integrated multibeam bathymetric survey system.

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-FPI's WinFrog (v3.10.49) navigation and data acquistion software

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5. NOAA Compiled: Bathymetric data is a compilation of NOAA sounding files in the area that were collected between 1938 to 1979.

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SEMI-MINOR AXIS:	6,356,752.3141
INVERSE FLATTENING:	298.257222101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 19 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0

N W E S

Coordinate Grid is UTM Zone 19N, NAD 1983, Meters

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Norfolk, Virginia 23510
Tel: (757) 625-3350,
Fax: (757) 625-3352
www.fugroconsultants.com

N W E S

SEAFLOOR DISTURBANCE FEATURE CATALOGUE

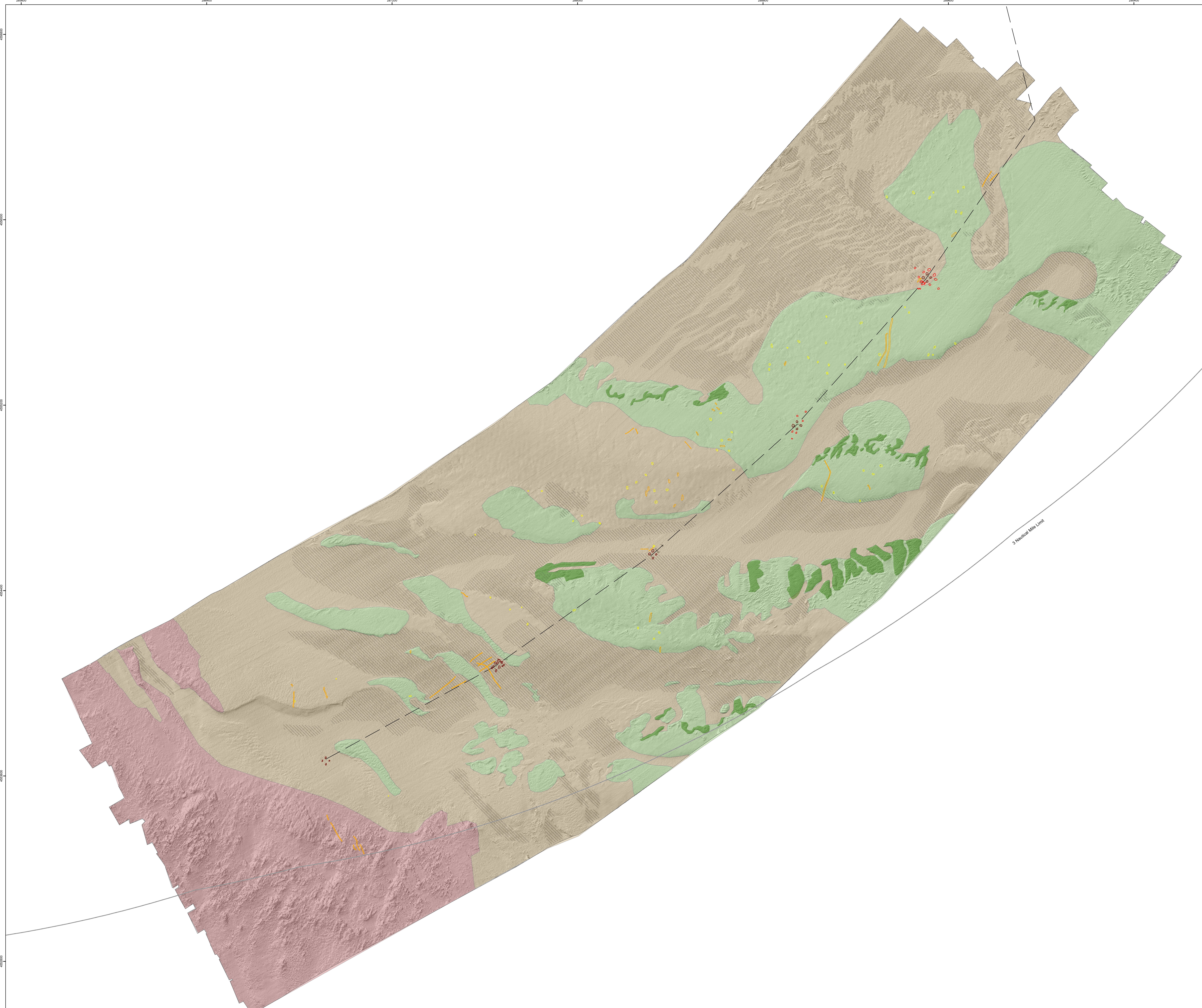
Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

0 0.25 0.5 Kilometers

0 0.125 0.25 Nautical Miles

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	Aug. 2016	Seafloor Disturbance Catalogue	MLG	WBC	KRS
2					
3					

JOB NUMBER: 04.81150001 CHART NO.: 3



LEGEND

- - - Export Cable/Inter Array Cable

3 Nautical Mile Limit

Interpreted Sediment Mobility Zones
(based on particle size, morphology, and comparison between 2012 and 2016 surveys)

- 1 High Mobility Ridges or Shoals (Fine Sand)
- 1a Higher Mobility Sand Dunes
- 2 Moderate Mobility (Medium-Coarse Sand)
- 2a Sand Ripple Area
- 3 Low Mobility Morraine Ridges (Gravel, Cobbles, and Boulders)

Interpreted Seafloor Disturbance Features

- Spud Location
- Scour
- Linear Feature
- Other Seafloor Disturbance

Notes:

1. Fugro marine survey data were collected from May 11 through May 13, 2016 onboard the R/V Jamie Hanna using a high-resolution integrated multibeam bathymetric survey system.

2. Differential Global Positioning System (DGPS) corrections were obtained from Fugro's OmniStar GNSS in real-time via a G2 subscription.

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-Applanix POS MV 320 (v4) Motion Reference Unit & Positioning System
-Applied Microsystems Limited (AML) SmartProbe for Sound Velocity Profiles
-FPI's WinFrog (v3.10.49) navigation and data acquistion software

GEODETIC INFORMATION

SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.0000
SEMI-MINOR AXIS:	6,356,752.3141
INVERSE FLATTENING:	298.257222101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 19 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0

+ Coordinate Grid is UTM Zone 19N, NAD 1983, Meters

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World Trade Center, Suite 350
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Tel: (757) 625-3350,
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www.fugroconsultants.com

INTERPRETED SEDIMENTARY ENVIRONMENTS

Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

0 — 0.25 — 0.5 Kilometers

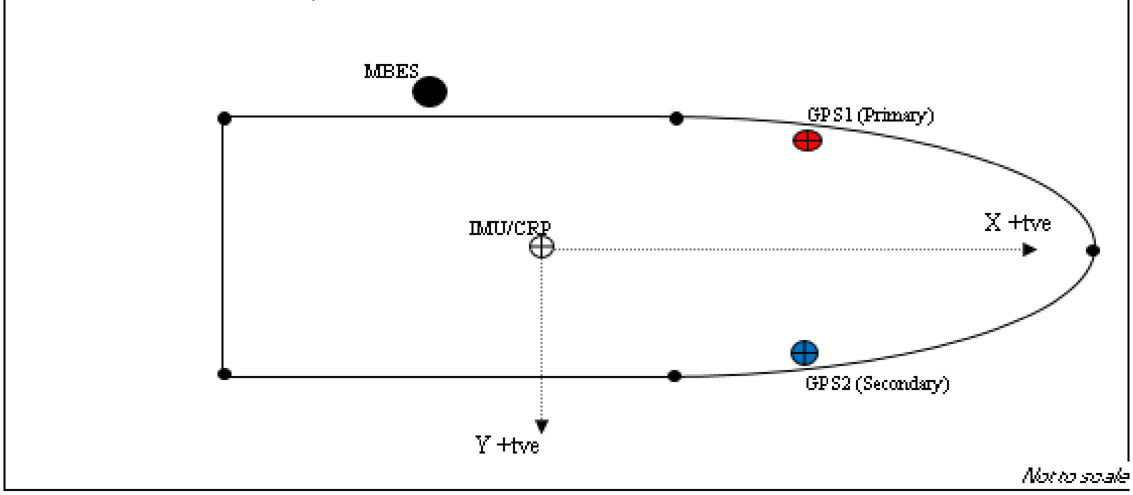
0 — 0.125 — 0.25 Nautical Miles

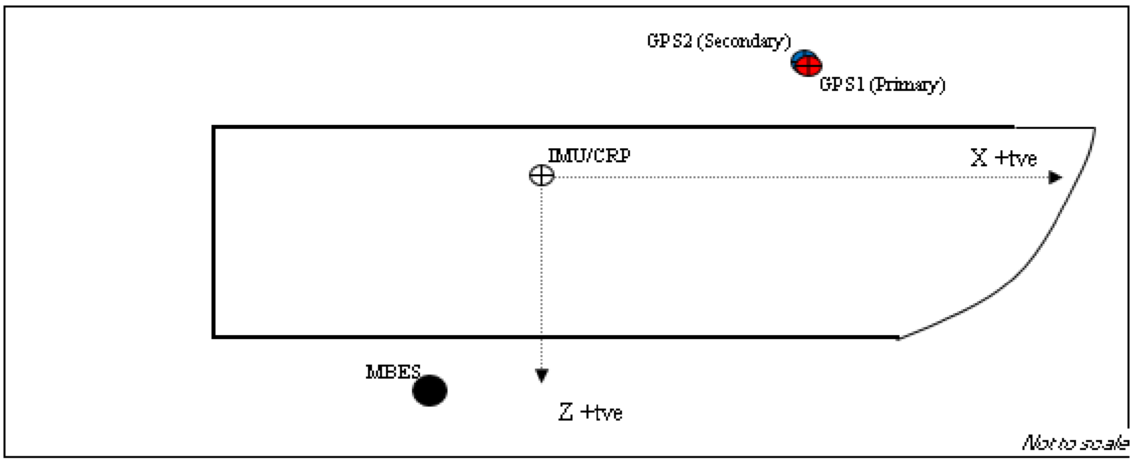
NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	Aug. 2016	Interpreted Sedimentry Environments from Fugro 2016 Bathymetry	MLG	WBC	KRS
2					
3					

JOB NUMBER: 04.81150001 — CHART NO.: 4

A. BATHYMETRIC SURVEY VESSEL SPECIFICATIONS

CRP: *The IMU is set as the CRP, centered above the MBES.*





EQUIPMENT	*Model*	OFFSET FROM CRP		
		X	Y	Z
IMU (CRP)	Applanix IMU	0.000	0.000	0.000
MBES Transmitter	Reson 7125	-0.905	-2.795	2.146
MBES Receiver	Reson 7125	-0.728	-2.795	2.170
Primary GPS	Trimble L1/L2	3.575	-1.905	-3.353
Secondary GPS	Trimble L1/L2	3.176	2.055	-3.422
Static Draft Mark	n/a	n/a	n/a	0.000

Notes

POS M/V Axis — X +tve toward bow; Y +tve toward stbd; Z +tve into water

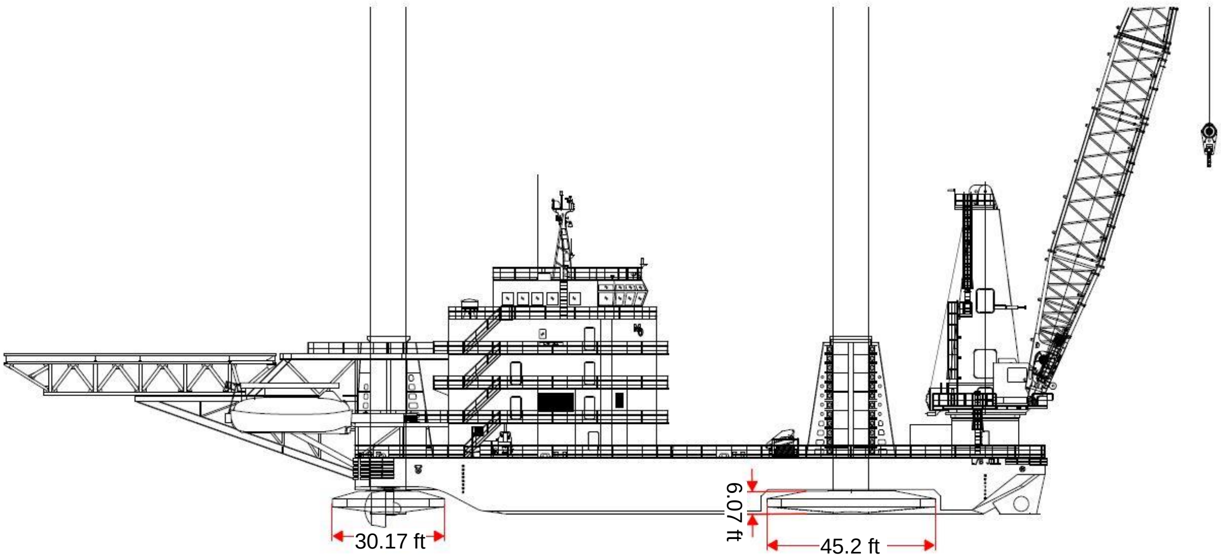
Units: **Meters**

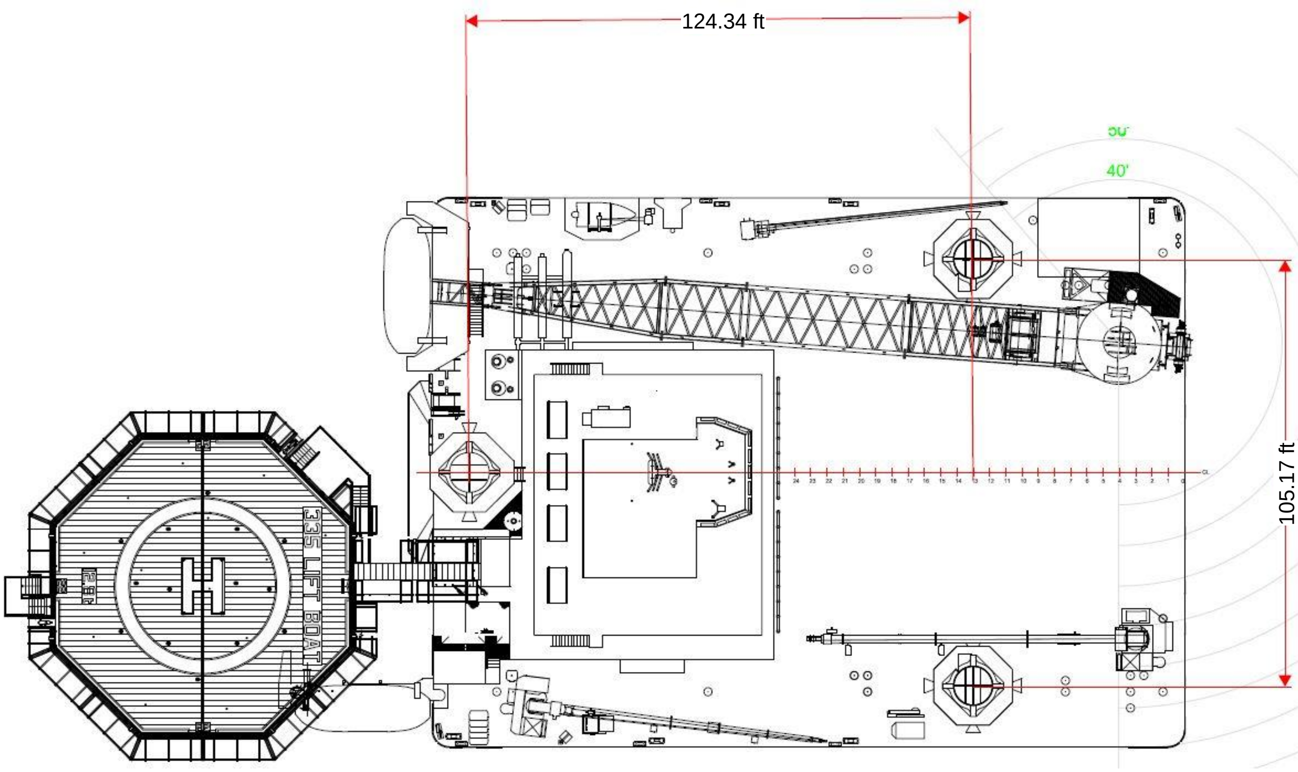
VESSEL OFFSET DIAGRAM FOR THE R/V *JAMIE HANNA*

Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE A-1

B. INSTALLATION VESSEL SPECIFICATIONS

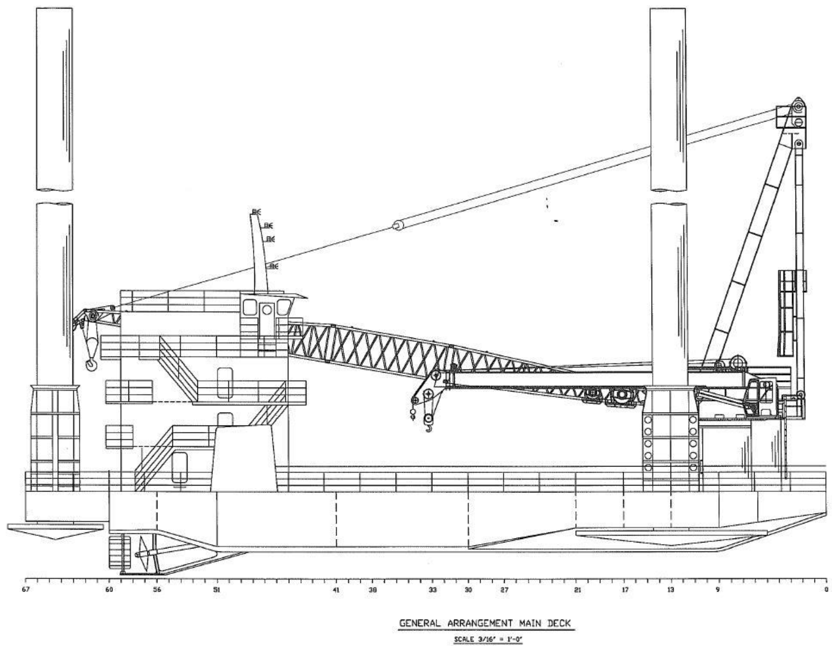


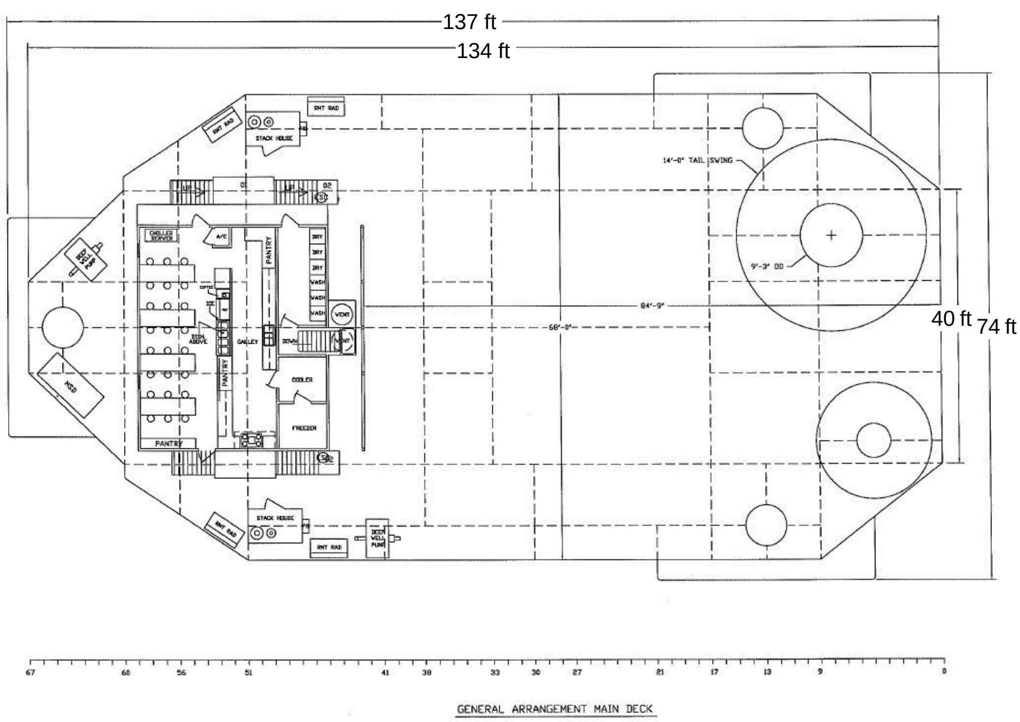


VESSEL SPECIFICATIONS FOR THE *L/B ROBERT*

Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE B-1





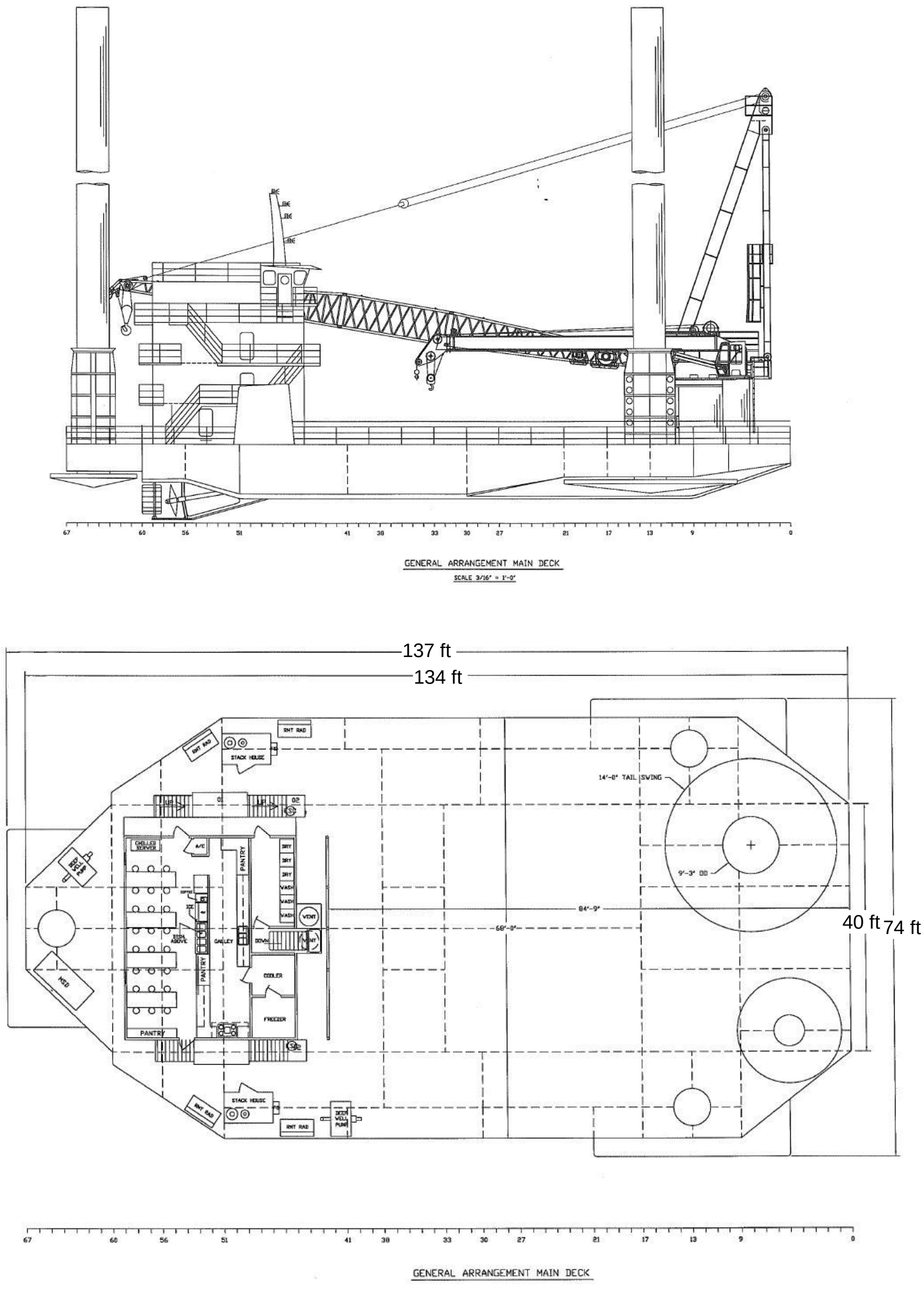
VESSEL SPECIFICATIONS FOR THE *L/B MICHAEL EYMARD*

Seafloor Monitoring Study

Block Island Wind Farm and Transmission Project

Offshore Rhode Island

FIGURE B-2



VESSEL SPECIFICATIONS FOR THE *L/B LACIE EYMARD*

Seafloor Monitoring Study
Block Island Wind Farm and Transmission Project
Offshore Rhode Island

FIGURE B-3

C. CATALOG OF SEAFLOOR DISTURBANCE FEATURES

Table C-1. Seafloor Disturbance Features (Pre-May 2016)

Feature ID	Northing[1] (m)	Easting[1] (m)	Elevation[2] (m)	Feature Perimeter (m)	Feature Area (m^2)	Max Depth (m)	Feature Interpretation	Attributed Vessel
F0	4554820	288297	-25.0	54	120	0.17	Drag Mark	Unknown
F1	4554840	288306	-25.0	39	82	0.16	Drag Mark	Unknown
F2	4554870	288395	-24.8	36	72	0.14	Drag Mark	Unknown
F3	4554900	288433	-24.8	37	76	0.22	Drag Mark	Unknown
F4	4554770	288418	-25.4	33	59	0.17	Drag Mark	Unknown
F5	4555020	288625	-25.4	49	108	0.13	Drag Mark	Unknown
F6	4555470	289343	-27.0	441	983	0.12	Drag Mark	Unknown
F7	4555440	289322	-26.9	310	603	0.11	Drag Mark	Unknown
F8	4554860	289072	-26.2	380	595	0.15	Drag Mark	Unknown
F9	4554290	288314	-24.4	86	205	0.13	Drag Mark	Unknown
F10	4554150	288357	-25.1	54	97	0.11	Drag Mark	Unknown
F11	4554320	287986	-25.6	30	59	0.25	Circular Depression	Unknown
F12	4554260	287784	-25.7	25	38	0.13	Circular Depression	Unknown

Notes: See Chart 2 for the location of each seafloor disturbance feature.
[1] UTM Zone 19, NAD83, Meter
[2] Elevation represents centroid location of the feature

Feature ID	Northing[1] (m)	Easting[1] (m)	Elevation[2] (m)	Feature Perimeter (m)	Feature Area (m^2)	Max Depth (m)	Feature Interpretation	Attributed Vessel
F13	4554370	287624	-26.2	19	24	0.09	Circular Depression	Unknown
F14	4553940	287279	-25.4	23	34	0.13	Circular Depression	Unknown
F15	4553960	286913	-23.5	95	155	0.12	Drag Mark	Unknown
F16	4555050	288655	-25.7	35	74	0.2	Drag Mark	Unknown
F17	4555010	288601	-25.3	26	42	0.15	Circular Depression	Unknown
F18	4555000	288653	-25.4	23	34	0.09	Circular Depression	Unknown
F19	4555080	288665	-25.9	22	35	0.07	Circular Depression	Unknown
F20	4555140	288574	-26.3	33	69	0.14	Circular Depression	Unknown
F21	4555180	288585	-26.7	30	48	0.18	Drag Mark	Unknown
F22	4555190	288606	-26.7	37	56	0.12	Drag Mark	Unknown
F23	4555210	288597	-27.0	24	31	0.13	Drag Mark	Unknown
F24	4554850	289258	-26.0	50	73	0.16	Drag Mark	Unknown
F25	4555940	289623	-28.0	60	151	0.09	Drag Mark	Unknown
F26	4556030	289655	-28.1	29	51	0.08	Circular Depression	Unknown

Notes: See Chart 2 for the location of each seafloor disturbance feature.
[1] UTM Zone 19, NAD83, Meter
[2] Elevation represents centroid location of the feature

Feature ID	Northing[1] (m)	Easting[1] (m)	Elevation[2] (m)	Feature Perimeter (m)	Feature Area (m^2)	Max Depth (m)	Feature Interpretation	Attributed Vessel
F27	4556030	289632	-28.1	30	53	0.08	Circular Depression	Unknown
F28	4556120	289641	-28.2	26	41	0.1	Circular Depression	Unknown
F29	4556140	289665	-28.3	28	54	0.19	Circular Depression	Unknown
F30	4556100	289334	-29.6	27	51	0.07	Circular Depression	Unknown
F31	4556120	289449	-29.0	35	74	0.11	Circular Depression	Unknown
F32	4556120	289535	-28.8	19	26	0.05	Circular Depression	Unknown
F33	4556100	289519	-28.7	31	56	0.1	Circular Depression	Unknown
F34	4553360	286958	-22.0	195	247	0.2	Drag Mark	Unknown
F35	4553420	286922	-21.8	52	70	0.1	Drag Mark	Unknown
F36	4553310	287048	-21.7	146	222	0.16	Drag Mark	Unknown
F37	4554690	288094	-26.3	18	22	0.1	Circular Depression	Unknown
F38	4554690	288098	-26.3	15	14	0.06	Circular Depression	Unknown
F39	4554720	288019	-26.4	20	28	0.14	Circular Depression	Unknown
F40	4554700	287980	-26.4	19	24	0.06	Circular Depression	Unknown

Notes: See Chart 2 for the location of each seafloor disturbance feature.
[1] UTM Zone 19, NAD83, Meter
[2] Elevation represents centroid location of the feature

Feature ID	Northing[1] (m)	Easting[1] (m)	Elevation[2] (m)	Feature Perimeter (m)	Feature Area (m^2)	Max Depth (m)	Feature Interpretation	Attributed Vessel
F41	4554830	287787	-26.8	12	11	0.1	Circular Depression	Unknown
F42	4554830	287846	-26.6	18	23	0.14	Circular Depression	Unknown
F43	4555370	289084	-27.2	25	44	0.09	Circular Depression	Unknown
F44	4555390	289036	-27.5	21	32	0.07	Circular Depression	Unknown
F45	4555380	288895	-28.0	52	80	0.13	Drag Mark	Unknown
F46	4555350	288826	-28.1	25	43	0.08	Circular Depression	Unknown
F47	4555380	288829	-28.2	26	50	0.06	Circular Depression	Unknown
F48	4555460	288838	-28.5	37	76	0.07	Circular Depression	Unknown
F49	4555410	288995	-27.7	28	46	0.08	Circular Depression	Unknown
F50	4555470	288954	-28.0	32	59	0.1	Circular Depression	Unknown
F51	4555450	288905	-28.2	18	22	0.05	Circular Depression	Unknown
F52	4555340	289077	-27.2	33	49	0.08	Circular Depression	Unknown
F53	4555380	289154	-27.1	18	24	0.06	Circular Depression	Unknown
F54	4555470	289071	-27.8	25	43	0.09	Circular Depression	Unknown

Notes: See Chart 2 for the location of each seafloor disturbance feature.
[1] UTM Zone 19, NAD83, Meter
[2] Elevation represents centroid location of the feature

Feature ID	Northing[1] (m)	Easting[1] (m)	Elevation[2] (m)	Feature Perimeter (m)	Feature Area (m^2)	Max Depth (m)	Feature Interpretation	Attributed Vessel
F55	4555580	289074	-28.4	21	26	0.09	Circular Depression	Unknown
F56	4555560	289223	-27.8	32	67	0.18	Circular Depression	Unknown
F57	4555600	289430	-27.9	22	34	0.12	Circular Depression	Unknown
F58	4555420	289304	-26.8	32	76	0.17	Circular Depression	Unknown
F59	4555450	289541	-26.5	28	52	0.13	Circular Depression	Unknown
F60	4555420	289514	-26.5	29	47	0.08	Circular Depression	Unknown
F61	4555420	289533	-26.5	17	21	0.03	Circular Depression	Unknown
F62	4555470	289629	-26.5	25	44	0.08	Circular Depression	Unknown
F63	4555620	289412	-28.1	15	16	0.06	Circular Depression	Unknown
F64	4554900	289275	-25.7	27	46	0.11	Circular Depression	Unknown
F65	4554940	289309	-25.6	33	78	0.09	Circular Depression	Unknown
F66	4554920	289234	-25.7	23	38	0.06	Circular Depression	Unknown
F67	4554850	289053	-26.4	23	37	0.14	Circular Depression	Unknown
F68	4554820	289105	-27.0	24	38	0.2	Circular Depression	Unknown

Notes: See Chart 2 for the location of each seafloor disturbance feature.
[1] UTM Zone 19, NAD83, Meter
[2] Elevation represents centroid location of the feature

Feature ID	Northing[1] (m)	Easting[1] (m)	Elevation[2] (m)	Feature Perimeter (m)	Feature Area (m^2)	Max Depth (m)	Feature Interpretation	Attributed Vessel
F69	4554950	288323	-24.3	28	57	0.1	Circular Depression	Unknown
F70	4554900	288294	-24.4	24	35	0.1	Circular Depression	Unknown
F71	4554870	288253	-24.6	25	42	0.06	Circular Depression	Unknown
F72	4554830	288332	-25.0	27	51	0.11	Circular Depression	Unknown
F73	4554190	288330	-24.6	21	31	0.07	Circular Depression	Unknown
F74	4554220	288352	-24.4	24	41	0.05	Circular Depression	Unknown
F75	4554800	288452	-25.4	43	106	0.09	Drag Mark	Unknown
F76	4555080	288517	-25.6	41	64	0.25	Drag Mark	Unknown
F77	4555740	289474	-28.1	64	89	0.07	Drag Mark	Unknown
F78	4554100	287659	-26.2	70	135	0.22	Scour	Unknown
F79	4555170	288618	-26.6	24	38	0.08	Circular Depression	Unknown
F80	4554590	288327	-26.2	17	19	0.07	Circular Depression	Unknown
F81	4554090	287646	-26.0	36	79	0.08	Scour	Unknown
F82	4555740	289545	-27.8	33	80	0.1	Spud	L/B Robert

Notes: See Chart 2 for the location of each seafloor disturbance feature.
[1] UTM Zone 19, NAD83, Meter
[2] Elevation represents centroid location of the feature

Feature ID	Northing[1] (m)	Easting[1] (m)	Elevation[2] (m)	Feature Perimeter (m)	Feature Area (m^2)	Max Depth (m)	Feature Interpretation	Attributed Vessel
F83	4555050	288622	-25.7	27	51	0.05	Circular Depression	Unknown
F84	4554920	288672	-25.6	25	45	0.05	Circular Depression	Unknown
F85	4554240	288261	-24.9	24	36	0.06	Circular Depression	Unknown
F86	4554790	289218	-26.7	22	32	0.08	Circular Depression	Unknown
F87	4554780	288338	-25.3	33	82	0.09	Circular Depression	Unknown
F88	4554830	288386	-24.8	31	68	0.05	Circular Depression	Unknown
F89	4554540	288325	-23.8	27	53	0.08	Scour	Unknown
F90	4554840	288214	-25.0	33	69	0.08	Circular Depression	Unknown
F91	4553920	286779	-22.0	23	39	0.12	Circular Depression	Unknown
F92	4555700	289557	-27.5	25	47	0.12	Spud	L/B Robert
F93	4554590	288330	-26.3	22	32	0.07	Circular Depression	Unknown
F94	4554560	288311	-26.1	31	71	0.06	Scour	Unknown
F95	4555760	289539	-27.8	37	99	0.13	Spud	L/B Robert
F96	4555720	289520	-27.9	28	56	0.16	Spud	L/B Robert

Notes: See Chart 2 for the location of each seafloor disturbance feature.
[1] UTM Zone 19, NAD83, Meter
[2] Elevation represents centroid location of the feature

Feature ID	Northing[1] (m)	Easting[1] (m)	Elevation[2] (m)	Feature Perimeter (m)	Feature Area (m^2)	Max Depth (m)	Feature Interpretation	Attributed Vessel
F97	4555780	289517	-28.0	36	94	0.16	Spud	L/B Robert
F98	4555750	289472	-28.2	24	43	0.15	Spud	L/B Robert
F99	4555790	289456	-28.4	21	32	0.19	Spud	L/B Robert
F100	4555770	289493	-28.2	27	51	0.11	Spud	L/B Robert
F101	4555730	289481	-28.3	32	62	0.38	Spud	L/B Michael Eymard
F102	4555130	288971	-26.8	21	30	0.1	Spud	L/B Robert
F103	4555720	289486	-28.1	17	19	0.15	Spud	L/B Michael Eymard
F104	4555720	289495	-28.2	18	19	0.33	Spud	L/B Michael Eymard
F105	4555730	289499	-28.1	17	17	0.20	Spud	L/B Michael Eymard
F106	4555730	289491	-28.3	14	12	0.20	Spud	L/B Michael Eymard
F107	4555730	289488	-28.2	19	21	0.20	Spud	L/B Michael Eymard

Notes: See Chart 2 for the location of each seafloor disturbance feature.
[1] UTM Zone 19, NAD83, Meter
[2] Elevation represents centroid location of the feature

Feature ID	Northing[1] (m)	Easting[1] (m)	Elevation[2] (m)	Feature Perimeter (m)	Feature Area (m^2)	Max Depth (m)	Feature Interpretation	Attributed Vessel
F108	4555700	289477	-28.0	19	21	0.14	Spud	L/B Michael Eymard
F109	4555700	289470	-28.1	19	19	0.15	Spud	L/B Michael Eymard
F110	4555130	288947	-26.7	28	55	0.06	Scour	Unknown
F111	4555150	288948	-26.8	21	34	0.1	Spud	L/B Robert
F112	4555170	288984	-26.9	21	34	0.07	Spud	L/B Robert
F113	4555110	288930	-26.6	40	99	0.11	Scour	Unknown
F114	4555090	288927	-26.5	23	35	0.13	Spud	L/B Michael Eymard
F115	4555080	288943	-26.5	22	32	0.12	Spud	L/B Michael Eymard
F116	4555060	288925	-26.4	15	15	0.12	Spud	L/B Michael Eymard
F117	4554090	287674	-25.9	30	45	0.08	Scour	Unknown
F118	4554090	287670	-25.9	20	20	0.06	Scour	Unknown
F119	4554080	287682	-25.9	24	32	0.06	Scour	Unknown

Notes: See Chart 2 for the location of each seafloor disturbance feature.
[1] UTM Zone 19, NAD83, Meter
[2] Elevation represents centroid location of the feature

Feature ID	Northing[1] (m)	Easting[1] (m)	Elevation[2] (m)	Feature Perimeter (m)	Feature Area (m^2)	Max Depth (m)	Feature Interpretation	Attributed Vessel
F120	4554070	287663	-26.0	33	75	0.04	Scour	Unknown
F121	4554060	287630	-26.0	12	11	0.12	Scour	Unknown
F122	4555750	289524	-23.7	31	66	0.1	Scour	Unknown
F123	4555770	289508	-28.0	32	78	0.06	Scour	Unknown
F124	4555750	289491	-25.4	36	99	0.07	Scour	Unknown
F125	4555730	289508	-28.0	33	65	0.08	Scour	Unknown
F126	4555110	288964	-26.6	30	62	0.02	Scour	Unknown
F127	4555100	288947	-18.7	25	47	0.03	Scour	Unknown
F128	4554570	288324	-13.8	37	98	0.06	Scour	Unknown
F129	4554560	288339	-26.0	25	42	0.03	Scour	Unknown
F130	4554070	287634	-17.7	43	90	0.12	Scour	Unknown
F131	4554050	287648	-26.0	32	52	0.05	Scour	Unknown
F132	4553650	286914	-18.9	21	32	0.05	Scour	Unknown
F133	4553670	286929	-23.6	16	18	0.09	Scour	Unknown

Notes: See Chart 2 for the location of each seafloor disturbance feature.
[1] UTM Zone 19, NAD83, Meter
[2] Elevation represents centroid location of the feature

Feature ID	Northing[1] (m)	Easting[1] (m)	Elevation[2] (m)	Feature Perimeter (m)	Feature Area (m^2)	Max Depth (m)	Feature Interpretation	Attributed Vessel
F134	4553670	286899	-23.3	19	22	0.1	Scour	Unknown
F135	4553680	286913	-19.2	24	38	0.02	Scour	Unknown
F136	4553280	287071	-21.7	93	155	0.05	Drag Mark	Unknown
F137	4553290	287037	-21.1	58	65	0.1	Drag Mark	Unknown
F138	4555090	288255	-25.3	48	40	0.09	Drag Mark	Unknown
F139	4555090	288225	-25.1	91	60	0.06	Drag Mark	Unknown
F140	4555030	288476	-25.1	86	34	0.06	Drag Mark	Unknown
F141	4554580	288290	-26.1	68	30	0.03	Drag Mark	Unknown
F142	4554580	288317	-26.2	53	19	0.06	Drag Mark	Unknown
F143	4554380	287514	-26.3	76	69	0.11	Drag Mark	Unknown
F144	4554070	287607	-26.0	164	176	0.02	Drag Mark	Unknown
F145	4554090	287595	-26.1	146	131	0.02	Drag Mark	Unknown
F146	4554120	287565	-26.1	112	109	0.02	Drag Mark	Unknown
F147	4554050	287615	-26.0	272	292	0.03	Drag Mark	Unknown

Notes: See Chart 2 for the location of each seafloor disturbance feature.
[1] UTM Zone 19, NAD83, Meter
[2] Elevation represents centroid location of the feature

Feature ID	Northing[1] (m)	Easting[1] (m)	Elevation[2] (m)	Feature Perimeter (m)	Feature Area (m^2)	Max Depth (m)	Feature Interpretation	Attributed Vessel
F148	4553990	287487	-26.3	142	121	0.02	Drag Mark	Unknown
F149	4553990	287423	-26.1	291	225	0.05	Drag Mark	Unknown
F150	4553930	286775	-22.1	141	151	0.08	Drag Mark	Unknown
F151	4553990	286768	-22.9	29	39	0.21	Drag Mark	Unknown
F152	4554020	286959	-24.2	13	12	0.15	Circular Depression	Unknown
F153	4553510	287184	-23.3	10	7	0.12	Circular Depression	Unknown
F154	4554140	287279	-25.8	28	41	0.07	Drag Mark	Unknown
F155	4554640	287558	-27.0	16	18	0.12	Circular Depression	Unknown
F156	4554330	287759	-26.1	12	9	0.20	Circular Depression	Unknown
F157	4554320	287709	-26.0	16	18	0.10	Circular Depression	Unknown
F158	4556180	289764	-28.0	161	129	0.02	Drag Mark	Unknown
F159	4556180	289793	-28.0	90	63	0.03	Drag Mark	Unknown

Notes: See Chart 2 for the location of each seafloor disturbance feature.
[1] UTM Zone 19, NAD83, Meter
[2] Elevation represents centroid location of the feature