US Wind Benthic Macroinvertebrate Community and Habitat Assessment

Site Assessment Plan Area

PREPARED FOR:
US Wind, Inc.
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Baltimore, Maryland 21201

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ESS Project No. U167-003

October 21, 2015

www.essgroup.com

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1.0 INTRODUCTION

1.1 Background

ESS Group, Inc. (ESS) conducted a benthic habitat assessment survey in the vicinity of the proposed meteorological tower associated with the Site Assessment Plan (SAP) for the Maryland Wind Energy Area (MD WEA) leased by US Wind, Inc. (US Wind). Sampling was conducted in accordance with *Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585* issued November 4, 2013 the Bureau of Ocean Energy Management (BOEM).

The survey included photodocumentation of seafloor habitat in the SAP area as well as the collection and analysis of benthic grab samples. These data were used to supplement existing studies and generate a taxonomic classification of benthic habitat in the SAP area to the lowest practicable taxonomic level under the Coastal and Marine Ecological Classification Standard (CMECS) (FGDC 2012).

1.2 Definitions

Benthic macroinvertebrate: For the purposes of this assessment, benthic macroinvertebrates are defined as those invertebrate organisms greater than 500 microns (µm) in length that either live on (epifauna) or within (infauna) the substrate, including but not limited to annelid (segmented) worms, mollusks, crustaceans, and echinoderms.

Hard bottom: Coral, cobble, rock, clay outcroppings, or other shelter forming features.

SAV: Submerged aquatic vegetation, such as eelgrass (*Zostera marina*) or macroalgae.

Sensitive habitat: Benthic habitats containing hard bottom or SAV features.

2.0 APPROACH

The BOEM guidelines for benthic habitat survey (issued November 4, 2013) were used as the primary guidance document for developing the survey approach. Additional comments received from BOEM on February 23, 2015 were also incorporated into the approach.

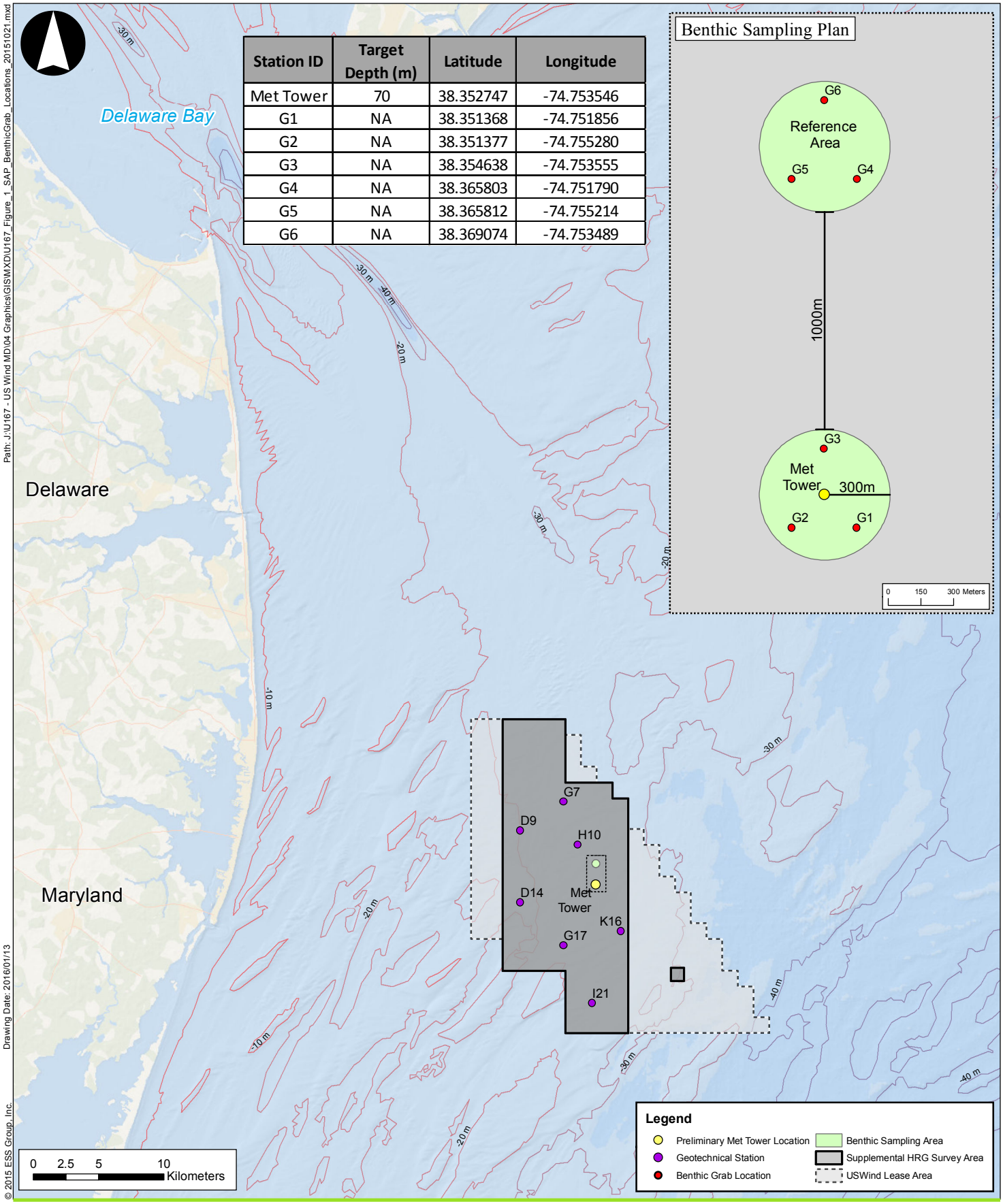
The benthic field survey was conducted from the R/V *Shearwater* on July 25, 2015 and was composed of two primary elements, including 1) collection of still images of the seafloor and 2) collection of benthic grab samples for laboratory analysis of taxonomic composition.

To obtain site-specific information on the benthic community, the benthic field survey focused on three locations near the site of the proposed meteorological tower (Figure 1). Three additional benthic samples were collected from an area of comparable habitat located 1,000 m (3,281 ft) north of the SAP area (reference area). This area was selected to represent background conditions as it is well outside the area of anticipated impact from the installation, operation and decommissioning of the proposed meteorological tower.

The survey vessel navigated to and recorded each sampling position using a Differential Global Positioning System (DGPS).

2.1 Benthic Imagery

Images of the seafloor were captured at each survey location with a Kongsberg/Simrad OE14-208 5.0-megapixel underwater camera with a dedicated strobe and video lamp, mounted within a stainless steel frame (Attachment A). The camera was equipped with a 10-centimeter (cm) laser scale. An ultra-short baseline (USBL) positioning beacon was attached to the camera frame for acoustic positioning.



Station ID	Target Depth (m)	Latitude	Longitude
Met Tower	70	38.352747	-74.753546
G1	NA	38.351368	-74.751856
G2	NA	38.351377	-74.755280
G3	NA	38.354638	-74.753555
G4	NA	38.365803	-74.751790
G5	NA	38.365812	-74.755214
G6	NA	38.369074	-74.753489

US Wind Maryland
Offshore Maryland

1 inch = 10 kilometers

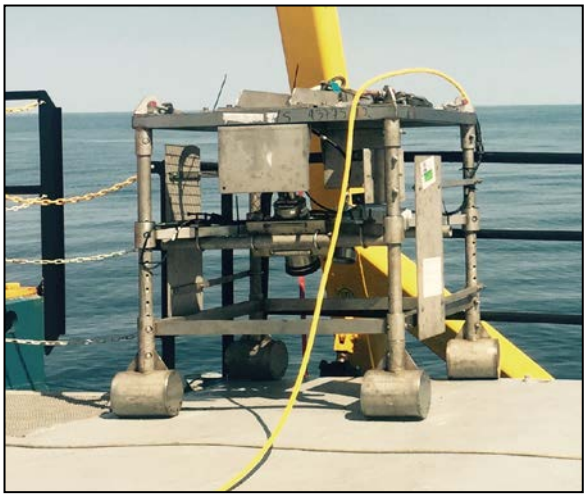
Source: 1) ESRI-NOAA-NGDC, Online Coastal Basemap
2) BOEM, OCS Atlantic Aliquots, 2012
3) NOAA-CRM, Bathymetric Contours

Benthic Sampling Locations

Figure 1

A hover and drift technique allowed the frame to move progressively along the seafloor as the vessel traversed the study area. Footage was viewed in real time via an umbilical, assisting in the control of the digital stills camera and selection of still photograph locations. Images were captured using the surface control unit and initially stored on the camera's internal memory card. On completion, photographs were downloaded onto a PC and copied onto CD-ROM.

The number of images captured at each station ranged from 13 to 18 and individual still photographs that were separated by a time gap of approximately 5 to 10 seconds (Attachment A and Attachment B). Substrate type was characterized and visible benthic taxa were identified in each set of images.



Underwater camera on aft deck of R/V Shearwater

2.2 Benthic Grab Sampling

2.2.1 Sample Collection

Surface benthic grab samples were successfully collected using a Van Veen grab sampler at each of the six sampling locations (Attachment A). The sampler measured approximately 11.8 inches by 11.8 inches (30 cm by 30 cm) at the sampling interface. After retrieval, each sample was examined for quality and a decision was made to accept or reject the sample based on representativeness of the grab. Sample grabs that did not retain at least 2.5 inches (6.4 cm) of material or showed evidence of uneven penetration (i.e. angled sample) were rejected as incomplete and the grab was redeployed until an acceptable sample was retained. Over the course of the field program, only one sample attempt was rejected. This occurred at Station G5, due to inadequate sample material recovery (Attachment C). The subsequent sample attempt at Station G5 was successful and no additional corrective action was necessary.

Preparing Van Veen grab sampler on R/V Shearwater

Once an acceptable sample was retrieved, a subsample was removed from a 0.04 m^2 area of the sampler. A stainless steel divider plate was inserted directly into the retrieved sample to isolate the area for subsampling. Descriptions of sample recovery and sediment type (i.e. grain size) were recorded in a field notebook (Attachment C).

The volume of sediment from the subsampled area was then removed from the sampler using a stainless steel spoon and sieved in the field. Prior to sieving, sediment type was observed and described. Sieving consisted of gently rinsing the sample material through a bucket sieve with 500-µm mesh to remove fine sediments. Sieved samples were preserved in a solution containing 10% buffered formalin in seawater. Preserved samples were stored in plastic quart-size sample jars and labeled with the project name, sample identification code, sampling date, preservative, and the initials of the collector.

Preserved samples were returned to ESS offices in East Providence, Rhode Island for storage and laboratory analysis.

Example of typical recovery in grab samples

2.2.2 Laboratory Analysis

Upon receipt at the laboratory, each sample was logged in and decanted through a 500-µm sieve. Samples were gently rinsed in the sieve to remove formalin and remaining fine sediments. Once thoroughly rinsed, each sample was returned to a labeled jar and preserved with 70% ethanol for storage.

For sorting, the contents of each sample were examined using a high-power dissecting microscope (7X to 45X magnification) and high-intensity gooseneck fiber optic lamp. Due to the large sample volume, sample sorting was conducted using a randomized sub-sampling methodology. For the sub-sampling process, sample material was emptied into and evenly distributed within a gridded tray, each cell of which was assigned a number. Cells were then randomly selected, one at a time, for sorting using a random number generator. Randomized selection of cells continued until a target of at least 100 organisms was retained for each sample. All randomly selected fractions of sample material were sorted in their entirety.

Organisms found during the sorting process were removed with forceps and placed in 70% ethanol. Each vial was labeled with the project name, collection date and sample identification number. All residue (sediment and organic matter) from the sorted and unsorted portion of each sample was placed in a separate labeled container and re-preserved in 70% ethanol.

Sorted organisms were subsequently identified by a qualified taxonomist to the lowest taxonomic level possible using a dissecting microscope and readily available taxonomic keys and references (Bartholomew, 2001; Martinez, 1999; Abbott and Morris, 1995; Weiss, 1995; Gosner, 1978; Bousfield, 1973; Gosner, 1971; Smith, 1964; Pettibone, 1963). Temporary slide mounts were prepared for annelid worms, as necessary to improve the taxonomic precision of identification for these groups. Slide-mounted organisms were identified under a compound microscope capable of 64X to 1600X magnification.

For quality assurance and quality control (QA/QC) purposes, a second qualified staff member (quality assurance officer) resorted 10% of the samples analyzed by each sorter to ensure organisms were being adequately retained. The quality assurance officer checked the sorted sample material for any remaining organisms and calculated an efficiency rating (E) using the following formula:

$$E = 100 \times \frac{n_a}{n_a + n_b}$$

Where n_a is the number of individuals originally sorted and verified as identifiable organisms by the QC checker and n_b is the number of organisms recovered by the QC checker. If the original sorter achieved E < 90% (i.e., less than 90% of the organisms in the sample removed), corrective action was taken to ensure greater sorting efficiency for other samples sorted by the same individual. Corrective action includes but is not necessarily limited to, additional training on organism recognition and re-sorting of sample material.

In the identification phase, the QA/QC reviewer checked at least 10% of taxonomic identifications for accuracy. Incorrect identifications were reviewed with the taxonomist and revised, as applicable, in the project taxonomic database.

2.2.3 Data Analysis

Measures of benthic diversity, abundance and community structure were selected to describe the affected environment. The rationale behind selection of each measure is as follows:

Diversity: *Taxa richness* is the number of different taxa that are found within a given area or community and is widely accepted as a good assessment measure of diversity (Magurran 2003). For this study, taxa richness is defined as the total number of unique taxa found in a sample.

Abundance: *Macrofaunal density* is a measure of abundance expressed as an estimate of the number of individuals per unit area. Although density often reflects the productivity of marine habitats (Williams et al. 2001), it may also serve as an indication of stress or disturbance at a location. Consequently, the density of benthic organisms may increase or decrease in response to different types of stress (e.g., thermal or chemical pollution, sediment deposition, physical abrasion or displacement).

The density of benthic organisms responds to disturbance as mitigated by the tolerance (or preference) of a given organism to the particular source of disturbance. However, density may vary substantially over small areas or short periods of time and should therefore be interpreted cautiously. For this study, macrofaunal density is expressed as the number of organisms per square meter.

Community structure: *Community composition* is a multivariate measure identifying the different benthic taxa present and respective abundances of each taxon. This descriptive measure provides detail to complement and help interpret summary metrics like taxa richness and macrofaunal density. Multivariate statistical analyses can also be used to evaluate changes in community composition over time.

3.0 RESULTS

3.1 Benthic Imagery

Benthic imagery suggests the bottom type is very similar between the SAP area and the reference area, primarily consisting of sand with shell hash and occasional debris (Attachment A and Attachment B). No sensitive habitats, such as areas of hard bottom or SAV were observed.

Qualitative analysis of the benthic imagery obtained indicated the presence of at least seven macrofaunal taxa overall, including six in the SAP area (Table A). Most of the observed taxa were primarily epifaunal species. Hermit crabs and sand dollars were the most frequently observed taxa. Slow-moving epifauna, such as sand dollars and moon snails, were present at each sampling location but rarely exceeded more

than one individual per photograph. Most photographs indicated the presence of multiple annelid worm burrows and tubes.

Table A. Summary of Macroinvertebrate Taxa Observed in Benthic Imagery

Common Name	Scientific Name	SAP Area	Reference Area
Hermit crabs	Paguridae	X	X
Sand dollars	Clypeasteroida	X	X
Sea stars	Asteroidea	X	X
Segmented worms	Annelida	X	X
Moon snails (includes egg collars)	Naticidae	X	X
Crabs	Decapoda	X	X
Hydrozoans	Hydrozoa		X

The results of the benthic imagery in the SAP area and reference area are consistent with recent video surveys and survey trawls of the WEA, which suggest that the primary benthic epifaunal taxa include common sand dollar (*Echinarachnius parma*), hermit crab (*Pagurus* spp.), rock crab (*Cancer irroratus*), moon snails (Naticidae), nassa snails (*Ilyanassa* [=*Nassarius*] spp.), and sea stars (*Asterias* spp.) (Guida et al. 2015).

3.2 Benthic Grab Sampling

The benthic grab samples provided additional information on the benthic community, especially infaunal taxa. The taxa richness, density and community composition of the samples collected from the SAP area were very similar to the reference area (Table B).

Table B. Summary of Key Statistics

Statistic	SAP Area	Reference Area
Number of Samples	3	3
Mean Density per Square Meter (±1 SD)	3,567 ± 666	3,300 ± 361
Mean Taxa Richness (±1 SD)	9 ± 1	9 ± 2
Total Number of Taxa	16	14
Number of Taxa Observed by Taxonomic Group		
Mollusks	4	3
Oligochaetes	1	1
Polychaetes	8	6
Crustaceans	1	2
Other	2	1
Percent of Total Abundance by Taxonomic Group		
Mollusks	4.7	3.0
Oligochaetes	8.4	11.1
Polychaetes	33.6	37.4
Crustaceans	6.5	12.1
Other	46.7	36.4

3.2.1 Taxa Richness

Overall, 19 species of benthic fauna were observed from the 6 grab samples. Taxa richness was fairly consistent overall, ranging from 7 to 10 at each sampling location (Attachment D), and averaging nine taxa in both the SAP area and reference area (Table C). Polychaete worms were the most taxonomically rich group, contributing as much as half of the taxa richness in the study area. Mollusks were less taxonomically rich, with just a handful of taxa encountered. Crustaceans, oligochaete worms and other taxonomic groups contributed one or two taxa each.

Table C. Taxa Richness

Taxon	Taxa Richness					
	G1	G2	G3	G4	G5	G6
Crustacea	1	1	1	2	2	2
Mollusca	1	1	2	2	0	1
Oligochaeta	0	1	1	0	1	1
Other	1	2	1	1	1	1
Polychaeta	5	4	4	2	3	5
Total	**8**	**9**	**9**	**7**	**7**	**10**

3.2.2 Macrofaunal Density

The highest macrofaunal density for this study (4,300 individuals/m^2) was found at G2, while faunal density was lowest (3,000 individuals/m^2) at G3 and G4 (Table D).

Overall macrofaunal density was comparable between the SAP area and the reference area (Table B). Nematode worms were the most abundant organism encountered in the site-specific benthic grab sampling program, although they made up a larger portion of the benthic community near the meteorological tower than in the reference area. Polychaete worms were the second-most abundant benthic organism observed, followed by oligochaete worms, crustaceans and mollusks.

Table D. Macrofaunal Density

Taxon	Density (Individuals/m^2)					
	G1	G2	G3	G4	G5	G6
Crustacea						
Tanaissus psammophilus	400	100	200	400	400	100
Trichophoxus epistomus	0	0	0	100	100	100
Mollusca						
Astarte castanea	0	0	0	100	0	0
Ensis directus	0	200	0	100	0	0
Ilyanassa trivittata	0	0	100	0	0	0
Spisula solidissima	0	0	100	0	0	100
Tellinidae	100	0	0	0	0	0
Oligochaeta						
Tubificidae	0	700	200	0	200	900
Other						
Nematoda	1800	1700	600	1500	1200	900

Taxon	Density (Individuals/m^2)					
	G1	G2	G3	G4	G5	G6
Turbellaria	0	900	0	0	0	0
Polychaeta						
Capitellidae	200	0	0	0	0	0
Cirratulidae	100	0	0	0	0	0
Exogone hebes	0	0	0	0	0	100
Glycinde solitaria	300	200	800	0	0	0
Lumbrinerides acuta	300	100	500	0	300	400
Orbiniidae	0	0	0	0	100	0
Paraonis sp.	200	100	0	100	0	100
Polygordius sp.	0	300	400	700	900	900
Sigalion arenicola	0	0	100	0	0	100
Total	**3400**	**4300**	**3000**	**3000**	**3200**	**3700**

The average faunal density observed within the study area is consistent with that reported for the WEA by Guida et al. (2015).

3.2.3 Community Composition

Most of the benthic macrofaunal taxa observed in the site-specific benthic grab samples were small burrowing or tube-building taxa. The most commonly observed polychaete taxa include *Polygordius* sp. and *Lumbrinerides acuta* (Table E), both typical of sandy shelf habitats (Solis-Weiss 1995, Ramey 2008). The most abundant crustacean (the tanaid *Tanaissus psammophilus*) and mollusk (the razor clam *Ensis directus*) are also shallow burrowers in sand (Weiss 1995).

No taxa indicative of sensitive habitats were observed in the benthic grab samples.

Table E. Relative Abundance of Taxa Observed in Site-Specific Benthic Grabs

Taxon	% Relative Abundance		
	Overall	SAP Area	Reference Area
Nematoda	37.38	38.32	36.36
Polygordius sp.	15.53	6.54	25.25
Tubificidae	9.71	8.41	11.11
Lumbrinerides acuta	7.77	8.41	7.07
Tanaissus psammophilus	7.77	6.54	9.09
Glycinde solitaria	6.31	12.15	0.00
Turbellaria	4.37	8.41	0.00
Paraonis sp.	2.43	2.80	2.02
Ensis directus	1.46	1.87	1.01
Trichophoxus epistomus	1.46	0.00	3.03
Capitellidae	0.97	1.87	0.00
Sigalion arenicola	0.97	0.93	1.01
Spisula solidissima	0.97	0.93	1.01
Astarte castanea	0.49	0.00	1.01
Cirratulidae	0.49	0.93	0.00

Taxon	% Relative Abundance		
	Overall	SAP Area	Reference Area
Exogone hebes	0.49	0.00	1.01
Ilyanassa trivittata	0.49	0.93	0.00
Orbiniidae	0.49	0.00	1.01
Tellinidae	0.49	0.93	0.00

Larger nematode worms (longer than 500 microns) were included in the site-specific data analysis. However, nematodes are often treated entirely as meiofauna and not included in analyses of the benthic macroinvertebrate community (e.g., Guida et al. 2015).

When nematodes are removed from the site-specific dataset, polychaete worms become the dominant taxonomic group, contributing 54.5 percent and 58.7 percent of the total benthic abundance, respectively. These community composition results are consistent with previous grab sampling of the benthic community near the proposed meteorological tower (Site F in Guida et al. 2015).

4.0 TAXONOMIC CLASSIFICATION OF BENTHIC HABITAT

Benthic habitat in the Maryland WEA is generally characterized by sandy substrates on gentle slopes with evidence of at least moderate levels of mobility (CB&I 2014, Guida et al. 2015). Shell hash frequently accompanies mineral substrates in the WEA and the resultant variations in sediment type and slope are minor.

Benthic habitat within the SAP area for the proposed meteorological tower is typical of the WEA, consisting primarily of sand with shell hash. Water depths are between 26 m and 27 m (85 ft and 89 ft). Sensitive or unique benthic habitats such as hard bottom, live bottom and SAV do not appear to be present. The proposed meteorological tower is located in one of the flattest portions of the WEA (CB&I 2014, Guida et al. 2015) and bedforms are generally muted.

Based on information reviewed in CB&I (2014), Guida et al. (2015) and site-specific investigations, benthic habitat in the SAP area has been classified to the lowest achievable taxonomic level under the Coastal and Marine Ecological Classification System (CMECS).

Biogeographic Setting:

Realm: Temperate North Atlantic

Province: Cold Temperate Northwest Atlantic

Ecoregion: Virginian

Aquatic Setting:

System: Marine

Subsystem: Marine Nearshore

Tidal Zone: Marine Subtidal

Water Column Component:

Water Column Layer: Marine Nearshore Lower Water Column

Salinity Regime: Euhaline Water

Temperature Regime: Moderate Water (Seasonal Variation from Cold to Warm)

Geoform Component:

Tectonic Setting: Passive Continental Margin

Physiographic Setting: Continental Shelf

Geoform Origin: Geologic

Level 1 Geoform: Sediment Wave Field

Substrate Component:

Substrate Origin: Geologic Substrate

Substrate Class: Unconsolidated Mineral Substrate

Substrate Subclass: Fine Unconsolidated Substrate

Substrate Group: Sand

Co-occurring Element: Substrate Subclass: Shell Hash

Biotic Component

Biotic Setting: Benthic Biota

Biotic Class: Faunal Bed

Biotic Subclass: Soft Sediment Fauna

Biotic Group: Small Surface-Burrowing Fauna

Co-occurring Element: Biotic Group: Small Tube-Building Fauna

Co-occurring Element: Biotic Group: Mobile Crustaceans on Soft Sediments

Co-occurring Element: Biotic Group: Sand Dollar Bed

5.0 SUMMARY

A benthic field survey was completed to collect supplemental site-specific data near the site of the proposed meteorological tower for the MD WEA leased by US Wind. Three locations in the SAP area and three locations in a reference area 1,000 m to the north were sampled using collection of still images of the seafloor and collection of benthic grab samples. These data were used to characterize the benthic community and generate a taxonomic classification of benthic habitat in the SAP area to the lowest practicable taxonomic level under CMECS.

Benthic imagery documented seafloor habitats dominated by sand with varying degrees of shell hash. Epifauna observed in the benthic imagery collected under this survey were consistent with those reported in recent video and trawl surveys of the WEA (Guida et al. 2015).

Taxa richness in the SAP area was somewhat lower than expected. However, macrofaunal density and community composition were consistent with recent observations (Guida et al. 2015). The benthic taxa found in this study are common and representative of sandy shelf habitats of the mid-Atlantic U.S. coast (Wigley and Theroux 1981). No rare taxa or taxa indicative of sensitive habitats were observed in the benthic grab samples.

Overall, benthic habitat was documented to be consistent with previous observations of the WEA by CB&I (2014) and Guida et al. (2015). The sandy offshore continental shelf habitat observed appears to support a benthic biotic community characterized by common soft sediment fauna. No sensitive habitats, such as SAV or hard bottom, were encountered.

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Attachment A

Environmental Field Report

Survey Report for
Alpine Ocean Seismic Survey, Inc.

Project:
The Provision of Geological Services and Geophysical Marine Survey Investigation

Offshore Maryland

Description:
Environmental Field Report

Survey Date:
Survey: 05-Jun-2015 to 25-Jul-2014
Environmental: 25-Jul-2015 to 25-Jul-2015

Project Number:
10505

Client Reference
ESS Project No. U167-002

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Distribution

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New Jersey, USA
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For attention of

Justin Bailey/Rob Mecarini

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1 PROJECT SUMMARY

Table 1.1 Survey Details

Item	Details
Type of survey	Benthic Habitat Assessment
Lease Areas	OCS-A0489 & OCS-A0490
Client	Alpine Ocean Seismic Survey, Inc.
SoW document ref(s) and date issued	FINAL SAP Survey Plan 052715.pdf, Issued May 27th, 2015 Memo_2014-12-19_Benthic Sampling Guidance, Issued December 19th, 2014 USwind_MEA_Bathy2.pdf USwind_MEA_Geology.pdf
Object(s) of survey	Acquired data in order to conduct a habitat assessment at six locations across the survey area. Three at the proposed Met Tower location and a further three at a baseline reference site approximately 1,000 meters north (See Figure 2.1). Camera imagery was to be acquired at each of these locations. In addition, grab samples were collected by ESS at these same locations using a modified Van Veen grab sampler (or similar). Benthic material will be sieved in the field through a 0.5 mm sieve bucket and jarred with preservative. Samples will be delivered to the environmental consultant for sample processing, identification and enumeration of benthic organisms to the lowest practicable taxonomic level. Results of the benthic habitat assessment of the Met Tower and reference samples will be presented in the SAP. In accordance with BOEM guidelines, results will be presented in both tabular and geospatial format. Geospatial data will be submitted according to BOEM's Spatial Data Submission Guidelines. Furthermore, the results will include classification of benthic habitat using the lowest taxonomic level achievable under the Coastal and Marine Ecological Classification Standard (CMECS). Combined with G&G survey results that characterize seabed conditions (including grain size), and the Assessment of Benthic Habitats in the Maryland Wind Energy Area commissioned by NOAA Northeast Fisheries Science Center, the benthic sampling program will meet BOEM guidelines for SAP benthic habitat assessment.
Sampling strategy in SoW	As above
Variations to SoW	None
Issues raised at pre-job meeting	None
Vessel (s)	RV Shearwater
Onboard environmentalists	Laura Jamieson, ENV/ MMO, 23-Jul-2015 to 27-Jul-2015, 12 hour ops
Size of survey area and orientation	Irregular shape, approximately 19.2km x 9.5km at largest extent
Any other operations (e.g. geophysical site survey)	A high resolution geophysical (HRG) survey was completed prior to environmental operations using the following equipment: Klein 3900 Dual Frequency SSS, Teledyne Benthos CHIRP III SBP, R2Sonic 2024 MBES, ODOM Echotrac CVM SBES, and Geometrics G-882 MAG. In addition, a geotechnical survey was completed using a combined borehole/ cone penetration test (CPTU) approach.

Table 1.2 Proposed MET Tower Co-ordinates

Proposed Co-ordinates	WGS84		UTM Zone 18 (N)	
	Latitude	Longitude	Easting	Northing
MET Tower	38° 21' 9.8892"N	74° 45' 12.7656"W	521533.96	4244982.95

Table 1.3 Intended and Achieved Survey Strategy

Environmental Survey Strategy	Intended	Achieved (give reasons if different from intended)
Survey template (e.g. cruciform)	Six predetermined stations, three located within the Met Tower area and another three located in a baseline reference area located approximately 1,000 metres North.	As intended
Number of stations (for each type of equipment)	Six	As intended
Equipment (e.g. Day grab, Deep water camera system)	Shallow water camera system	As intended
Sieve size	N/A	N/A

2 PRELIMINARY RESULTS

Table 2.1 Target Locations

Station	Reason for selecting target or feature	Distance and Direction from Proposed Met Tower	Target Easting	Target Northing	Required data	Data / Samples Obtained
G1	Predetermined	213m SE	521682	4244830	Camera	Camera
G2	Predetermined	214m SW	521383	4244831	Camera	Camera
G3	Predetermined	210m N	521533	4245193	Camera	Camera
G4	Predetermined	1457m N	521683	4246432	Camera	Camera
G5	Predetermined	1457m N	521384	4246432	Camera	Camera
G6	Predetermined	1812m N	521534	4246795	Camera	Camera

For further details on specific issues please refer 'Survey Strategy' and 'Issues Arising' tables.

Table 2.2 Initial Interpretation

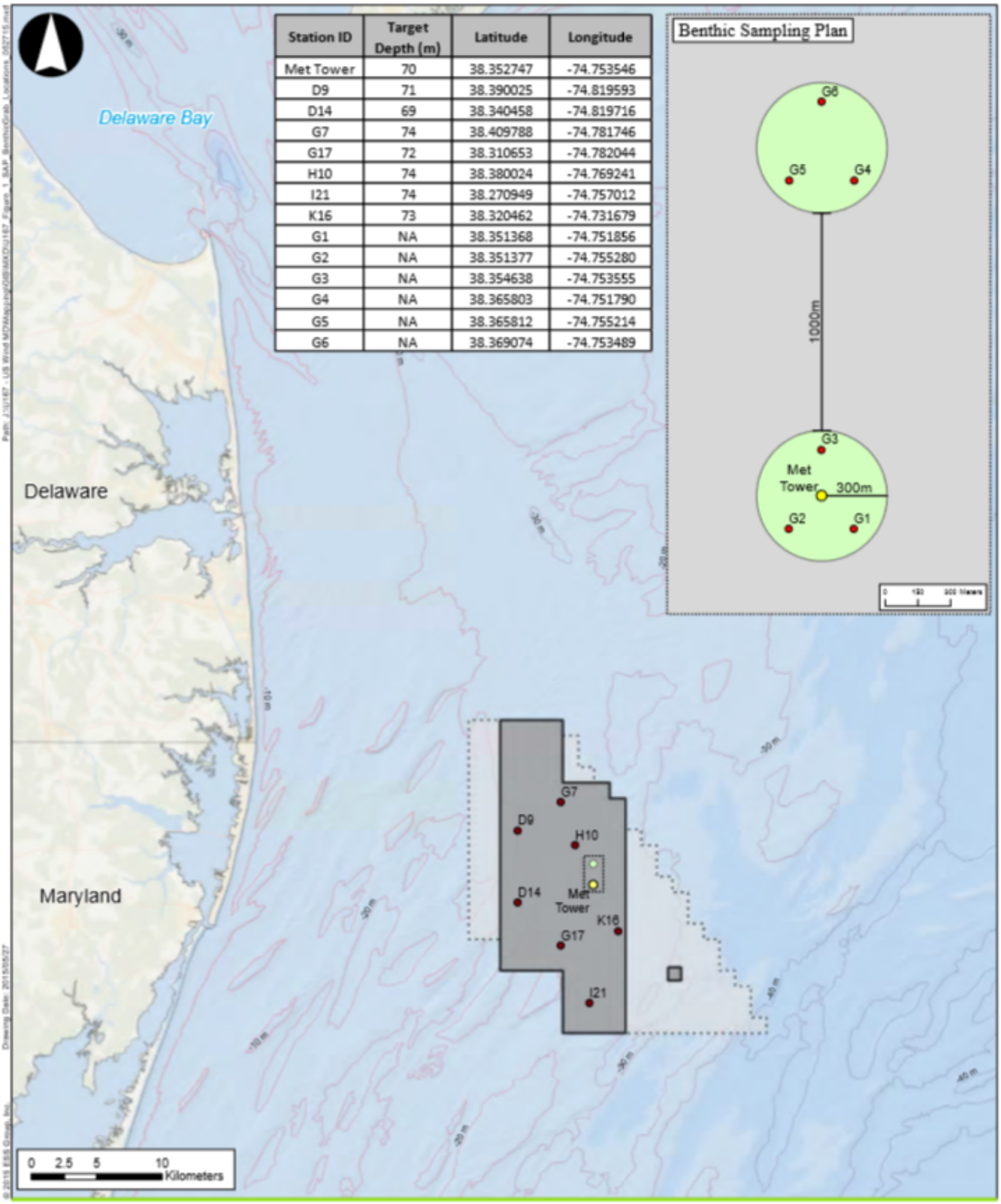
Item	Detail
Brief summary of sonar and bathy data (main seabed types and features of interest)	Sonar and bathymetry data were assessed for operational safety reasons only, no thorough review undertaken for additional features of environmental interest as stations were predetermined.
How did this influence your survey strategy / sampling locations?	Stations were predetermined.
Preliminary seabed imagery findings (sediment and fauna)	**Sediment:** The video footage revealed yellow/ brown sand with shells and shell fragments at all stations. **Fauna:** Observed faunal density and diversity were relatively low at all stations. Observed fauna included Annelida (indet. tube worms), Crustacea (Paguridae and Decapoda) and Echinodermata (Asteroidea and Clypeasteroida).
Preliminary seabed sampling findings (sediment and fauna)	Not applicable as this was carried out seperately by ESS.
Any sensitive habitats or species?	No sensitive habitats or species observed
Dominant current direction (inc tide table if possible)	The dominant current direction is SE to NW.

Table 2.3 Summary of Data Obtained

Station	Water Depth (to nearest m)*	VIDEO	PHOTOS
G1	27	VHS/DVD	18
G2	27	VHS/DVD	16
G3	27	VHS/DVD	17
G4	27	VHS/DVD	13
G5	27	VHS/DVD	14
G6	27	VHS/DVD	18

* water depths relate to the first camera fix location and are not corrected to LAT

Figure 2.1 Target Locations Plot



3 SURVEY ISSUES AND ACTIONS

Table 3.1 Issues Arising During the Survey and Remedial Action Taken

Issue	Details and Remedial Action
Equipment	Wire fitted to winch had no eye so used Crosby Wedge belonging to vessel (see images in misc folder).
Safety	None
Weather	None
Currents	None
Beacon and Positioning	QINSy was utilised to produce navigation string for overlay and to take fixes. There were a few minor issues with integrating this, which were mostly overcome during the mobilisation. The fix number had to be changed manually by the surveyor and at the start of the project the fix number was incorrect until first fix taken where it is reset to 1. A number of items were not logged during initial Station G1 including depth range and bearing. These were calculated after the project and depth was taken from the overlaid navigation string. Lastly dN/ dE was not filled in the log and this was also added after the project. Overall the integration was successful.
Existing infrastructure (e.g. exclusion zones)	Advised by party chief that no infrastructure was within areas of intended camera operations.
Failed sampling attempts	N/A
Recommendations for future surveys	None
Contamination (e.g. greased wire)	N/A
Any other (please specify)	None

Table 3.2 Summary of Equipment Success

Equipment Type	Camera
Successful deployments	6
Attempted deployments	6
% Success	100

4 SURVEY METHODS

4.1 Camera Procedure

Environmental seabed images were taken by means of a digital stills camera system with a dedicated strobe and video lamp, mounted within a stainless steel frame. A USBL positioning beacon was attached to the camera frame.

Footage was viewed in real time via an umbilical, assisting in the control of the digital stills camera. This allowed for shot selection, in the event that the system recorded a sediment change or feature at the seafloor.

A minimum of 10 seabed photographs were taken at each station using a hover and drift technique, separated by a time gap of approximately 5-10 seconds. This technique allowed the frame to move progressively along the seabed as the vessel traversed the work area on its thrusters or drifted. The images were captured remotely using the surface control unit and stored on the camera's internal memory card. Video footage was overlaid with time, position, and depth, and recorded directly onto VHS video and DVD. On completion, photographs were downloaded onto a PC via a USB download cable and copied onto CD-Rom. All CDs, DVDs and videos were labelled with the relevant job details, write-protected and stored.

Main instrumental and acquisition details are as follows:

Equipment	
Manufacturer	Konsberg/Simrad.
Model	OE14-208
Pixels	5.0 M
Standard Lens	f 7.2 – 28.8 (35mm format equivalent to 38 – 140mm)
Focus Control	Automatic or manual 50mm to infinity
Trigger	Remote from deck
Height Control	USBL Beacon and Video footage
Video Overlay	Oceantools HDO
Field of View	47.8 (deg H) by 36.2 (deg V)
Lighting	1 strobe, 1 Bowtech lamp
Scale bar	10cm green laser lines

APPENDICES

APPENDIX A ENVIRONMENTAL LOGS

APPENDIX A ENVIRONMENTAL LOGS

SEABED IMAGERY LOG SHEET (Deck)									QPRO-0753
Job No:	10505	**Area:**	Offshore Maryland	**Vessel:**	RV Shearwater	**Operator:**	LJ		
Date:	from: 25-Jul-2015 to: 25-Jul-2015	**Page:**	1 of 2	**Client:**	Alpine Ocean Seismic Survey, Inc.	**Scale bar:**	10cm (Lasers)		
Project:	Provision of Geological Services and Geophysical Marine Survey Investigation					**Equipment:**	Shallow water camera system		

Sample Number	Station Number	Time on overlay	DVD/ Video No	DVD Chapter	Counter (start & end)	Sediment Description	Comments	TOT FIXES	FIXES Nos
25-Jul-15 Wx SE Force 2, Swell <0.5m									
1	G1	09:48:06	1	1, 2	00:00:00	**Sediment:** Yellow/brown sand with shells and shell fragments **Visible fauna:** Numerous jellyfish including Ctenophora in water column, blue starfish (Asteroidea) and Paguridae.	Depth readings on nav string have extra digits. Numbers are correct up to two decimal places. i.e -21.55 High Turbidity at all stations.	18	1 to 18
		10:12:20	1		00:24:14				
2	G2	10:30:17	1	3, 4 (5 G3 Site Marker)	00:24:14	**Sediment:** Yellow/brown sand with shells and shell fragments **Visible fauna:** Numerous jellyfish including Ctenophora in water column, Decapoda, Paguridae and Annelida.	Depth readings corrected to two decimal places only.	16	19 to 34
		10:46:00	1		00:40:31				
3	G3	11:04:40	2	1	00:40:31	**Sediment:** Yellow/brown sand with shells and shell fragments **Visible fauna:** Numerous jellyfish including Ctenophora in water column, sand dollar (Clypeasteroida), Paguridae, Annelida and egg mass of Naticidae.	No photo taken for Fix 39	17	35 to 52
		11:18:45	1		00:54:33				

APPENDIX A ENVIRONMENTAL LOGS

SEABED IMAGERY LOG SHEET (Deck)									QPRO-0753
Job No:	10505	**Area:**	Offshore Maryland	**Vessel:**	RV Shearwater	**Operator:**	LJ		
Date:	from: 25-Jul-2015 to: 25-Jul-2015	**Page:**	2 of 2	**Client:**	Alpine Ocean Seismic Survey, Inc.	**Scale bar:**	10cm (Lasers)		
Project:	Provision of Geological Services and Geophysical Marine Survey Investigation					**Equipment:**	Shallow water camera system		

Sample Number	Station Number	Time on overlay	DVD/ Video No	DVD Chapter	Counter (start & end)	Sediment Description	Comments	TOT FIXES	FIXES Nos
4	G4	11:40:45	2	2, 3	00:54:33	**Sediment:** Yellow/brown sand with shells and shell fragments **Visible fauna:** Numerous jellyfish including Ctenophora in water column, sand dollar (Clypeasteroida) and Paguridae.		13	53 to 65
		11:52:52	1		01:06:40				
5	G5	12:04:21	2	4, 5	01:06:40	**Sediment:** Yellow/brown sand with shells and shell fragments **Visible fauna:** Numerous jellyfish including Ctenophora in water column, sand dollar (Clypeasteroida) and Paguridae.		14	66 to 79
		12:19:25	1		01:21:44				
6	G6	12:31:00	2	6, 7	01:21:44	**Sediment:** Yellow/brown sand with shells and shell fragments **Visible fauna:** Numerous jellyfish including Ctenophora in water column, sand dollar (Clypeasteroida), Decapoda, Paguridae and indeterminate Hydrozoa.		18	80 to 97
		12:45:25	1		01:36:09				

APPENDIX A ENVIRONMENTAL LOGS

Gardline Geosurvey — Seafloor Sampling Positioning Summary

Job No	10505			Vessel	RV Shearwater						
Client	Alpine Ocean Seismic Survey, Inc.			Vessel Reference Point (VRP)	IMU						
Project Name	Provision of Geological Services and Geophysical Marine Survey Investigation			Deployment Location	Starboard Drop Point Aft Deck (Environmental Camera)	x	NA	y	NA	z	NA
Primary Positioning System	Applanix POS MV			Actual Coordinates derived from	Beacon						
Geodetic Reference System	Datum	NAD83	Ellipsoid	GRS80	Projection	UTM Zone 18 (N)		Vertical / Tidal Datum			

Date	Time (UTC/GMT)	Fix number	Stn No	Penetration	Sample Retention	Retention	Observed Seafloor Depth (m)	Actual coordinates		Target coordinates		Offset from target				Surveyor	Remarks
								Easting	Northing	Easting	Northing	dE	dN	Range	Bearing		
25-Jul-2015	09:55:19	1	G1			Camera	26.82	521682.31	4244829.17	521682.00	4244830.00	-0.31	0.83	0.89	339.52	MK	
25-Jul-2015	09:55:53	2	G1			Camera	26.67	521681.42	4244831.42	521682.00	4244830.00	0.58	-1.42	1.53	157.78	MK	
25-Jul-2015	09:56:36	3	G1			Camera	26.47	521683.00	4244828.50	521682.00	4244830.00	-1.00	1.50	1.80	326.31	MK	
25-Jul-2015	09:57:15	4	G1			Camera	26.50	521682.55	4244830.90	521682.00	4244830.00	-0.55	-0.90	1.05	211.43	MK	
25-Jul-2015	09:58:08	5	G1			Camera	26.33	521682.53	4244829.38	521682.00	4244830.00	-0.53	0.62	0.82	319.47	MK	
25-Jul-2015	09:58:47	6	G1			Camera	25.69	521682.13	4244829.88	521682.00	4244830.00	-0.13	0.12	0.18	312.71	MK	
25-Jul-2015	10:00:14	7	G1			Camera	26.67	521684.52	4244826.72	521682.00	4244830.00	-2.52	3.28	4.14	322.47	MK	
25-Jul-2015	10:00:31	8	G1			Camera	26.33	521687.22	4244822.96	521682.00	4244830.00	-5.22	7.04	8.76	323.44	MK	
25-Jul-2015	10:00:48	9	G1			Camera	26.54	521688.92	4244821.40	521682.00	4244830.00	-6.92	8.60	11.04	321.18	MK	
25-Jul-2015	10:01:21	10	G1			Camera	26.36	521690.26	4244824.16	521682.00	4244830.00	-8.26	5.84	10.12	305.26	MK	
25-Jul-2015	10:02:27	11	G1			Camera	26.69	521688.76	4244835.99	521682.00	4244830.00	-6.76	-5.99	9.03	228.46	MK	
25-Jul-2015	10:03:40	12	G1			Camera	26.55	521679.80	4244841.01	521682.00	4244830.00	2.20	-11.01	11.23	168.70	MK	
25-Jul-2015	10:04:57	13	G1			Camera	26.65	521671.88	4244835.90	521682.00	4244830.00	10.12	-5.90	11.71	120.24	MK	
25-Jul-2015	10:06:11	14	G1			Camera	26.55	521673.16	4244820.08	521682.00	4244830.00	8.84	9.92	13.29	41.71	MK	
25-Jul-2015	10:06:33	15	G1			Camera	26.41	521675.90	4244817.51	521682.00	4244830.00	6.10	12.49	13.90	26.03	MK	
25-Jul-2015	10:07:13	16	G1			Camera	26.28	521682.30	4244818.08	521682.00	4244830.00	-0.30	11.92	11.92	358.56	MK	
25-Jul-2015	10:10:03	17	G1			Camera	26.43	521700.27	4244833.26	521682.00	4244830.00	-18.27	-3.26	18.56	259.88	MK	
25-Jul-2015	10:11:31	18	G1			Camera	26.61	521694.93	4244842.49	521682.00	4244830.00	-12.93	-12.49	17.98	225.99	MK	
25-Jul-2015	10:31:15	19	G2			Camera	26.62	521381.67	4244831.03	521383.00	4244831.00	1.33	-0.03	1.33	91.29	MK	
25-Jul-2015	10:31:30	20	G2			Camera	26.81	521382.19	4244831.25	521383.00	4244831.00	0.81	-0.25	0.85	107.15	MK	
25-Jul-2015	10:32:18	21	G2			Camera	26.79	521381.30	4244829.64	521383.00	4244831.00	1.70	1.36	2.18	51.34	MK	
25-Jul-2015	10:32:59	22	G2			Camera	26.86	521382.40	4244831.36	521383.00	4244831.00	0.60	-0.36	0.70	120.96	MK	
25-Jul-2015	10:34:09	23	G2			Camera	26.73	521382.54	4244830.18	521383.00	4244831.00	0.46	0.82	0.94	29.29	MK	
25-Jul-2015	10:35:34	24	G2			Camera	26.72	521385.01	4244836.65	521383.00	4244831.00	-2.01	-5.65	6.00	199.58	MK	
25-Jul-2015	10:36:33	25	G2			Camera	26.67	521384.96	4244838.83	521383.00	4244831.00	-1.96	-7.83	8.07	194.05	MK	
25-Jul-2015	10:36:59	26	G2			Camera	26.58	521382.10	4244837.64	521383.00	4244831.00	0.90	-6.64	6.70	172.28	MK	
25-Jul-2015	10:37:37	27	G2			Camera	26.64	521376.16	4244837.71	521383.00	4244831.00	6.84	-6.71	9.58	134.45	MK	
25-Jul-2015	10:38:50	28	G2			Camera	26.55	521369.38	4244829.25	521383.00	4244831.00	13.62	1.75	13.73	82.68	MK	
25-Jul-2015	10:39:52	29	G2			Camera	26.51	521374.24	4244822.55	521383.00	4244831.00	8.76	8.45	12.17	46.03	MK	
25-Jul-2015	10:41:00	30	G2			Camera	26.33	521385.47	4244817.52	521383.00	4244831.00	-2.47	13.48	13.70	349.62	MK	
25-Jul-2015	10:41:56	31	G2			Camera	26.91	521391.87	4244822.31	521383.00	4244831.00	-8.87	8.69	12.42	314.41	MK	
25-Jul-2015	10:43:28	32	G2			Camera	26.49	521392.26	4244833.88	521383.00	4244831.00	-9.26	-2.88	9.70	252.72	MK	
25-Jul-2015	10:44:45	33	G2			Camera	26.42	521389.42	4244845.47	521383.00	4244831.00	-6.42	-14.47	15.83	203.93	MK	
25-Jul-2015	10:45:28	34	G2			Camera	26.86	521385.42	4244846.46	521383.00	4244831.00	-2.42	-15.46	15.65	188.90	MK	
25-Jul-2015	11:05:23	35	G3			Camera	26.67	521530.81	4245192.76	521533.00	4245193.00	2.19	0.24	2.20	83.75	MK	
25-Jul-2015	11:06:39	36	G3			Camera	26.88	521532.04	4245193.61	521533.00	4245193.00	0.96	-0.61	1.14	122.43	MK	
25-Jul-2015	11:07:23	37	G3			Camera	26.81	521532.62	4245192.49	521533.00	4245193.00	0.38	0.51	0.64	36.69	MK	

APPENDIX A ENVIRONMENTAL LOGS

Gardline Geosurvey — Seafloor Sampling Positioning Summary

Job No	10505				Vessel	RV Shearwater					
Client	Alpine Ocean Seismic Survey, Inc.				Vessel Reference Point (VRP)	IMU					
Project Name	Provision of Geological Services and Geophysical Marine Survey Investigation				Deployment Location	Starboard Drop Point Aft Deck (Environmental Camera)	x	NA	y	NA	z	NA
Primary Positioning System	Applanix POS MV				Actual Coordinates derived from	Beacon						
Geodetic Reference System	Datum	NAD83	Ellipsoid	GRS80		Projection	UTM Zone 18 (N)			Vertical / Tidal Datum		

Date	Time (UTC/GMT)	Fix number	Stn No	Penetration	Sample Retention	Retention	Observed Seafloor Depth (m)	Actual coordinates		Target coordinates		Offset from target				Surveyor	Remarks
								Easting	Northing	Easting	Northing	dE	dN	Range	Bearing		
25-Jul-2015	11:08:17	38	G3			Camera	26.65	521538.05	4245196.57	521533.00	4245193.00	-5.05	-3.57	6.18	234.74	MK	
25-Jul-2015	11:08:24	39	G3			Camera	26.78	521539.06	4245197.30	521533.00	4245193.00	-6.06	-4.30	7.43	234.64	MK	No Photo. Extra Fix
25-Jul-2015	11:09:17	40	G3			Camera	26.56	521539.91	4245201.85	521533.00	4245193.00	-6.91	-8.85	11.23	217.98	MK	
25-Jul-2015	11:09:51	41	G3			Camera	26.87	521536.47	4245203.73	521533.00	4245193.00	-3.47	-10.73	11.28	197.92	MK	
25-Jul-2015	11:10:18	42	G3			Camera	26.70	521531.52	4245204.85	521533.00	4245193.00	1.48	-11.85	11.94	172.88	MK	
25-Jul-2015	11:10:43	43	G3			Camera	26.72	521527.16	4245202.88	521533.00	4245193.00	5.84	-9.88	11.48	149.41	MK	
25-Jul-2015	11:11:22	44	G3			Camera	26.74	521519.01	4245196.60	521533.00	4245193.00	13.99	-3.60	14.45	104.43	MK	
25-Jul-2015	11:12:19	45	G3			Camera	26.53	521521.39	4245186.68	521533.00	4245193.00	11.61	6.32	13.22	61.44	MK	
25-Jul-2015	11:13:24	46	G3			Camera	26.36	521530.38	4245180.96	521533.00	4245193.00	2.62	12.04	12.32	12.28	MK	
25-Jul-2015	11:14:08	47	G3			Camera	26.40	521541.02	4245184.01	521533.00	4245193.00	-8.02	8.99	12.05	318.26	MK	
25-Jul-2015	11:14:57	48	G3			Camera	26.29	521546.07	4245188.02	521533.00	4245193.00	-13.07	4.98	13.99	290.86	MK	
25-Jul-2015	11:16:26	49	G3			Camera	26.68	521543.90	4245198.67	521533.00	4245193.00	-10.90	-5.67	12.29	242.52	MK	
25-Jul-2015	11:17:35	50	G3			Camera	26.17	521541.82	4245221.00	521533.00	4245193.00	-8.82	-28.00	29.36	197.48	MK	
25-Jul-2015	11:18:19	51	G3			Camera	26.42	521544.72	4245233.05	521533.00	4245193.00	-11.72	-40.05	41.73	196.31	MK	
25-Jul-2015	11:18:34	52	G3			Camera	26.64	521545.27	4245237.25	521533.00	4245193.00	-12.27	-44.25	45.92	195.50	MK	
25-Jul-2015	11:41:15	53	G4			Camera	27.39	521682.62	4246431.76	521683.00	4246432.00	0.38	0.24	0.45	57.72	MK	
25-Jul-2015	11:41:43	54	G4			Camera	26.90	521682.53	4246430.59	521683.00	4246432.00	0.47	1.41	1.49	18.43	MK	
25-Jul-2015	11:42:29	55	G4			Camera	27.09	521682.13	4246432.22	521683.00	4246432.00	0.87	-0.22	0.90	104.19	MK	
25-Jul-2015	11:43:31	56	G4			Camera	27.42	521682.52	4246436.31	521683.00	4246432.00	0.48	-4.31	4.34	173.65	MK	
25-Jul-2015	11:44:38	57	G4			Camera	27.32	521678.46	4246443.32	521683.00	4246432.00	4.54	-11.32	12.20	158.15	MK	
25-Jul-2015	11:45:28	58	G4			Camera	26.86	521668.59	4246438.55	521683.00	4246432.00	14.41	-6.55	15.83	114.44	MK	
25-Jul-2015	11:46:17	59	G4			Camera	27.02	521667.68	4246428.95	521683.00	4246432.00	15.32	3.05	15.62	78.74	MK	
25-Jul-2015	11:47:00	60	G4			Camera	27.67	521675.74	4246416.62	521683.00	4246432.00	7.26	15.38	17.01	25.27	MK	
25-Jul-2015	11:47:51	61	G4			Camera	27.22	521679.84	4246420.44	521683.00	4246432.00	3.16	11.56	11.98	15.29	MK	
25-Jul-2015	11:48:43	62	G4			Camera	27.21	521690.63	4246425.00	521683.00	4246432.00	-7.63	7.00	10.35	312.53	MK	
25-Jul-2015	11:49:32	63	G4			Camera	26.98	521695.47	4246434.04	521683.00	4246432.00	-12.47	-2.04	12.64	260.71	MK	
25-Jul-2015	11:51:56	64	G4			Camera	27.28	521650.25	4246437.63	521683.00	4246432.00	32.75	-5.63	33.23	99.75	MK	
25-Jul-2015	11:52:43	65	G4			Camera	27.51	521640.76	4246431.26	521683.00	4246432.00	42.24	0.74	42.25	89.00	MK	
25-Jul-2015	12:04:45	66	G5			Camera	27.36	521382.02	4246432.15	521384.00	4246432.00	1.98	-0.15	1.99	94.33	MK	
25-Jul-2015	12:05:03	67	G5			Camera	27.54	521383.27	4246432.38	521384.00	4246432.00	0.73	-0.38	0.82	117.50	MK	
25-Jul-2015	12:06:41	68	G5			Camera	27.47	521384.87	4246436.83	521384.00	4246432.00	-0.87	-4.83	4.91	190.21	MK	
25-Jul-2015	12:07:27	69	G5			Camera	27.47	521381.02	4246443.60	521384.00	4246432.00	2.98	-11.60	11.98	165.59	MK	
25-Jul-2015	12:08:33	70	G5			Camera	27.23	521369.59	4246433.18	521384.00	4246432.00	14.41	-1.18	14.46	94.68	MK	
25-Jul-2015	12:09:42	71	G5			Camera	27.29	521374.17	4246417.89	521384.00	4246432.00	9.83	14.11	17.20	34.86	MK	
25-Jul-2015	12:11:18	72	G5			Camera	26.84	521386.90	4246420.68	521384.00	4246432.00	-2.90	11.32	11.69	345.63	MK	
25-Jul-2015	12:12:04	73	G5			Camera	26.93	521394.14	4246427.12	521384.00	4246432.00	-10.14	4.88	11.25	295.70	MK	
25-Jul-2015	12:12:54	74	G5			Camera	27.03	521395.60	4246436.45	521384.00	4246432.00	-11.60	-4.45	12.42	249.01	MK	

APPENDIX A ENVIRONMENTAL LOGS

Gardline Geosurvey — Seafloor Sampling Positioning Summary

Job No	10505			Vessel	RV Shearwater						
Client	Alpine Ocean Seismic Survey, Inc.			Vessel Reference Point (VRP)	IMU						
Project Name	Provision of Geological Services and Geophysical Marine Survey Investigation			Deployment Location	Starboard Drop Point Aft Deck (Environmental Camera)	x	NA	y	NA	z	NA
Primary Positioning System	Applanix POS MV			Actual Coordinates derived from	Beacon						
Geodetic Reference System	Datum	NAD83	Ellipsoid	GRS80	Projection	UTM Zone 18 (N)		Vertical / Tidal Datum			

Date	Time (UTC/GMT)	Fix number	Stn No	Penetration	Sample Retention	Retention	Observed Seafloor Depth (m)	Actual coordinates		Target coordinates		Offset from target				Surveyor	Remarks
								Easting	Northing	Easting	Northing	dE	dN	Range	Bearing		
25-Jul-2015	12:13:30	75	G5			Camera	27.13	521389.82	4246440.28	521384.00	4246432.00	-5.82	-8.28	10.12	215.10	MK	
25-Jul-2015	12:14:24	76	G5			Camera	27.24	521376.11	4246443.86	521384.00	4246432.00	7.89	-11.86	14.24	146.37	MK	
25-Jul-2015	12:16:34	77	G5			Camera	27.26	521368.02	4246423.09	521384.00	4246432.00	15.98	8.91	18.30	60.86	MK	
25-Jul-2015	12:18:31	78	G5			Camera	27.03	521385.51	4246442.94	521384.00	4246432.00	-1.51	-10.94	11.04	187.86	MK	
25-Jul-2015	12:19:04	79	G5			Camera	27.30	521389.58	4246448.12	521384.00	4246432.00	-5.58	-16.12	17.06	199.09	MK	
25-Jul-2015	12:31:40	80	G6			Camera	27.02	521534.08	4246794.29	521534.00	4246795.00	-0.08	0.71	0.71	353.57	MK	
25-Jul-2015	12:32:25	81	G6			Camera	27.24	521532.38	4246795.98	521534.00	4246795.00	1.62	-0.98	1.89	121.17	MK	
25-Jul-2015	12:32:52	82	G6			Camera	27.30	521531.96	4246794.45	521534.00	4246795.00	2.04	0.55	2.11	74.91	MK	
25-Jul-2015	12:33:28	83	G6			Camera	27.48	521530.92	4246796.12	521534.00	4246795.00	3.08	-1.12	3.28	109.98	MK	
25-Jul-2015	12:34:40	84	G6			Camera	27.22	521532.29	4246802.64	521534.00	4246795.00	1.71	-7.64	7.83	167.38	MK	
25-Jul-2015	12:35:18	85	G6			Camera	27.49	521525.57	4246802.63	521534.00	4246795.00	8.43	-7.63	11.37	132.15	MK	
25-Jul-2015	12:36:25	86	G6			Camera	27.18	521518.21	4246788.06	521534.00	4246795.00	15.79	6.94	17.25	66.27	MK	
25-Jul-2015	12:37:09	87	G6			Camera	27.61	521525.79	4246779.30	521534.00	4246795.00	8.21	15.70	17.72	27.61	MK	
25-Jul-2015	12:38:26	88	G6			Camera	27.16	521542.51	4246787.34	521534.00	4246795.00	-8.51	7.66	11.45	311.99	MK	
25-Jul-2015	12:39:35	89	G6			Camera	27.49	521547.52	4246795.19	521534.00	4246795.00	-13.52	-0.19	13.52	269.19	MK	
25-Jul-2015	12:40:28	90	G6			Camera	27.63	521539.78	4246804.70	521534.00	4246795.00	-5.78	-9.70	11.29	210.79	MK	
25-Jul-2015	12:41:13	91	G6			Camera	27.31	521523.56	4246806.23	521534.00	4246795.00	10.44	-11.23	15.33	137.09	MK	
25-Jul-2015	12:41:48	92	G6			Camera	27.18	521515.93	4246800.77	521534.00	4246795.00	18.07	-5.77	18.97	107.71	MK	
25-Jul-2015	12:42:36	93	G6			Camera	27.54	521527.69	4246782.20	521534.00	4246795.00	6.31	12.80	14.27	26.24	MK	
25-Jul-2015	12:43:03	94	G6			Camera	27.05	521532.38	4246777.65	521534.00	4246795.00	1.62	17.35	17.43	5.33	MK	
25-Jul-2015	12:43:36	95	G6			Camera	27.30	521533.01	4246779.70	521534.00	4246795.00	0.99	15.30	15.33	3.70	MK	
25-Jul-2015	12:44:27	96	G6			Camera	27.06	521536.50	4246779.01	521534.00	4246795.00	-2.50	15.99	16.18	351.11	MK	
25-Jul-2015	12:45:09	97	G6			Camera	27.15	521539.01	4246767.02	521534.00	4246795.00	-5.01	27.98	28.42	349.85	MK	

Attachment B

Benthic Imagery (Electronic)

Attachment C

Field Notes

Location: Ocean City Maryland / Shearwater vessel Date: July 23-

Project / Client: US Wind

Van Veen → Subsample: 20 cm by 20 cm of 10 by 4

* Describe type and amount of substrate material, note presence of any large or unusual organisms

- arrive @ Boat docked at 1515 (7/23/15)
- subsample: 20 cm by 20 cm, 4 cm depth
- ma
  * take from one side of scoop if pos

Van Veen Grab

Grab measurements: 30 by 30 cm, depth: 15 cm

7/24/15

1230 - left dock from Ocean City

1245 - Observed bottlenose dolphins in harbor

1500 - Deployed and calibrated "US-BL" (Alpine)

1640 - observed leatherback sea turtle (Gardline)

1645 - finished calibration of USBL

1650 - deployed PAMS cable (Gardline)

7/25/15

0145 - finished PAMS

0500 - start taking photos / videos w/ shallow water cam.

0845 - finish shallow water photos

0900 - Arrive @ G-6 for Grab

0910 - accept Grab, Sand and shell hash (8 cm)

0915 - arrive @ G-5
- reject 1st attempt (not enough material)
- 2nd attempt accept - (12 cm)
  Sand + Shell hash

Location: Maryland / Shearwater vessel Date: 7/25/15

Project / Client: US Wind

0925 - arrive @ G-4
1st attempt - accept 10 cm (Sand) Shell hash

0940 - arrive @ G-3 (photo)
1st attempt - accept 11 cm Sand/Shell hash
↳ coarser sand

0945 - arrive @ G-2 - Sample split into 2 jars
1st attempt accept (13 cm)
↳ Coarser sand + Shell hash

0950 - arrive @ G-1
1st attempt accept - 12 cm
Course sand + Shell hash

1000 - head back to Ocean City

Depths (meters)	
26.8	G1 - Lat: 38°21.0819009 N Long: 74°45.1113856 W
26.6	G2 - Lat: 38°21.0828731 N Long: 74°45.3166996 W
26.6	G3 - Lat: 38°21.2784039 N Long: 74°45.2130349 W
27.0	G4 - Lat: 38°21.9481582 N Long: 74°45.1077416 W
27.4	G5 - Lat: 38°21.9485899 N Long: 74°45.3130922 W
27.4	G6 - Lat: 38°22.1446609 N Long: 74°45.2094107 W

1330 - Arrive back @ dock in ocean City