SITE ASSESSMENT PLAN

GSOE I, LLC
Commercial Lease – OCS-A 0482

Prepared With Technical Assistance from:

Stantec Consulting Services Inc.
6110 Frost Place
Laurel, MD 20707

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

AHMS	Atlantic Highly Migratory Species
APE	Area of Potential Effect
AXYS	AXYS Technology, Inc.
BMPs	Best Management Practices
BOEM	Bureau of Ocean Energy Management
BP	before present / years ago
BSEE	Bureau of Safety and Environmental Enforcement
CFR	Code of Federal Regulations
CVA	Certified Verification Agent
DMA	dynamic management area
DNREC	Delaware Department of Natural Resources and Environmental Control
EA	Environmental Assessment
EFH	essential fish habitat
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FLiDAR	Floating light detection and ranging
FONSI	Finding of No Significant Impact
GHG	greenhouse gases
GPS	Global Positioning System
GSOE I	Garden State Offshore Energy I, LLC
HAPC	Habitat Areas of Particular Concern
HAPs	hazardous air pollutants
HSE	Health, Safety, and Environment
LiDAR	light detection and ranging
LNM	Local Notice to Mariners
MAB	Mid-Atlantic Bight
MDCF	meteorological data collection facility
MLLW	mean lower low water
Met Buoy	AXYS NOMAD Environmental Monitoring Buoy
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOMAD	Navy Oceanographic Meteorological Automatic Device
NOx	Nitrogen Oxides
NRHP	National Register of Historic Places
NTL	Notice to Lessees
OCS	Outer Continental Shelf
OTR	Ozone Transportation Region
PATON	private aids to navigation
PM	particulate matter

PSD	Prevention of Significant Deterioration
SAP	Site Assessment Plan
SAV	submerged aquatic vegetation
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
Skipjack	Skipjack Offshore Energy, LLC
SMA	seasonal management areas
SOC	Standard Operating Conditions
UDP	Unanticipated Discoveries Plan
USACE	United States Army Corps of Engineers
USCG	Unites States Coast Guard
USC	United States Code
VHF	very high frequency
VOCs	Volatile organic compounds
WEA	Wind Energy Area
W-386	United States Navy Warning Area 386

1.0 INTRODUCTION

GSOE I, LLC (GSOE I) has prepared this Site Assessment Plan (SAP) in support of the installation and operation of a stand-alone offshore meteorological data collection system referred to as the AXYS Floating Light Detection and Ranging 6M buoy (FLiDAR 6M [Met Buoy]) to be located within the area of *Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf # OCS-A 0482* (Lease).

The Met Buoy will be deployed at or about 74° 45' 55.68" W, 38° 40' 50.93" N (installation location) within the OCS Official Protraction Diagram Salisbury, NJ 18-05 Lease Block 6375 aliquot A located in Lease Area OCS-A 0482 (Lease Area). Figure 1-1 illustrates the location of the Met Buoy within the Lease Area. The data collected by the Met Buoy will be used to determine energy production estimates and design inputs for a wind energy project within the Lease Area. The Met Buoy will be installed, operated, and decommissioned by a vendor under contract to Skipjack Offshore Energy, LLC.

A SAP was prepared by the previous lease owner, Bluewater Wind Delaware, LLC (Bluewater), and submitted to BOEM in 2013 and revised in 2014. BOEM started the review process, but Bluewater withdrew the SAP prior to BOEM approval. Initially, Bluewater proposed a single meteorological tower (Met Tower), also referred to as a meteorological data collection facility (MDCF), at the location shown in Figure 1-1, but later revised the SAP to include two Met Buoys, both to be deployed, approximately 0.5 miles from the original Met Tower site. The two Bluewater buoys, one to measure surface conditions and one FLiDAR buoy, were to be deployed sequentially – the measurement buoy first and the FLiDAR buoy at an unspecified time after. GSOE I is proposing to locate its Met Buoy at the same location as that proposed for the Bluewater Met Buoys as shown in Figure 1-1.

Bluewater conducted geophysical and geotechnical (G&G) surveys in a 1 nautical mile by 1 nautical mile (1.8 kilometer by 1.8 kilometer) area (Survey Area) within the Lease from 2009 through 2011 to support submittal of the SAP. This Survey Area, which is shown in Figure 1-2, includes both the proposed Met Tower location (in Lease Block 6325) and the proposed Met Buoys location (in Lease Block 6375). Because the GSOE I Met Buoy is proposed in the same location as the Bluewater Met Buoys, and the Bluewater Met Tower location is only 0.5 miles away from the buoys site, much of the site-specific survey data collected and presented in the Bluewater SAPs, original and revised, is relevant to this project and has been incorporated into this SAP. Similarly, other data in the Bluewater SAPs describe site conditions at or in the vicinity of the GSOE I Met Buoy. This information has been included where applicable and/or updated where necessary.

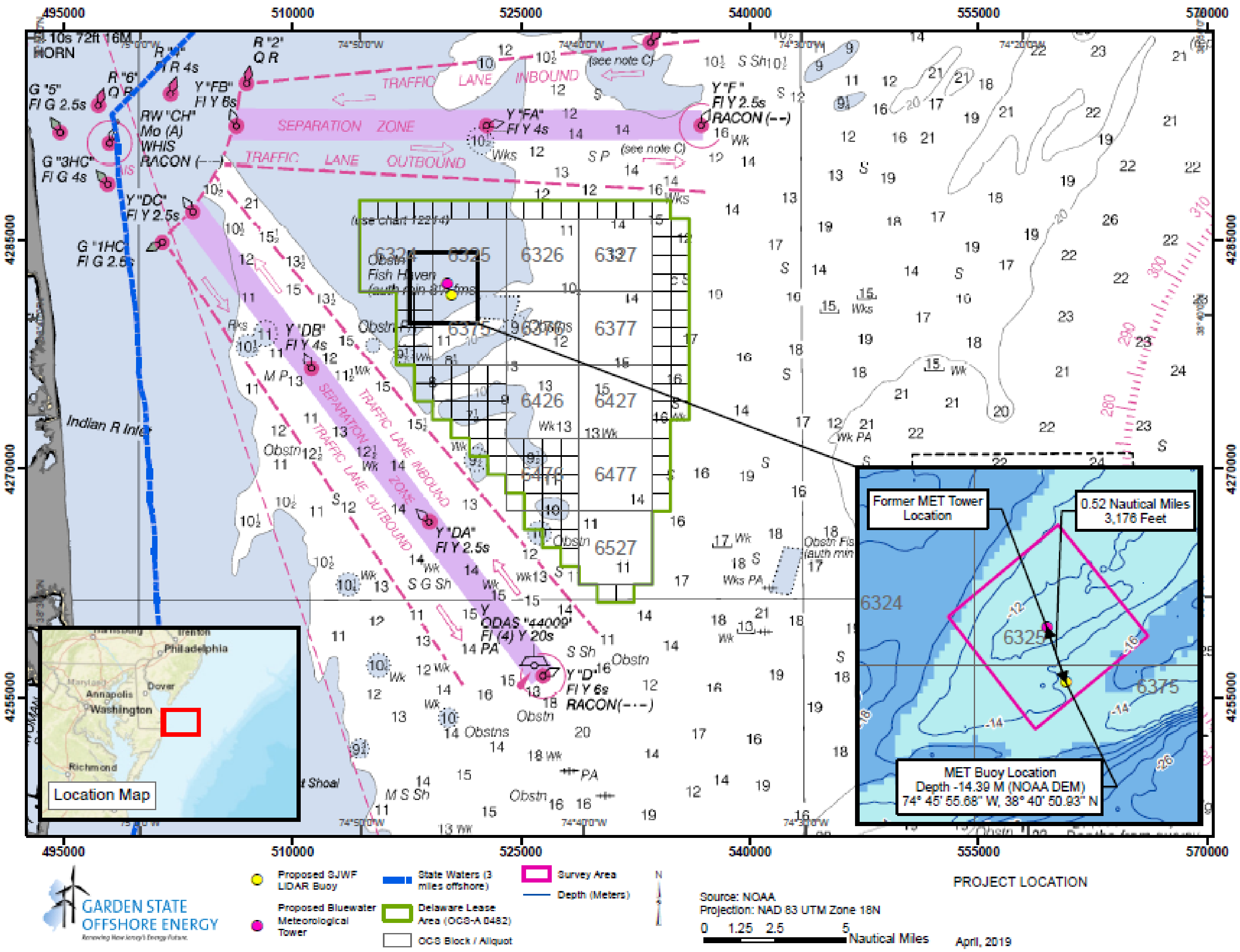

Figure 1-1. Met Buoy Location

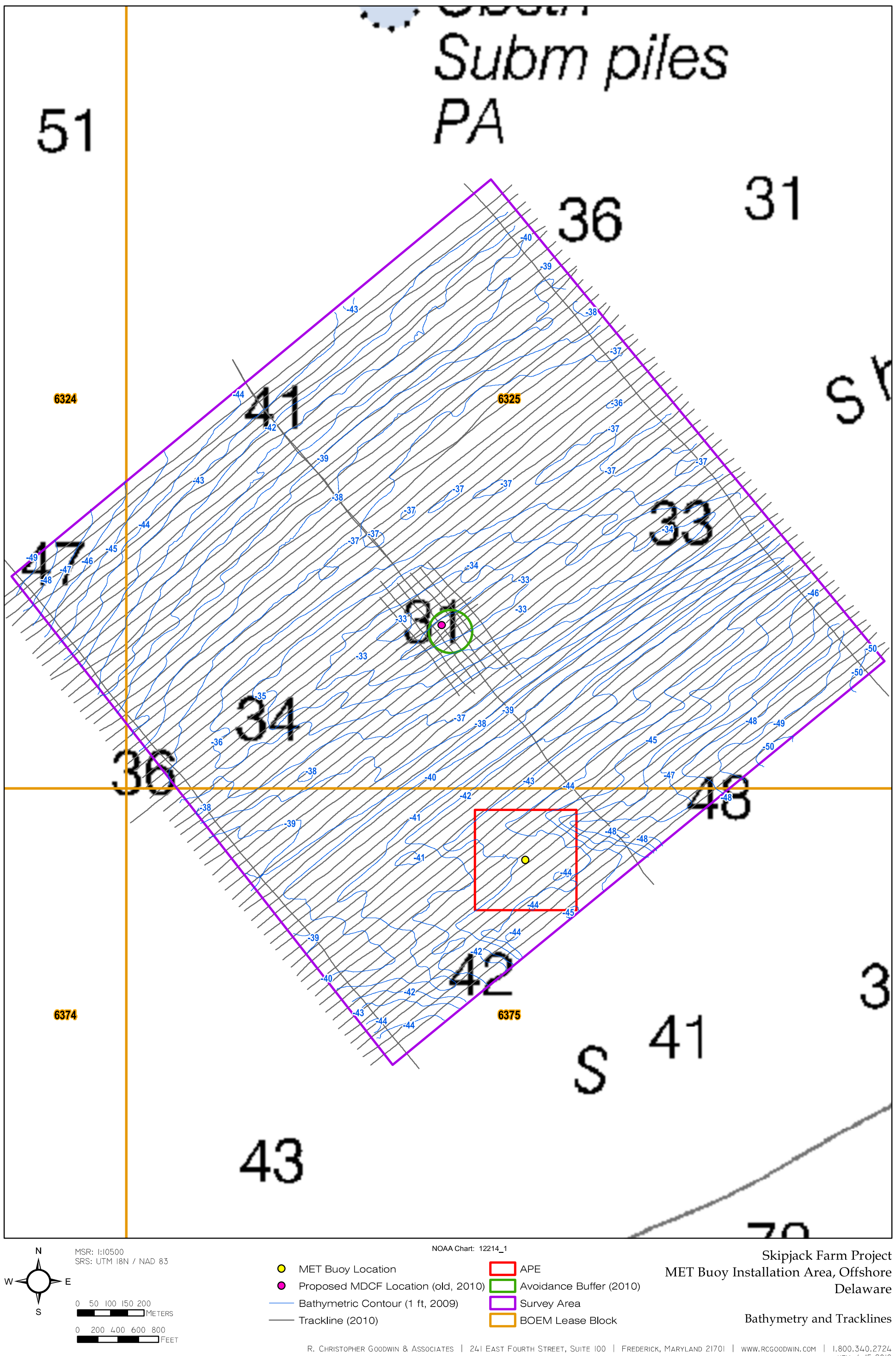

Figure 1-2. Survey Area: Bathymetry and Tracklines

A comparison was completed between the previously proposed Bluewater Met Buoys and the proposed GSOE I Met Buoy to ensure that the potential impacts did not differ significantly. In summary, the proposed GSOE I Met Buoy is expected to have a smaller impact since Bluewater proposed two met buoys and GSOE I is planning to deploy only one Met Buoy. Table 1-1 describes the basic specifications of the Buoys for comparison.

Table 1-1. Buoy Specification Comparison

Specification	Bluewater Wind	GSOE I
Number of Buoys	2 Buoys, deployed sequentially at same location	1 Buoy
Type of Buoy	Guardian Surface Buoy (deployed first), AXYS Wind Sentinel Buoy (to be deployed after the Guardian buoy, timing unspecified)	AXYS Wind Sentinel Buoy
Mooring Type	3- to 5-ton concrete block anchor and chain	5-ton anchor and chain

he Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia Final Environmental Assessment (Mid-Atlantic EA, 2012) prepared in accordance with the National Environmental Policy Act (NEPA; 42 USC § 4321 et seq.), analyzed the reasonably foreseeable consequences associated with issuing commercial leases within Wind Energy Areas (WEAs), which include the Lease Area (Figure 1-1), as well as site assessment activities including the installation of meteorological towers and Met Buoys. The actions proposed within this SAP are within the limits of the activities described in the Mid-Atlantic EA, and no further environmental assessment pursuant to NEPA is necessary.

This SAP has been prepared in accordance with 30 CFR §§ 585.606, 610, and 611 (see Table 1-2), as well as the Guidelines for Information Requirements for a Renewable Energy SAP issued by BOEM on February 24, 2016. Prior to installation of the Met Buoy, GSOE I will obtain all required permits and approvals from various jurisdictional agencies as identified in Table 1-3. GSOE I will provide copies of the final agency authorizations to BOEM prior to the initiation of SAP activities. All installation, operation, and decommissioning activities will be conducted in compliance with any additional requirements stipulated in the final permits to be issued by other regulatory agencies.

This SAP has also been prepared in accordance with, and as required by, Addendum C, Section 2.1.2 of the Lease. Table 1-2 presents a summary of compliance with SAP Requirements pursuant to 30 CFR § 585.105(a), 606(a), 610(a) and (b), and 611(a) and (b) in Appendix A.

Table 1-2. SAP Requirements Pursuant to 30 CFR § 585.105(a), 606(a), 610(a) and (b), and 611(a) and (b)

Requirement	Compliance Statement
585.105(a)	
Design your projects and conduct all activities in a manner that ensures safety and will not cause undue harm or damage to natural resources, including their physical, atmospheric, and biological components to the extent practicable; and take measures to prevent unauthorized discharge of pollutants including marine trash and debris into the offshore environment.	GSOE I will comply with this requirement, as evidenced in this SAP.
§ 585.606(a) Your SAP must demonstrate that you have planned and are prepared to conduct the proposed site assessment activities in a manner that conforms to your responsibilities listed in § 585.105(a) and:	
1) Conforms to all applicable laws, regulations, and lease provisions of your commercial lease	GSOE I will comply with this requirement. See Table 1-2, Table 1-3, and Appendix A.

Requirement	Compliance Statement
2) Is safe	GSOE I will comply with this requirement. Specifically, see Section 4.6.
3) Does not unreasonably interfere with other uses of the OCS, including national security or defense	GSOE I will comply with this requirement. See Appendix A for specific activities to ensure compliance.
4) Does not cause undue harm or damage to natural resources; life; property; the marine, coastal, or human environment; or historical or archeological resources	See Section 7 for an analysis of site characteristics and for avoidance and mitigation measures
5) Uses best available and safest technology	GSOE I will comply with this requirement. See Section 3.1 and Appendix B for a description and technical specifications on the selected Met Buoy.
6) Uses best management practices	GSOE I will comply with this requirement. Best management practices are described in Table 1-4.
7) Uses properly trained personnel	GSOE I will comply with this requirement.
§ 585.610(a) For all activities you propose to conduct under your SAP, you must provide the following information:	
Contact Information	Aileen Kenney, Head of Development & Permitting 56 Exchange Terrace, Suite 300 Providence, RI 02903 Phone: 401-468-0607
The site assessment or technology testing concept	Meteorological, metocean, and biological data collection one stand-alone environmental monitoring buoy.
Designation of operator, if applicable	Skipjack Offshore Energy, LLC
Commercial lease stipulations and compliance	See Appendix A
A location plat	See Figure 1-1
General structural and project design, fabrication, and installation information	See Sections 3 and 4
Deployment activities	See Section 4
Your proposed measures for avoiding, minimizing, reducing, eliminating, and monitoring environmental impacts	This SAP has been prepared in accordance with the Mid-Atlantic EA and stipulations in Commercial Lease OCS-A 0482. Specific efforts to avoid, minimize, reduce, eliminate, or monitor environmental impacts can be found in Section 7
CVA nomination, if required	Not applicable; See Section 1.2
Reference information	See Section 8
Decommissioning and site clearance procedures	See Section 6
Air quality information	See Section 7.3.1
A listing of all Federal, State, and local authorizations or approvals required to conduct site assessment activities on your lease	See Table 1-3
A list of agencies and persons with whom you have communicated, or with whom you will communicate, regarding potential impacts associated with your proposed activities	See Table 1-3
Financial assurance information	To be provided prior to installation activities.
§585.610(b)	
Geotechnical	
(i) A description of all relevant seabed and engineering data and information to allow for the design of the foundation for that facility…	See Section 7.1

Requirement	Compliance Statement
Shallow Hazards	
(i) Shallow faults;	See Section 7.1.1
(ii) Gas seeps or shallow gas;	See Section 7.1.1
(iii) Slump blocks or slump sediments;	See Section 7.1.1
(iv) Hydrates; or	See Section 7.1.1
(v) Ice scour of seabed sediments.	See Section 7.1.1
Archeological Resources	
(i) A description of the results and data from the archeological survey;	See Section 7.3.3, EA 4.1.3.1
(ii) A description of the historic and prehistoric archeological resources, as required by the National Historic Preservation Act (NHPA) of 1966, as amended.	See Section 7.3.3, EA 4.1.3.1
Geological Survey	
(i) Seismic activity at your proposed site;	See Section 7.1.1
(ii) Fault zones;	See Section 7.1.1
(iii) The possibility and effects of seabed subsidence; and	See Section 7.1.1
(iv) The extent and geometry of faulting attenuation effects of geologic conditions near your site.	See Section 7.1.1
Biological	
(i) Live bottoms	See Section 7.2.1, EA 4.1.2
(ii) Hard bottoms	See Section 7.2.1, EA 4.1.2
(iii) Topographic features; and	See Section 7.2.1
(iv) Surveys of other marine resources such as fish populations (including migratory populations), marine mammals, sea turtles, and sea birds.	See Sections 7.2.1, 7.2.2, 7.2.3, EA 4.1.2
§ 585.611(a) and (b) Requirements	
Hazard information	See Section 7.1.1
Water quality	See Section 7.3.1, EA 4.1.1.2
Biological resources	
(i) Benthic communities	See Section 7.2.1, EA 4.1.2.2
(ii) Marine mammals	See Section 7.2.2, EA 4.1.2.3
(iii) Sea turtles	See Section 7.2.2, EA 4.1.2.4
(iv) Coastal and marine birds	See Section 7.2.3, EA 4.1.2.5
(v) Fish and shellfish	See Section 7.2.1, EA 4.1.2.7
(vi) plankton and seagrasses, and	See Section 7.2.1, EA 4.1.2.2
(vii) plant life	See Section 7.2.1, EA 4.1.2.2
Threatened or endangered species	See Sections 7.2.1, 7.2.2 and 7.2.3, EA 4.1.2
Sensitive biological resources or habitats	See Section 7.2
Archeological resources	See Section 7.3.3, EA 4.1.3.1
Social and economic resources	See Section 7.3.2, EA 4.1.3.2
Coastal and marine uses	See Section 7.3.2, EA 4.1.3.5, 4.1.3.6
Consistency Certification	See Table 1-3 Permit Matrix
Other Resources, conditions, and activities	N/A

Table 1-3. Permit Matrix

Permitting Agency	Applicable Permit or Approval	Statutory Basis	Regulations	Applicant Requirements
National Oceanic and Atmospheric Administration, National Marine Fisheries Service	Endangered Species Act Section 7 Consultation	16 USC 1536	50 CFR 402	No action required. These consultations were completed as part of the Mid-Atlantic EA.
	Magnuson-Stevens Fishery Conservation and Management Act Section 305(b) Consultation	16 USC 1801	50 CFR 600	No action required. These consultations were as part of the Mid-Atlantic EA.
	Incidental Take Authorization	Marine Mammal Protection Act	16 USC §§ 1361 *et seq.*	No action required. As detailed in Section 7.2.2 installation, operation and decommissioning of the Met Buoy will not result in the harassment of marine mammals protected under the MMPA.
U.S. Army Corps of Engineers (USACE)	Nationwide Permit No. 5 – Scientific Measuring Devices	Clean Water Act 33 USC 1342	33 CFR 320 et seq.	GSOE I will file letter to USACE documenting conformance to Nationwide Permit No. 5 conditions.
BOEM	National Historic Preservation Act Section 106 Consultation	National Historic Preservation Act 16 USC 470	36 CFR Part 60, Part 800	On April 26, 2012, BOEM made a Finding of No Historic Properties Affected for the issuance of a commercial offshore wind lease off Delaware and the subsequent approval of site assessment activities on the leasehold. In the finding, BOEM established a Programmatic Agreement with its consulting parties to continue Section 106 consultations throughout BOEM's approval processes, including the approval of any subsequent SAP(s).
	Abandoned Shipwreck Act/Consultation and Determination	Abandoned Shipwreck Act 43 USC 2101 et seq.		Appendix E includes a marine cultural resources report; that assessment along with this SAP indicates Met Buoy deployment will have no impact on submerged pre- or post-contact period archeological properties or archeologically sensitive paleosols.
United States Environmental Protection Agency (EPA)	Outer Continental Shelf Air Permit[1]	Clean Air Act 42 U.S.C. 762	40 CFR 55, 60;	Appendix D includes detailed air emission calculations and assumptions to be included in the OCS permit application
United States Coast Guard (USCG)	Approval for Private Aids to Navigation	14 USC 81	33 CFR Part 66	GSOE I (or designated representative) will file Private Aids to Navigation (PATON) applications prior to Met Buoy

[1] The proposed Met Buoy is powered by a rechargeable battery pack, that can be charged by an onboard wind turbine and/or, solar panels with an optional back-up engine generator. When powered by the wind turbine and/or solar panels, there is no potential to emit pollutants and the Met Buoy would not qualify as an OCS source under 40 CFR § 55.2. GSOE I will apply for an OCS air permit to have the option to use the back-up generator to charge the rechargeable battery pack for the MET Buoy. GSOE I may deploy the Met Buoy. once the SAP is approved, without the back-up generator option before an OCS air permit is issued.

Permitting Agency	Applicable Permit or Approval	Statutory Basis	Regulations	Applicant Requirements
				deployment.
Responsible State Agency	Coastal Zone Consistency Determination	16 USC 1451	15 CFR 930	No action required. These consultations were completed as part of the Mid-Atlantic EA.

1.1 Authorized Representative and Designated Operator

GSOE I designates Skipjack Offshore Energy, LLC (Skipjack) as the Operator for the Met Buoy. The authorized representative for GSOE I and Skipjack is Aileen Kenney, her contact information is:

Aileen Kenney
Head of Development & Permitting
401-648-0607
akenney@dwwind.com
56 Exchange Terrace, Suite 300
Providence, RI 02903

1.2 Certified Verification Agent Waiver Request

Pursuant to 30 CFR § 585.610(a)(9), BOEM may require a Certified Verification Agent (CVA) to certify that the Met Buoy is designed to withstand the environmental and functional load conditions for the intended life of the Met Buoy at the Installation Area. GSOE I requests a waiver of the CVA requirement per 30 CFR § 585.705(c) because the Met Buoy is a commercially available technology that has been deployed in similar conditions. The engineering team, which includes a Professional Engineer, will review and accept the design. The engineering team will also inspect the equipment prior to installation, witness the installation, and prepare an installation report. This report will include a description of the equipment and the installation, including final coordinates of the installation site, the results of all commissioning tests, the plans and schedule for upcoming inspections and maintenance, and any noted problems or issues to be addressed.

1.3 Best Management Practices

Best management practices (BMPs) are described in Sections 1.3, 4.2.4, and 7.0. GSOE I will use many of the BMPs identified in the *Establishment of an OCS Alternative Energy and Alternate Use Program*, Record of Decision, December 2007. See Table 1-4 for a summary of these BMPs (numbering in Table 1-4 corresponds to the format of the noted Record of Decision).

Table 1-4. Best Management Practices

Best Management Practice	Location in SAP Document
7. Avoid known sensitive seafloor habitats	Section 7.1.2
8. Avoid anchoring on sensitive seafloor habitats	Section 7.1.2
9. Minimize seafloor disturbance during installation of the equipment	Sections 7.1.2
11. Routine inspection of the facilities to monitor scouring and ensure structural integrity	Section 5.2
12. Avoid the use of explosives that may impact fish or benthic organisms	No explosives will be used for activities proposed in the SAP.
15, 16, 18, and 22 related to minimizing/avoiding vessel impacts to marine mammals and sea turtles	Section 4.3
19. Use existing data to identify important, sensitive, and unique marine habitats in the vicinity of the project and design the deployment to avoid adverse impacts to these habitats	Section 7
20. Minimize construction activities in areas containing anadromous fish during migration periods	Section 7.2.1
21. Minimize seafloor disturbance during installation of the buoy	Section 7.1
26. Minimize perching opportunities	Section 7.2.3
29. Comply with USCG lighting and marking requirements while using lighting technology that minimizes impacts to avian species	Section 4.1, 7.2.3

Table 1-4. Best Management Practices

Best Management Practice	Location in SAP Document
37. Avoid impacts to the commercial fishing industry by marking the buoy(s) with USCG-approved marking and lighting to ensure safe vessel operation	Section 4.1
39. Avoid hard-bottom habitats, including seagrass communities and kelp beds	Section 7.1.2
54. Prepare an oil spill response plan	Prior to commencing installation of the Met Buoy, GSOE I will submit an Oil Spill Response Plan for review and approval to the Oil Spill Response Division of the Bureau of Safety and Environmental Enforcement. The plan will demonstrate compliance with 30 CFR 254.22(a), 254.23(a) and 254.23(g)(1).

2.0 CONFORMANCE WITH THE MID-ATLANTIC EA/FONSI AND THE COMMERCIAL LEASE

On January 20, 2012, BOEM issued a Finding of No Significant Impact (FONSI) based on the Mid-Atlantic EA (BOEM 2012). The Mid-Atlantic EA analyzed the reasonably foreseeable consequences associated with issuing commercial leases within Wind Energy Areas (WEAs), which include the Lease Area (Figure 1-1), as well as site assessment activities including the installation of meteorological towers and monitoring buoys. The Met Buoy and associated equipment proposed is consistent with the equipment that has been analyzed in the Mid-Atlantic EA. BOEM identified several mitigation measures or Standard Operation Conditions (SOCs) in the Mid-Atlantic EA for buoy installation, operation, and decommissioning. The SOCs were developed by BOEM in consultation with other Federal and State agencies to minimize the potential environmental risks to or conflicts with individual environmental and socioeconomic resources upon issuance of a commercial lease for site assessment and characterization activities. BOEM has issued stipulations for GSOE I's lease-specific site characterization activities and site assessment activities in the Lease Area based upon these SOCs. Appendix A and Section 7 of this SAP demonstrate how GSOE I will conform to the stipulations outlined in the Commercial Lease documents.

3.0 PROJECT DESCRIPTION AND OBJECTIVES

3.1 Project Description

The Met Buoy will be deployed for the purpose of collecting wind resource, metocean, and biological data to support development of offshore wind energy within the Lease Area. The meteorological data will be used to model energy production estimates.

GSOE I has selected a state-of-the-art Met Buoy that incorporates the best available technology. Design drawings of the technology proposed are provided in Appendix B. The Met Buoy will consist of instrumentation systems and supporting systems atop an instrumentation panel platform (Figure 3-1). The floating platform consists of the AXYS Navy Oceanographic Meteorological Automated Device (NOMAD) hull, mooring chain, and clump weight anchor (Figure 3-2). The NOMAD hull consists of marine grade aluminum and measures 19.7 feet (6 meters) in length by 10.2 feet (3.1 meters) in width. The vertical profile of the Met Buoy including instrumentation will be approximately 13.8 feet (4.2 meters) from the sea surface to the top of the hull mast. The submerged portion of the hull will measure approximately 11.5 feet (3.5 meters) below the sea surface from the water line to the bottom of the mooring yoke. The outer hull is finished with a marine grade epoxy and polyurethane yellow paint and bumpers.

The hull has also been designed with consideration for avian species. Landing areas have been minimized, and anti-perching devices will be installed.

The Met Buoy will be moored to the seabed by a 5-ton clump weight anchor representing a 27-square foot (2.5-square meter) contact area with the bottom. The anchor and buoy are connected via 250 feet (76.2 meters) of 1.25-inch (3.2-centimeter) mooring chain providing a chain to water depth scope of 5:1. The maximum total footprint of the proposed buoy including impacts from anchor chain sweep during operations is approximately 142,870 square feet (3.3 acres, 13,273 square meters). Anodes will be installed on the mooring yoke and hull for corrosion protection.

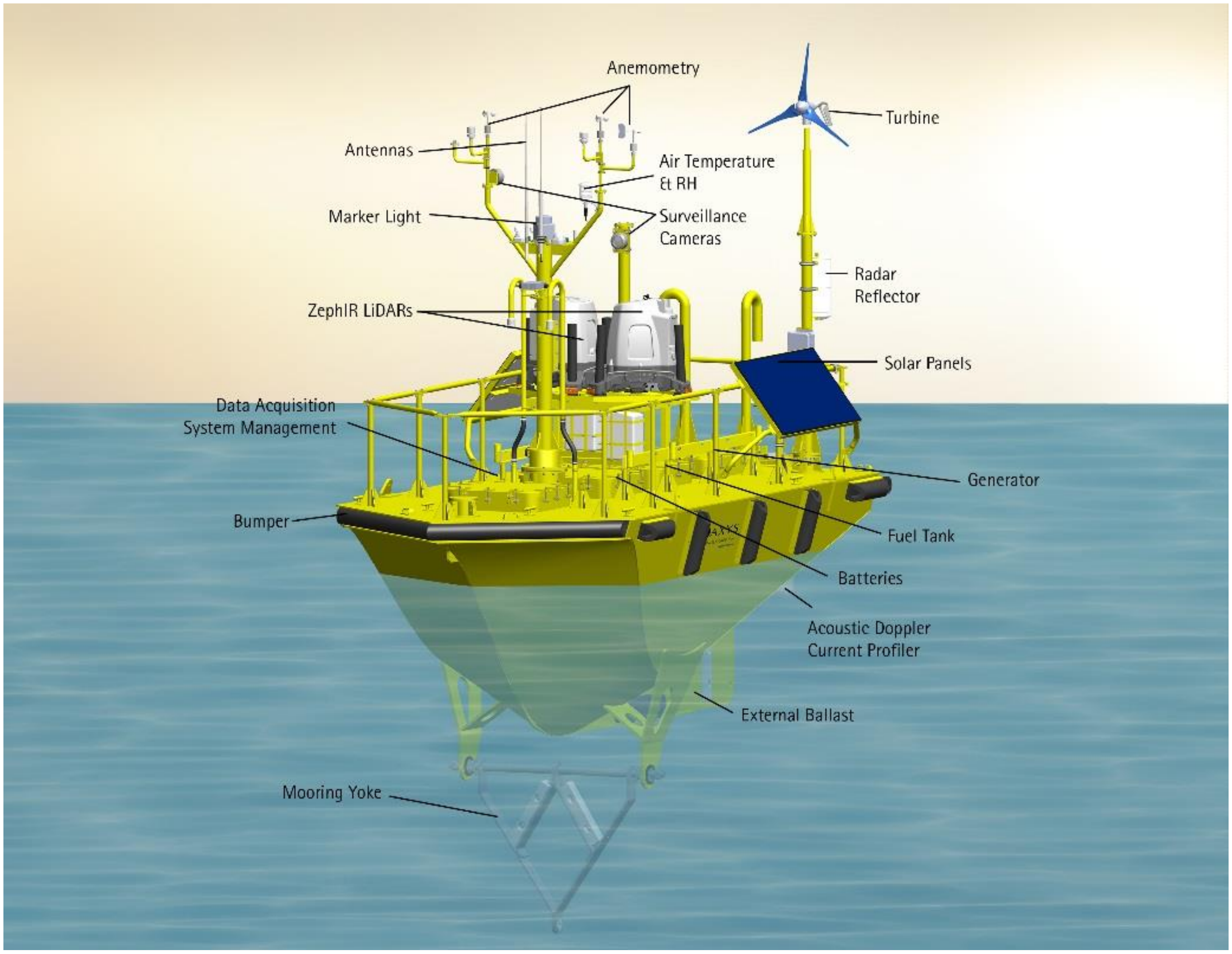

Figure 3-1. AXYS FLiDAR 6M™ Meteorological Buoy

A single or dual light detection and ranging (LiDAR) instrumentation package will be installed atop the hull. The LiDAR unit is a wind profiling device capable of remotely collecting wind data at heights up to 656 feet (200 meters) above the platform level. Each LiDAR unit is approximately 3.3 feet (1 meter) in height. In addition to the LiDAR package, the Met Buoy instrumentation package consists of the following sensors:

- a wave sensor for measuring wave height, direction, and period;
- acoustic doppler current profiler for measuring current speed and direction;
- wind anemometer for measuring surface wind speed and direction;
- a sensor for measuring air temperature and relative humidity;
- barometric pressure sensor or measuring ambient air pressure; and
- an avian and bat monitor sensor.

Supporting systems for navigational aids, power supply, position tracking, and remote monitoring and data acquisition will also be installed atop the hull, including the following components:

- navigation aids such as lights, radar reflectors, and broadcasting devices;
- rechargeable batteries, powered by onboard wind turbines, solar panels, and a backup generator;
- global positioning system (GPS) and motion sensor for recording and transmitting Met Buoy position; and
- onboard computers, antennas, and cameras for system monitoring and data acquisition, processing, and transmission.

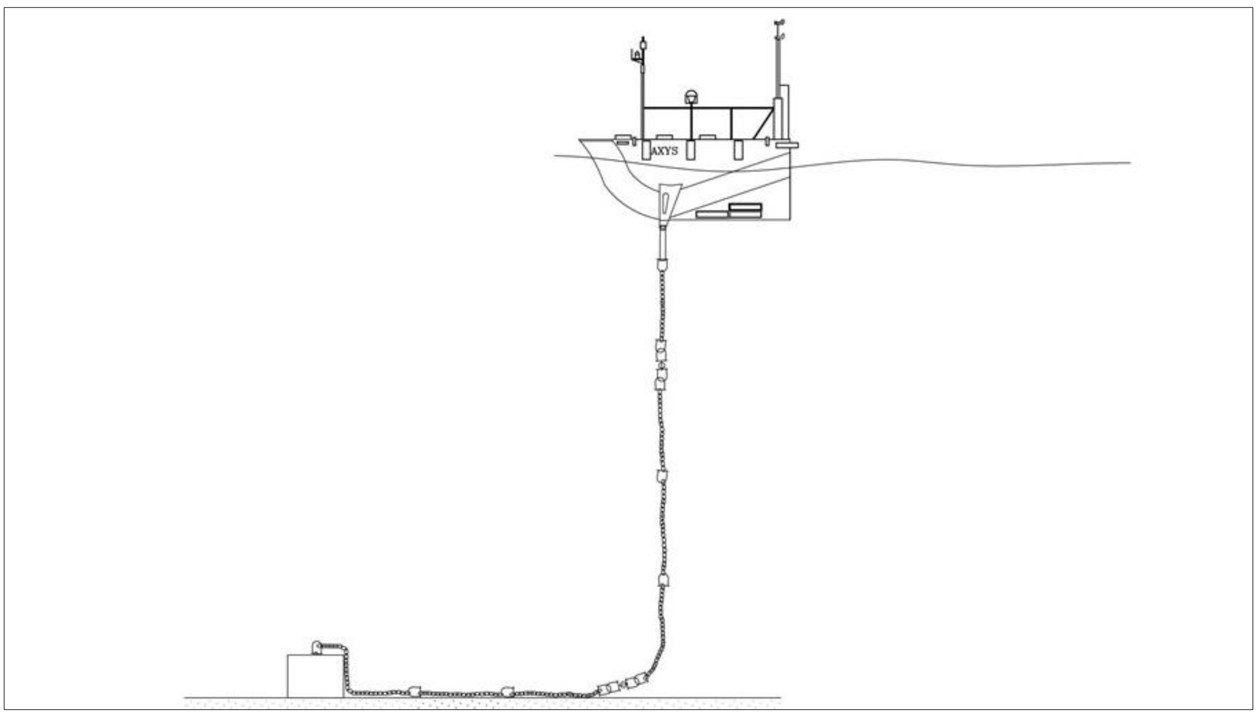

Figure 3-2. Mooring Arrangement Met Buoy

As described in the Mid-Atlantic EA (BOEM 2012), the project site is seasonally subject to periodic hurricanes and other extreme weather events. The proposed 5-ton anchor and a 250-foot long chain (scope of approximately 5 times the water depth at the GSOE I buoy location) have been designed to withstand these expected weather and oceanographic conditions.

3.2 Site Location

The Met Buoy will be deployed at or about 74° 45' 55.68" W, 38° 40' 50.93" N (installation location) within the OCS Official Protraction Diagram Salisbury, NJ 18-05 Lease Block 6375 aliquot A located in the Lease Area (see Figure 1-1). The Lease Area rests between the incoming and outgoing shipping routes for Delaware Bay and is made up of 11 whole OCS blocks and 16 partial blocks. The proposed Met Buoy site is located approximately 14 nautical miles (25.9 kilometers) offshore of Rehoboth Beach, Delaware at a water depth of approximately 43.5 feet (13.2 meters). The entire Lease Area is approximately 96,430 acres; (39,024 hectares) (BOEM 2012).

3.3 Schedule

GSOE I is proposing to deploy the Met Buoy in early 2019. The operational life of the Met Buoy is anticipated to be 6 years. A minimum deployment of one-year is planned, with extensions of 4 months up to 1 year or more possible. The Met Buoy will be decommissioned at the end of its operational life as described in Section 6.

4.0 DEPLOYMENT / INSTALLATION

Installation of the Met Buoy is planned over a one to four day installation period, barring weather delays, and will be staged from the Port of Wilmington, Delaware, or comparable existing port in the mid-Atlantic.

4.1 Overview of Installation and Deployment Activities

As part of the mobilization process, GSOE I will notify mariners and other users of the area by submitting a request to the USCG for publication of a Local Notice to Mariners (LNM) prior to the start of the in-water work. This notice will include the contact names for the installation vessels, channels of communication, and the duration of the work. Copies of all USCG communications will be provided to BOEM as required. Additionally, in accordance with standard maritime practices, the vessel captain(s) will broadcast via very high frequency (VHF) radio on Marine Channel 16 notification to mariners of their position and limited mobility during installation activities and submit an application to the USCG for a private aid to navigation (PATON) for the Met Buoy (see Table 1-3).

The installation process will be completed in two stages. The first stage will consist of installation of the clump weight anchor and mooring chain. The second stage will consist of connection of the hull to the mooring chain.

Upon commencement of the work, the installation vessel will position itself near the clump weight anchor deployment location. A marker float and rope will be attached to the free end of the mooring chain section that is connected to the clump weight and released into the water. This section of the mooring chain will then be released into the water. The installation vessel will adjust its position as necessary prior to deploying the clump weight. Upon reaching the desired location, the clump weight will be lifted via an A-frame or crane from the installation vessel into the water and lowered to the desired location. GSOE I may elect to utilize a Remotely Operated Vehicle to observe the underwater installation.

The Met Buoy installation will occur either by towing the hull to the site or by deploying from the deck of the installation vessel. The installation vessel and/or support tug will retrieve the marker float connected to the previously deployed anchored mooring chain. The anchored section of the mooring chain will be connected via shackle to the section connected to the mooring yoke on the hull of the Met Buoy. The completed mooring will then be released into the water. Post installation checks will be completed, including visual checks of the mooring behavior and buoy movement.

4.2 Vessels

A qualified marine contractor will be employed to transport and deploy the Met Buoy under the management and direction of the buoy manufacturer. The marine contractor is expected to use the vessel types described in Table 4-1. Specific vessels will be identified prior to installation.

Table 4-1. Vessels to be Used for Met Buoy Installation

Vessel Type	Approximate Dimensions	Lifting Capacity	Remarks
Work Vessel	120' x 30'	30 tons	Flat-topped barge or comparable work vessel with sufficient deck space to store and secure clump weight, mooring chain, hull, and all miscellaneous monitoring equipment to be installed on the Met Buoy. May use anchors or dynamic positioning for station keeping.
Handling Tug	49' x 15'	24	Ocean-going tug for moving the work barge, anchor handling, and installation support.
Crew Boat	TBD	N/A	30-person crew boat to bring personnel to the work vessel twice per day as needed.

The installation vessel will utilize a two- to four-point anchor or dynamic positioning system to hold position during installation activities. Vessel anchors will consist of up to four 4-ton anchors, each covering an area up to 10 feet by 10 feet (3 meters by 3 meters) to a depth of up to 12 feet (3.7 meters). The anchor radius for a typical installation vessel will be up to approximately 2,000 feet (600 meters).

4.3 Protected Species Avoidance

All marine mammals are federally protected by the Marine Mammal Protection Act of 1972 (as amended through 2015), and most large whales and sea turtles, as well as any federally listed species of fish in the region are further protected under the Endangered Species Act (ESA).

Lease stipulation 4.1.1 specifies that all vessels conducting activities in support of this SAP submittal comply with the vessel-strike avoidance measures specified in stipulations 4.1.1.1 through 4.1.1.7, except under extraordinary circumstances when the safety of the vessel or crew is in doubt or the safety of life at sea is in question. These measures, as specified in the Commercial Lease Addendum C, are presented in Appendix A.

During all phases of SAP activities, GSOE I will also ensure that sightings of any injured or dead protected species (e.g., marine mammals, sea turtles, or sturgeon) are reported to BOEM, National Marine Fisheries Service (NMFS), and the NMFS Northeast Regional Stranding Hotline within 24 hours of sighting. If necessary, GSOE I will file an Incident Report, an example of which is included as Appendix F.

4.4 Marine Trash and Debris Awareness and Elimination

GSOE I will ensure that all employees and contractors are briefed on marine trash and debris awareness elimination, as required in Addendum C, Section 4.1.2 of the Lease and as described in the Bureau of Safety and Environmental Enforcement (BSEE) NTL No. 2015-G03 which has superseded NTL 2012-G01.

4.5 Oil Spill Response Plan

The Met Buoy will carry approximately 225 gallons of diesel to provide fuel for the backup generator. Prior to deploying the Met Buoy, GSOE I will submit an Oil Spill Response Plan for review and approval to the Oil Spill Response Division of the BSEE. The plan will demonstrate compliance with 30 CFR 254.22(a), 254.23(a), and 254.23(g)(1).

4.6 Health and Safety

GSOE I will implement a project-specific Health and Safety Plan to protect the health and safety of all personnel involved in the deployment, operation and maintenance, and decommissioning of the Met Buoy system. The plan will also address incident response and reporting requirements in the event of an accident.

Prior to the installation of the Met Buoy, all personnel will attend a Health, Safety, and the Environment (HSE) and installation plan briefing. In addition to HSE, the briefing will also establish responsibilities of each person, define the chains of command, discuss communication procedures, and provide an overview of planned installation activities and emergency procedures. New personnel will be briefed as they join the work in progress. Additional topics for the briefing include protected species avoidance, marine trash and debris awareness, and oil spill response procedures.

5.0 OPERATIONS AND MAINTENANCE

5.1 Data Collection and Operations

The Met Buoy will remain moored in position and transmit data autonomously via a satellite telecommunications link. The Met Buoy operator, AXYS Technologies, has developed a system (WatchCircle) to monitor buoy position. The WatchCircle uses buoy coordinates from the onboard GPS receiver to determine whether the buoy is within a predefined area. If the buoy were to drift out of its WatchCircle, a satellite transmitter is activated, and location messages are transmitted, enabling the tracking of the buoy until recovered. Use of the satellite transmitter enables a redundant position message to be received even if other telemetry systems are not available. The WatchCircle for the proposed system (also identified as the drift radius) is 50-55 meters.

Operating status, including buoy power supply and GPS position, will be monitored remotely by a shore side base. Data packets including 10-minute average min/max/mean speed and direction will be downloaded daily for analysis. Routine operations will be limited to checking system status and data validation, troubleshooting, and remote resets if necessary.

5.2 Maintenance Activities

Planned maintenance will be conducted semi-annually, consisting of at-sea and/or onshore inspections. Work at sea will be completed by vessels comparable or smaller to the installation vessel. Planned maintenance activities will include replacement of consumables, service of sensors, data retrieval, and an annual visual inspection of the mooring system to ensure integrity of the configuration and equipment and to assess scour. Additional detail regarding the maintenance schedule is provided below:

- An at sea inspection of the buoy will be completed at the 6-month mark. A second inspection will be completed at 1 year, including a visual inspection of the mooring system, if the campaign is extended beyond 12 months. If the Met Buoy campaign is not extended beyond 12 months the buoy will be recovered with no 1-year inspection.

- If the Met Buoy campaign is extended beyond 16 months, the buoy will be recovered, and an onshore inspection will be completed.
- Emergency maintenance may be conducted, as needed.

5.3 Reporting

A copy of the maintenance and inspection report will be provided to BOEM with Semi-Annual Progress Reports required by the Commercial Lease (Stipulation No. 2.2.1) or upon request.

5.4 Potential Faults or Failures

The Met Buoy will be remotely monitored for the duration of operations. Unplanned maintenance activities may be required in the event of a power supply failure, hull leak, buoy drift outside designated area, mooring component failure, or other such event. If any of these problems are suspected, a technical service crew will be promptly dispatched to investigate and repair the issue. The Met Buoy is capable of operating at full capacity without renewable power or backup generator supply to the batteries for up to one week.

6.0 DECOMMISSIONING

BOEM requires decommissioning of facilities described in the SAP in accordance with § 585.901. GSOE I will submit a decommissioning application to BOEM as required by § 585.902(b) prior to decommissioning of the Met Buoy. Following BOEM approval of the decommissioning application, GSOE I will notify BOEM at least 60 days prior to vessel deployment.

6.1 Overview of Decommissioning Activities

Upon completion of SAP activities, the Met Buoy will be decommissioned. The decommissioning process will be similar to the installation process but in reverse. Similar types and numbers of vessels used for the installation of the Met Buoy will be used for decommissioning. The work vessel will position itself on-site to detach the hull from the mooring chain and attach float markers to the loose ends of the mooring chain. The Met Buoy and mooring chain will either be recovered to the vessels deck or towed off site. The clump weight will be connected to the crane or A-frame of the work vessel and recovered to the vessels deck.

6.2 Site Clearance Survey

Following decommissioning, GSOE I will conduct a photographic or video bottom survey to provide objective evidence to BOEM that the area has been cleared as required in § 585.902(a)(2). The operation of the Met Buoy is not expected to result in any trash or bottom debris.

6.3 Reporting

As specified in the Commercial Lease, Addendum C (see Appendix A), GSOE I will submit a final progress report to BOEM at the conclusion of the activities covered by the SAP or at the conclusion of the site assessment term, whichever comes first. GSOE I will notify BOEM of decommissioning activities in accordance with § 585.900-913. The notification and reporting process involves the following requirements:

- Prior to decommissioning, GSOE I will submit a decommissioning application to BOEM in accordance with § 585.902 and § 585.905. GSOE I will notify BOEM six months prior to decommissioning to allow BOEM sufficient time to respond.

- Once BOEM approves the decommissioning application, a decommissioning notice must be submitted to BOEM at least 60 days before commencing decommissioning activities.
- If an archaeological resource is discovered while conducting decommissioning activities, bottom-disturbing activities within 1,000 feet of the discovery will be halted. The discovery will be reported to BOEM within 72 hours. BOEM will inform GSOE I on how to proceed. The discovery will be kept confidential outside of required BOEM notifications.
- GSOE I will provide BOEM with documentation of any coordination efforts made with other agencies regarding decommissioning activities.
- GSOE I will submit a decommissioning report to the BOEM within 60 days of completion of the decommissioning activities.

7.0 AFFECTED ENVIRONMENT, POTENTIAL IMPACTS, AND MITIGATION MEASURES

In February 2012, BOEM issued a FONSI based on the final Mid-Atlantic EA (BOEM 2012). The Mid-Atlantic EA analyzed the reasonably foreseeable consequences associated with issuing commercial leases in the four identified WEAs, which included an evaluation of the Lease Area (see Figure 1-1), as well as site characterization activities (geophysical, geotechnical, and certain biological surveys) and site assessment activities which included the installation of meteorological towers and Met Buoys. In addition, the Commercial Lease includes specific requirements for collecting data and avoiding and/or minimizing impacts to biological, historical, and cultural resources as well as other activities, such as other social, economic, and marine uses that may occur in the Lease Area.

A detailed understanding of the biological resources, archaeological resources, and geophysical and geotechnical conditions has been developed through site surveys and analyses that were conducted between 2006 and 2011 within a 1 nautical mile by 1 nautical mile (1.8 kilometer by 1.8 kilometer) survey area that encompasses the proposed installation location for the Buoy (see Figure 1-1). These study results are included as Appendices C through E of this SAP and are summarized in the following sections.

While these site surveys and analyses were originally conducted to support the installation of a fixed-platform meteorological tower within the Lease Area, they were conducted per BOEM requirements under agency-approved survey protocols. The proposed Met Buoy installation location is within the previously surveyed area (see Figure 1-2), and the existing analyses have been used or updated, as appropriate, in this SAP.

Area of Potential Effect

An area 1,000 ft by 1,000 feet (305 m by 305 m) centered on the buoy location and measuring approximately 22.9 ac (9.3 ha) has been conservatively assessed as the Project's Area of Potential Effect (APE) for all activities including installation, operations, and decommissioning (Figure 1-2), with a vertical extent of 12 ft (3.7 m). The vertical APE accounts for potential seabed impacts during anchoring activities to support installation and decommissioning procedures. This APE is based on the project description and installation/decommissioning details provided in Sections 3 through 6 above, and as summarized below:

- The Met Buoy will be moored to the seabed by a 5-ton anchor representing a 27-square foot (2.5-square meter) contact area with the bottom. The anchor and buoy are connected via 250 feet (76.2 meters) of 1.25-inch (3.2-centimeter) mooring chain providing a chain to water depth scope of 5:1. The maximum total footprint of the proposed buoy including impacts from anchor chain sweep during operations is approx. 142,870 square feet (3.3 acres, 13,273 square meters).

- The installation vessel will utilize a two to four-point anchor or dynamic positioning system to hold position during installation activities. Vessel anchors will consist of up to four 4-ton anchors, each covering an area up to 10 ft by 10 ft (3 m by 3 m) to a depth of up to 12 ft (3.7 m). The anchor radius for the installation vessel will be up to approximately 175 ft (53.3 m). Vessels used for decommissioning will be similar to those used for installation.

While bottom disturbing activity associated with the Met Buoy will be limited to the mooring, anchor sweep, and vessel anchoring areas, the larger APE was evaluated to provide maximum flexibility for vessel anchoring during deployment, maintenance and decommissioning.

7.1 Geologic Conditions

Affected Environment

The proposed Met Buoy site is located approximately 14 nautical miles (25.9 kilometers) offshore of Rehoboth Beach, Delaware at a water depth of approximately 43.5 feet (13.2 meters) mean lower low water (MLLW) in the Delaware Shelf Valley of the Mid-Atlantic Bight (MAB). The information on geologic conditions associated with the proposed installation location is based on data from several field surveys and reports from a 1.0 nautical mile by 1.0 nautical mile (1.8 kilometer by 1.8 kilometer) survey area (Figure 1-2) that encompasses the installation location of the proposed Met Buoy.

Geophysical and geotechnical studies were conducted between 2006 and 2010 in the Survey Area. A geotechnical hazards assessment (Fugro 2010b) based on this survey data is included as Appendix C. Although the Fugro report was prepared specifically to discuss a Met tower, the data collected and presented in the report describes the overall Survey Area, including the proposed Met Buoy location, and therefore, is also relevant to this submission. Information from the report specific to the Met Buoy site and vicinity are discussed below and summarized in Table 7-1.

Collected data indicated that surface sediments in the survey area were comprised primarily of medium to fine sand (Fugro 2010b). Three scales of bedforms were observed in the acquired geophysical data that were inferred to reflect bottom current flows of different duration, intensity, and direction. The proposed buoy anchor location is situated on the southeast flank of a northeast-southwest-trending ridge. This sand ridge is the largest of the three bedforms present in the survey area. Two types of smaller bedforms were found superimposed on the ridge and adjacent swales. Dunes approximately 4 feet (1.2 meters) in height were mapped on the southeastern flank of the larger ridge, and smaller ripples were mapped throughout the area (Fugro 2010b).

A seismic reflection investigation conducted in 2009 and 2010 mapped nine seismic units underlying the Survey Area to a depth of 460 feet (140.2 meters) below the seafloor (Fugro 2010b). The seismic reflection data, along with sub-bottom profiler (CHIRP) data collected during the same survey, were used to map the subsurface stratigraphy. The upper four of the seismic reflection units correlated well to sediment stratigraphy defined in the boring log from boring B-102, drilled in 2007 at the originally proposed meteorological tower site to a depth of 167 feet (50.9 meters) below the mudline. Subsurface sediments were interpreted to be comprised of alternating layers of unconsolidated sand and clay sediments.

Magnetometer data collected in the Survey Area in 2009 and in 2010 (Fugro 2010b) indicated no anomalies at the buoy location or in the vicinity that would interfere with buoy installation or decommissioning.

A scour study conducted for the Survey Area (Fugro 2010a) concluded that sediments in the area are frequently suspended and that long-term sediment transport and scour due to wave and current flow should be expected. Using estimated peak current speeds of about 3ft/s at the anchor location with average speeds of 1ft/s, AXYS has proposed a 5-ton anchor for the Met Buoy. This anchor type and size are appropriate for anticipated conditions at the site and AXYS is confident that the anchor will hold its position and the mooring integrity will be maintained. Any potential scour around the low profile (1 foot/ 330mm high) anchor will be minimal and localized. Evidence of scour at the anchor location will be assessed during regular maintenance; however, it is not anticipated to be a problem for the Met Buoy or mooring system given the relatively short-term deployment and limited size of the anchor.

Table 7-1 summarizes additional hazard information at the location of the proposed Met Buoy from the Fugro report (Fugro 2010b, Appendix C).

Table 7-1. Seafloor and Sub-Seafloor Hazards

Hazard	Definition	Identified and Description
Seafloor		
Scarp	An exposed face of soil above the head of a landslide	None present
Channels	The deepest portion of a body of water through which the main volume or current of water flows	None present
Ridges	A relatively narrow elevation which is prominent on account of steep angle at which it rises	Sand ridges described with typical relief of 15-25 feet, 0.5 to 1.5 Nm wide and 5-15 Nm long with gradient 0.45 degrees (0.8 percent) at location of Met Buoy
Bedforms	Features that develop due to the movement of sediment by the interaction of flowing water; critical angle and forces required for movement are dependent upon many factors	Dunes approximately 4 feet (1.2 meters) in height were mapped on the southeastern flank of the larger ridge in the vicinity of the Met Buoy location, and smaller ripples were mapped throughout the survey area
Exposed Rocky Area	Surface expression of bedrock outcropping on seafloor	Bedrock surface not resolved within project depth of interest
Boulders	Glacial erratics (boulders) greater than 12 inches in diameter (USCS); outcropping coarse till/drift or lag deposit	None present
Buried Boulders	Glacial erratics (boulders) greater than 12 inches in diameter (USCS); subsurface coarse till/drift or lag deposits	None detected
Pock Marks / Depressions	Craters in the seabed caused by fluids (gas and liquids) erupting /streaming through the seabed sediments	None present
Seabed Scars / Ice Scour / Drag Marks	Incisions or cuts into the seafloor may be associated with glacial advances/retreats or bottom fishing activity	None present
Buried Channels	Former fluvial drainage pathways during sea level low stands, usually only deepest portion of the waterway in-filled and preserved; Mark ancestral patterns of glacier meltwater runoff	None present
Submarine Canyons	Steep-sided valley cut into the seafloor of the continental slope, sometimes extending well onto the continental shelf	None present
River Channel	Outline of a path of relatively shallow and narrow body of fluid	N/A
Exposed Hardbottom Surfaces	Any semi-lithified to solid rock strata exposed at the seafloor; in this area, may include bedrock or a nearly continuous pavement of fragmented rock or boulders	None present
Shallow Gas	Subsurface concentration of material in gaseous form that has accumulated by the process of decomposition of carbon-based materials (former living organisms)	Inferred observations by geophysical signature in shallow subsurface; no geophysical anomalies suggesting presence of natural gas in the Met Buoy project area.

Hazard	Definition	Identified and Description
Gas Hydrates	Subsurface gas deposits that were formed at or near the seafloor in association with hydrocarbon seeps	None present
Gas/Fluid Expulsion Features	Upward movement of gas/fluid via low resistance pathways through sediments onto the seafloor; may be related to other hazards diapirs, faults, shallow water flows)	None present
Diapiric Structure Expressions	The extrusion of more mobile and ductily deformable material forced onto the seafloor from pressure below	None present
Karst Areas	Landscape formed from the dissolution of soluble rocks	N/A
Faults, Faulting Expression, Fault Activity	Physiographic feature (surface expression) related to a fracture, fault, or fracture zone along which there has been displacement of the sides relative to one another	None present
Slumping, Sliding Seafloor Features	Large-scale structures that result from the downslope movement of sediments due to instability and gravity. In the submarine environment these structures are often found in slope environments along coastal margins	None present
Steep/Unstable Seafloor Slopes	Large-scale feature/stretch of ground forming a natural or artificial incline, with a slope that approaches the angle of repose (maximum angle at which the material remains stable)	None present
Scour/Erosion Features	Erosion of material due to water flow. Often associated with erosion adjacent to larger natural and man-made structures	None present
Sensitive Benthic Habitats (chemosynthetic communities, SAV)	Shallow water habitats of submerged aquatic vegetation (SAV) including macroalgae and sea grasses	None present

Potential Impacts and Proposed Mitigation Measures

Based on the results of the aforementioned studies and the results of the Mid-Atlantic EA, the site conditions are suitable for the installation of the Met Buoy and associated mooring equipment. No notable hazards have been identified which will preclude installation at this location.

Due to possibility of scour around the Met Buoy anchors, evidence of scour at the anchor locations will be investigated during regular maintenance, if required. It is not anticipated to be a problem for the Met Buoy or mooring system. Additional maintenance surveys will be conducted, as needed, following major storm events to monitor for movement of the anchors, sediment deposition, and/or scour around the anchors.

7.2 Biological Resources

7.2.1 Benthic and Fisheries Resources

Affected Environment

During information gathering for the Bluewater Wind Delaware SAP, Bluewater and Tetra Tech (2013) concluded the area for deployment of the meteorological buoy was predominantly medium to fine grain sand and "does not support any seagrasses, hardbottom, livebottom, or any other unique habitat feature."

GSOE I assessed benthic habitat conditions at the proposed Met Buoy site using the Marine Cadastre Viewer (NOAA and BOEM 2013) and the MARCO Mid-Atlantic Ocean Data Portal, including data from The Nature Conservancy's Benthic Habitat Model (Greene et al. 2010) This data on benthic habitat distribution, including sensitive areas (e.g., protected areas, sanctuaries, current and past fisheries sites, archaeological resources that could act as habitat, and general formations of sub-sea banks, canyons, and rocky outcrops) is described below and shown in Figure 7-1.

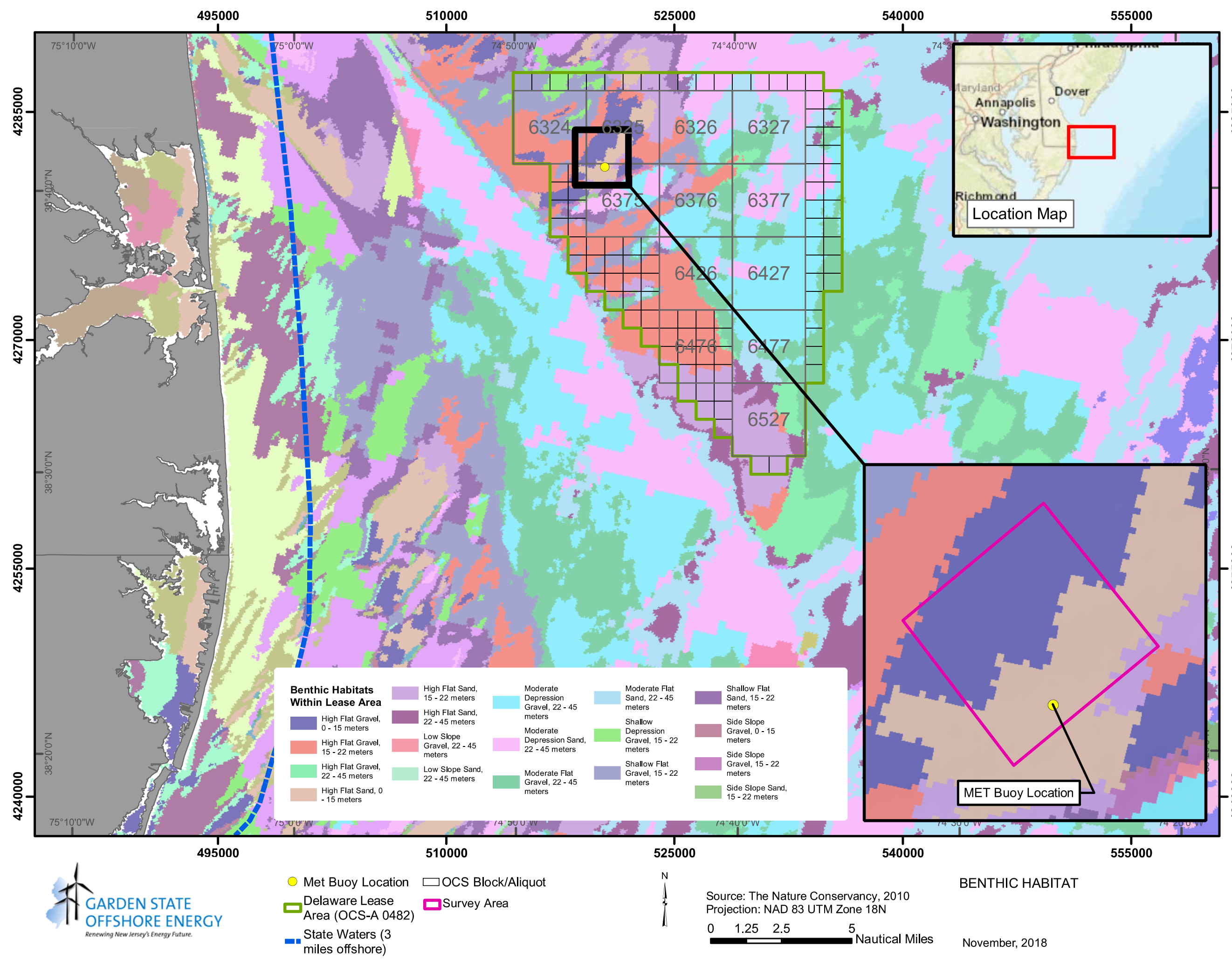

Figure 7-1. Benthic Habitats in Project Area

The Nature Conservancy's Northwest Atlantic Marine Ecoregional Assessment (Greene et. al. 2010) maps benthic habitats based on ecological marine units representing a combination of the depth, sediment grain size analysis and seabed forms. As shown in Figure 7-1, benthic habitat at the Met Buoy location is characterized as High Flat Sand (0-15m depth).

Grain size results from sediment samples taken in the vicinity of the proposed Met Buoy installation location (Fugro 2010b, Figure 20C) indicate surficial sediments were visually classified as medium to fine sand. This type of sandy substrate provides habitat for a diversity of benthic invertebrates and likely dominated by nematode worms, polychaete worms (Phylum: Annelida), and to a lesser extent, mollusks and small crustaceans. (BOEM 2012).

BOEM defines sensitive benthic habitat as "areas where information suggests the presence of exposed hard bottoms of high, moderate, or low relief; hard bottoms covered by thin, ephemeral sand layers; seagrass patches; algal beds; anthozoan species" (BOEM 2013, 2014). Guida et. al. (2017) mapped physical habitat features in the Delaware Lease Area, including at the Met Buoy location. The results, as shown in Figure 7-2, do not indicate the presence of hardbottom, corals, or other sensitive habitats at the Met Buoy location.

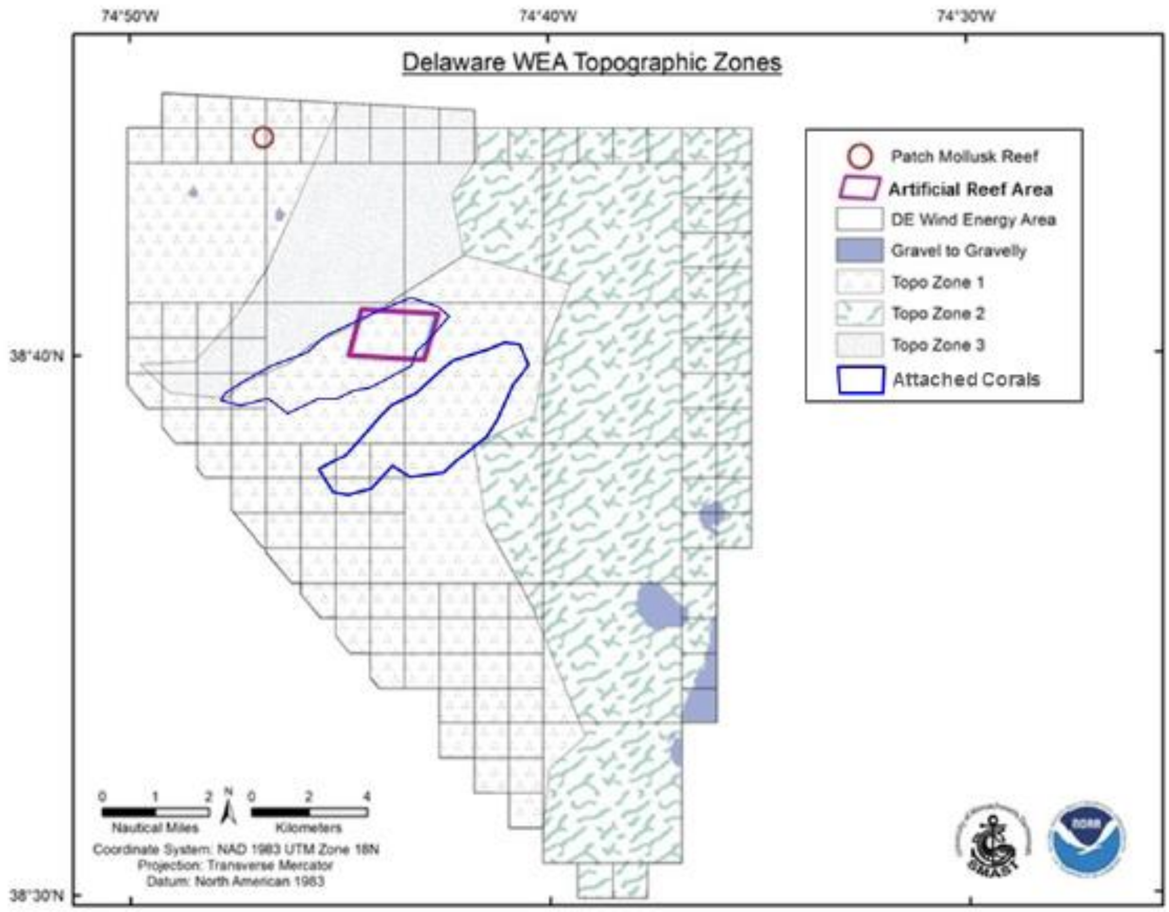

Figure 7-2. Physical Benthic Habitat Features of the Delaware Lease Area (Source: Guida et.al. (2017)

Many habitat and oceanic factors affect the abundance and distribution of fish within the waters of the MAB, such as temperature, salinity, pH, physical habitat, and currents (Helfman et al. 2009). The influence of these factors on fish abundance and distribution varies on multiple spatial and temporal scales. The fish of the Lease Area can be classified primarily as temperate species, but also include subtropical-tropical and highly migratory species (Helfman et al. 2009) that occur over vast geographic areas as they follow seasonal temperature isotherms (Olney and Bilkovic 1998). Unlike pelagic and migratory species, demersal fish have a close affinity to the benthic zone and rely on habitat complexity (e.g., hardbottom, reef) for foraging and shelter. Pelagic fish can be broadly categorized into horizontal and vertical distributions in the water column, with the highest number and diversity occurring where the habitat is most diverse (Helfman et al. 2009; Moyle and Cech 1996; Parin 1984). Given the homogeneity of the sandy, benthic habitat at the Met Buoy installation location, a high density or diversity of finfish at this proposed location is unlikely, and those that are found here are likely to be transient.

The Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended through 1996 (Magnuson-Stevens Act; Public Law 94-265), is the primary law governing marine fisheries management in Federal waters. NMFS administers the law and works with regional fishery management councils to identify, map, and describe essential fish habitat (EFH) for managed species. The Magnuson-Stevens Act includes a mandate to protect EFH and requires Federal agencies to consult with NMFS on activities that may adversely affect EFH. The Magnuson-Stevens Act defines an adverse effect as any impact that reduces quality and/or quantity of EFH and may include direct (e.g., contamination or physical disruption) and indirect (e.g., loss of prey or reduction in species) effects. Any action that could adversely affect EFH must work with NMFS to identify steps for conserving the habitat and reducing impact of that action.

The installation location is contained within a 10 minute by 10 minute EFH block bounded by coordinates 38° 50.0 N, 74° 40.0 W, 38° 40.0 N, 75° 50.0 W. EFH at this location includes the species listed in Table 7-3. Based on the limited and temporary impacts from the Met Buoy installation to the homogeneous and plentiful marine habitat in the area, it is unlikely to have adverse impacts to EFH for the species listed.

Table 7-1. List of species and life stages for which EFH is designated in the vicinity of the Lease Area.

Common Name	Species	EFH Presence by Life Stage Found in vicinity of Lease Area			
		Eggs	Larvae	Juveniles	Adults
bluefish	*Pomatomus saltatrix*	X	X	X	X
Atlantic butterfish	*Peprilus triacanthus*	X	X	X	X
spiny dogfish	*Squalus acanthias*			X	X
summer flounder	*Paralichthys dentatus*		X	X	X
scup	*Stenotomus chrysops*			X	X
black sea bass	*Centropristis striata*		X	X	
Atlantic mackerel	*Scomber scombrus*				X
Atlantic surfclam	*Spisula solidissima*			X	X
albacore tuna	*Thunnus alalonga*			X	
sand tiger shark	*Carcharias Taurus*		X (neonate)	X	X
Atlantic angel shark	*Squatina dumeril*	X	X	X	X
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*				X
dusky shark	*Carcharhinus obscurus*		X (neonate)	X	
sandbar shark	*Carcharhinus plumbeus*		X (neonate)	X	X
shortfin mako shark	*Isurus oxyrinchus*	X	X	X	X
skipjack tuna	*Katsuwonus pelamis*				X
tiger shark	*Galeocerdo cuvier*			X	
smoothhound shark	*Mustelus mustelus*	X	X	X	X
bluefin tuna	*Thunnus thynnus*			X	X
yellowfin tuna	*Thunnus albacares*			X	
thresher shark	*Alopias vulpinus*	X	X	X	X
Northern shortfin squid	*Illex illecebrosus*			X	
longfin inshore squid	*Doryteuthis pealeii*			X	X

In addition to EFH designations, NMFS also designates aquatic habitats for Atlantic Highly Migratory Species (AHMS) and Habitat Areas of Particular Concern (HAPC). HAPCs are established to help prioritize conservation areas and mapped subsets of EFH that provide important ecological functions or are vulnerable to degradation. There are no HAPCs near the proposed Met Buoy installation area. Based on the National Oceanic and Atmospheric Administration (NOAA 2017a) EFH online mapper, of the 23 species with designated EFH for the installation area, two are classified as AHMS: the bluefin tuna and the sand tiger shark (BOEM 2017). However, the HAPCs for these two species are located in the Gulf of Mexico and Delaware Bay, respectively.

In addition to the aforementioned EFH species, two ESA-listed species, the Atlantic sturgeon and giant manta ray (*Manta birostris*), have the potential to occur within the vicinity of the proposed Met Buoy installation location. The preferred habitat and life histories of those two fish species relative to the location of the Met Buoy installation site are discussed below.

<u>Atlantic sturgeon</u>

Atlantic sturgeon spawn in freshwater riverine habitats but spend most of their adult life in the marine environment. The exact locations of spawning and nursery grounds for Atlantic sturgeon are not well known. Atlantic sturgeon spawning is believed to occur in flowing water between the salt front and fall line of large rivers. In the Mid-Atlantic coast, Atlantic sturgeon are known to spawn in the Delaware River and James River. After hatching, young-of-year (greater than 3 months and less than 1 year) move downstream to freshwater rearing grounds and eventually to brackish waters where they become residents in estuarine waters for months or years (ASSRT 2007).

Upon reaching a size of approximately 76 to 92 centimeters (2.4 to 3.0 feet), the Atlantic sturgeon subadults (i.e., greater than 1 year but not sexually mature) may move to coastal waters. Large subadults and adults have been shown to migrate long distances along the east coast (COSEWIC 2011). Coastal features or shorelines where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy, Massachusetts Bay, Rhode Island, New Jersey, Delaware, Delaware Bay, Chesapeake Bay, and North Carolina, but the fish` return to their natal river to spawn.

Important habitats for adult and subadult Atlantic sturgeon appear to be rivers with deep channels and access to the sea, estuaries with relatively warm, mesohaline conditions (salinity equals 5 to 25 parts per thousand (ppt)), and a coastal shelf region to at least 50 meters (164 feet) in depth dominated by gravel and sand substrates (COSEWIC 2011). While there are suitable depths and substrates present in the larger Lease Area (that could provide habitat to Atlantic sturgeon juveniles and/or adults during their coastal migrations in portions of the year during offshore migrations), conditions present in the vicinity of the Met Buoy installation location do not provide preferred habitat for Atlantic sturgeon.

<u>Giant manta ray</u>

Recently listed as a threatened species under the ESA in January 2018 by NMFS, the giant manta ray is a wide-ranging species inhabiting tropical, subtropical, and temperate waters worldwide. Very little information is available on giant manta populations in Atlantic waters, though they are observed as far north as coastal New Jersey (NOAA 2017b; NOAA 2018). Giant mantas are a migratory species commonly found offshore in oceanic waters and near productive coastlines with regular upwelling; including oceanic island groups, offshore pinnacles and seamounts (NOAA 2018). Giant mantas are capable of covering long distances, though recent studies conducted in waters off of coastal Mexico suggest that some populations demonstrate high degrees of residency and have shown connectivity between coastal sites and offshore islands (Miller and Klimovich 2016; NOAA 2017b).

Considered to be primarily a solitary species, giant mantas are known to aggregate seasonally to feed and mate and large numbers can be found at cleaning sites associated with coastal reefs (NOAA 2018; Rohner, et. al. 2013) While known to aggregate as described above, pupping and nursery grounds remain unknown and no critical habitat has been designated for this species (NOAA 2018). Giant manta rays are known to utilize surface waters for feeding where plankton are prevalent; however, they will utilize the entire water column within their habitat including water depths exceeding 1,000 m (NOAA 2017b). The Met Buoy anchoring system will extend from the surface to the sea floor within suitable depths for Giant manta rays, however, no known aggregation habitat exists in the vicinity of the Met Buoy location.

Giant manta rays are targeted and caught as bycatch in several global fisheries and commercial fishing, including those serving a demand from the traditional Chinese medicine market for their dried gill rakers, is the primary threat to this species (NOAA 2018). No known direct fishery for this species exists in the area of the Met Buoy and it is expected that in areas where the species is not subject to fishing, populations may be stable (NOAA 2017). Other threats include boats strikes and entanglement (Miller and Klimovich 2017).

Potential Impacts and Proposed Mitigation Measures

The potential effects caused by the Met Buoy installation, operation, and decommissioning to fisheries resources, community assemblage and species diversity, or available benthic and water column habitats are expected to be localized, short-term, and temporary. As BOEM concluded in consultation with NMFS, the limited spatial extent and duration of activities analyzed in the Mid-Atlantic EA are not likely to cause more than temporary impacts and will not substantially affect fish populations or their habitats in the Lease Area (BOEM 2012).

Potential impacts to fisheries and their habitats as it pertains to installation and operation of the Met Buoy include noise (hydroacoustic), turbidity, vessel traffic, and physical disturbance of benthos (i.e., anchor chain scour), physical loss of sandy substrate beneath the anchor, and gain of hard substrate habitat (i.e., surface of the clump anchor, and subsurface of the Met Buoy). Each of these potential stressors as it pertains to this project is summarized below.

<u>Noise</u>: Vessel noise may affect but is not likely to adversely affect Atlantic sturgeon, giant manta rays, or EFH designated species. Vessel noise associated with installation of the mooring system could disturb normal fish behavior in the immediate vicinity of the installation, but would be temporary, likely undetectable, and thus insignificant. Furthermore, no pile driving or vibratory techniques are required for the installation; therefore, significant effects to fish populations are not anticipated. Operation of the Met Buoy will not generate noise that would significantly affect fish behavior.

<u>Turbidity</u>: The placement of mooring system would disturb the sediment and temporarily increase the turbidity in the water column. The expected turbidity levels resulting from the installation of the mooring system will be extremely localized, ephemeral, and likely confined to depths near the seafloor, and thus unlikely to impart lethal or sub-lethal effects to fish. Demersal fish in the immediate area of impact may experience some temporary physiological stress and exhibit flight behavior, but re-settlement of the sediment plume is likely to be minimal and unlikely to cause burial impacts to benthic invertebrates. No turbidity effects are anticipated during the Met Buoy operational period.

<u>Vessel Traffic</u>: Most of the vessel traffic generated during the proposed Met Buoy installation will be associated with transiting between the Met Buoy installation location and shore-based staging areas. The frequency and magnitude of vessel trips is expected to be minimal during installation and operation of the Met Buoy. This, combined with adherence to the avoidance protocols described in Appendix A, would likely eliminate the potential for significant effects to ESA-listed and other EFH designated species.

<u>Physical Effects/Contact</u>: Installation activities including placement of the mooring system would result in the temporary loss of the sandy seafloor habitat occupied by the footprint of the clump weight anchor and disturbance of the seafloor in the area of chain sweep (see Section 3.1). Sedentary and slow-moving benthic

fauna that are directly within the 27-square foot (2.5-square meter) footprint of the clump weight anchor during installation will likely experience mortality. In the area of anchor chain sweep, tube-dwelling amphipods and polychaetes, sedentary anemones, and other infauna are probably the most susceptible to either displacement or mortality. Given the relatively small spatial area 142,870 square feet (3.3 acres, 13,273 square meters) and temporal extent of impact, the loss of benthos from this area during Met Buoy installation and operation will not affect the general population or productivity. The single mooring chain for the buoy should not pose an entanglement threat to giant mantas, particularly since no known aggregation habitat exists in the vicinity of the met buoy location.

As described in Appendix C, the seabed near the installation area is 43.5 feet (13.2 meters) deep with evidence of large dunes and small ripples, suggesting a highly dynamic physical environment that will recover to its pre-disturbance state relatively rapidly by natural processes. The species most likely to be adversely affected (i.e., localized mortality of sedentary, benthic infauna such as nematode worms and mollusks) are also the species most likely to be early colonists of damaged habitat (e.g., Rhoads and Germano 1986). Recolonization of the benthic infaunal community will occur naturally by (a) immigration of species from surrounding, unimpacted habitats, (b) settlement of propagules from the water column, and (c) active transport of infaunal species within moving seabed sediments, driven by ocean waves and currents.

It is expected that placement of the Met Buoy in the relatively homogenous habitats present in the installation location would introduce an artificial hard substrate that opportunistic benthic and structure dependent species (e.g., tautog, black sea bass, striped bass) would be attracted to and colonize the newly formed habitat provided by the floating and mooring system components.

After completion of site assessment activities, the Met Buoy would be removed and transported by vessel to shore. After the Met Buoy is removed, the areas temporarily disturbed by the mooring system will fill in through natural processes and will ultimately be recolonized with native benthic species (Lundquist et al. 2010). It is expected that Met Buoy removal activities will have similar effects to those described for installation activities. The temporary and isolated disturbance to fish during removal of the Met Buoy is expected to have negligible effects (BOEM 2012).

7.2.2 Marine Mammals and Sea Turtles

Affected Environment

Over 30 species of marine mammal and five species of sea turtles have been documented as occurring or potentially occurring in the OCS waters off the Delaware and Maryland coast (BOEM 2012) (see Table 7-4). Among the more common species, marine mammals that may be observed in these waters include: baleen whales (e.g., humpback (*Megaptera novaeangliae*), fin (*Balaenoptera physalus*), minke (*Balaenoptera acutorostrata*), and North Atlantic right whales (*Eubalaena glacialis*)), toothed whales (e.g., bottlenose (*Tursiops truncatus*), Risso's (*Globicephala melas melas*), and short-beaked common dolphins (*Delphinus delphis*), and long-finned pilot whales (*Globicephala melas melas*)), as well as the occasional seal, West Indian manatee (*Trichechus manatus latirostris*), and other less common species (see Table 7-4). Many of the baleen and toothed whales are migratory and transit along the U.S. coastal and continental shelf waters during their annual migrations between temperate feeding grounds and tropical breeding grounds, although some species are present year-round. Loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) sea turtles and occasionally hawksbill (*Eretmochelys imbricata*), Kemp's ridley (*Lepidochelys kempii*), and green (*Chelonia mydas*) sea turtles can also be found in the marine waters off Delaware and Maryland when ocean water temperatures are warmest (hawksbill are considered only accidental visitors to Mid-Atlantic waters). According to the Delaware Department of Natural Resources and Environmental Control (DNREC), most sea turtle strandings in Delaware occur between May and October (DNREC 2013). Large whale strandings also typically occur in spring and fall, during the whales' seasonal migrations, while strandings of species that prefer cooler water temperatures, such as harbor porpoise (*Phocoena phocoena*), are more common in winter or spring.

During GMI's avian surveys for NRG Bluewater from May through August 2008 and October 2010 through February 2011, opportunistic marine mammal and sea turtle sightings were recorded. In the winter 2010-2011 surveys, observers recorded sightings of fin whales, humpback whales, common dolphins, and harbor porpoises in or adjacent to the Project Area. During the fall 2010 surveys, opportunistic sightings consisted of bottlenose dolphins, common dolphins, fin whales, humpback whales, leatherback sea turtles, and a harbor seal (*Phoca vitulina*). A sighting of two North Atlantic right whales was also recorded in the Project Area during this season. During the spring and summer of 2008, sightings of bottlenose dolphins, a fin whale, and a loggerhead sea turtle were recorded.

Of the stocks or distinct populations of marine mammals that may interact with Project activities, six are listed under the ESA as either endangered (i.e., blue [*Balaenoptera musculus*], fin, North Atlantic right, sei [*Balaenoptera borealis*], and sperm whale [*Physeter macrocephalus*]), or threatened (i.e., the West Indian manatee). Leatherback, hawksbill, and Kemp's ridley sea turtles are listed as endangered under the ESA, while green and loggerhead sea turtles are listed as threatened. All cetaceans (whales, dolphins, and porpoises), pinnipeds (e.g., seals), and sirenians (e.g., manatees) are also protected under the Marine Mammal Protection Act of 1972 (as amended through 2015) and species (or stocks) that are designated as depleted are afforded additional conservation efforts.

All the aforementioned species of ESA-listed marine mammals and sea turtles are highly mobile and migratory and occurrence in any particular area (outside of their breeding or foraging aggregation areas) is typically transient in nature. There are no designated critical habitats in Atlantic OCS waters for any of the above sea turtle or marine mammal species, with the exception of the North Atlantic right whale. The North Atlantic right whale is critically endangered and has designated critical habitat around its northeastern U.S. foraging area (off Maine, New Hampshire, and Massachusetts) and southeastern U.S. calving area (from southern North Carolina to Florida). Additionally, seasonal management areas (SMA; i.e., mandatory 10 knot speed restriction zones) are in place to help reduce the potential for vessel collisions; the closest SMA is at the entrance to the Delaware Bay, to the northwest of the Met Buoy location. Skipjack will ensure that any Project-related vessels transiting through North Atlantic right whale seasonal (or dynamic) management areas follow the regulations in place at the time (see also Section 4.3 and Appendix A for protected species avoidance measures).

Additional, detailed life history information on marine mammals and sea turtles in mid-Atlantic waters is available in the *Final Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf* (Programmatic EIS) (USDOI, MMS 2007)).

Table 7-2. Marine Mammals and Sea Turtles with Geographic Ranges that Include the Project Area

Common Name	Scientific Name	Stock or Distinct Population Segment (DPS)	Status under ESA/MMPA	Relative Likelihood of Occurrence in Lease Area	Expected Seasonal Occurrence
Mysticetes (Baleen Whales)					
Blue whale	*Balaenoptera musculus*	Western North Atlantic	ESA Endangered/ Depleted and Strategic	Rare	summer
Fin whale	*Balaenoptera physalus*	Western North Atlantic	ESA Endangered/ Depleted and Strategic	Regular	spring, summer, fall, winter
Humpback whale	*Megaptera novaeangliae*	West Indies DPS	Protected	Common	spring, summer, fall, winter
Minke whale	*Balaenoptera acutorostrata*	Canadian East Coast	Protected	Regular	spring, summer, fall, winter
North Atlantic right whale	*Eubalaena glacialis*	Western North Atlantic	ESA Endangered/ Depleted and Strategic	Regular	spring, summer, fall, winter
Sei whale	*Balaenoptera borealis*	Nova Scotia	ESA Endangered/ Depleted and Strategic	Uncommon	winter, spring
Odontocetes (Toothed whales, dolphins, and porpoises)					
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic	Protected	Uncommon	summer
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic	Protected	Uncommon	spring, summer, fall, winter
Bottlenose dolphin	*Tursiops truncatus*	Western North Atlantic (1) Offshore and (2) northern migratory coastal	(1) Protected (2) Strategic	(1) Uncommon (2) Common	spring, summer, fall
Clymene dolphin	*Stenella clymene*	Western North Atlantic	Protected	Not Expected	summer
Common dolphin	*Delphinus delphis*	Western North Atlantic	Protected	Common	spring, summer, fall, winter
Cuvier's beaked whale	*Ziphius cavirostris*	Western North Atlantic	Protected	Rare	spring, summer
Dwarf sperm whale	*Kogia sima*	Western North Atlantic	Protected	Rare	summer
False killer whale	*Pseudorca crassidens*	Western North Atlantic	Strategic	Rare	summer
Fraser's dolphin	*Lagenodelphis hosei*	Western North Atlantic	Protected	Rare	spring, summer, fall, winter

Common Name	Scientific Name	Stock or Distinct Population Segment (DPS)	Status under ESA/MMPA	Relative Likelihood of Occurrence in Lease Area	Expected Seasonal Occurrence
Harbor porpoise	*Phocoena phocoena*	Gulf of Maine/Bay of Fundy	Protected	Uncommon	winter, spring
Killer whale	*Orcinus orca*	Western North Atlantic	Protected	Rare	spring, summer, fall, winter
Long-finned pilot whale	*Globicephala melas melas*	Western North Atlantic	Strategic	Common	summer, fall
Melon-headed whale	*Peponocephala electra*	Western North Atlantic	Protected	Not Expected	spring, summer, fall, winter
Northern bottlenose whale	*Hyperoodon ampullatus*	Western North Atlantic	Protected	Not Expected	spring
Pantropical spotted dolphin	*Stenella attenuata*	Western North Atlantic	Protected	Rare	summer
Pygmy killer whale	*Feresa attenuata*	Western North Atlantic	Protected	Not Expected	spring, summer, fall, winter
Pygmy sperm whale	*Kogia breviceps*	Western North Atlantic	Protected	Rare	summer
Risso's dolphin	*Grampus griseus*	Western North Atlantic	Protected	Common	spring, summer, fall
Rough-toothed dolphin	*Steno bredanensis*	Western North Atlantic	Protected	Rare	summer
Short-finned pilot whale	*Globicephala macrorhynchus*	Western North Atlantic	Strategic	Rare	summer, fall
Mesoplodon beaked whales	*Mesoplodon spp.*	Western North Atlantic	Depleted	Rare	spring, summer
Sperm whale	*Physeter macrocephalus*	North Atlantic	ESA Endangered/ Depleted and Strategic	Uncommon	spring, summer, fall
Spinner dolphin	*Stenella longirostris*	Western North Atlantic	Protected	Rare	summer
Striped dolphin	*Stenella coeruleoalba*	Western North Atlantic	Protected	Rare	summer
White-beaked dolphin	*Lagenorhynchus albirostris*	Western North Atlantic	Protected	Rare	summer
Phocids					
Gray seal	*Halichoerus grypus*	Western North Atlantic	Protected	Rare	fall, winter, spring
Harbor seal	*Phoca vitulina*	Western North Atlantic	Protected	Rare	fall, winter, spring
Harp seal	*Pagophilus groenlandicus*	Western North Atlantic	Protected	Rare	winter and spring

Common Name	Scientific Name	Stock or Distinct Population Segment (DPS)	Status under ESA/MMPA	Relative Likelihood of Occurrence in Lease Area	Expected Seasonal Occurrence
Hooded seal	*Cystophora cristata*	Western North Atlantic	Protected	Rare	summer and fall
Sirenia					
West Indian manatee (Florida manatee subspecies)	*Trichechus manatus latirostris*	–	ESA Threatened/ Depleted and Strategic	Rare	summer
Sea Turtles					
Green sea turtle	*Chelonia mydas*	North Atlantic DPS	ESA Threatened	Rare	spring, summer, fall
Hawksbill sea turtle	*Eretmochelys imbricata*	–	ESA Endangered	Rare	spring, summer, fall
Kemp's ridley sea turtle	*Lepidochelys kempii*	–	ESA Endangered	Rare	spring, summer, fall
Leatherback sea turtle	*Dermochelys coriacea*	Northwest Atlantic	ESA Endangered	Regular	spring, summer, fall
Loggerhead sea turtle	*Caretta caretta*	Northwest Atlantic Ocean DPS	ESA Threatened	Regular	spring, summer, fall
NOTES: Common – Occurring consistently in moderate to large numbers Regular – Occurring in low to moderate numbers on a regular basis or seasonally Uncommon – Occurring in low numbers or on an irregular basis Rare – Records for some years but limited Not expected – Range includes the Lease Area but due to habitat preferences and distribution information, species are not expected to occur in the Project Area although records may exist for adjacent waters					

Potential Impacts and Proposed Mitigation Measures

The primary potential impacts to marine mammals associated with the installation and operation of a stand-alone offshore Met Buoy are related to the slight increase in vessel traffic involved in the installation, maintenance, and decommissioning of the Met Buoy. Specifically, service vessels will result in a slight increase in the risk of a vessel collision, and potential for harassment resulting from underwater noise.

Vessel Collisions: The operation of vessels around marine mammals or sea turtles increases the potential for a vessel-animal collision; however, BOEM (in consultation with NMFS) included stipulations in the Commercial Lease to reduce the likelihood of any such potential effects. All vessels will abide by the vessel strike avoidance measures detailed in Lease Addendum C, stipulation No. 4.1.1 (see Appendix A), and no significant impacts due to vessel strikes are anticipated.

Underwater Noise: Vessels also produce underwater noise, which stems primarily from cavitation of the vessels' propellers (Richardson et al. 1995) and is thus generally lower at lower vessel speeds. Installation of the Met Buoy will involve the use of work vessel(s), handling tug(s), and crew boat(s) (see Section 4.2). Underwater noise associated with these vessels is expected to be above sound-pressure levels considered capable of causing acoustic disturbance in marine mammals; however, noise will dissipate quickly with distance from the source, and the overall potential for marine mammal or sea turtle exposure to these vessels is limited. Installation activities will occur once, over a period of only 1 to 4 days. Planned on-site maintenance will be scheduled to occur only twice per year and will be undertaken by vessels comparable or smaller-sized than the installation vessel. Upon completion of SAP activities, decommissioning of the Met Buoy will involve similar types and numbers of vessels to those used for the installation. Thus, the potential for marine mammals to interact with or be adversely affected by vessels associated with the Met Buoy will be extremely limited, both temporally (a few days per year) and spatially (within the immediate vicinity of the Met Buoy or transiting vessels). Given the Commercial Lease stipulations, the speeds at which the vessels will be travelling (which reduces both the likelihood of strike and the amount of underwater noise produced), and the short-term nature of the activities, effects of vessel noise on marine mammals and sea turtles are expected to be negligible.

In assessing potential environmental consequences associated with full leasing of the WEAs offshore of New Jersey, Delaware, Maryland, and Virginia, BOEM and NMFS agreed that the activities to be conducted are not likely to adversely affect listed whale species when implemented according to BOEM's mandatory project design criteria (detailed in Appendix A of the Mid-Atlantic EA) (BOEM 2012). Site assessment activities located within the Lease Area are therefore conservatively assumed to be of lesser impact than those assessed by BOEM for the maximum area of WEAs in the Mid-Atlantic.

Potential effects to sea turtles, specifically leatherback, loggerhead, green, and Kemp's ridley, include minor loss or displacement from foraging areas, noise harassment, and (to a lesser degree than marine mammals) vessel collisions. As for marine mammals, effects are expected to be short-term and highly localized and to result in minimal or negligible harassment. BOEM, supported by NMFS, concluded that the consequences to sea turtles are not anticipated to be significant (BOEM 2012). Potential effects to marine mammals and sea turtles from installation of buoys are assessed in greater detail in the Mid-Atlantic EA (BOEM 2012). Mitigation measures to reduce potential for vessel strikes are outlined in Appendix A.

7.2.3 Avian and Bat Resources

Affected Environment

As described in BOEM's 2009 compendium report of seabird occurrence information for the Continental Shelf waters along the Atlantic Coast (O'Connell et al. 2009), as well as DOE and BRI's Mid-Atlantic Baseline Survey (Williams et al. 2015), several types of birds including seaducks (e.g., eiders and scoters), waterbirds (e.g., loons and cormorants), seabirds (e.g., terns, gulls, shearwaters, alcids), shorebirds (e.g., plovers and sandpipers), and landbirds (e.g., nocturnal migrant passerines and migrant raptors) may seasonally occur in the region surrounding the Met Buoy installation location. The region provides year-round habitat for some species of gull. Some bird groups use offshore environments for foraging, roosting, and/or overwintering, while others, including shorebirds and migratory landbirds, may cross offshore locations during spring and fall migration. In the offshore environment, seaducks, waterbirds, and seabirds may forage at the water's surface or dive for prey sources, including small fish, plankton (larval fish, krill, and jellyfish), or benthic mollusks and crustaceans (Gaston 2004; Goudie et al. 2000). Federally listed bird species that may occur in the region include the endangered roseate tern (*Sterna dougallii*), threatened piping plover (*Charadrius melodus*), and threatened rufa red knot (*Calidris canutus*). These species specifically may cross areas of the Mid-Atlantic OCS during spring (March through May) and fall (August through October) migratory periods. Crossings of the area of the Met Buoy by these listed species are expected to be rare.

As described in BOEM's 2011 compendium report of shorebird occurrence information, there are 35 species of shorebird that are known to regularly occur either along the coast or offshore over the Atlantic during migration. With the exception of phalaropes, most shorebird species occur over areas of the OCS during a brief period (O'Connell et al. 2011), with individuals crossing the OCS potentially up to twice per year. The Federal waters of the Mid-Atlantic provide habitat for large numbers of seaducks and waterbirds during wintering and migratory periods (Spiegel et al. 2017). During a recent BOEM study, Spiegel et al. (2017) used satellite telemetry to study the distributions of three species, red-throated loon (*Gavia stellata*), surf scoter (*Melanitta perspicillata*), and northern gannet (*Morus bassanus*), in relation to WEA and Lease Areas in Federal waters from Long Island to southern North Carolina. The authors found that wintering birds were largely concentrated closer to shore (particularly at the mouths of bays), and the area that these species overlapped with WEA and Lease Areas accounted for less than 5 percent of the overall distribution of the species within the study area, and their occurrence in these areas was relatively short in duration (Spiegel et al. 2017). Another recent BOEM study was conducted by Viet et al. (2015) to identify seabird hot spots (defined by abundance and/or number of species) over the shelf waters of the East Coast. The researchers identified two primary hotspots of abundance, one off southeastern Cape Cod and the other at the mouth of Chesapeake Bay. The primary diversity hot spots were identified off northern New Jersey and in the New York Harbor area (Viet et al. 2015). The location of the Met Buoy does not occur within an identified hotspot for seabirds, and because migratory and wintering seaduck and waterbird distribution covers a large area, with concentrations closer to the coast, relatively few of these species are expected to occur in the area of the Met Buoy.

Emerging data from a recent BOEM telemetry study (Dowling et al. 2017) and bat acoustic surveys coordinated by BOEM and DOE (Pelletier et al. 2013; Stantec 2016) conducted at locations along the Atlantic Coast, islands, and the OCS suggest that, while offshore environments provide no natural roosting habitat, several bat species do occur offshore. Several bat species have been documented in coastal and offshore locations in the Mid-Atlantic region (Sjollema 2011; Sjollema et al. 2014). Bats have been documented as far as 130 km (81 mi) off the Mid-Atlantic coast (Stantec 2016a). Their presence offshore and on remote islands and structures has been documented primarily during spring or late summer/fall migration. Species documented offshore or on remote islands or structures include long-distance migrants (hoary bat [*Lasiurus cinereus*], eastern red bat [*Lasiurus borealis*], and silver-haired bat [*Lasionycteris noctivagans*]) and non-migrants/cave dwelling bats (the federally threatened northern long-eared bat [*Myotis septentrionalis*], little brown bat [*Myotis lucifugus*], eastern small-footed bat [*Myotis leibii*], big brown bat [*Eptesicus fuscus*], and tri-colored bat [*Perimyotis subflavus*]). The evening bat (*Nycticeius humeralis*) may also occur offshore of the mid-Atlantic, but its calls are difficult to distinguish from other species. Bats may forage for insects offshore, and in some rare cases may take small prey (e.g., crustaceans) from the surface of the water (Pelletier et al. 2013).

Potential Impacts and Proposed Mitigation Measures

The proposed deployment of the Met Buoy is unlikely to have an adverse effect on avifauna because the structures will not be large enough to substantially displace birds, will not extend substantially above the water to act as barriers to movement, or pose a substantial risk of collision to birds or bats. BOEM concluded that commercial lease issuances and site assessment activities in the Delaware WEA will have negligible effects on birds, including species protected under the Migratory Bird Treaty Act and the ESA, because the height of the Met Buoy will be generally low to the water and there will only be one buoy at a time in a large area (BOEM 2012). Similarly, BOEM concluded that site assessment activities are unlikely to adversely affect bats (BOEM 2012). Each type of potential effect is discussed in more detail below.

Risk of Collision: Above-water structures extending into the airspace of an otherwise flat landscape can pose risk of collision for birds, particularly during periods of reduced visibility (nighttime, fog, rain). Some birds may be at an increased risk of collision including shearwaters and storm-petrels which fly just above the surface of the waves while foraging and/or commuting. However, most commuting birds and migrants are expected to fly well above the height of the Met Buoy. Although bats may pass near the Met Buoy during migration or foraging, the Met Buoy is not expected to pose any threat of collision mortality to bats due to the lack of large moving components. The Met Buoy will be equipped with a small wind turbine to charge batteries; however, the blades are short (approximately 2 meters [6.6 feet] in length) and therefore will not pose a substantial risk of collision. The Met Buoy's above water structure is self-supported, not requiring guylines (which are more difficult to visually detect), which reduces the risk of collision. Risk of collision at the Met Buoy is expected to result in negligible or minor impacts to birds and bats.

Attraction: Lights on deployment vessels and the Met Buoy could attract birds migrating at night and potentially foraging bats. Artificial lighting, particularly steady burning lights, can disorient nighttime migrants, particularly in fog or rain, and can cause birds to circle around or collide with lit structures. The minimal navigational lighting required by the USCG will be used, and lighting on deployment vessels and the Met Buoy will be negligible compared with other sources of light in the area, including lighting on commercial vessels moving in and out of Delaware Bay. Installation activities will take place during daylight hours, and no shielding of vessel lights will be necessary to avoid potential attraction of nocturnal migrant birds or bats to the deployment vessel.

The increase in underwater substrate resulting from the clump weight anchors and mooring the yoke and chain will promote colonization by benthic crustaceans and mollusks and may also attract fish around these underwater structures. The availability of prey may attract some species of bird to forage around the underwater structures. However, the level of attraction will be minimal due to the dynamic availability and location of prey sources in the offshore environment and the minimal increase in underwater substrate. Some species of birds such as gulls, terns, and cormorants may be attracted to the Met Buoy for perching opportunities. Bats may also be attracted to the Met Buoy for roosting opportunities as they are known to roost on other offshore structures such as ships, barges, lighthouses, and wind turbines (Pelletier et al. 2013; Stantec 2016b). However, the potential for attraction for perching or roosting is expected to be minimal due the relatively small size of the Met Buoy.

GSOE I will install anti-perching devices on the proposed Met Buoy, and landing areas will be minimized. Anti-perching devices are an effective way of preventing perching on isolated structures, including remote sensing equipment (Avery and Genchi 2004). Anti-perching devices will be non-corrosive (either stainless steel or composite) to increase longevity and reduce potential for corrosion at the attachment point. Due to measures that will be in place to minimize attraction of birds and bats to the Met Buoy, only negligible to minor impacts are anticipated due to attraction.

The Met Buoy will be equipped with avian and bat sensors, specifically Wildlife Acoustic passive monitoring systems, which allows recording of both ultrasonic bat echolocation calls, as well as audible bird vocalizations. The acoustic detectors locally store the data on removable SD cards, which will be downloaded opportunistically during deployment and maintenance of the Met Buoy. Species-level identification of bat echolocation calls and bird calls is possible for most species that would be expected to be present. These data would be useful for supplementing the baseline of avian and bat activity data in the study area. BOEM has explicitly identified the advantages to future development projects of deploying acoustic monitoring systems on site characterization platforms (BOEM 2012).

7.3 Physical Resources

7.3.1 Water and Air Quality

Water Quality

BOEM concluded in the Mid-Atlantic EA that any impacts to coastal and marine waters would be minimal, if detectable (BOEM 2012). GSOE I will comply with Lease stipulation 4.1.2 regarding marine trash and debris prevention. Additionally, as stated in Sections 4.1.4 and 4.1.5 of the Commercial Lease, GSOE I will ensure that all employees and contractors are briefed on marine trash and debris awareness elimination and as appropriate, oil spill response procedures. In addition, GSOE I will implement an Oil Spill Response Plan prior to beginning any activities.

Air Quality

According to EPA's most recent listing of Nonattainment/Maintenance Status (the "Green Book"), several counties (in whole or in part) in Delaware and Maryland, the two States that could potentially be affected by air emissions from the project, are designated as either Nonattainment or Maintenance for certain criteria pollutants.

In Delaware, Sussex County and New Castle County are marginal nonattainment areas for the 2008 8-hour ozone standard. Kent County is designated as Unclassifiable/Attainment, meaning that there is not enough information to make a determination at this time and/or the State does not need to take additional steps to control emissions of nitrogen oxides (NOx) and volatile organic compounds (VOCs), the pollutants that react in the atmosphere to form ozone (EPA 2018a). New Castle County is a maintenance area for the 2006 PM2.5 standard, while Kent County and Sussex County are designated as Unclassifiable/Attainment.

In Maryland, Anne Arundel County, Baltimore City, and Baltimore, Carroll, Harford, and Howard Counties are designated as moderate nonattainment areas for the 2008 8-hour ozone standard, while Calvert, Cecil, Charles, Frederick, Montgomery, and Prince George's counties are designated as marginal nonattainment areas (EPA 2018b). Parts of Baltimore City and Montgomery and Prince George's counties are designated as maintenance areas for the carbon monoxide standard, while parts of Anne Arundel and Baltimore counties are designated as nonattainment for the 2010 sulfur dioxide standard.

Additionally, all of Delaware and Maryland are within the Northeast Ozone Transportation Region (OTR) as designated by the Clean Air Act. The OTR is a group of northeast States that are required to submit a State Implementation Plan (SIP) and require a certain level of controls for the pollutants that form ozone, even if they meet the ozone standards.

The installation, operation and decommissioning of the Met Buoy has the potential to impact local air quality. Potential emission sources would however be limited to the diesel engines on a tug boat, work vessels, a crane, and other equipment that would be used for the installation, operation, and decommissioning, and a small electrical generator powered by a diesel engine, to provide backup power for the Met Buoy. The diesel engines on the vessels and the backup generator would emit criteria air pollutants (nitrogen oxides, carbon monoxide, sulfur dioxide, particulate matter less than 10 microns in diameter [PM10], particulate matter less than 2.5 microns in diameter [PM2.5]), and volatile organic compounds), hazardous air pollutants (HAPs) and greenhouse gases (GHGs). These pollutants would be emitted both in State and Federal waters while traveling to and from the Met Buoy Installation Area throughout the operational lifecycle. Impacts from pollutant emissions associated with these vessels would be short-term in nature, and likely be localized within immediate vicinity of the Met Buoy location and in the vicinity of vessel activity.

It is anticipated that the installation and decommissioning of the Met Buoy would each be completed over a period of approximately 1 to 4 days for a total of 4 to 8 days. To be conservative, GSOE I based the air emission calculations on 10 days for installation and an additional 10 days for decommissioning, for a total of 20 days. This contingency covers the potential for weather and other unforeseen events that, although unlikely, might occur. GSOE I has assumed 8 round-trips per year of a work boat during the 6- year operational period for a total of 42 round-trips during the operations phase. A summary of the air emission estimates is presented in Table 7-5, and the detailed emission calculations and assumptions are presented in Appendix D.

Table 7-3. Met Buoy Air Emissions Summary

Activity	VOC tons	NOX tons	CO tons	PM/PM10 tons	PM2.5 tons	SO2 tons	HAPs tons	GHG tons
Installation Activities	0.30	6.09	3.06	0.37	0.36	0.0041	0.06	441.1
Operation & Maintenance Activities	0.01	0.34	0.20	0.01	0.01	0.0002	0.00	24.6
Decommissioning Activities	0.30	6.09	3.06	0.37	0.36	0.0041	0.06	441.1
Maximum Annual Emissions [1]	0.32	6.43	3.27	0.38	0.37	0.0045	0.06	465.7

Note:
1. The estimate of maximum annual emissions assumes that the annual maintenance activities and either the installation or decommissioning activities occur in the same year.

These emissions are well below the major source thresholds established under Prevention of Significant Deterioration (PSD) and Nonattainment New Source Review regulations applicable to new emission sources, and also below the *de minimis* emissions thresholds under the Federal General Conformity regulations (40 CFR Part 93). The emissions of Hazardous Air Pollutants (HAPs) are also well below the major source levels under the National Emission Standards for Hazardous Air Pollutants (NESHAPs) regulations, in which a major source is defined as one that has the potential to emit 25 tons or more per year of all HAPs combined, or 10 tons or more per year of any individual HAP. Most of these emissions would occur within Met Buoy installation area and therefore would not affect local onshore air quality in either Delaware or Maryland. Additionally, the presence of the back-up generator on the Met Buoy, makes the Met Buoy an OCS source and an OCS air permit will likely be required.

7.3.2 Socioeconomic Resources

Commercial Fishing, Recreational Fishing, and Coastal and Marine Uses

Affected Environment

Based on Federal permit data of commercial fishery landings from 2007 to 2012, approximately $14.0 million in annual commercial fishing revenue was sourced from the eight WEAs from Massachusetts to North Carolina (Kirkpatrick, et al., 2017). In a socio-economic analysis of impacts to fisheries from OCS wind energy development published in 2017, BOEM reported that the total annual revenue from these WEAs is approximately the historical yearly fluctuation in fisheries revenue observed every 5 years. Therefore, under the maximum impact scenario modeled (i.e., assuming no reallocation of effort and no harvesting occurs within a given WEA), the maximum potential impact to commercial fishing revenue would be equivalent to the fluctuation that is observed in the dataset every 5 years (Kirkpatrick, et al., 2017).

Of the total revenue calculated for the Mid-Atlantic WEAs, the Delaware WEA has a total of $356,631 in annual commercial revenue, which was the fourth-lowest intensity of all eight WEAs. (Kirkpatrick, et al., 2017). Sea scallop (*Placopecten magellanicus*), Menhaden (*Brevoortia tyrannus*), and black sea bass (*Centropristis striata*) are the most economically important species harvested from the Delaware WEA, although harvest of these species from this area represents only approximately 0, 2.1, and 1.5 percent of the average total annual revenue for these species, respectively (BOEM, 2012) (Kirkpatrick, et al., 2017).

Because of the relatively low total revenue sourced within the Delaware WEA, this area did not meet the minimum thresholds to explicitly model the exposure to commercial fisheries that BOEM conducted in their analysis of socio-economic impacts. However, estimates based on the model results for WEAs that did meet the criteria (greater than 2 percent of total revenue from the WEA) led BOEM to conclude that any impacts realized from the development of the Delaware WEA were expected to be negligible on commercial fisheries in this area (Kirkpatrick, et al., 2017).

The Mid-Atlantic region has a robust recreational fishing sector in its coastal waters. BOEM reports that between 2008 and 2010 anglers from New Jersey, Delaware, and Maryland averaged 550,000, 24,000, and 67,500 recreational fishing trips in Federal waters, respectively (BOEM, 2012). Anglers from recreational for-hire and private fishing trips leaving from ports in Delaware, Maryland, and New Jersey reported more than 5.4 million trips from 2007 to 2012. However, fewer than 2 percent of those fishing trips traveled to within 1 nautical mile (the distance used by BOEM to assess exposure to impacts) of the Delaware WEA (Kirkpatrick, et al., 2017).

The top fish species targeted by recreational fishers in the Mid-Atlantic include bluefish (*Pomatomus saltatrix*), black sea bass (*Centropristis striata*), Atlantic striped bass (*Morone saxatilis*), and dolphin (*Coryphaena hippurus*) (BOEM, 2012). Exposure to impacts from development in the Delaware WEA can be affected by the species targeted. For example, Federal regulations prohibit striped bass fishing beyond 3 nautical miles from shore (BOEM, 2012). Therefore, striped bass fishers would not be expected to be within the Delaware WEA and would not be impacted by the Met Buoy deployment.

Potential Impacts and Proposed Mitigation Measures

Impacts may differ for WEA construction and operation; likewise, effects to recreational fish species from the deployment/retrieval of the Met Buoy may differ from the operational phase. Disruption to species that may be targeted by recreational fishers may occur in the immediate area during buoy deployment due to increased boat traffic and bottom disturbance, although any impacts would be localized and temporary. Alternatively, as was noted previously, because the benthic habitat in the Lease Area is primarily sand with minimal habitat features, the installation of the anchoring system for the Met Buoy will introduce artificial hard substrate that, although limited in size, may attract opportunistic benthic and structure dependent species. Likewise, the Met Buoy itself will provide surface structure that may act to attract pelagic or migratory species (Kirkpatrick, et al., 2017).

Based on the finding of negligible impact for the development of the Delaware WEA, it is unlikely that the deployment, operation, and retrieval of the Met Buoy within the Lease Area will have measurable long-term effects on commercial or recreational fishers or other marine uses. With the low percentage of anglers exposed to impacts from the WEA development in general, the installation of the Met Buoy in the Lease Area is expected to be negligible. The possibility of improved recreational fishing experiences due to the limited increase in habitat complexity at the Met Buoy site exists, although these positive effects would also be limited in scale and would be eliminated upon retrieval of the Met Buoy.

While no specific stipulations concerning interactions with commercial and recreational fishing are provided in the Commercial Lease, as recommended in BOEM's October 20, 2015, Fisheries Social and Economic Conditions guidance document (BOEM 2015), GSOE I has hired a Fisheries Liaison, Mr. Rodney Avila. As necessary, Mr. Avila will conduct outreach with the surrounding commercial and recreational fishing communities including, but not limited to, Rehoboth Beach and Bethany Beach, Delaware; Ocean City, Maryland; and Cape May, New Jersey prior to buoy deployment. Outreach with commercial and recreational fishermen will continue throughout the buoy deployment period as part of GSOE I's standard fisheries communication plan. In addition, GSOE I will notify commercial and recreational fishermen, as well as other users the area about the proposed activities via a Local Notice to Mariners and broadcasts on Marine Channel 16 prior to installation and decommissioning.

Coastal and Marine Uses

GSOE I will notify commercial and recreational fishermen, as well as other users of the OCS, via a Notice to Local Mariners and broadcasts on Marine Channel 16 prior to installation and decommissioning activities as described in Sections 4 and 6.

Prior to deployment, the USCG will approve a Private Aids to Navigation for the Met Buoy. The navigational lighting will notify vessels in the area of the Met Buoy location so it can be avoided. BOEM included Lease stipulations regarding notification of and coordination with military and defense in the Lease Area (see Appendix A). GSOE I will notify Fleet Forces Command before the proposed installation of the Met Buoys to avoid conflicts with any seaspace and airspace activities planned by the United States Navy in the Warning Area 386 (W-386). Fleet Forces Command has confirmed that most at-sea training and operations in W-386 occurs to the south of the Lease Area. At the request of Fleet Forces Command, GSOE I provided the operational frequencies for data transmission equipment on the Met Buoy to avoid any potential conflicts due to electromagnetic emissions.

Potential Impacts and Proposed Mitigation Measures

Due to the distance from shore and the use of existing infrastructure, the Met Buoy is not anticipated to impact social and economic resources such as recreation and minority or low-income populations (BOEM 2012). GSOE I will use the existing facilities for vessel deployments, resulting in a short-term negligible beneficial economic effect in and around those ports. Adherence to the International Regulations for Preventing Collisions at Sea 1972 and the "Rule of Good Seamanship" by vessel operators will mitigate risks that the buoy may pose to safe navigation. GSOE I will notify mariners and other users of the area about the proposed activities via an LNM and broadcasts on Marine Channel 16 prior to installation and decommissioning. GSOE I will also submit an application to the USCG for a PATON for the Met Buoy. Additionally, the navigational lighting will notify vessels of the Met Buoy so it can be safely avoided.

7.3.3 Archeological Resources

Affected Environment

Cultural resources include archaeological sites, historic standing structures, objects, districts, cultural landscapes, and traditional cultural properties that illustrate or represent important aspects of prehistory or history or that have important and long-standing cultural associations with established communities or social groups. Significant archaeological and architectural properties, cultural landscapes, and traditional cultural properties are generally defined by the eligibility criteria for listing in the National Register of Historic Places (NRHP). Review under Section 106 of the National Historic Preservation Act (NHPA) (16 USC § 470f) occurs when projects require Federal permits, are located on Federal lands or in Federal waters, or are federally funded. Such Federal undertakings require consultation by Federal agencies with the SHPO, interested Native American tribes, and other stakeholders.

These consultations identify the Area of Potential Effect (APE) (the archaeological APE differs from the APE for structures, objects, landscapes, and traditional cultural properties) and potential adverse effects to archaeological, architectural, or other cultural resources that are listed in or are potentially eligible for listing in the NRHP.

The installation of the proposed Met Buoy has the potential to affect submerged archaeological resources that may relate to time periods both prior to and after contact between Native American and European groups. The proposed installation location is on the now-submerged Delaware Continental Shelf. During the late Pleistocene-early Holocene geological periods, the Delaware Continental Shelf was exposed upland, available for use by hunters and gatherers. Archaeological remnants of these populations date to the Paleo-Indian Stage (ca. 15,000 to 10,000 years ago [Before Present {BP}]) and parts of the Archaic Stage (i.e., Early Archaic ca. 10,000 to 8,500 BP and Middle Archaic ca. 8,500 to 5000 BP).

In 2018, R. Christopher Goodwin & Associates reported on the results of an initial marine archaeological survey conducted in 2009 and a follow-up survey conducted in 2010 covering a 1-nautical square mile (1.8-square kilometer) area located within OCS Blocks 6324, 6325, and 6375 (Appendix E). The proposed location for the Met Buoy is within this evaluated area. As reported in Schmidt et al. (2018) and included in Appendix E, background research did not indicate the presence of any pre-contact Native American archaeological resources or post-contact shipwrecks within the survey area. The on-water geophysical survey in 2009 employed multibeam echo sounder, magnetometer, side scan sonar, sub-bottom profiler (CHIRP), and multi-channel seismic reflection (BOOMER) equipment to collect data along transects spaced at 98.4-foot (30-meter) intervals with tie lines spaced at 492.1–foot (150-meter) intervals. In 2010, additional magnetometer and side scan sonar data were collected along survey transects spaced at 98.4-foot (30-meter) intervals and supplemental magnetic data were collected at 49.2-foot (15-meter) line spacing.

Schmidt et al. (2018) reviewed the data collected in 2009 and 2010 to determine whether submerged archaeological resources are present within the 22.9-acre (9.3-ha) Met Buoy Installation Area of Potential Effects (APE). Data from high resolution side-scan sonar (Schmidt et al. 2018: 49, 52, 54, Appendix II) and marine magnetometry (Schmidt et al. 2018:48, 51, 54, Appendix II) datasets were reviewed, and the authors concluded that no anthropometric seafloor disturbances or features and no magnetic anomalies were present with the 22.9-acre (9.3-ha) APE.

The surveyed area appears to be within a former inter-fluvial region that most likely was an estuarine/lagoonal setting during the Late Pleistocene and Early Holocene periods. Such a setting will have very low potential for the location of pre-contact Native American archaeological sites dating to any period.

Sonar images of the sub-bottom profiles were also reviewed to determine whether geomorphic features, such as now-submerged shorelines of freshwater rivers or lakes or salt water estuaries, locations favored by the earliest Native American inhabitants of North America, were present within the APE (Schmidt et al. 2018:54). No conclusive indicators of these geomorphic paleolandscapes were identified. Detailed information on the physiography and geologic evolution of the Delaware Continental Shelf is provided in Fugro (2010b) (Appendix C: pages 9-12; Figures 14, 15, 16, 17, and 18) and in the Goodwin & Associates report in Appendix E (pages 27-31, 53-54, 56; Figure 5-1), as required in Appendix A of the Commercial Lease (pages 9-10).

Based on these results, Schmidt et al. (2018:56) recommended that a determination of No Historic Properties Affected be made for this undertaking. However, the authors did recommend the preparation and implementation of an Unanticipated Discoveries Plan for the Met Buoy Installation APE.

Potential Impacts and Proposed Mitigation Measures

Based on the results of the 2009 and 2010 marine archaeological investigations and review of the data collected at that time for the current Met Buoy installation area, the installation, operation, and decommissioning of the Met Buoy will not result in impacts to marine archaeological resources. However, in compliance with 30 CFR 585.802 and the Commercial Lease, GSOE I will develop an Unanticipated Discoveries Plan (UDP) prior to the start of installation. In the case of an inadvertent discovery of a cultural resource, GSOE I's UDP will be implemented to prevent further disturbance of the resource.

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APPENDIX A

LEASE STIPULATION TABLE

Lease (OCS-A 0482) Stipulations

Addendum "C" Stipulation: Activity	Condition	Compliance
2 SCHEDULE		
2.2.1.2 SAP Survey Plan.	If the Lessee proposes to conduct site assessment activities during the site assessment term, then the Lessee must submit to the Lessor a complete SAP survey plan. This SAP survey plan must include the results of prior relevant surveys conducted in the lease area, if available to the Lessee, and details of any surveys to be conducted on this lease necessary to support the submission of a SAP (see 2.1.2). The Lessee must submit in the SAP survey plan a supporting explanation to substantiate any assertion that the results of prior surveys conducted in the lease area satisfy all or some of the information requirements of a SAP. The Lessee must submit the SAP survey plan to the Lessor by the date specified in the Lessee's pre-filing plan and schedule. The Lessor will require that the Lessee modify the SAP survey plan to .address any comments the Lessor submits to the Lessee on the contents of the SAP survey plan in a manner deemed satisfactory to the Lessor prior to the commencement of any survey activities described in the SAP survey plan.	SAP Survey Plan to be submitted by March 1, 2019
2.2.1.3 COP Survey Plan	The Lessee must submit to the Lessor for review a complete COP survey plan providing details and timelines of the surveys to be conducted on this lease necessary to support of the submission of a COP (i.e., necessary to satisfy the information requirements in the applicable regulations, including but not limited to 30 CFR 621, 626, 627.). The COP survey plan must be submitted to the Lessor no later than the first anniversary of this lease's Effective Date, unless the deadline for submission of this plan is extended by the Lessor per 2.2.4. The Lessee must modify the COP survey plan to address any comments the Lessor submits to the Lessee on the contents of the COP survey plan in a manner deemed satisfactory to the Lessor prior to the commencement of these survey activities.	COP Survey Plan Submitted February 13, 2018
2.2.2: Pre-Survey Meeting with Lessor	At least 60 days prior.to the initiation of survey activities in support of the submission of a plan (i.e., SAP and/ or COP), the Lessee must hold a pre-survey meeting with the Lessor to discuss the applicable proposed survey plan and timelines. The Lessee must ensure the presence of a Qualified Marine Archaeologist at this meeting (See 4.2.2).	A pre-survey meeting will be completed 60 days prior to the start of survey activities
2.3.1 Semi-Annual Progress Report	The Lessee must submit to the Lessor a semi-annual (i.e., every six months) progress report through the duration of the site assessment term that includes a brief narrative of the overall progress since the last progress report, or – in the case of the first report – since the Effective Date. The progress report must include an update regarding progress in executing the activities included in the survey plans, and include as an enclosure updated survey plans accounting for any modifications in schedule.	Deepwater will comply when necessary
3 NATIONAL SECURITY AND MILITARY OPERATIONS		
3.2.4: Lessee Point-of-Contact for Evacuation/ Suspension Notifications	The Lessee must inform the Lessor of the persons/offices to be notified to implement the terms of 3.2.2 and 3.2.3.	Aileen Kenney Vice President Deepwater Wind akenney@dwwind.com (401) 648-0607 – office (617) 852-7031 – mobile
3.2.5: Coordination with Command Headquarters	The Lessee must establish and maintain early contact and coordination with the appropriate command headquarters, in order to avoid or minimize the potential to conflict with and minimize the potential effects of conflicts with military operations.	Skipjack will establish a point of contact at United States Fleet Forces in Norfolk, Virginia, as directed in the Lease.

Addendum "C" Stipulation: Activity	Condition	Compliance
3.3: Electromagnetic Emissions	The Lessee, prior to entry into any designated defense operation area, warning area, or water test area, must enter into an agreement with the commander of the appropriate command headquarters prior to commencing survey activities undertaken to support SAP or COP submittal, to coordinate the electromagnetic emissions associated with such survey activities. The lessee must ensure that all electromagnetic emissions associated with such survey activities are controlled as directed by the commander of the appropriate command headquarters.	To be addressed for any relevant survey activities when coordinating with Command Headquarters (see stipulation 3.2.5).
4 STANDARD OPERATING CONDITIONS		
4.1 General		
4.1.1 Vessel Strike Avoidance Measures	The Lessee must ensure that all vessels conducting activities in support of plan (i.e., SAP and COP) submittal comply with the vessel-strike avoidance measures specified in stipulations 4.1.1.1 through 4.1.1.7, except under extraordinary circumstances when the safety of the vessel or crew is in doubt or the safety of life at sea is in question."	All vessel operators and crews will be informed of this requirement
4.1.1.1	The Lessee must ensure that vessel operators and crews maintain a vigilant watch for cetaceans, pinnipeds, and sea turtles and slow down or stop their vessel to avoid striking these protected species.	All vessel operators and crews will be informed of this requirement
4.1.1.2	The Lessee must ensure that all vessel operators comply with 10 knot (18.5 km/hr.) speed restrictions in any Dynamic Management Area (DMA). In addition, the Lessee must ensure that all vessels operating from November 1 through April 30 operate at speeds of 10 knots (18.5 km/hr) or less.	All vessel operators and crews will be informed of this requirement
4.1.1.3 North Atlantic right whales.	4.1.1.3.1 The Lessee must ensure all vessels maintain a separation distance of 500 meters (1,640 ft) or greater from any sighted North Atlantic right whale. 4.1.1.3.2 The Lessee must ensure that the following avoidance measures are taken if a vessel comes within 500 meters (1,640 ft) of any North Atlantic right whale: 4.1.1.3.2. 4 If underway, any vessel must steer a course away from the North Atlantic right whale at 10 knots (18.5 km/hr) or less until the 500 meters (1,640 ft) minimum separation distance has been established (except as provided in 4.1.1.3.2.2). 4.1.1.3.2. 4 If a North Atlantic right whale is sighted within 100 meters (328 ft) to an underway vessel, the vessel operator must immediately reduce speed and promptly shift the engine to neutral. The vessel operator must not engage the engines until the North Atlantic right whale has moved beyond 100 meters (328 ft). 4.1.1.3.2. 4 If a vessel is stationary, the vessel must not engage engines until the North Atlantic right whale has moved beyond 100 meters (328 ft), at which point the Lessee must comply with 4.1.1.3.2.1.	All vessel operators and crews will be informed of this requirement

Addendum "C" Stipulation: Activity	Condition	Compliance
4.1.1.4 Non-delphinoid cetaceans other than the North Atlantic right whale.	4.1.1.4.1 The Lessee must ensure that all vessels maintain a separation distance of 100 meters (328 ft) or greater from any sighted non-delphinoid cetacean. 4.1.1.4.2 The Lessee must ensure that the following avoidance measures are taken if a vessel comes within 100 meters (328 ft) of any non-delphinoid cetacean: Amendment, 2014 Page 4 of 9 4.1.1.4.2. 4 If any non-delphinoid cetacean is sighted, the vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the nondelphinoid cetacean has moved beyond 100 meters (328 ft). 4.1.1.4.2. 4 If a vessel is stationary, the vessel must not engage engines until the nondelphinoid cetacean has moved beyond 100 meters (328 ft).	All vessel operators and crews will be informed of this requirement
4.1.1.5 Delphinoid cetaceans.	4.1.1.5.1 The Lessee must ensure that all vessels maintain a separation distance of 50 meters (164 ft) or greater from any sighted delphinoid cetacean. 4.1.1.5.2 The Lessee must ensure that the following avoidance measures are taken if the vessel comes within 50 meters (164 ft) of any delphinoid cetacean: 4.1.1.5.2. 4 The Lessee must ensure that any vessel underway remain parallel to a sighted delphinoid cetacean's course whenever possible, and avoid excessive speed or abrupt changes in direction. The Lessee may not adjust course and speed until the delphinoid cetacean has moved beyond 50 meters (164 ft) or the delphinoid cetacean has moved abeam of the underway vessel. 4.1.1.5.2. 4 The Lessee must ensure that any vessel underway reduce vessel speed to 10 knots (18.5 km/hr) or less when pods (including mother/calf pairs) or large assemblages of delphinoid cetaceans are observed. The Lessee may not adjust course and speed until the delphinoid cetaceans have moved beyond 50 meters (164 ft) or abeam of the underway vessel.	All vessel operators and crews will be informed of this requirement
4.1.1.6 Sea Turtles and Pinnipeds.	4.1.1.6.1 The Lessee must ensure all vessels maintain a separation distance of 50 meters (164 ft) or greater from any sighted sea turtle or pinniped.	All vessel operators and crews will be informed of this requirement
4.1.1.7 Vessel Operator Briefing.	The Lessee must ensure that all vessel operators are briefed to ensure they are familiar with the requirements specified in 4.1.1."	All vessel operators will be briefed on requirements specified in 4.1.1
4.1.2: Marine Trash and Debris Prevention	The Lessee must ensure that vessel operators, employees and contractors actively engaged in activity in support of plan (i.e., SAP and COP) submittal are briefed on marine trash and debris awareness and elimination, as described in the BSEE NTL No. 2012-G01 ("Marine Trash and Debris Awareness and Elimination") or any NTL that supercedes this NTL, except that the Lessor will not require the Lessee, vessel operators, employees and contractors to undergo formal training or post placards. The Lessee must ensure that these vessel operator employees, and contractors are made aware of the environmental and socioeconomic impacts associated with marine trash and debris and their responsibilities for ensuring that trash and debris are not intentionally or accidentally discharged into the marine environment. The above-referenced NTL provides information the Lessee may use for this awareness training."	All vessel operators, employees, and contractors conducting the COP survey will be briefed on NTL No. 2012-G01 prior to vessel deployment.
4.2 Archaeological Survey Requirements		
4.2.1 Archaeological Survey Required.	The Lessee must provide the results of an archaeological survey with its SAP and COP.	Results of the archaeological surveys will be provided in the SAP and COP.

Addendum "C" Stipulation: Activity	Condition	Compliance
4.2.2 Qualified Marine Archaeologist	The Lessee must ensure that the analysis of archaeological survey data collected in support of plan (e.g, SAP and/or COP) submittal and the preparation of archaeological reports in support of plan submittal are conducted by a Qualified Marine Archaeologist	R. Christopher Goodwin & Associates, Inc. of Frederick, MD will serve as the Qualified Marine Archaeologist
4.2.3: Tribal Pre-Survey Meeting	Subsequent to any pre-survey meeting with the Lessor (see 2.2.2) and at least forty-five (45) calendar days prior to commencing survey activities performed in support of plan (Le., SAP and/ or COP) submittal, the Lessee must invite by certified mail the Narragansett Indian Tribe, the Shinnecock Indian Nation, and the Lenape Tribe of Delaware to a tribal pre-survey meeting. The purpose of this meeting will be for the Lessee and the Qualified Marine Archaeologist to discuss the Lessee's Survey Plan and consider requests to monitor portions of the archaeological survey and the geotechnical sampling activities, including the visual logging and analysis of geotechnical samples (e.g., cores, etc.). The meeting must be scheduled for a date at least thirty (30) calendar days prior to commencing survey and at a location and time that affords the participants a reasonable opportunity to participate. The anticipated date for the meeting must be identified in the timeline of activities described in the applicable survey plan (see 2.2.1).	Skipjack will host a tribal pre-survey meeting at least forty-five calendar days prior to initiating survey activities, as described in this plan. Invitations will be sent via certified mail to the Narragansett Indian Tribe, the Shinnecock Indian Nation, and the Lenape Tribe of Delaware
4.2.4 Geotechnical Exploration	The Lessee may only conduct geotechnical exploration activities, including geotechnical sampling or other direct sampling or investigation techniques, which are performed in support of plan (i.e., SAP and COP) submittal in locations where an analysis of the results of geophysical surveys has been completed. This analysis must include a determination by a Qualified Marine Archaeologist as to whether any potential archaeological resources are present in the area. Except as allowed by the Lessor under 4.2.6, the geotechnical exploration activities must avoid potential archaeological resources by a minimum of 50 meters, and the avoidance distance must be calculated from the maximum discernible extent of the archaeological resource. A Qualified Marine Archaeologist must certify, in the Lessee's archaeological reports, that geotechnical exploration activities did not impact potential historic properties identified as a result of the HRG surveys performed in support of plan submittal, except as follows: in the event that the geotechnical exploration activities did impact potential historic properties identified in the archaeological surveys without the Lessor's prior approval, the Lessee and the Qualified Marine Archaeologist who prepared the report must instead provide a statement documenting the extent of these impacts.	Skipjack will comply. R. Christopher Goodwin & Associates, Inc. of Frederick, MD will serve as the Qualified Marine Archaeologist
4.2.5: Monitoring and Avoidance	The Lessee must inform the Qualified Marine Archaeologist that he or she may be present during HRG surveys and bottom-disturbing activities performed in support of plan (i.e., SAP and/or COP) submittal to ensure avoidance of potential archaeological resources, as determined by the Qualified Marine Archaeologist (including bathymetric, seismic, and magnetic anomalies; side scan sonar contacts; and other seafloor or sub-surface features that exhibit potential to represent or contain potential archaeological sites or other historic properties). In the event that this Qualified Marine Archaeologist indicates that he or she wishes to be present, the Lessee must facilitate the Qualified Marine Archaeologist's presence, as requested by the Qualified Marine Archaeologist, and provide the Qualified Marine Archaeologist the opportunity to inspect data quality.	Skipjack will comply. R. Christopher Goodwin & Associates, Inc. of Frederick, MD will serve as the Qualified Marine Archaeologist
4.2.6: No Impact Without Approval	In no case may the Lessee knowingly impact a potential archaeological resource without BOEM's prior approval.	Skipjack will comply.

Addendum "C" Stipulation: Activity	Condition	Compliance
4.2.7: Post-Review Discovery Clause	If the Lessee, while conducting site characterization activities in support of plan (i.e., SAP and/ or COP) submittal, discovers a potential archaeological resource as determined by a Qualified Marine Archaeologist, such as the presence of a shipwreck (e.g., a sonar image or visual confirmation of an iron, steel, or wooden hull, wooden timbers, anchors, concentrations of historic objects, piles of ballast rock), prehistoric artifacts, and/ or relict landforms, etc. within the project area, the Lessee must: 4.2.7.1 Immediately halt seafloor bottom-disturbing activities within the area of discovery; 4.2. 7.2 Notify the Lessor within 24 hours of discovery; 4.2.7.3 Notify the Lessor in writing via report to the Lessor within 72 hours of its discovery; 4.2.7.4 Keep the location of the discovery confidential and take no action that may adversely affect the archaeological resource until the Lessor has made an evaluation and instructs the applicant on how to proceed; and 4.2.7.5 Conduct any additional investigations as directed by the Lessor to determine if the resource is eligible for listing in the National Register of Historic Places (30 CFR 585.802(b)). The Lessor will do this if: (1) the site has been impacted by the Lessee's project activities; or (2) impacts to the site or to the area of potential effect cannot be avoided If investigations indicate that the resource is potentially eligible for listing in the National Register of Historic Places, the Lessor will tell the Lessee how to protect the resource or how to mitigate adverse effects to the site. If the Lessor incurs costs in protecting the resource, under Section 110(g) of the National Historic Preservation Act, the Lessor may charge the Lessee reasonable costs for carrying out preservation responsibilities under the OCS Lands Act (30 CFR 585.802(c-d)).	Skipjack will comply
4.4 Benthic Habitat		
4.4.1 Grounds/Fish Habitat	The Lessee must survey, collecting physical and biological survey data, the fishing grounds/fish habitat known as the "Old Grounds", "Mussel Bed", "Inside Mud Hole", "Middle Mud Hole", and "Outer Mud Hole."	Skipjack will comply.
4.5 Protected Species Reporting Requirements		
4.5.1: Reporting Injured or Dead Protected Species	The Lessee must ensure that sightings of any injured or dead protected species (e.g., marine mammals, sea turtles or sturgeon) are reported to the Lessor, NMFS, and the NMFS Northeast Regional Stranding Hotline within 24 hours of sighting, regardless of whether the injury or death is caused by a vessel. In addition, if the injury or death was caused by a collision with a project-related vessel, the Lessee must ensure that the Lessor is notified of the incident within 24 hours. The Lessee must use the form provided in Appendix A to Addendum "C" to report the sighting or incident. If the Lessee's activity is responsible for the injury or death, the Lessee must ensure that the vessel assist in any salvage effort as requested by NMFS.	Skipjack will comply.
4.5.2 Protected Species Observer Reports	The Lessee must ensure that the protected species observer record all observations of protected species using standard marine mammal observer data collection protocols. The list of required data elements for these reports is provided in Appendix B of Addendum "C"	Skipjack will provide the protected species observers with a copy of Appendix B of Addendum "C" and submit reports that comply.

Addendum "C" Stipulation: Activity	Condition	Compliance
4.5.3: Final Report of G&G Survey Activities and Observations	The Lessee must provide the Lessor with a report within 90 calendar days following the commencement of HRG or geotechnical sampling activities that includes a summary of survey activities, and an estimate of the number of listed marine mammals and sea turtles observed and/or Taken during these survey activities.	Within 90 days of HRG survey commencement, Skipjack will provide a field survey report describing survey activities, including protected species reports s.
4.5.4 Marine Mammal Protection Act Authorization(s)	If the Lessee is required to obtain an authorization pursuant to section 101(a)(5) of the Marine Mammal Protection Act prior to conducting survey activities, then the Lessee must provide to the Lessor a copy of the authorization prior to commencing these activities	No IHA is required.~~Skipjack has applied for an IHA with NMFS~~

APPENDIX B

MET BUOY EQUIPMENT SPECIFICATIONS

(CONFIDENTIAL – PROVIDED UNDER SEPARATE COVER)

APPENDIX C

SHALLOW HAZARD ASSESSMENT

Originally prepared for the Bluewater SAP and attached hereto in support of the Current Submission

FUGRO ATLANTIC

REVISED SHALLOW HAZARDS ASSESSMENT
PROPOSED METEOROLOGICAL DATA COLLECTION FACILITY (MDCF)
SALISBURY NJ 18-05 BLOCK 6325 OFFSHORE DELAWARE

Prepared for:
NRG BLUEWATER WIND

November 2010
Fugro Job No. 3671.004-r1

World Trade Center
101 West Main Street, Suite 350
Norfolk, Virginia 23510
Tel: (757) 625-3350

November 29, 2010
Project No. 3671.004-r1

COPY FORWARD
11-30-10
for review and comment

NRG Bluewater Wind
22 Hudson Place - 3rd Floor
Hoboken, NJ 07030

Attention: Kevin Pearce

Subject: **Revised Shallow Hazards Assessment Report**
Proposed Meteorological Data Collection Facility (MDCF)
Salisbury NJ 18-05 Block 6325, Offshore Delaware

Dear Mr. Pearce:

Fugro Atlantic (Fugro) is pleased to present our *Revised Shallow Hazards Assessment* for Bluewater Wind's proposed offshore Delaware Meteorological Data Collection Facility (MDCF). Our shallow hazards assessment is based on the geophysical survey conducted in October and November 2009, as well as supplemental survey data collected in October and November 2010, in the 1.8-km by 1.8-km survey area located in Outer Continental Shelf (OCS) Block 6325, about 14 nautical miles offshore of Dewey's Beach, Delaware. The geophysical surveys collected data for both shallow hazards and archeological resource evaluations.

The survey and reporting were authorized by the signed Master Service Agreement between Bluewater Wind and Fugro. The survey was conducted in accordance with Fugro's proposal dated September 30, 2009. The supplemental geophysical data acquisition and revision of our original report were authorized by NRG PO #: K0923101. The survey was planned and executed to meet the U.S. Minerals Management Service (MMS; in spring 2010, MMS was renamed Bureau of Ocean Energy Management, Regulation and Enforcement [BOEMRE]) *Guidelines* for: *1) Shallow Geologic Hazards and 2) Archaeological Resources Surveys for Meteorological Towers*. Those guidelines are included as Appendices C and B, respectively, of MMS' Interim Lease OCS-A-0474 to Bluewater Wind for Salisbury NJ 18-05 Block 6325. As recommended by those MMS guidelines, Fugro prepared a *Marine Geophysical Survey Plan*, dated September 29, 2009, for submittal to and review by the MMS.

The original *Shallow Hazards Assessment* report, based on geophysical data collected in fall 2009, was dated February 5, 2010. That prior report has been revised and updated to include the results of the supplemental geophysical data collected in fall 2010. The revised *Archaeological Resources Assessment* report that also includes consideration of the supplemental data will be prepared by R. Christopher Goodwin & Associates, Inc. under contract to Tetra Tech EC. Under separate cover, Fugro will transmit the electronic survey data to NRG Bluewater Wind for submittal to the MMS, in accordance with MMS' *Guidelines*.

On behalf of the Fugro organization, we appreciate the opportunity to contribute to NRG Bluewater Wind's development of renewable energy resources offshore the United States. Please call us if you have any questions or when we can be of further assistance.

Sincerely,
FUGRO ATLANTIC

Kevin R. Smith
Senior Engineering Geologist

Thomas W. McNeilan, P.E.
Vice President

Copies Submitted: (5) Hard Copies and CDs with PDF files

CONTENTS

TABLES

(within and following text)

Page

FIGURES
(following text and tables)

CHARTS

APPENDICES

EXECUTIVE SUMMARY

PROJECT AND STUDY DESCRIPTION

Fugro Atlantic (Fugro) has conducted a shallow hazard survey and evaluation for NRG Bluewater Wind's proposed meteorological tower (referred to as a meteorological data collection facility [MDCF]), offshore Delaware. The proposed MDCF is to be located in about 32.5-foot water depth (re: MLLW Datum) at Latitude N 38˚41' 14"/Longitude W 74˚ 46' 06" (WGS84), and is to be founded on a 9-foot-diameter monopile foundation. The site is about 14 nautical miles offshore of Rehoboth Beach, Delaware in the southwestern quadrant of Salisbury Protraction Area NJ18-05, Block 6325 of the Atlantic Offshore Continental Shelf (OCS).

This *Revised Scour Evaluation Report* is one of three technical reports provided by Fugro for NRG Bluewater Wind's proposed MDCF. The other two reports are the *Geotechnical and Pile Design Report* (dated February 28, 2010) and the *Scour Evaluation Report* (dated November 23, 2010). Collectively, these reports document the geologic, seafloor, and subsurface conditions and their implications for the siting, design, installation and performance of the proposed MDCF. Our evaluations are based on the fall 2009 and fall 2010 geophysical survey data acquisition at the proposed project area, a historical boring drilled at the site of the proposed MDCF, and other preliminary investigations, regional data, and prior studies.

The fall 2009 geophysical survey was conducted to satisfy the U.S. Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE; formerly the Minerals Management Service's [MMS]) requirements for: 1) shallow hazards assessment, and 2) marine archaeological resource assessment. The data acquisition and reporting were performed in general accordance with the MMS' *Guidelines for Geological and Geophysical Site-Surveys for Meteorological Towers and Other Seafloor Founded Structures and Devices on the OCS* (MMS, 2009a) and *Archaeological Resources: Recommended Guidelines for Field Surveys and Reporting* (MMS, 2009b). Those guidelines are included as Appendices to MMS' *Interim Lease OCS-A-0474 to Bluewater Wind for Salisbury NJ 18-05 Block 6325*.

The shallow hazards assessment is based on an integrated interpretation of two-dimensional, high-resolution seismic reflection (to a maximum depth limit of 0.5 seconds two-way travel time [~1,250 feet] below the seafloor), sub-bottom profiler, side scan sonar, multibeam echosounder, and magnetometer data in the 1.8-km by 1.8-km survey area. The data collected during the surveys were provided to R. Christopher Goodwin and Associates, Inc. (Goodwin) for the archaeological resource assessment which is provided in Goodwin's report.

The *Revised Shallow Hazards Assessment* report supersedes and replaces the previous *Shallow Hazards Assessment* report, dated February 5, 2010. The revised report updates the previous report to include the results of the supplemental geophysical data collected in the fall 2010. The supplemental data were collected to: 1) provide new magnetometer data at the northwest and southeast limits of the survey area, 2) add supplemental data at 15-meter line spacing in the central portion of the survey area, where the original data disclosed several magnetometer anomalies, 3) obtain a second set of side scan sonar data using a different system than used to collect the original data, and 4) obtain samples of the seafloor sediment.

SITE AND SEAFLOOR CONDITIONS

The project is to be sited on the Atlantic Shelf. The proposed MDCF is located on the crest of a large northeast-southwest-trending ridge. The water depth at the proposed MDCF location is 32.4 feet (re: MLLW) and varies by up to 5 feet within a 1,000-foot radius around the proposed MDCF location.

The Atlantic Shelf is an area of complex seafloor geomorphology and dynamic ocean currents. Subtle changes in the seafloor have been documented at the site during minor storms, while large storms can produce significant changes in the seafloor due to erosion, transport and redeposition of the seafloor sediments. It is the interrelationship between the bottom currents produced by the various oceanographic processes and conditions, and the seafloor conditions and materials that produce the seafloor geomorphology and create the potential for sediment mobility.

The geophysical data and seafloor sampling document three scales of bedforms that are inferred to reflect bottom current flows of different duration, intensity, and direction. As noted, the MDCF is to be on the crest of a regional northeast-southwest-trending ridge. The sand ridge is the largest of the three bedforms present in the survey area. Two types of smaller bedforms or sand waves are superimposed on the ridge and adjacent swales. Approximately 4-foot-high dunes are present on the southeastern flank of the sand ridge, while smaller sand ripples are present throughout most of the survey area. The fall 2009 geophysical data collection documented modification to the sand ripples on the northern flank of the sand ridge during a small wind-event.

Seafloor sampling shows that the seafloor sediments are fine sand and fine to medium sand. The measured grain size of the seafloor sediments correlates with the side scan sonar reflectivity, which allows the sediment grain size to be mapped in the survey area. The distribution of the sediment grain size in the project survey area is consistent with the inferred long-term evolution of the ridge.

POTENTIAL MAN-MADE ARTIFACTS

The magnetometer data from both the fall 2009 and fall 2010 surveys indicate the presence of a large (800+ gamma) artifact to the southeast of the proposed MDCF location. The presence of the anomaly or a cluster of anomalies was observed in the magnetometer data from multiple survey lines during both surveys. Analyses of the magnetic signatures suggest a probable location of the anomaly (or center of the cluster of anomalies) to be about 85 feet to the southeast of the proposed MDCF location. No seafloor expression of this magnetic anomaly was observed in either the fall 2009 or fall 2010 side scan sonar data. The buried metal object may be debris from prior investigation activities for the MDCF.

The two geophysical surveys also documented the presence of several other point-source magnetic anomalies (typically less than 5 to 10 gamma intensity with a 3 point-source anomalies with intensities of 40 to 50 gammas) and side scan sonar targets (typically no larger than a 6 feet in length or width and extending less than 0.5- to 1-foot above the seafloor; the maximum size of one long, narrow target is about 20 feet and maximum height of a different target is about 6 feet above the seafloor). None of the magnetic anomalies correlated with side scan sonar targets on either survey. In addition, none of the small anomalies and side scan sonar targets was identified in both surveys. This is inferred to suggest that the dynamic seafloor conditions periodically bury, expose, and/or move the small artifacts that may have been imaged in either the magnetometer or side scan sonar data.

SUBSURFACE CONDITIONS

The sediments underlying the site to the depth of stratigraphic mapping (approximately 460 feet below the seafloor) are comprised of alternating layers of unconsolidated sand and clay sediments. Boring B-102, drilled in 2007 and logged by Halcrow/HPA, provides lithologic information to 167 feet below mudline. Nine seismic units (Units 1 through 9) were mapped using the two-dimensional, high-resolution seismic data. The upper four of those units are within the depth penetrated by the boring. The seismic units correlate fairly well to soil strata defined in the boring log.

Sub-seafloor amplitude anomalies observed in the seismic data are inferred to represent shallow, free-gas accumulations. A number of water column anomalies (that could be due to intermittent gas seeps) in the side scan sonar data generally correlate to the area where shallow gas was mapped below the seafloor. Near the MDCF, the potential gas zone correlates to a layer of silty clay with organics and strong organic odor. The anomalies were observed in seismic Units 2 and 3. The gas is likely produced from decaying organics within estuarine-lagoonal deposits and is accumulating within sandy layers or lenses. The anomalies are observed at fairly shallow depths below the seafloor and therefore will have limited overburden capable of capping low-pressured gas accumulations. Boring B-102 drilled in 2007 (Halcrow/HPA, 2009) did not report any encounters with gas during drilling (e.g. kick-backs, gas blisters in samples, etc.).

CONCLUSIONS

The seafloor and shallow geologic conditions are generally favorable for installation of the proposed MDCF. The proposed MDCF location avoids known obstructions identified in this survey. Construction and installation activities should be planned to avoid the area of magnetic anomalies or further investigation should be conducted to identify the source of those anomalies. Sediment transport processes, most likely caused by storms, and potential scour should be considered during design of the MDCF foundation.

No applicable BOEMRE Notice to Lessees (NTLs) have been issued for Atlantic OCS structures. Thus, there are no criteria for required offset between the MDCF and the buried metal object(s) to the southeast of the proposed MDCF location or to areas where gas is present in the shallow sediments. We anticipate that these issues will require dialogue with the BOEMRE.

INTRODUCTION

LOCATION AND SURVEY PURPOSE

Fugro Atlantic (Fugro) conducted the marine geophysical survey and prepared the shallow hazards assessment report for NRG Bluewater Wind's (or Bluewater's) proposed meteorological tower (referred to as a meteorological data collection facility [MDCF]), offshore Delaware. The proposed MDCF location (Figure 1) is about 14 nautical miles (Nm) offshore of Rehoboth Beach, Delaware in Salisbury Protraction Area NJ18-05, Block 6325 of the Atlantic Offshore Continental Shelf (OCS). The location of the proposed MDCF is at:

- Latitude N 38˚41' 14", Longitude W 74˚ 46' 06" WGS84,
- UTM Zone 18N, E 520,148 meters, N 4,282,094 meters, WGS84, and
- Water depth = 32.4 feet re: Mean Lower Low Water (MLLW), measured with a multibeam echosounder.

The 1.8-km by 1.8-km geophysical survey area is centered near the southwest corner of OCS Block 6325 (Figures 2 and 3). The western and southern corners of the survey area extend into Blocks 6324 and 6375, respectively.

The purpose of the geophysical survey was to satisfy the U.S. Minerals Management Service's (MMS'; in spring 2010, MMS was renamed Bureau of Ocean Energy Management, Regulation and Enforcement [BOEMRE]; the terms MMS and BOEMRE are used interchangeably within this report) requirements for: 1) shallow hazards assessment, and 2) marine archaeological resource assessment. The data acquisition and reporting were performed in general accordance with the MMS *Guidelines for Geological and Geophysical Site-Surveys for Meteorological Towers and Other Seafloor Founded Structures and Devices on the OCS* (MMS, 2009a) and *Archaeological Resources: Recommended Guidelines for Field Surveys and Reporting* (MMS, 2009b). Those guidelines are included as Appendices C and B, respectively, of MMS' *Interim Lease OCS-A-0474 to Bluewater Wind for Salisbury NJ 18-05 Block 6325*.

Currently, Notice To Lessees (NTLs) have not been released for alternate-energy-project shallow hazard and marine archaeology assessments on the Atlantic OCS. However, the aforementioned guidance documents (MMS, 2009a and 2009b) refer to the following NTLs for data acquisition and reporting requirements: Pacific OCS Region NTL No. 06-P01 (MMS, 2006), Gulf of Mexico Region NTL 2008-G05 (MMS, 2008), and Alaska OCS Region NTL 05-A01 (MMS, 2005b). Considering those NTLs were developed for siting oil and gas structures and drilling wells, in our opinion, this study and report meets or exceeds requirements from the NTLs that are applicable to the proposed meteorological tower project described herein.

ORIGINAL FALL 2009 SURVEY AND SHALLOW HAZARDS REPORT

The scope of this study consists of the interpretation, mapping, and geologic/hazard assessment of the high-resolution-survey data. The data include bottom charting and sub-bottom imaging data. The bottom charting systems included: multibeam echosounder, side scan sonar, and magnetometer data acquisition. The sub-bottom imaging systems included: a Chirp sub-bottom profiler and two-dimensional (2D) high-resolution, multichannel seismic reflection data collection.

Considering that few studies (consistent with the requirements of the MMS guidelines) have been conducted on the Atlantic OCS and the requirements for future wind turbine foundations will likely require investigative depths that exceed those for the meteorological tower, we used two multichannel hydrophone arrays (streamers) to aid in defining optimal data acquisition parameters for the MDCF and future turbine foundations. The 16-channel, 3.125-meter group interval (mgi) streamer obtained data to a two-way travel time (TWT) of 0.5 seconds (~1,250 feet), and the 8-channel, 1.56-mgi streamer obtained mappable data to a TWT of 0.080 seconds (~200 feet). The 1.56-mgi streamer provided high-resolution, detailed data of the shallower interval while the 3.125-mgi provided deeper data, and defines the depth limit of this investigation (~0.5 seconds TWT).

A *Marine Survey Plan* (Fugro, 2009b) was prepared by Fugro on behalf of Bluewater for submittal to the MMS. The original *Shallow Hazards Assessment* report (Fugro 2010a) was the second of three Fugro submittals for the marine survey for Bluewater's proposed Delaware MDCF project. The first submittal was comprised of the electronic bottom charting and sub-bottom data with documentation of data acquisition and processing procedures for use by and inclusion in the *Archaeological Resources Assessment* report being prepared by R. Christopher Goodwin & Associates, Inc. under contract to Tetra Tech EC. The first submittal was transmitted to R. Christopher Goodwin & Associates on February 2, 2010. Fugro's third survey submittal transmitted the electronic survey data to Bluewater for submittal to the MMS, in accordance with MMS' *Guidelines*.

The original survey data collection and reporting were authorized by Bluewater Wind Delaware Energy LLC's acceptance of Fugro's proposal dated September 30, 2009 and the execution of the Master Service Agreement between Fugro and Bluewater.

SUPPLEMENTAL FALL 2010 SURVEY AND REVISED SHALLOW HAZARDS REPORT

In fall 2010, Fugro collected additional side scan sonar and magnetometer data across the 1.8-km by 1.8-km survey area. The purposes of the supplemental data collection were to:

- Collect new magnetometer data at the northwest and southeast limits of the survey area, where the original magnetometer data were collected with the instrument being flown too high from the seafloor;
- Add supplemental magnetometer data at 15-meter line spacing in the central portion of the survey area, where the original data disclosed several magnetometer anomalies;

- Obtain a second set of side scan sonar data using a different system than was used to collect the original data; and
- Obtain samples of the seafloor sediment.

Rather than merge the supplemental data with the original data, full sets of magnetometer and side scan sonar data were collected across the entire survey area.

The supplemental survey and reporting were authorized by NRG Energy, Inc's Purchase Order # K0923101, dated September 23, 2010. The survey was conducted in accordance with Fugro's proposal dated September 22, 2010.

PROJECT TEAM

Fugro was contracted by Bluewater to provide geophysical and shallow hazards interpretation, mapping, and report preparation services. The equipment choices and survey plan were prepared by: Mr. Tom McNeilan, Vice President; Mr. Jeff Carothers, Survey Manager; Mr. Kevin Smith, Senior Engineering Geologist; and Mr. Mike Barth, Senior Geophysical Systems Technician.

The principal personnel involved in the original 2009 offshore acquisition stage of the project were:

- Pat Nissen - Party Chief and Multibeam Echosounder (MBES) Engineer,
- Herb Tovar - Survey Technician,
- Mike Barth - Senior Geophysical Systems Technician, and
- Robbie Dame - Engineering Geologist.

Miller's Launch, under subcontract to Fugro, provided captains and crew for the M/V *Samantha Miller*. Two marine mammal observers (MMOs) were provided by Geo-Marine, under separate contract to Bluewater.

The supplemental data acquisition systems were evaluated by the Fugro staff and the new data were collected under the direction of Mr. Kevin Morris, Fugro Atlantic's survey supervisor, from the survey vessel R/V *Chinook*. Because no sub-bottom systems were used, MMOs were not required during the supplemental data collection.

The 2D seismic reflection data were processed by Legg Geophysical. The Fugro interpretation, mapping and reporting team included: Mr. James Fisher, Staff Engineering Geologist; Ms. Cindy Pratt, Senior Surveyor; Mr. John Reitman, subconsultant; Mr. Kevin Morris, survey supervisor; and Mr. Kevin Smith, Senior Engineering Geologist. Report graphics and charts were prepared by Mr. Dan Shaffer, Senior GIS Analyst; Mr. Fisher; and Mr. Smith. The report text was authored by Mr. Smith and reviewed by Mr. Tom McNeilan, Vice President.

REPORT FORMAT

This introductory section is followed by a section summarizing the field survey and data acquired. That section is followed by sections describing the regional geologic setting, the seafloor conditions, and the sub-seafloor conditions. Sections describing our conclusions and the implications of the findings conclude the main text. References, figures, and charts follow the main text. Appendix A provides and describes the survey operational overviews, instrumentation settings, vessel diagrams, geophysical job logs, and data processing procedures. Appendix B describes the geophysical mapping procedures used to produce the interpretational charts accompanying this report.

REFERENCED REPORTS FOR PROPOSED MDCF SITE

Fugro has provided three reports for Bluewater Wind's proposed Delaware MDCF that are directly relevant to the evaluation of scour. Those reports are:

- Fugro 2010a: *Shallow Hazards Assessment Report, Proposed Meteorological Data Collection Facility (MDCF), Salisbury NJ 18-05 Block 6325, Offshore Delaware*. Report Number 36714.004, dated February 5, 2010. This report is subsequently referred to as the Shallow Hazards Report.
- Fugro 2010b: *Geotechnical and Pile Design Report, Proposed Meteorological Data Collection Facility (MDCF), Salisbury NJ 18-05 Block 6325, Offshore Delaware.* Report Number 3671.006, dated February 28, 2010. This report is subsequently referred to as the Pile Design Report.
- Fugro 2010c: *Seafloor Scour Evaluation Report, Proposed Meteorological Data Collection Facility (MDCF), Salisbury NJ 18-05 Block 6325, Offshore Delaware.* Report Number 36714.004-r1, dated November 23, 2010. This report is subsequently referred to as the Scour Evaluation Report.

In addition to the Fugro reports, two prior survey and geotechnical exploration efforts also contributed to understanding the site and seafloor conditions. Those surveys and explorations (and their results) are documented in the following:

- Preliminary Geophysical Survey: Ocean Surveys, Inc. (OSI) (2006), *Reconnaissance Marine Geophysical Survey, Bluewater Wind Energy Project, Delaware Wind Park Development, Delaware Bay and Atlantic Ocean*, Final Report, prepared for Bluewater Wind, LLC, OSI Report #06ES081.
- Geotechnical Exploration:
  - o "Bluewater Wind Delaware Site - Final Boring Logs," e-mail transmittal from Halcrow/HPA to Bluewater Wind, November 2, 2009.
  - o *Technical Report on Physical Testing of Sediment from Delaware Wind Park*, prepared by Aqua Survey for Bluewater Wind LLC, November 2007, ASI Job No. 27-249.

- *Field Report, Presentation of CPTU Test Results for Bluewater Wind Project, Offshore from Bethany Beach, DE*, Prepared by ConeTec for Aqua Survey, October 2007, ConeTec Job No. 07-798.

FIELD SURVEY DATA AND DATA ASSESSMENT

SURVEY DESCRIPTIONS

The shallow hazards (also termed the geologic and geophysical [G&G]) survey included collection of bottom charting and sub-bottom imaging data over the 1.8-km by 1.8-km survey area (Figure 4 and Chart 1). All geophysical data were digitally recorded during field acquisition. Further description of the geophysical systems utilized during the G&G surveys and a summary of survey operations are provided in Appendix A.

The original survey was conducted using Fugro's equipment onboard Miller's Launch survey vessel the M/V *Samantha Miller* from October 11 through November 1, 2009. The supplemental data were collected during October and early November 2010 from the R/V *Chinook*.

Original, Fall 2009 Data Acquisition

The bottom charting systems included: MBES, side scan sonar, and magnetometer data acquisition. The sub-bottom imaging systems included: a Chirp sub-bottom profiler and 2D high-resolution, multichannel seismic reflection system. The seismic reflection data were collected using a mechanical, dual-plate "boomer" source and two multichannel, GeoEel, hydrophone arrays.

The sub-bottom profiler, side scan sonar, magnetometer, and MBES systems were run simultaneously along 61 primary lines (line numbers 101 through 161) oriented 051°/231° and spaced nominally 30 meters apart (Figure 4a and Chart 1a). These systems also were used along the 13 crosslines (line numbers 201 through 213) run at a nominal spacing of 150 meters, with an orientation of 141°/321°.

The 2D seismic reflection "boomer" data were collected along every third (i.e. line 101, 104, … , 158, and 161) primary lines oriented 051°/231°. The nominal spacing of those primary seismic reflection lines is 90 meters apart (Figure 5 and Chart 2). The 2D seismic reflection data were also collected on each of the 13 crosslines (line numbers 201 through 213) run at a nominal spacing of 150 meters, with an orientation of 141°/321°.

Supplemental Fall 2010 Data Acquisition

The supplemental, fall 2010 magnetometer and side scan sonar data were collected along: 61 primary lines (line numbers 501 through 561) oriented 051°/231° and spaced nominally 30 meters apart and three equally spaced crosslines (line numbers 601 through 603) with an orientation of 141°/321°, at the edges and through the center of the survey area (Figure

4b and Chart 1b). Additional data were collected in the center of the survey area where the original data identified several magnetometer anomalies; that additional data included: six approximately 0.4-km-long crosslines (numbered 701 though 706) at 30-meter spacing and two approximately 300-meter-long primary lines (numbered 801 and 802) at 15-meters spacing.

DATA SETS AND LIMITATIONS

Bottom Charting Data

The MBES survey provided high-quality, full-coverage bathymetry data of the survey area (Figures 6 through 8, and Chart 3). Line spacing was sufficient to provide overlapping side scan sonar coverage (Figures 9 and 10 and Chart 4). The multibeam hydrographic data, collected with a Reson SeaBat 8101, provide a high quality data set.

Side scan sonar data display good lateral resolution, are free of distortion and interference, and are judged to resolve seafloor features as small as 1.5 feet (0.5 meter). The original 2009 side scan sonar data, collected with an Edgetech 272-TD side scan sonar system, are considered to be of good quality. The 2010 data, collected with a Klein 3000 side scan sonar system are considered to be of superior quality.

The magnetometer survey data for both surveys were collected with a SeaSPY magnetometer. The data provided adequate coverage to identify small magnetometer anomalies and interpolate a relative magnetic field chart (Figures 11 and 12 and Chart 4). The 2009 magnetometer data are judged to be of acceptable quality but somewhat "noisy" due to the sea conditions. The 2010 data are considered to be of superior quality and provide detail for interpretations of: natural variations in magnetic field across the site magnetic field trends due to geology, and point-source magnetic anomalies.

Sub-Bottom Imaging Systems and Data

An EdgeTech X-Star Full Spectrum Sub-bottom Profiler (Chirp) system was employed to obtain shallow seismic reflection data in the sediment layers immediately beneath the seafloor. These shallow data provide information on the spatial distribution and thickness of surficial sediments. The EdgeTech X-Star system included a SB-216S towfish, a Model 3200 topside processor, and EdgeTech's Discover acquisition software. The system was triggered at a 6-hertz (-Hz) pulse rate with a swept frequency range between 2 kilohertz (kHz) to 15 kHz over 20 milliseconds (ms). The Chirp sub-bottom profiler typically achieved penetration of 30 to 40 feet below the seafloor and was capable of resolving layers approximately 1 foot thick.

The 2D, high-resolution seismic reflection survey was conducted using a dual-plate, boomer source and two multichannel, GeoEel, hydrophone arrays. The shorter hydrophone array was comprised of four elements per group, eight groups (channels), and a group interval of 1.56 meters. The 1.56-mgi streamer acquired good data to approximately 0.08 seconds (TWT) or ~200 feet below sea surface (BSS) and provided high-resolution data of the shallow geologic structure. The longer hydrophone array was comprised of five elements per group interval, sixteen groups, and a group interval of 3.125 meters. The 3.125-mgi streamer acquired good data for the full record length (TWT of 0.5 seconds) or ~1,250 feet BSS.

The processed data were loaded onto a workstation and interpreted by Fugro using Seismic Micro-Technology (SMT) interpretation software. The dominant frequency in the shallow section imaged by the 1.56-mgi streamer is approximately 143 Hz (Figure B-1a). The dominant frequency range in the section imaged the 3.125-mgi streamer is between 88 Hz and 215 Hz (Figure B-1b).

The dominant frequency can be used to calculate the characteristic "limit of separability" for the seismic data volume. The limit of separability, which is a function of vertical resolution, is defined as the minimum bed thickness for which the top and bottom of the bed can be fully resolved in the seismic data. This limit is based on the one-quarter acoustic wavelength approximation. Based on the dominant frequency, the limit of separability is about 8 feet for the 1.56-mgi streamer and 5 feet to 14 feet for the 3.125-mgi streamer, assuming an average velocity of approximately 5,000 feet per second (ft/s). Individual strata or other geologic features thinner than the limit of separability, which varies locally, may be detected but not resolved in true thickness or lateral extent. Small-scale topographic features and man-made obstructions such as pipelines, shipwrecks, and seafloor debris cannot be resolved in this data set.

Previous Seismic Reflection Survey OCS Block 6325

In 2006, Bluewater subcontracted work for a reconnaissance geophysical survey to support concept planning for a future wind farm. Ocean Surveys, Inc. conducted the survey in 2006 using an Applied Acoustics 300-joule boomer system (0.4-8 kHz) with a single-channel hydrophone. The survey tracklines were widely spaced and conducted along conceptual turbine layouts. Primary lines were oriented NW-SE and spaced nominally 0.4 Nm apart and crosslines were oriented NE-SW and spaced nominally 1.9 Nm apart. Survey tracklines, within the MDCF survey vicinity, are shown on Chart 2 and Figure 5. Fugro was provided with PDF files of the seismic records.

Survey tracklines 2 and 11 through 14 pass through the 2009 shallow hazards survey area. The seismic records provide data from the seafloor to the first seafloor water-bottom multiple (approximately 13 to 20 ms TWT [~30 to 50 feet] below the seafloor) within the shallow hazards survey area. Interpretation and mapping of seismic data within the shallow hazards survey area below the first seafloor multiple is difficult to impossible with the data from the 2006 survey. However, the data provide useful insight that assists with interpretation of the seismic data (above the first seafloor multiple) into the larger geologic context. Shallow hazards assessment using the seismic data was not conducted as part the preliminary study (OSI, 2006).

Previous Geotechnical Boring in OCS Block 6325

During October 14 through 17, 2007, a soil boring was advanced to a depth of 167 feet below mudline (BML) near the proposed MDCF location by Halcrow/HPA and subcontractors.

The work was performed under contract to Bluewater. The borehole was advanced using rotary wash techniques and included standard penetration test sampling at approximately 5-foot intervals. One Shelby Tube sample was attempted, but failed to recover sample. The reported location coordinates were N38˚ 41.2352' and W74˚ 46.1035', and the reported water depth was 31 feet (MLW). The details of navigation and measurement methods were not reported (by Halcrow/HPA), so the precision of the position and water depth measurement is unknown. The location of boring is shown on relevant figures and charts in this report. Halcrow/HPA provided the final boring log in November 2009 and it is reproduced in this report as Figure 13.

The boring log provides a description of the soil stratigraphy of the sediments from the seafloor to 167 feet below mudline (BML). The soil types encountered in the boring are reported to include alternating layers of unconsolidated sand and fine-grained sediments of varying thickness and composition.

Two relatively thick fine-grained units (an upper 20-foot-thick silty clay with abundant organics at 33.5 feet and a lower 30-foot-thick silty clay at 108.5 feet) were encountered. The upper fine-grained unit contained organics, and "strong organic odors" are noted on the log. One sample in the lower fine-grained unit was reported to contain "trace organic debris." Decaying organics of those two fine-grained units may be potential sources for biogenic gas.

Figure 21 through 25 provide comparisons of the boring log stratigraphy and seismic data. Graphical depiction of the soils encountered in the boring are also superimposed on the seismic records shown on Figures 21 through 25. In general, the seismic and geotechnical data are judged to correlate fairly well.

METHODS OF ANALYSIS

As noted, all of the navigation and geophysical data were digitally recorded. The multibeam data were velocity-corrected with velocimeter information collected at the project site. Observed tides for the Lewes, Delaware National Oceanic and Atmospheric Agency (NOAA) tidal station 8557380 were used to reduce observed bathymetric values to MLLW tide level. The tide-corrected data were contoured within ArcGIS for final presentation.

Both the side scan sonar and magnetic data were imported into Chesapeake Technology's SonarWiz software on a line-by-line basis. The magnetic anomalies and side scan sonar targets identified in the 2009 and 2010 data sets were cross-checked between surveys, and the side scan sonar targets and magnetic anomalies were cross-checked against each other. For each set of magnetic data, we used least squares regression analysis on each line to remove variations in the magnetic field (e.g. diurnal effects) and a relative magnetic difference from the best fit line calculated along each trackline. The resulting relative magnetic fields were contoured using ArcGIS version 9.3 3D Analyst software.

The bottom charting, sub-bottom profiler, and high-resolution geophysical data collected from the remote sensing systems were reviewed for geologic interpretation, evidence of man-made obstructions and the possible presence of geohazards. The results of our interpretations are discussed and presented herein.

CHART PRESENTATIONS

The study area charts and figures display a plan view of the survey area and include:

- Bottom Charting and Seismic Reflection Navigation Post-Plots (Charts 1 and 2, Figures 4 and 5),
- Bathymetry (Chart 3 and Figure 6),
- Side Scan Sonar Mosaic (Chart 4 and Figure 9),
- Magnetic Anomalies (Chart 5 and Figures 11 and 12),
- Units 1 and 2 Isopach Charts (Charts 6 and 7, Figures 26 and 27),
- Events 10 and 20 Structure Contour Charts (Charts 8 and 9, Figures 28 and 29), and
- Site Features that includes surface and sub-surface hazards (Chart 10 and Figure 30).

Where two sets of data have been collected (i.e. the original fall 2009 and supplemental fall 2010 data), the Figure or Chart for the original fall 2009 data is numbered Figure Xa. The Figure or Chart number for the supplemental fall 2010 data is numbered Figure Xb.

The charts and figures are presented at scales of 1:6,000 (1 inch = 500 feet) and 1:12,000 (1 inch = 1,000 feet), respectively. The charts and figures present coordinate grids for UTM Zone 18N, WGS84, meters, and Latitude/Longitude WGS84. Navigation station markers are displayed every 100 meters.

REGIONAL SETTING

PHYSIOGRAPHY

The study area is located in the Delaware Shelf Valley of the Mid-Atlantic Bight (Figure 13). The Delaware Shelf Valley is part of the continental shelf, which is the submerged extension of the Coastal Plain Province. The continental shelf has a very gentle, regional slope of about 0.1 degree and extends from the southern New Jersey/Delaware coastline eastward for about 75 Nm. The edge of the continental shelf is demarcated by the shelf break at about the 650-foot (200-meter) isobath. Seaward of that isobath, the slope of the seafloor steepens to about 3 to 6 degrees down the continental slope.

Predominant features on or buried beneath the continental shelf include paleoshorelines, shoals, filled channels, and shoal retreat massifs. The presence or absence of these features defines the seafloor and subsurface conditions and their variability at any specific location.

GEOLOGIC FRAMEWORK

Continental Shelf

The project area lies near the western rim, or the hinge-line, of the Baltimore Canyon Trough -- a northeast-southwest-trending rift basin structure (Figure 14) that formed as a result of extensional tectonics during the Jurassic and Triassic periods (Grow et al, 1988). Following the basin formation, from Late Cretaceous through the Cenozoic, sedimentation and erosion as sea level fluctuated controlled much of the geologic development (Figures 15 and 16). As an undertone during this time, minor structural deformation is attributed to: 1) sediment loading and thermal subsidence eastward of the hinge-line (from zero westward of the hinge-line up to 0.015 mm/yr east of the hinge-line [Greenlee et al., 1988]), 2) differential crustal movement from isostatic adjustment to the north of the "glacial-isostatic hinge zone" (Figure 14) following retreat of the Late Wisconsin ice sheet (Dillon and Oldale, 1978), and 3) local uplift from movement of salt intrusions near the seaward edge of the shelf (Carey et al., 1998). This region is currently considered to be a tectonically quiet, passive margin.

The geologic units underlying the site are comprised of Cenozoic-age sediments. The sediments consist of sand, gravel, silt, and clay. Although Quaternary glaciers did not advance across the site, the subsurface conditions were significantly influenced by the glacial-interglacial cycles (Figures 15 and 16). Sea-level fluctuations that occurred as a result of the glacial-interglacial cycles caused the shoreline to regress and transgress across the shelf several times throughout geologic time. Those geologic processes during the Quaternary (Figures 15 and 16) are primarily responsible for shaping the geology and subsurface conditions that will influence the siting, type selection, engineering design, installation, and performance of the MDCF foundation.

During periods of inundation, marine sediments were deposited on the shelf. During sea level low-stands, paleodrainages developed on the shelf, deltas formed at river mouths, and estuary-lagoon-barrier complexes formed behind inlets. During the Last Glacial Maximum (Wisconsin glacial period, approximately 25 to 15.7 thousand years ago [kya]), the sea level was approximately at the 120-meter isobath. During this time, drainages formed across and carved channels into what is now the shelf (Figure 16 inset B).

As the sea level rose and the shoreline transgressed and retreated westward (Figure 16 - inset C), the channels were flooded, transitioned into estuaries, and then were infilled with sediments. The channels typically are infilled with a fining-upward sequence. That sequence often included coarse basal lag deposits overlain by sands and then silts or clays. The infill sediments may be dissimilar to the sediments outside the incised channel or they may be composed of similar, but younger, materials.

Additionally, an estuary-lagoon-barrier depositional system transitioned west along the shelf as sea level rose. Estuary and lagoon deposits are generally fine-grained, may contain organics, and can be channelized to varying degrees. Barrier deposits (islands, spits, or bars) are generally sandy sediments. After the shoreline transgressed to near its current position, the shelf was inundated and marine sediments deposited over the shelf. These marine deposits have buried and masked the underlying geology.

The combined effects of these processes often result in a subsurface stratigraphy that is composed of sequences of layered deposits. In some locations, individual layers may be many tens of feet thick and extend over significant distances. Elsewhere, the layers may be much thinner and laterally discontinuous.

Ancestral Delaware River Drainage

The ancestral Delaware River drainage system is buried beneath the seafloor of the Delaware Shelf Valley (Figures 17 and 18). During sea level lowstands, this major ancestral river system is inferred to have flowed across the continental shelf and emptied at the head of canyons that are still present along the shelf break.

The post-Wisconsin (approximately 10,000 kya) drainage course was interpreted by Twichell et al. (1977) to have flowed from the existing mouth of the Delaware Bay, across the shelf, and emptied into Wilmington Canyon. Twichell et al. (1977) interpret the main trunk of the ancestral paleodrainage to be about 2 to 3 Nm to the southeast of the proposed MDCF location. The thalweg of the Holocene Delaware River paleodrainage is inferred to be as deep as 190 feet below present day sea level (Kraft, 1971). The Holocene channel infill materials are inferred to be fine-grained, lagoonal-estuarine deposits with appreciable organics (Sheridan et al., 1974).

The buried system of drainages that fed into the ancestral Delaware River drainage is not well documented in the vicinity of the MDCF. The 2006 reconnaissance seismic survey conducted in 2006 (OSI, 2006) suggests the presence of buried paleochannels to the north, south, and west of the proposed MDCF. Figure 19 shows the 2006 seismic record from trackline 12 that passes through the shallow hazards survey area. A large paleochannel, which likely connects to the main ancestral Delaware drainage, is present approximately 5,800 feet northwest of the proposed MDCF location (between navigation fix points 830 and 850). The current shallow hazards survey confirms that the proposed MDCF location is not underlain by a large, deeply incised paleochannel.

The ancestral Delaware River channel and its tributaries can be infilled with thick deposits of soft, fine-grained sediment that may not provide adequate end-bearing strata for the MDCF pile foundations. Those sediments or associated lagoonal-estuarine deposits can include decaying organics that may be the source shallow gas accumulations.

Regional Seafloor Geomorphology

The inner and mid continental shelf areas off the Mid-Atlantic coastline are comprised of ridges and swales that have a northeasterly trend (Figures 2 and 3). The sand ridges typically exhibit relief of 15 to 25 feet, are between 0.5 and 1.5 Nm wide, and may extend for a distance of 5 to 15 Nm. The ridges are postulated to be shoreface deposits abandoned as the shoreline transgressed during the last rise in sea level (Swift et al., 1973). As discussed by Snedden et al

(1999), ridge shape and morphology are inferred to be a function of the hydrodynamic environment with ridges evolving over time until dynamic equilibrium is reached with the hydrodynamic environment.

Smaller-scale bedforms are commonly superimposed on the larger ridges and swales. Dunes, sand waves, and sand ripples of varying size are common throughout the area and form in response to flow conditions. It is not uncommon to observe bedforms in an area that form in response to two or more flow conditions (e.g. downwelling currents from the north during nor'easters and currents from the south in response to tropical storms).

GEOLOGIC STRUCTURES AND PROCESSES

Faulting

Potentially Active Faults. Based on our review of publicly available information and data acquired as part of this study, no known active faults (defined as ruptured during the Holocene or last 10,000 years) or potentially active faults (defined as ruptured during the Quaternary or last 1.6 million years) were identified within or trend toward the study area. Thus, no known faults are considered to pose a fault rupture hazard to the project.

Basement Faults. The three closest, post-basement forming (post-Jurassic) fault zones are described below.

The New York Bight fault is a 27-Nm-long fault that forms the western margin of the New York Bight Basin (Figure 14). The fault trends north-south from approximately 8 Nm south of Long Island's southern shoreline to a location approximately 16 Nm east of Asbury Park, New Jersey. The southern mapped extent of this fault is approximately 105 Nm north of the proposed MDCF. The New York Bight fault has accommodated the largest post-Cretaceous and younger displacement of the base of the Coastal Plain along the East Coast (Hutchinson and Grow, 1985). The displacement is inferred to have occurred during the Late Cretaceous (95 million years before present [mybp]) and middle Oligocene (30 mybp). Hutchinson and Grow (1985) indicate that evidence for Quaternary activity is ambiguous.

The Ramapo fault in the Newark Basin is located in northern New Jersey near the New York-New Jersey border (Figure 14). This fault is approximately 95 Nm northwest of the proposed MDCF. The Ramapo fault formed during the Mesozoic but is possibly reactivated and associated with the cluster of recorded microseismicity in northern New Jersey (Ratcliffe and Burton, 1985).

Several listric growth faults have been indentified beneath the shelf break approximately 45 Nm east of the proposed MDCF (Klitgord et al., 1988). Klitgord et al. (1988) indicate that the faults offset geologic units as young as Tertiary age.

Seismicity

Earthquakes may pose hazards to meteorological towers by: 1) causing ground shaking that may affect the structure, especially if the site resonance matches the structural resonances;

2) causing liquefaction that will decrease lateral resistance and the skin friction of the soils around the foundation; 3) generating a tsunami; and/or 4) inducing submarine landslides. Although earthquake magnitudes that the known faults are capable of generating are limited, ground motions from earthquakes in the eastern U.S. are capable of travelling larger distances than in the western U.S. due to differences in the attenuation properties of the crust.

Based on our review of historical seismicity, the known earthquakes that occurred within 100 Nm of the proposed MDCF location were less than a magnitude 5. The locations of the instrument-recorded microseismicity are primarily onshore. The three nearest clusters of microseismicity are located in southeastern Pennsylvania (approximately 90 Nm from the site), northern New Jersey (associated with the Ramapo fault, Figure 14; approximately 95 Nm from the site) and the Central Virginia Seismic Zone (approximately 120 Nm from the site). Microseismicity can be used to illuminate the location of an active fault (e.g. the New Madrid Seismic Zone in the central U.S.) or indicate the reactivation of a dormant fault (e.g. Ramapo fault). The absence of recorded microseismicity offshore Delaware suggests that no active faults are present within the study area or (more likely) that the land-based seismic recording network cannot record or accurately locate micro-earthquakes that have occurred offshore.

Shallow Gas

During our literature review (Fugro, 2009a), we found that certain geologic conditions may be present beneath the site that are favorable for producing shallow biogenic gas. Geologic sediments with abundant organic deposits (e.g. peat) have been mapped in the regional subsurface (e.g. Sheridan, et al., 1974).

The decaying organics may produce appreciable gas concentrations in the shallow subsurface. The ancestral Delaware River incised large channels (150+ feet deep) that are inferred to be infilled with fine-grained, organic-rich sediments (Sheridan et al., 1974). Additionally, thick sequences of organic-rich, lagoonal-estuarine deposits of Quaternary age have been mapped in the regional subsurface. Seismic surveys within Delaware Bay have observed shallow gas in Quaternary-aged sediments.

The 2006 boring B-102 noted organic-rich sediments and samples that had a "strong organic odor," which suggests that biogenic gas may be present. In addition, we observed features in the 2006 and 2009 seismic data that suggest shallow gas is likely present in the subsurface. We have incorporated that information in our shallow gas hazard evaluation.

Slope Failures

Submarine mass movement features are not common in this part of the Mid-Atlantic continental shelf. Among other factors, the lack of slope instability features is likely attributed to the lack of seismic activity, canyons, valleys, submarine fans or deltas with high sedimentation rates. The nearest documented large-scale submarine slope failures (Chaytor et al., 2007) are located near the shelf break and slope, approximately 45 Nm east of the proposed MDCF.

Active Sediment Transport Processes

On the continental shelf, sediments can be transported by tidal currents, density-driven circulation currents, wind-driven circulation, and/or wave-driven currents. Sediment transport processes may result in net erosion or deposition. Erosion processes may be problematic for structures if scour occurs at the base of the structure, where removal of material can reduce skin friction resistance (and transfer axial pile loads farther down the pile shaft), reduce lateral resistance, or modify the resonance of the structure.

Scour produced by sediment transport is considered to be a primary geologic hazard for structures in the study area. Storm-driven bottom currents are anticipated to be the primary sediment transport mechanism for this part of the continental shelf. Circulation currents are likely also capable of transporting sediments. An evaluation of the sediment mobility and potential for scour at the MDCF is provided in Fugro (2010c).

SEAFLOOR CONDITIONS

The survey area water depths are shown on Chart 3 and Figure 5 at scales of 1:6,000 and 1:12,000, respectively. Water depth contours in Chart 3 and Figure 5 are presented at 1-foot intervals within the multibeam survey area and at 5-foot intervals outside the surveyed area. Figure 6 presents a three-dimensional (3D) rendering of the seafloor within the survey area. Water depth data and discussion of seafloor conditions within the survey area are based on Fugro's 2009 multibeam survey data.

We augmented the 2009 multibeam survey data with regional data from: 1) the New Jersey Department of Environmental Protection (NJDEP), which extends south into the proposed MDCF area, and 2) NOAA. The regional bathymetric data shown in Figure 3 represent a compilation of surveys conducted during the last several decades. The sounding data point spacing is variable and may be tens to hundreds of feet. The regional datasets are provided as 100-foot and 25-foot binned data. The regional bathymetry data are present at 5-foot contour intervals on all charts and figures except Figure 3 where it is presented at a 10-foot contour interval.

WATER DEPTH AND SEAFLOOR GRADIENT AT PROPOSED MDCF SITE

The survey area covers a portion of a large ridge, which is outlined by the 50-foot water depth contour on Figure 3. The ridge is elongated and its axis has a bearing of approximately 45 degrees northeast. Within the surveyed area, the water depth at the crest of the ridge is between 32 and 37 feet (re: MLLW datum). The northwest flank of the ridge deepens to the northwest from 37 to about 50 feet in the survey area. The southeast flank of the ridge deepens from 37 feet to about 50 feet within the surveyed area. The water depth at the proposed MDCF location is 32.4 feet (re: MLLW) and varies by up to 5 feet within a 1,000-foot radius of the proposed MDCF location (Figure 6). A 3D view of the bathymetric surface is shown on Figure 7.

Figure 8 presents the seafloor slope gradient calculated from the multibeam, echosounder data. Characterization of the seafloor gradient within the survey area is divided herein into three areas: the central area (area enclosed by the El. -37-foot contour), the northern flank (seafloor area below El. -37 feet sloping to the northwest), and the southern flank (seafloor area below El. -37 feet sloping to the southeast).

The central area forms the axis of the ridge and is generally flat with a smaller, elongated ridge in the area above El. -36 feet oriented parallel to the larger ridge. The proposed MDCF is located on top of this smaller ridge. The seafloor gradient at the proposed MDCF location is approximately 0.45 degrees (0.8 percent). Above El. -35 feet, the seafloor gradient is typically between 0.3 and 0.4 degrees (0.5 and 0.6 percent). Elsewhere within the central area, the seafloor is generally flat with a gradient between <0.05 and 0.4 degrees (<0.08 and 0.6 percent).

The northern flank of the ridge is generally flatter than the southern flank. The seafloor slope gradient of the northern flank is typically between 0.3 and 0.4 degrees (0.5 and 0.6 percent) and slopes to the northwest.

The seafloor slope gradient of the southern flank is typically between 0.3 and 0.8 degrees (0.5 and 1.4 percent). The seafloor gradients along the northern faces of the broad sand waves, near the southeastern boundary of the survey area, are about 1.4 degrees (2.5 percent).

SEAFLOOR FEATURES AND MORPHOLOGY

The bathymetry in the study area is comprised of three scales of bedforms (Figure 8a). Each type of bedform is inferred to reflect bottom current flows of different duration, intensity, and direction. The largest and most prominent bedform is the sand ridge, on which the proposed MDCF is located. Two other types of bed waves or sand waves were also observed on the site. The larger-scale bed waves are dunes along the southeastern flank of the sand ridge. The smaller-scale bed waves are ripples that are present throughout most of the survey area and are superimposed on the sand ridge and dunes.

The ridge and other bedforms likely have been influenced and modified by storms and tidal currents associated with the Delaware Bay. The modern tidal channel is located approximately 2 Nm southwest of the survey area and extends more than 15 Nm seaward of the bay mouth. The water depth in the modern tidal channel to the southwest of the proposed MDCF is up to 100 feet deep.

We did not observe evidence of pockmarks, fluid expulsion features, slope failures, chemosynthetic communities, or gravel and rock outcrops.

Sand Ridge

The dominant seafloor feature in the survey area is the large, elongated ridge that crosses the center of the survey area. The proposed MDCF location is centered on this ridge.

Previous scientific studies have suggested that these ridges form due to eustatic processes; i.e., shoreface deposits abandoned as the shoreline transgressed during the last rise in sea level (Swift et al., 1973; Snedden et al., 1999). The ridges are believed to further evolve under the influence of the modern hydrodynamic flow regime (Snedden et al., 1999).

Dunes

Superimposed on the ridge are smaller-scale bedforms. Large, low-amplitude dunes (note arrows on Figure 7 and Figure 20a) are located on the seaward flank (southern portion) of the sand ridge and splay from its crest. The dunes are asymmetrical in shape and oriented more-or-less perpendicular to the axis of the ridge. The large, broad sand waves (e.g. dunes) are up to 4 feet high and their crests are about 900 feet apart. The northeastern flanks of these dunes are significantly steeper than their southwestern flank, which implies a northeasterly migration in response to currents from the south.

Ripples

Ripples, the smallest bedforms, are visible in the increased sonar reflectivity areas of both the shoal ridge and the smaller dunes (Figure 20b). Throughout most of the northwestern third of the study area, the ripples are linear and parallel, with their long axes oriented approximately north-south. The extent of those 2D ripples is shown on Figure 20a. The ripples on the low-amplitude dunes appear to be much more laterally discontinuous (similar to 3D ripples) in the side scan sonar data.

These features typically have a wavelength of up to about 3 feet and amplitude of about 0.5 feet. Some of the features are too small to measure using sonar or multibeam data. These features are modified by bottom currents as was documented in the side scan sonar images captured the day before and the day after a strong wind event on October 31, 2009 (Figure 21). It is apparent when comparing the pre-storm and post-storm images that this event generated bottom currents that diminished or planed off the ripples.

SEAFLOOR SEDIMENTS

Concurrent with the supplemental geophysical data collection, Fugro also collected nine, approximately 1/2-gallon grab samples of the seafloor sediments. The nine sample locations and the mean grain size d_{50} for each sample are shown on Figure 20c.

In general, the seafloor sediments in the survey area are comprised of poorly-graded fine to medium sand and fine sand. Figure 20c presents the interpreted sediment type distribution based on side scan sonar and grain size data. The side scan sonar data show higher-amplitude backscatter on the northwest flank than on the southeast flank of the sand ridge. This implies (and is supported by the grain size analyses of the grab samples) that the sediments are coarser grained on the northwest flank than the southeast flank. The sediments appear to grade from predominantly medium sand on the northwest flank to medium and fine sand on the ridge crest and to fine sand on the southeast flank. Backscatter intensity in the side scan data suggests that this transition is gradational and that the transitions appear to roughly parallel the bathymetric contours.

MAN-MADE FEATURES AND POSSIBLE ARTIFACTS

General Comments

Fugro conducted a review of: 1) publicly available data (e.g. NOAA Charts 12200 and 12214 [NOAA, 2007a and 2007b], 2) various charts of shipwrecks [CSS, 2006a and 2006b], New Jersey Scuba, 2007) and 3) Fugro's proprietary database for man-made structures in the project vicinity (Fugro, 2009a). Figures 2 and 3 show the locations of known obstructions, including reefs and shipwrecks in the region.

The nearest known structure is Delaware Reef 11 that is located approximately 1.3 Nm southeast of the proposed MDCF location (Figure 3). An unknown obstruction charted on NOAA Chart 12214 is located approximately 800 feet northwest of the proposed MDCF location (Figures 3, 8, 10, and 11; Charts 4 and 5). That obstruction location does not coincide with any identified side scan sonar targets or magnetometer anomalies in either survey. The nearest anomaly or target in either survey was a side scan sonar target about 530 feet to the northeast of the NOAA location identified in the fall 2009 survey data.

The study area falls within an area considered to potentially have cultural resources (e.g. shipwrecks, ancient civilization artifacts), and the MMS requires an archaeological resource survey and report to be completed. To satisfy these requirements, Fugro conducted the survey and provided the data (Fugro, 2010a) to R. Christopher Goodwin & Associates, Inc., under subcontract to Tetra Tech EC, for the archaeological resource assessment. R. Christopher Goodwin & Associates has prepared a standalone Archaeological Resources Assessment Report.

Side Scan Sonar and Magnetometer Data Tables and Data Presentations

The side scan sonar targets and their characteristics from the two surveys are tabulated in Tables 2a and 2b at the conclusion of the text of this report. The maps of the side scan sonar target locations are shown on the side scan sonar mosaic provided on Figure 9 and Chart 4. As noted previously Figure 9a and Chart 4a provide the 2009 side scan sonar mosaic, while Figures 9b and Chart 4b provide the 2010 side scan sonar mosaic. Figure 10 provides detailed views of the contacts identified in both survey data.

The magnetometer anomalies and their characteristics from the two surveys are tabulated in Tables 3a and 3b at the conclusion of the text of this report. Maps of the locations of the anomalies are provided on Figure 11 and Chart 5. As noted previously, Figure 11a and Chart 5a provide the 2009 data, while Figures 11b and Chart 4b provide the 2010 data.

Central Area Anomaly

The artifact of greatest significance to the siting of the proposed MDCF is a large magnetic anomaly, or cluster of anomalies, located to the southeast of the proposed MDCF location. The presence of the anomaly or the cluster of anomalies was observed in the magnetometer data from multiple survey lines during both the fall 2009 and fall 2010 surveys. The magnetometer anomalies, as imaged on the various 2009 and 2010 survey lines, in the central portion of the survey area are shown on Figure 12.

We note that the anomaly or cluster of anomalies is in the vicinity of where the 3-legged, 65-foot, lift boat R/V Russell W. Peterson floundered during a storm in March 2008. Information relative to possible debris left behind from that accident is unknown to Fugro. The anomaly (or cluster of anomalies) also is to the southeast of the reported location where boring B-102 was advanced and a cone penetration test (CPT) sounding was attempted in 2007. Bluewater's communication with the contractors who conducted the work in 2007 did not establish the record of loss of drill string, casing, or other metal objects. The accuracy and precision of the reported boring and CPT sounding locations are unknown to Fugro.

The largest measured magnetic intensities in the 2010 survey were 832 gammas (M-23) on trackline 802 and 340 gammas (M-7) on trackline 529. Anomaly M-23 had the character of a monopole anomaly, while anomaly M-7 had the character of a dipole anomaly. The mapped location of anomaly M-23 is interpreted to be very close to the center of the magnetic mass that produced the various anomalies on the different survey tracklines.

During the fall 2009 survey, anomaly M-11 on trackline 207 had the greatest measured intensity (613 gammas). This anomaly exhibited a clean ricker signature (Figure A-5). Anomaly M-11 was identified during the first run of line 207 which was rerun due to noise along the line. In spite of the noisy data from the initial run of line 207, anomaly M-11 was very clean, well-defined, and large. Because of this, we include the anomaly as a target, but do not use the rest of the magnetometer data along the initial run of line 207 (which explains why we present the trackline of the reshoot instead of the initial pass)

Analyses of the 2010 magnetic signatures suggest a probable location of the anomaly (or center of the cluster of anomalies) to be about 85 feet to the southeast of the proposed MDCF location, while the 2009 data suggest the center of the anomaly to be farther to the southeast. We consider the 2010 location to be more probable, as those data are of superior quality and at closer spacing. No seafloor expression of this magnetic anomaly was observed in either the fall 2009 or fall 2010 side scan sonar data.

Other Anomalies and Targets

The two geophysical surveys also documented the presence of various other side scan sonar targets and point-source magnetic anomalies.

The numbers, typical sizes, and maximum size of the side scan sonar targets are as follows:

- Fall 2009 Survey - 7 targets:
  - Typical size: less than 6 feet,
  - Typical height above seafloor: less than 0.5 to 1 foot,
  - Maximum size: one narrow target about 20 feet long, and
  - Maximum height above seafloor: 6 feet (3-foot-long target with minimal width)

- Fall 2010 Survey - 3 targets:
  - Size: less than 10 feet ,and
  - Height above seafloor: less than about 0.5 foot

The numbers of point-source magnetic anomalies with more than 10 gamma intensities are as follows:

- Fall 2009 Survey - Three dipole anomalies with 10 to 20 gamma intensity
- Fall 2010 Survey - One dipole and two monopole anomalies with 40 to 50 gamma intensity

None of the targets or anomalies correlates to features in our database of known man-made structures. None of the anomalies correlated with side scan sonar targets on either survey. In addition, none of the small anomalies and side scan sonar targets was identified in both surveys. None of the targets' origins was discernable. This is inferred to suggest that the dynamic seafloor conditions periodically bury, expose, and/or move the small artifacts that may have been imaged in either the magnetometer or side scan sonar data.

In addition to the point-source magnetic anomalies, the 2010 data identify several geologic trends due to sediment composition. The most significant of those trends is the northwest-southeast trend of higher magnetic intensity along the southwest boundary of the survey area. The southwest linear trend has a relative intensity of between about 3 and 6 gammas and as shown on the Figure 11b and Chart 5b is interpreted to be of geologic origin. In addition to this geological trend, several trends with a magnetic intensity of about 1 to 2 gammas appear to correlate with the crests of the dunes present on the seaward flank of the ridge.

SUBSURFACE CONDITIONS

STRATIGRAPHY AND STRUCTURE

The seismic reflection and Chirp data have been used to interpret seismic reflectors (or events) that separate different units of sediment. The mapped events (Events 5, 10, 15, 20, 25, 30, 40, 43, 45, 50, and 60) divide the shallow section into nine stratigraphic units (Units 1 through 9) with distinct seismic character and inferred sediment (or lithologic) characteristics. Higher numbers indicate deeper, older events and units. The inferred lithology that correlates to the seismic character of each unit is based primarily on the information obtained from boring B-102, located at the center of the survey area and conducted by Halcrow/HPA and subcontractors as part of the proposed MDCF geotechnical program (Halcrow/HPA, 2009).

Correlations Between Seismic Units and Boring Stratigraphy

Boring B-102 was drilled in 2007 near the crossing of seismic reflection lines 131 and 207. The stratigraphy encountered in the boring is superimposed on seismic reflection lines 131 and 207 on Figures 22 and 23, respectively. The wiggle variable, area-filled presentation of the seismic reflection data (such as shown on Figures 22 and 23) shows both positive- and negative-amplitude reflections. Figures 24, 25, and 26 also present the subsurface conditions as interpreted from seismic reflection data.

Seismic impedance is the product of a layer's density times the compression wave velocity (Vp). When using American polarity (e.g. seismic data collected by Fugro in this study), a positive impedance contrast (lower impedance layer overlying a higher impedance layer) produces a positive-amplitude reflection (blue reflectors in Figures 22 and 23). Conversely, a negative impedance contrast (higher impedance layer overlying a lower impedance layer) produces a negative-amplitude reflection (red reflectors in Figures 22 and 23). Thus, negative- or positive-amplitude reflections provide information indicating whether a stratigraphic boundary is a hard or dense layer overlying a softer layer (negative impedance contrast) or vice versa. The amplitude of the reflection is proportional to the magnitude of the impedance contrast. The greater the difference between the seismic impedance of the two layers, the larger is the reflection coefficient and amplitude of the reflection at the interface between the layers.

Table 1 correlates the seismic units and corresponding strata encountered in boring B-102. A seismic unit may include more than one soil stratum for several reasons. One reason is that lithologic transitions may not correlate to seismic events. For example, transitions between Unified Soil Classification System (USCS) lithologies may not always result in impedance contrasts strong enough to produce mappable seismic reflections. Additionally, the thickness of a thin stratum defined in the boring may be less than the limit of separability for the seismic data (refer to previous discussion) or the variability of the stratum's thickness may be less than the limit of separability in portions of the site and therefore preclude mapping the seismic events that correspond to the top and bottom of the stratum. The mapped events and the units that these events separate are noted on the annotated data examples accompanying this report.

The seismic reflection data and subsurface boring at the center of the survey area are judged to correlate moderately well. Some of the thinner soil layers identified in the boring are thinner than the limit of separability in the seismic data. Thus, the top and bottom of those layers are unresolved by the seismic reflection data.

The correlation between seismic units and soil lithology/strata are summarized in the following table:

Table 1. Subsurface Stratigraphy Identified in Boring at Proposed MDCF Location

Seismic Unit	Penetration at Boring B-102 (ft)		Lithologic Description from Boring B-102
	From	To	
1a	0	10	No Recovery (running sands)
1b	10	33.5	Sand (increase in penetration resistance)
2	33.5	80	Soft silty Clay with occasional sand lenses and abundant organics
3	80	138	Interbedded silty Sand to Sand with silt overlying silty Clay with sand lenses
4	138	167*	Sand with silt to Sand with gravel

* Bottom of drill hole is 167 feet below mudline.

Unit 1 (Seafloor to Event 10)

Unit 1 comprises the surficial unit throughout the survey area and is bound between the Seafloor and Event 10. The unit is inferred to be Holocene-aged sediments. Unit 1 may be subdivided into two units. Unit 1a, the upper unit extends from the seafloor to Event 5. Unit 1a is inferred to be loose, potentially mobile sand and corresponds to the zone of "no recovery" in boring B-102. Gently dipping, parallel to subparallel internal reflectors that are near parallel to the seafloor of the large shoal's southern flank are observed in the Chirp data. Event 5, a moderately strong positive-amplitude event is a relatively flat-lying reflector that is inferred to represent the base of the loose sediments. The Event 5 positive reflector correlates to a significant increase in sediment density inferred from an increase in standard penetration test blow counts (standard penetration blows or N-values are the number of blows it takes to drive a 1-3/8" inner-diameter, split spoon sampler 12 inches using a 140-lb hammer dropped from a height of 30 inches). The higher blow counts and positive-amplitude reflection of Event 5 imply that Unit 1b is denser and has a higher impedance than the overlying Unit 1a.

Unit 1 ranges in thickness from 18 to 36 feet (Figure 27 and Chart 6). This unit is thickest beneath axis of the shoal and thins to the north and south. At the proposed MDCF location it is about 37 feet thick. Elevation of the base of this unit ranges from El. -63 to -72 feet (MLLW). At the proposed MDCF location it is at about El. -64 feet.

Unit 2 (Event 10 to Event 20)

Seismic Unit 2 is defined by Events 10 and 20. Unit 2 is comprised of soft silt and clay with high organic content, and is inferred to be Holocene transgressive, estuarine-lagoonal deposits. This unit is considered to be equivalent to the sediments that infilled the large ancestral Delaware River Holocene Channel (Figures 17 and 19). Negative-amplitude anomalies were identified in this unit (Figure 26). The anomalies are likely free-phase gas accumulating from decaying organics. Locations of those anomalies are shown Chart 10 and Figure 31.

Unit 2 is mapped using an upper negative-amplitude reflector (Event 10) that correlates to the sand over clay interface. The bottom of Unit 2 is defined by the positive-amplitude reflector (Event 20) correlating to the clay over sand boundary. Sand layers noted in boring log B-102 are inferred to be laterally discontinuous based on the seismic data. Bright stringers inferred to be sand interbeds are observed in the seismic data. A small, shallow, nested channel was identified near the proposed MDCF location (Figure 23). Channeling in this unit within the survey area is considerably smaller and subtle compared to channeling observed in larger paleochannels of the regional seismic lines from the 2007 survey (e.g. Figure 19a).

The unit ranges in mapped thickness from 38 to 57 feet (Chart 7 and Figure 28). The unit thickens and deepens to the southeast and southwest (possibly due to a regional, buried drainage trend; see Figure 18). Chart 9 and Figure 30 show that the mapped surface elevation of the base of Unit 2 is between El. -103 and -126 feet (MLLW). The base of the unit dips gently to the southeast and northwest. Beneath the proposed MDCF location, Unit 2 is approximately 35 feet thick and the base of the unit is at approximate El. -104 feet (MLLW).

Unit 3 (Event 20 to Event 25)

Seismic Unit 3 is defined by Events 20 and 25. This unit is comprised of interbedded sand deposits that transition downward to clay. Reflectors within this unit are discontinuous and demonstrate the interbedded nature of Unit 3. It is inferred that these layers represent fluvial-estuarine sand and clay layers. This unit is likely comprised of late Pleistocene-aged sediments. Unit 3 is approximately 47 feet thick.

Unit 4 (Event 25 to Event 30)

Seismic Unit 4 is defined by Events 25 and 30. Based on the boring log data, the top of this unit is composed of sand with gravel layers. The bottom of the unit does not have any direct data to help define unit lithology or changes in the lithology. It is inferred that Unit 4 is comprised primarily of sand with the base having strong positive-over-negative amplitude reflectors implying a transition from higher impedance to lower impedance (possibly sand over clay). Limited areas with diffractions within this unit observed outside the survey area in regional seismic lines suggest that gravel is present elsewhere in this unit but may be limited to localized deposits.

Unit 5 (Event 30 to Event 40)

Seismic Unit 5 is defined by Events 30 and 40. Reflectors within this unit appear to be more flat-lying than the internal reflectors of Unit 4 which imply that they may be marine sediments.

Unit 6 (Event 40 to Event 43)

Unit 6 consists of high-amplitude, flat-lying positive reflectors. The lithology is inferred to be sandy marine sediments. The base of this unit has strong positive-over-negative amplitude reflectors suggesting a transition to lower impedance unit (possible clay or fine-grained deposits).

Unit 7 (Event 43 to Event 45)

Unit 7 is defined by the strong positive-over-negative amplitude reflector at the base of Unit 6 and Event 45. This reflector changes in character across the site, having a higher amplitude in the southern section of the area and then a lower amplitude from the center of the area northward. The low-amplitude portion of this reflector was very weak in several sections and often difficult to correlate between survey lines. The unit consists of flat-lying positive and negative reflectors.

Unit 8 (Event 45 to Event 50)

Unit 8 consists of low-amplitude, flat-lying reflectors that are relatively parallel. The top of the unit is Event 45, which changes from high amplitude to low amplitude from the south of the site to the north. Event 50 defines the base of the unit, which appears to be an erosional surface. Event 50 dips to the south at the northern end of the site and becomes flat-lying toward the south. The lithology is inferred as possible fine-grained deposits.

Unit 9 (Event 50 to Event 60)

Seismic Unit 9 underlies Event 50 and exhibits generally flat-lying internal reflectors. Several seismic units above Event 50 exhibit features that suggest influence by the large ancestral drainage. Below this unit, most horizons are relatively flat-lying do not exhibit significant channeling, which suggests that this unit predates when this site was carved by the ancestral Delaware drainage.

FAULTS

No faults were identified in the survey data.

GAS HAZARDS

All seismic in-lines and crosslines from the seafloor to the depth limit of investigation (0.5 seconds TWT BSS) were screened for high-amplitude anomalies. Multiple high-amplitude anomalies representing possible shallow gas were identified throughout the survey area. Figure 24 presents the inferred shallow gas potential. Figure 26 presents an example of a typical gas anomaly. Figure 31 and Chart 10 present the spatial distribution of the anomalies inferred to be potential gas. The anomalies displayed on Figure 31 and Chart 10 are symbolized to indicate in which seismic unit the shallowest part of the anomaly is identified.

At the MDCF, the potential gas zone correlates to a layer of silty clay with organics and strong organic odor. The potential shallow gas is thus inferred to be biogenic gas associated with the decay of organic matter. The amplitude anomalies were observed in seismic Units 2 and 3. The anomalies are observed at fairly shallow depths below the seafloor and therefore will have limited overburden capable of capping low-pressured gas accumulations. Moreover, boring B-102 drilled in 2007 (Halcrow/HPA, 2009) did not report any encounters with gas (e.g. kick-backs, gas blisters in samples, etc.).

SLOPE FAILURES

We did not find evidence of existing slope failures or evidence such as deformed sediment structure that suggests slope instability will pose a hazard to the proposed MDCF.

CONCLUSIONS AND IMPLICATIONS

Based on our assessment of shallow hazards data for the study area, we conclude the following:

- The proposed MDCF is located on the crest of a NE-SW-trending ridge in a water depth of about 32.5 feet (re: MLLW datum).
- The seafloor sediments are poorly-graded fine to medium and fine sand.
- There are many bedforms on the seafloor in the survey area and the seafloor sediments are mobile.
- The magnetometer data from both surveys indicate the presence of a large (800+ gamma) artifact to the southeast of the proposed MDCF location. The presence of the anomaly or a cluster of anomalies was observed in the magnetometer data from multiple survey lines during both surveys. Analyses of the magnetic signatures suggest a probable location of the anomaly (or center of the cluster of anomalies) to be about 85 feet to the southeast of the proposed MDCF location. No seafloor expression of this magnetic anomaly was observed in either set of side scan sonar data.
- Several small side scan sonar targets and magnetic anomalies were identified in other portions of the survey area. No side scan sonar targets correlate with magnetic anomalies. No targets or anomalies correlated between surveys. None is considered significant.
- During the drilling and sampling of Boring B-102, no samples were recovered from sampling attempts at the seafloor and at 5-foot depth. The presumably loose surface sands are likely another indication of potential sediment mobility.
- Boring B-102 encountered soft, organic, clay and silt between 33 and 54 feet below the seafloor. Leg penetration evaluations for future construction jack-up or lift-barge activities should consider the potential for punch-through into this layer.
- Several near-surface amplitude anomalies were identified in the seismic reflection data within the study area. The amplitude anomalies suggest that free-phase gas has accumulated in the shallow subsurface. The anomalies were generally observed in seismic Units 2 and 3 at fairly shallow depths below the seafloor and therefore will have limited overburden capable of capping low-pressured gas accumulations. The gas is likely produced from decaying organics within the estuarine-lagoonal deposits.
- No seafloor or subsurface faults were identified within the study area.

The seafloor and shallow geologic conditions are generally favorable for installation of the proposed MDCF. The proposed MDCF location avoids known obstructions identified in this survey. Construction and installation activities should be planned to avoid the area of magnetic anomalies, or further investigation should be conducted to identify the source of those anomalies. Sediment transport processes, most likely caused by storms, and potential scour should be considered during design of the MDCF foundation.

No applicable BOEMRE NTLs have been issued for Atlantic OCS structures. Thus, there are no established criteria for required offsets between the MDCF and: 1) the buried metal object to the southeast of the proposed MDCF location, or 2) to areas where gas is present in the shallow sediments. Although no applicable NTLs have been issued for Atlantic OCS structures, the MMS guidelines for MDCF structures make reference to NTLs issued for other areas. Thus, it is appropriate to compare the mapped location of the magnetic anomalies and the subsurface gas with set-back distances as defined by MMS NTL 2008-G05 (MMS, 2008) for the Gulf of Mexico (GOM) OCS.

Figure 32 shows the proposed location of the MDCF together with the mapped site features and set-back distances defined by that reference MMS NTL 2008-G05. As shown, the mapped magnetic anomalies lie at the periphery of the set-back defined by the reference NTL, and the apparent subsurface gas is within the set-back established by the reference NTL. The referenced NTL indicates three options when anomalies or subsurface gas are located within the immediate area (within 30 meters of a 50 gamma or greater intensity magnetic anomaly or 75 meters of shallow gas; MMS, 2008) from a proposed structure. Those options are: 1) relocation of the structure to avoid the hazard, 2) demonstration to the MMS that the use of special protective measures will minimize the risk to safe operations (e.g. pile driving), or 3) further investigation to establish that such operations will not be adversely affected by the shallow hazard. While Fugro does not consider the subsurface gas to be a significant hazard (because it is due to biogenic decay at shallow depths, it is unlikely to be under excess pressure), it will be appropriate for installation plans to recognize and mitigate the existence of these conditions.

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Table 2a. 2009 Side Scan Sonar Targets

Target No.	OCS Block[1]	Height (m)	Length (m)	Width (m)	Latitude[2]	Longitude[2]	Easting[3] (m)	Northing[3] (m)	Corresponding Magnetic Anomaly	Minimum Avoidance Distance (m)	Description
S-1	6325	0.2	1.5	0.5	38.69649981	74.76941528	520052	4283123	--	50	Unknown
S-2	6325	0.1	1.9	0.5	38.68761188	74.76052709	520827	4282139	--	50	Circular target
S-3	6325	<0.1	1.4	1.6	38.69727279	74.7664679	520308	4283209	--	50	Unknown
S-4	6325	0.5	1.8	0.7	38.69447953	74.7689347	520094	4282899	--	50	Unknown
S-5	6325	<0.1	6.6	0.3	38.68162939	74.76279469	520632	4281474	--	50	Linear target
S-6	6325	0.3	1.0	1.2	38.68883885	74.76904042	520087	4282273	--	50	Square target
S-7	6325	1.9	1.0	0.0	38.68938088	74.7578803	521057	4282336	M-9(?)	75	Circular target

[1] Located in Salisbury Protraction Area (NJ 18-05)
[2] WGS84
[3] UTM Zone 18N, WGS84

Table 2b. 2010 Side Scan Sonar Targets (Sonar Contacts)

Target No.	OCS Block[1]	Line[2]	Height (m)	Length (m)	Width (m)	Latitude[2]	Longitude[2]	Easting[3] (m)	Northing[3] (m)	Minimum Avoidance Distance (m)	Description
S-1	6325	549	0.1	2.8	2.1	38.696142	74.765299	520409.82	4283084.2		Debris
S-2	6325	512	0.2	2.6	0.9	38.689192	74.755695	521247.05	4282315.1		Debris
S-3	6975	502	0	2.2	1.3	38.682078	74.761819	520716.52	4281524.3		Debris

[1] Located in Salisbury Protraction Area (NJ 18-05)
[2] Survey Line Number
[3] WGS84
[4] UTM Zone 18N, WGS84

Table 2c. 2010 Side Scan Sonar Returns from Water Column (possible intermittent gas seeps)

Target No.	OCS Block[1]	Line[2]	Height (m)	Length (m)	Width (m)	Latitude[2]	Longitude[2]	Easting [3] (m)	Northing[3] (m)	Minimum Avoidance Distance (m)	Description
G-1	6324	547	-	-	-	38.685492	74.781611	518994.11	4281898.8		Possible Gas
G-2	6325	539	-	-	-	38.683578	74.778237	519288.11	4281687.2		Possible Gas
G-3	6375	530	-	-	-	38.681863	74.77816	519295.28	4281496.9		Possible Gas
G-4	6325	534	-	-	-	38.68289	74.776981	519397.52	4281611.1		Possible Gas
G-5	6375	528	-	-	-	38.681268	74.77697	519398.9	4281431.2		Possible Gas
G-6	6375	532	-	-	-	38.681639	74.776917	519403.42	4281472.3		Possible Gas
G-7	6325	532	-	-	-	38.683098	74.776235	519462.36	4281634.4		Possible Gas
G-8	6325	533	-	-	-	38.683484	74.775532	519523.36	4281677.3		Possible Gas
G-9	6325	542	-	-	-	38.687995	74.772917	519749.61	4282178.5		Possible Gas
G-10	6325	526	-	-	-	38.683119	74.772382	519797.47	4281637.5		Possible Gas
G-11	6325	527	-	-	-	38.683134	74.772179	519815.09	4281639.2		Possible Gas
G-12	6325	526	-	-	-	38.683043	74.771974	519833.01	4281629.2		Possible Gas
G-13	6325	532	-	-	-	38.685868	74.771819	519845.66	4281942.7		Possible Gas
G-14	6325	535	-	-	-	38.687949	74.77096	519919.83	4282173.8		Possible Gas
G-15	6325	529	-	-	-	38.686043	74.770059	519998.7	4281962.4		Possible Gas
G-16	6325	526	-	-	-	38.684283	74.769544	520043.95	4281767.3		Possible Gas
G-17	6325	534	-	-	-	38.688128	74.769186	520074.04	4282194		Possible Gas
G-18	6325	533	-	-	-	38.688928	74.768139	520164.89	4282283.1		Possible Gas
G-19	6325	535	-	-	-	38.688937	74.767411	520228.21	4282284.2		Possible Gas
G-20	6325	527	-	-	-	38.68693	74.767239	520243.68	4282061.5		Possible Gas
G-21	6325	533	-	-	-	38.688515	74.766779	520283.28	4282237.5		Possible Gas
G-22	6325	528	-	-	-	38.688457	74.765883	520361.25	4282231.2		Possible Gas
G-23	6325	534	-	-	-	38.690254	74.765474	520396.28	4282430.8		Possible Gas
G-17	6325	534	-	-	-	38.688128	74.769186	520074.04	4282194		Possible Gas
G-18	6325	533	-	-	-	38.688928	74.768139	520164.89	4282283.1		Possible Gas
G-19	6325	535	-	-	-	38.688937	74.767411	520228.21	4282284.2		Possible Gas
G-20	6325	527	-	-	-	38.68693	74.767239	520243.68	4282061.5		Possible Gas
G-21	6325	533	-	-	-	38.688515	74.766779	520283.28	4282237.5		Possible Gas
G-22	6325	528	-	-	-	38.688457	74.765883	520361.25	4282231.2		Possible Gas
G-23	6325	534	-	-	-	38.690254	74.765474	520396.28	4282430.8		Possible Gas
G-24	6325	519	-	-	-	38.685352	74.764713	520463.81	4281887		Possible Gas
G-25	6325	519	-	-	-	38.685371	74.764449	520486.77	4281889.2		Possible Gas
G-26	6325	507	-	-	-	38.683794	74.760137	520862.29	4281715.1		Possible Gas
G-27	6325	504	-	-	-	38.684179	74.757901	521056.63	4281758.3		Possible Gas

[1] Located in Salisbury Protraction Area (NJ 18-05)
[2] Survey Line Number
[3] WGS84
[4] UTM Zone 18N, WGS84

Table 3a. 2009 Magnetic Anomaly Summary

Target	OCS Block[2]	Line[1]	Nav. Fix Mark	Latitude (N)[3]	Longitude (W)[3]	Easting (m)[4]	Northing (m)[4]	Duration (m)[5]	Intensity (γ)[6]	Altitude (m)[7]	Type[8]	Minimum Avoidance (m)	Corresponding Side Scan Sonar Target	Comments[9]
M-1	6325	207	210.8	38.6869	74.7687	520148	4282075	85.8	31.1	2.6	COMPLEX	41	--	Correlate 5/11
M-2	6325	125	105.8	38.6912	74.7656	520417	4282552	41.5	10.3	3.3	DP	20	--	Possible noise
M-3	6325	125	118.9	38.6838	74.7773	519397	4281730	93.4	8	4.2	DP	44	--	Possible SOL noise
M-4	6375	131	118.9	38.6826	74.776	519516	4281592	93.1	7.1	4.2	MP +	44	--	Possible SOL noise
M-5	6325	132	109.4	38.6867	74.7685	520160	4282052	52	105.4	2.6	MP +	25	--	Correlate 1/11
M-6	6375	136	119	38.6814	74.7752	519586	4281460	137.1	12.5	4.2	MP +	65	--	Possible SOL noise
M-7	6325	142	109.1	38.6849	74.7659	520390	4281858	45.6	19.5	4.2	DP	22	--	Debris
M-8	6375	143	119.6	38.6796	74.7741	519678	4281263	90.7	4.5	4.8	MP +	43	--	Possible SOL noise
M-9	6325	145	100.3	38.689	74.7575	521118	4282314	67.6	22.2	4.2	DP	32	S-7	Possible SOL noise
M-10	6375	148	119.5	38.6786	74.7729	519786	4281155	75.4	5.4	5	MP +	36	--	Possible SOL noise
M-11	6325	207	211.2	38.6867	74.7681	520197	4282056	73.1	613.1	2.6	COMPLEX	35	--	Correlate 1/5

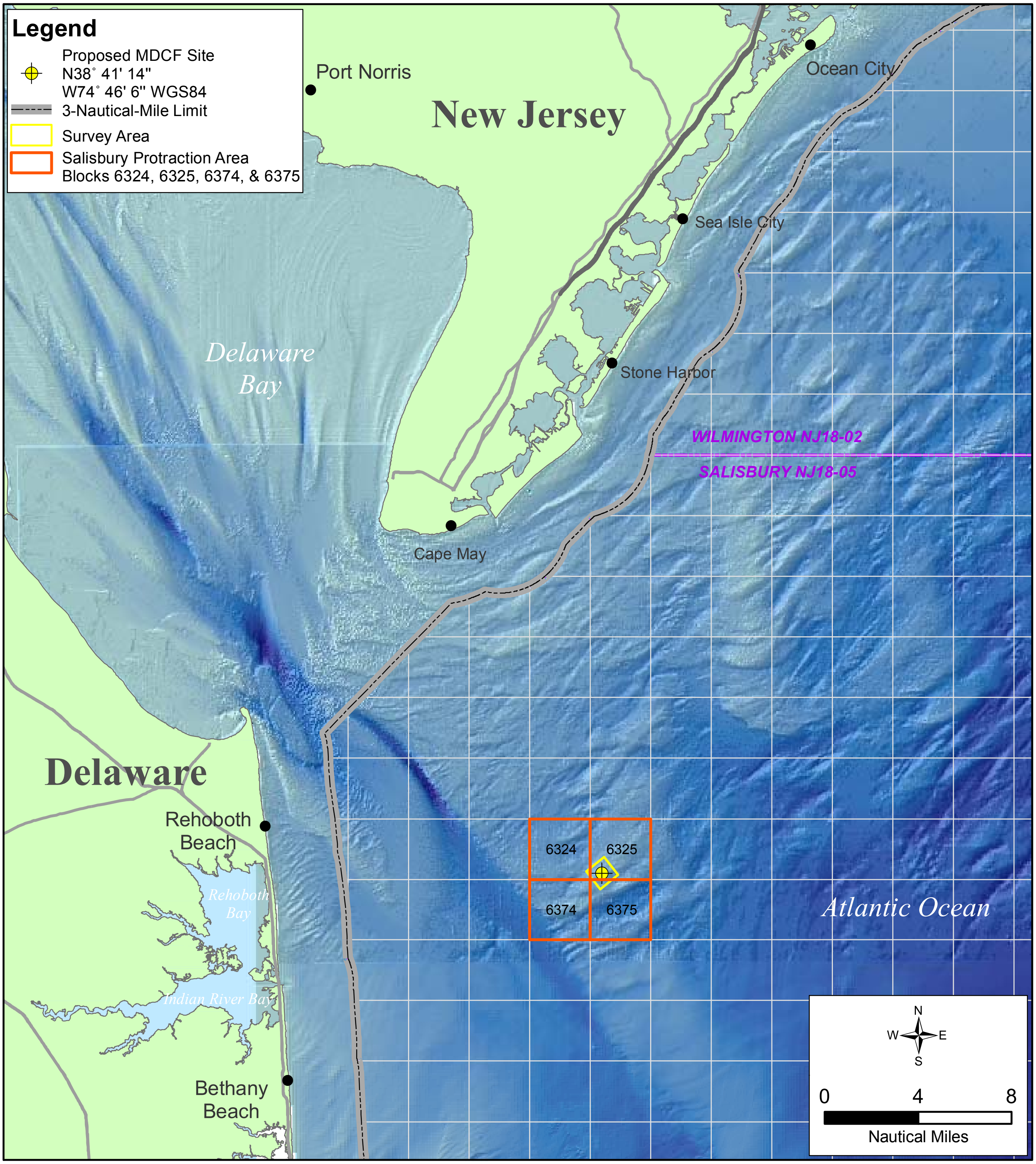
[1] Survey line number
[2] Salisbury Protraction Area (NJ 18-05)
[3] WGS 84 Geographic
[4] UTM Zone 18 North, WGS 84, meters
[5] Length of the magnetic anomaly in meters
[6] Intensity in Gammas [Monopole = baseline to peak, Bipole = peak to peak]
[7] Height above the seafloor in meters
[8] Anomaly Shape BP=Bipolar, DP=Dipole, MP=Monopole +/- = negative/positive
[9] Interpreters observations

Table 3b. 2010 Magnetic Anomaly Summary

Target	OCS Block[2]	Line[1]	Nav. Fix Mark	Latitude (N)[3]	Longitude (W)[3]	Easting (m)[4]	Northing (m)[4]	Duration (m)[5]	Intensity (γ)[6]	Altitude (m)[7]	Type[8]	Minimum Avoidance (m)	Comments[9]
M-1	6375	501	10.9	38.6812	74.7620	520703	4281425	45.1	2.0	5.6	MP +	22	N/A
M-2	6325	505	20.0	38.6868	74.7551	521297	4282053	55.6	8.0	4.6	DP	27	N/A
M-3	6375	513	2.6	38.6790	74.7719	519844	4281184	40.3	4.0	4.1	DP	20	N/A
M-4	6325	517	8.9	38.6831	74.7677	520207	4281636	65.9	3.0	4.9	MP +	33	N/A
M-5	6325	526	13.0	38.6873	74.7659	520364	4282106	69.3	14.0	3.3	DP	34	N/A
M-6	6325	528	11.4	38.6869	74.7678	520195	4282054	94.8	5.0	3.3	MP +	47	Central anomaly cluster
M-7	6325	529	11.3	38.6871	74.7680	520174	4282076	77.5	339.5	3.4	DP	39	Central anomaly cluster
M-8	6325	530	11.4	38.6873	74.7682	520159	4282102	61.1	3.5	3.3	DP	30	Central anomaly cluster
M-9	6325	535	17.3	38.6920	74.7635	520563	4282620	64.3	2.0	5.1	DP	32	Correlate with 10
M-10	6325	536	17.4	38.6922	74.7637	520550	4282648	73.2	43.0	5.1	MP +	36	Correlate with 9
M-11	6325	538	9.5	38.6882	74.7712	519902	4282205	93.1	45.0	5	DP	46	N/A
M-12	6325	540	11.8	38.6900	74.7694	520053	4282398	70.0	3.0	5.1	MP +	35	N/A
M-13	6325	544	15.4	38.6928	74.7672	520249	4282710	63.0	3.0	3.1	DP	31	Correlate with 24
M-14	6325	547	11.0	38.6907	74.7722	519809	4282476	42.9	2.5	4.9	MP +	21	N/A
M-15	6324	550	3.5	38.6870	74.7796	519168	4282063	43.0	48.0	5.3	MP +	21	N/A
M-16	6325	552	16.8	38.6949	74.7682	520159	4282947	40.1	3.0	4.7	COMPLEX	19	N/A
M-17	6325	556	5.4	38.6897	74.7787	519242	4282361	99.9	4.0	4.7	DP	50	Probable Geologic (#18)
M-18	6325	557	5.5	38.6899	74.7789	519227	4282387	69.2	6.0	5.2	DP	34	Probable Geologic (#17)
M-19	6325	559	19.6	38.6983	74.7667	520289	4283327	35.2	5.0	4.9	MP -	17	N/A
M-20	6325	601	610.1	38.6870	74.7682	520163	4282072	55.3	64.0	1.5	DP	28	Central anomaly cluster
M-21	6325	704	7.3	38.6873	74.7679	520189	4282101	73.0	5.0	2.5	DP	36	Central anomaly cluster
M-22	6325	801	6.6	38.6874	74.7684	520144	4282110	81.3	3.0	2.2	DP	41	Central anomaly cluster
M-23	6325	802	5.7	38.6871	74.7681	520165	4282084	78.9	832.0	2	DP	39	Central anomaly cluster
M-24	6325	1543	15.5	38.6927	74.7671	520257	4282704	45.2	8.5	4.7	DP	22	Correlate with 13

1 Survey line number
2 Salisbury Protraction Area (NJ 18-05)
3 WGS 84 Geographic
4 UTM Zone 18 North, WGS 84, meters
5 Length of the magnetic anomaly in meters
6 Intensity in Gammas [Monopole = baseline to peak, Bipole = peak to peak]
7 Height above the seafloor in meters
8 Anomaly Shape BP=Bipolar, DP=Dipole, MP=Monopole +/- = negative/positive
9 Interpreters observations

FIGURES



Source: MMS; NOAA; NJDEP

PROJECT LOCATION
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 1

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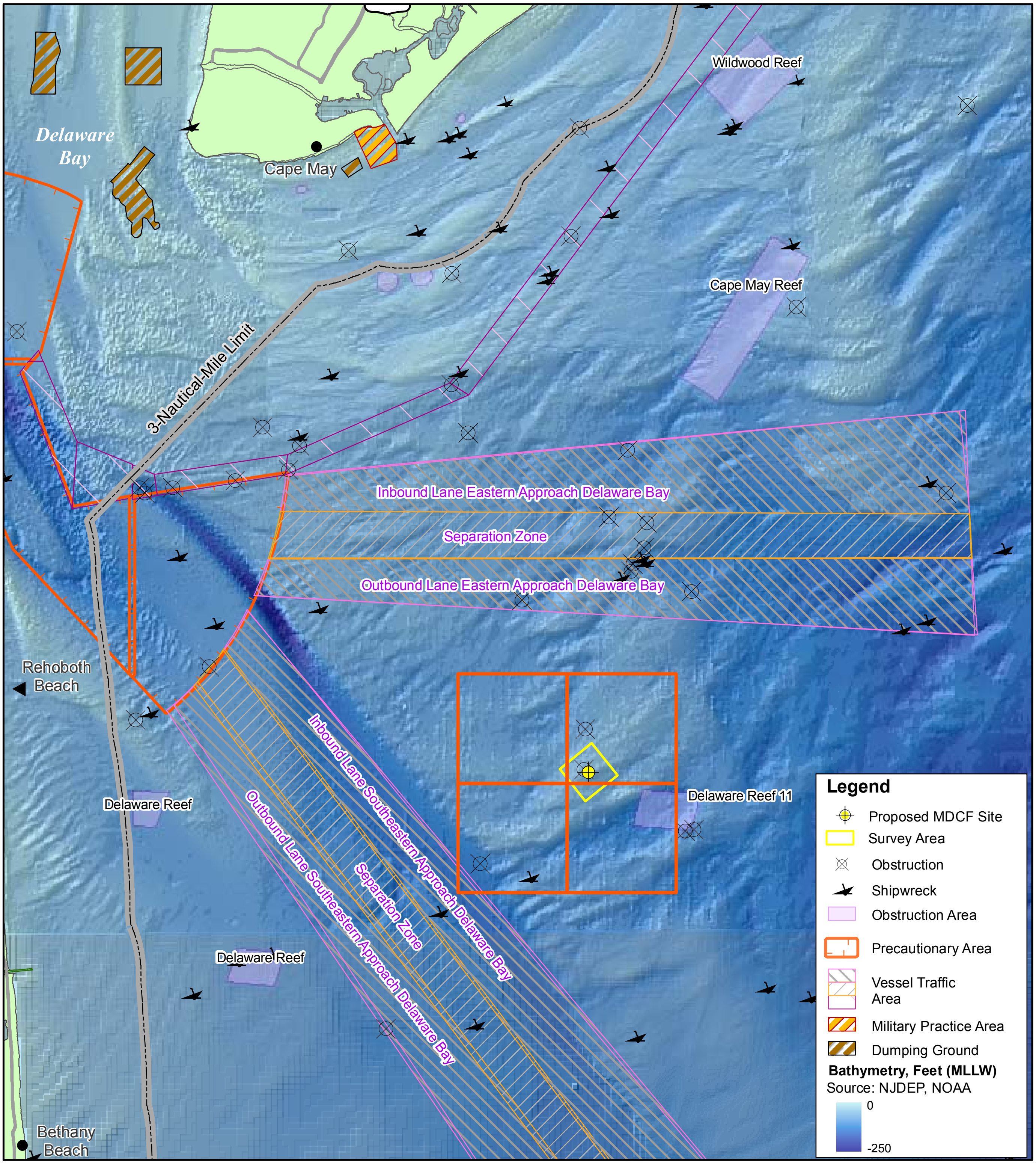
NRG Bluewater Wind
Project No. 3671.004



Source: New Jersey Dept. of Environmental Protection; NOAA Charts 12200 & 12214

PROJECT VICINITY
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 2

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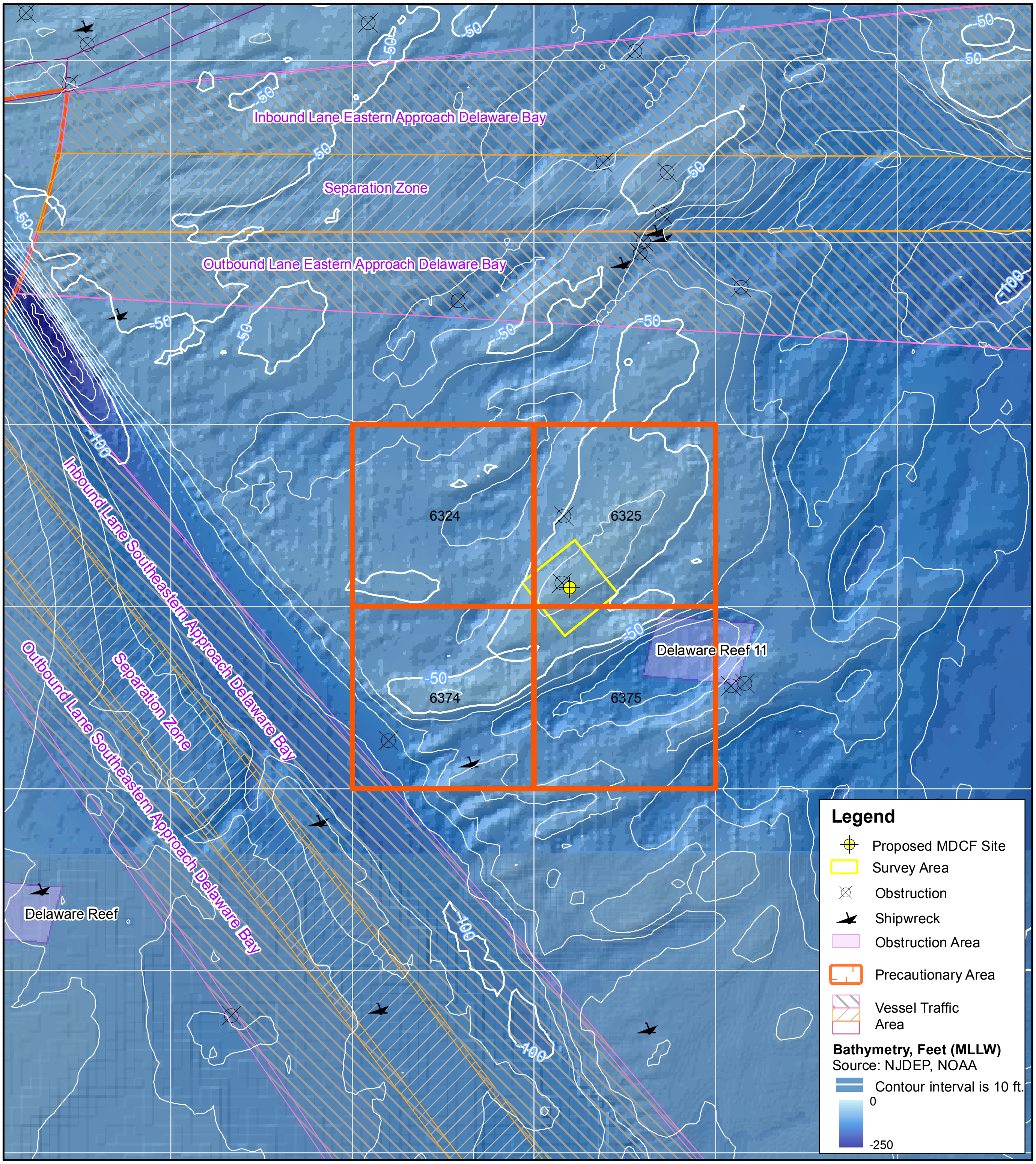

Source: New Jersey Dept. of Environmental Protection; NOAA Charts 12200 & 12214

0 2 4
Nautical Miles

N S E W

REGIONAL BATHYMETRY
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 3

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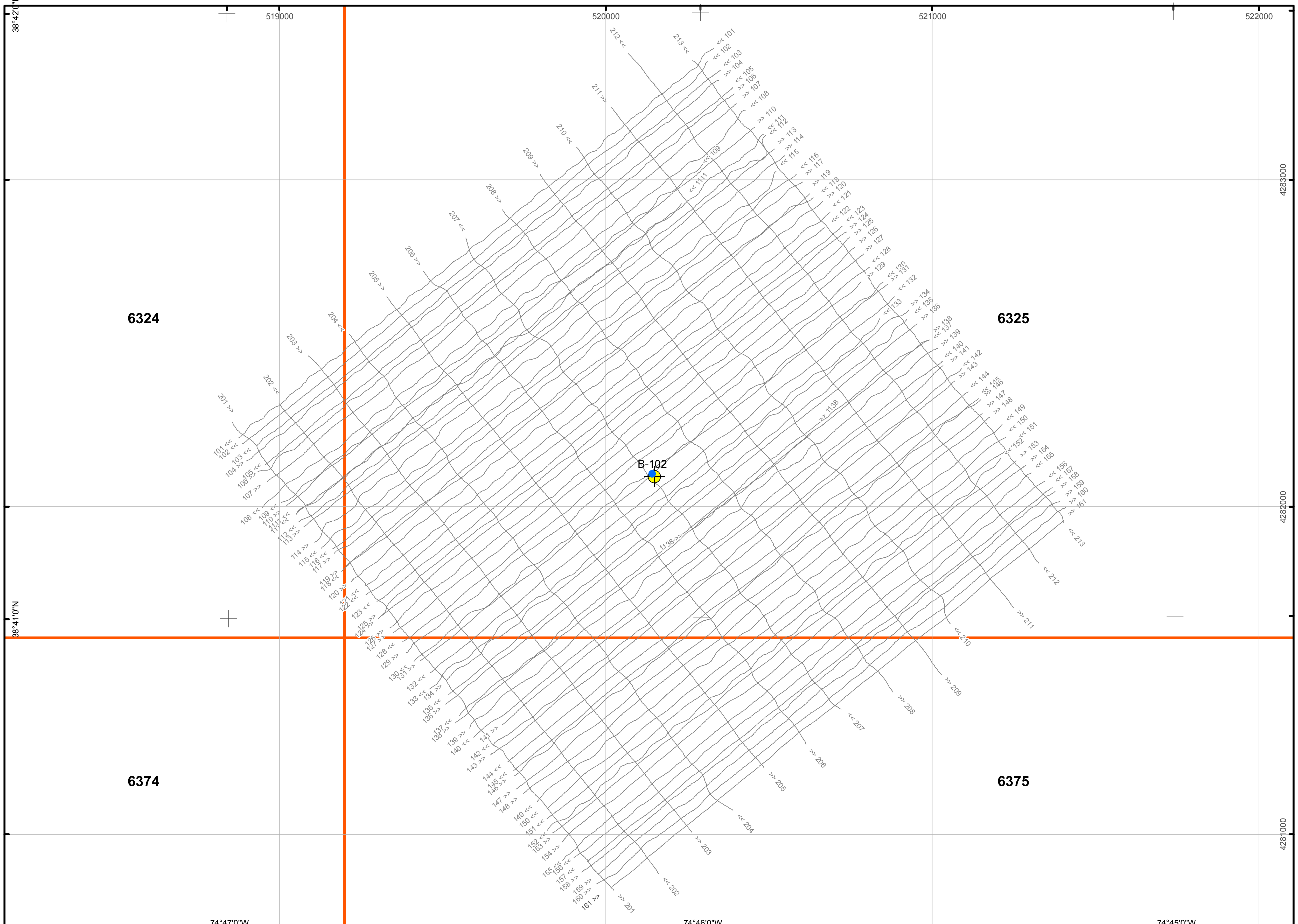

Legend

Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74° 46' 6"

2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)

6325 Salisbury Protraction Area OCS Block

150>> Bottom Charting/Marine Archeological Survey Line and Navigation Fix Marks
Systems Used:
- Chirp Sub-bottom Profiler
- Multibeam Echosounder
- Side Scan Sonar
- Magnetometer

Arrows on line number indicate direction of vessel travel.
Refer to Chart 1 for Navigation Fix Points

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005
3. Trackline represents position of GOS antenna.

N
W E
S

0 500 1,000 2,000 Feet

0 100 200 400 Meters

BOTTOM CHARTING SURVEY
NAVIGATION POST-PLOT
Fall 2009 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 4a

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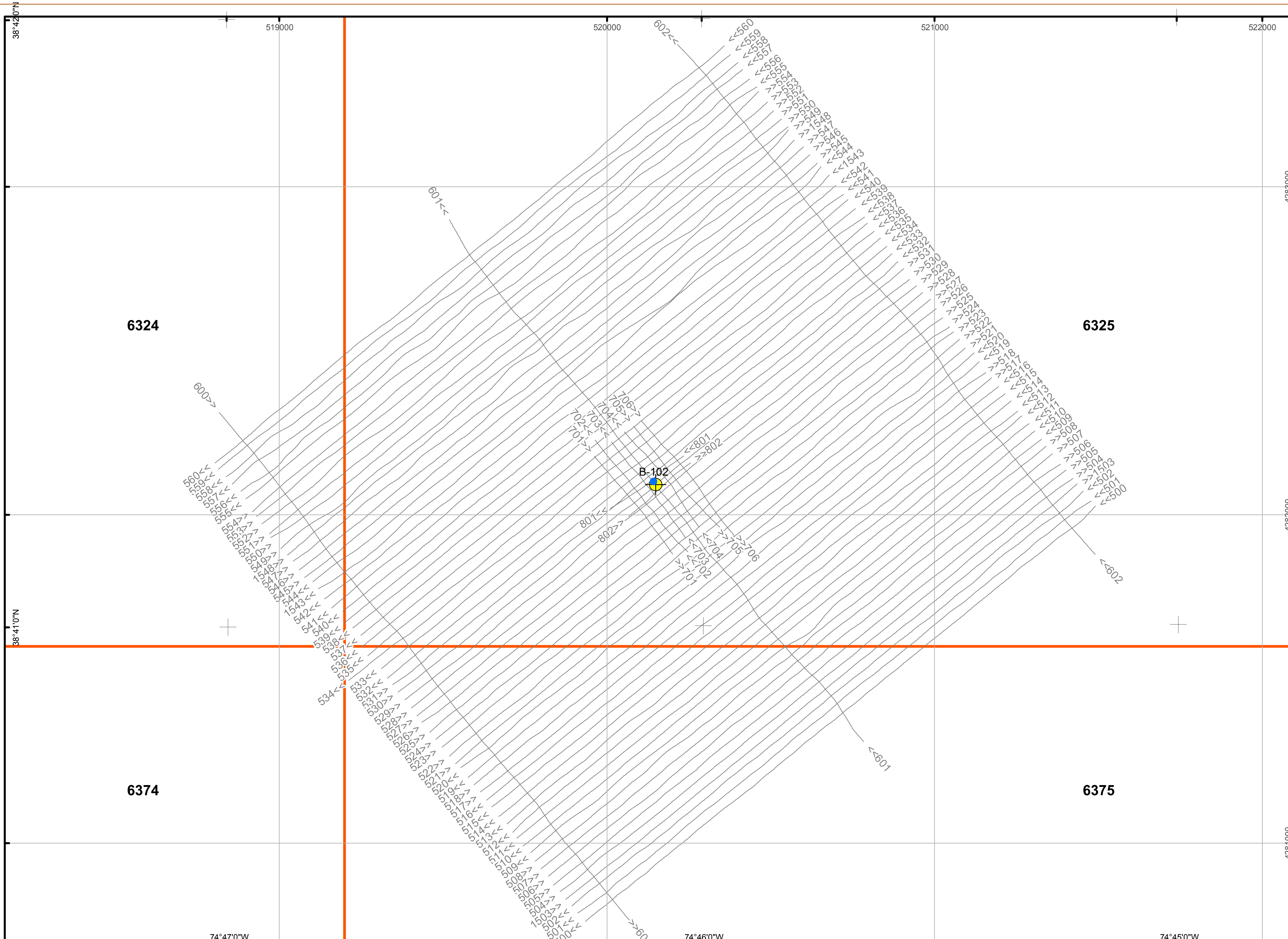

Legend

- Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74° 46' 6"
- 2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)
- 6325 Salisbury Protraction Area OCS Block
- 150>> Bottom Charting/Marine Archeological Survey Line
  Systems Used:
  Side Scan Sonar
  Magnetometer
  Arrows on line number indicate direction of vessel travel.
  Refer to Chart 1b for Navigation Fix Points

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005
3. Trackline represents position of common reference point (CRP).

N W E S

0 500 1,000 2,000 Feet
0 100 200 400 Meters

BOTTOM CHARTING SURVEY
NAVIGATION POST-PLOT
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 4b

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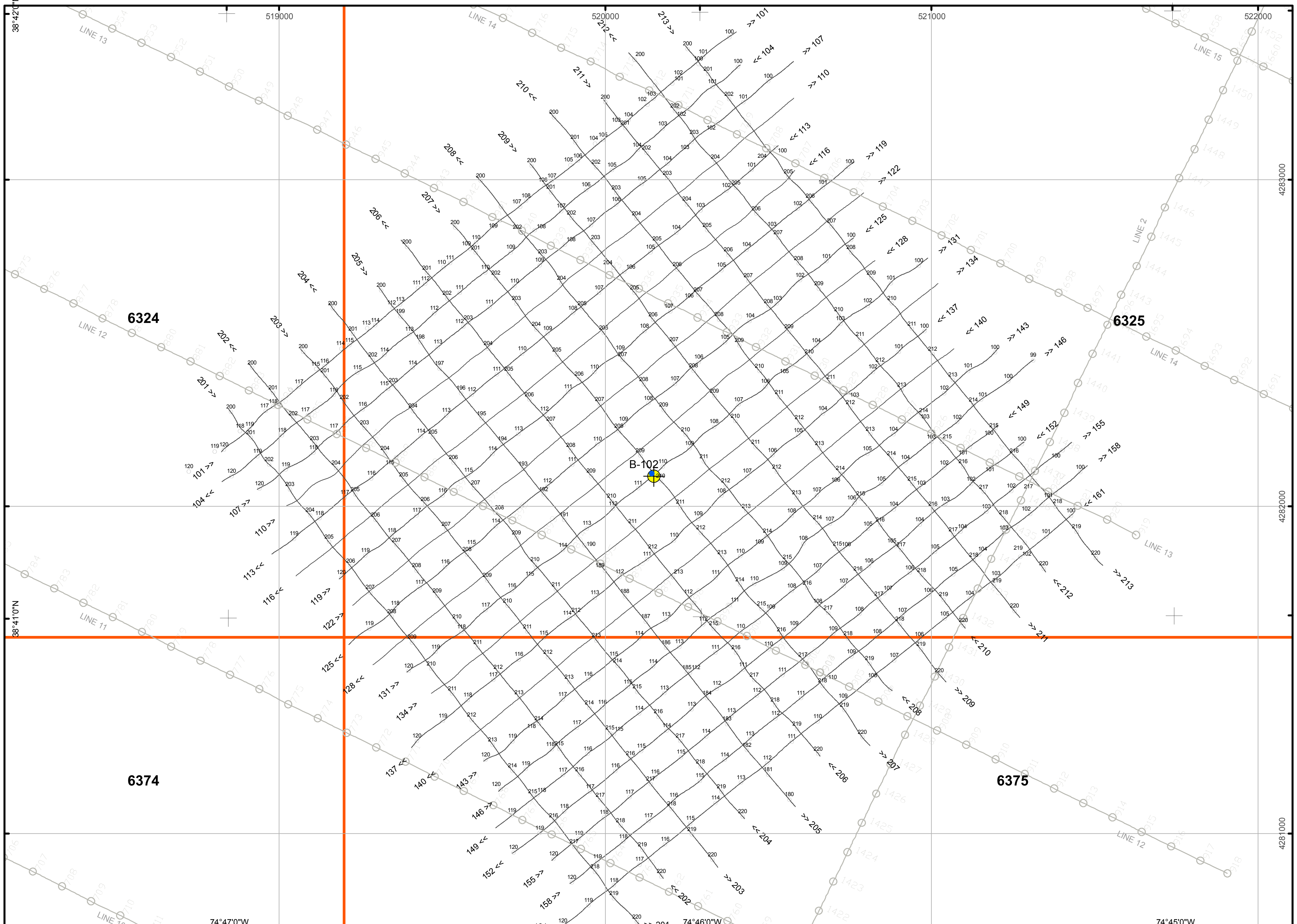

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Legend

Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74°46' 6"

2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)

6325 Salisbury Protraction Area OCS Block

155>> 120 Seismic Reflection Survey Vessel Trackline.
Systems Used:
8-channel, 1.56-mgi GeoEel Hydrophone Array
16-channel, 3.125-mgi GeoEel Hydrophone Array
600-joule Boomer Source
Chirp Sub-bottom Profiler
Survey line number and navigation fix points are labeled. Arrows indicate direction of vessel travel.

LINE 2 1455 2006 OSI Seismic Reflection Survey Vessel Trackline
Systems Used:
Applied Acoustics 300-joule boomer system (0.4-8 kHz) with a single-channel hydrophone array
Survey line number and navigation fix points are labeled.

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005
3. Trackline represents position of GPS antenna

N W E S

0 500 1,000 2,000 Feet

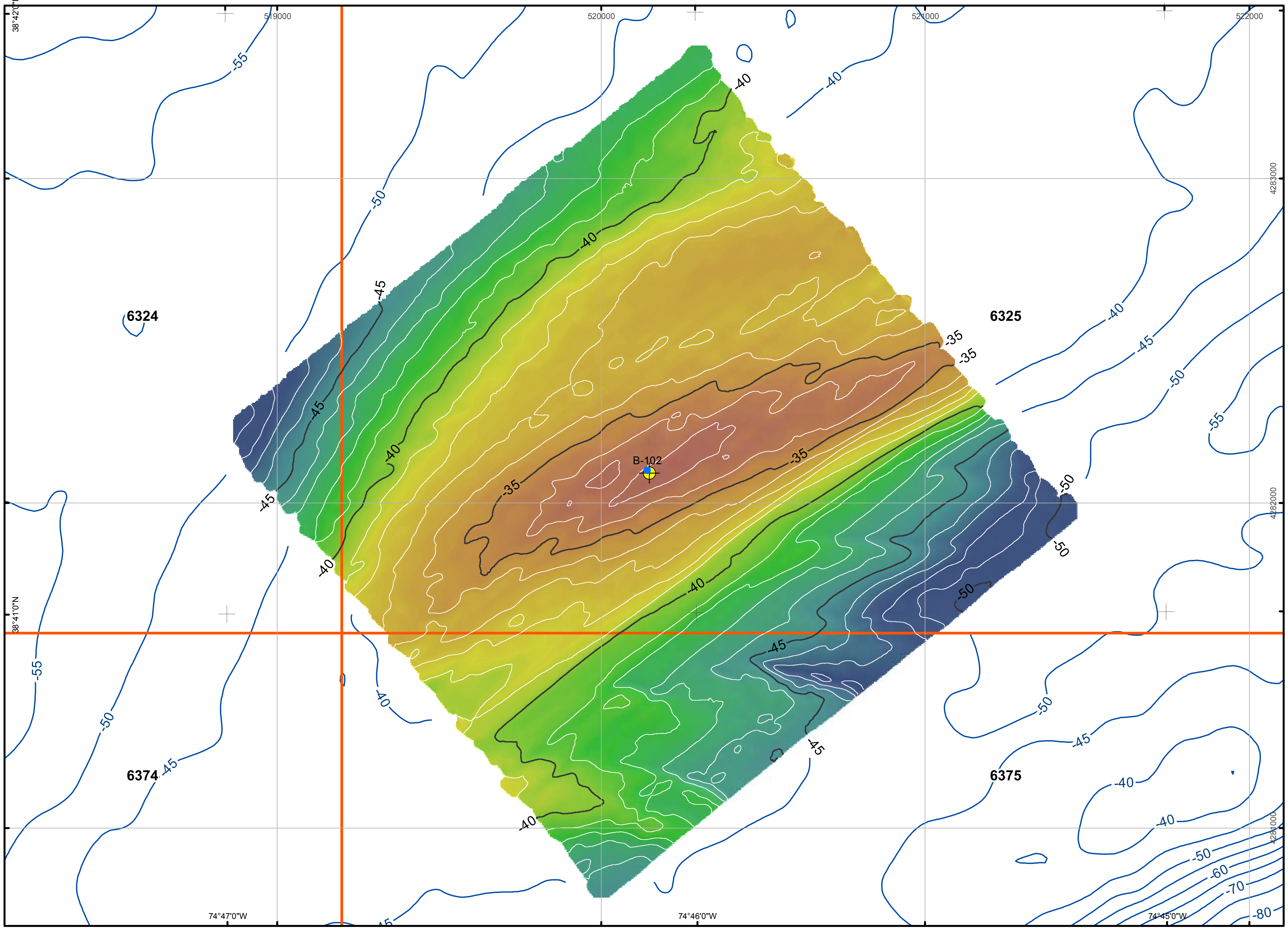
0 100 200 400 Meters

SEISMIC REFLECTION SURVEY NAVIGATION POST-PLOT

Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 5

NRG Bluewater Wind
Project No. 3671.004



Legend

Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74° 46' 6"

2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)

6325 Salisbury Protraction Area OCS Block

-40 **Regional Bathymetry - NJDEP** Contour interval is 5 feet.

-35 **Fugro 2009 Bathymetric Survey** Contour interval is 1 foot and referenced to MLLW.

Fugro 2009 Bathymetric Survey
Referenced to MLLW

-32 feet

-51 feet

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005

N W E S

0 500 1,000 2,000 Feet

0 100 200 400 Meters

BATHYMETRY
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 6

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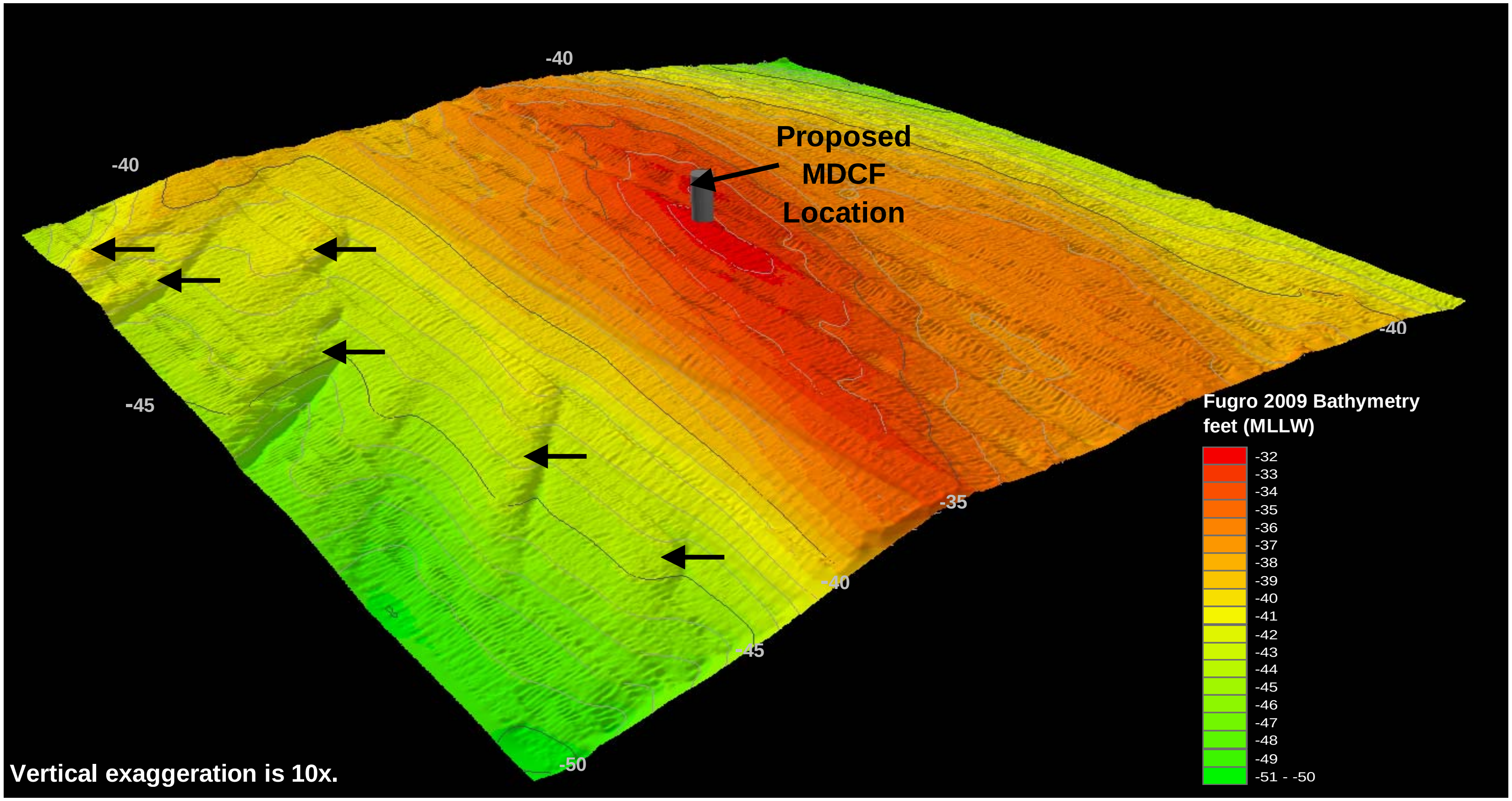
N:\PROJECTS\3671_BLUEWATER\3671-004_BLUEWATER_WIND-DESURVEY\OUTPUTS\REVISED SHALLOW HAZARDS REPORT NOV2010\DOC\FIG-7A 3D MODEL ORIGBATHYMETRY.DOC

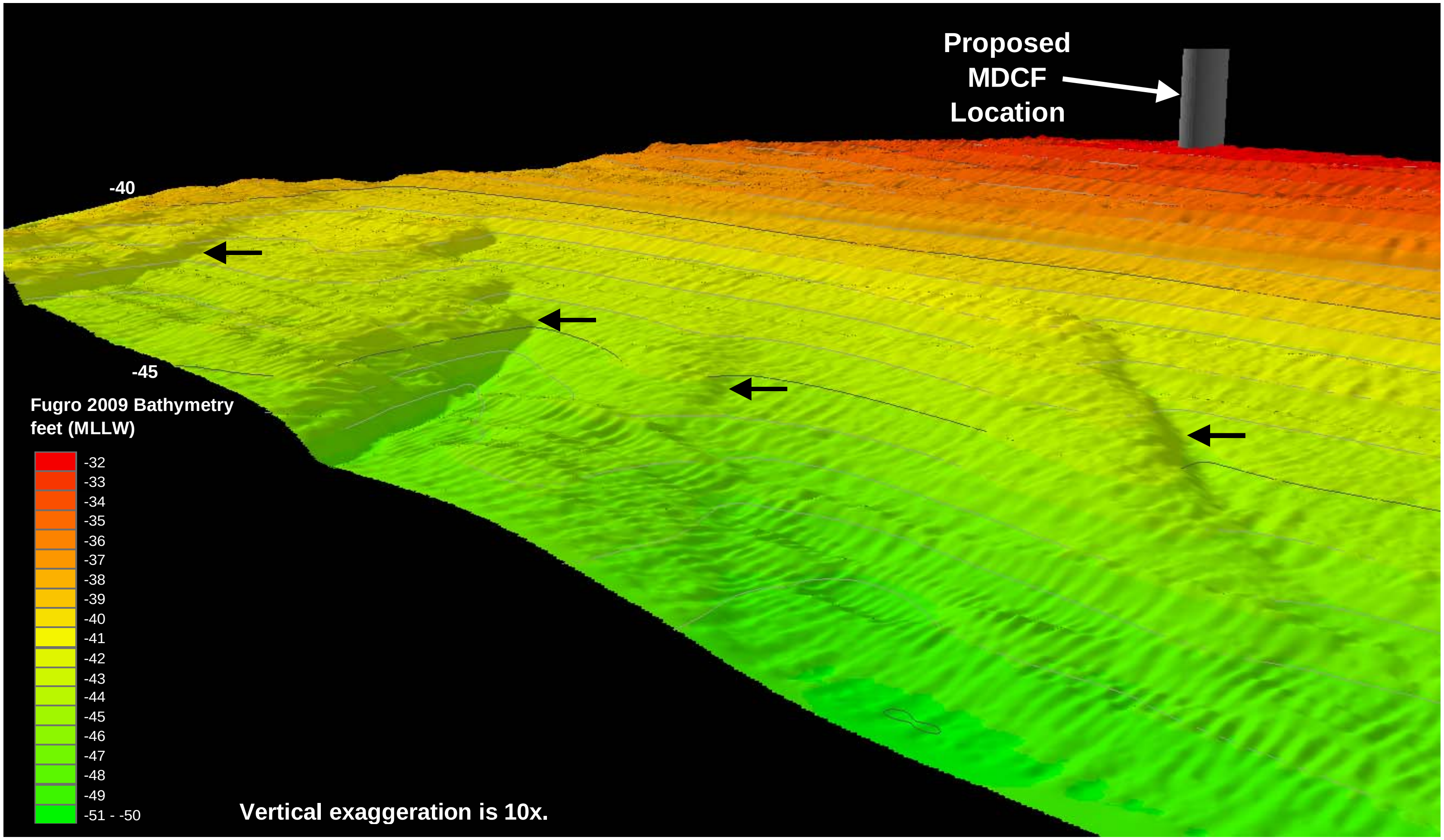
NRG Bluewater Wind
Project No. 3671.004



Notes:
1) View is looking west-northwest.
2) Contour interval is 1 foot.
3) Bathymetric surface is original, unsmoothed surface that shows weather-related artifacts. Small-scale “ripples” are resultant from strong winds and rough sea state. They are not bedforms.
4) Arrows point to large, low-amplitude sand waves. Refer to Figure 7b and Chart 4a Insets 3 and 3a for detailed view. It is unclear whether features are active or dormant.

THREE-DIMENSIONAL, SUN-ILLUMINATED, HILLSHADED BATHYMETRY
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 7a



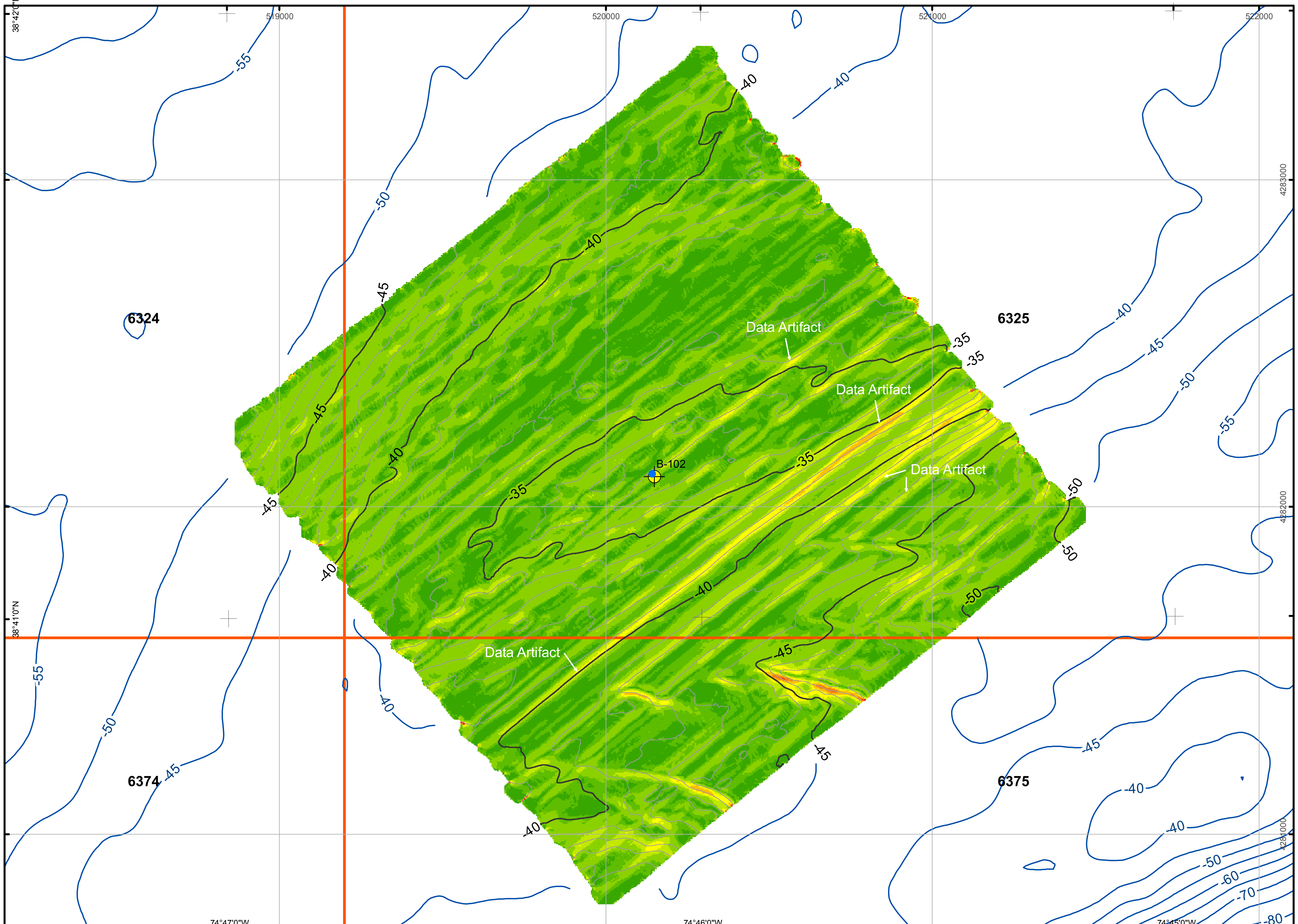
Notes:
1) View is looking west-northwest.
2) Contour interval is 1 foot.
3) Bathymetric surface is original, unsmoothed surface that shows weather-related artifacts. Small-scale “ripples” are resultant from strong winds and rough sea state. They are not bedforms.
4) Arrows point to large, low-amplitude sand waves. Refer to Chart 4a Insets 3 and 3a for additional detailed views. It is unclear whether features are active or dormant.

THREE-DIMENSIONAL, SUN-ILLUMINATED, HILLSHADED BATHYMETRY

Bluewater Wind Meteorological Tower

Delaware Continental Shelf

NRG Bluewater Wind
Project No. 3671.004



Legend

- Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74° 46' 6"
- 2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)
- 6325 Salisbury Protraction Area OCS Block
- -35 **Regional Bathymetry - NJDEP** Contour interval is 5 feet.
- -35 **Fugro 2009 Bathymetric Survey** Contour interval is 1 foot and referenced to MLLW.

Seafloor Slope Gradient

Degrees	Percent
0 - 0.15	0 - 0.25
0.15 - 0.3	0.25 - 0.5
0.3 - 0.55	0.5 - 1
0.55 - 0.85	1.0 - 1.5
0.85 - 1.1	1.5 - 2
1.1 - 1.4	2.0 - 2.5
1.4 - 1.7	2.5 - 3
1.7 - 2.0	3.0 - 3.5
2.0 - 2.9	3.5 - 5

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005

N W E S

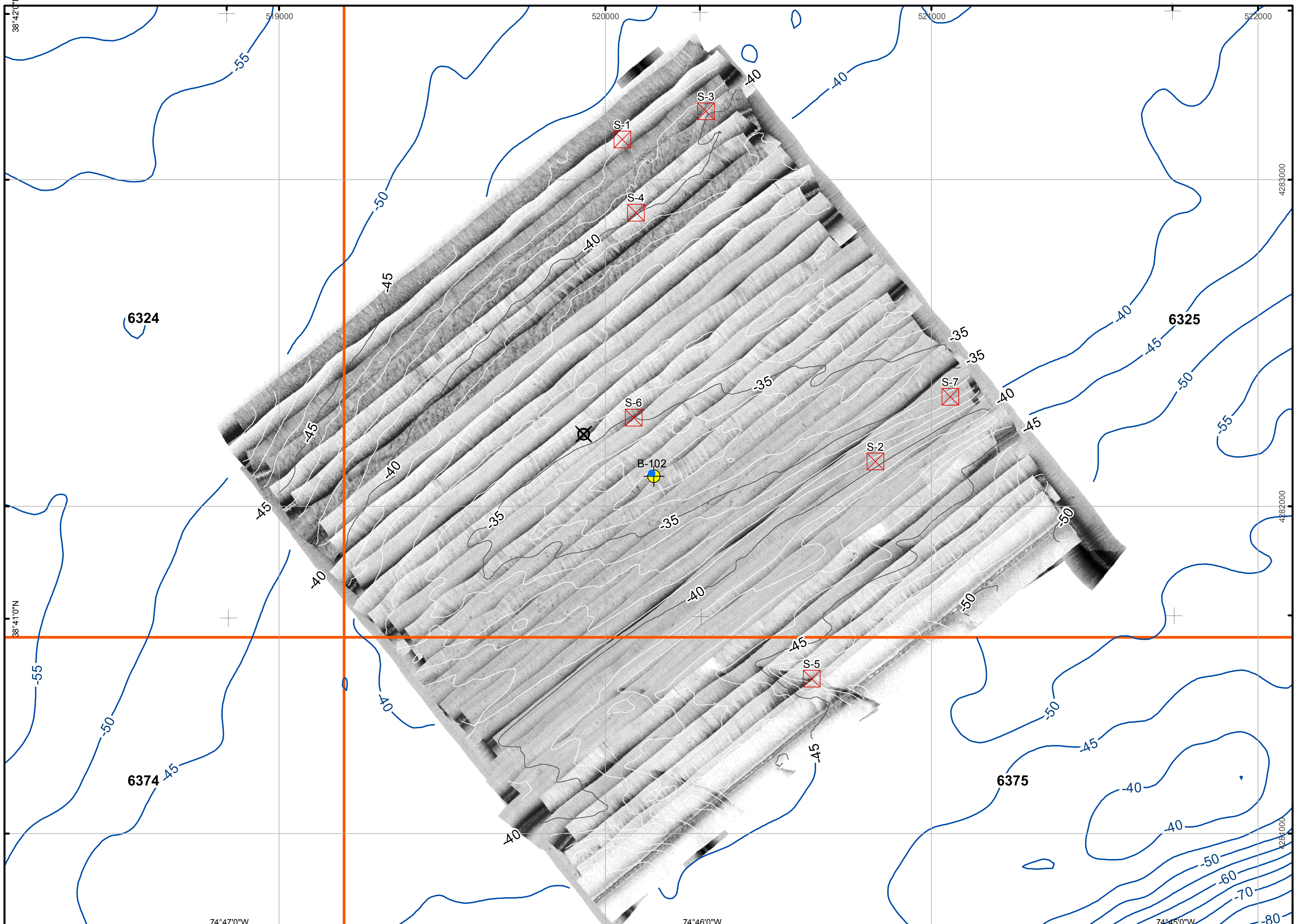
0 500 1,000 2,000 Feet

0 100 200 400 Meters

SEAFLOOR SLOPE GRADIENT
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 8

N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Shallow_Hazards_Report_Jan2010\mxd\Fig-08_Seafloor_Slope_Gradient.mxd, 11/29/10, kstevens



Legend

- Proposed Meteorological Data Collection Facility (MDCF) N 38° 41' 14" W 74° 46' 6"
- 2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)
- S-5 Side Scan Sonar Targets. Sonar target designation is posted above symbol.
- **NOAA-Charted Obstruction** See NOAA Chart 12214
- 6325 Salisbury Protraction Area OCS Block
- -50 **Regional Bathymetry - NJDEP** Contour interval is 5 feet.
- -35 **Fugro 2009 Bathymetric Survey** Contour interval is 1 foot and referenced to MLLW.

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS84, Meters; and Latitude/Longitude, WGS84
2. Side Scan Sonar Instrumentation: EdgeTech Model 272-TD sonar towfish interfaced to the EdgeTech analog control interace (ACI), and A/D card and acquisition software. Chesapeake Technology, Inc.'s SonarWiz.MAP software was utilized to provide real-time mosaics for quality control.
3. OCS Block Boundaries: Minerals Management Service, 2005

N S W E

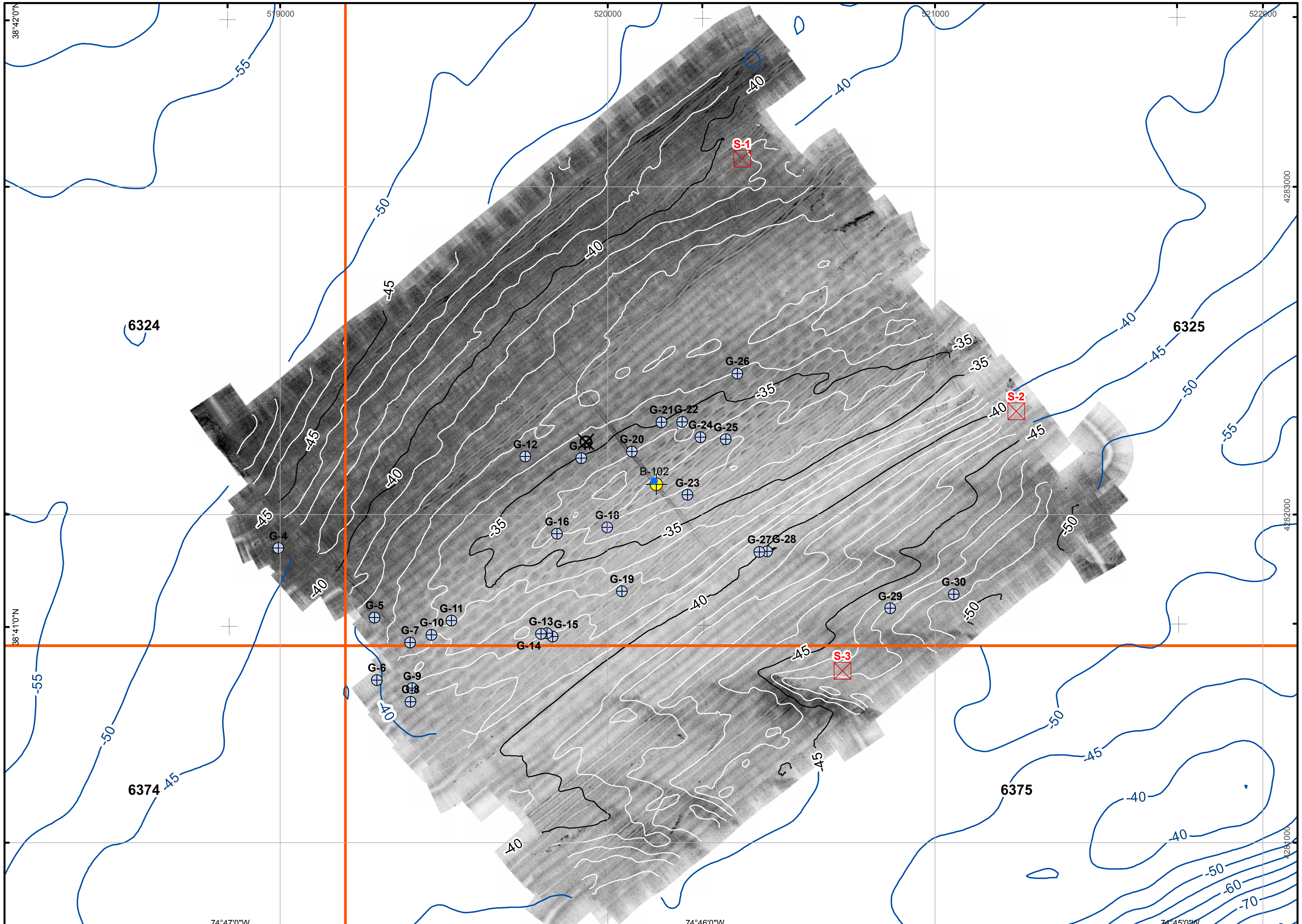
0 500 1,000 2,000 Feet

0 100 200 400 Meters

SIDE SCAN SONAR MOSAIC
Fall 2009 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 9a

N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Shallow_Hazards_Report_Jan2010\mxd\Fig-09_SideScanSonarMosaic.mxd, 11/29/10, kstevens



Legend

- Proposed Meteorological Data Collection Facility (MDCF) N 38° 41' 14" W 74° 46' 6"
- 2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)
- G-1 Gas Seeps (Fugro, 2010)
- S-1 2010 Side Scan Sonar Targets. Sonar target designation is posted above symbol.
- **NOAA-Charted Obstruction** See NOAA Chart 12214
- 6325 Salisbury Protraction Area OCS Block
- -50 **Regional Bathymetry - NJDEP** Contour interval is 5 feet.
- -35 **Fugro 2009 Bathymetric Survey** Contour interval is 1 foot and referenced to MLLW.

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS84, Meters; and Latitude/Longitude, WGS84
2. Side Scan Sonar Instrumentation: Klein System 3000 sonar Towfish and armored tow cable interfaced to the Klein topside unit, which was networked to a data logging computer and Klein's SonarPro acquisition software. SonarPro features include, amongst other features, automatic gain control, real-time bottom tracking, and time varied gain.
3. OCS Block Boundaries: Minerals Management Service, 2005

N
W E
S

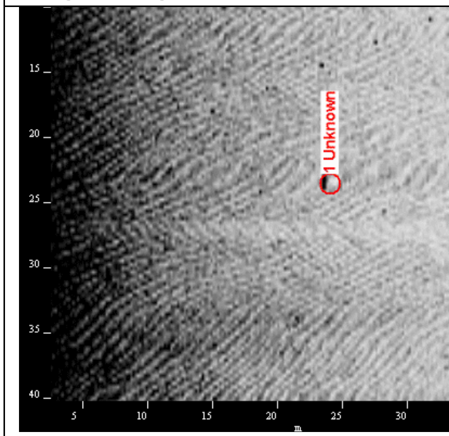
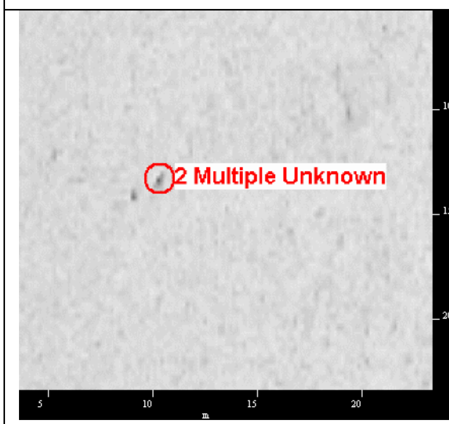
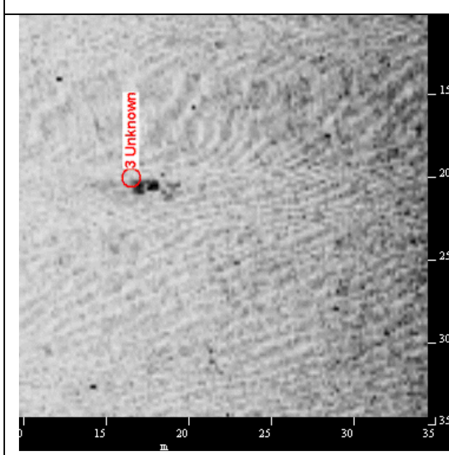
0 500 1,000 2,000 Feet

0 100 200 400 Meters

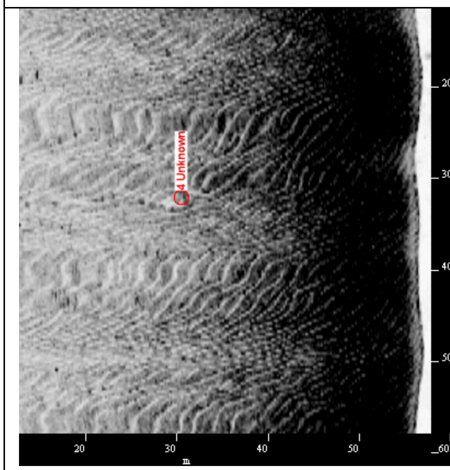
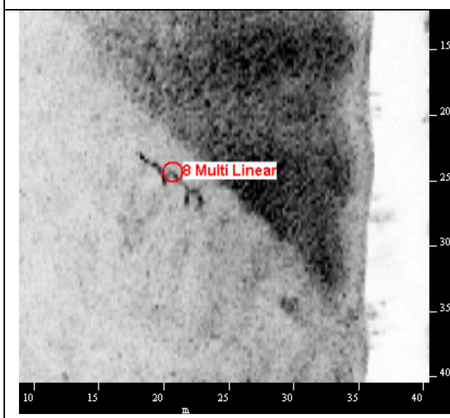
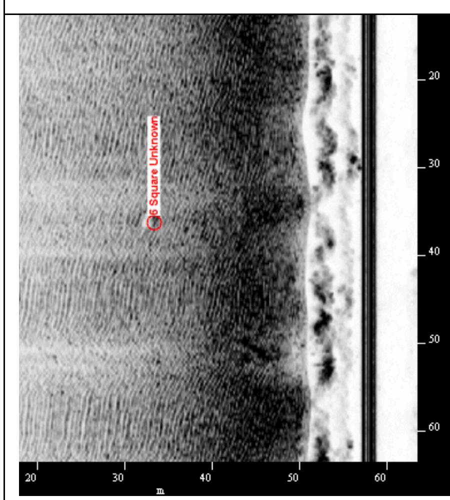
SIDE SCAN SONAR MOSAIC
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 9b

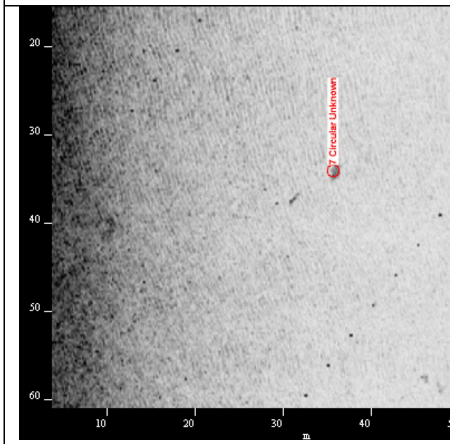
N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Revised_Shallow_Hazards_Report_Nov2010\MXD\Fig-09b_SideScanSonarMosaic.mxd, 11/29/10, kstevens

Target Image	Target Info	User Entered Info
	**1 Unknown** • Sonar Time at Target: 10/20/2009 15:11:22 • Click Position (Lat/Lon Coordinates) 38° 41.78998' N 074° 46.16491' W (WGS84) 38° 41.78322' N 074° 46.18827' W (NAD27) • Click Position (Projected Coordinates) (X) 520,051.77 (Y) 4,283,122.94 • Map Proj: WGS 1984 UTM, Zone 18 North, Meter • Acoustic Source File: C:\SSS\BWW_2\XTF\SSS_101.xtf • Ping Number: 231370 • Range to Target: 36.10 Meters • Fish Height: 7.65 Meters • Heading: 49.90000153 • Event Number: 0 • Line Name: SSS_101	**Dimensions** Target Height = 0.19 Meters Target Length: 1.46 Meters Target Shadow: 0.92 Meters Target Width: 0.50 Meters Mag Anomaly: None Avoidance Area: Classification 1: Classification 2: Area: Salisbury Block: 6325 Description:
	**2 Multiple Unknown** • Sonar Time at Target: 10/22/2009 12:57:16 • Click Position (Lat/Lon Coordinates) 38° 41.25671' N 074° 45.63162' W (WGS84) 38° 41.24994' N 074° 45.65500' W (NAD27) • Click Position (Projected Coordinates) (X) 520,827.27 (Y) 4,282,138.67 • Map Proj: WGS 1984 UTM, Zone 18 North, Meter • Acoustic Source File: C:\SSS\BWW_2\XTF\SSS_146.xtf • Ping Number: 121889 • Range to Target: 60.53 Meters • Fish Height: 9.47 Meters • Heading: 50.79999924 • Event Number: 0 • Line Name: SSS_146	**Dimensions** Target Height = 0.12 Meters Target Length: 0.91 Meters Target Shadow: 0.78 Meters Target Width: 0.46 Meters Mag Anomaly: None Avoidance Area: Classification 1: Classification 2: Area: Salisbury Block: 6325 Description:
	**3 Unknown** • Sonar Time at Target: 10/20/2009 15:21:37 • Click Position (Lat/Lon Coordinates) 38° 41.83636' N 074° 45.98807' W (WGS84) 38° 41.82960' N 074° 46.01143' W (NAD27) • Click Position (Projected Coordinates) (X) 520,307.85 (Y) 4,283,209.37 • Map Proj: WGS 1984 UTM, Zone 18 North, Meter • Acoustic Source File: C:\SSS\BWW_2\XTF\SSS_104.xtf • Ping Number: 236837 • Range to Target: 40.10 Meters • Fish Height: 6.66 Meters • Heading: 226.69999695 • Event Number: 0	**Dimensions** Target Height = 0.03 Meters Target Length: 1.37 Meters Target Shadow: 0.15 Meters Target Width: 1.60 Meters Mag Anomaly: None Avoidance Area: Classification 1: Classification 2: Area: Salisbury Block: 6325 Description:

SIDE SCAN SONAR TARGETS
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

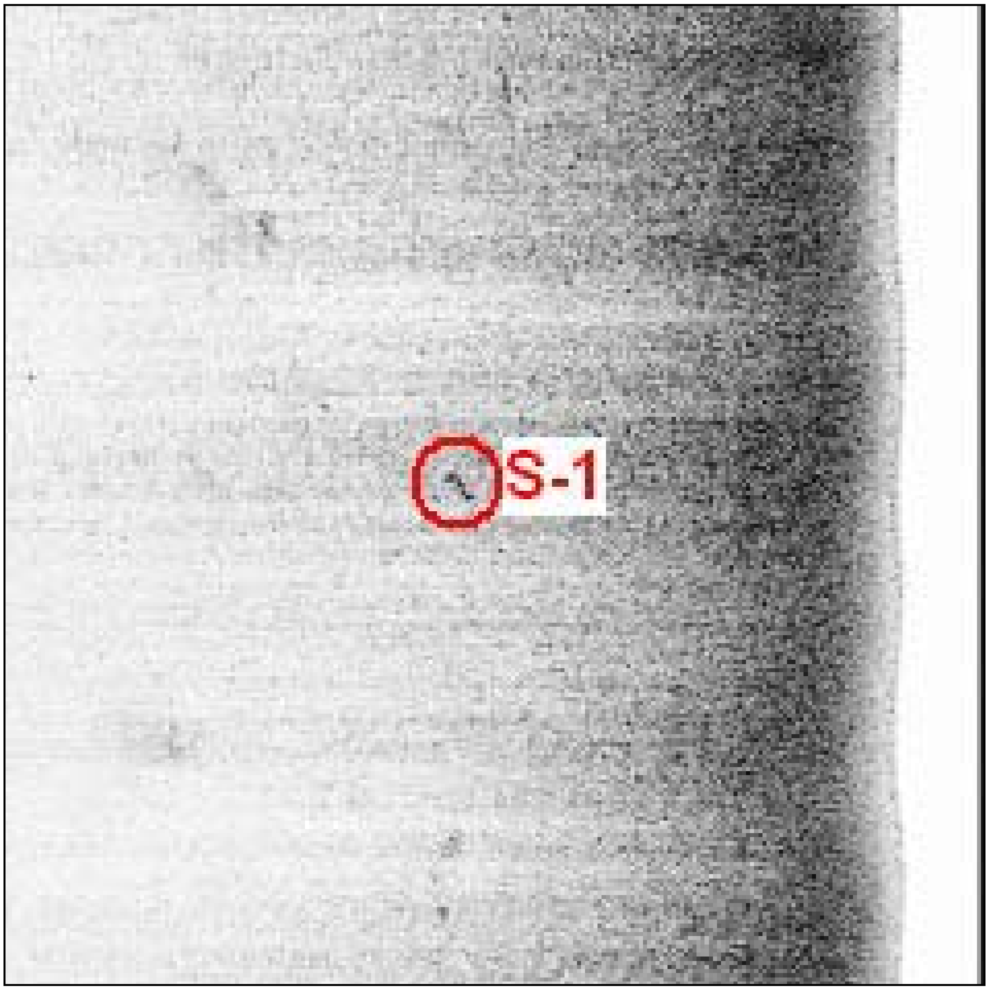
	• Line Name: SSS_104	
	**4 Unknown** • Sonar Time at Target: 10/30/2009 16:50:27 • Click Position (Lat/Lon Coordinates) 38° 41.66877' N 074° 46.13608' W (WGS84) 38° 41.66201' N 074° 46.15943' W (NAD27) • Click Position (Projected Coordinates) (X) 520,094.12 (Y) 4,282,898.87 • Map Proj: WGS 1984 UTM, Zone 18 North, Meter • Acoustic Source File: C:\SSS\BWW_2\XTF\SSS_110.xtf • Ping Number: 221408 • Range to Target: 32.43 Meters • Fish Height: 8.81 Meters • Heading: 58.59999847 • Event Number: 0 • Line Name: SSS_110	**Dimensions** Target Height = 0.50 Meters Target Length: 1.76 Meters Target Shadow: 2.02 Meters Target Width: 0.72 Meters Mag Anomaly: None Avoidance Area: Classification 1: Classification 2: Area: Salisbury Block: 6325 Description:
	**5 Multi Linear** • Sonar Time at Target: 11/01/2009 15:18:42 • Click Position (Lat/Lon Coordinates) 38° 40.89776' N 074° 45.76768' W (WGS84) 38° 40.89099' N 074° 45.79104' W (NAD27) • Click Position (Projected Coordinates) (X) 520,631.77 (Y) 4,281,474.31 • Map Proj: WGS 1984 UTM, Zone 18 North, Meter • Acoustic Source File: C:\SSS\BWW_2\XTF\SSS_158.xtf • Ping Number: 232173 • Range to Target: 22.83 Meters • Fish Height: 10.63 Meters • Heading: 50.79999924 • Event Number: 0 • Line Name: SSS_158	**Dimensions** Target Height = 0.03 Meters Target Length: 6.63 Meters Target Shadow: 0.06 Meters Target Width: 0.34 Meters Mag Anomaly: None Avoidance Area: Classification 1: Classification 2: Area: Salisbury Block: 6325 Description:
	**6 Square Unknown** • Sonar Time at Target: 11/01/2009 12:22:18 • Click Position (Lat/Lon Coordinates) 38° 41.33033' N 074° 46.14242' W (WGS84) 38° 41.32356' N 074° 46.16577' W (NAD27) • Click Position (Projected Coordinates) (X) 520,086.51 (Y) 4,282,272.92 • Map Proj: WGS 1984 UTM, Zone 18 North, Meter • Acoustic Source File: C:\SSS\BWW_2\XTF\SSS_126_A.xtf • Ping Number: 138141 • Range to Target: 22.77 Meters • Fish Height: 6.82 Meters • Heading: 60.79999924 • Event Number: 0 • Line Name: SSS_126_A	**Dimensions** Target Height = 0.32 Meters Target Length: 0.97 Meters Target Shadow: 1.05 Meters Target Width: 1.23 Meters Mag Anomaly: None Avoidance Area: Classification 1: Classification 2: Area: Salisbury Block: 6325 Description:

SIDE SCAN SONAR TARGETS
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

	**7 Circular Unknown** • Sonar Time at Target: 10/20/2009 10:53:38 • Click Position (Lat/Lon Coordinates) 38° 41.36285' N 074° 45.47281' W (WGS84) 38° 41.35608' N 074° 45.49620' W (NAD27) • Click Position (Projected Coordinates) (X) 521,056.94 (Y) 4,282,335.58 • Map Proj: WGS 1984 UTM, Zone 18 North, Meter • Acoustic Source File: C:\SSS\BWW_2\XTF\SSS_213.xtf • Ping Number: 93993 • Range to Target: 43.34 Meters • Fish Height: 7.98 Meters • Heading: 137.69999695 • Event Number: 0 • Line Name: SSS_213	**Dimensions** Target Height = 0.00 Meters Target Length: 1.90 Meters Target Shadow: 0.00 Meters Target Width: 1.00 Meters Mag Anomaly: M-9(?) Avoidance Area: Classification 1: Classification 2: Area: Salisbury Block: 6325 Description:

SIDE SCAN SONAR TARGETS
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

Sonar Contacts-2010 S-1



Target Info for S-1

- Sonar Time at Target: 10/23/2010 12:23:01
- Click Position (Lat/Lon Coordinates)
  38° 41.76853' N 074° 45.91794' W (WGS84)
  38° 41.76177' N 074° 45.94130' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 520,409.82 (Y) 4,283,084.17
- Map Proj: WGS 1984 UTM, Zone 18 North, Meter
- Acoustic Source File:
C:\SonarSurveys\3671_004\SSS\XTF\549.xtf
- Ping Number: 23650
- Range to Target: -40.34 Meters
- Fish Height: 7.54 Meters
- Heading: 56.09999847
- Event Number: 0
- Line Name: 549

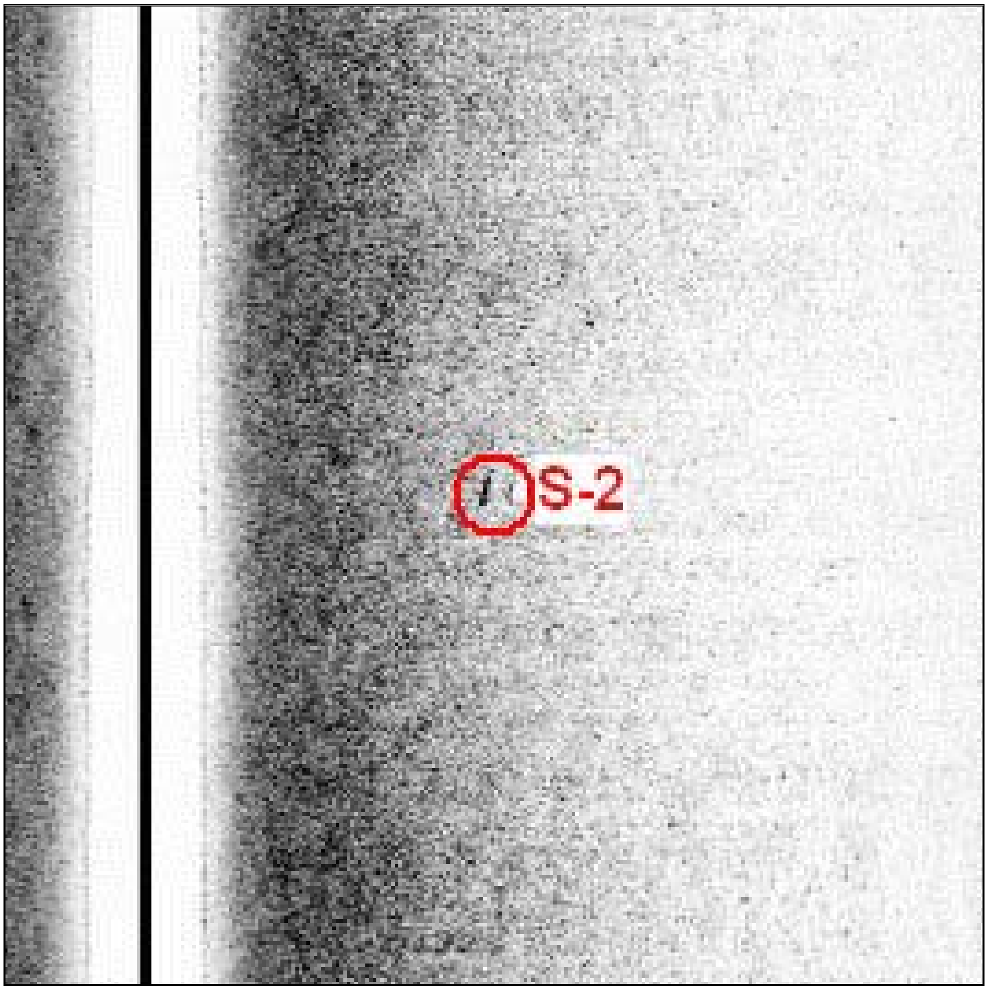
User Entered Info

Target Height = 0.12 Meters
Target Length: 2.75 Meters
Target Shadow: 0.63 Meters
Target Width: 2.12 Meters
Mag Anomaly:
Avoidance Area:
Classification 1: debris
Classification 2:
Area:
Block:
Description:

SIDE SCAN SONAR TARGETS
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 10d

Sonar Contacts-2010 S-2



Target Info for S-2

- Sonar Time at Target: 10/20/2010 14:02:49
- Click Position (Lat/Lon Coordinates)
  38° 41.35149' N 074° 45.34169' W (WGS84)
  38° 41.34472' N 074° 45.36508' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 521,247.05 (Y) 4,282,315.07
- Map Proj: WGS 1984 UTM, Zone 18 North, Meter
- Acoustic Source File:
C:\SonarSurveys\3671_004\SSS\XTF\512.xtf
- Ping Number: 68435
- Range to Target: 26.66 Meters
- Fish Height: 5.14 Meters
- Heading: 257.79998779
- Event Number: 0
- Line Name: 512

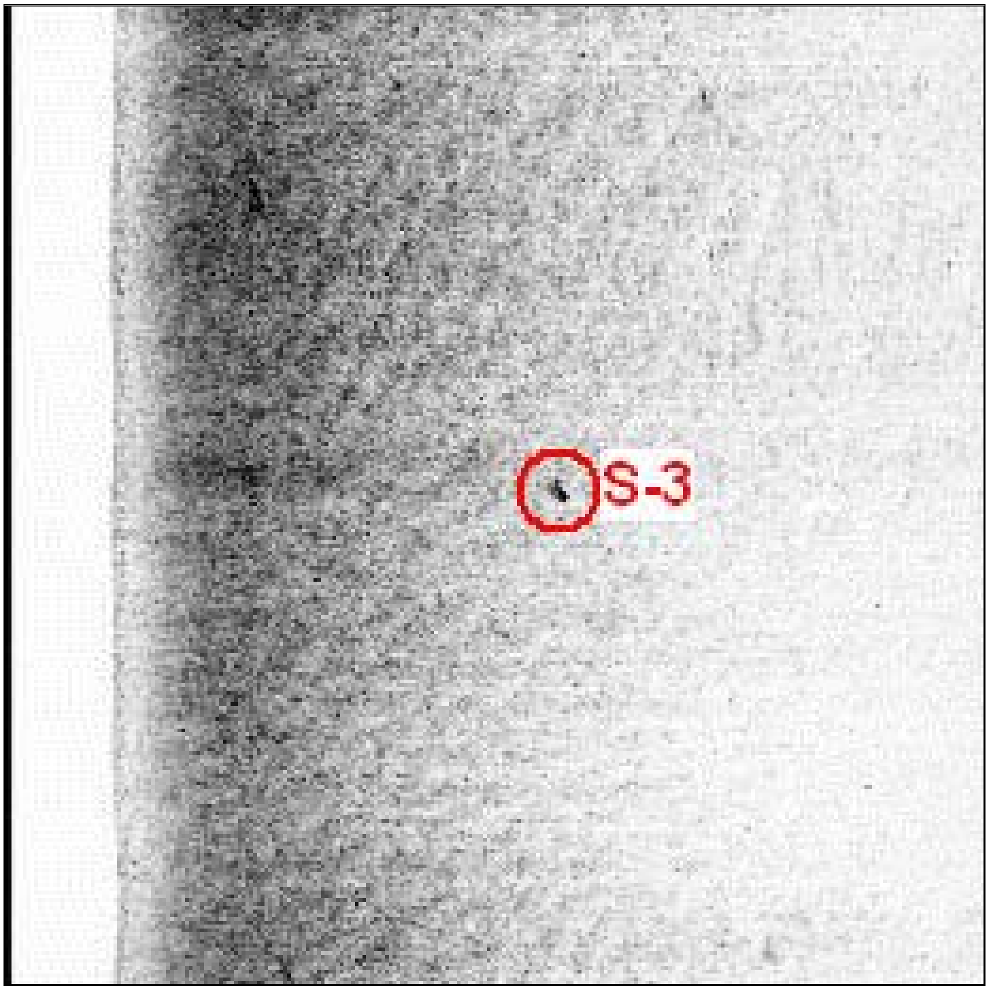
User Entered Info

Target Height = 0.16 Meters
Target Length: 2.56 Meters
Target Shadow: 0.85 Meters
Target Width: 0.89 Meters
Mag Anomaly:
Avoidance Area:
Classification 1: debris
Classification 2:
Area:
Block:
Description:

SIDE SCAN SONAR TARGETS
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 10e

Sonar Contacts-2010 S-3



Target Info for S-3

- Sonar Time at Target: 10/14/2010 14:51:26
- Click Position (Lat/Lon Coordinates)
  38° 40.92465' N 074° 45.70912' W (WGS84)
  38° 40.91789' N 074° 45.73249' W (NAD27)
- Click Position (Projected Coordinates)
  (X) 520,716.52 (Y) 4,281,524.27
- Map Proj: WGS 1984 UTM, Zone 18 North, Meter
- Acoustic Source File:
C:\SonarSurveys\3671_004\SSS\XTF\502.xtf
- Ping Number: 61361
- Range to Target: 42.33 Meters
- Fish Height: 9.15 Meters
- Heading: 262.50000000
- Event Number: 0
- Line Name: 502

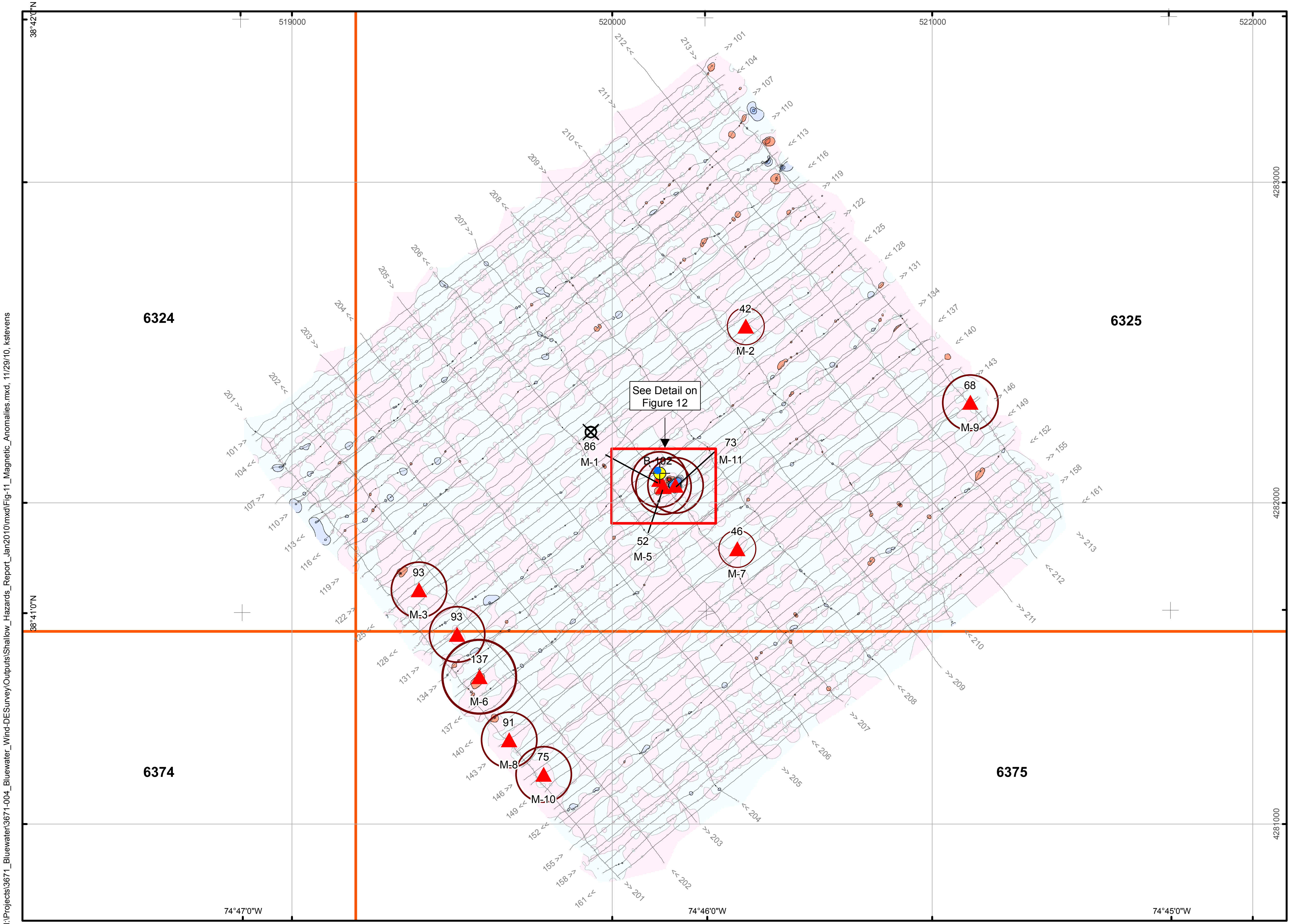
User Entered Info

Target Height = 0.00 Meters
Target Length: 2.23 Meters
Target Shadow: 0.00 Meters
Target Width: 1.28 Meters
Mag Anomaly:
Avoidance Area:
Classification 1: debris
Classification 2:
Area:
Block:
Description:

SIDE SCAN SONAR TARGETS
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 10f

NRG Bluewater Wind
Project No. 3671.004



Legend

- Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74° 46' 6"
- 2007 Halcrow/HPA Boring B-102 (Halcrow/HPA, 2009)
- **NOAA-Charted Obstruction** See NOAA Chart 12214
- 155>> 120 Magnetometer Survey Trackline. Survey line number and navigation fix points are labeled. Arrows indicate direction of vessel travel.
- 6325 Salisbury Protraction Area OCS Blocks

MAGNETOMETER SURVEY DATA

- 35 M-3 Magnetic Anomaly
  Diameter of circle does not represent actual duration of anomaly. Number above symbol is intensity of anomaly (gammas). Anomaly designation is labeled symbol (M-3).
- 0 gamma [γ] contour
- -20 to +20 γ: 5 γ contour interval
- +20 to +50 γ,-20 to -50 γ: 10 γ contour interval
- Less than -50 γ: 50 γ contour interval

Relative Magnetic Field (gamma [γ])

- Greater than 20
- 15.1 - 20
- 10.1 - 15
- 5.1 - 10
- 0.1 - 5
- -4.9 - 0
- -9.9 - -5
- -14.9 - -10
- -19.9 - -15
- -24.9 - -20
- -99.9 - -25
- Less than -100

Approximate Duration of Magnetic Anomalies (m)

Size of circle is proportional to duration of the anomaly.

- Less than 50
- 50-100
- Greater than 100

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. Magnetometer Survey Instrumentation: Marine Magnetics Corp., SeaSPY Overhauser Total Field Magnetometer
3. OCS Block Boundaries: Minerals Management Service, 2005
4. Trackline represents position of GPS antenna.

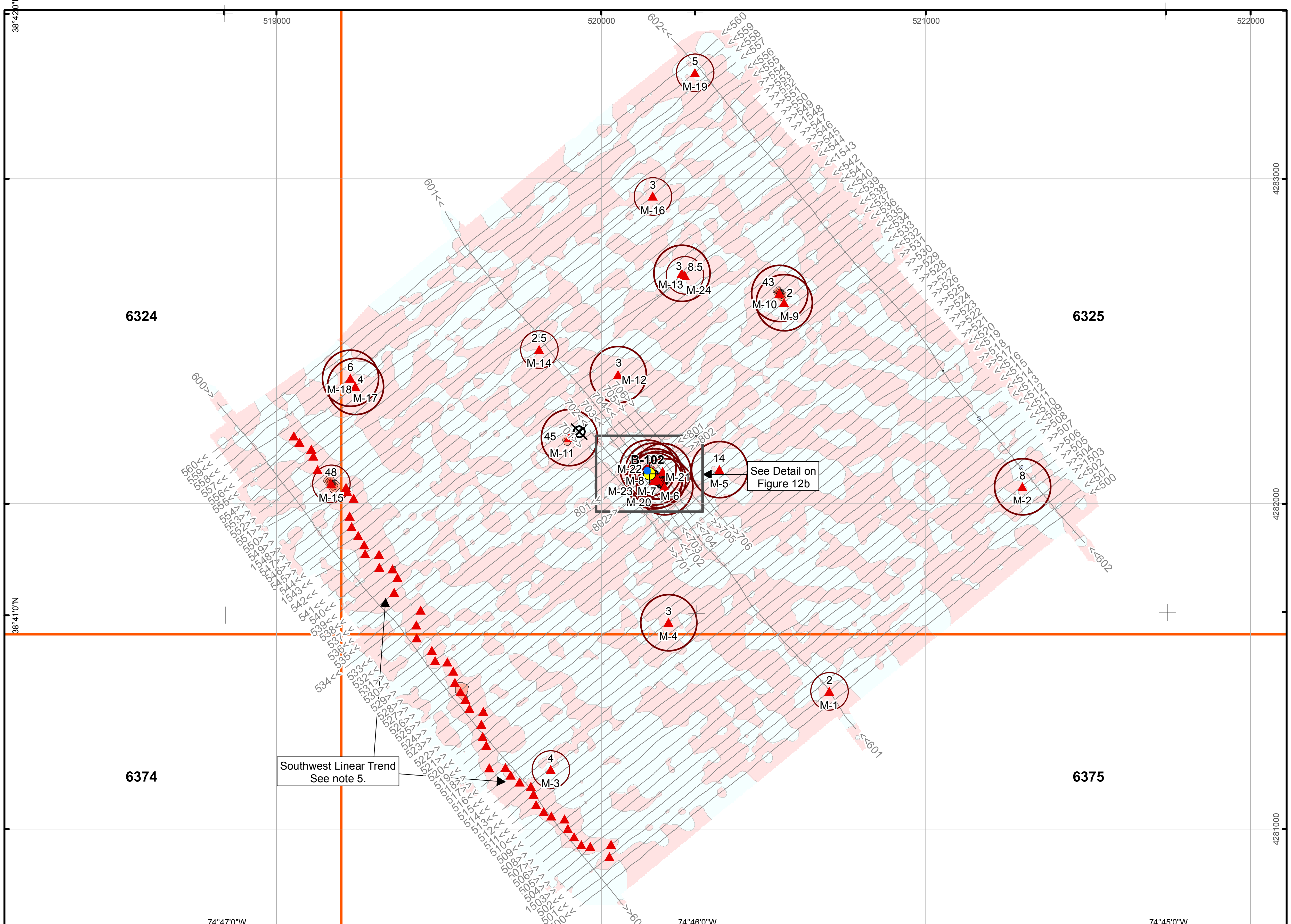
N W E S

0 500 1,000 2,000 Feet
0 100 200 400 Meters

MAGNETIC ANOMALIES
Fall 2009 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 11a

NRG Bluewater Wind
Project No. 3671.004



Legend

Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74° 46' 6"

2007 Halcrow/HPA Boring B-102 (Halcrow/HPA, 2009)

NOAA-Charted Obstruction
See NOAA Chart 12214

528>> 11 Magnetometer Survey Trackline. Survey line number and navigation fix points are labeled. Arrows indicate direction of vessel travel.

6325 Salisbury Protraction Area OCS Blocks

MAGNETOMETER SURVEY DATA

8 M-2 Magnetic Anomaly
Diameter of circle does not represent actual duration of anomaly. Number above symbol is intensity of anomaly (gammas). Anomaly designation is labeled symbol (M-3).

0 gamma [γ] contour

-20 to +20 γ: 5 γ contour interval

+20 to +50 γ,-20 to -50 γ: 10 γ contour interval

Less than -50 γ or Greater than 50 γ: 50 γ contour interval

Relative Magnetic Field (gamma [γ])

- Greater than 20
- 15.1 - 20
- 10.1 - 15
- 5.1 - 10
- 0.1 - 5
- -4.9 - 0
- -9.9 - -5
- -14.9 - -10
- -19.9 - -15
- -24.9 - -20
- -99.9 - -25
- Less than -100

Approximate Duration of Magnetic Anomalies (m)

Size of circle is proportional to duration of the anomaly.

- Less than 50
- 50-100
- Greater than 100

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS84, Meters; and Latitude/Longitude, WGS84
2. Magnetometer Survey Instrumentation: Marine Magnetics Corp., SeaSPY Overhauser Total Field Magnetometer
3. OCS Block Boundaries: Minerals Management Service, 2005
4. Trackline represents position of CRP (common reference point).
5. Southwest linear trending features include anomaly IDs M-25 to M-27. Duration and intensity values are not labeled but intensity values range from 1.5 to 8.6 gammas.

N S E W

0 500 1,000 2,000 Feet

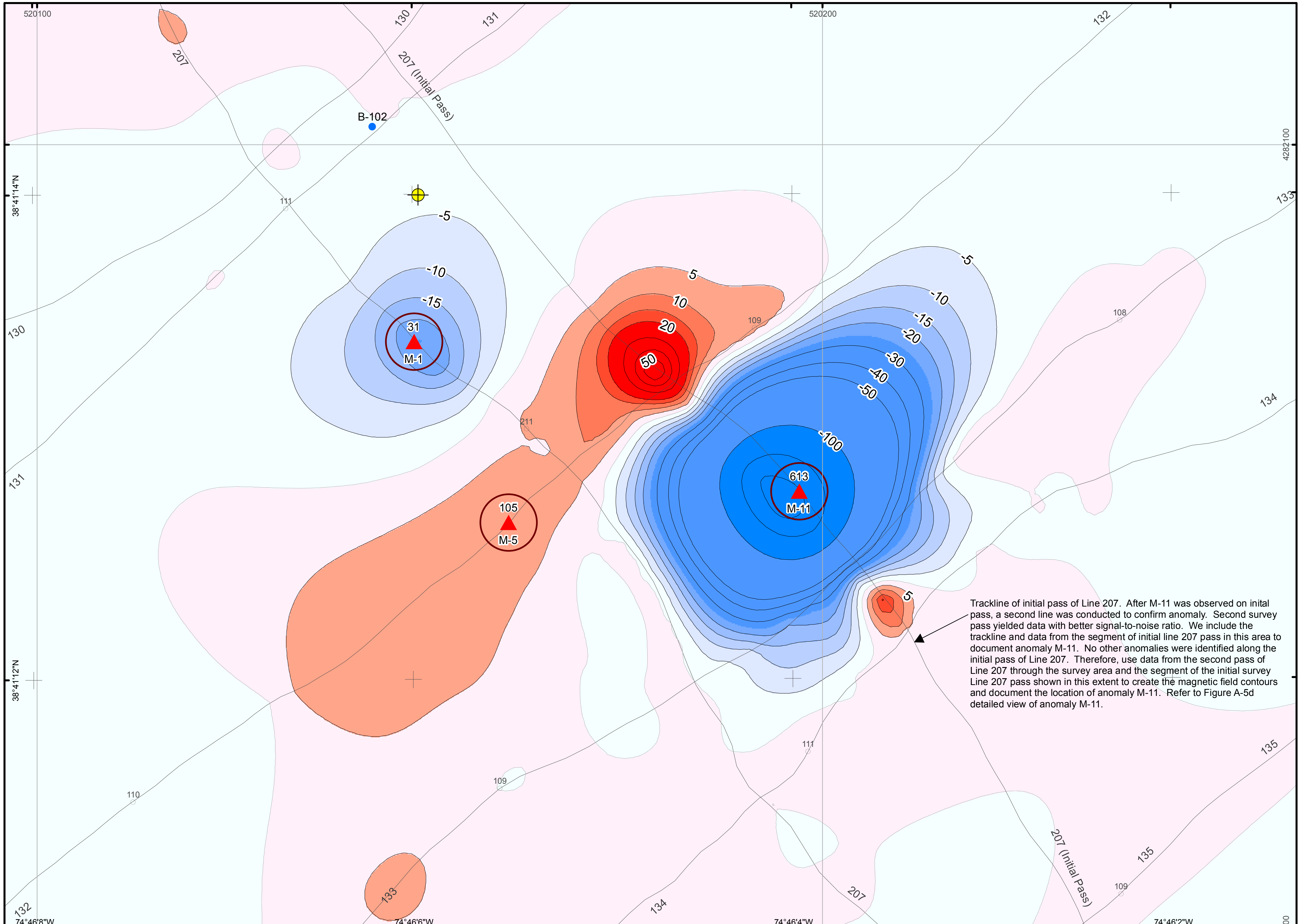
0 100 200 400 Meters

MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 11b

N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Revised_Shallow_Hazards_Report_Nov2010\MXD\Fig-11b_Magnetic_Anomalies.mxd, 11/29/10, kstevens

NRG Bluewater Wind
Project No. 3671.004



N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Shallow_Hazards_Report_Jan2010\mxd\Fig-12_Magnetic_Anomalies_MDCF_Area.mxd, 11/29/10, kstevens

Legend

Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74° 46' 6"

2007 Halcrow/HPA Boring B-102 (Halcrow/HPA, 2009)

155>> 120 Magnetometer Survey Trackline. Survey line number and navigation fix points are labeled. Arrows indicate direction of vessel travel.

6325 Salisbury Protraction Area OCS Blocks

MAGNETOMETER SURVEY DATA

35 M-3 Magnetic Anomaly
Diameter of circle does not represent actual duration of anomaly. Number above symbol is intensity of anomaly (gammas). Anomaly designation is labeled symbol (M-3).

0 gamma [γ] contour

-20 to +20 γ: 5 γ contour interval

+20 to +50 γ,-20 to -50 γ: 10 γ contour interval

Less than -50 γ: 50 γ contour interval

Relative Magnetic Field (gamma [γ])

Greater than 20
15.1 - 20
10.1 - 15
5.1 - 10
0.1 - 5
-4.9 - 0
-9.9 - -5
-14.9 - -10
-19.9 - -15
-24.9 - -20
-99.9 - -25
Less than -100

Approximate Duration of Magnetic Anomalies (m)

Size of circle is proportional to duration of the anomaly.

Less than 50
50-100
Greater than 100

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. Magnetometer Survey Instrumentation: Marine Magnetics Corp., SeaSPY Overhauser Total Field Magnetometer
3. OCS Block Boundaries: Minerals Management Service, 2005
4. Trackline represents position of GPS antenna.

N
W E
S

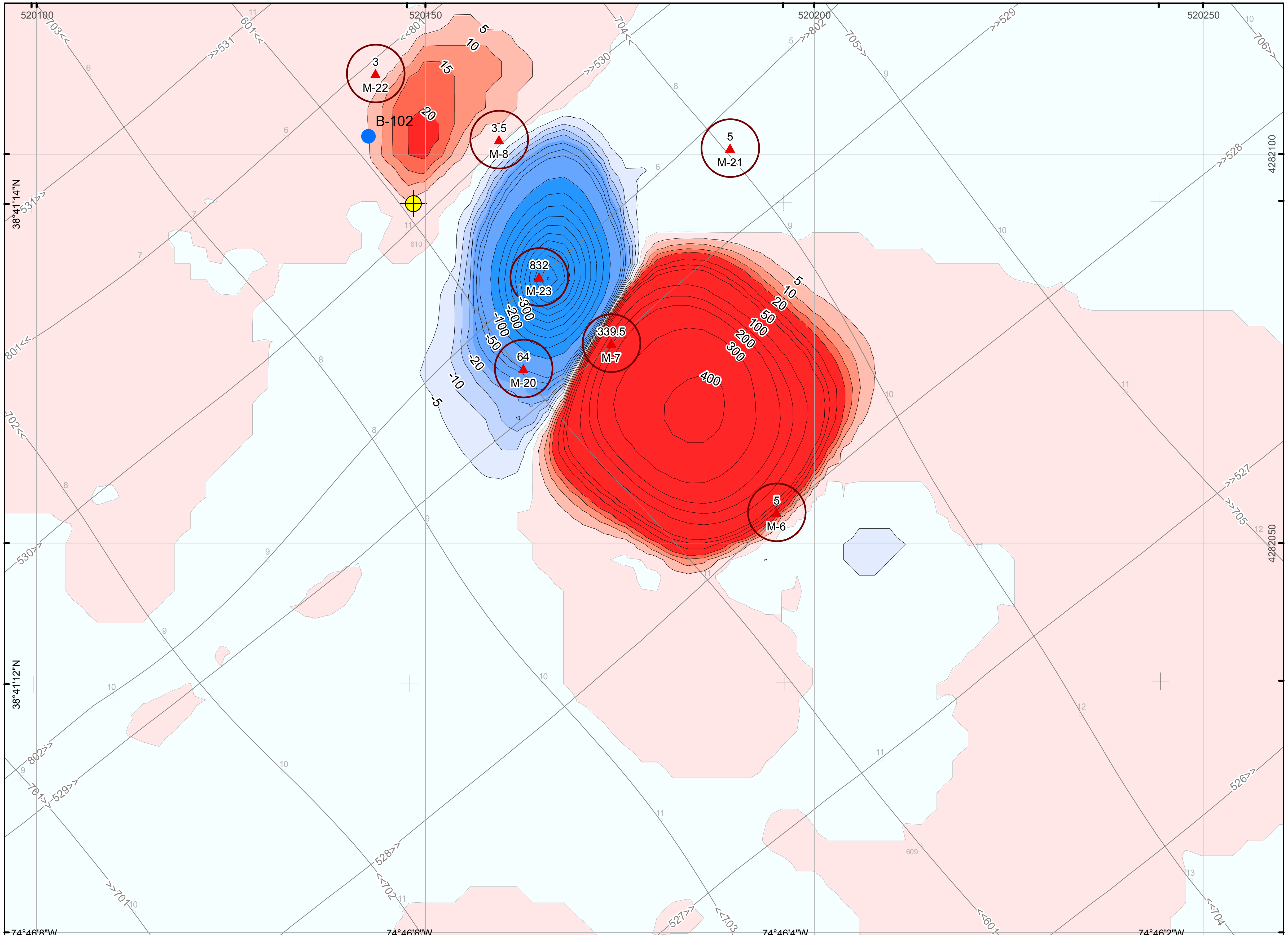
0 25 50 100 Feet

0 15 30 Meters

MAGNETIC ANOMALIES
Fall 2009 Survey
Proposed MDCF Area
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 12a

NRG Bluewater Wind
Project No. 3671.004



Legend

- Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74° 46' 6"
- 2007 Halcrow/HPA Boring B-102 (Halcrow/HPA, 2009)
- **NOAA-Charted Obstruction** See NOAA Chart 12214
- 528>> Magnetometer Survey Trackline. Survey line number and navigation fix points are labeled. Arrows indicate direction of vessel travel.
- 6325 Salisbury Protraction Area OCS Blocks

MAGNETOMETER SURVEY DATA

8 M-2 Magnetic Anomaly
Diameter of circle does not represent actual duration of anomaly. Number above symbol is intensity of anomaly (gammas). Anomaly designation is labeled symbol (M-3).

0 gamma [γ] contour
-20 to +20 γ: 5 γ contour interval
+20 to +50 γ,-20 to -50 γ: 10 γ contour interval
Less than -50 γ or Greater than 50 γ: 50 γ contour interval

Relative Magnetic Field (gamma [γ])

Greater than 20
15.1 - 20
10.1 - 15
5.1 - 10
0.1 - 5
-4.9 - 0
-9.9 - -5
-14.9 - -10
-19.9 - -15
-24.9 - -20
-99.9 - -25
Less than -100

Approximate Duration of Magnetic Anomalies (m)

Size of circle is proportional to duration of the anomaly.

Less than 50
50-100
Greater than 100

NOTES
1. Coordinate Grid: UTM Zone 18 North, WGS84, Meters; and Latitude/Longitude, WGS84
2. Magnetometer Survey Instrumentation: Marine Magnetics Corp., SeaSPY Overhauser Total Field Magnetometer
3. OCS Block Boundaries: Minerals Management Service, 2005
4. Trackline represents position of CRP (common reference point).

N W E S

0 25 50 100 Feet
0 15 30 Meters

MAGNETIC ANOMALIES
Fall 2010 Survey
Proposed MDCF Area
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 12b

N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Revised_Shallow_Hazards_Report_Nov2010\MXD\Fig-12b_Magnetic_Anomalies_MDCF_Area.mxd, 11/29/10, kstevens

BORING RECORD SHEET
HALCROW/HPA

Sheet no.: 1 of 7
Boring no.: B-102
Date: 10/14/07 to 10/17/07
Boring Elev.: -31.0 feet
Datum: Mean Low Water

Project: Bluewater Wind, LLC - Delaware Wind Park
Location: Offshore Delaware [Coordinates - 38º 41.2352, 74º 46.1035]
Contractor: Jersey Boring & Drilling Company, Inc.
Inspector: J. Silva

PROGRESS	DEPTH	CASING BLOWS	SAMPLE Depth	SAMPLE No.	SAMPLE Blows/6"	REC.	STRATA	FIELD DESCRIPTION AND REMARKS
10/14/2007 1:30 PM			0 / 2	S-1	10, 11, 10, 11	NR	SAND	No Recovery (Excessive Water Pressure - Running Sands Observed)
	5		5 / 7	S-2	Jetted	NR		No Recovery (Excessive Water Pressure - Running Sands Observed) Wash Sample Recovered in Its Place Brown Fine SAND, Trace Silt, (SP)
	10		10 / 12	S-3	18, 41, 30, 27	20"		Gray Medium to Fine SAND, Trace Silt, (SP) (MC = 15.4%)
	15		15 / 17	S-4	19, 27, 38, 47	18"		Gray Medium to Fine SAND, Trace Silt, Trace Shells, (SP-SM)
	20		20 / 22	S-5	23, 38, 61, 76	14"		Gray Medium to Fine SAND, Trace Silt, Trace Shells, (SP)
	25							

Sample Type: S: 1 3/8" I.D. Split Spoon, 140# hammer, 30" drop, 2 wraps
U: Undisturbed thin wall tube sampler __ push __ fixed piston
C: Core size, I.D. ___ Type ___ Casing ___.

Groundwater depth at completion:
Groundwater depth after ___hrs:
Boring no.: B-102

BORING LOG B-102
Provided by Halcrow/HPA
Delaware Continental Shelf

FIGURE 13a

BORING RECORD SHEET
HALCROW/HPA

Sheet no.: 2 of 7
Boring no.: B-102
Date: 10/14/07 to 10/17/07
Boring Elev.: -31.0 feet
Datum: Mean Low Water

Project: Bluewater Wind, LLC - Delaware Wind Park
Location: Offshore Delaware [Coordinates - 38º 41.2352, 74º 46.1035]
Contractor: Jersey Boring & Drilling Company, Inc.
Inspector: J. Silva

PROGRESS	DEPTH	CASING BLOWS	SAMPLE Depth	SAMPLE No.	SAMPLE Blows/6"	REC.	STRATA	FIELD DESCRIPTION AND REMARKS
10/15/2007			25	S-6	30	16"	SAND	Gray Medium to Fine SAND, Trace Silt, (SP-SM)
8:30 AM					48		CONT'D	Medium Grading to Fine Sand
					56			
			27		50			
	30							
			30	S-7	17	14"		Gray Fine SAND, Trace Silt, (SP-SM)
					28			
					32			
			32		27			
							Organic SILT	
	35							
			35	S-8	WOR	24"		Gray SILT & CAY, Trace Yellow/Brown Organic Fibers, (OL)
								[Strong Organic Odor] (MC = 28.7%)
			37					PP = 0.25 tsf
								Tv = 0.15 tsf
	40							
			40	S-9	WOR	24"		Same as Above, with Occasional 1/4 to 1/2 inch Medium to Fine Sand Lenses, (OH)
			42					
			40	S-10	WOR	24"		Attempted Shelby Tube Sample From 40 to 42 Feet with No Recovery. Split-Spoon Sample Taken Following Attempt.
								12" Gray Medium to Fine SAND, Some Clayey Silt, (SM)
			42					[Strong Organic Odor]
								12" Gray Clayey SILT, Some Medium to Fine Sand, (OH)
	45							[Strong Organic Odor]
			45	S-11	WOR	17"		Gray SILT & CLAY, Some Medium to Fine Sand, (O)
								(Occasional Sand Lenses)
								[Strong Organic Odor in Top 6 inches] (MC = 21.8%)
			47					
								PP = 0.25 tsf
								Tv = 0.1 tsf
	50							

Sample Type: S: 1 3/8" I.D. Split Spoon, 140# hammer, 30" drop, 2 wraps
U: Undisturbed thin wall tube sampler __ push __ fixed piston
C: Core size, I.D. ___ Type ___ Casing ___.

Groundwater depth at completion:
Groundwater depth after ___hrs:
Boring no.: B-102

BORING LOG B-102
Provided by Halcrow/HPA
Delaware Continental Shelf

FIGURE 13b

BORING RECORD SHEET
HALCROW/HPA

Sheet no.: 3 of 7
Boring no.: B-102
Date: 10/14/07 to 10/17/07
Project: Bluewater Wind, LLC - Delaware Wind Park
Boring Elev.: -31.0 feet
Location: Offshore Delaware [Coordinates - 38º 41.2352, 74º 46.1035]
Datum: Mean Low Water
Contractor: Jersey Boring & Drilling Company, Inc.
Inspector: J. Silva

PROGRESS	DEPTH	CASING BLOWS	SAMPLE Depth	SAMPLE No.	SAMPLE Blows/6"	REC.	STRATA	FIELD DESCRIPTION AND REMARKS
			50	S-12	WOH	24"	Organic SILT Cont'd	Gray Clayey SILT, Little Fine Sand, Trace Organic Fibers, (MH)
								[No Organic Odor]
					2			
			52		2			PP = 0.25 tsf
								Tv = 0.1 tsf
							SAND	
	55							
			55	S-13	7	20"		Green/Gray & Yellow/Brown, Medium to Fine SAND, Little
					8			Clayey Silt, Trace Fine Rounded Gravel, (SM) (MC = 16.0%)
					10			
			57		14			
							CLAY	
	60							
			60	S-14	7	24"		Gray Silty CLAY, And Medium to Fine Sand, (CL)
					7			
					10			
			62		14			
	65							
			65	S-15	5	24"		Gray Medium to Fine SAND, Little Silty Clay, (SC) (MC = 19.7%)
					6			
					7			
			67		8			
	70							
			70	S-16	3	24"		18" Gray Silty CLAY, Some Fine Sand, (CL)
					4			Grading To
					5			6" Gray Silty CLAY, Little Fine Sand, (CL)
			72		8			
								PP = 1.0 tsf
								Tv = 0.15 tsf
	75							

Sample Type: S: 1 3/8" I.D. Split Spoon, 140# hammer, 30" drop, 2 wraps
U: Undisturbed thin wall tube sampler __ push __ fixed piston
C: Core size, I.D. ___ Type ___ Casing ___.

Groundwater depth at completion:
Groundwater depth after ___hrs:
Boring no.: B-102

BORING LOG B-102
Provided by Halcrow/HPA
Delaware Continental Shelf

BORING RECORD SHEET
HALCROW/HPA

Sheet no.: 4 of 7
Boring no.: B-102
Date: 10/14/07 to 10/17/07
Boring Elev.: -31.0 feet
Datum: Mean Low Water

Project: Bluewater Wind, LLC - Delaware Wind Park
Location: Offshore Delaware [Coordinates - 38º 41.2352, 74º 46.1035]
Contractor: Jersey Boring & Drilling Company, Inc.
Inspector: J. Silva

PROGRESS	DEPTH	CASING BLOWS	SAMPLE Depth	SAMPLE No.	SAMPLE Blows/6"	REC.	STRATA	FIELD DESCRIPTION AND REMARKS
			75'-77'	S-17	3, 7, 8, 11	16"	CLAY CONT'D	Gray Silty CLAY, And Medium to Fine Sand, (CL)
							SAND	
	80		80-82	S-18	9, 11, 15, 16	21"		Gray Coarse to Fine SAND, Some Clayey Silt, (SM)
10/16/2007 8:30 AM	85		85-87	S-19	42, 22, 38, 41	20"		Gray Medium to Fine SAND, Some Silt, Trace Fine Gravel, Trace Wood Fragments/Lignite, (SM)
	90		90-92	S-20	53, 69, 83, 92	20"		Light Brown Coarse to Fine SAND, Trace Silt, (SP-SM) (MC = 13.1%)
	95		95-97	S-21	11, 8, 11, 20	24"	CLAY	6" Gray Fine SAND, Some Silt, (SM) 18" Gray Silty CLAY, Little Fine Sand, (CL) [Occasional Fine Sand Lenses Spaced 3 to 4 inches] PP = 1.75 tsf Tv = 0.35 tsf
							SAND	
	100							

Sample Type: S: 1 3/8" I.D. Split Spoon, 140# hammer, 30" drop, 2 wraps
U: Undisturbed thin wall tube sampler __ push __ fixed piston
C: Core size, I.D. ___ Type ___ Casing ___.

Groundwater depth at completion:
Groundwater depth after ___hrs:
Boring no.: B-102

BORING LOG B-102
Provided by Halcrow/HPA
Delaware Continental Shelf

FIGURE 13d

BORING RECORD SHEET
HALCROW/HPA

Sheet no.: 5 of 7
Boring no.: B-102
Date: 10/14/07 to 10/17/07
Boring Elev.: -31.0 feet
Datum: Mean Low Water

Project: Bluewater Wind, LLC - Delaware Wind Park
Location: Offshore Delaware [Coordinates - 38º 41.2352, 74º 46.1035]
Contractor: Jersey Boring & Drilling Company, Inc.
Inspector: J. Silva

PROGRESS	DEPTH	CASING BLOWS	SAMPLE Depth	SAMPLE No.	SAMPLE Blows/6"	REC.	STRATA	FIELD DESCRIPTION AND REMARKS
			100 / 102	S-22	43	20"	SAND CONT'D	Gray/Brown Coarse to Fine SAND, Trace Silt, (SP-SM)
					55			
					71			
					85			
	105							
			105 / 107	S-23	60	9"		Gray/Brown Coarse to Fine SAND, Little Fine Gravel, Little Silt, (SP-SM)
					100/5"			
					-			
					-			
							CLAY	
	110							
			110 / 112	S-24	WOR	24"		Gray CLAY & SILT, Little Fine Sand, Trace Organic Debris, (CL)
					↓			(MC = 24.6%)
								PP = 1.0 tsf
					8			Tv = 0.35 tsf
	115							
			115 / 117	S-25	17	24"		12" Gray Fine SAND, And Silt, (SM)
					15			12" Gray Silty CLAY, Little Fine Sand, (CL)
					15			(Fine Sand Lenses @ 3" to 4" Spacing within the Clay)
					19			
								PP = 0.75 to 1.5 tsf
								Tv = 0.3 to 0.4 tsf
	120							
			120 / 122	S-26	WOH	24"		Gray Silty CLAY, Little Fine Sand, (CL)
					3			(Fine Sand Lenses @ 3" to 4" Spacing)
					11			
					13			PP = 2.0 to 3.5 tsf
								Tv = 0.4 to 0.7 tsf
	125							

Sample Type: S: 1 3/8" I.D. Split Spoon, 140# hammer, 30" drop, 2 wraps
U: Undisturbed thin wall tube sampler __ push __ fixed piston
C: Core size, I.D. ___ Type ___ Casing ___.

Groundwater depth at completion:
Groundwater depth after ___hrs:
Boring no.: B-102

BORING LOG B-102
Provided by Halcrow/HPA
Delaware Continental Shelf

FIGURE 13e

BORING RECORD SHEET
HALCROW/HPA

Sheet no.: 6 of 7
Boring no.: B-102
Date: 10/14/07 to 10/17/07
Boring Elev.: -31.0 feet
Datum: Mean Low Water

Project: Bluewater Wind, LLC - Delaware Wind Park
Location: Offshore Delaware [Coordinates - 38º 41.2352, 74º 46.1035]
Contractor: Jersey Boring & Drilling Company, Inc.
Inspector: J. Silva

PROGRESS	DEPTH	CASING BLOWS	SAMPLE Depth	SAMPLE No.	SAMPLE Blows/6"	REC.	STRATA	FIELD DESCRIPTION AND REMARKS
			125 / 127	S-27	WOR	14"	CLAY CONT'D	Gray Silty CLAY, Trace Fine Sand, (CL)
								PP = 1.25 to 1.5 tsf
								Tv = 0.4 to 0.6 tsf
	130		130 / 132	S-28	WOR	24"		Gray CLAY & SILT, Trace Fine Sand, (CL) (MC = 24.3%)
					WOH			
					5			PP = 1.0 to 1.5 tsf
					14			Tv = 0.4 to 0.8 tsf
	135		135 / 137	S-29	WOR	24"		Gray Silty CLAY, Trace Fine Sand, (CL)
								PP = 1.25 tsf
								Tv = 0.6 to 0.7 tsf
							SAND	
	140							
10/17/2007 9:00 AM			140 / 142	S-30	38	20"		Gray Medium to Fine SAND, Trace Silt, Trace Shells, (SP-SM)
					48			
					55			
					72			
	145		145 / 147	S-31	35	18"		Gray Coarse to Fine SAND, Trace Silt, (SP)
					46			
					53			
					68			
	150							

Sample Type: S: 1 3/8" I.D. Split Spoon, 140# hammer, 30" drop, 2 wraps
U: Undisturbed thin wall tube sampler __ push __ fixed piston
C: Core size, I.D. ___ Type ___ Casing ___.

Groundwater depth at completion:
Groundwater depth after ____hrs:
Boring no.: B-102

BORING LOG B-102
Provided by Halcrow/HPA
Delaware Continental Shelf

FIGURE 13f

BORING RECORD SHEET
HALCROW/HPA

Sheet no.: 7 of 7
Boring no.: B-102
Date: 10/14/07 to 10/17/07
Boring Elev.: -31.0 feet
Datum: Mean Low Water

Project: Bluewater Wind, LLC - Delaware Wind Park
Location: Offshore Delaware [Coordinates - 38º 41.2352, 74º 46.1035]
Contractor: Jersey Boring & Drilling Company, Inc.
Inspector: J. Silva

PROGRESS	DEPTH	CASING BLOWS	SAMPLE Depth	SAMPLE No.	SAMPLE Blows/6"	REC.	STRATA	FIELD DESCRIPTION AND REMARKS
			150	S-32	30	18"	SAND CONT'D	Gray Coarse to Fine SAND, Trace Silt, (SP) (MC = 14.7%)
					35			
					41			
			152		46			
								Increased Pressure Observed on Roller-bit
	155							
			155	S-33	91	12"		6" Gray Fine Subrounded & Rounded GRAVEL, Some Coarse to Fine Sand, Trace Silt, (GP)
					70			
					100/5"			6" Gray Medium to Fine SAND, Trace Silt, (SP)
			157		-			
								Continued High Pressure Observed on Roller-bit
	160							
			160	S-34	45	8"		Gray Medium to Fine SAND, Trace Silt, (SP)
					97			
					100/3"			
			162		-			
								Continued High Pressure Observed on Roller-bit
	165							
			165	S-35	40	8"		Gray Medium to Fine SAND, Trace Silt, Trace Fine Rounded Gravel, (SP-SM)
					78			
					100/5"			
10/17/2007			167		-			
1:00 PM							END	Boring Terminated @ 167 Feet Below The Sea Floor.
	170							
	175							

Sample Type: S: 1 3/8" I.D. Split Spoon, 140# hammer, 30" drop, 2 wraps
U: Undisturbed thin wall tube sampler __ push __ fixed piston
C: Core size, I.D. ___ Type ___ Casing ___.

Groundwater depth at completion:
Groundwater depth after ___hrs:
Boring no.: B-102

BORING LOG B-102
Provided by Halcrow/HPA
Delaware Continental Shelf

FIGURE 13g

BORING RECORD SHEET
HALCROW/HPA

Sheet no.: 1 of 1
Boring no.: B-102
Date: 10/14/07 to 10/17/07

Project: Bluewater Wind, LLC - Delaware Wind Park
Boring Elev.: -31.0 feet
Location: Offshore Delaware [Coordinates - 38º 41.2352, 74º 46.1035]
Datum: Mean Low Water
Contractor: Jersey Boring & Drilling Company, Inc.
Inspector: J. Silva

Groundwater Level Observations:

Date	Time	TOC to Mud	TOD to Water	Tide Height Above MLW	Conditions of Observation
10/14/2007	1:30 PM	48' - 7"	9' - 11"	2' - 5"	TOC is +5' - 3" above TOD

Boring Equipment Used:

Drill Rig: Acker — Casing Used
Truck ___ — Dia. (in): ___ Depth (ft) from: ___ to ___
Skid XLS — Dia. (in): 4 Depth (ft) from: ___ to ___
Barge ___ — Dia. (in): ___ Depth (ft) from: ___ to ___
Other ___ — Dia. (in): ___ Depth (ft) from: ___ to ___

Sampling Methods: Automatic Hammer

S-sampler: Split-Spoon — Drilling Mud: ZeoGel, QuikGel
U-sampler: ___ — Type and Dia of Bit: ___
Core Barrel: ___ — Auger type and Dia: ___
Core Bit: ___ — Casing Hammer, lbs.: ___ Avg. Fall (in) ___
Drill Rods: ___ — Sampler Hammer, lbs.: 140 Avg. Fall (in) 30

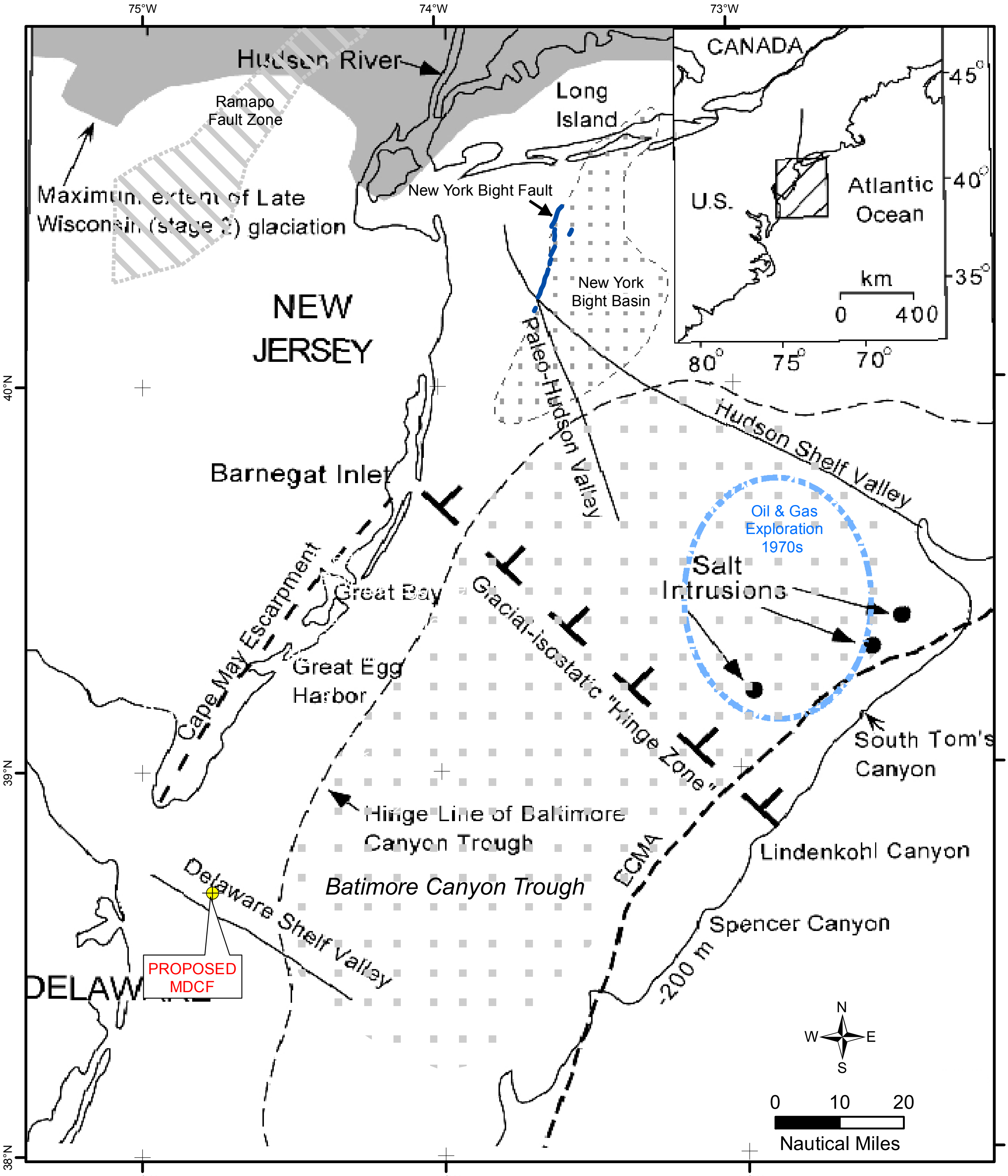
Piezometer Installation:

Standpipe: Type: ___ ID (in) ___ Length (ft) ___ Top Elev.: ___
Intake: Type: ___ OD (in) ___ Length (ft) ___ Tip Elev.: ___
Filter: Material: ___ OD (in) ___ Length (ft) ___ Bot Elev.: ___

Boring Contractor: Jersey Boring & Drilling Company, Inc.
Driller: Gerry Helper: Brent
Inspector: Joseph Silva
Remarks: ___ Date: 10/14/07 to 10/17/07
Boring No.: B-102

BORING LOG B-102
Provided by Halcrow/HPA
Delaware Continental Shelf

FIGURE 13h

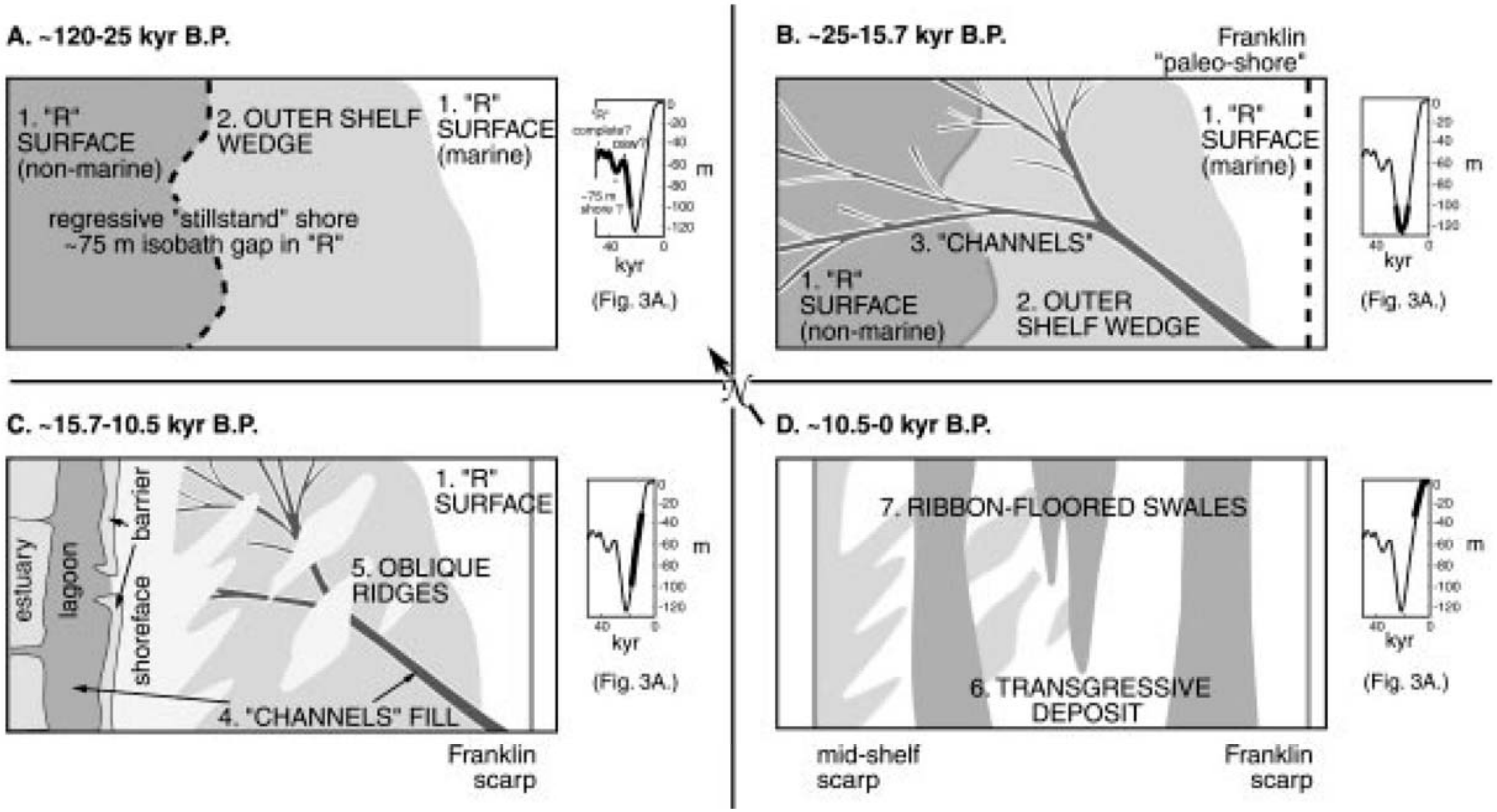


Modified From: Carey et al. (1998)

GEOLOGIC STRUCTURE
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 14

N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Shallow_Hazards_Report_Jan2010\mxd\Fig-14_Geologic_Structure.mxd, 11/29/10, kstevens



Schematic geologic evolution of the mid-shelf corridor since ~120 kyr B.P. The portion of the global eustatic curve (inset Fig. 3A above) displayed in each cartoon is marked with a heavy black line. (A) Depicts period when the shoreline moved seaward across the mid-shelf corridor during the last regression (~120-25 kya); (B) shows the Wisconsin glacial maximum, when the mid-shelf corridor was subaerially exposed, and "channels" were carved (~25-15.7 kya); (C) illustrates the portion of the Holocene transgression when the shoreline moved from the Frankline "paleo-shore" to the mid-shelf scarp, and "channels" were infilled with an upward-deepening succession of lagoonal and estuarine muds; estuaries, lagoons, shoreface barriers, and nearshore shores/oblique ridges comprised the various depositional environments in this cartoon (~15.7-10.5 kya); (D) shows the modern seafloor of the mid-shelf corridor (10.5 kyr to Present). Shelf currents have reworked and winnowed the oblique ridges, creating the surficial unit. *"Channels" and other subsurface features (e.g. deltas, unconformities, etc.) have no seafloor bathymetric expression*, and the ribbon-floored swales represent erosion of the surficial unit.

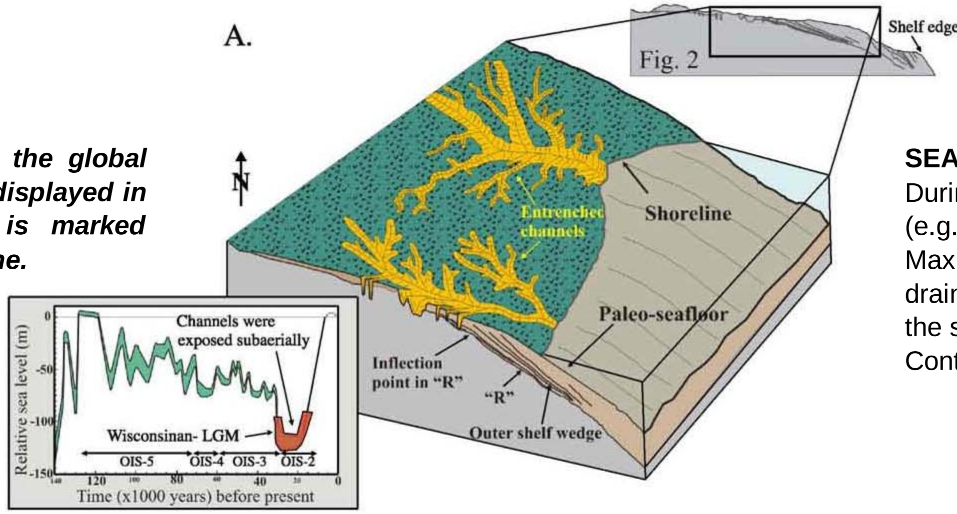
Source: Duncan et al. (2000)

GEOLOGIC EVOLUTION OF MID-SHELF CORRIDOR

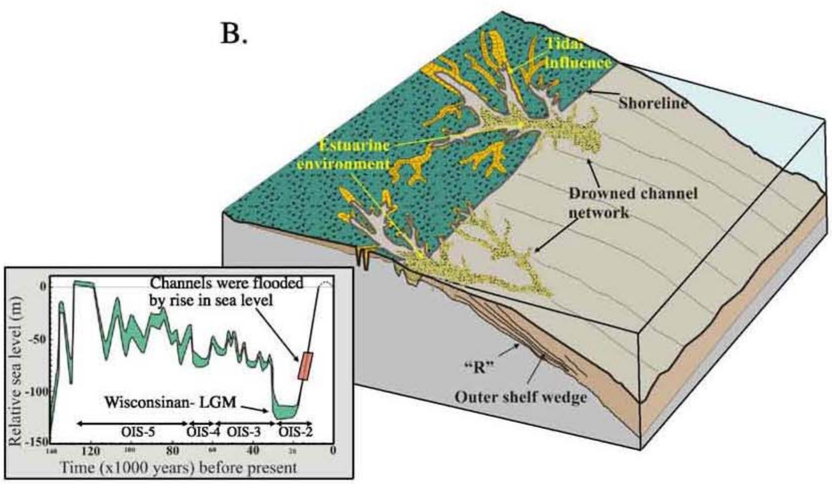
Bluewater Wind Meteorological Tower

Delaware Continental Shelf

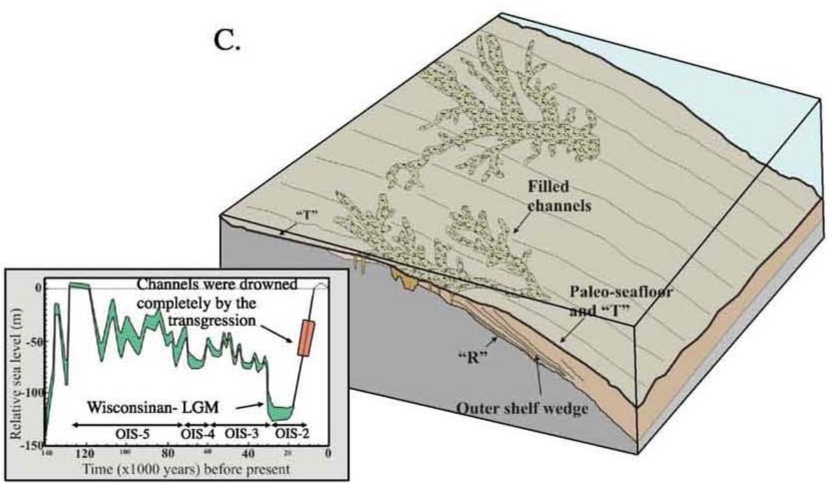
The portion of the global eustatic curve displayed in each cartoon is marked with a red outline.



SEA LEVEL LOWSTANDS
During Sea Level Lowstands (e.g. Wisconsin – Last Glacial Maximum ~25-15.7 kya), drainage systems developed on the subaerially exposed Continental Shelf.



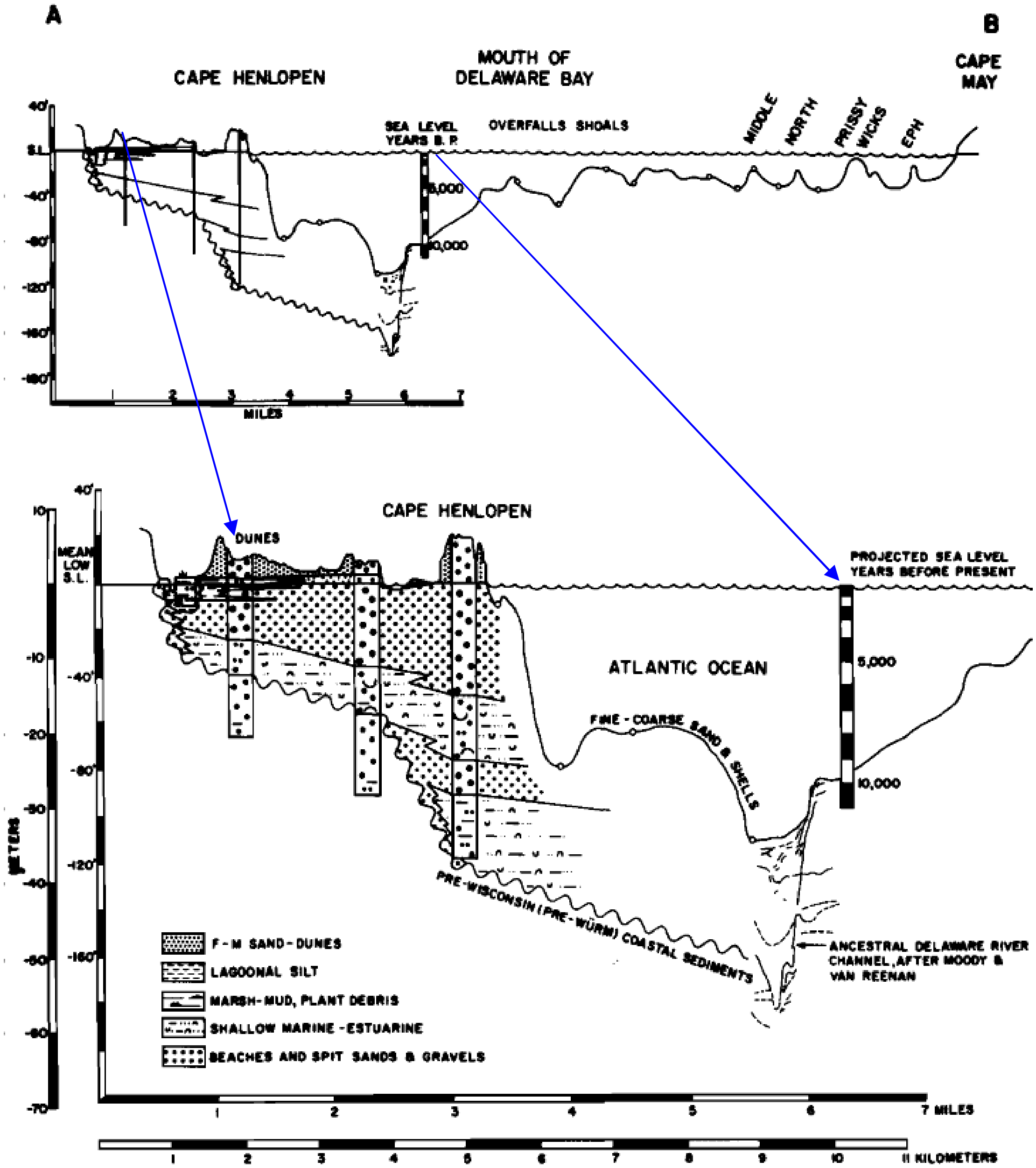
MARINE TRANSGRESSION
As sea level rose, the shoreline transgressed across the shelf which resulted in: 1) fluvial channels transitioning to estuarine environments, and 2) drowning, infilling, and burial of channels; channels infilled with upward deepening succession of lagoonal and estuarine muds.



CONDITIONS TODAY
Following transgression, Holocene-age marine sediments mask the location of channels and the materials that infill them.

Source: Nordfjord et al. 2005

CHANNEL INCISION AND BURIAL EXAMPLE
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

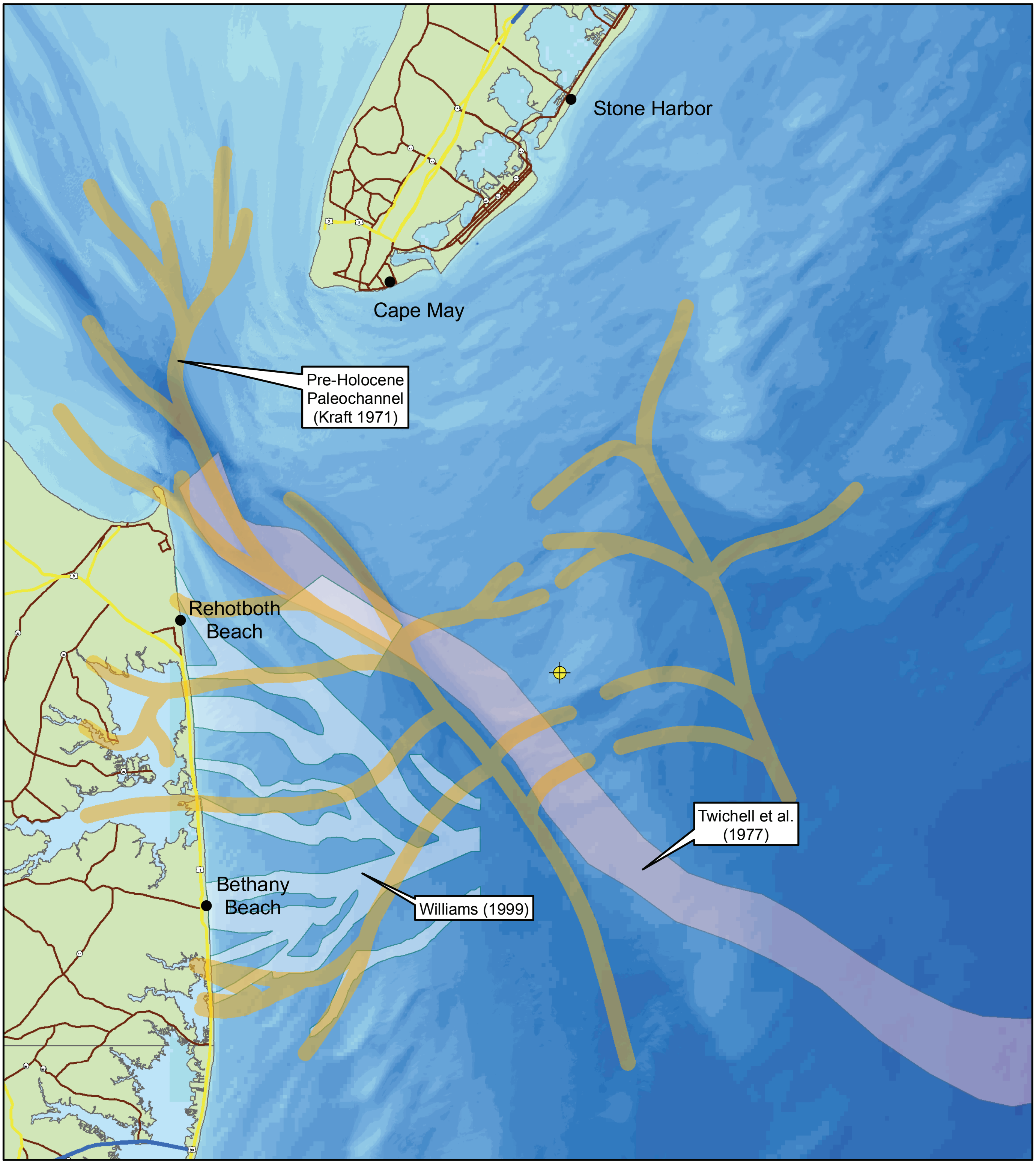


Modified from Kraft (1971). Interpretive cross section showing Holocene sedimentary environments near mouth of Delaware Bay. The ancestral Delaware River channel is inferred to be as deep as 100 feet below sea level in the thalweg areas. Pre-Holocene paleochannels are inferred to exist below the Holocene thalweg. Channel infill materials are inferred to consist of silt, clay, organic-rich sediments, and variable amounts of sand (Sheridan et al., 1974). The proposed MDCF is located approximately 14 Nm southeast (downstream) of this cross section. Based on the seismic survey, the proposed in MDCF is not located in a thalweg of a major drainage related to this system.

ANCESTRAL DELAWARE RIVER

Bluewater Wind Meteorological Tower

New Jersey Continental Shelf



PALEODRAINAGES BENEATH THE DELAWARE SHELF VALLEY

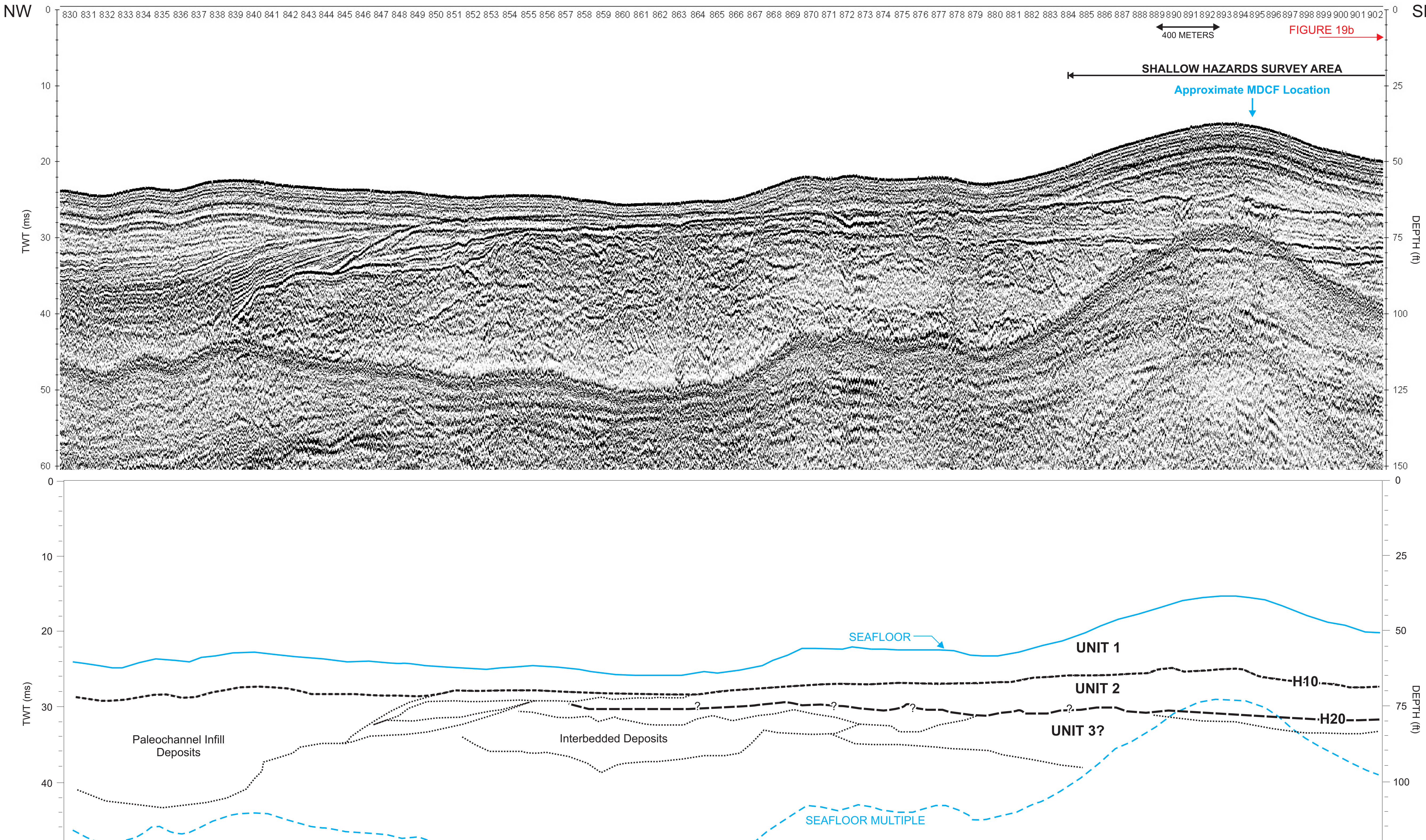
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

Legend

Proposed MDCF Site

FIGURE 18

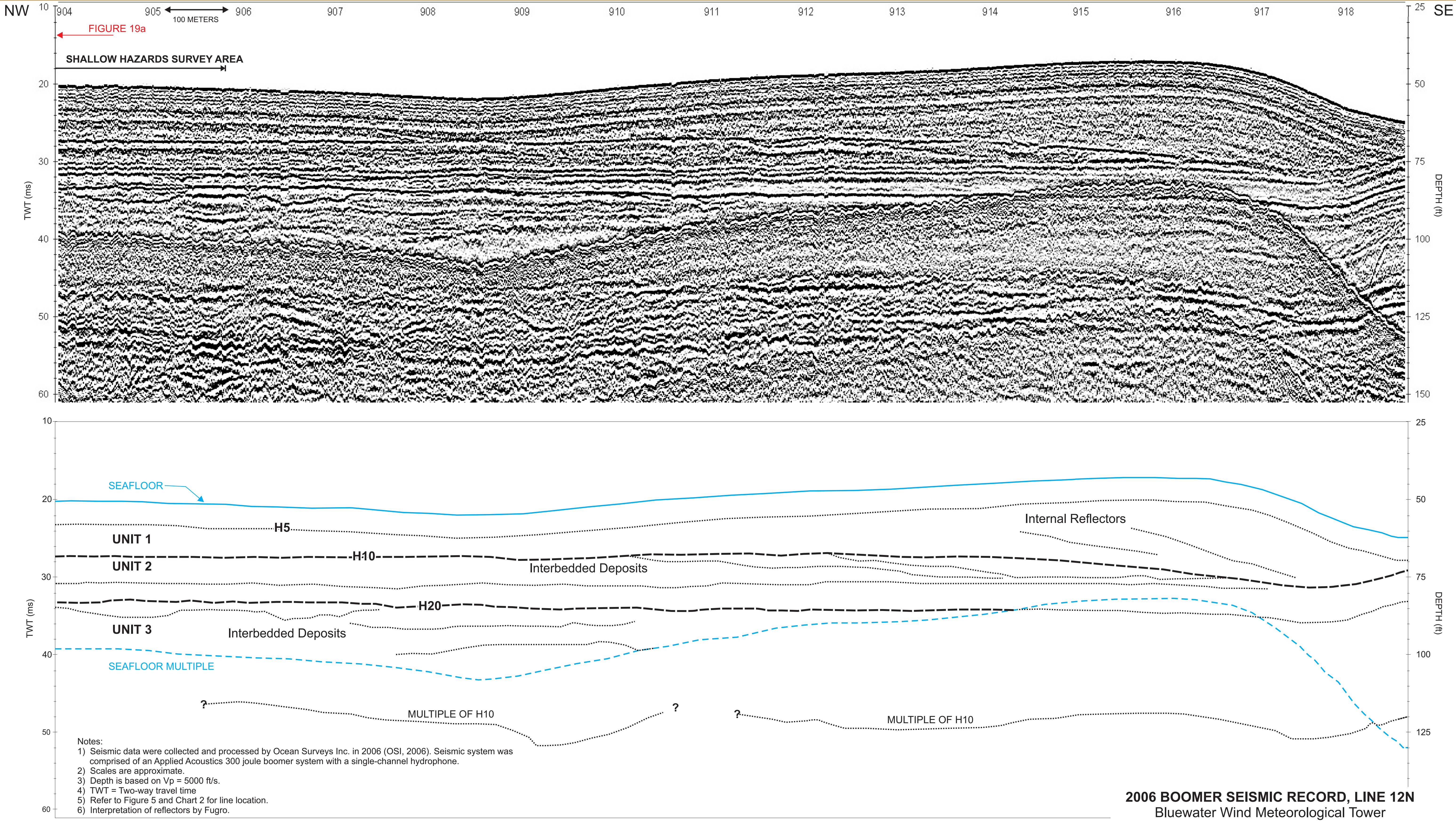
N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Shallow_Hazards_Report_Jan2010\mxd\Fig-18_Paleodrainages_Beneath_The_Delaware_Shelf_Valley.mxd, 11/29/10, kstevens



Notes:
1) Seismic data were collected and processed by Ocean Surveys Inc. in 2006 (OSI, 2006). Seismic system was comprised of an Applied Acoustics 300 joule boomer system with a single-channel hydrophone.
2) Scales are approximate.
3) Depth is based on Vp = 5000 ft/s.
4) TWT = Two-way travel time
5) Refer to Figure 5 and Chart 2 for line location.
6) Interpretation of reflectors by Fugro.

2006 BOOMER SEISMIC RECORD, LINE 12N
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

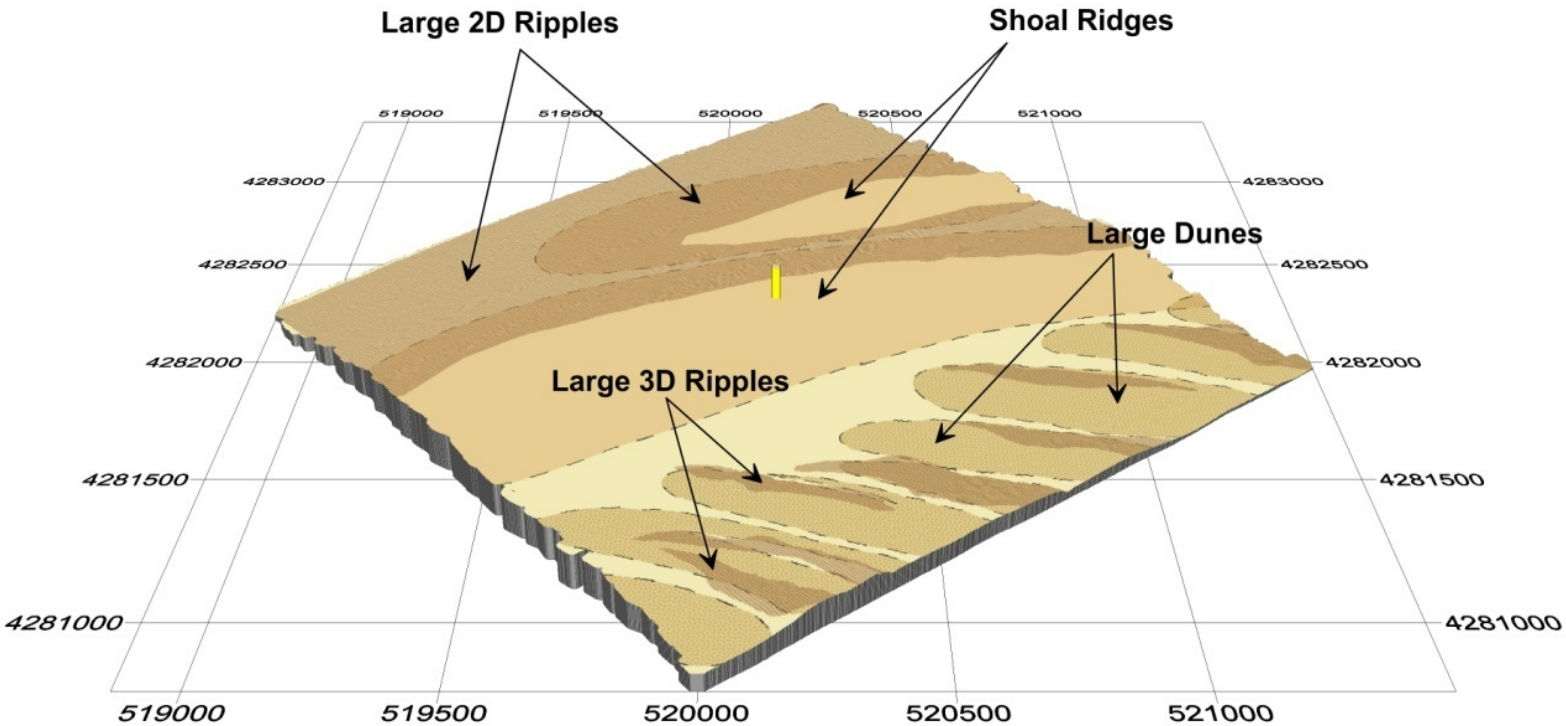
FIGURE 19a



Notes:
1) Seismic data were collected and processed by Ocean Surveys Inc. in 2006 (OSI, 2006). Seismic system was comprised of an Applied Acoustics 300 joule boomer system with a single-channel hydrophone.
2) Scales are approximate.
3) Depth is based on Vp = 5000 ft/s.
4) TWT = Two-way travel time
5) Refer to Figure 5 and Chart 2 for line location.
6) Interpretation of reflectors by Fugro.

2006 BOOMER SEISMIC RECORD, LINE 12N
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 19b



The three bedform scales in the study area are sand ridges, large dunes and ripples of both straight (2D) and discontinuous (3D) types. The proposed MDCF (yellow cylinder in center) is located on the crest of the primary ridge. A smaller crest is superimposed on the ridge north of the MDCF. The dunes crests are on the order of 900 ft apart, and approximately 5 ft high. The 2D ripple crests are approximately 3 ft apart; those of the 3D ripples were not sufficiently visible to be measured. The yellow post is the location of the proposed meteorological tower.

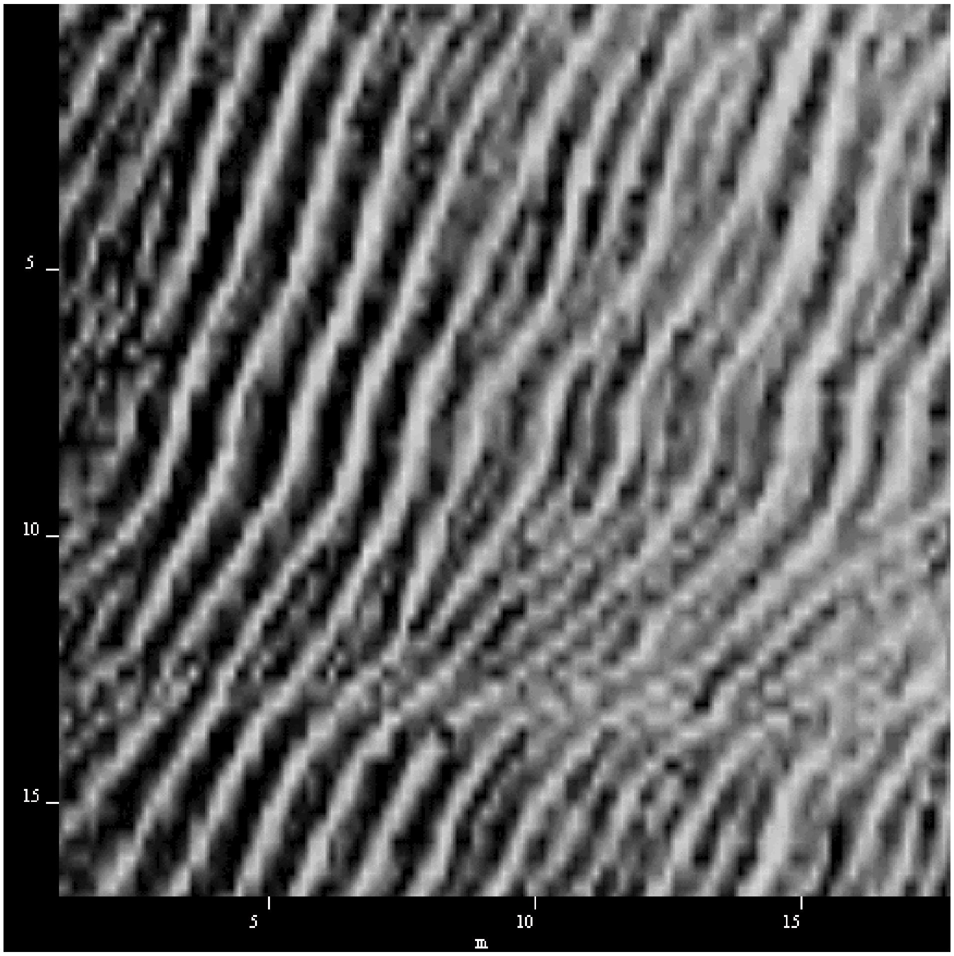
BEDFORMS

Bluewater Wind Meteorological Tower

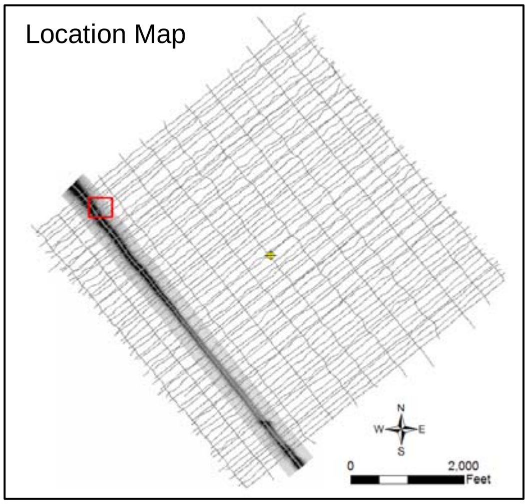
Delaware Continental Shelf

FIGURE 20a

NRG Bluewater Wind
Project No. 3671.004



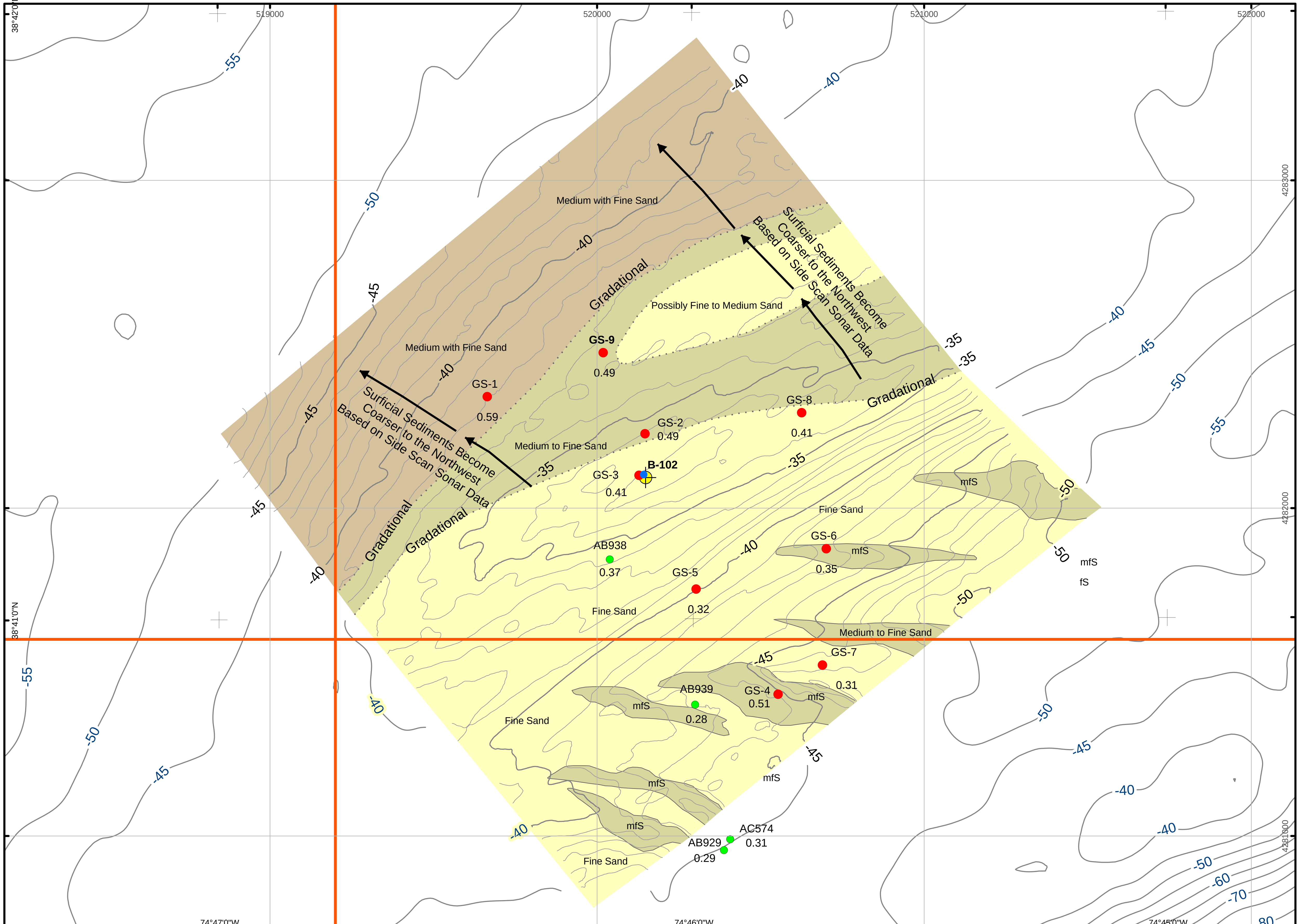
Side scan sonar data example (above) showing ripples from survey line 207. The ripples are up to about 3 feet in wavelength and 0.5 feet in wave height. Many ripples are too small to measure. The tick marks along the sides of the image are in meters. Ripples were observed throughout the survey area but were more prevalent in the northern half and southwestern corner of the survey area. The ripples are transient. For example, after strong wind events the ripples were planed off in areas where they were prevalent prior to the wind event (refer to Figure 21 for an example). The location of the image above is shown in the location map to the right.



BEDFORMS
Ripples
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 20b

NRG Bluewater Wind
Project No. 3671.004



Legend

Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74° 46' 6"

GS-3 0.41 — 2010 Fugro Grab Sample [Sample ID is labeled above the symbol and median grain size (D_{50}) in mm is labeled below the symbol]

2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)

0.37 — USGS East-Coast Database (Hastings, 2000) [Sample ID is labeled above the symbol and median grain size (D_{50}) in mm is labeled below the symbol]

A — A' Subsurface Profile Location

6325 — Salisbury Protraction Area OCS Block

-40 — **Regional Bathymetry - NJDEP** Contour interval is 5 feet.

-35 — **Fugro 2009 Bathymetric Survey** Contour interval is 1 foot and referenced to MLLW.

Interpreted Predominant Surficial Sediment Type

Fine Sand (fS)

Medium to Fine Sand (mfS)

Medium with Fine Sand (mS)

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005
3. 2010 Fugro grab samples were collected using a Petite Ponar sampler.

N W E S

0 500 1,000 2,000 Feet

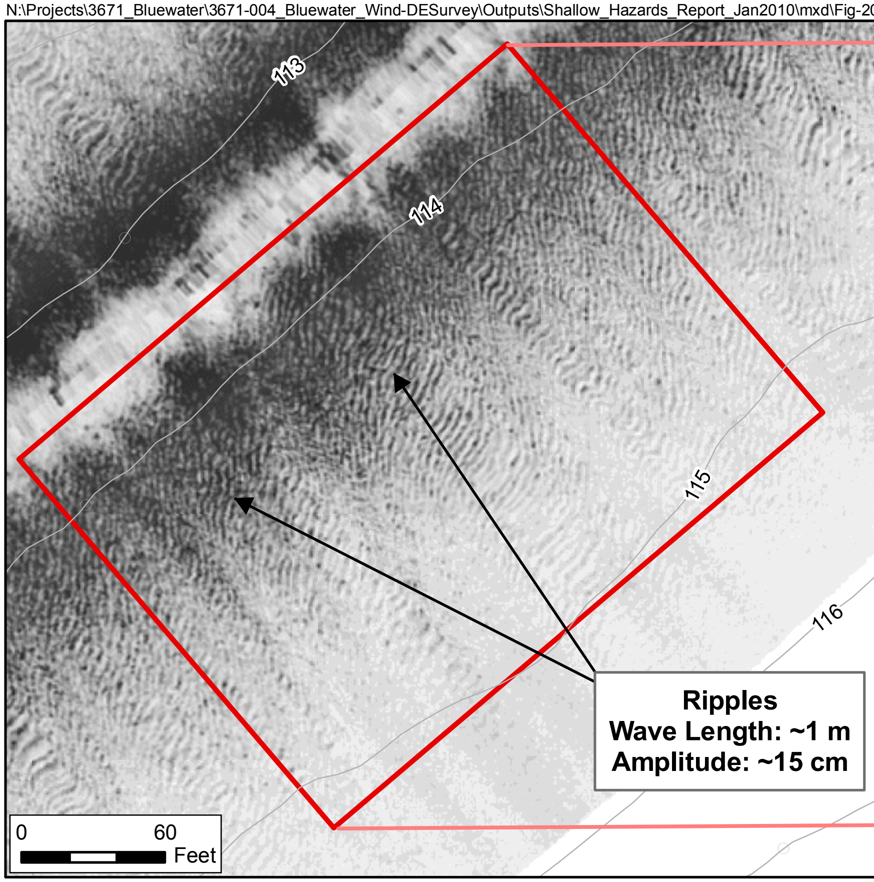
0 100 200 400 Meters

SITE SURFICIAL SEDIMENTS
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

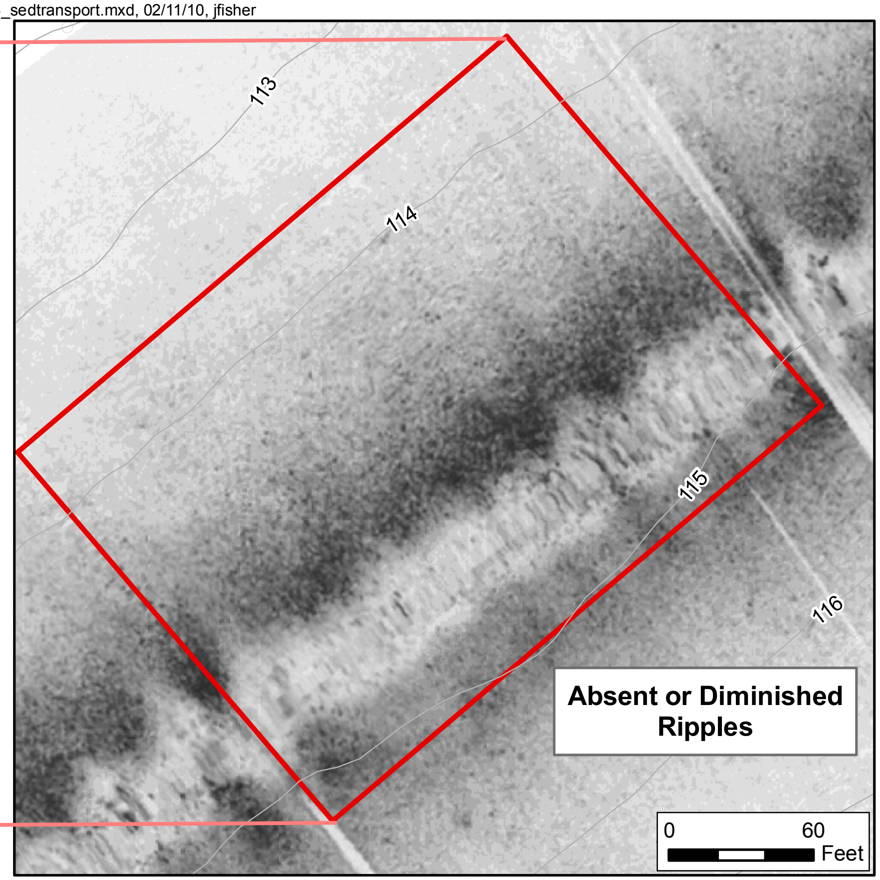
FIGURE 20c

N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Revised_Shallow_Hazards_Report_Nov2010\MXD\Fig-20c_Surficial_Sediments.mxd, 11/29/10, kstevens

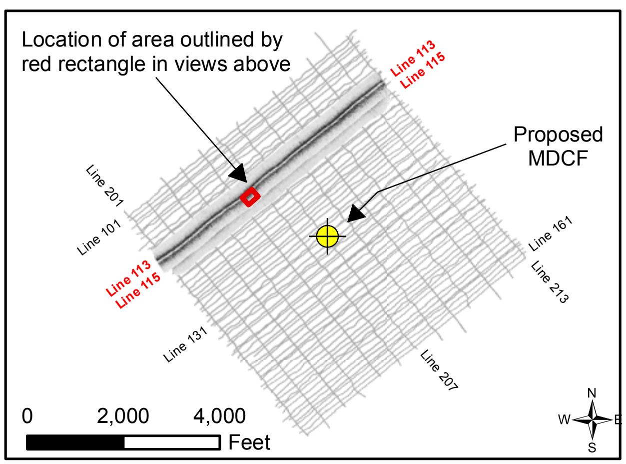
N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Shallow_Hazards_Report_Jan2010\mxd\Fig-20_SSS_sedtransport.mxd, 02/11/10, jfisher



Pre-Storm Seafloor Conditions, Survey Line 113, October 30, 2009



Post-Storm Seafloor Conditions, Survey Line 115, November 1, 2009



No surveying was performed on October 30, 2009 due to strong wind and rough sea-state conditions associated with a storm event. The side scan sonar image on the left (Line 113) shows the seafloor conditions prior to the storm event and the side scan sonar image on the right (Line 115) shows the seafloor conditions after the storm event. The red rectangle defines the same extent in both images.

The image on the left shows bedforms (ripples) that are planed off or diminished in the right image. It is postulated that the storm event produced strong bottom flow and turbulance which induced sediment transport and modified bedforms on the seafloor.

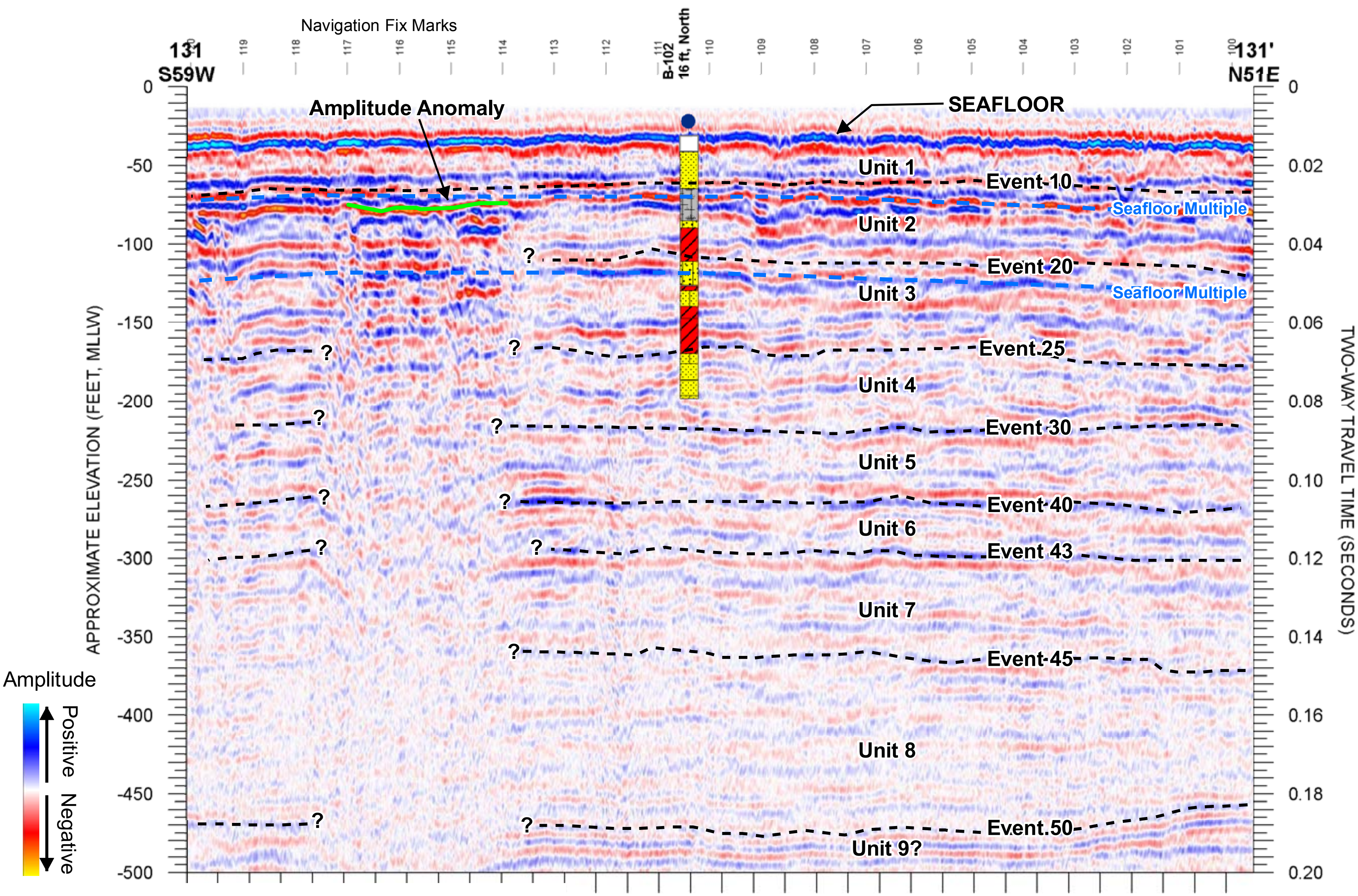
EVIDENCE OF SEDIMENT TRANSPORT
IN SIDE SCAN SONAR DATA
Fall 2009 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 21

NRG Bluewater Wind
Project No. 3671.004

FUGRO

N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Shallow_Hazards_Report_Jan2010\mxd\Fig-22_3125mgi_line131_Seismic_Record.mxd, 02/12/10, jfisher



Notes:
1) Seismic data converted to depth using Vp = 5,000 ft/s.
2) Boring B-102 drilled in 2007 by Halcrow/HPA under contract to Bluewater Wind.
3) Scales are approximate.

3.125-mgi BOOMER SEISMIC RECORD, LINE 131
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

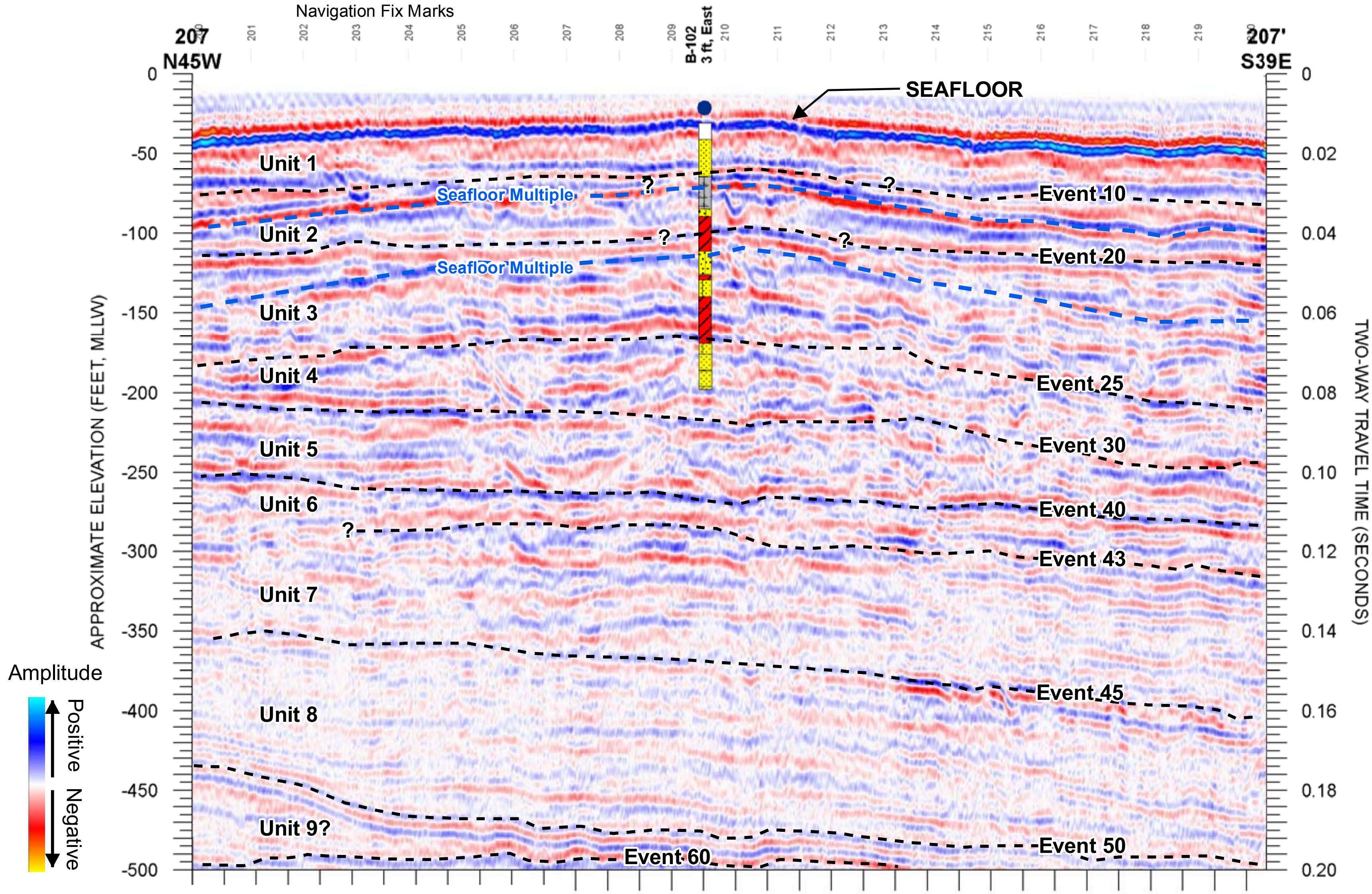
Legend

No Recovery
Sand
Gravel
Organic/Clay
Clay

NRG Bluewater Wind
Project No. 3671.004

FIGURE 22

N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Shallow_Hazards_Report_Jan2010\mxd\Fig-23_3125mgi_line207_Seismic_Record.mxd, 02/11/10, jfisher



Notes:
1) Seismic data converted to depth using Vp = 5,000 ft/s.
2) Boring B-102 drilled in 2007 by Halcrow/HPA under contract to Bluewater Wind.
3) Scales are approximate.

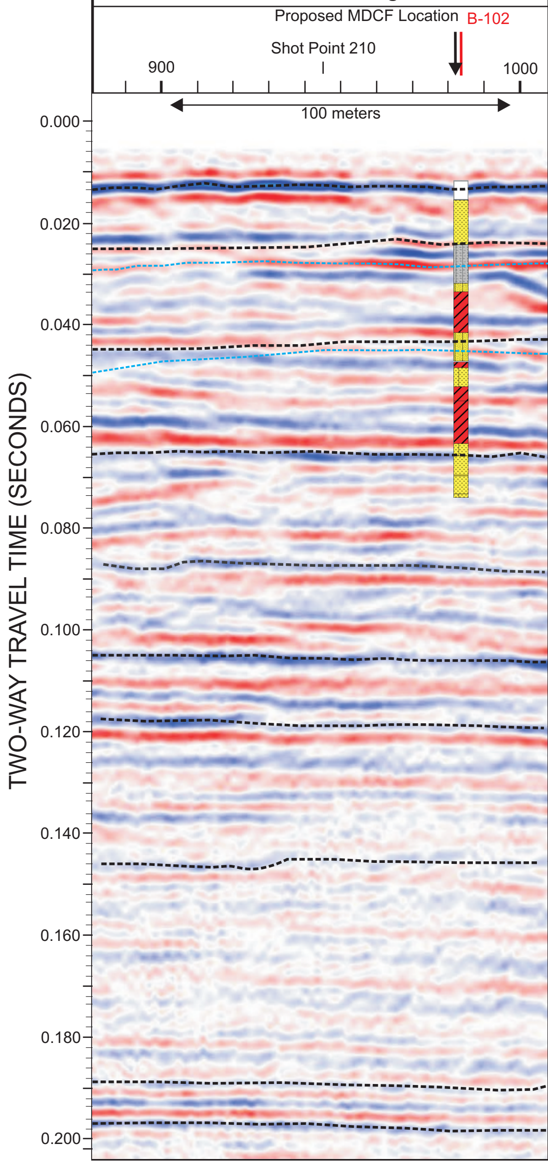
Legend

No Recovery
Sand
Gravel
Organic/Clay
Clay

3.125-mgi BOOMER SEISMIC RECORD, LINE 207
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 23

NRG Bluewater Wind
Project No. 3671.004



EVENT & SEISMIC UNIT DESIGNATION	INFERRED LITHOLOGY & SURFACE CONDITIONS	DEPTH FEET (BML)	DEPTH FEET (BSS)	TWO-WAY TRAVEL TIME (sec)	APPROXIMATE UNIT/EVENT THICKNESS (ft)	SHALLOW GAS POTENTIAL
SEAFLOOR	Local seafloor is smooth and stable, with a gradient of about 0.5° (0.8 %) to the northwest.	0	32	0.013		
1	Holocene-age sand ridge deposits that are parallel bedded sand layers, dipping west-northwest.				37	NEGLIGIBLE
EVENT 10		37	69	0.027		
WBM 2	Thin estuarine or lagoonal clay deposits overlying sand with silt and silty sand deposits. Reflectors in sand deposits are low-amplitude, subparallel, and discontinuous amplitude anomalies present.				35	MODERATE
EVENT 20		72	104	0.041		
WBM 3	Lagoonal sand deposits that transition to clay deposits. Reflectors are discontinuous and subparallel. Few amplitude anomalies present.				47	MODERATE
EVENT 25		119	151	0.060		
4	Sand deposits with variable amounts of gravel. Reflectors are low-amplitude and subparallel.				68	NEGLIGIBLE
EVENT 30		187	219	0.088		
5	Possible clay deposits. Reflectors are discontinuous and low-amplitude.				47	NEGLIGIBLE
EVENT 40		234	266	0.106		
6	Possible sand with silt and sandy silt strata. High amplitude, flat-lying, parallel reflectors. Probable marine sediments.				31	NEGLIGIBLE
EVENT 43		265	297	0.119		
7	Possible sand or fine grained sediments. Reflectors are low-amplitude, flat-lying, and parallel. Probable marine sediments.				71	NEGLIGIBLE
EVENT 45		334	368	0.147		
8	Possible fine grained deposits with low-amplitude, flat-lying, parallel reflectors. Base of sequence is a possible erosional contact.				108	NEGLIGIBLE
EVENT 50		444	476	0.190		
9?	Parallel, high-amplitude reflectors that dip to the south in the north and then are flat-lying.				18	NEGLIGIBLE
EVENT 60	Limit of mapping	462	494	0.198		

BML: Below Mudline
BSS: Below Sea Surface

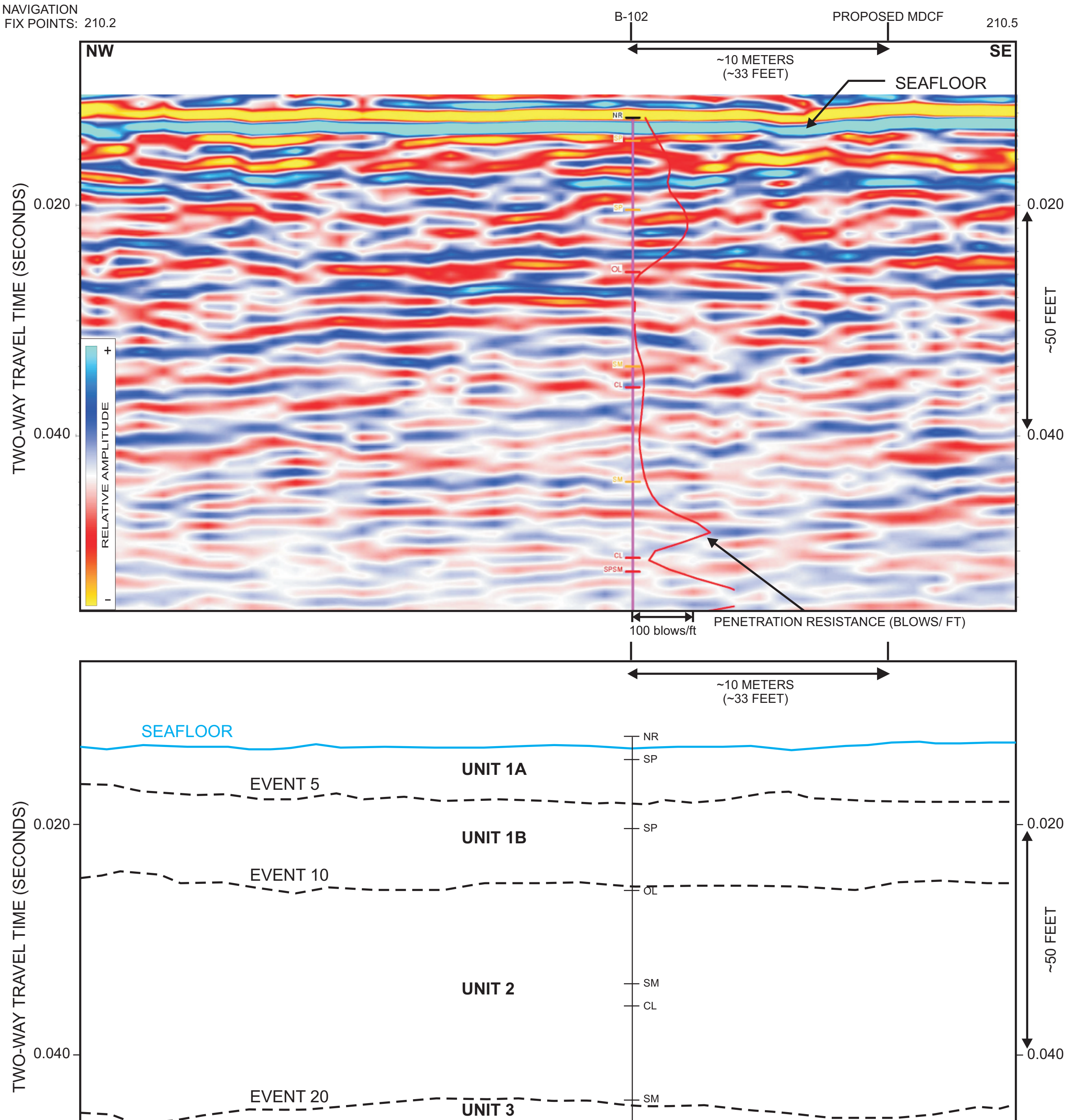
SHALLOW GAS POTENTIAL
- HIGH
- MODERATE
- LOW
- NEGLIGIBLE

Note:
1) Time-to-depth conversions for the sediment column are approximate and calculated using Vp = 5,000 ft/sec.
2) Halcrow/HPA boring B-102 was advanced within 35 feet of the proposed MDCF location.

TOPHOLE PROGNOSIS CHART
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

NRG Bluewater Wind
Project No. 3671.004

FIGURE 24

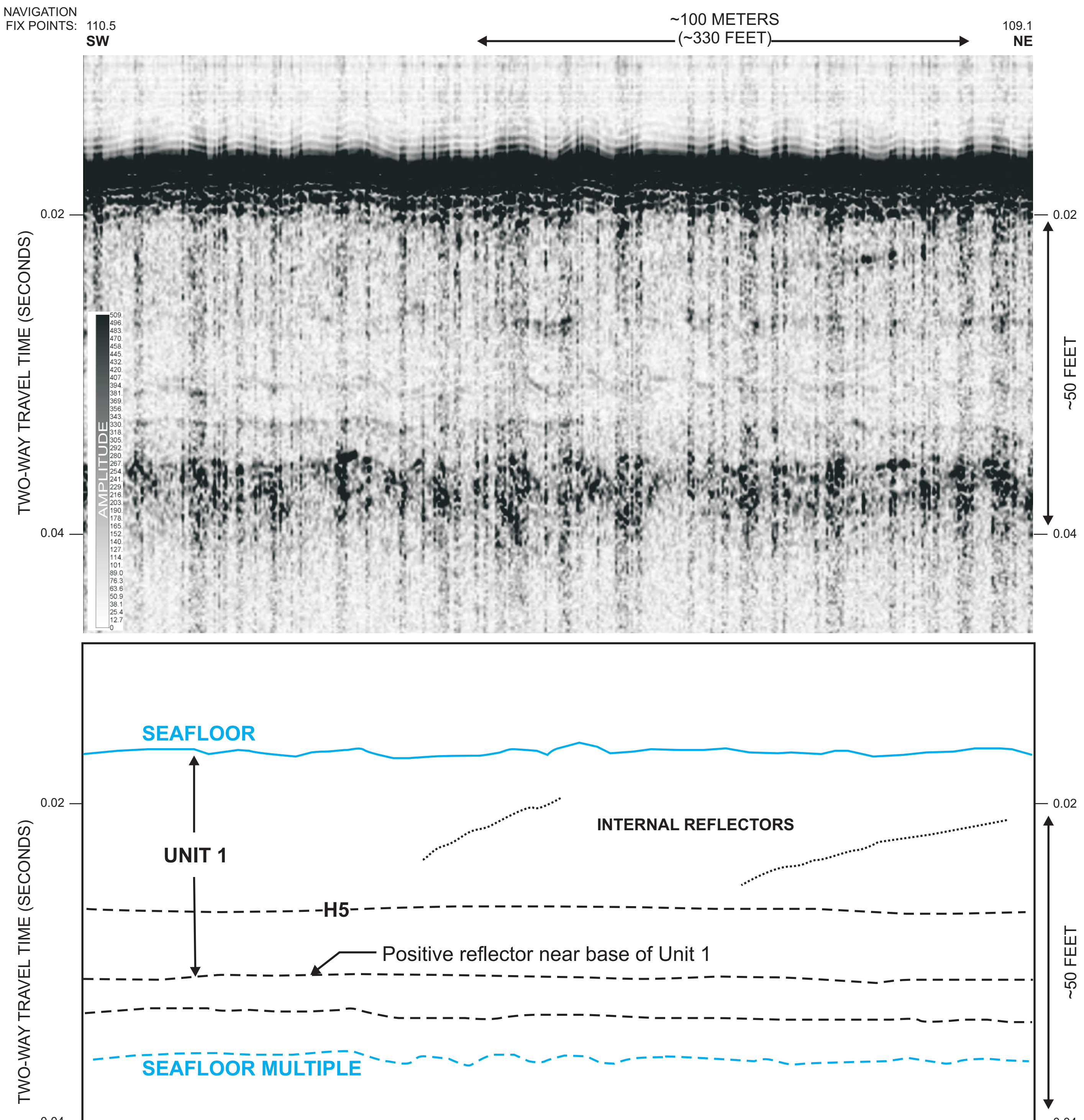


Notes:
1) Time-to-depth conversions for the sediment column are approximate and calculated using Vp = 5,000 ft/sec.
2) Vertical exaggeration is ~2x.
3) Lithologic classification for Boring Log B-102 from Halcrow/HPA (2009).
4) Penetration resistance (SPT N-values) are from standard penetration tests (SPT). SPT N-values are the number of blows required to advance a sampler 12 inches using a 140-lb hammer from a 30 inch drop height. inner-diameter of split spoon sampler is 1 3/8 inches.

Boring Legend:
CL = Lean clay, OL = Organic clay/silt
SP = Poorly graded sand, SM = Silty sand,
SPSM = Poorly graded sand with silt
NR = No recovery

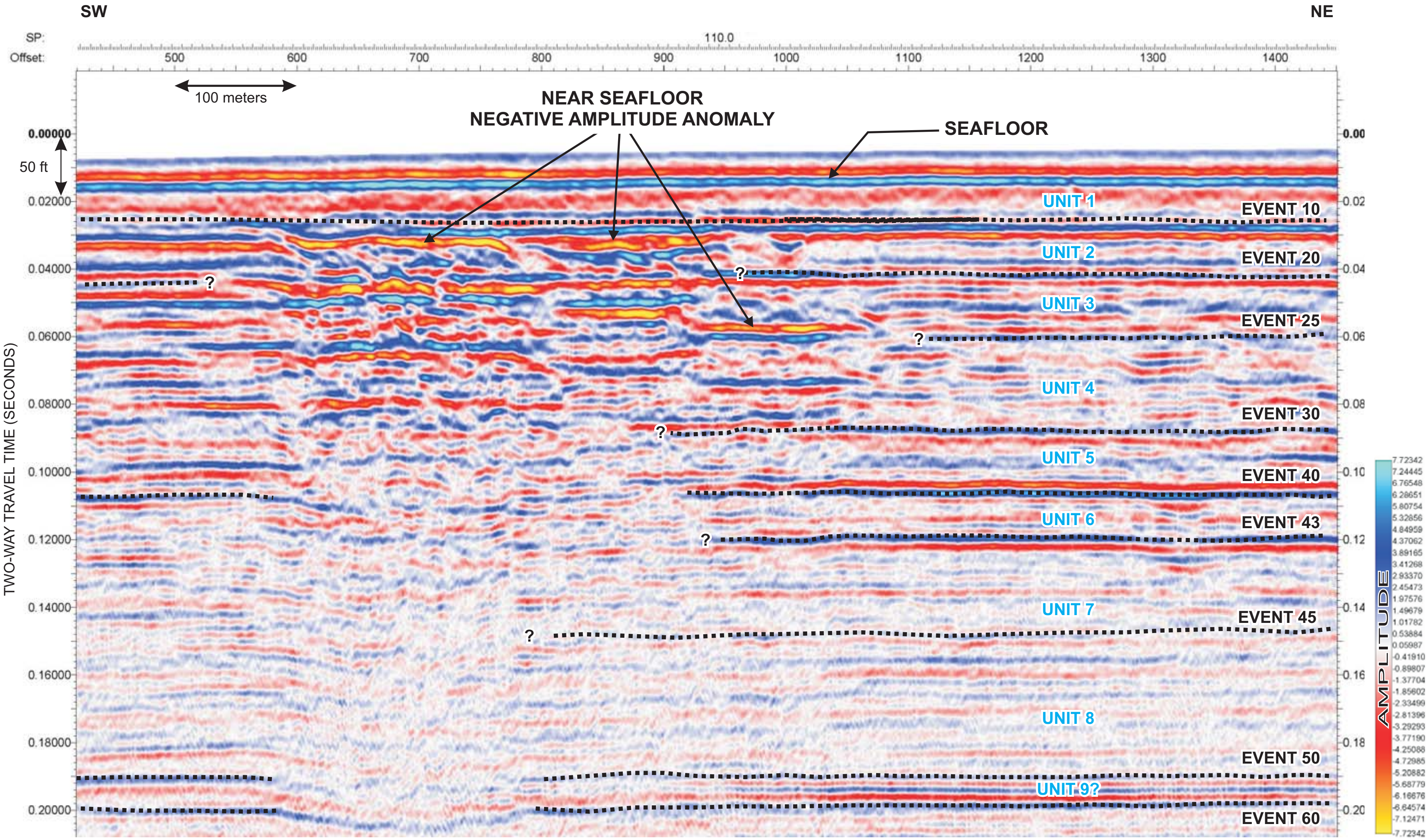
1.56-mgi BOOMER SEISMIC RECORD, LINE 207
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 25a



Note:
1) Time-to-depth conversions for the sediment column are approximate and calculated using Vp = 5,000 ft/sec.
2) Positive reflector at the base of Unit 1 likely represents coarser-grained, basal deposits at the base of Unit 1. The reflector identified above correlates to interval above negative-amplitude reflector inferred to be the top of Unit 2 as mapped from the boomer data.
3) Vertical exaggeration is ~4x.

CHIRP SEISMIC RECORD, LINE 143
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

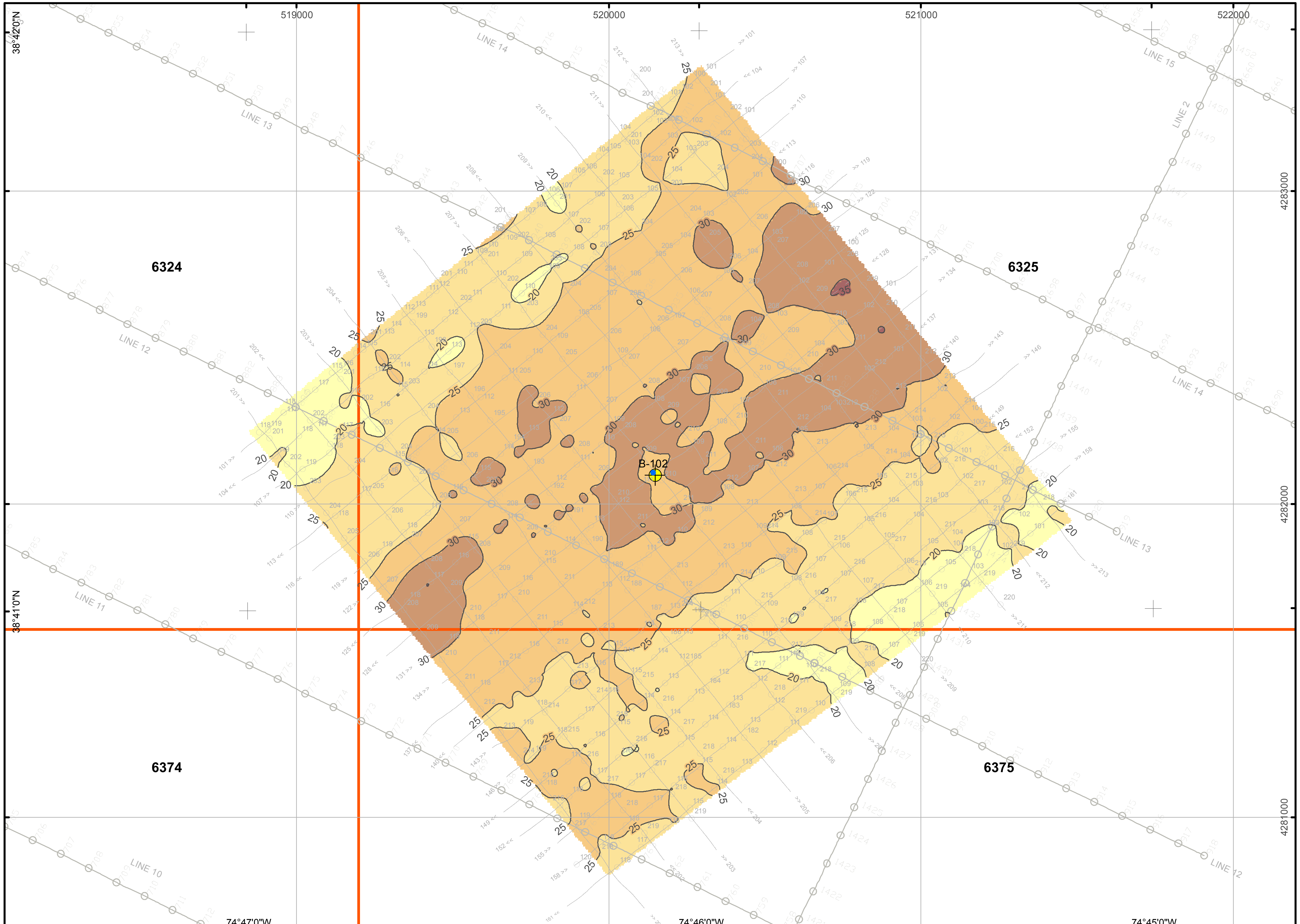


Notes:
1) Scales are approximate.
2) Time converted to depth using Vp = 5,000 ft/s.
3) Negative amplitude anomalies suggest that free phase gas may be present.
Note degradation of data quality and pull down effects below the anomalies.

3.125-mgi BOOMER SEISMIC RECORD LINE 134
NEAR SEAFLOOR ANOMALY
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 26

NRG Buewater Wind
Project No. 3671.004



Legend

- Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74°46' 6"
- 2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)
- 6325 Salisbury Protraction Area OCS Block
- 155>> 120 2009 Fugro Seismic Reflection Trackline
- LINE 2 1455

Unit 1 Isopach (thickness), feet
Unit 1 isopach is from the Seafloor to Event 10. The seafloor and Event 10 are interpreted from boomer source, 8-channel, 1.56-mgi and 16-channel, 3.125-mgi GeoEel hydrophone arrays.

- Contour interval is 5 feet.
- Less than 20
- 20 to 25
- 25 to 30
- 30 to 35
- Greater than 35

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005
3. Trackline represents position of GPS antenna.

N W E S

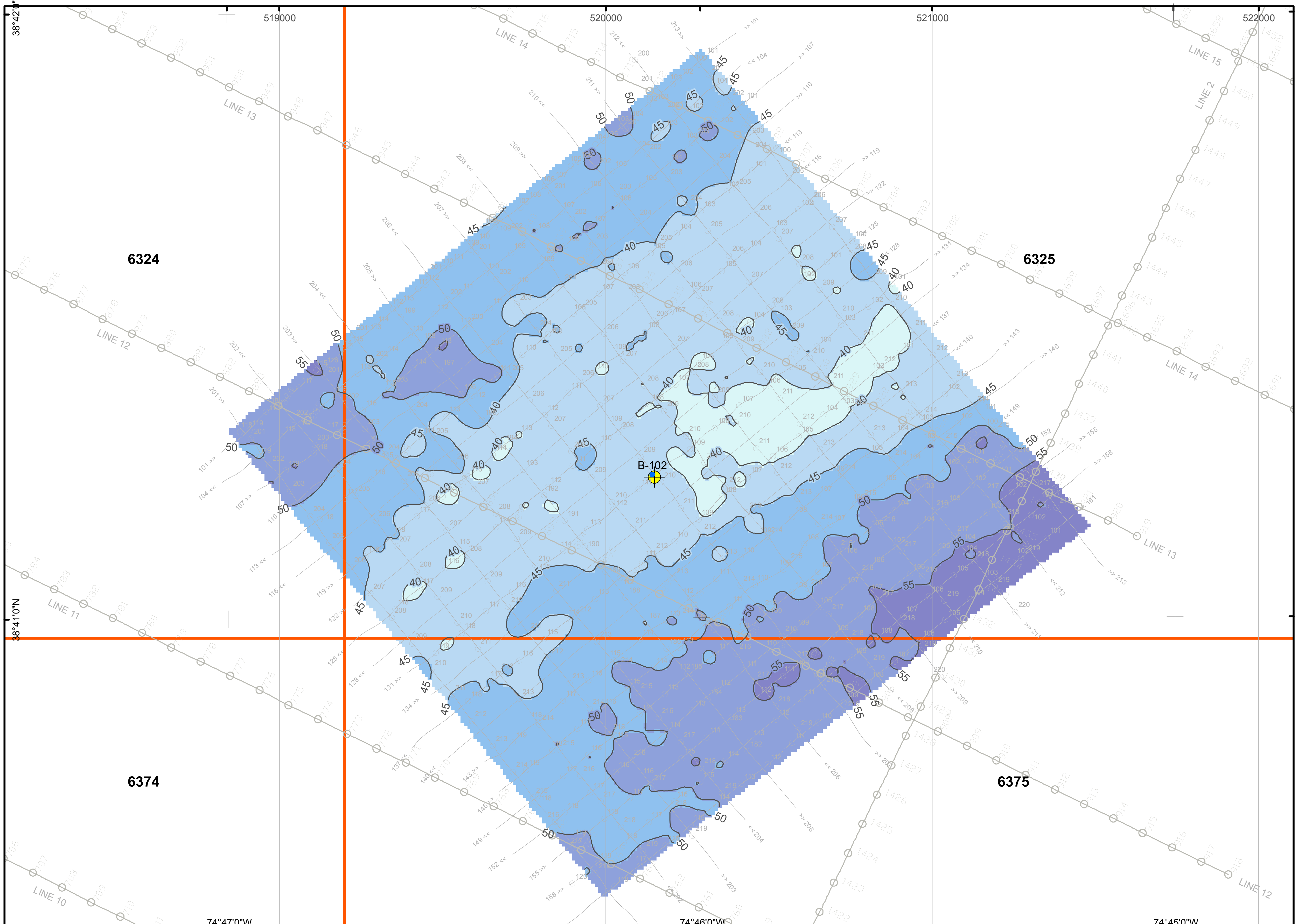
0 500 1,000 2,000 Feet
0 100 200 400 Meters

UNIT 1 ISOPACH (Between Seafloor and Event 10)
Bluewater Wind Meteorolgical Tower
Delaware Continental Shelf

FIGURE 27

N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Shallow_Hazards_Report_Jan2010\mxd\Fig-27_Unit_1_Iso_Map.mxd, 11/30/10, kstevens

NRG Bluewater Wind
Project No. 3671.004



Legend

Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74°46' 6"

2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)

6325 Salisbury Protraction Area OCS Block

155>> 120 2009 Fugro Seismic Reflection Trackline

LINE 2 1455 2006 OSI Seismic Reflection Trackline

Unit 2 Isopach (thickness), feet
Between Events 10 and 20
Events 10 and 20 are interpreted from boomer source, 8-channel, 1.56-mgi and 16-channel, 3.125-mgi GeoEel hydrophone arrays.

Contour interval is 5 feet.

Less than 40
40 to 45
45 to 50
50 to 55
Greater than 55

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005
3. Trackline represents position of GPS antenna.

N W E S

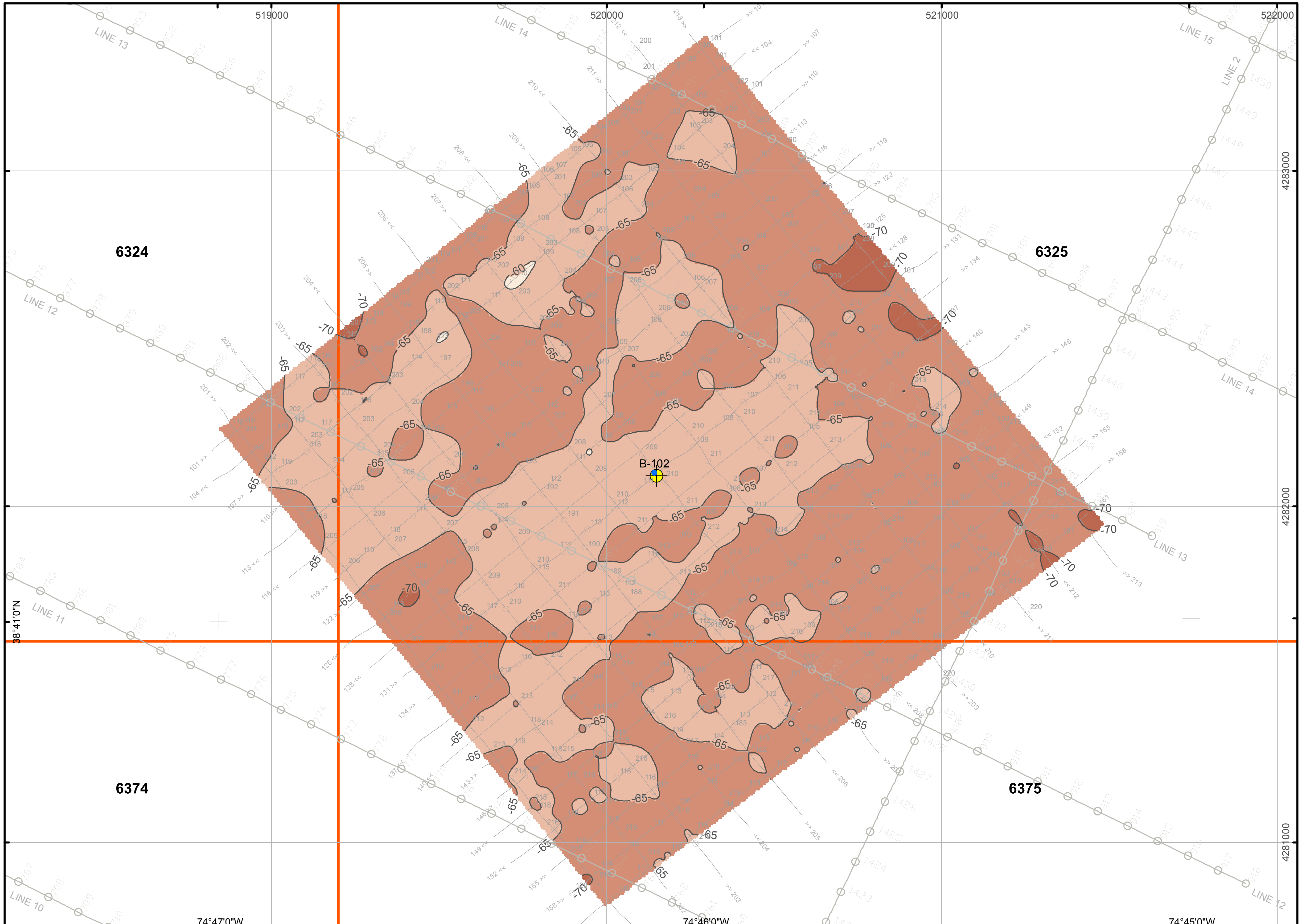
0 500 1,000 2,000 Feet

0 100 200 400 Meters

UNIT 2 ISOPACH
(Between Events 10 and 20)
Bluewater Wind Meteorolgical Tower
Delaware Continental Shelf

FIGURE 28

N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Shallow_Hazards_Report_Jan2010\mxd\Fig-28_Unit_2_Iso_Map.mxd, 11/29/10, kstevens



Legend

Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74°46' 6"

2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)

6325 Salisbury Protraction Area OCS Block

155>> 120 2009 Fugro Seismic Reflection Trackline

LINE 2 1455 2006 OSI Seismic Reflection Trackline

Structural Elevation of Event 10, feet (MLLW)
Event 10 interpreted from boomer source, 8-channel, 1.56-mgi and 16-channel, 3.125-mgi GeoEel hydrophone arrays.

Contour interval is 5 feet.

Above -60

-60 to -65

-65 to -70

Below -70

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005
3. Trackline represents position of GPS antenna.

N W E S

0 500 1,000 2,000 Feet

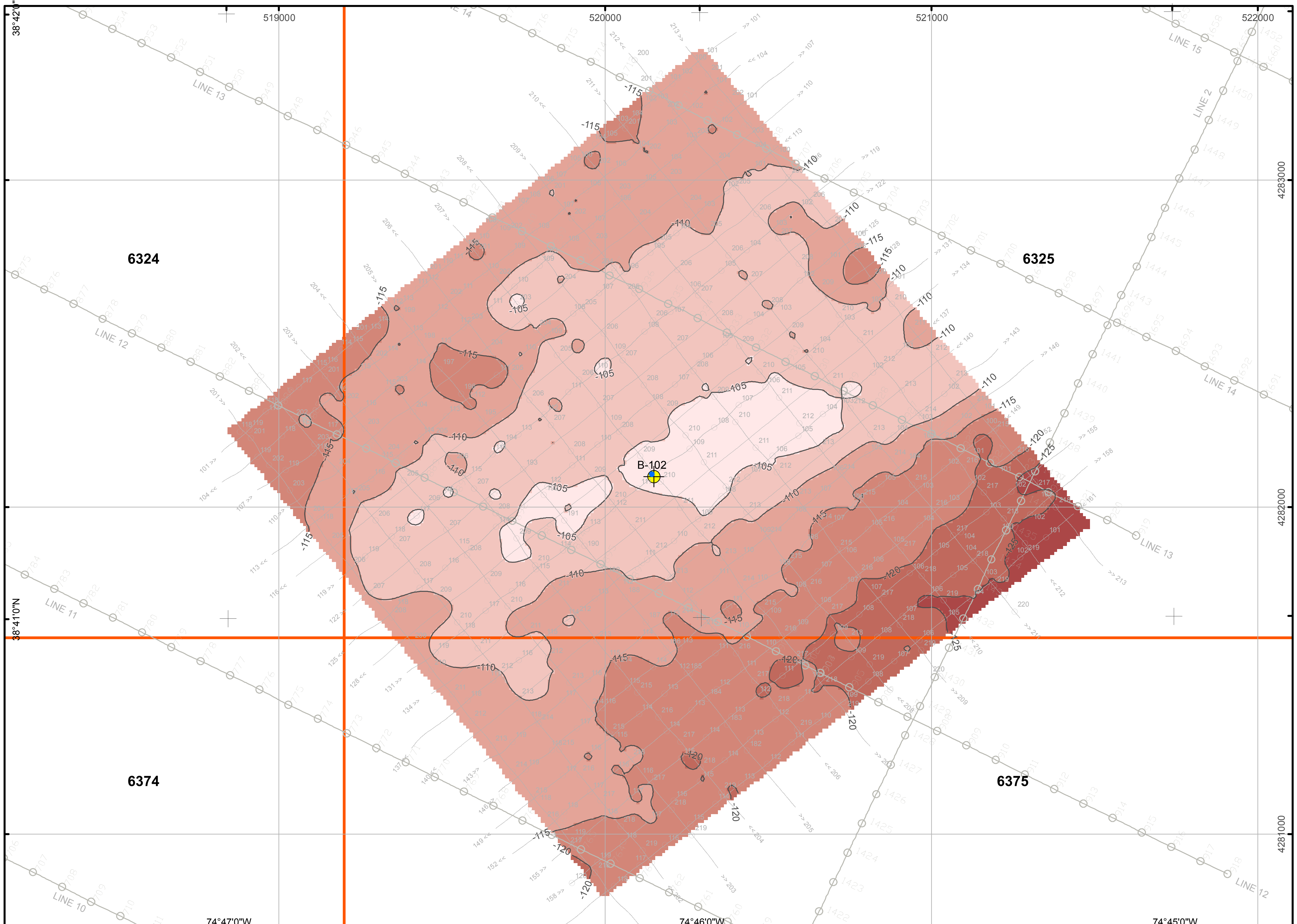
0 100 200 400 Meters

STRUCTURAL CONTOUR MAP OF EVENT 10
Bluewater Wind Meteorolgical Tower
Delaware Continental Shelf

FIGURE 29

N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Shallow_Hazards_Report_Jan2010\mxd\Fig-29_H10_Structure_Map.mxd, 11/30/10, kstevens

NRG Bluewater Wind
Project No. 3671.004



Legend

Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74°46' 6"

2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)

6325 Salisbury Protraction Area OCS Block

155>> 120 2009 Fugro Seismic Reflection Trackline

LINE 2 1455 2006 OSI Seismic Reflection Trackline

Structural Elevation of Event 20, feet (MLLW)
Event 20 interpreted from boomer source, 8-channel, 1.56-mgi and 16-channel, 3.125-mgi GeoEel hydrophone arrays.

Contour interval is 5 feet.

- Above -105
- -105 to -110
- -110 to -115
- -115 to -120
- -120 to -125
- Below -125

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005
3. Trackline represents position of GPS antenna.

N W E S

0 500 1,000 2,000 Feet

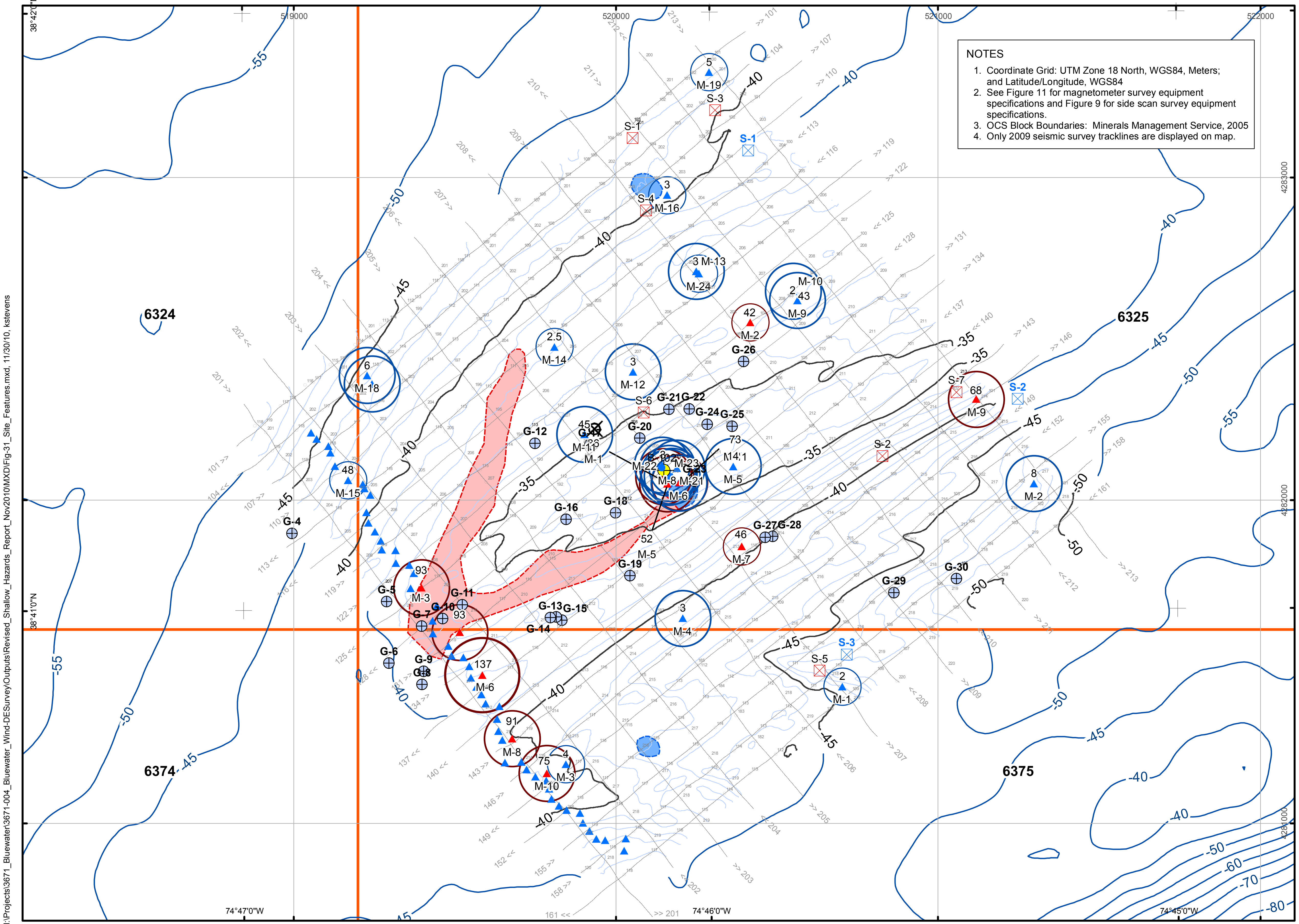
0 100 200 400 Meters

STRUCTURAL CONTOUR MAP OF EVENT 20
Bluewater Wind Meteorolgical Tower
Delaware Continental Shelf

FIGURE 30

N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Shallow_Hazards_Report_Jan2010\mxd\Fig-30_H20_Structure_Map.mxd, 11/29/10, kstevens

NRG Bluewater Wind
Project No. 3671.004



Legend

Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74° 46' 6"

2007 Halcrow/HPA Boring B-102 (Halcrow/HPA, 2009)

NOAA-Charted Obstruction See NOAA Chart 12214

6325 Salisbury Protraction Area OCS Blocks

S-5 2009 Side Scan Sonar Targets

S-2 2010 Side Scan Sonar Targets

155>> Seismic Reflection Survey Vessel Trackline Survey line number and navigation fix points are labeled. Arrows indicate direction of vessel travel.

MAGNETOMETER SURVEY DATA

Magnetic Anomaly
35 M-3 Diameter of circle does not represent actual duration of anomaly. Number above symbol is intensity of anomaly (gammas). Anomaly designation is labeled symbol (M-3).

Approximate Duration of Magnetic Anomalies (m)
Size of circle is proportional to duration of the anomaly.

Less than 50

50-100

Greater than 100

Fall 2009 Survey Magnetometer Anomalies

Fall 2010 Survey Magnetometer Anomalies

BATHYMETRY

Fugro 2009 Multibeam Survey

Contour interval is 5 feet.

Contour interval is 1 foot.

Regional Bathymetry (NJDEP, 2007)

Contour interval is 5 feet.

High-Amplitude Anomalies Indicative of Possible Shallow Gas Accumulations

Amplitude Anomalies within Seismic Unit 2 (Event 10 to Event 20) Burial Depth to these Anomalies is ~69 feet to ~104 feet BSS.

Amplitude Anomalies within Seismic Unit 3 (Event 20 to Event 25) Burial Depth to these Anomalies is ~104 feet to ~151 feet BSS.

G-1 Side Scan Sonar Returns from Water Column: Possible Gas Seeps (Fugro, 2010)

N S E W

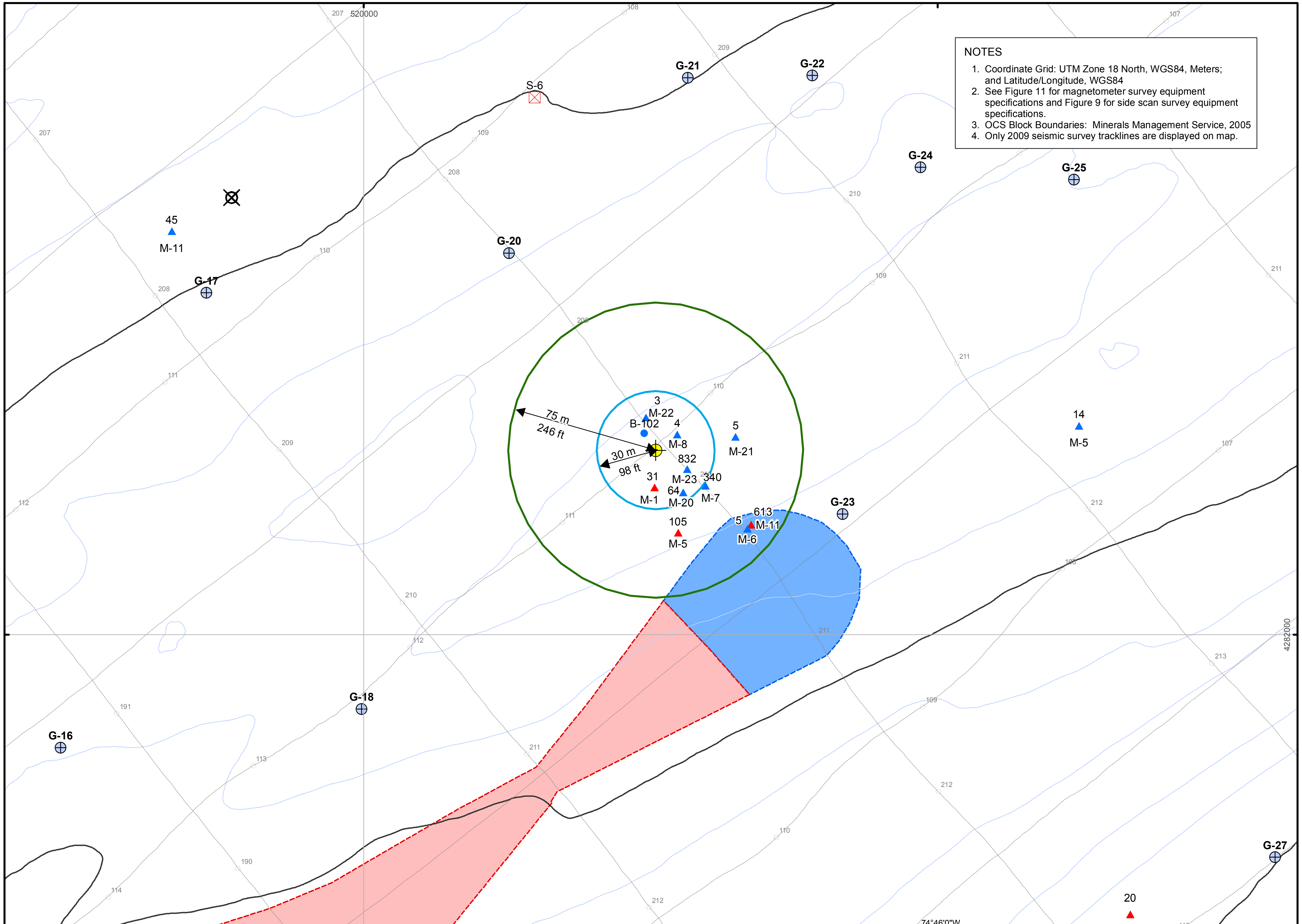
0 500 1,000 2,000 Feet

0 100 200 400 Meters

SITE FEATURES
Fall 2009 and Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 31

NRG Bluewater Wind
Project No. 3671.004



Legend

- Proposed Meteorological Data Collection Facility (MDCF) - N 38° 41' 14" W 74° 46' 6"
- 2007 Halcrow/HPA Boring B-102 (Halcrow/HPA, 2009)
- **NOAA-Charted Obstruction** See NOAA Chart 12214
- 6325 Salisbury Protraction Area OCS Blocks
- S-5 2009 Side Scan Sonar Targets
- S-5 2010 Side Scan Sonar Targets
- 35 M-3 Magnetic Anomaly
  Number above symbol is intensity of anomaly (gammas).
  Anomaly designation is labeled symbol (M-3).
  Red: Fall 2009 Survey
  Blue: Fall 2010 Survey
- 155>> Seismic Reflection Survey Vessel Trackline
  Survey line number and navigation fix points are labeled. Arrows indicate direction of vessel travel.
  Refer to Chart 1 and Figure 4 for magnetometer survey tracklines.

BATHYMETRY

Fugro 2009 Multibeam Survey
Contour interval is 5 feet.
Contour interval is 1 foot.

Regional Bathymetry (NJDEP 2007)
Contour interval is 5 feet.

High-Amplitude Anomalies Indicative of Possible Shallow Gas Accumulations
- Amplitude Anomalies within Seismic Unit 2 (Event 10 to Event 20) Burial Depth to these Anomalies is ~69 feet to ~104 feet BSS.
- Amplitude Anomalies within Seismic Unit 3 (Event 20 to Event 25) Burial Depth to these Anomalies is ~104 feet to ~151 feet BSS.
- G-1 Side Scan Sonar Returns from Water Column: Possible Gas Seeps (Fugro, 2010)
- Hazard Mitigation Set-back Distance (30 meters) from Magnetic Anomalies with Intensity 50 gammas or greater per Gulf of Mexico OCS NTL 2008-G05 (MMS, 2008)
- Hazard Mitigation Set-back Distance (75 meters) from Shallow Gas per Gulf of Mexico OCS NTL 2008-G05 (MMS, 2008)

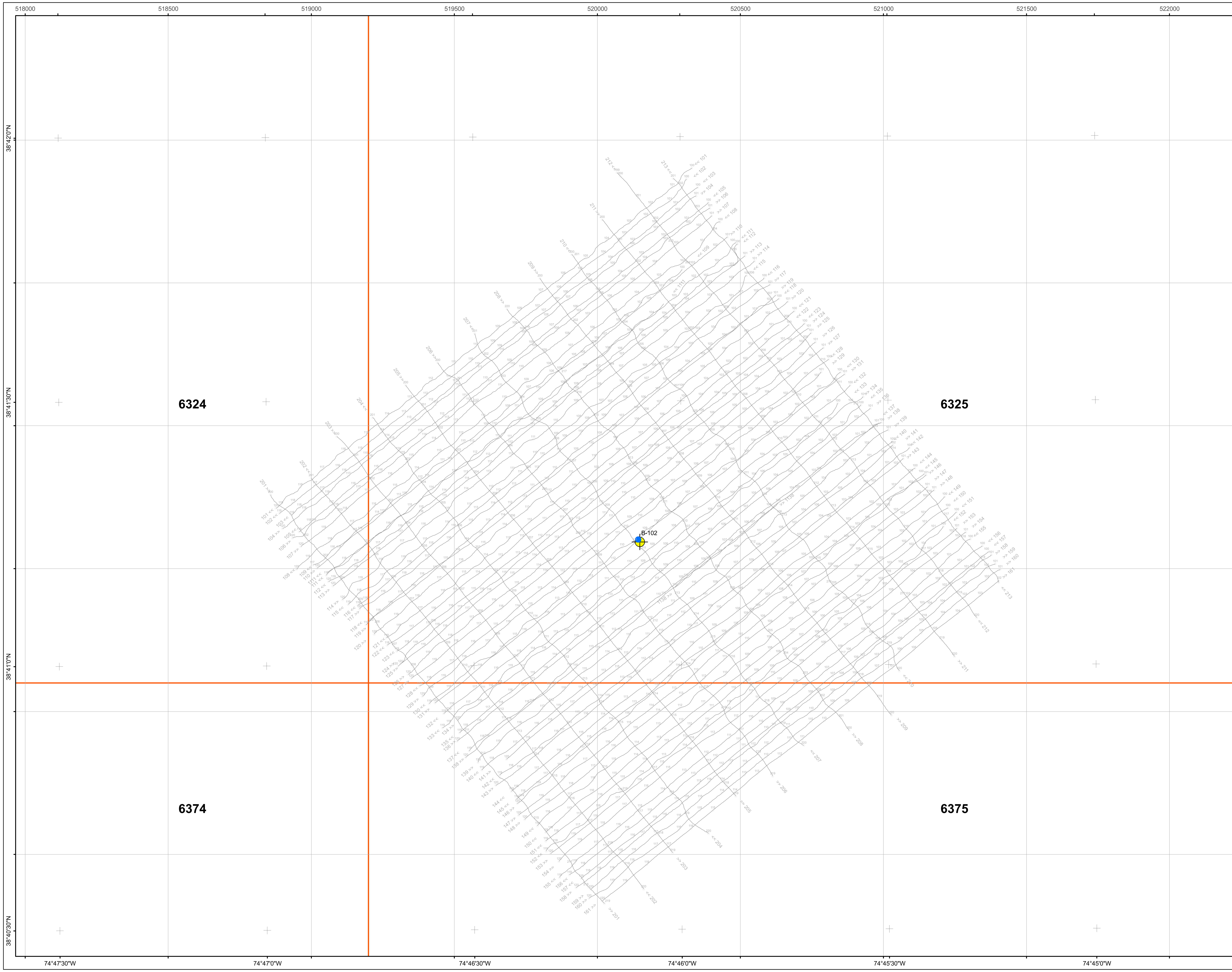
0 100 200 400 Feet
0 25 50 100 Meters

SITE FEATURES
Fall 2009 and Fall 2010 Survey
Proposed MDCF Area
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE 32

N:\Projects\3671_Bluewater\3671-004_Bluewater_Wind-DESurvey\Outputs\Revised_Shallow_Hazards_Report_Nov2010\MXD\Fig-32_Site_Features_MDCF_Area.mxd, 11/30/10, kstevens

CHARTS



Legend

- Proposed Meteorological Data Collection Facility (MDCF) N 38° 41' 14" W 74° 46' 6"
- 2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)
- 6325 — Salisbury Protraction Area OCS Block
- 150>> — Bottom-Charting / Marine Archeological Survey Line and Navigation Fix Marks
  Systems Used:
  - Chirp Sub-bottom Profiler
  - Multibeam Echosounder
  - Side Scan Sonar
  - Magnetometer

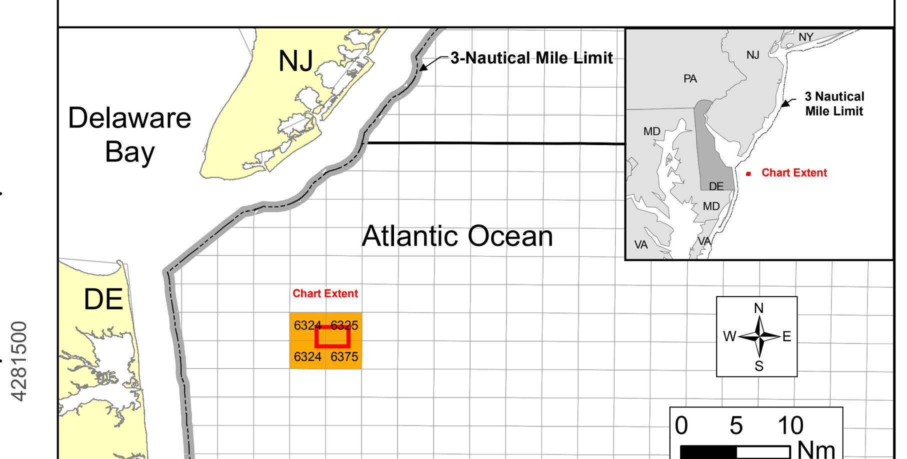
  Arrows on line number indicate direction of vessel travel.

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005
3. Trackline represents position of GPS antenna.

GEODETIC INFORMATION

SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.000
SEMI-MINOR AXIS:	6,356,752.314
INVERSE FLATTENING:	298.25722101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 18 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0



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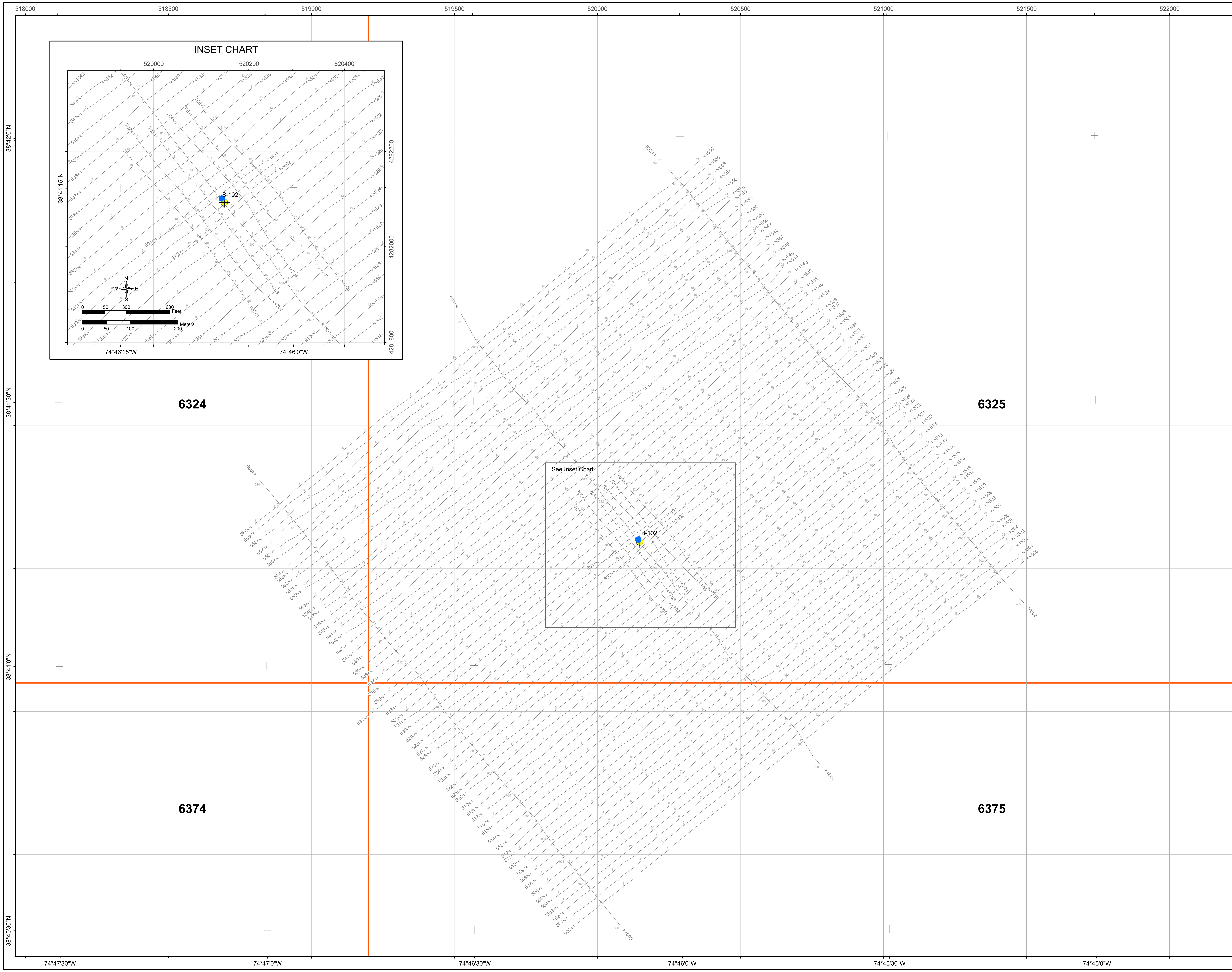
BOTTOM-CHARTING SURVEY
Fall 2009 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

Scale 1:6,000

0 500 1,000 2,000 Feet
0 150 300 600 Meters

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	January 2010	Shallow Hazards Report	KWS	KRS	TWM
2	November 2010	Revised Shallow Hazards Report	KWS	KRS	TWM
3					

JOB NUMBER: 3671.004
CHART NO.: 1a



Legend

- Proposed Meteorological Data Collection Facility (MDCF) N 38° 41' 14" W 74° 46' 6"
- 2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)
- 6325 — Salisbury Protraction Area OCS Block
- 512>> — Bottom-Charting / Marine Archeological Survey Line and Navigation Fix Marks

Systems Used:
- Side Scan Sonar
- Magnetometer

Arrows on line number indicate direction of vessel travel.

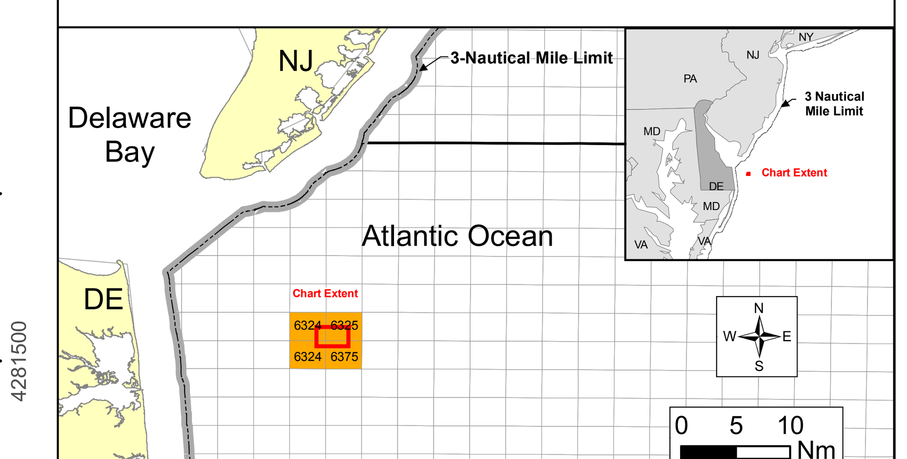
See inset chart for detail view of MDCF area.

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005
3. Trackline represents position of common reference point (CRP).

GEODETIC INFORMATION

SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.000
SEMI-MINOR AXIS:	6,356,752.314
INVERSE FLATTENING:	298.25722101
$ECCENTRICITY^2$:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 18 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0



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BOTTOM-CHARTING SURVEY NAVIGATION POST-PLOT

Fall 2010 Survey

Bluewater Wind Meteorological Tower
Delaware Continental Shelf

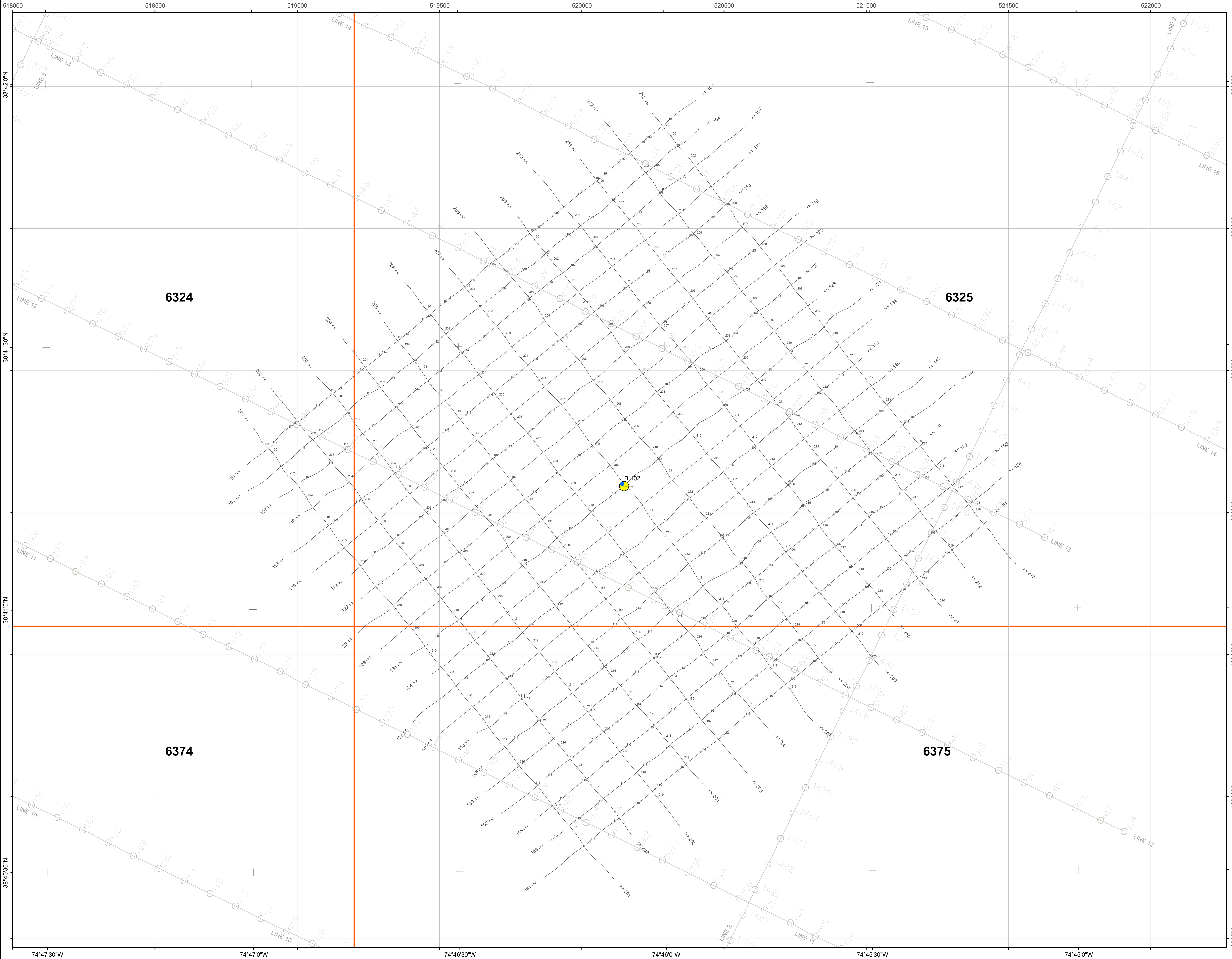
Scale 1:6,000

0 500 1,000 2,000 Feet
0 150 300 600 Meters

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	November 2010	Revised Shallow Hazards Report	KCS	KRS	TWM
2					
3					

JOB NUMBER: 3671.004

CHART NO.: 1b



Legend

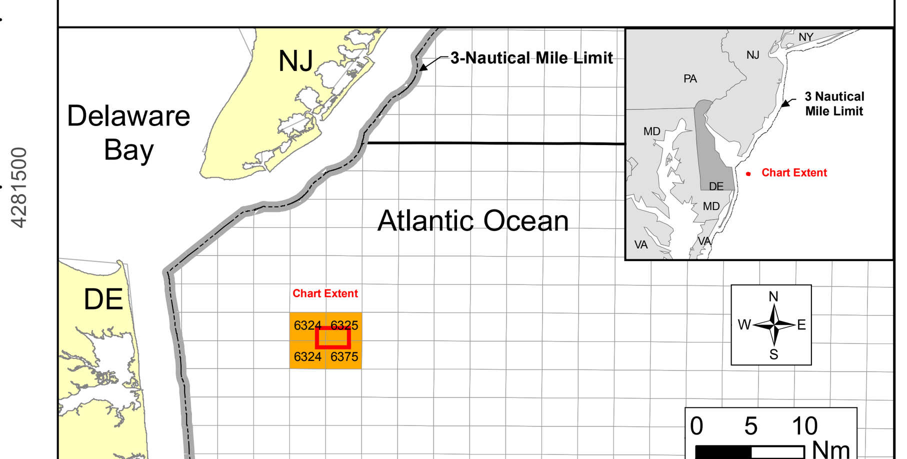
- Proposed Meteorological Data Collection Facility (MDCF) N 38° 41' 14" W 74° 46' 6"
- 2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)
- 6325 — Salisbury Protraction Area OCS Block
- 155>> 120 — 2009 Fugro Seismic Reflection Survey Vessel Trackline
  Systems Used:
  8-channel, 1.56 mgi GeoEel Hydrophone Array
  16-channel, 3.125 mgi GeoEel Hydrophone Array
  600-joule Boomer Source
  Chirp Sub-bottom Profiler
  Survey line number and navigation fix points are labeled.
  Arrows indicate direction of vessel travel.
- LINE 2 1455 — 2006 OSI Seismic Reflection Survey Vessel Trackline
  Systems Used:
  Applied Acoustics 300-joule boomer system (0.4-8 kHz) with a single-channel hydrophone array
  Survey line number and navigation fix points are labeled.

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005
3. Trackline represents position of GPS antenna.

GEODETIC INFORMATION

SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.000
SEMI-MINOR AXIS:	6,356,752.314
INVERSE FLATTENING:	298.25722101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 18 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0



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N W E S

SEISMIC REFLECTION SURVEY NAVIGATION POST-PLOT

Bluewater Wind Meteorological Tower Delaware Continental Shelf

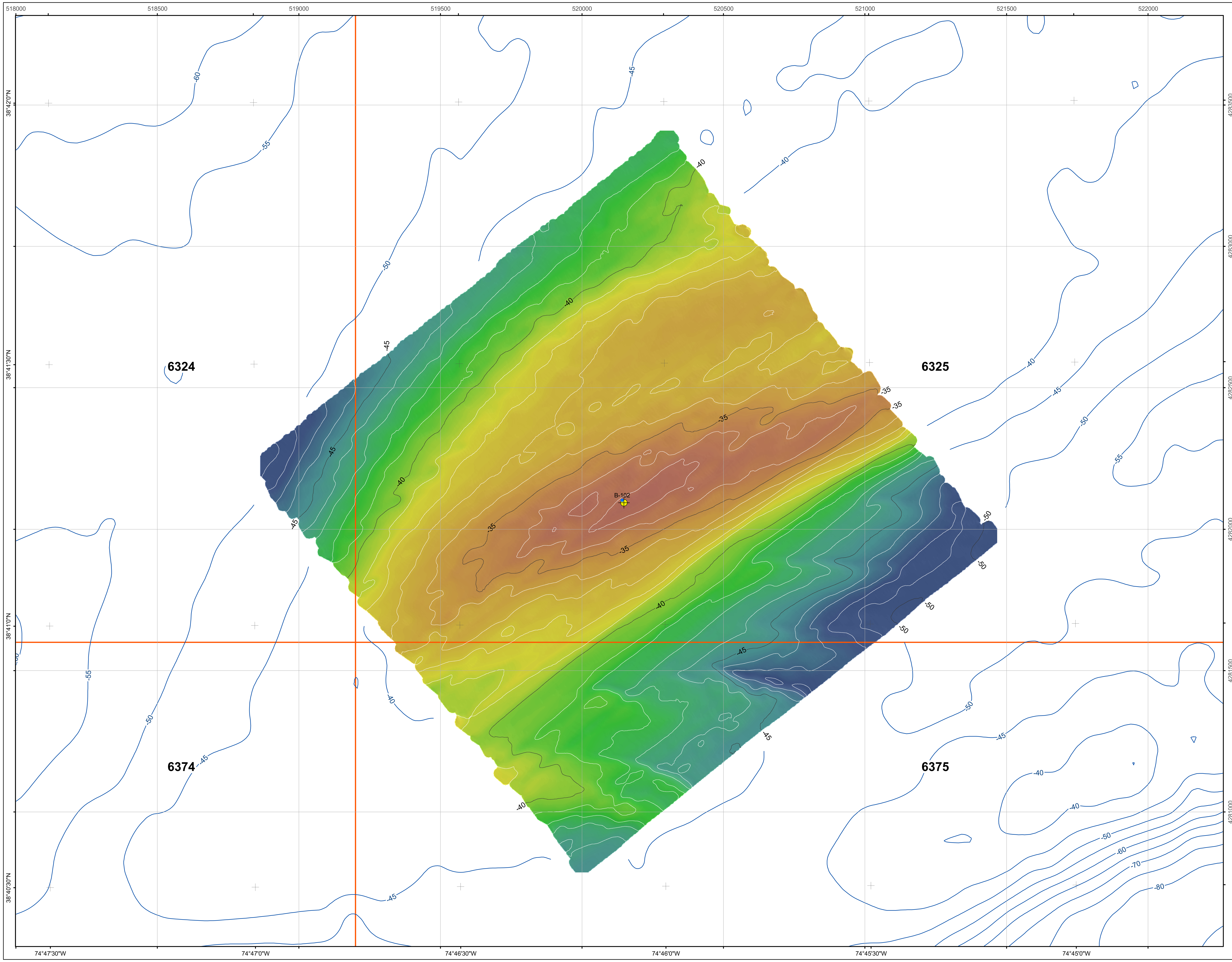
Scale 1:6,000

0 500 1,000 2,000 Feet
0 150 300 600 Meters

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	January 2010	Shallow Hazards Report	KWS	KRS	TWM
2	November 2010	Revised Shallow Hazards Report	KWS	KRS	TWM
3					

JOB NUMBER: 3671.004

CHART NO.: 2



Legend

Proposed Meteorological Data Collection Facility (MDCF)
N 38° 41' 14" W 74° 46' 6"

2007 Halcrow/HPA Boring Location
(Halcrow/HPA, 2009)

6325 Salisbury Protraction Area OCS Block

-40 **Regional Bathymetry - NJDEP**
Contour interval is 5 feet.

-35 **Fugro 2009 Bathymetric Survey**
Contour interval is 1 foot.

Fugro 2009 Bathymetric Survey
Referenced to MLLW

-32 feet

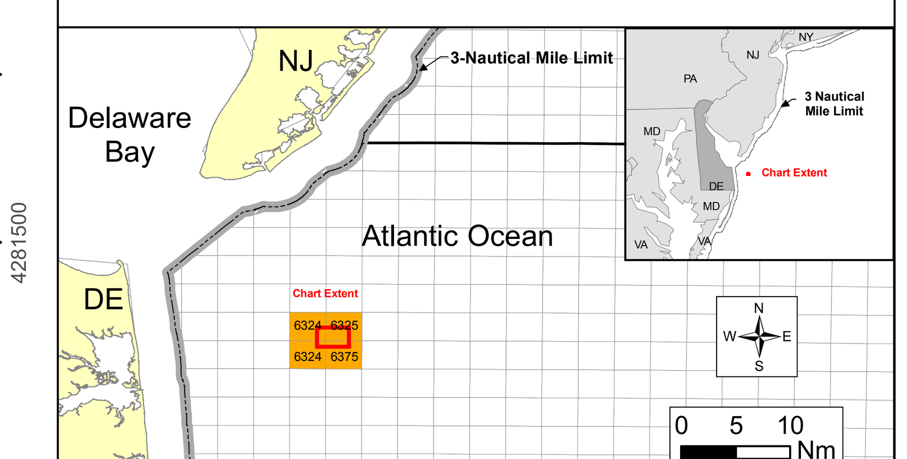
-51 feet

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005

GEODETIC INFORMATION

SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.000
SEMI-MINOR AXIS:	6,356,752.314
INVERSE FLATTENING:	298.25722101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 18 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0



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N
W E
S

BATHYMETRY
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

Scale 1:6,000

0 500 1,000 2,000 Feet

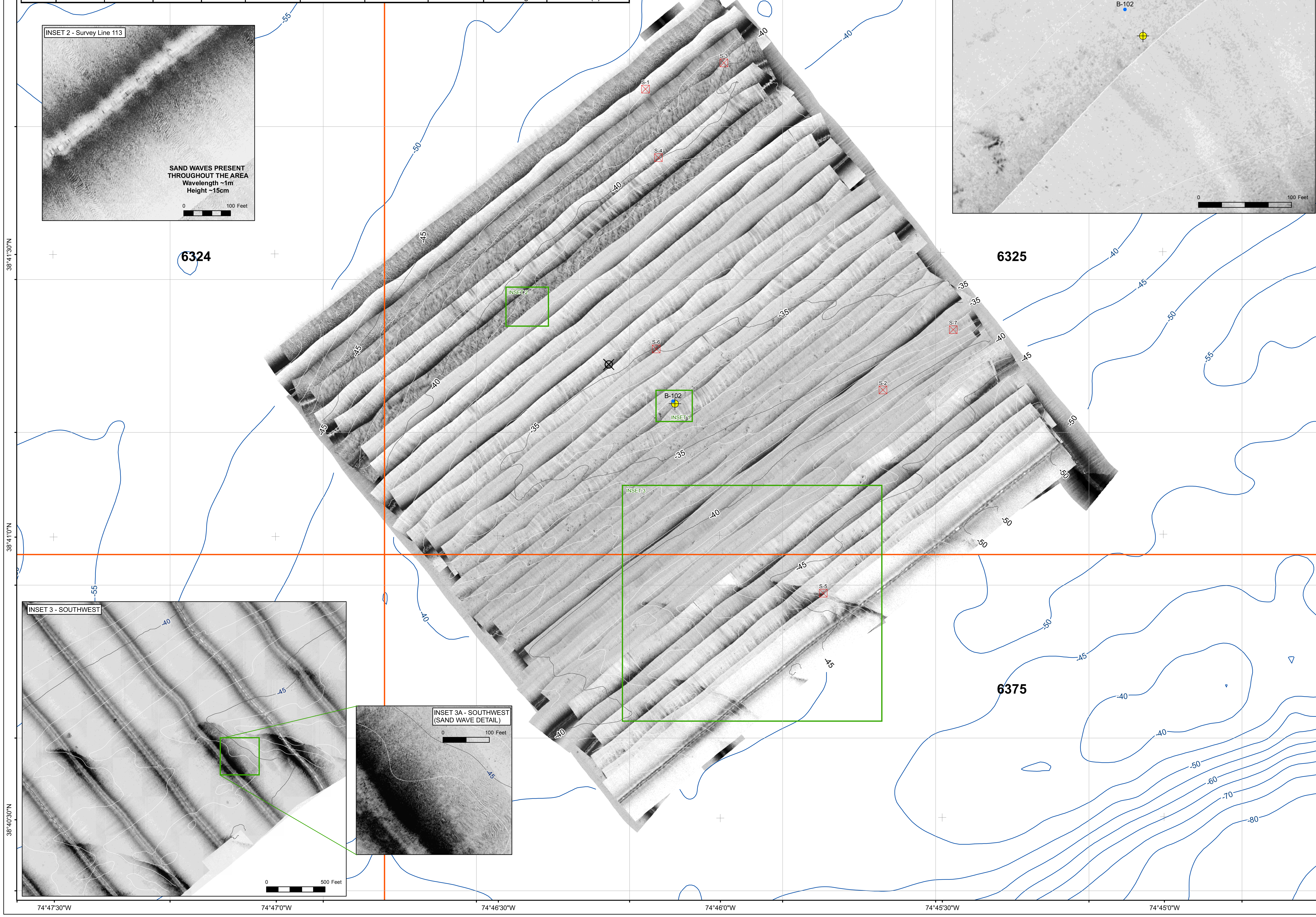
0 150 300 600 Meters

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	January 2010	Shallow Hazards Report	JEF	KRS	TWM
2	November 2010	Revised Shallow Hazards Report	JEF	KRS	TWM
3					

JOB NUMBER: 3671.004

CHART NO.: 3

2009 Side Scan Sonar Targets										
					WGS 84 Geographic		WGS 84, UTM Zone 18 North			Corresponding Magnetic Anomaly
Target	OCS Block	Height (m)	Length (m)	Width (m)	Latitude	Longitude	Easting (m)	Northing (m)	Description	
S-1	6325	0.2	1.5	0.5	38.69649981	-74.76941528	520052	4283123	Unknown	--
S-2	6325	0.1	1.9	0.5	38.68761188	-74.76052709	520827	4282139	Circular target	--
S-3	6325	<0.1	1.4	1.6	38.69727279	-74.7664679	520308	4283209	Unknown	--
S-4	6325	0.5	1.8	0.7	38.69447953	-74.7689347	520094	4282899	Unknown	--
S-5	6375	<0.1	6.6	0.3	38.68162939	-74.76279469	520632	4281474	Linear target	--
S-6	6325	0.3	1.0	1.2	38.68883885	-74.76904042	520087	4282273	Square target	--
S-7	6325	1.9	1.0	0.0	38.68938088	-74.7578803	521057	4282336	Circular target	M-9(?)



Legend

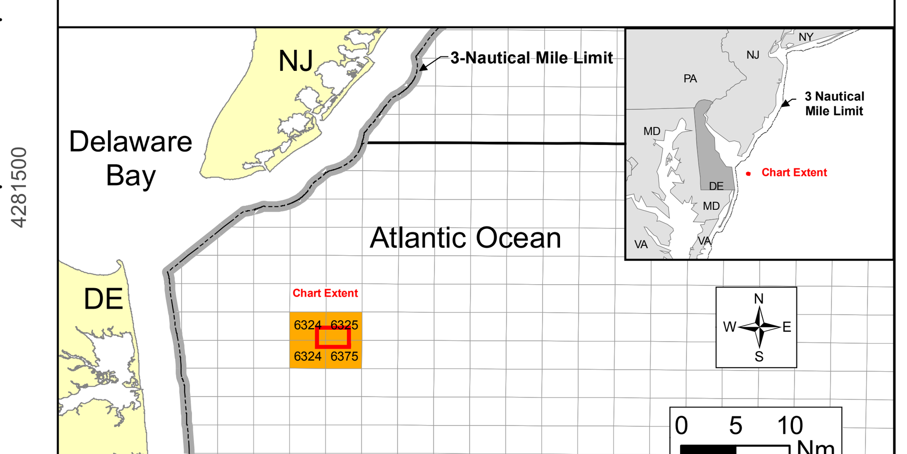
- Proposed Meteorological Data Collection Facility (MDCF) N 38° 41' 14" W 74° 46' 6"
- 2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)
- S-5 Side Scan Sonar Targets. Sonar target designation is posted above symbol.
- **NOAA-Charted Obstruction** See NOAA Chart 12214
- 6325 Salisbury Protraction Area OCS Block
- -40 **Regional Bathymetry - NJDEP** Contour interval is 5 feet.
- -35 **Fugro 2009 Bathymetric Survey** Contour interval is 1 foot.

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. Side Scan Sonar Instrumentation:
   EdgeTech Model 272-TD sonar towfish interfaced to the EdgeTech analog control interace (ACI), and A/D card and acquisition software. Chesapeake Technology, Inc.'s SonarWiz.MAP software was utilized to provide real-time mosaics for quality control.
3. OCS Block Boundaries: Minerals Management Service, 2005

GEODETIC INFORMATION

SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.000
SEMI-MINOR AXIS:	6,356,752.314
INVERSE FLATTENING:	298.25722101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 18 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0



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SIDE SCAN SONAR MOSAIC
Fall 2009 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

Scale 1:6,000

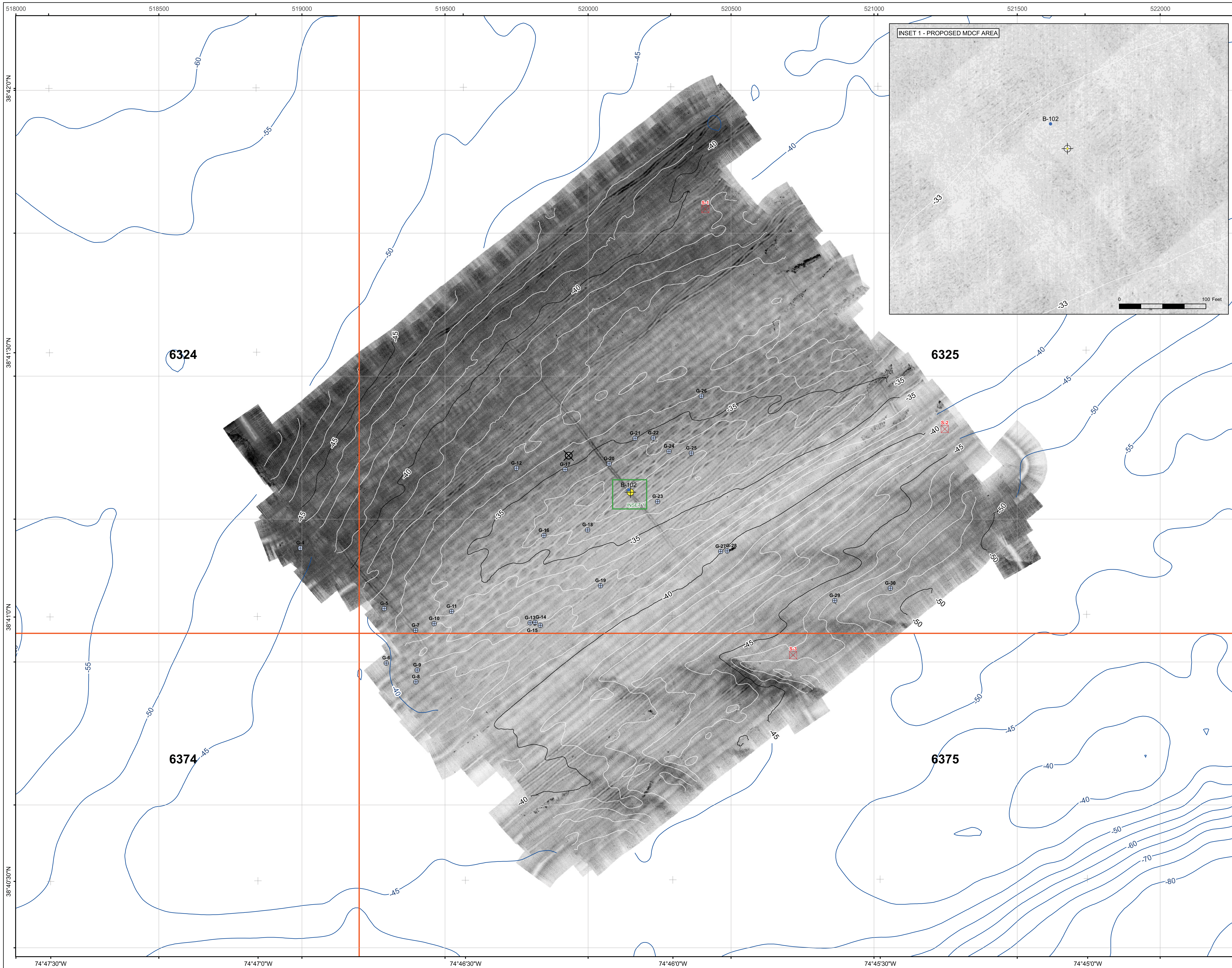
0 500 1,000 2,000 Feet

0 150 300 600 Meters

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	January 2010	Shallow Hazards Report	KWS	KRS	TWM
2	November 2010	Revised Shallow Hazards Report	KWS	KRS	TWM
3					

JOB NUMBER: 3671.004

CHART NO.: 4a



Legend

Proposed Meteorological Data Collection Facility (MDCF)
N 38° 41' 14" W 74° 46' 6"

2007 Halcrow/HPA Boring Location
(Halcrow/HPA, 2009)

G-1 Gas Seeps
(Fugro, 2010)

S-1 2010 Side Scan Sonar Targets
Sonar target designation is posted above symbol.

NOAA-Charted Obstruction
See NOAA Chart 12214

6325 Salisbury Protraction Area OCS Block

-40 **Regional Bathymetry - NJDEP**
Contour interval is 5 feet.

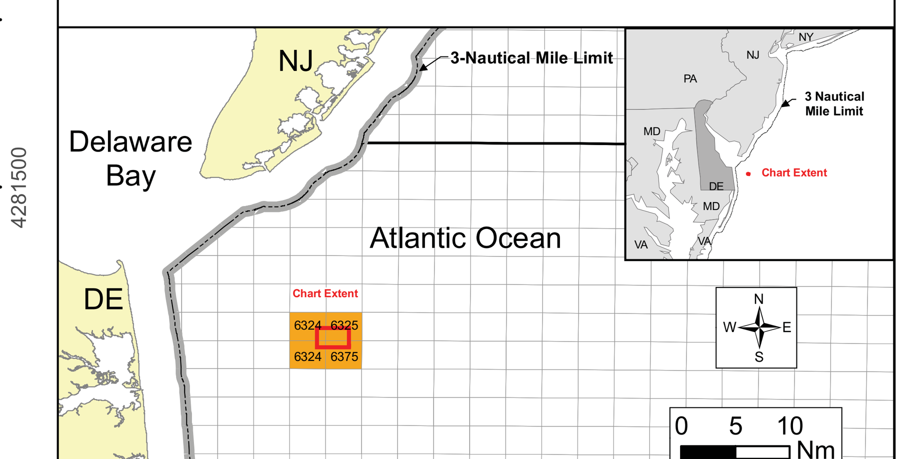
-35 **Fugro 2009 Bathymetric Survey**
Contour interval is 1 foot.

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS84, Meters; and Latitude/Longitude, WGS84
2. Side Scan Sonar Instrumentation:
Klein System 3000 sonar Towfish and armored tow cable interfaced to the Klein topside unit, which was networked to a data logging computer and Klein's SonarPro acquisition software. SonarPro features include, amongst other features, automatic gain control, real-time bottom tracking, and time varied gain.
3. OCS Block Boundaries: Minerals Management Service, 2005

GEODETIC INFORMATION

SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.000
SEMI-MINOR AXIS:	6,356,752.314
INVERSE FLATTENING:	298.25722101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 18 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0



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SIDE SCAN SONAR MOSAIC
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

Scale 1:6,000

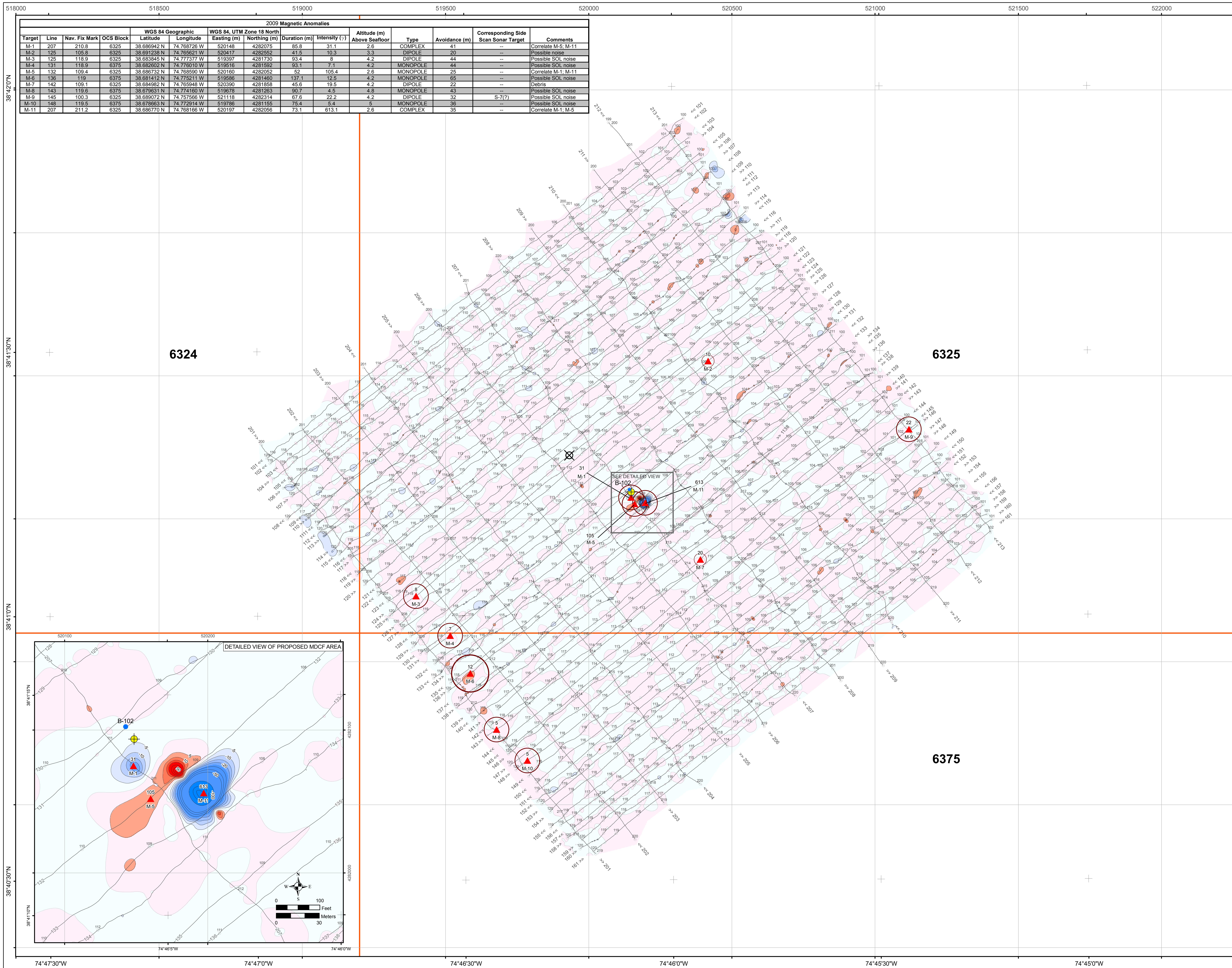
0 500 1,000 2,000 Feet
0 150 300 600 Meters

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	November 2010	Revised Shallow Hazards Report	KCS	KRS	TWM
2					
3					

JOB NUMBER: 3671.004

CHART NO.: 4b

2009 Magnetic Anomalies														
				WGS 84 Geographic		WGS 84, UTM Zone 18 North								
Target	Line	Nav. Fix Mark	OCS Block	Latitude	Longitude	Easting (m)	Northing (m)	Duration (m)	Intensity (γ)	Altitude (m) Above Seafloor	Type	Avoidance (m)	Corresponding Side Scan Sonar Target	Comments
M-1	207	210.8	6325	38.686942 N	74.768726 W	520148	4282075	85.8	31.1	2.6	COMPLEX	41	--	Correlate M-5; M-11
M-2	125	105.8	6325	38.691238 N	74.765621 W	520417	4282552	41.5	10.3	3.3	DIPOLE	20	--	Possible noise
M-3	125	118.9	6325	38.683845 N	74.777377 W	519397	4281730	93.4	8	4.2	DIPOLE	44	--	Possible SOL noise
M-4	131	118.9	6375	38.682602 N	74.776010 W	519516	4281592	93.1	7.1	4.2	MONOPOLE	44	--	Possible SOL noise
M-5	132	109.4	6325	38.686732 N	74.768590 W	520160	4282052	52	105.4	2.6	MONOPOLE	25	--	Correlate M-1; M-11
M-6	136	119	6375	38.681412 N	74.775211 W	519586	4281460	137.1	12.5	4.2	MONOPOLE	65	--	Possible SOL noise
M-7	142	109.1	6325	38.684982 N	74.765948 W	520390	4281858	45.6	19.5	4.2	DIPOLE	22	--	Debris
M-8	143	119.6	6375	38.679631 N	74.774160 W	519678	4281263	90.7	4.5	4.8	MONOPOLE	43	--	Possible SOL noise
M-9	145	100.3	6325	38.689072 N	74.757566 W	521118	4282314	67.6	22.2	4.2	DIPOLE	32	S-7(?)	Possible SOL noise
M-10	148	119.5	6375	38.678663 N	74.772914 W	519786	4281155	75.4	5.4	5	MONOPOLE	36	--	Possible SOL noise
M-11	207	211.2	6325	38.686770 N	74.768166 W	520197	4282056	73.1	613.1	2.6	COMPLEX	35	--	Correlate M-1; M-5



Legend

Proposed Meteorological Data Collection Facility (MDCF)
N 38° 41' 14" W 74° 46' 6"

2007 Halcrow/HPA Boring Location
(Halcrow/HPA, 2009)

NOAA-Charted Obstruction
(See NOAA Chart 12214)

155>> Magnetometer Survey Vessel Trackline. Survey line number and navigation fix points are labeled. Arrows indicate direction of vessel travel.

6325 Salisbury Protraction Area OCS Block

MAGNETOMETER SURVEY DATA

35 M-3 Magnetic Anomaly
Diameter of circle does not represent actual duration of anomaly. Number above symbol is intensity (gammas) of anomaly. Anomaly designation is labeled below symbol (M-3).

0 gamma [γ] contour

-20 to +20 gammas: 5 gamma [γ] contour interval
+20 to +50 gammas, -20 to -50 gammas: 10 gamma [γ] contour interval
Less than -50 gammas: 50 gamma [γ] contour interval

Relative Magnetic Field (gamma [γ])
Refer to Note 3 for explanation.

- Greater than 20
- 15.1 - 20
- 10.1 - 15
- 5.1 - 10
- 0.1 - 5
- -4.9 - 0
- -9.9 - -5
- -14.9 - -10
- -19.9 - -15
- -24.9 - -20
- -99.9 - -25
- Less than -100

Approximate Duration of Magnetic Anomalies (m)
Size of circle is proportional to duration of the anomaly.

- Less than 50
- 50 - 100
- Greater than 100

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. Magnetometer Survey Instrumentation:
   Marine Magnetics Corp., SeaSPY Overhauser Total Field Magnetometer
3. Relative magnetic field was calculated by first performing a regression analysis along each survey line to establish a base line for each survey transect. This removed the effects from changes in the Earth's magnetic field over the duration of the short survey since a recording base station was not used. The regression analysis was used to determine an equation that estimates the ambient magnetometer readings as a function of travel distance at the location of each measurement. Subtracting these calculated values from the original dataset produces a new dataset, wherein the values represent deviations from the (assumed) magnetic field of the Earth. This method was employed on a line-by-line basis for the entire dataset. The resulting data are magnetic fluctuations relative to each survey line's baseline. The contours were generated from the resulting "relative mangetic field" values.
4. Magnetic anomaly M-11 was identified on the initial pass of survey Line 207. Line 207 was resurveyed due to high noise levels in the inital pass. The trackline of the second survey pass is presented. However, due to the magnitude of the M-11 anomaly identified on the initial survey pass, we include the location, intensity, and duration of the anomaly on this chart.
5. OCS Block Boundaries: Minerals Management Service, 2005
6. Trackline represents position of GPS antenna.

GEODETIC INFORMATION

SPHEROID:	GRS 1980
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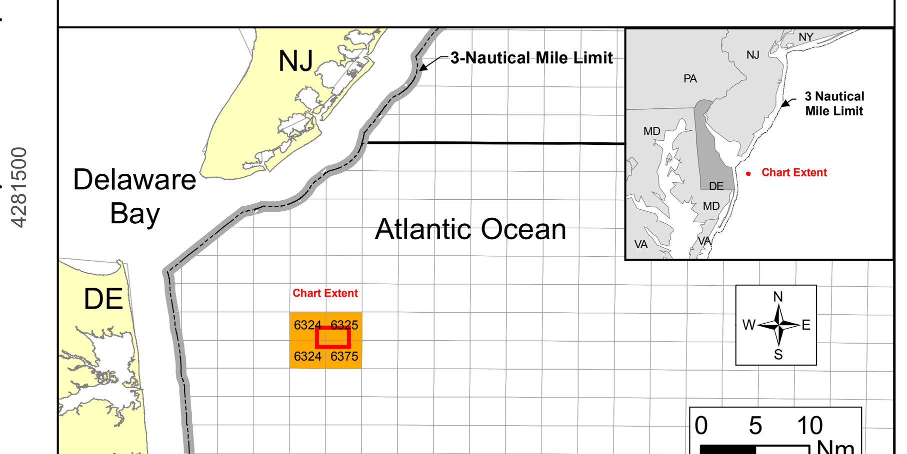
SEMI-MINOR AXIS:	6,356,752.314
INVERSE FLATTENING:	298.25722101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 18 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0



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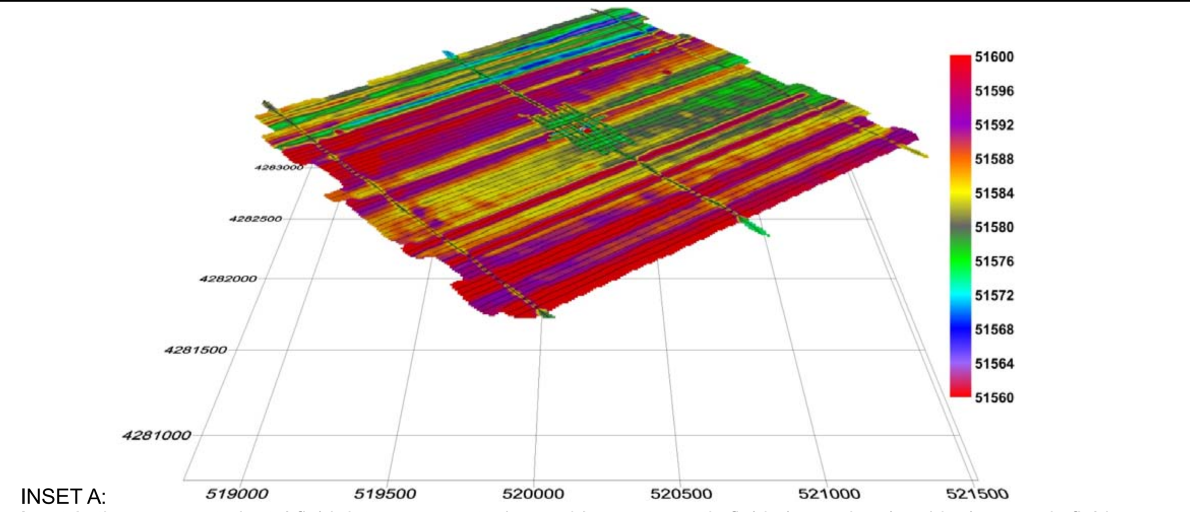
MAGNETIC ANOMALIES
Fall 2009 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

Scale 1:6,000

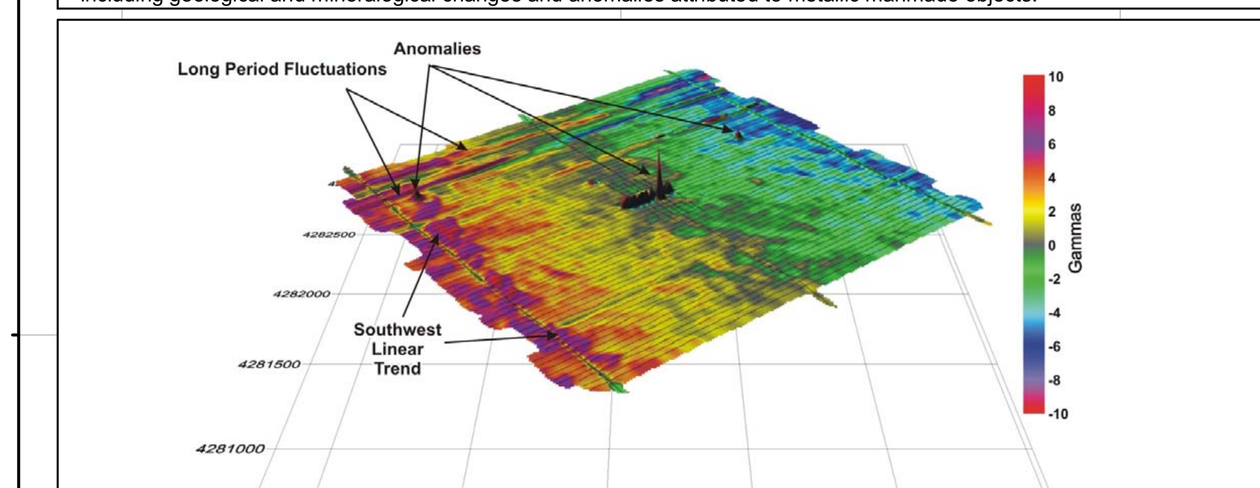
0 500 1,000 2,000 Feet
0 150 300 600 Meters

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	January 2010	Shallow Hazards Report	KWS	KRS	TWM
2	November 2010	Revised Shallow Hazards Report	KWS	KRS	TWM
3					

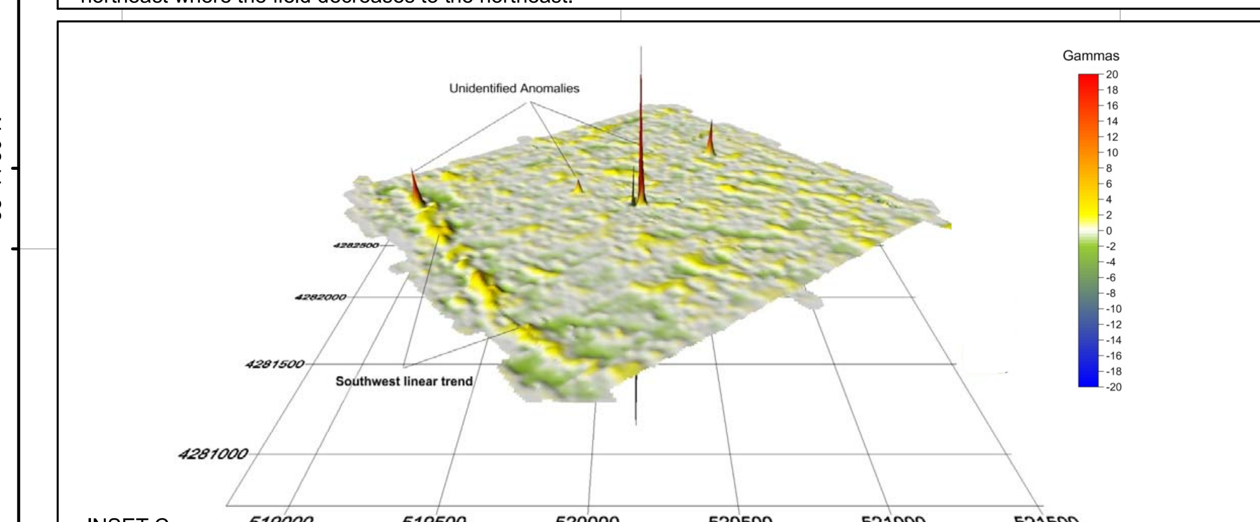
JOB NUMBER: 3671.004
CHART NO.: 5a



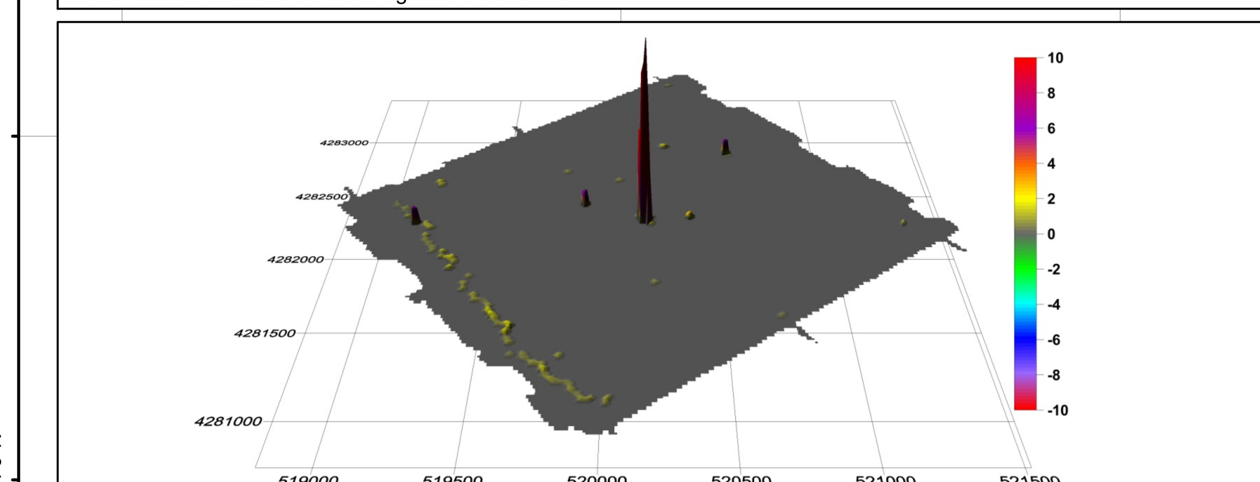
Inset A, the uncorrected total field data, represents the earth's geomagnetic field plus regional residual magnetic fields including geological and mineralogical changes and anomalies attributed to metallic manmade objects.



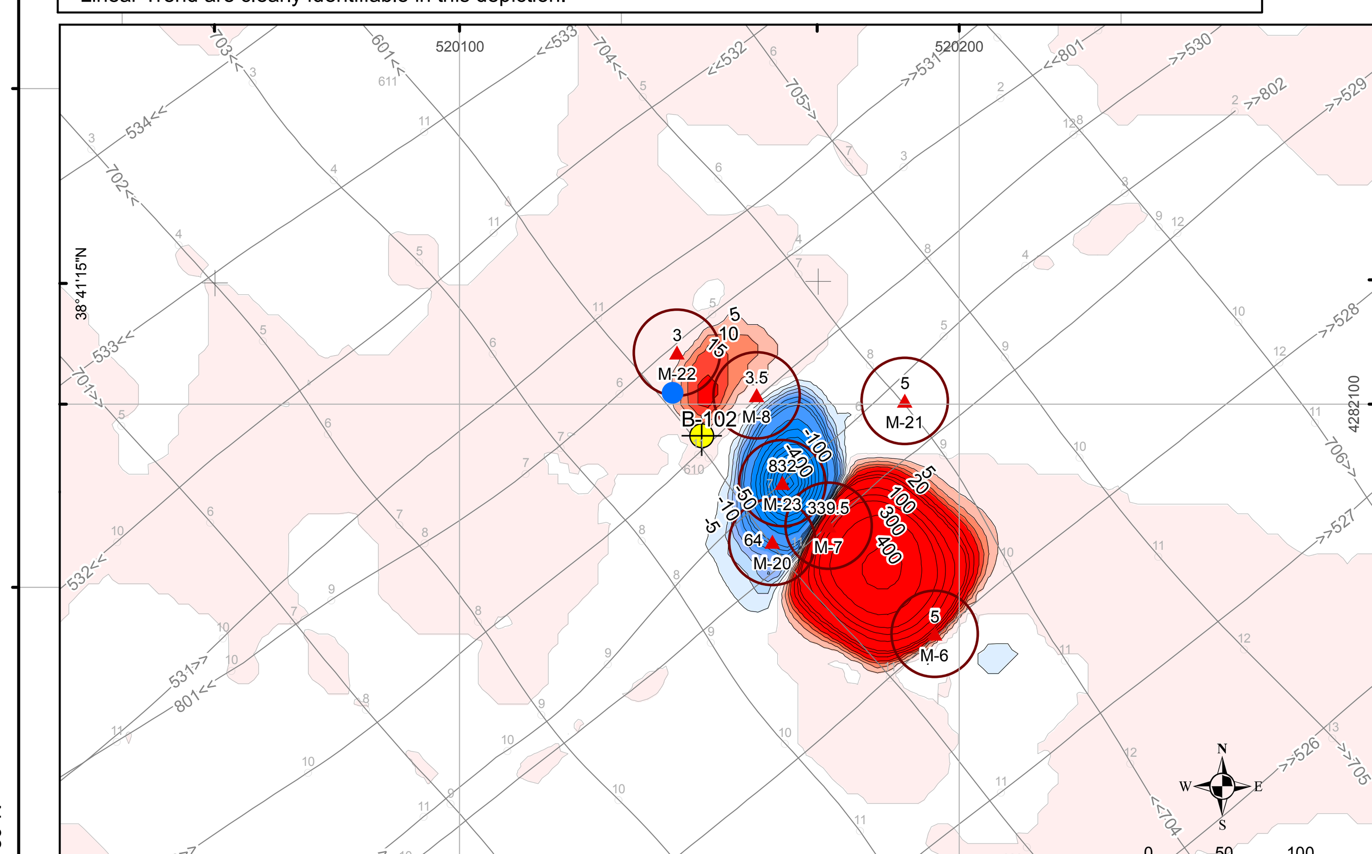
INSET B:
Inset B represents the measured magnetic field that has had the effects of geomagnetic fluctuations removed. The resulting gradient map represents the local magnetic field. The gradient map reveals a gradational change from the southwest to the northeast where the field decreases to the northeast.



INSET C:
Inset C depicts the relative magnetic field. This relative magnetic field differs from the geomagnetic corrected plot (Inset B) in that the local magnetic gradient is removed. This gradient data set was contoured and presented with the magnetic anomalies in this Chart and on Figures 11b and 12b.



INSET D:
Inset D presents the absolute value of the magnetic anomalies in the survey area. The central anomaly and Southwest Linear Trend are clearly identifiable in this depiction.



INSET E:
DETAILED VIEW OF PROPOSED MDCF AREA

Legend

- Proposed Meteorological Data Collection Facility (MDCF) N 38° 41' 14" W 74° 46' 6"
- 2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)
- NOAA-Charted Obstruction (See NOAA Chart 12214)
- Magnetometer Survey Vessel Trackline. Survey line number and navigation fix points are labeled. Arrows indicate direction of vessel travel.
- Salisbury Protraction Area OCS Block

MAGNETOMETER SURVEY DATA

Magnetic Anomaly
Diameter of circle does not represent actual duration of anomaly. Number above symbol is intensity (gammas) of anomaly. Anomaly designation is labeled below symbol (M-3).

0 gamma [γ] contour

-20 to +20 gammas: 5 gamma [γ] contour interval
+20 to +50 gammas, -20 to -50 gammas: 10 gamma [γ] contour interval
Less than -50 γ or Greater than 50 γ:
50 γ contour interval

Relative Magnetic Field (gamma [γ])
Refer to Note 3 for explanation.

- Greater than 20
- 15.1 - 20
- 10.1 - 15
- 5.1 - 10
- 0.1 - 5
- -4.9 - 0
- -9.9 - -5
- -14.9 - -10
- -19.9 - -15
- -24.9 - -20
- -99.9 - -25
- Less than -100

Approximate Duration of Magnetic Anomalies (m)
Size of circle is proportional to duration of the anomaly.

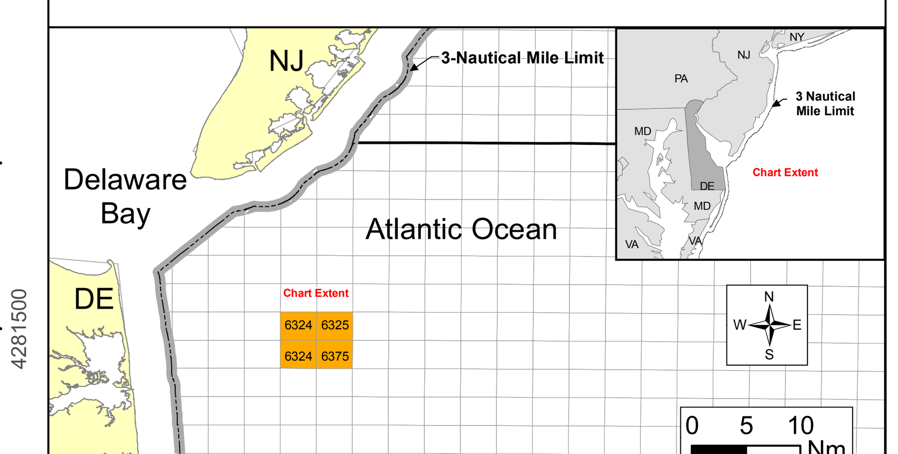
- Less than 50
- 50 - 100
- Greater than 100

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS84, Meters; and Latitude/Longitude, WGS84
2. Magnetometer Survey Instrumentation:
   Marine Magnetics Corp., SeaSPY Overhauser Total Field Magnetometer
3. Relative magnetic field was calculated by first performing a regression analysis along each survey line to establish a base line for each survey transect. This removed the effects from changes in the Earth's magnetic field over the duration of the short survey since a recording base station was not used. The regression analysis was used to determine an equation that estimates the ambient magnetometer readings as a function of travel distance at the location of each measurement. Subtracting these calculated values from the original dataset produces a new dataset, wherein the values represent deviations from the (assumed) magnetic field of the Earth. This method was employed on a line-by-line basis for the entire dataset. The resulting data are magnetic fluctuations relative to each survey line's baseline. The contours were generated from the resulting "relative mangetic field" values.
4. OCS Block Boundaries: Minerals Management Service, 2005
5. Trackline represents position of CRP (common reference point).
6. Southwest linear trending features include anomaly IDs M-25 to M-73. Duration and intensity values range from 1.5 to 8.6 gammas.

GEODETIC INFORMATION

SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.000
SEMI-MINOR AXIS:	6,356,752.314
INVERSE FLATTENING:	298.25722101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 18 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0



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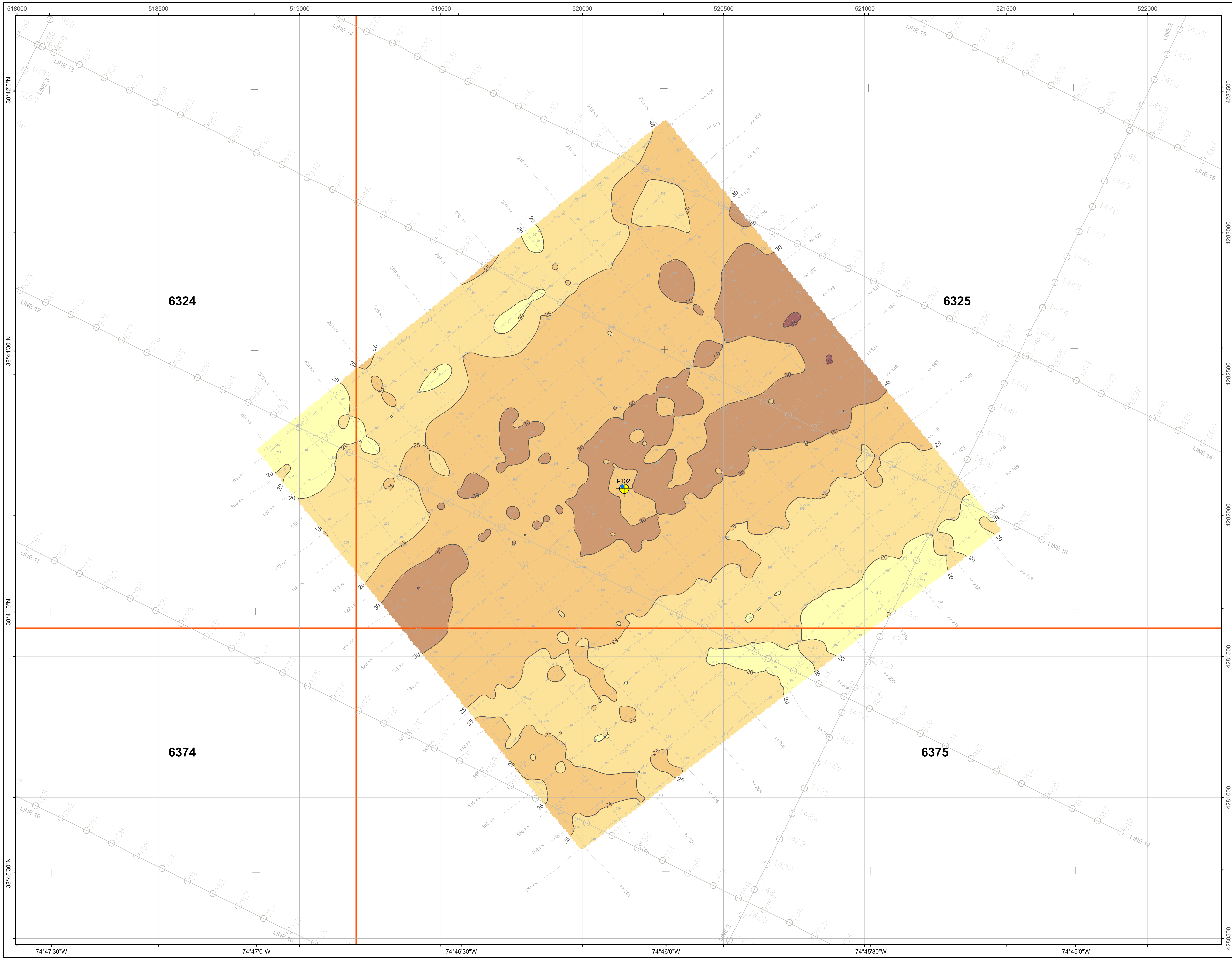
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

Scale 1:6,000

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	November 2010	Revised Shallow Hazards Report	KCS	KRS	TWM
2					
3					

JOB NUMBER: 3671.004 CHART NO.: 5b



Legend

Proposed Meteorological Data Collection Facility (MDCF)
N 38° 41' 14" W 74° 46' 6"

2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)

6325 Salisbury Protraction Area OCS Block

155>> 120 2009 Fugro Seismic Reflection Trackline

LINE 12 912 2006 OSI Seismic Reflection Survey Vessel Trackline

Unit 1 Isopach (thickness), feet
Unit 1 isopach is from the Seafloor to Event 10. The seafloor and Event 10 are interpreted from boomer source, 8-channel, 1.56-mgi and 16-channel, 3.125-mgi GeoEel hydrophone arrays.

Contour interval is 5 feet.

Less than 20

20 to 25

25 to 30

30 to 35

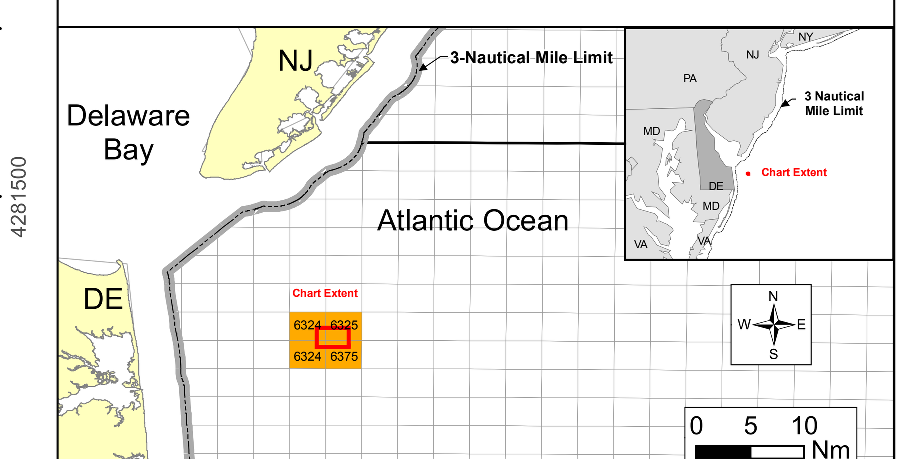
Greater than 35

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005
3. Seismic data was converted from time to depth using Vp = 5,000 ft/sec.

GEODETIC INFORMATION

SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.000
SEMI-MINOR AXIS:	6,356,752.314
INVERSE FLATTENING:	298.25722101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 18 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0



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N
W E
S

UNIT 1 ISOPACH (Between Seafloor and Event 10)

Bluewater Wind Meteorological Tower
Delaware Continental Shelf

Scale 1:6,000

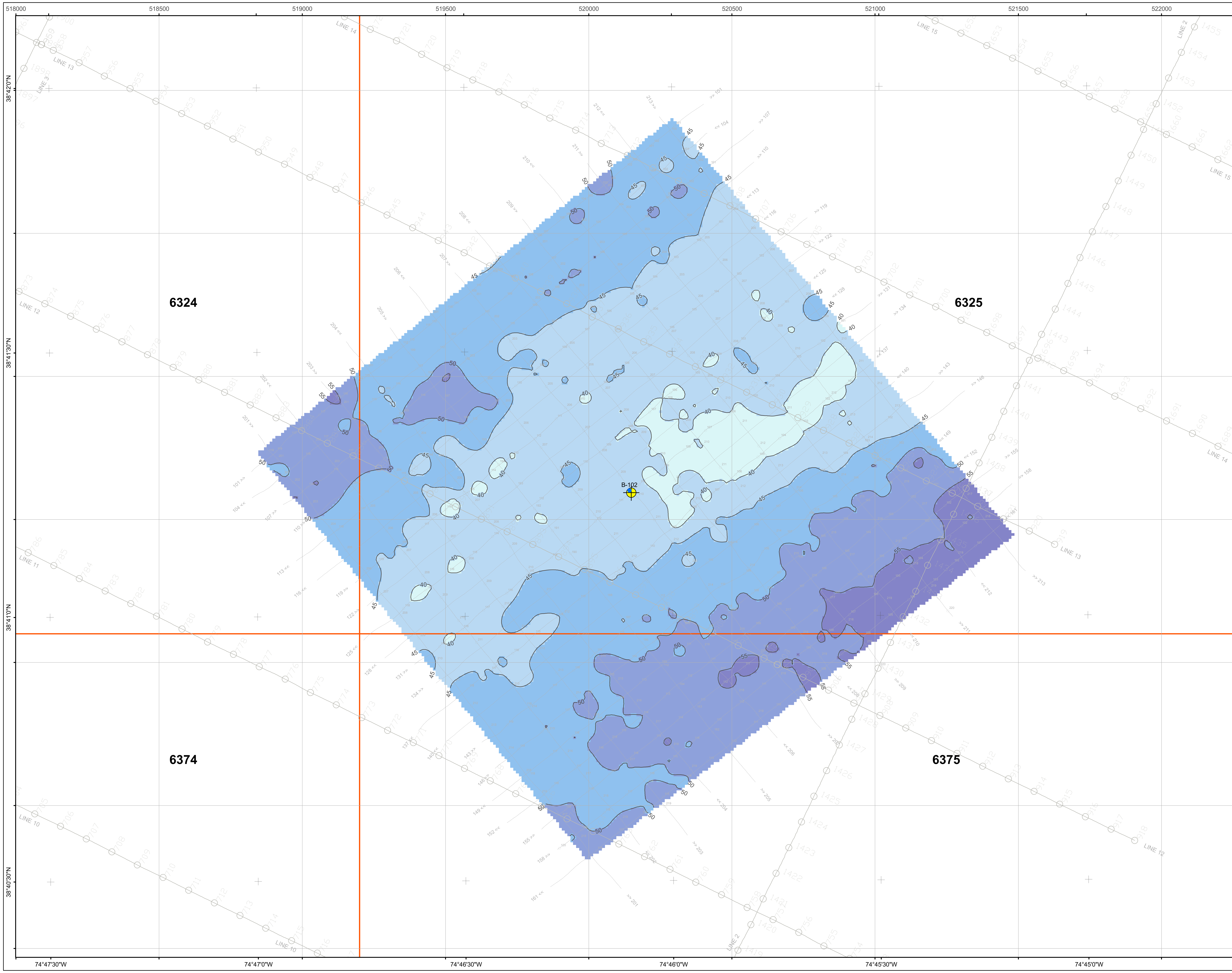
0 500 1,000 2,000 Feet

0 150 300 600 Meters

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	January 2010	Shallow Hazards Report	KWS	KRS	TWM
2	November 2010	Revised Shallow Hazards Report	KWS	KRS	TWM
3					

JOB NUMBER: 3671.004

CHART NO.: 6



Legend

Proposed Meteorological Data Collection Facility (MDCF)
N 38° 41' 14" W 74° 46' 6"

2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)

6325 Salisbury Protraction Area OCS Block

155>> 120 2009 Fugro Seismic Reflection Trackline

LINE 12 912 2006 OSI Seismic Reflection Survey Vessel Trackline

Unit 2 Isopach (thickness), feet
Between Events 10 and 20
Events 10 and 20 are interpreted from boomer source, 8-channel, 1.56-mgi and 16-channel, 3.125-mgi GeoEel hydrophone arrays.

Contour interval is 5 feet.

Less than 40

40 to 45

45 to 50

50 to 55

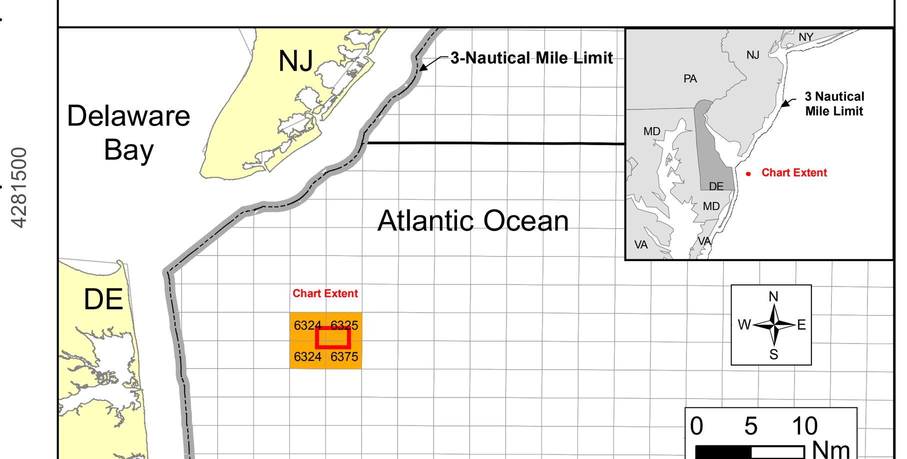
Greater than 55

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005
3. Seismic data was converted from time to depth using Vp = 5,000 ft/sec.

GEODETIC INFORMATION

SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.000
SEMI-MINOR AXIS:	6,356,752.314
INVERSE FLATTENING:	298.25722101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 18 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0



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UNIT 2 ISOPACH (Between Events 10 and 20)
Bluewater Wind Meteorological Tower Delaware Continental Shelf

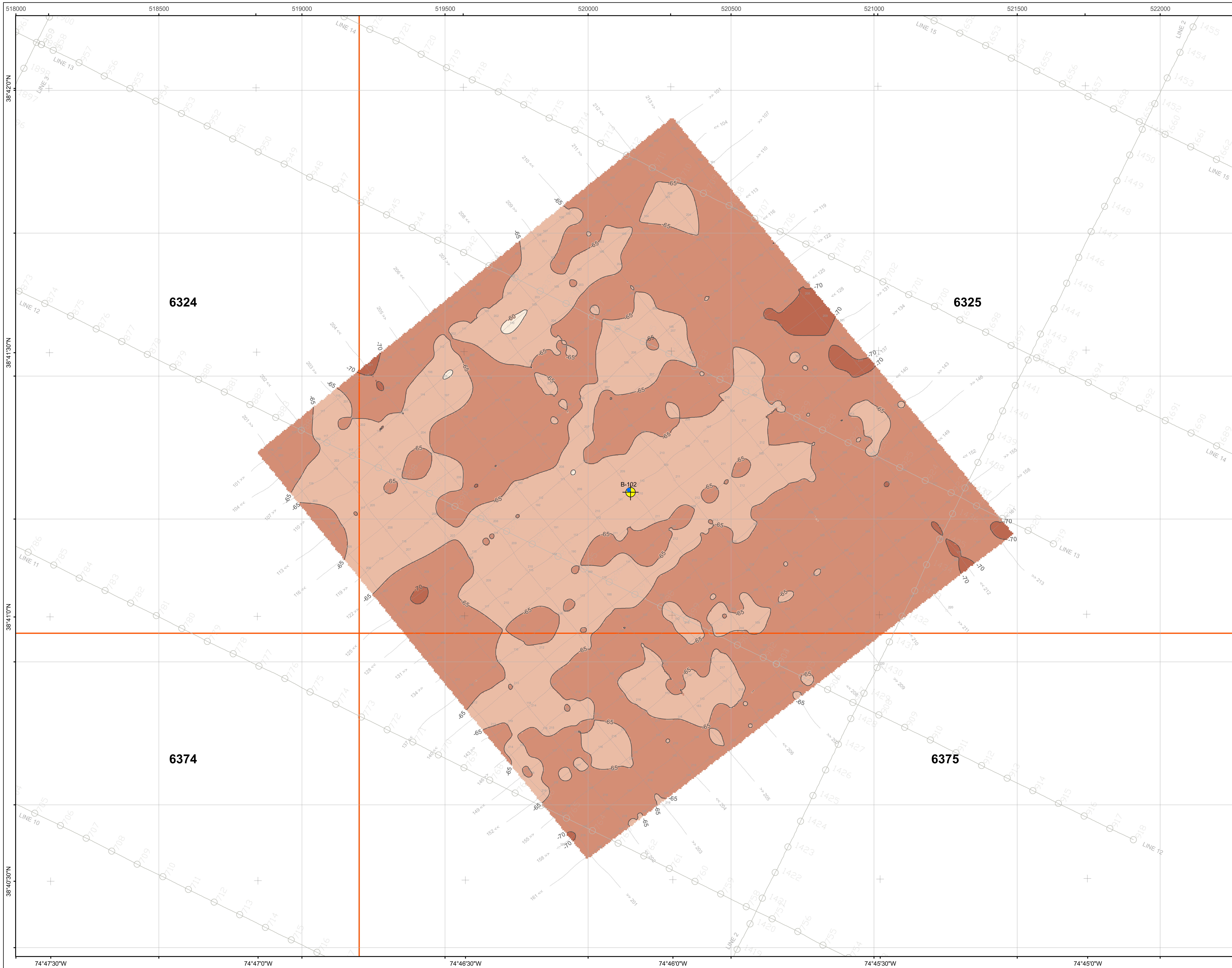
Scale 1:6,000

0 500 1,000 2,000 Feet
0 150 300 600 Meters

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	January 2010	Shallow Hazards Report	KWS	KRS	TWM
2	November 2010	Revised Shallow Hazards Report	KWS	KRS	TWM
3					

JOB NUMBER: 3671.004

CHART NO.: 7



Legend

Proposed Meteorological Data Collection Facility (MDCF)
N 38° 41' 14" W 74° 46' 6"

2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)

6325 Salisbury Protraction Area OCS Block

155>> 120 2009 Fugro Seismic Reflection Trackline

LINE 12 912 2006 OSI Seismic Reflection Survey Vessel Trackline

Structural Elevation of Event 10, feet (MLLW)
Event 10 interpreted from boomer source, 8-channel, 1.56-mgi and 16-channel, 3.125-mgi GeoEel hydrophone arrays.

Contour interval is 5 feet.

Above -60

-60 to -65

-65 to -70

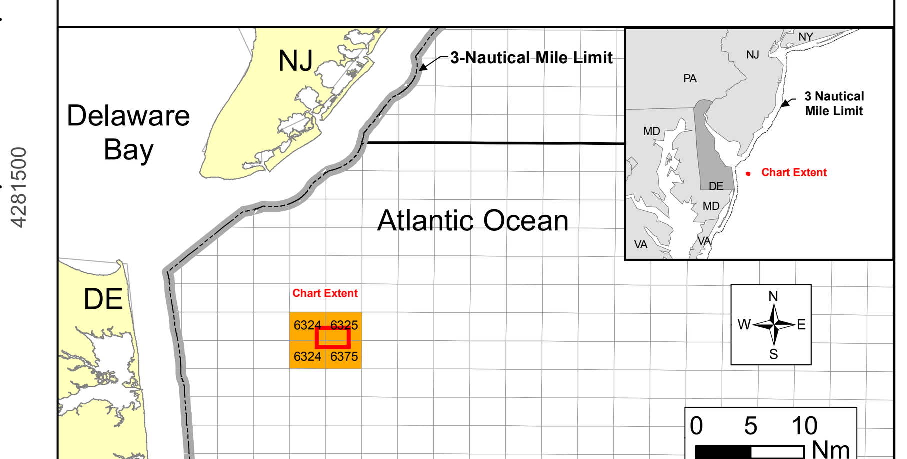
Below -70

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005
3. Seismic data was converted from time to depth using Vp = 5,000 ft/sec.

GEODETIC INFORMATION

SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.000
SEMI-MINOR AXIS:	6,356,752.314
INVERSE FLATTENING:	298.25722101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 18 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0



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STRUCTURAL CONTOUR MAP OF EVENT 10

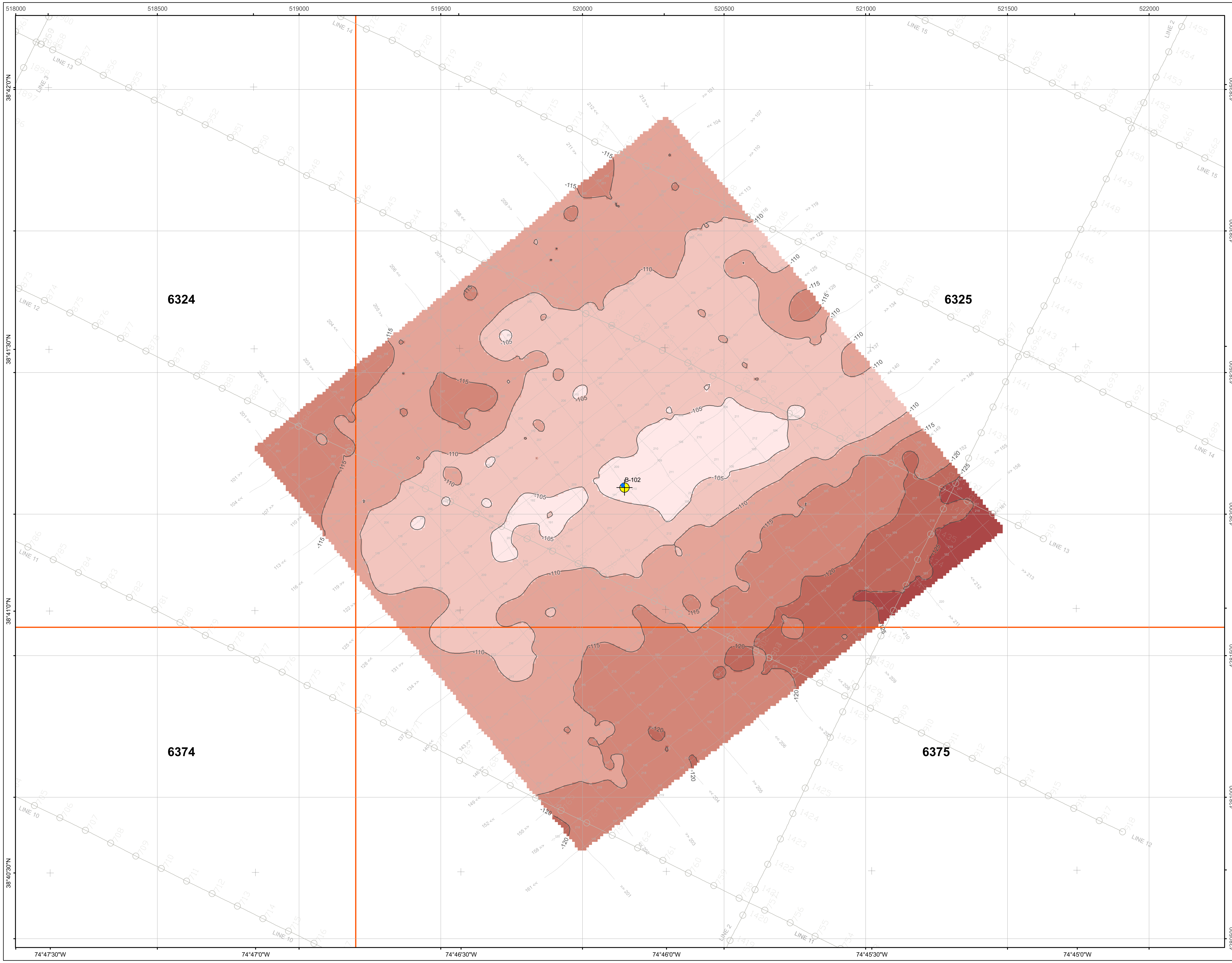
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

Scale 1:6,000

0 500 1,000 2,000 Feet
0 150 300 600 Meters

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	January 2010	Shallow Hazards Report	KWS	KRS	TWM
2	November 2010	Revised Shallow Hazards Report	KWS	KRS	TWM
3					

JOB NUMBER: 3671.004
CHART NO.: 8



Legend

Proposed Meteorological Data Collection Facility (MDCF)
N 38° 41' 14" W 74° 46' 6"

2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)

6325 Salisbury Protraction Area OCS Block

155>> 120 2009 Fugro Seismic Reflection Trackline

LINE 12 912 2006 OSI Seismic Reflection Survey Vessel Trackline

Structural Elevation of Event 20, feet (MLLW)
Event 20 interpreted from boomer source, 8-channel, 1.56-mgi and 16-channel, 3.125-mgi GeoEel hydrophone arrays.

Contour interval is 5 feet.

Above -105

-105 to -110

-110 to -115

-115 to -120

-120 to -125

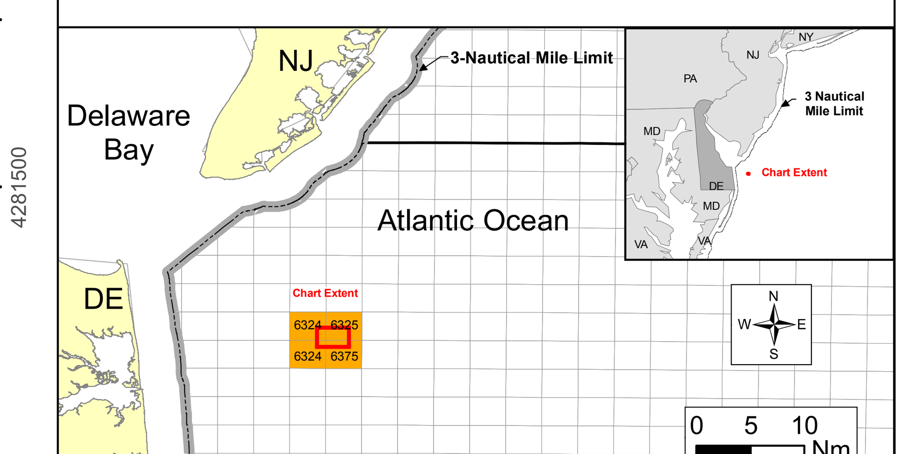
Below -125

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS 84, Meters; and Latitude/Longitude, WGS84
2. OCS Block Boundaries: Minerals Management Service, 2005
3. Seismic data was converted from time to depth using Vp = 5,000 ft/sec.

GEODETIC INFORMATION

SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.000
SEMI-MINOR AXIS:	6,356,752.314
INVERSE FLATTENING:	298.25722101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 18 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0



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N W E S

STRUCTURAL CONTOUR MAP OF EVENT 20

Bluewater Wind Meteorological Tower Delaware Continental Shelf

Scale 1:6,000

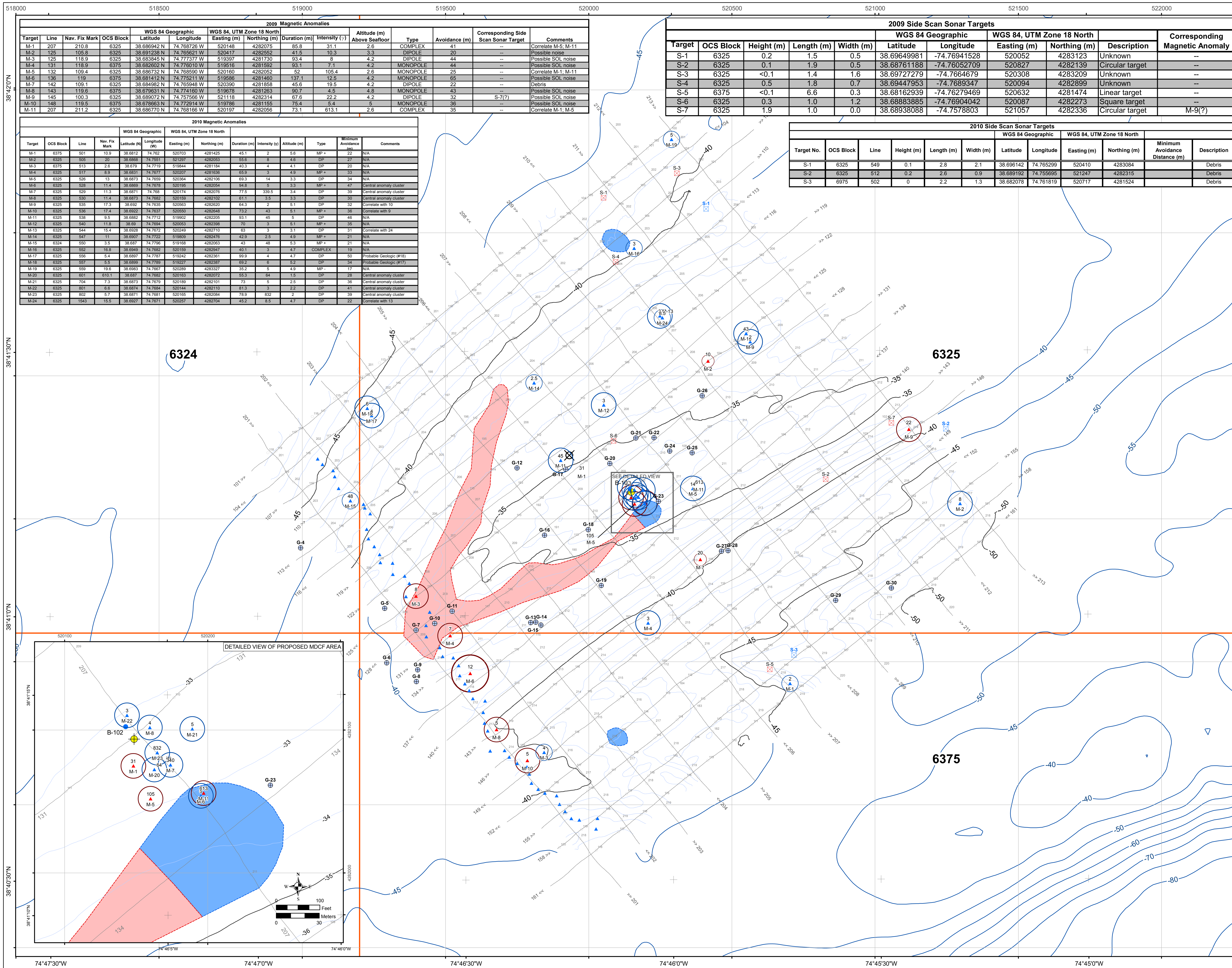
0 500 1,000 2,000 Feet

0 150 300 600 Meters

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	January 2010	Shallow Hazards Report	KWS	KRS	TWM
2	November 2010	Revised Shallow Hazards Report	KWS	KRS	TWM
3					

JOB NUMBER: 3671.004

CHART NO.: 9



2009 Magnetic Anomalies

Target	Line	Nav. Fix Mark	OCS Block	WGS 84 Geographic Latitude	WGS 84 Geographic Longitude	WGS 84, UTM Zone 18 North Easting (m)	WGS 84, UTM Zone 18 North Northing (m)	Duration (m)	Intensity (γ)	Altitude (m) Above Seafloor	Type	Avoidance (m)	Corresponding Side Scan Sonar Target	Comments
M-1	207	210.8	6325	38.686942 N	74.768726 W	520148	4282075	85.8	31.1	2.6	COMPLEX	41	--	Correlate M-5; M-11
M-2	125	105.8	6325	38.691238 N	74.765621 W	520417	4282552	41.5	10.3	3.3	DIPOLE	20	--	Possible noise
M-3	125	118.9	6325	38.683845 N	74.777377 W	519397	4281730	93.4	8	4.2	DIPOLE	44	--	Possible SOL noise
M-4	131	118.9	6375	38.682602 N	74.776010 W	519516	4281592	93.1	7.1	4.2	MONOPOLE	44	--	Possible SOL noise
M-5	132	109.4	6325	38.686732 N	74.768590 W	520160	4282052	52	105.4	2.6	MONOPOLE	25	--	Correlate M-1; M-11
M-6	136	119	6375	38.681412 N	74.775211 W	519586	4281460	137.1	12.5	4.2	MONOPOLE	65	--	Possible SOL noise
M-7	142	109.1	6325	38.684982 N	74.765948 W	520390	4281858	45.6	19.5	4.2	DIPOLE	22	--	Debris
M-8	143	119.6	6375	38.679631 N	74.774160 W	519678	4281263	90.7	4.5	4.8	MONOPOLE	43	--	Possible SOL noise
M-9	145	100.3	6325	38.689072 N	74.757566 W	521118	4282314	67.6	22.2	4.2	DIPOLE	32	S-7(?)	Possible SOL noise
M-10	148	119.5	6375	38.678663 N	74.772914 W	519786	4281155	75.4	5.4	5	MONOPOLE	36	--	Possible SOL noise
M-11	207	211.2	6325	38.686770 N	74.768166 W	520197	4282056	73.1	613.1	2.6	COMPLEX	35	--	Correlate M-1; M-5

2010 Magnetic Anomalies

Target	OCS Block	Line	Nav. Fix Mark	WGS 84 Geographic Latitude (N)	WGS 84 Geographic Longitude (W)	WGS 84, UTM Zone 18 North Easting (m)	WGS 84, UTM Zone 18 North Northing (m)	Duration (m)	Intensity (γ)	Altitude (m)	Type	Minimum Avoidance (m)	Comments
M-1	6375	501	10.9	38.6812	74.762	520703	4281425	45.1	2	5.6	MP +	22	N/A
M-2	6325	505	20	38.6868	74.7551	521297	4282053	55.6	8	4.6	DP	27	N/A
M-3	6375	513	2.6	38.679	74.7719	519844	4281184	40.3	4	4.1	DP	20	N/A
M-4	6325	517	8.9	38.6831	74.7677	520207	4281636	65.9	3	4.9	MP +	33	N/A
M-5	6325	526	13	38.6873	74.7659	520364	4282106	69.3	14	3.3	DP	34	N/A
M-6	6325	528	11.4	38.6869	74.7678	520195	4282054	94.8	5	3.3	MP +	47	Central anomaly cluster
M-7	6325	529	11.3	38.6871	74.768	520174	4282076	77.5	339.5	3.4	DP	39	Central anomaly cluster
M-8	6325	530	11.4	38.6873	74.7682	520159	4282102	61.1	3.5	3.3	DP	30	Central anomaly cluster
M-9	6325	535	17.3	38.692	74.7635	520563	4282620	64.3	2	5.1	DP	32	Correlate with 10
M-10	6325	536	17.4	38.6922	74.7637	520550	4282648	73.2	43	5.1	MP +	36	Correlate with 9
M-11	6325	538	9.5	38.6882	74.7712	519902	4282205	93.1	45	5	DP	46	N/A
M-12	6325	540	11.8	38.69	74.7694	520053	4282398	70	3	5.1	MP +	35	N/A
M-13	6325	544	15.4	38.6928	74.7672	520249	4282710	63	3	3.1	DP	31	Correlate with 24
M-14	6325	547	11	38.6907	74.7722	519809	4282476	42.9	2.5	4.9	MP +	21	N/A
M-15	6324	550	3.5	38.687	74.7796	519168	4282063	43	48	5.3	MP +	21	N/A
M-16	6325	552	16.8	38.6949	74.7682	520159	4282947	40.1	3	4.7	COMPLEX	19	N/A
M-17	6325	556	5.4	38.6897	74.7787	519242	4282361	99.9	4	4.7	DP	50	Probable Geologic (#18)
M-18	6325	557	5.5	38.6899	74.7789	519227	4282387	69.2	6	5.2	DP	34	Probable Geologic (#17)
M-19	6325	559	19.6	38.6983	74.7667	520289	4283327	35.2	5	4.9	MP -	17	N/A
M-20	6325	601	610.1	38.687	74.7682	520163	4282072	55.3	64	1.5	DP	28	Central anomaly cluster
M-21	6325	704	7.3	38.6873	74.7679	520189	4282101	73	5	2.5	DP	36	Central anomaly cluster
M-22	6325	801	6.6	38.6874	74.7684	520144	4282110	81.3	3	2.2	DP	41	Central anomaly cluster
M-23	6325	802	5.7	38.6871	74.7681	520165	4282084	78.9	832	2	DP	39	Central anomaly cluster
M-24	6325	1543	15.5	38.6927	74.7671	520257	4282704	45.2	8.5	4.7	DP	22	Correlate with 13

2009 Side Scan Sonar Targets

Target	OCS Block	Height (m)	Length (m)	Width (m)	WGS 84 Geographic Latitude	WGS 84 Geographic Longitude	WGS 84, UTM Zone 18 North Easting (m)	WGS 84, UTM Zone 18 North Northing (m)	Description	Corresponding Magnetic Anomaly
S-1	6325	0.2	1.5	0.5	38.69649981	-74.76941528	520052	4283123	Unknown	--
S-2	6325	0.1	1.9	0.5	38.68761188	-74.76052709	520827	4282139	Circular target	--
S-3	6325	<0.1	1.4	1.6	38.69727279	-74.7664679	520308	4283209	Unknown	--
S-4	6325	0.5	1.8	0.7	38.69447953	-74.7689347	520094	4282899	Unknown	--
S-5	6375	<0.1	6.6	0.3	38.68162939	-74.76279469	520632	4281474	Linear target	--
S-6	6325	0.3	1.0	1.2	38.68883885	-74.76904042	520087	4282273	Square target	--
S-7	6325	1.9	1.0	0.0	38.68938088	-74.7578803	521057	4282336	Circular target	M-9(?)

2010 Side Scan Sonar Targets

Target No.	OCS Block	Line	Height (m)	Length (m)	Width (m)	WGS 84 Geographic Latitude	WGS 84 Geographic Longitude	WGS 84, UTM Zone 18 North Easting (m)	WGS 84, UTM Zone 18 North Northing (m)	Minimum Avoidance Distance (m)	Description
S-1	6325	549	0.1	2.8	2.1	38.696142	74.765299	520410	4283084		Debris
S-2	6325	512	0.2	2.6	0.9	38.689192	74.755695	521247	4282315		Debris
S-3	6975	502	0	2.2	1.3	38.682078	74.761819	520717	4281524		Debris

Legend

Proposed Meteorological Data Collection Facility (MDCF) N 38° 41' 14" W 74° 46' 6"

2007 Halcrow/HPA Boring Location (Halcrow/HPA, 2009)

NOAA-Charted Obstruction (See NOAA Chart 12214)

S-5 2009 Side Scan Sonar Targets

S-5 2010 Side Scan Sonar Targets

6325 Salisbury Protraction Area OCS Block

155>> 120 2009 Fugro Seismic Reflection Survey Vessel Trackline Survey line number and navigation fix points are labeled. Arrows indicate direction of vessel travel.

MAGNETOMETER SURVEY DATA

35 M-3 Magnetic Anomaly
Diameter of circle does not represent actual duration of anomaly. Number above symbol is intensity (gammas) of anomaly. Anomaly designation is labeled below symbol (M-3).

Approximate Duration of Magnetic Anomalies (m)
Size of circle is proportional to duration of the anomaly.

Less than 50

50 - 100

Greater than 100

Fall 2009 Survey Magnetometer Anomalies

Fall 2009 Survey Magnetometer Anomalies

BATHYMETRY
Fugro 2009 Multibeam Survey

Contour interval is 5 feet.

Contour interval is 1 foot.

Regional Bathymetry (NJDEP 2007)

Contour interval is 5 feet.

High-Amplitude Anomalies Indicative of Possible Shallow Gas Accumulations

Amplitude Anomalies within Seismic Unit 2 (Event 10 to Event 20) Burial Depth to these Anomalies is ~69 feet to ~104 feet BSS.

Amplitude Anomalies within Seismic Unit 3 (Event 20 to Event 25) Burial Depth to these Anomalies is ~104 feet to ~151 feet BSS.

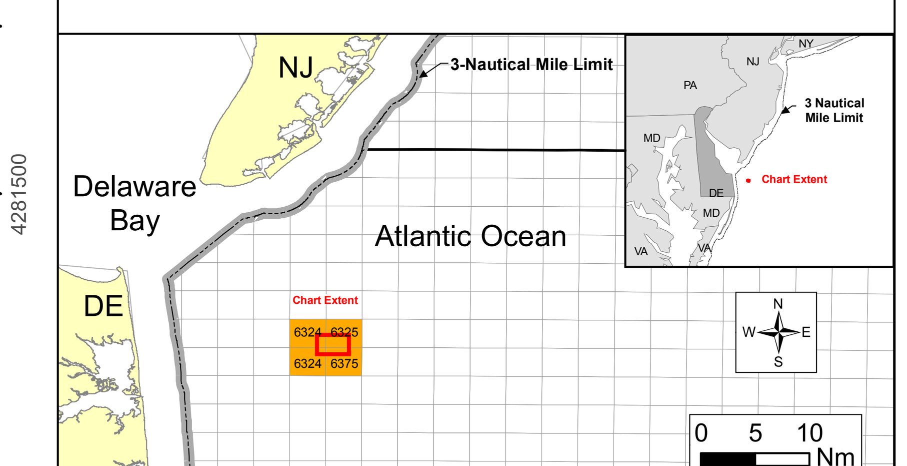
G-1 Side Scan Sonar Returns from Water Column: Possible Gas Seeps (Fugro, 2010)

NOTES

1. Coordinate Grid: UTM Zone 18 North, WGS84, Meters; and Latitude/Longitude, WGS84
2. See Figure 11 for magnetometer survey equipment specifications and Figure 9 for side scan survey equipment specifications.
3. OCS Block Boundaries: Minerals Management Service, 2005
4. Trackline represents position of GPS antenna.
5. Only 2009 seismic survey tracklines are displayed on map.
6. See Tabel 2c in text for table of 2010 side scan sonar returns from water column (possible intermittent gas seeps).

GEODETIC INFORMATION

SPHEROID:	GRS 1980
SEMI-MAJOR AXIS:	6,378,137.000
SEMI-MINOR AXIS:	6,356,752.314
INVERSE FLATTENING:	298.25722101
ECCENTRICITY^2:	0.006694380
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 18 NORTH
LONGITUDE OF ORIGIN:	0°
FALSE EASTING:	500,000
FALSE NORTHING:	0



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Tel: (757) 625-3350,
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SITE FEATURES
Fall 2009 and Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

Scale 1:6,000

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	January 2010	Shallow Hazards Report	KWS	KRS	TWM
2	November 2010	Revised Shallow Hazards Report	KWS	KRS	TWM
3					

JOB NUMBER: 3671.004 CHART NO.: 10

APPENDIX A
DATA ACQUISITION AND PROCESSING

APPENDIX A - DATA ACQUISITION AND PROCESSING

CONTENTS

Page

ILLUSTRATIONS

Figure

DATA ACQUISITION AND PROCESSING

This appendix describes the data acquisition and processing procedures. The original, fall 2009 survey was conducted using Miller's Launch S/V *Samantha Miller* (Figure A-1a), while the supplemental fall 2010 data collection was conducted from the R/V *Chinook* (Figure A-1b). Survey equipment configurations are shown on Figures A-2a, A-2b, and A-2c.

ORIGINAL, FALL 2009 SURVEY OVERVIEW

GEOLOGICAL AND GEOPHYSICAL (G&G) SURVEY

The geological and geophysical (G&G) survey was comprised of collecting two-dimensional (2D) high-resolution, multichannel seismic reflection, sub-bottom profiler, multibeam echosounder, side scan sonar, and magnetometer data over the 1.8-km x 1.8-km survey area (Figure 5 and Chart 2). Twenty-one primary G&G lines (line numbers 101 through 161) oriented 051°/231° and spaced nominally 90 meters apart (Figure 5 and Chart 2). Thirteen crosslines were run at a nominal spacing of 150 meters, with an orientation of 141°/321°. Survey equipment tow configurations are shown in Figures A-2.

MARINE ARCHAEOLOGY RESOURCE SURVEY

The marine archaeology resource survey was comprised of collecting sub-bottom profiler, multibeam echosounder, side scan sonar, and magnetometer data over the 1.8-km x 1.8-km survey area (Figure 4 and Chart 1). Those systems were run on all survey tracklines. Sixty-one primary lines were run at an orientation of 051°/231°, nominally spaced 30 meters apart. Thirteen crosslines were run at a nominal spacing of 150 meters, with an orientation of 141°/321°.

WORK PERFORMED

Fugro survey equipment was mobilized onto the *Samantha Miller* (Figures A-1a and A-2a) at Miller's Launch shipyard in Staten Island, New York. System checks and calibrations were performed offshore Staten Island prior to transiting to the survey area. The survey was commenced on October 11, 2009, and conducted during the periodic suitable weather days through November 1, 2009. The vessel then returned to Staten Island for demobilization. Two marine mammal observers (MMOs) were provided by Geo-Marine, under separate contract to Bluewater Wind.

AUTHORIZATION

Fugro's survey efforts were authorized by Bluewater Wind's execution of a Master Service Agreement (MSA) between Fugro and Bluewater Wind. The scope of work was as established by Fugro Proposal No. 2009.398, dated September 30, 2009.

Fugro's scope of work included the collection of marine survey data for both the G&G survey and the Archaeological Resources survey, as described by the U.S. Minerals

Management Service (MMS') *Guidelines*. Fugro's scope of work included the G&G interpretation and reporting. The archaeological resources interpretation will be provided by R. Christopher Goodwin & Associates (Goodwin), working for Tetra Tech EC, under separate contract to Bluewater Wind. The survey data for archaeological resource interpretation are included in this data report. In addition, the applicable survey data have been provided to Goodwin in electronic format.

A Marine Survey Plan, dated September 29, 2009, was prepared by Fugro on behalf of Bluewater Wind for submittal to the MMS.

SUPPLEMENTAL, FALL 2010 SURVEY OVERVIEW

SCOPE OF SUPPLEMENTAL DATA COLLECTION

In the fall 2010, Fugro collected additional side scan sonar and magnetometer data across the 1.8-km by 1.8-km survey area. The purposes of the supplemental data collection were to: 1) collect new magnetometer data at the northwest and southeast limits of the survey area, where the original magnetometer data were collected with the instrument being flown too high from the seafloor, 2) add supplemental tie-lines and infill data lines at 15-meter line spacing in the central portion of the survey area where the original data disclosed several magnetometer anomalies, and 3) obtain a second set of side scan sonar data using a different system than used to collect the original data. Rather than merge the supplemental data with the original data, full sets of magnetometer and side scan sonar data were collected across the entire survey area.

WORK PERFORMED

Fugro survey equipment was mobilized onto the R/V *Chino*ok (Figures A-1b and A-2b) in Ocean City, Maryland. System checks and calibrations were performed offshore Staten Island prior to transiting to the survey area. The survey was commenced on October 10, 2010, and conducted during 6 days of suitable weather days through November 3, 2010_. The vessel then returned to Ocean City, Maryland for demobilization.

AUTHORIZATION

The supplemental survey data acquisition was authorized by NRG Bluewater Wind Purchase Order (PO) #: K0923101, dated 09-23-2010. The related bottom grab sampling was authorized by NRG Bluewater Wind PO #: K1025101, dated 10-25-2010.

DATA COLLECTION AND PROCESSING

POSITIONING AND NAVIGATION

Wide-area Differential Global Position System (DGPS) was used to position the survey vessel. DGPS is a satellite-based positioning system operated by the U.S. Department of Defense. A "wide-area" application operates with correction values applied to a standalone

GPS receiver from base stations located over large distances. DGPS corrections were supplied to the system using the STARFIX II network. This differential network is a nationwide system operated by Fugro. STARFIX II broadcasts differential corrections via a communications satellite downlink to field receivers.

The vessel position information was linked to an onboard Pentium-based personal computer (PC) running Fugro's Starfix.SEIS Suite 9.1 navigational software. Starfix is an advanced PC-based Windows navigation system designed for both surface and subsurface vehicle positioning. A helmsman's display continually updates true vessel position, tracklines, distances off line, and distances along line. Other common input/output (I/O) interfaces include connections to gyros, echosounders, sub-bottom profilers, magnetometers, acoustic tracking systems, or virtually any receiver/sensor capable of a standard serial interface.

Positional fixes, from the navigation system, were output at a rate of 1 pulse per second. This enables external instruments (e.g. PC or navigation program) to synchronize their internal time with a time that is derived from highly accurate GPS time. Positional accuracy with this system is sub-meter for the GPS antenna.

Event data or navigation fix marks were recorded in the field every 100 meters as a single ASCII raw data file, which was used to plot ship tracks for the survey. The positional data were used to produce the post-plot map (Charts 1 and 2, Figures 3 and 4) used to reference and locate information derived from the geophysical interpretation.

Equipment offsets and laybacks from the GPS antenna were measured during the mobilization using a steel tape and level. Measurements were recorded to the tenth of an inch. Layback distances during deployment were measured and noted if adjusted. Coordinate locations reported herein have been corrected for instrument layback and offset.

BATHYMETRIC SURVEY

Data Collection

Bathymetric data was acquired using an over-the-side mounted Reson SeaBat 8101 (240 kilohertz [kHz]) Multibeam Echosounder (MBES). The Reson SeaBat 8101 is designed to meet International Hydrographic Organization (IHO) standards to measure the seafloor to a maximum depth of 320 meters. The Reson SeaBat 8101 system was used to collect bathymetry data from approximately 32.4 to 50.9 feet water depth during the survey. Heave, pitch and roll were compensated for with a Coda F185 Inertial Motion Unit (IMU). The IMU was used to compensate for the varying dynamics of vessel motion in an open water environment, thus achieving a higher level of bathymetric accuracies.

A patch test, or the measurement of the angular mounting components of the correction sensors (roll, pitch, and yaw), was conducted prior to collecting data on October 11, 2009. The patch test is a data collection and processing exercise designed to document the offsets, corrections and positioning system latency. The patch test calibration capability of Caris HIPS/SIPS processing Suite 6.1 was used to determine the orientation of the multibeam system, along with the combined delay time between the inertial system and multibeam sonar, and any azimuthal misalignment. By running a defined pattern of six short survey lines, the patch test program provides the "best fit" solution for each of these items.

The Reson SeaBat 8101 measured the water depths across an approximately 45-meter swath that is perpendicular to the survey vessel's track. The system has a sonar footprint on the seafloor approximately 150° across track by 1.5° along track. Due to a high degree of water velocity variability at the survey site, the swath width of data used for our interpretation was confined to the inner 130° of the swath. The swath consisted of 101 individual 1.5° by 1.5° beams with a bottom detection range resolution of 1.25 centimeters (cm).

The 101 beams were sampled at intervals corresponding to the 1.25-cm range resolution. The intensity data were displayed in real-time together with a readout of the detected bottom. This ability to display the raw data gave the operator an excellent quality-check facility. The 101 detected bottom samples were read out to the acquisition system on a serial port up to 40 times per second. The format was X, Y and Z relative to the acoustical center of the sonar head.

Data Processing

A software package by Caris was used to process the multibeam data. The Caris processing software was used on a Windows XP workstation to edit and bin the raw data sets. Multibeam bathymetric data processing involves two steps:

- Applying acquisition or field-specific variables, and
- Data editing to remove spurious soundings.

The sensor calibration factors and sensor offsets were applied during data processing together with sound velocity (derived from sound velocity profile casts) and tidal corrections (from the National Oceanic and Atmospheric Administration [NOAA] acoustic tide gauge, Station No. 8557380 located in Lewes, Delaware).

Sound Velocity Profiles

Sound velocity profiles were conducted each day at a minimum at the start and end of the survey data collection. The *Samantha Miller* was brought to an all stop, and the cast was performed near the multibeam sensor along the port side of the vessel. Sound velocity profiles are used in the processing of the multibeam data and provide accurate conversions of beam travel times to water depth.

An Applied Microsystems Limited (AML) PA-10 sound velocity and pressure smart sensor profiler was used to conduct the sounding casts. The sensor records the sound velocity in meters per second while being deployed downward through the water column at a rate of 10 scans per second. The data are recorded using HyperTerminal text acquisition, and then incorporated into Caris HIPS/SIPS during processing of the multibeam data. Table A-1 lists the location, date, and time of the sound casts. Figure A-3) presents the sound velocity profiles.

Table A-1. Summary of Sound Velocity Profiles

Sounding Cast	Sounding Cast Date	UTM Zone 18N, WGS 84, meters		Water Depth (meters)
		Northing	Easting	
C-1	11-Oct-09	4281084	521119	12.50
C-2	13-Oct-09	4306537	519968	11.97
C-3	21-Oct-09	4283788	519591	16.56
C-4	21-Oct-09	4282372	521429	13.01
C-5	21-Oct-09	4282440	521890	15.55
C-6	22-Oct-09	4283821	519443	16.62
C-7	22-Oct-09	4281290	519284	13.40
C-8	22-Oct-09	4281169	519501	12.99
C-9	30-Oct-09	4283323	520287	13.38
C-10	30-Oct-09	4282643	519011	15.78
C-11	1-Nov-09	4283234	519905	11.23
C-12	1-Nov-09	4283355	519809	10.74

SIDE SCAN SONAR SURVEY

Original, Fall 2009 Data Collection

Seabed features and obstructions have been interpreted from a digital, dual-frequency (100 kHz and 500 kHz) side scan sonar system. The system consisted of an EdgeTech Model 272-TD sonar towfish and Kevlar tow cable that was interfaced to a data logging computer with the EdgeTech analog control interface (ACI), an A/D card, and acquisition software. Chesapeake Technology, Inc.'s SonarWiz.MAP software was utilized to provide real-time mosaics for quality control. The software also provides complete post-processing capabilities. Features include automatic gain control, Time Variable Gain (TVG), beam angle correction, integrated bottom tracking, and a navigation editor.

During the survey, the towfish was deployed from the stern of the *Samantha Miller* as the vessel traversed the survey grid. The towfish was towed at an altitude between 10 and 20 percent of the range and provided full coverage of the survey area.

Supplemental, Fall 2010 Data Collection

Surficial features and targets were interpreted from data collected with a digital, dual-frequency, side scan sonar system. The system consisted of a Klein 3000 sonar towfish and armored tow cable interfaced to the Klein topside unit, which was networked to a data logging computer and Klein's SonarPro acquisition software. SonarPro features include: automatic gain control, real-time bottom tracking, and time varied gain.

During the survey, the towfish was deployed from the center stern of the R/V *Chinook* as the vessel traversed the survey grid. The side scan sonar was operated simultaneously using frequencies of 100 kHz and 500 kHz at a slant range of 75 meters for all survey lines. The towfish altitude was maintained at about 7 to 8 meters above the seafloor so as to provide the optimal altitude of the attached magnetometer. The side scan towfish altitude was about 10% of the slant range which is within the optimal range for the data acquisition.

Data Processing

During data processing, the individual sonar data files, each comprised of one sonar survey trackline, were reviewed and corrected for towfish altitude. Navigation data for each file were edited for errant position fixes and velocity errors. Finally, the resulting files were processed to construct a side scan mosaic of the site utilizing Chesapeake Technology's SonarWiz. The system's mosaics' multiple overlapping survey lines used different blending options: direct overlay, shine through, or weighted selection. The mosaic provides a view of the seafloor in black and white similar to an aerial photograph. Final contrast adjustments, filtering, and line editing were performed before the final mosaic image was produced. The complete mosaic image was georeferenced to the real-world coordinate system for the final maps. A total field sonar mosaic is exported as a geo-registered tagged image file format (TIFF) at a resolution of 0.25 m. Individual survey lines were also exported as geo-registered TIFF files at a resolution of 0.25 m.

MAGNETOMETER SURVEY

Original, Fall 2009 Data Collection

A magnetometer survey was conducted to detect ferrous or other magnetically susceptible objects at the seafloor or shallowly buried. A Marine Magnetic Corporation SeaSPY model marine magnetometer was used for the survey to measure the ambient magnetic field.

A Marine Magnetics' magnetometer measures the ambient magnetic field using a specialized branch of nuclear magnetic resonance technology applied specifically to hydrogen nuclei producing very high sensitivity and accuracy. The sensor is reported to have an absolute accuracy of 0.2ηT and a counter sensitivity of 0.001ηT. The tow sensor was further equipped with a pressure/depth sensor and an altimeter to maintain optimum towing altitude. Total field readings were logged together with the sensor altitude and depth data to the navigation computer through the SeaSPY's communications transceiver.

The magnetometer was towed from the center stern with about 30 to 70 meters of tow cable to achieve an altitude of about 5 to 7 meters above the seafloor. On the penultimate day of the original, fall 2009 data collection, the magnetometer was snagged on an obstruction off the seafloor in the vicinity of survey line 126 between fixes 115 & 114 (Chart 1 Figure 4). Although we successfully grappled for and recovered the magnetometer (along with a piece of floating Polypropylene line attached to a medium sized grapple hook that it had snagged), the armor tow cable for the magnetometer was damaged. Thus, on the last day of the survey, the magnetometer was towed using a soft Kevlar line, which resulted in its altitude being overly high off the bottom. Thus for the outermost primary lines, at the northwest and southeast limits of the survey area, the original magnetometer data were collected at altitudes greater than the maximum altitudes recommended in the MMS' *Archaeological Resources: Recommended Guidelines for Field Surveys and Reporting*.

Ambient magnetic field measurements were recorded at a rate of 1 hertz (Hz). Data were recorded using Starfix.Seis where measurements were attributed with measurement position coordinates.

Supplemental, Fall 2010 Data Collection

The supplemental magnetometer data collected in fall 2010 also was collected with a Marine Magnetic Corporation SeaSPY model marine magnetometer. The magnetometer was deployed 10 meters behind and in line with the Klein 3000 side-scan towfish using a special Kevlar bridal. This configuration allows the magnetometer to fly at sustainable attitudes meeting the guidelines of the NTL / BOEMRE. Using this tow configuration, the data from the magnetometer were transmitted through the Klein 3000 and directly interfaced to the navigation PC.

Ambient magnetic field measurements were recorded at a rate of 2 hertz (Hz). Communication and control to the SeaSPY Magnetometer were sent via command line prompts through Klein SonarPro Data acquisition program. Data were recorded using Starfix.Seis where measurements were attributed with measurement position coordinates. Methods for QA/QC were monitored by the use of Starfix Real Time Graphics. Graphics were displayed at a rate of 1 Hz.

The magnetometer altitude varied from a minimum of 1.5 to 6.5 meters during the supplemental data collection. The average altitude was 4.6 meters.

Data Processing

The magnetometer sensor noise levels used for this survey are negligible when considering system noise. The average change in intensity between data points is less than 1 gamma. Numerous strong gradient changes that occur over long distances are not considered magnetic anomalies derived from iron objects. Over a distance of several hundred meters, these changes can be as high as ±50 gammas.

The magnetometer data were directly imported into Chesapeake Technology's SonarWiz. No total-field data correction or trend lines were applied to the data. Each survey line was evaluated independently. Even though several lines were re-shot because of spikes, all magnetometer records (including the spiky ones that were later re-shot) were evaluated; this helps confirm the validity of an anomaly.

A recording base station was not used to measure the changes in earth's magnetic field over the duration of the survey. Assuming the Earth's magnetic field will change only slightly and at a nearly constant rate over the time interval of a survey line, a simple way to correct for its influence on magnetometer data is to fit them with a linear regression. Once calculated, the equation can be used to recalculate the magnetometer readings as a function of travel distance at the location of each measurement. Subtracting these calculated values from the original data set produces a new data set, wherein the values represent deviations from the (assumed) magnetic field of Earth. This method was employed on a line-by-line basis for the entire dataset using specific software written by Geo-Marine Technology, Inc. The resulting data are magnetic fluctuations relative to the survey line's baseline.

In order to produce a contour plot of the magnetic intensity, it is necessary to remove the noise spikes. This task is not easy as several attempts were made to auto-despike the data. The main problem with auto-de-spiking was that actual anomalies were removed. All individual magnetometer data files were individually de-spiked by manually identifying and correcting spikes. Long and intermediate period noise along individual lines was observed on several lines. A swell filter algorithm was used to reduce those artifacts and the noise was not considered to degrade the ability to identify and characterize anomalies.

Once all the line data were corrected, they were combined them into a single data file and then gridded in ArcGIS v9.3 with 3D Analyst. To generate a contour map, we used an inverse distance weighting calculation with a bin interval of 5 meters and a search radius of 40 meters. The resulting contour map is depicted in Figures 11 and 12 and Chart 5; a good correlation exists between the localized anomalies and the hand-picked anomalies derived from the individual line charts.

Figure A-4 presents the magnetic anomalies and pertinent characteristics. The hand-picked anomaly locations are presented on Chart 5, Figures 11 and 12, and in the table at the end of the main body of text. The contour interval on the maps is five gammas. The variations among uncorrected total field data, geomagnetic corrected data, and relative field data for the fall 2010 data are included as insets on Chart 5b. These depictions illustrate the contoured data through the various processing steps described previously.

CHIRP SUB-BOTTOM PROFILER

Data Collection

An EdgeTech X-Star Full Spectrum Sub-bottom Profiler (Chirp) system was employed to obtain shallow seismic reflection data of the sediment layers immediately beneath the seafloor. These shallow data provide information on the spatial distribution and thickness of surficial sediments. The EdgeTech X-Star system included the SB-216S towfish, the Model 3200 topside processor, and EdgeTech's Discover acquisition software.

The towfish was deployed and towed from the port side stern of the *Samantha Miller*. The system was triggered at a 6 Hz pulse rate with a swept frequency range between 2 to 15 kHz over 20 ms. Navigation fix marks were sent to the systems' printer every 100 m (328 feet) along the survey line. All navigation information and sub-bottom data were time tagged and logged to a hard drive. The reflection profiles were also simultaneously displayed on the EPC thermal plotter.

Data Processing

Processing for the Chirp sub-bottom data included checking and de-spiking all navigation points using Starfix.Proc, an application for automated (batch) processing of navigation data. After the data are cleaned, verification was made that the corrected navigation files were referenced from the towed position (where the sub-bottom was towed from the vessel). The corrected navigation data were then inserted into a raw JSF file (Edgetech's Proprietary format) using Starfix.Gplot (Addxyz). The JSF files were replayed through the Discover software for TVG, swell filtering, and direct arrival removal. Following the data filtering, the JSF files were then converted to SEG-Y format and loaded into Kingdom Suite for interpretation. An example of the Chirp data is shown on Figure 25.

MULTICHANNEL SEISMIC REFLECTION SURVEY

Data Collection

High-resolution, shallow seismic reflection data were concurrently collected with the sub-bottom profiler data for later processing and interpretation. The seismic reflection system consisted of a double-plate "boomer" seismic source, power and tow cable, two power supplies, two 24-channel hydrophone streamers, shipboard electronics, and recording instruments. The *Samantha Miller* towing configuration and system-offset values are shown on Figure A-2.

Two Applied Acoustics Engineering CSP seismic energy sources were used to power the double-plate "boomer" system. The boomer plate is an electromechanical transducer made of an insulated metal plate and a rubber diaphragm adjacent to a flat wound electrical coil. A short-duration, high-energy pulse is discharged from the energy source into the coil and the resulting magnetic field repels the metal plate in the transducer. The plate motion is transferred to the water by the rubber diaphragm, generating a broadband acoustic pulse that does not have strong cavitations or ringing. Each transducer was triggered simultaneously at an energy level of 300 joules.

The reflected acoustic signal was received by two separate multichannel, Ethernet-based GeoEel digital hydrophone arrays. One of the arrays used 8 channels and had a group interval of 1.56 meters. The other 16-channel array had a group interval of 3.125 meters. The streamers were towed approximately 0.3 meters below the sea surface. Raw data from the digital streamers were recorded using a Geometrics CNT PC-based acquisition system. Data were stored on hard disk in SEG-Y format for later postprocessing. Data were also backed up on DVD and an external hard drive. A near trace record for the streamer was displayed and printed in real-time using a Pentax Pocketjet 3-Plus plotter.

Data Processing

Data processing of the multichannel seismic reflection data followed the basic premise of the wavelet processing method used in the petroleum exploration industry. A double-plate boomer source type was used combined with two different hydrophone streamer configurations, with the objective of deeper penetration for the 3.125-meter group interval (mgi), 24-channel streamer and higher resolution at lesser penetration for the 1.56-mgi, 24-channel mini-streamer.

Basic seismic data processing consists of filtering in time and space, deconvolution to provide a sharper and more consistent seismic wavelet for interpretation, correction of normal moveout due to varying subsurface velocity structure, stacking of data traces to increase the signal-to-noise ratio, and migration to put the reflecting horizons back into their proper lateral positions. Seismic data processing included the following steps:

- FK filter to reduce boat noise,
- Spiking deconvolution,
- Spherical divergence (ExpG) correction,
- Trace scaling,
- Normal move-out (NMO) correction and stacking, and
- Post-stack FK migration and acquisition geometry for common mid-point (CMP) binning.

Velocity analyses were performed for four lines of the 3.125-mgi streamer data and the average results were then used to processes the 3.125-mgi streamer data. A constant stacking velocity of 5,000 feet per second (ft/sec) provided comparable results and was used for processing the 1.56-mgi streamer lines. For migration, a constant velocity of 4,800 ft/sec was used for both steamer output data. Output files were saved in SEG-Y format for the stacked and migrated data.

The 1.56-mgi streamer acquired good data for approximately 0.080 seconds (two-way travel time [TWT]) or ~200 feet below sea surface (BSS) and provided high-resolution data of the shallow geologic structure. The 3.125-mgi streamer acquired good data for the full record length (TWT of 0.5 seconds or ~1,250 feet BML).

SURVEY LINE LOGS

Survey line logs for the bottom-charting and seismic reflection systems are provided as Figures A-5 and A-6, respectively. Figure A-5a provides the line logs from the original, fall 2009 data collection. Figure A-5b provides the line logs from the supplemental, fall 2010 data collection. The line logs provide various information documenting equipment used and configuration, date, time, vessel heading and speed, and commentary regarding equipment issues for each survey line.

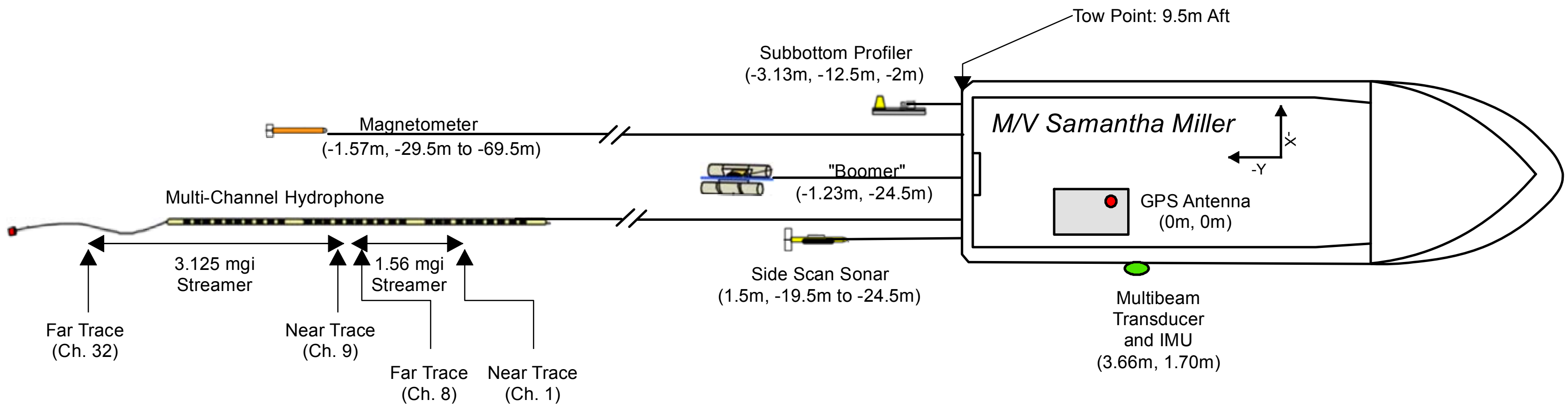
Vessel Description	
Vessel Name	**Samantha Miller**
Coast Guard Registry Number	**D641114**
Owner/Operator	**Miller's Launch**
Home Port	**Pier 7 1/2 Staten Island, NY**
24-hr Contact #:	**718-727-7303**
Vessel Monitors VHF Channels:	**13 & 16**
Vessel Length	**65 feet**
Vessel Beam	**26 feet**
Vessel Draft	**7.5 feet**
Cruising Speed	**10 knots**
Planned Survey Operations	**Daylight Hours**
Planned Hours on Site	**Daylight Hours**

SURVEY VESSEL *SAMANTHA MILLER*
Bluewater Wind Delaware Meteorological Tower
Delaware Continental Shelf

FIGURE A-1a

SURVEY VESSEL *R/V CHINOOK*
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-1b



Notes:

1) Diagram not to scale.

2) Equipment (X, Y)
X and Y are the offset and layback, respectively, from the GPS antenna.

3) Not all systems were operated simultaneously for the G&G survey lines. In general, seismic reflection (Boomer and streamer) and Chirp systems were operated during one line run and the sidescan sonar, magnetometer and multibeam echosounder were operated during a separate line run. Refer to the survey line logs in Appendix A for details.

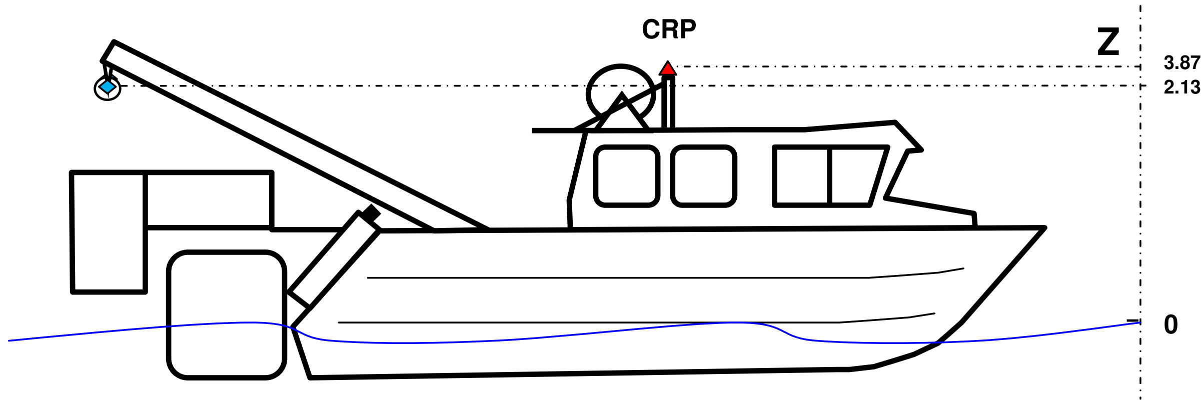
Multi-Channel Streamer Offsets and Laybacks From GPS Antenna

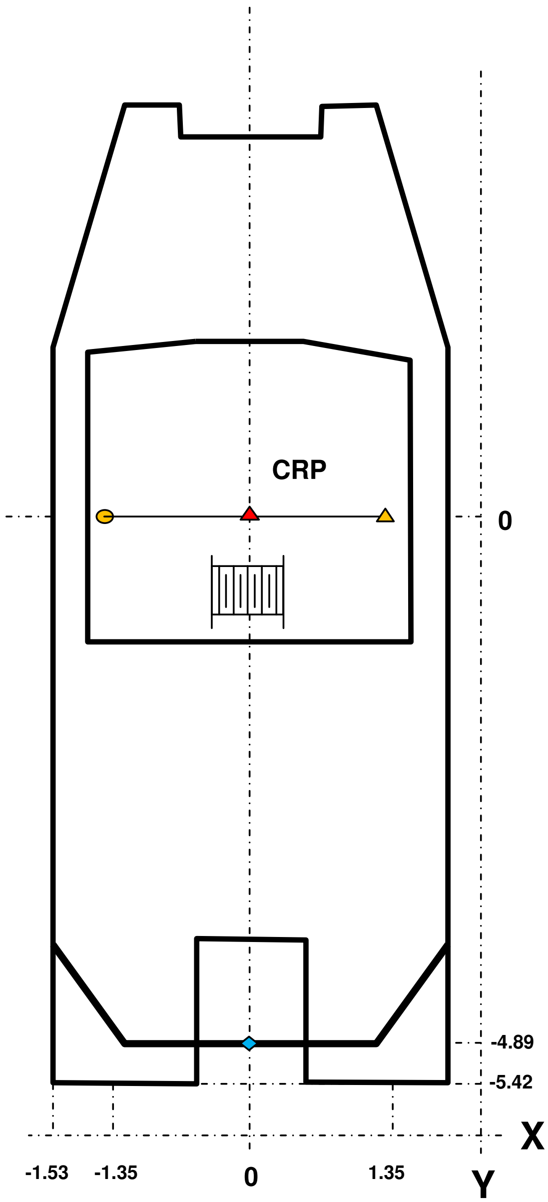
Streamer	Offset and Layback (X,Y)	
	October 11, 2009	**2009**
1.56-mgi Streamer		
Near Trace (Channel 1)	1 m, -29.69 m	1 m, -31.25 m
Far Trace (Channel 8)	1 m, -45.32 m	1 m, -48.44 m
3.125-mgi Streamer		
Near Trace (Channel 9)	1 m, -47.63 m	1 m, -49.94 m
Far Trace (Channel 32)	1 m, -119.5 m	1 m, -122.63 m

EQUIPMENT CONFIGURATION
Fall 2009 Survey

Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-2a

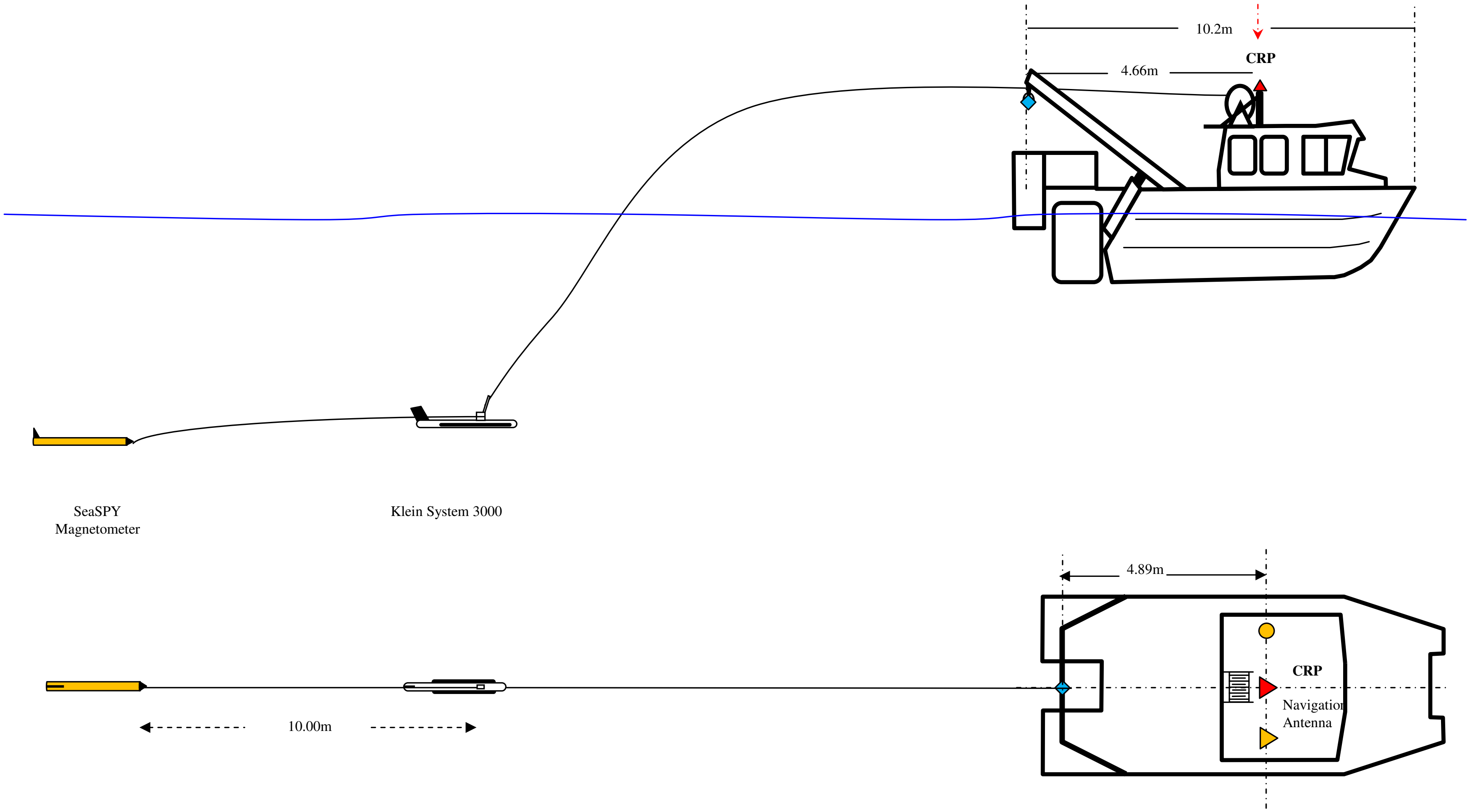




ID	Offset name	X	Y	Z
▲ (red)	Primary GPS	0.00	0.00	3.87
● (yellow)	GPS1 (Heading)	-1.35	0.00	3.87
▲ (yellow)	GPS2 (Heading)	1.35	0.00	3.87
◆ (blue)	SSS Tow Point	0.00	-4.89	2.13

RV/ CHINOOK OFFSET DIAGRAM
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

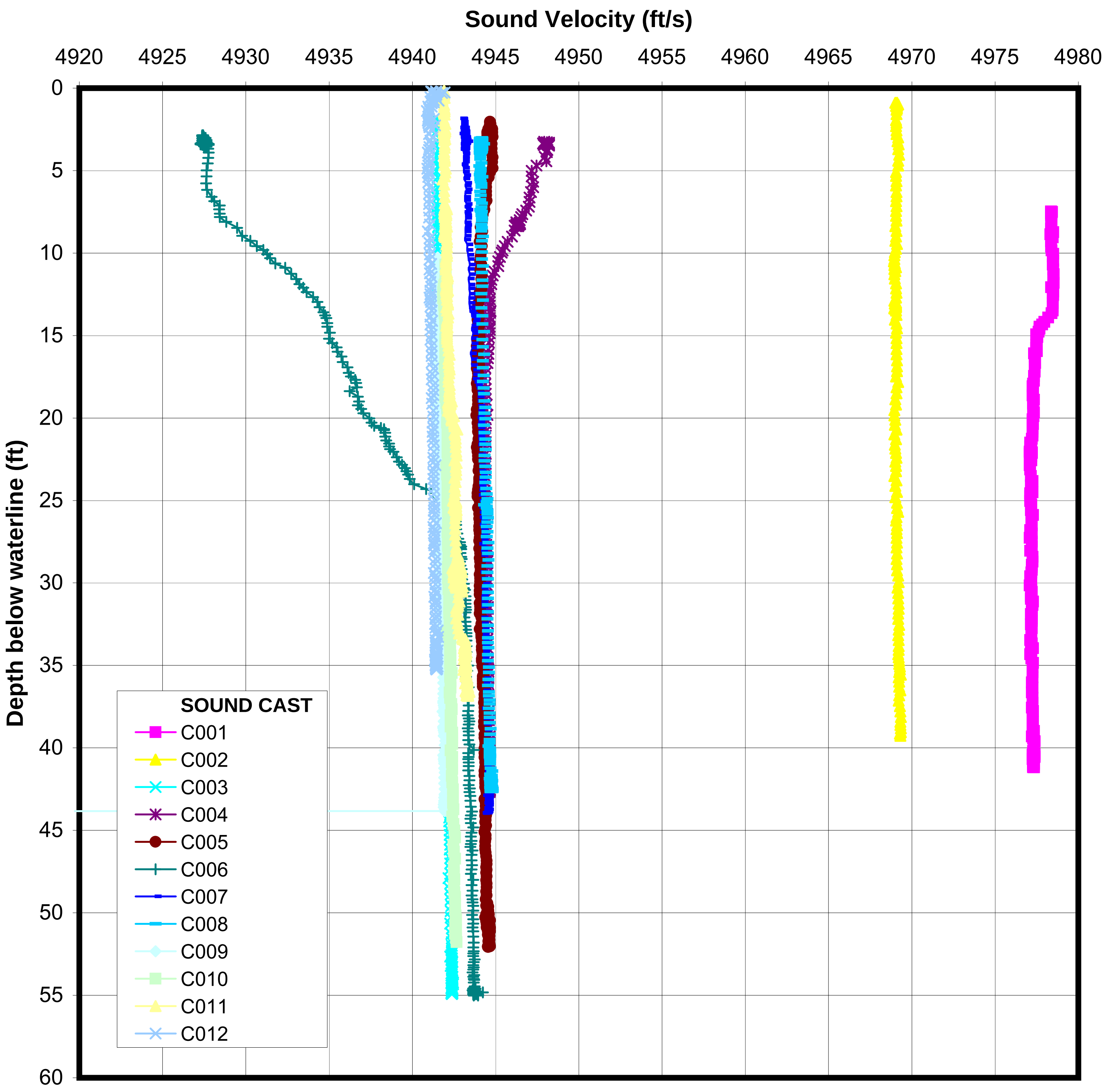
FIGURE A-2b



EQUIPMENT CONFIGURATION
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-2c

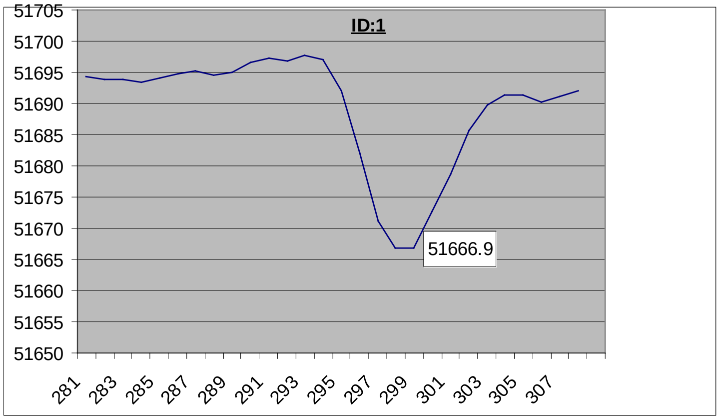
Bluewater Wind, LLC
Project No. 3671.004



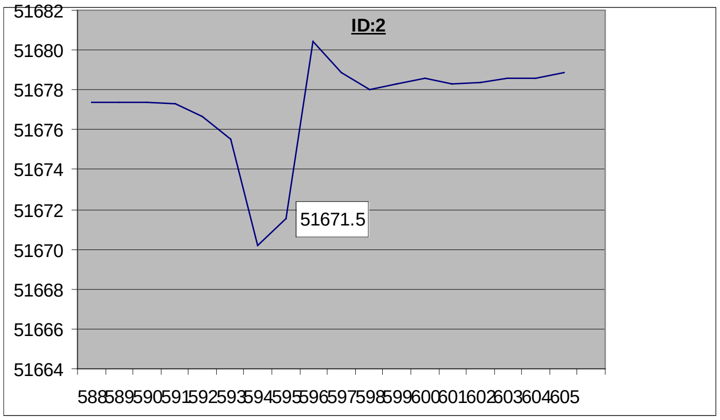
SOUND VELOCITY PROFILES
Bluewater Wind Meteorological Tower
Delaware Contintential Shelf

FIGURE A-3

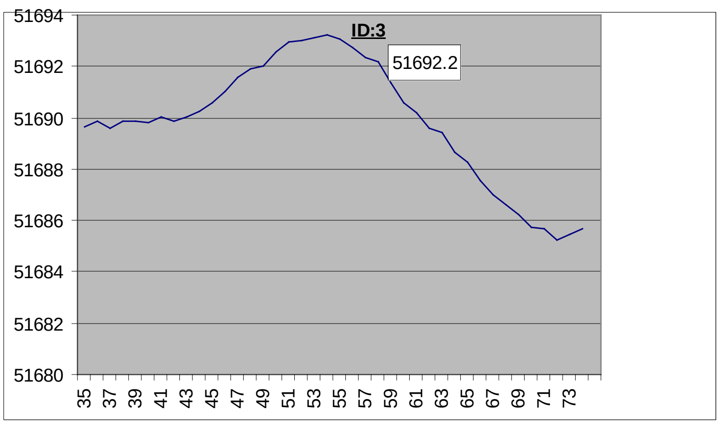
TARGET INTENSITY CHART (GAMMAS)



ATTRIBUTE	VALUE
ID	1
Easting	520148.21
Northing	4282075.05
Latitude	38° 41.2357' N
Longitude	074° 46.1148' W
Line	207
Gamma	51666.90
Peak-to-Peak	31.05
Duration	85.81
Type	COMPLEX
Description	Correlate 5/11
Depth	10.6
Sensor Depth	8
Altitude	2.6



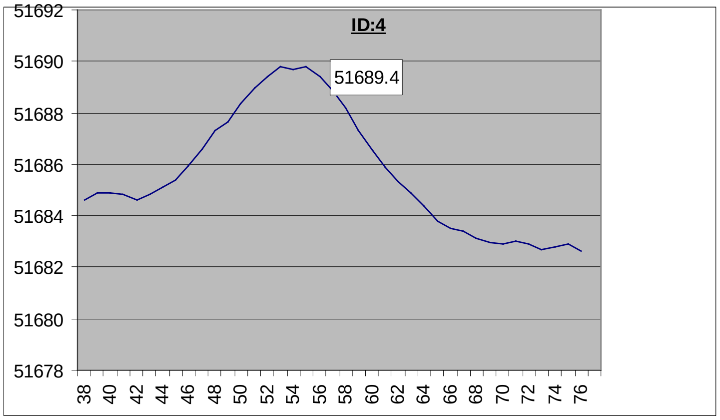
ATTRIBUTE	VALUE
ID	2
Easting	520417.06
Northing	4282552.47
Latitude	38° 41.4913' N
Longitude	074° 45.8960' W
Line	125
Gamma	51671.54
Peak-to-Peak	10.29
Duration	41.51
Type	DIPOLE
Description	Possible Noise
Depth	11.3
Sensor Depth	8
Altitude	3.3



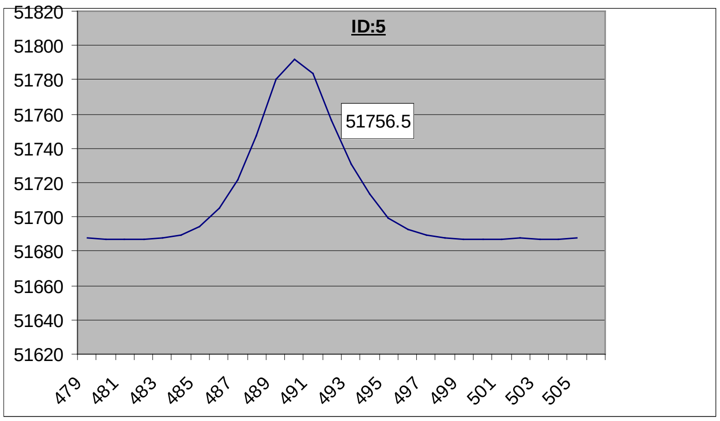
ATTRIBUTE	VALUE
ID	3
Easting	519396.59
Northing	4281729.54
Latitude	**38° 41.0484' N**
Longitude	**074° 46.6024' W**
Line	125
Gamma	51692.20
Peak-to-Peak	8.04
Duration	93.43
Type	DIPOLE
Description	Possible SOL noise
Depth	12.2
Sensor Depth	8
Altitude	4.2

MAGNETIC ANOMALIES
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

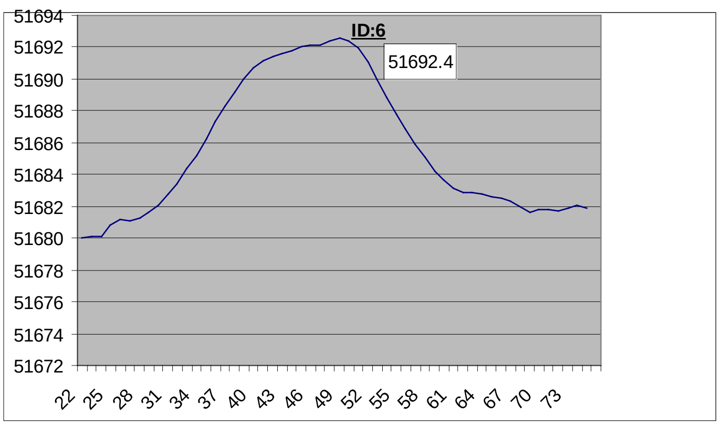
TARGET INTENSITY CHART (GAMMAS)



ATTRIBUTE	VALUE
ID	4
Easting	519515.88
Northing	4281591.89
Latitude	38° 40.9734' N
Longitude	074° 46.5203' W
Line	131
Gamma	51689.4
Peak-to-Peak	7.11
Duration	93.07
Type	MONOPOLE
Description	Possible SOL noise
Depth	12.2
Sensor Depth	8
Altitude	4.2



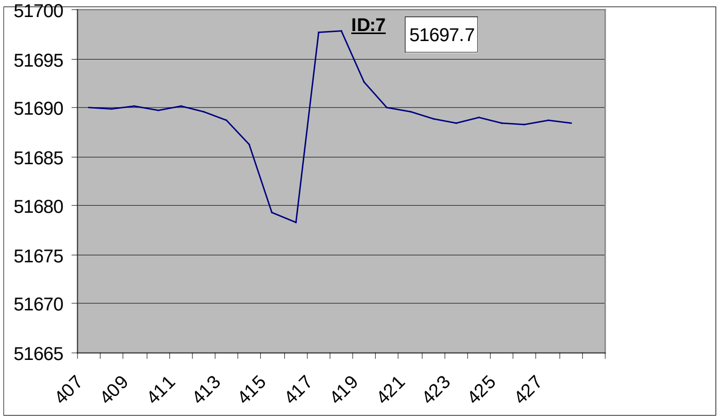
ID	5
Easting	520160.1
Northing	4282051.84
Latitude	38° 41.2002' N
Longitude	074° 46.1085' W
Line	132
Gamma	51756.48
Peak-to-Peak	105.44
Duration	52.01
Type	MONOPOLE
Description	Correlate 1/11
Depth	10.6
Sensor Depth	8
Altitude	2.6



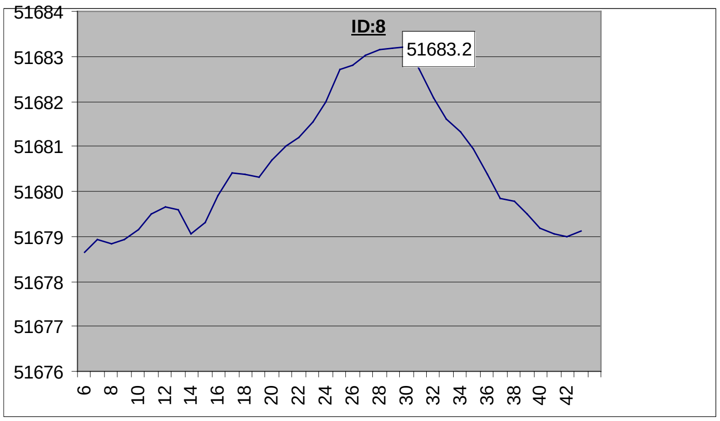
ID	6
Easting	519585.68
Northing	4281460.07
Latitude	38° 40.9011' N
Longitude	074° 46.4726' W
Line	136
Gamma	51692.37
Peak-to-Peak	12.53
Duration	137.07
Type	MONOPOLE
Description	Possible SOL noise
Depth	12.2
Sensor Depth	8
Altitude	4.2

MAGNETIC ANOMALIES
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

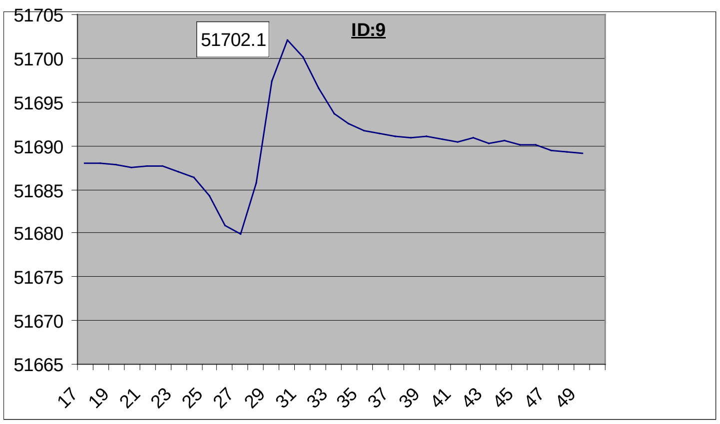
TARGET INTENSITY CHART (GAMMAS)	ATTRIBUTE	VALUE



ATTRIBUTE	VALUE
ID	7
Easting	520390.41
Northing	4281858.17
Latitude	38° 41.0942' N
Longitude	074° 45.9486' W
Line	142
Gamma	51697.70
Peak-to-Peak	19.54
Duration	45.55
Type	DIPOLE
Description	Debris
Depth	12.2
Sensor Depth	8
Altitude	4.2



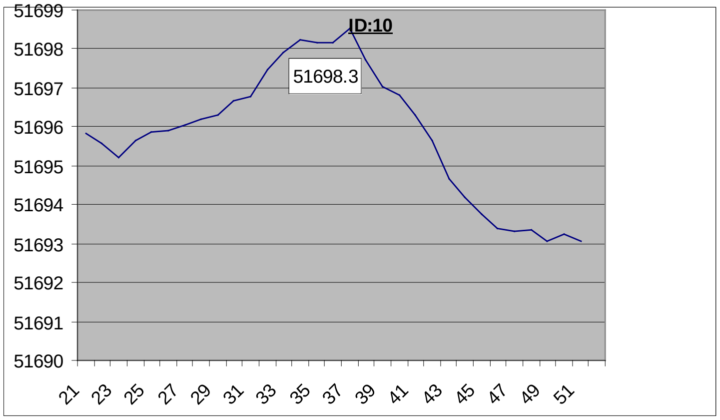
ATTRIBUTE	VALUE
ID	8
Easting	519677.57
Northing	4281262.64
Latitude	38° 40.7937' N
Longitude	074° 46.4080' W
Line	143
Gamma	51683.19
Peak-to-Peak	4.54
Duration	90.70
Type	MONOPOLE
Description	Possible SOL noise
Depth	12.8
Sensor Depth	8
Altitude	4.8



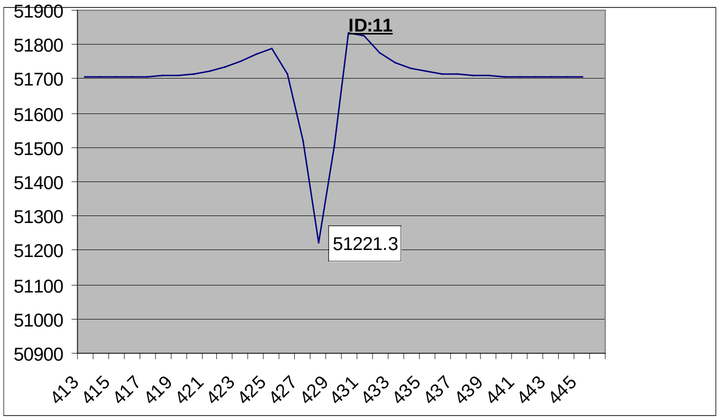
ATTRIBUTE	VALUE
ID	9
Easting	521118.22
Northing	4282313.92
Latitude	38° 41.3400' N
Longitude	074° 45.4469' W
Line	145
Gamma	51702.11
Peak-to-Peak	22.22
Duration	67.57
Type	DIPOLE
Description	Possible SOL noise
Depth	12.2
Sensor Depth	8
Altitude	4.2

MAGNETIC ANOMALIES
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

TARGET INTENSITY CHART (GAMMAS)



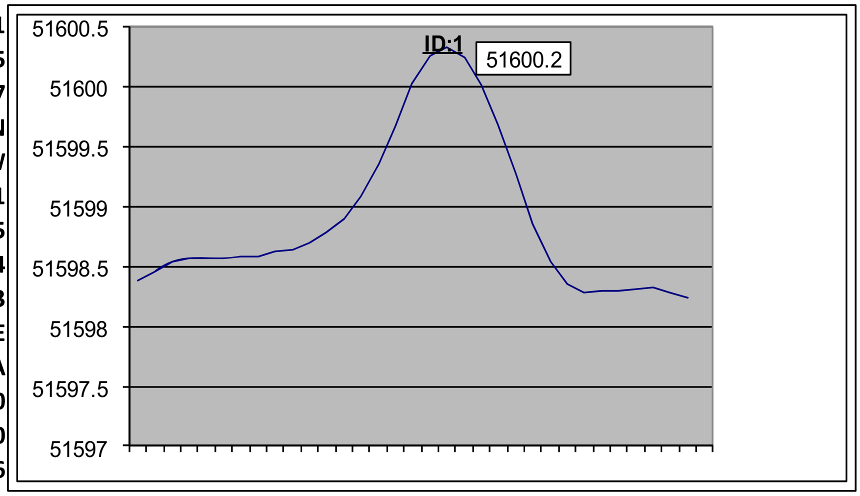
ATTRIBUTE	VALUE
ID	10
Easting	519786.21
Northing	4281155.46
Latitude	38° 40.7360' N
Longitude	074° 46.3328' W
Line	148
Gamma	51698.25
Peak-to-Peak	5.44
Duration	75.41
Type	MONOPOLE
Description	Possible SOL noise
Depth	13
Sensor Depth	8
Altitude	5



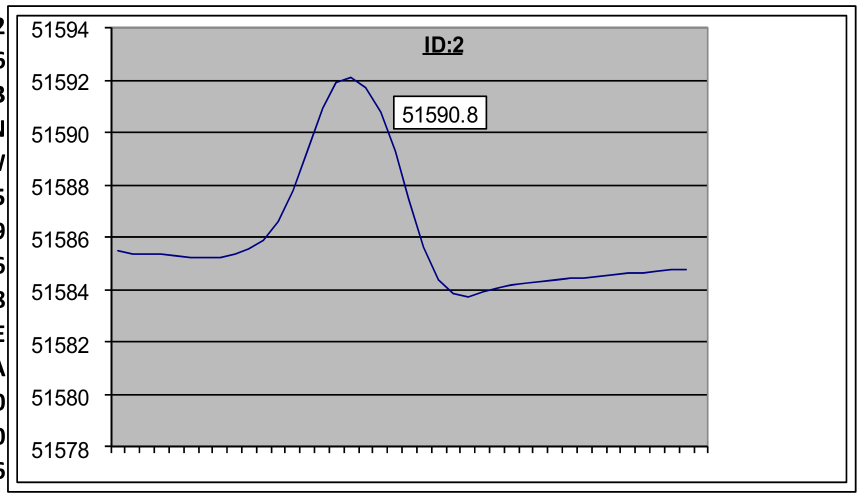
ID	11
Easting	520196.99
Northing	4282056.16
Latitude	38° 41.1996' N
Longitude	074° 46.0546' W
Line	207
Gamma	51221.29
Peak-to-Peak	613.14
Duration	73.12
Type	COMPLEX
Description	Correlate 1/5
Depth	10.6
Sensor Depth	8
Altitude	2.6

MAGNETIC ANOMALIES
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

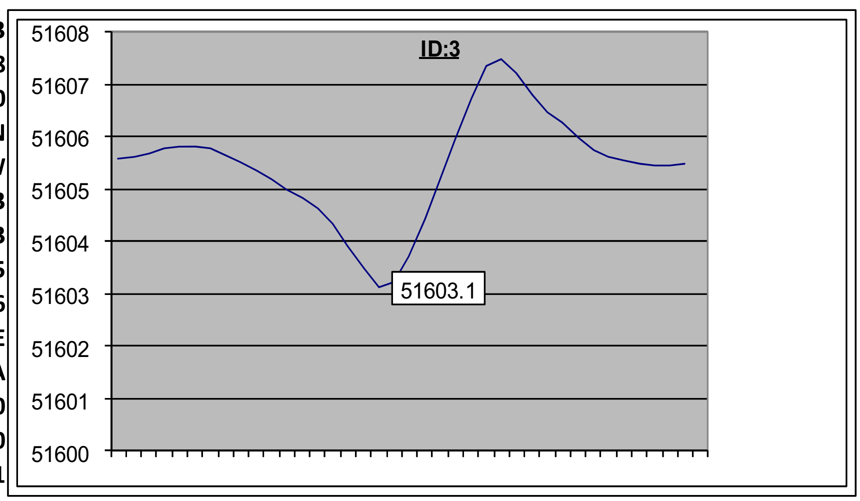
ID	**1**
Easting	**520702.65**
Northing	**4281424.67**
Latitude	**38° 40.8708' N**
Longitude	**074° 45.7188' W**
Line	**501**
Gamma	**51600.25**
Peak-to-Peak	**2.04**
Duration	**45.13**
Type	**MONOPOLE**
Description	**NA**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**5.6**



ID	**2**
Easting	**521296.56**
Northing	**4282053.43**
Latitude	**38° 41.2099' N**
Longitude	**074° 45.3080' W**
Line	**505**
Gamma	**51590.79**
Peak-to-Peak	**8.36**
Duration	**55.58**
Type	**DIPOLE**
Description	**NA**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**4.6**



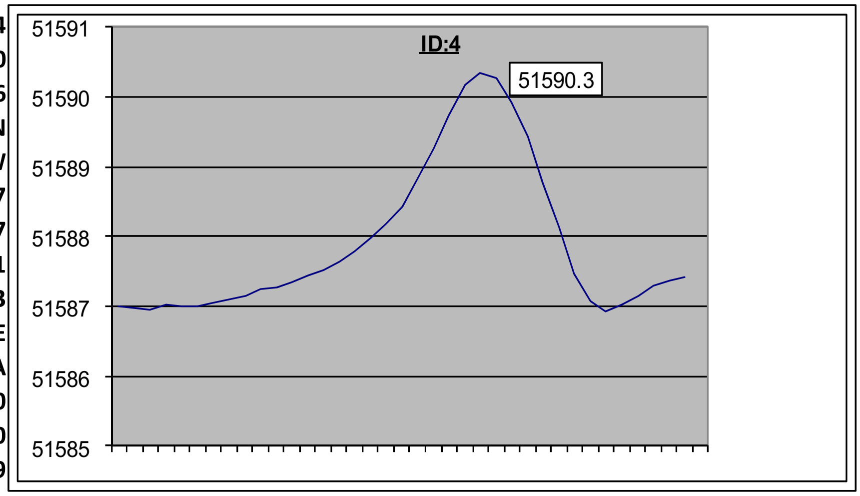
ID	**3**
Easting	**519844.48**
Northing	**4281183.70**
Latitude	**38° 40.7417' N**
Longitude	**074° 46.3112' W**
Line	**513**
Gamma	**51603.13**
Peak-to-Peak	**4.35**
Duration	**40.26**
Type	**DIPOLE**
Description	**NA**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**4.1**



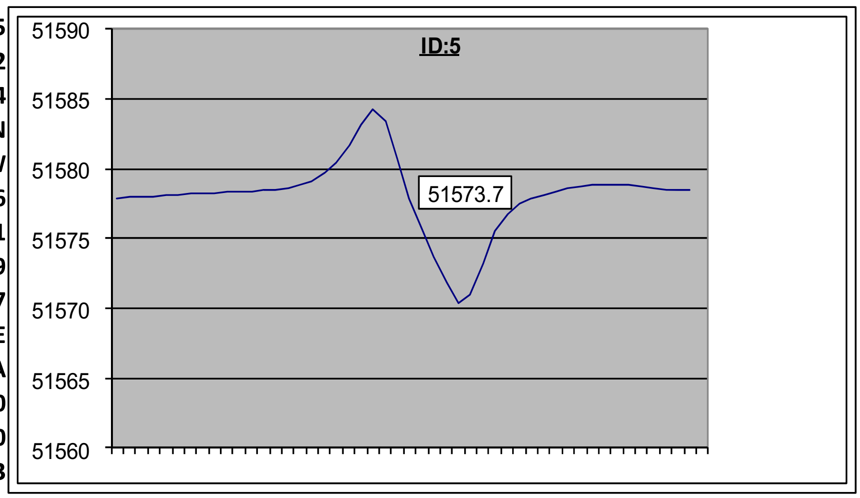
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4e

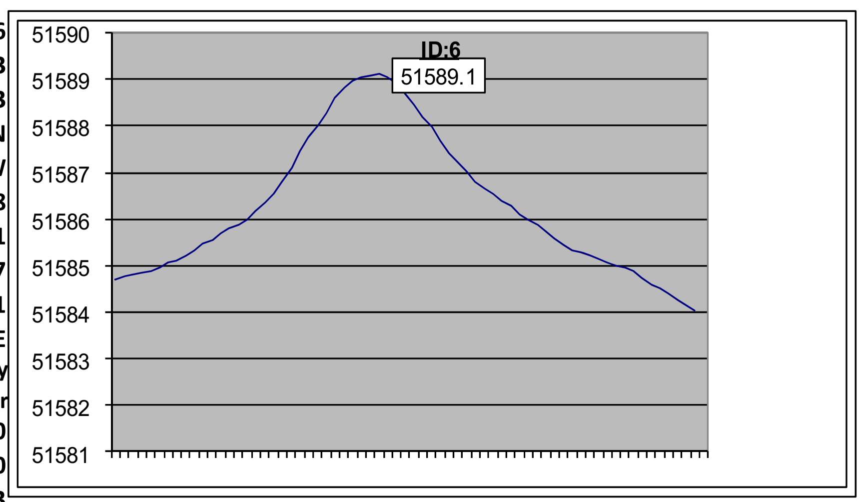
ID	**4**
Easting	**520207.20**
Northing	**4281636.06**
Latitude	**38° 40.9858' N**
Longitude	**074° 46.0602' W**
Line	**517**
Gamma	**51590.27**
Peak-to-Peak	**3.41**
Duration	**65.93**
Type	**MONOPOLE**
Description	**NA**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**4.9**



ID	**5**
Easting	**520363.92**
Northing	**4282106.34**
Latitude	**38° 41.2398' N**
Longitude	**074° 45.9513' W**
Line	**526**
Gamma	**51573.71**
Peak-to-Peak	**13.79**
Duration	**69.27**
Type	**DIPOLE**
Description	**NA**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**3.3**



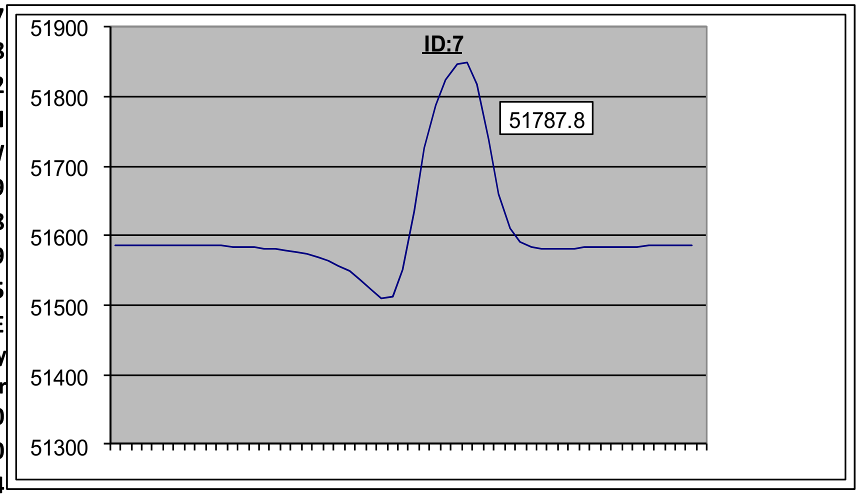
ID	**6**
Easting	**520195.13**
Northing	**4282054.03**
Latitude	**38° 41.2118' N**
Longitude	**074° 46.0678' W**
Line	**528**
Gamma	**51589.11**
Peak-to-Peak	**4.97**
Duration	**94.81**
Type	**MONOPOLE**
Description	**Central anomaly cluster**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**3.3**



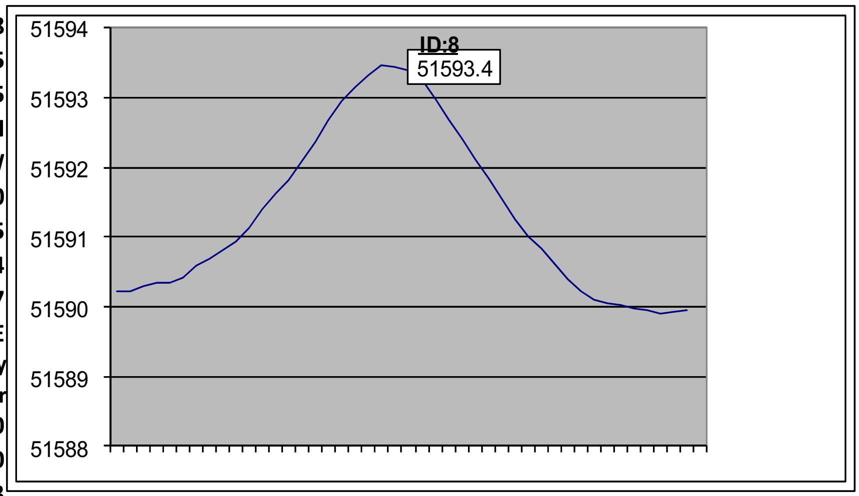
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4f

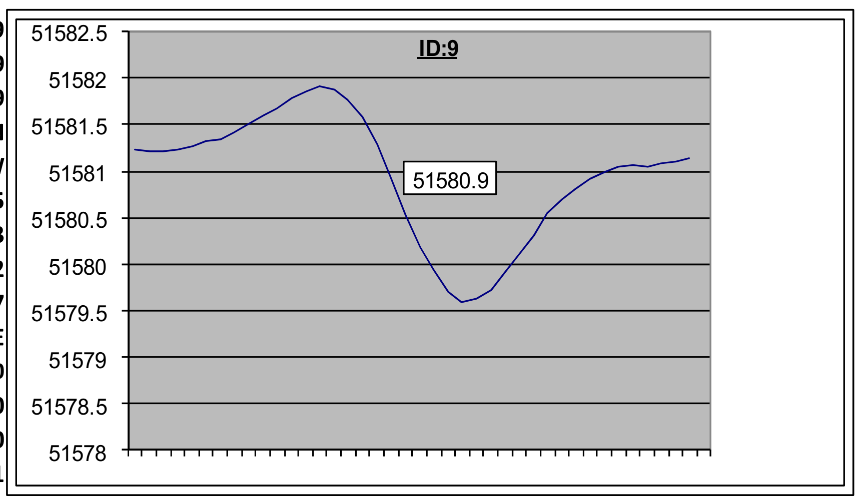
ID	7
Easting	520173.88
Northing	4282075.72
Latitude	38° 41.2235' N
Longitude	074° 46.0824' W
Line	529
Gamma	51787.78
Peak-to-Peak	339.49
Duration	77.55
Type	DIPOLE
Description	Central anomaly cluster
Depth	0.0
Sensor Depth	0.0
Altitude	3.4



ID	8
Easting	520159.45
Northing	4282101.85
Latitude	38° 41.2377' N
Longitude	074° 46.0924' W
Line	530
Gamma	51593.45
Peak-to-Peak	3.54
Duration	61.07
Type	MONOPOLE
Description	Central anomaly cluster
Depth	0.0
Sensor Depth	0.0
Altitude	3.3



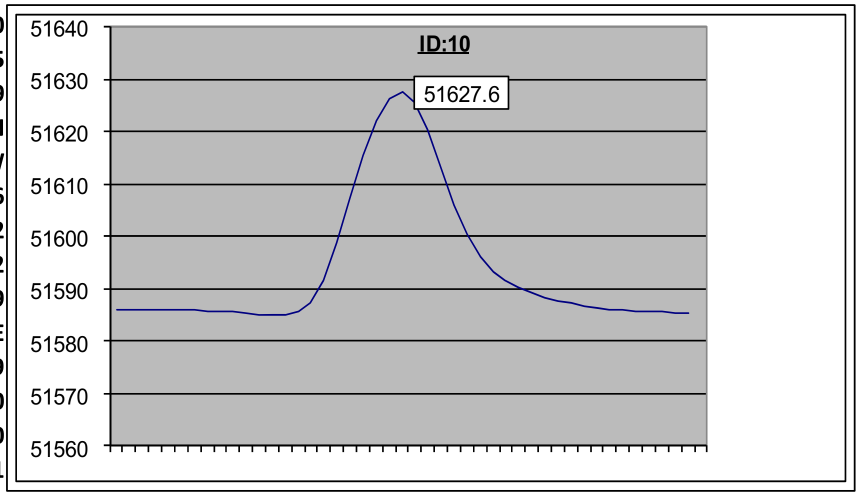
ID	9
Easting	520563.39
Northing	4282619.59
Latitude	38° 41.5171' N
Longitude	074° 45.8128' W
Line	535
Gamma	51580.93
Peak-to-Peak	2.32
Duration	64.27
Type	DIPOLE
Description	Correlate with 10
Depth	0.0
Sensor Depth	0.0
Altitude	5.1



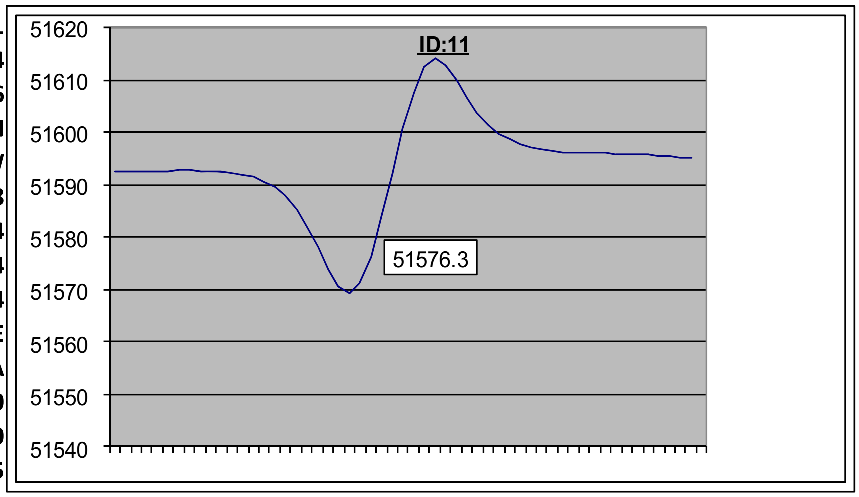
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4g

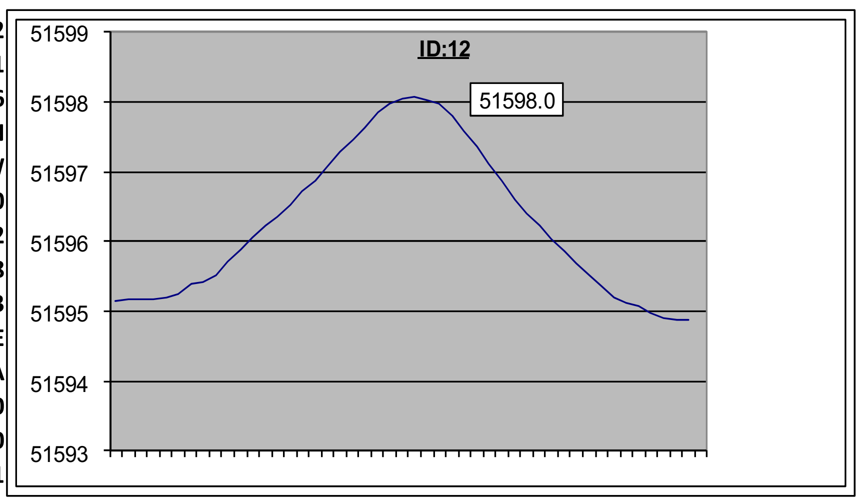
ID	10
Easting	520549.55
Northing	4282648.49
Latitude	38° 41.5327' N
Longitude	074° 45.8223' W
Line	536
Gamma	51627.62
Peak-to-Peak	42.62
Duration	73.19
Type	MONOPOLE
Description	Correlate with 9
Depth	0.0
Sensor Depth	0.0
Altitude	5.1



ID	11
Easting	519902.34
Northing	4282205.16
Latitude	38° 41.2939' N
Longitude	074° 46.2695' W
Line	538
Gamma	51576.34
Peak-to-Peak	44.74
Duration	93.14
Type	DIPOLE
Description	NA
Depth	0.0
Sensor Depth	0.0
Altitude	5



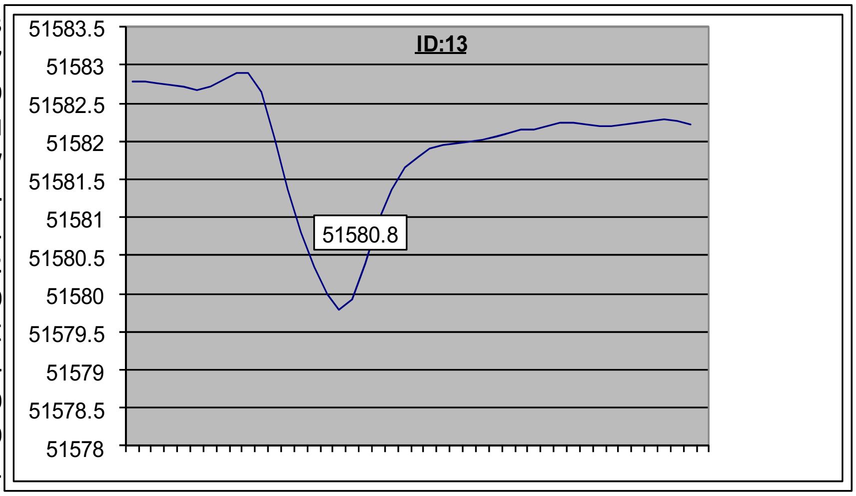
ID	12
Easting	520052.71
Northing	4282398.46
Latitude	38° 41.3982' N
Longitude	074° 46.1655' W
Line	540
Gamma	51598.02
Peak-to-Peak	3.18
Duration	70.03
Type	MONOPOLE
Description	NA
Depth	0.0
Sensor Depth	0.0
Altitude	5.1



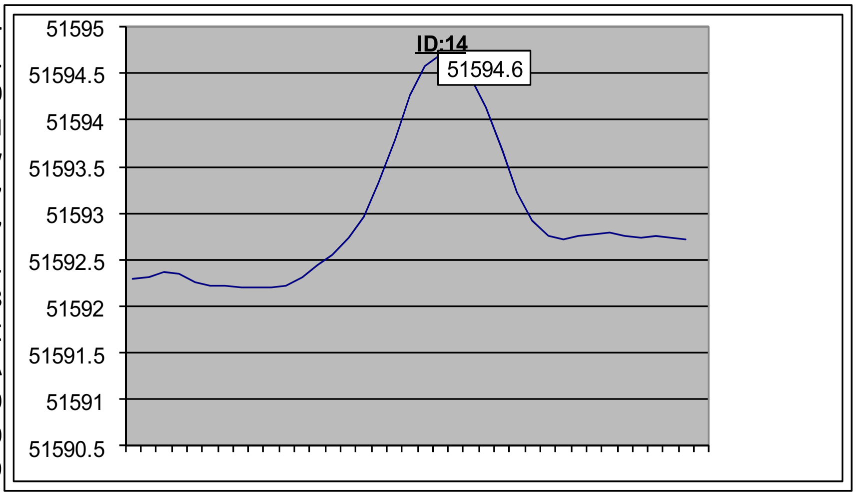
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4h

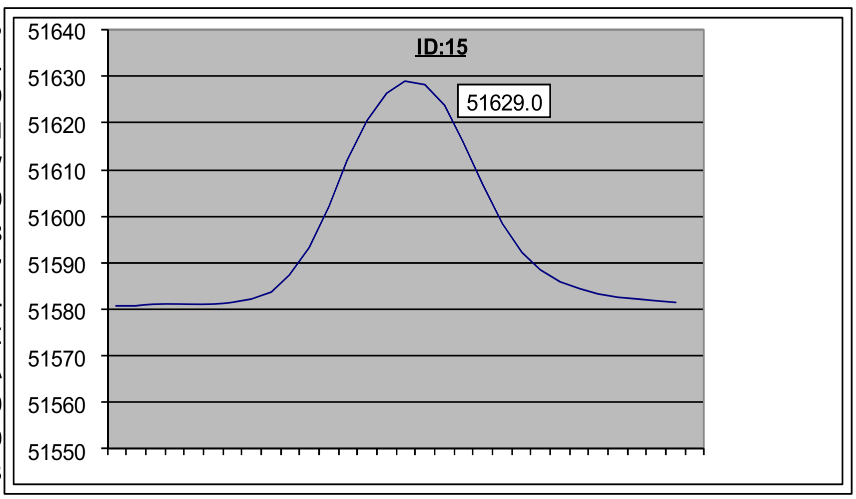
ID	13
Easting	520248.67
Northing	4282710.19
Latitude	38° 41.5665' N
Longitude	074° 46.0297' W
Line	544
Gamma	51580.81
Peak-to-Peak	3.12
Duration	63.00
Type	DIPOLE
Description	Correlate with 24
Depth	0.0
Sensor Depth	0.0
Altitude	3.1



ID	14
Easting	519809.21
Northing	4282475.90
Latitude	38° 41.4404' N
Longitude	074° 46.3333' W
Line	547
Gamma	51594.57
Peak-to-Peak	2.51
Duration	42.88
Type	MONOPOLE
Description	NA
Depth	0.0
Sensor Depth	0.0
Altitude	4.9



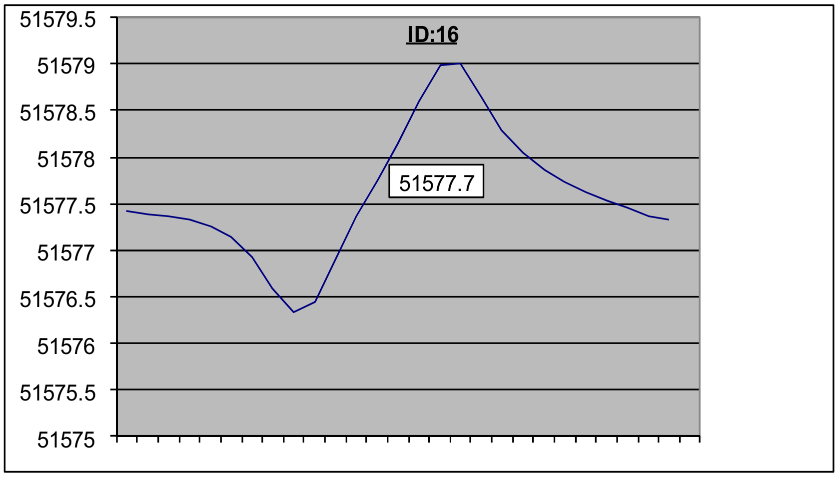
ID	15
Easting	519168.01
Northing	4282063.39
Latitude	38° 41.2182' N
Longitude	074° 46.7764' W
Line	550
Gamma	51628.98
Peak-to-Peak	48.17
Duration	43.04
Type	MONOPOLE
Description	NA
Depth	0.0
Sensor Depth	0.0
Altitude	5.3



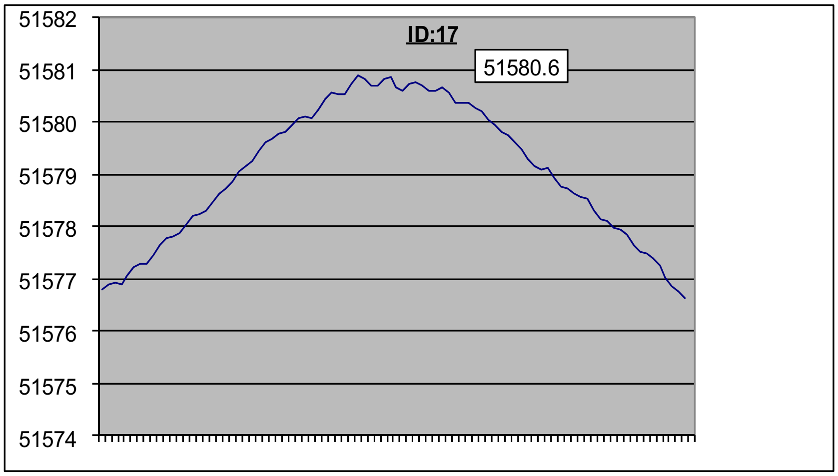
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4i

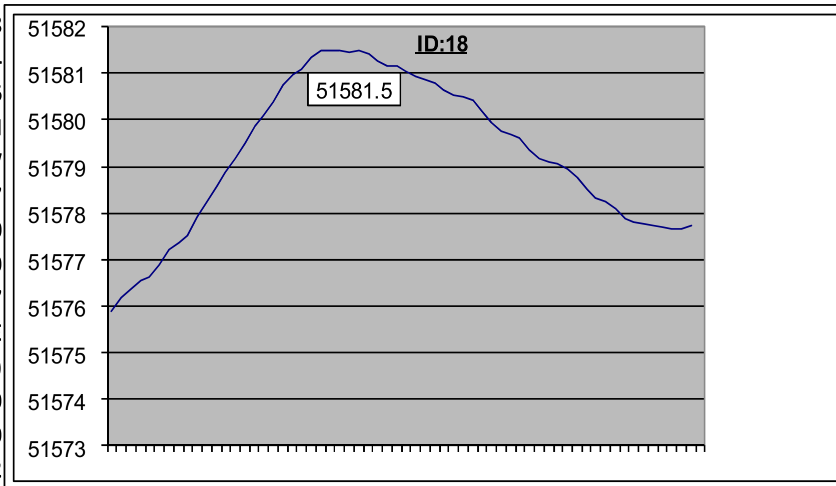
ID	16
Easting	520158.85
Northing	4282946.66
Latitude	38° 41.6945' N
Longitude	074° 46.0913' W
Line	552
Gamma	51577.75
Peak-to-Peak	2.67
Duration	40.06
Type	DIPOLE
Description	NA
Depth	0.0
Sensor Depth	0.0
Altitude	4.7



ID	17
Easting	519242.47
Northing	4282361.35
Latitude	38° 41.3792' N
Longitude	074° 46.7245' W
Line	556
Gamma	51580.61
Peak-to-Peak	4.10
Duration	99.95
Type	MONOPOLE
Description	Probable Geologic (#18)
Depth	0.0
Sensor Depth	0.0
Altitude	4.7



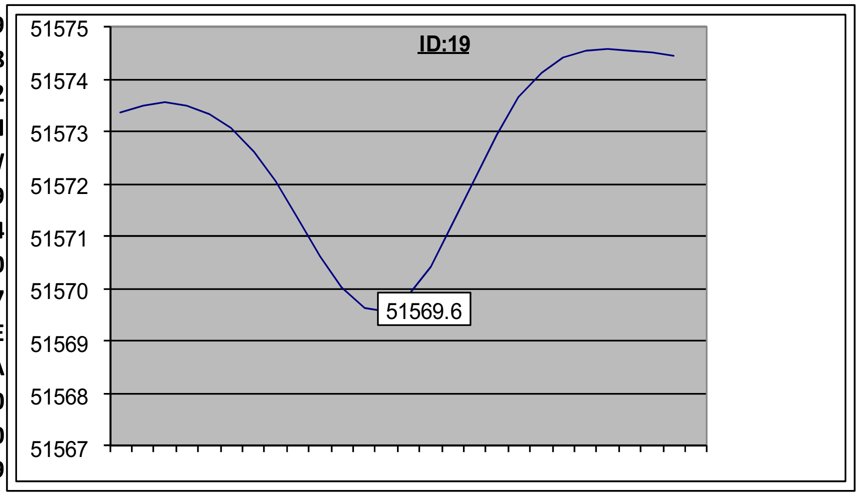
ID	18
Easting	519227.04
Northing	4282387.06
Latitude	38° 41.3931' N
Longitude	074° 46.7351' W
Line	557
Gamma	51581.50
Peak-to-Peak	5.60
Duration	69.17
Type	MONOPOE
Description	ble Geologic (#17)
Depth	0.0
Sensor Depth	0.0
Altitude	5.2



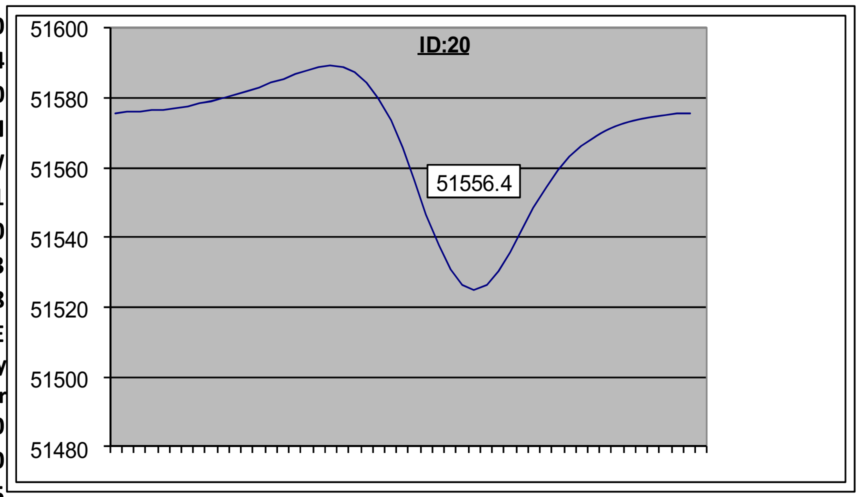
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4j

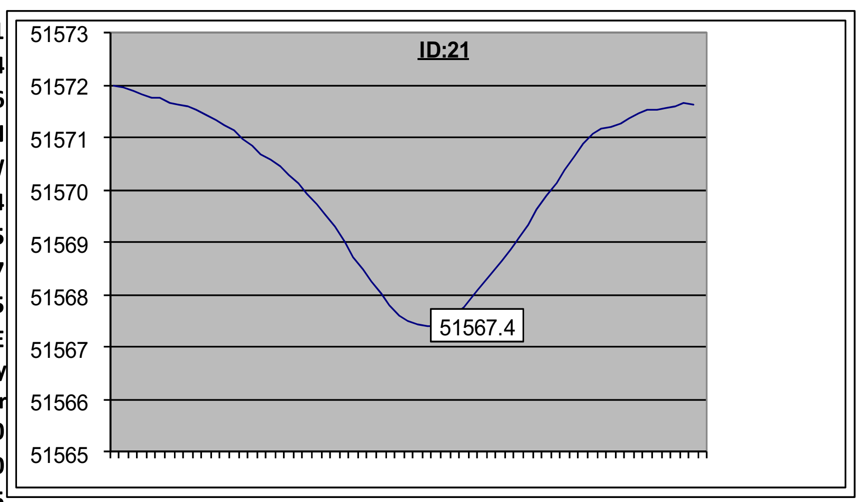
ID	19
Easting	520289.18
Northing	4283327.22
Latitude	38° 41.9001' N
Longitude	074° 46.0007' W
Line	559
Gamma	51569.64
Peak-to-Peak	5.00
Duration	35.17
Type	MONOPOLE
Description	NA
Depth	0.0
Sensor Depth	0.0
Altitude	4.9



ID	20
Easting	520164.04
Northing	4282070.70
Latitude	38° 41.2208' N
Longitude	074° 46.0892' W
Line	601
Gamma	51556.40
Peak-to-Peak	64.13
Duration	54.08
Type	DIPOLE
Description	Central anomaly cluster
Depth	0.0
Sensor Depth	0.0
Altitude	1.5



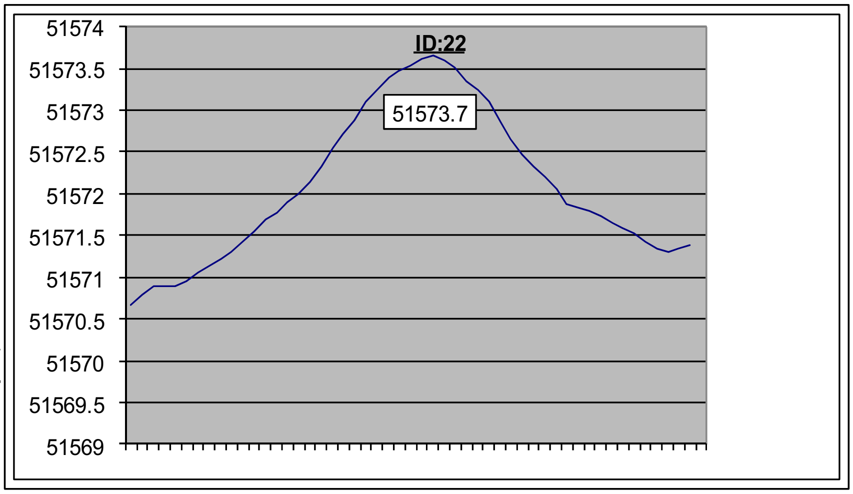
ID	21
Easting	520189.14
Northing	4282100.76
Latitude	38° 41.2371' N
Longitude	074° 46.0719' W
Line	704
Gamma	51567.45
Peak-to-Peak	4.57
Duration	72.95
Type	MONOPOLE
Description	Central anomaly cluster
Depth	0.0
Sensor Depth	0.0
Altitude	2.5



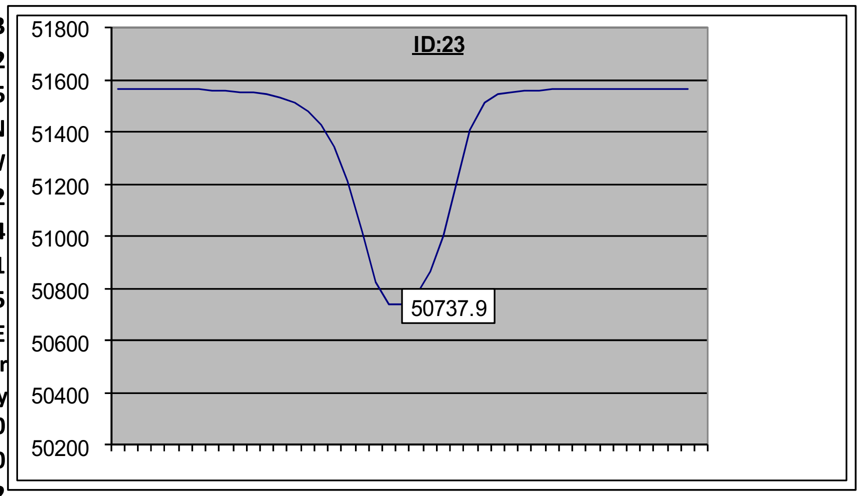
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4k

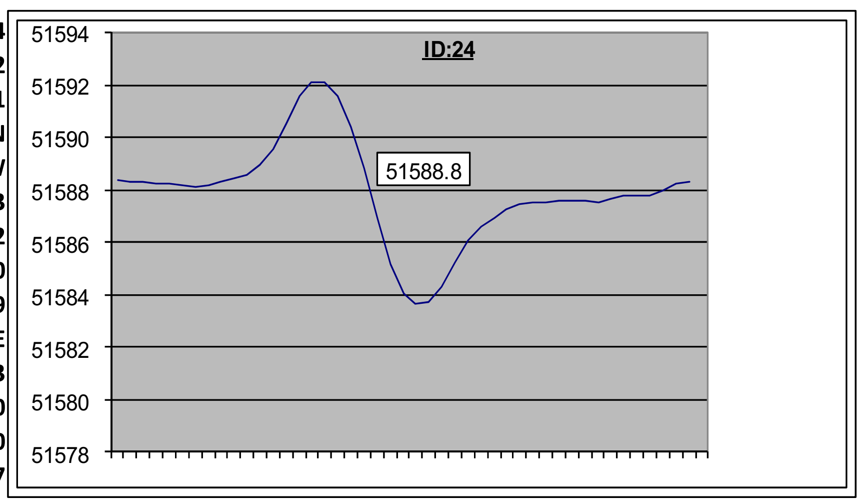
ID	**22**
Easting	**520143.52**
Northing	**4282110.39**
Latitude	**38° 41.2423' N**
Longitude	**074° 46.1033' W**
Line	**801**
Gamma	**51573.67**
Peak-to-Peak	**3.00**
Duration	**67.73**
Type	**MONOPOLE**
Description	**Central anomaly cluster**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**2.2**



ID	**23**
Easting	**520164.62**
Northing	**4282084.25**
Latitude	**38° 41.2282' N**
Longitude	**074° 46.0888' W**
Line	**802**
Gamma	**50737.94**
Peak-to-Peak	**830.61**
Duration	**55.05**
Type	**MONOPOLE**
Description	**Central cluster anomaly**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**2**



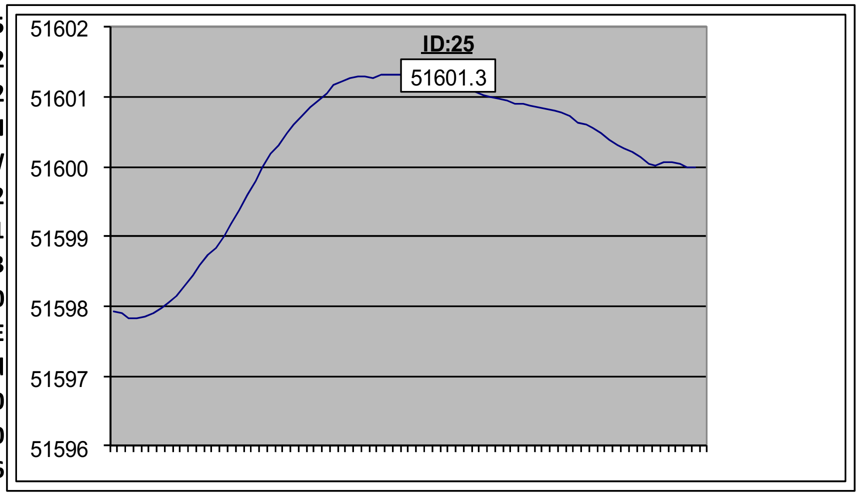
ID	**24**
Easting	**520257.02**
Northing	**4282703.51**
Latitude	**38° 41.5629' N**
Longitude	**074° 46.0240' W**
Line	**1543**
Gamma	**51588.82**
Peak-to-Peak	**8.50**
Duration	**45.19**
Type	**DIPOLE**
Description	**Correlate with 13**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**4.7**



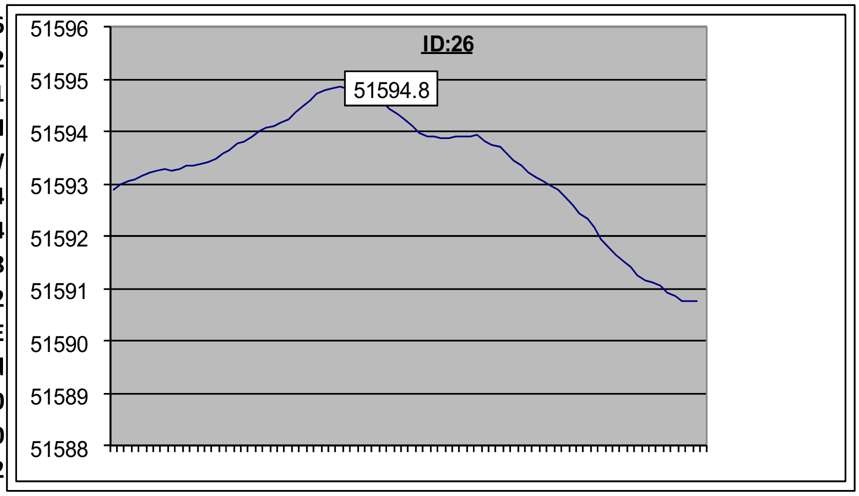
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4I

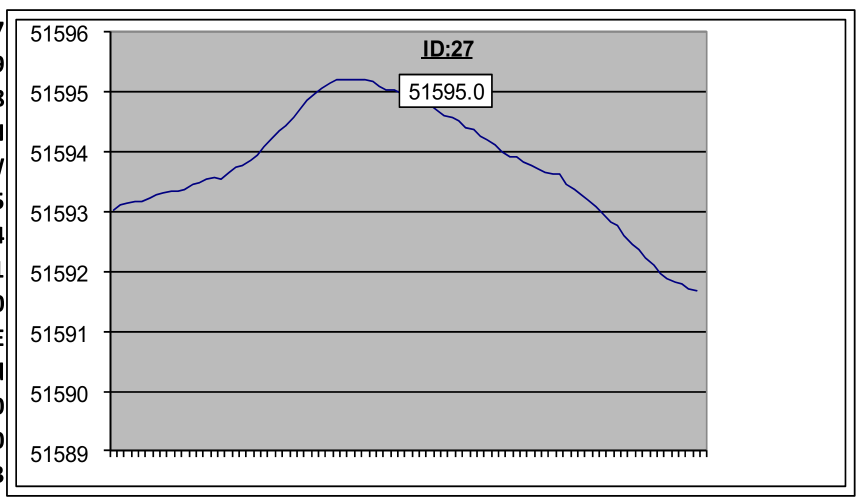
ID	25
Easting	520025.72
Northing	4280915.82
Latitude	38° 40.5966' N
Longitude	074° 46.1867' W
Line	502
Gamma	51601.31
Peak-to-Peak	3.53
Duration	106.30
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	2.6



ID	26
Easting	519967.12
Northing	4280947.41
Latitude	38° 40.6137' N
Longitude	074° 46.2270' W
Line	504
Gamma	51594.84
Peak-to-Peak	4.08
Duration	112.42
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	3.2



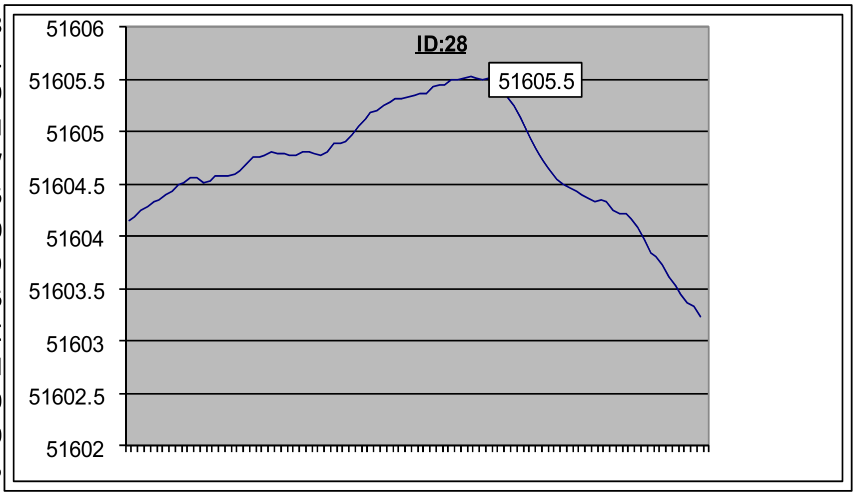
ID	27
Easting	519939.29
Northing	4280952.28
Latitude	38° 40.6164' N
Longitude	074° 46.2462' W
Line	505
Gamma	51595.04
Peak-to-Peak	3.51
Duration	114.30
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	3



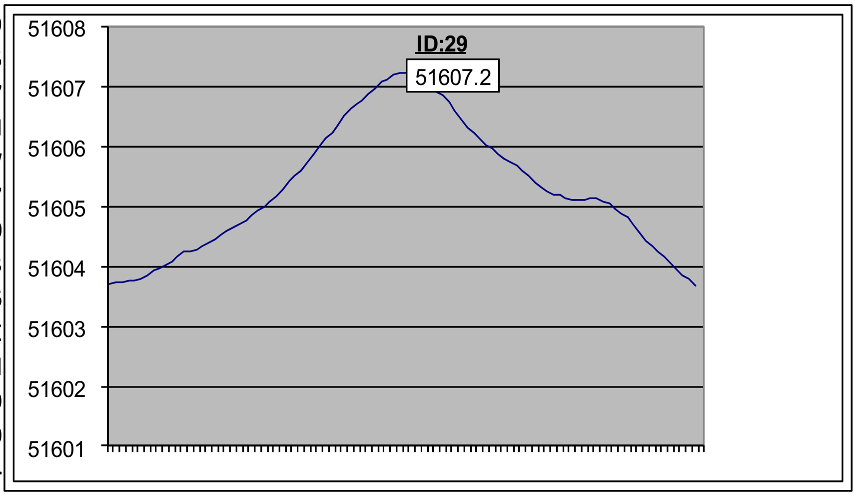
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4m

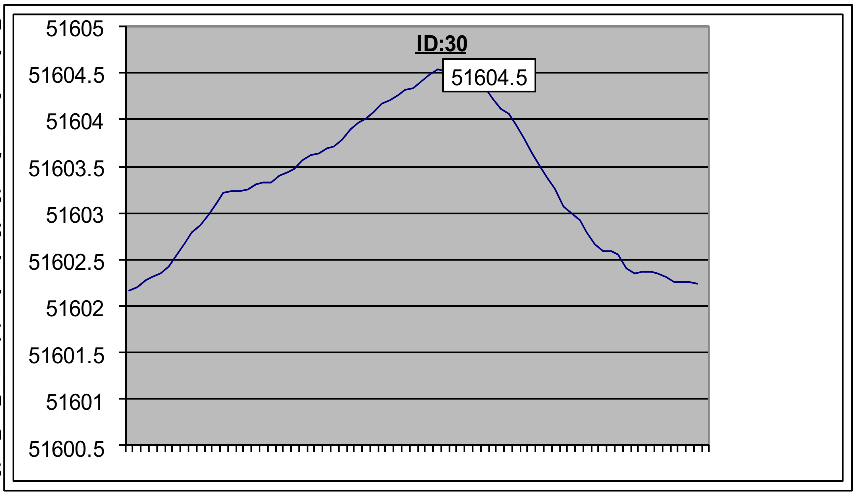
ID	**28**
Easting	**519917.51**
Northing	**4280976.59**
Latitude	**38° 40.6296' N**
Longitude	**074° 46.2612' W**
Line	**506**
Gamma	**51605.50**
Peak-to-Peak	**2.19**
Duration	**114.66**
Type	**MONOPOLE**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**5**



ID	**29**
Easting	**519897.95**
Northing	**4281001.97**
Latitude	**38° 40.6433' N**
Longitude	**074° 46.2746' W**
Line	**507**
Gamma	**51607.20**
Peak-to-Peak	**3.53**
Duration	**118.76**
Type	**MONOPOLE**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**4.4**



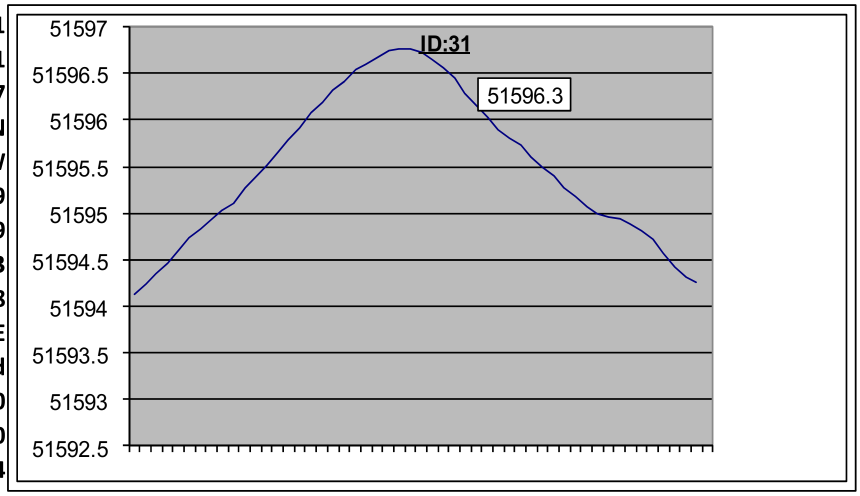
ID	**30**
Easting	**519887.97**
Northing	**4281031.85**
Latitude	**38° 40.6595' N**
Longitude	**074° 46.2815' W**
Line	**508**
Gamma	**51604.48**
Peak-to-Peak	**2.37**
Duration	**95.17**
Type	**MONOPOLE**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**4.8**



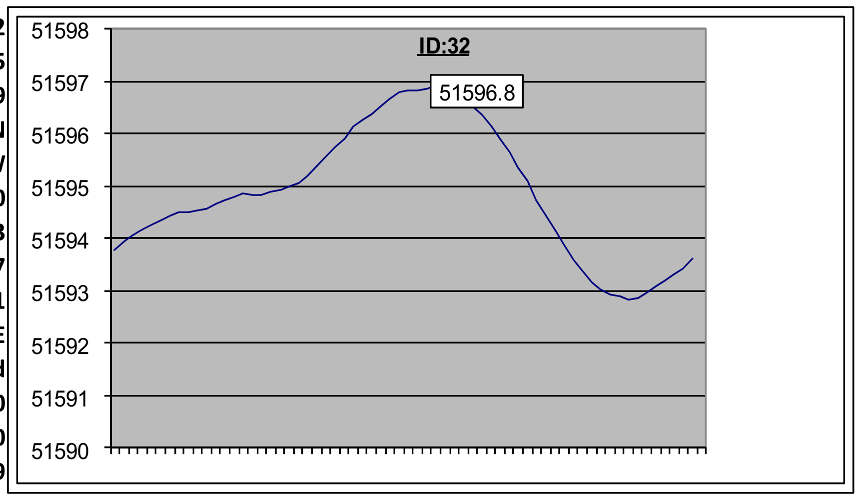
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4n

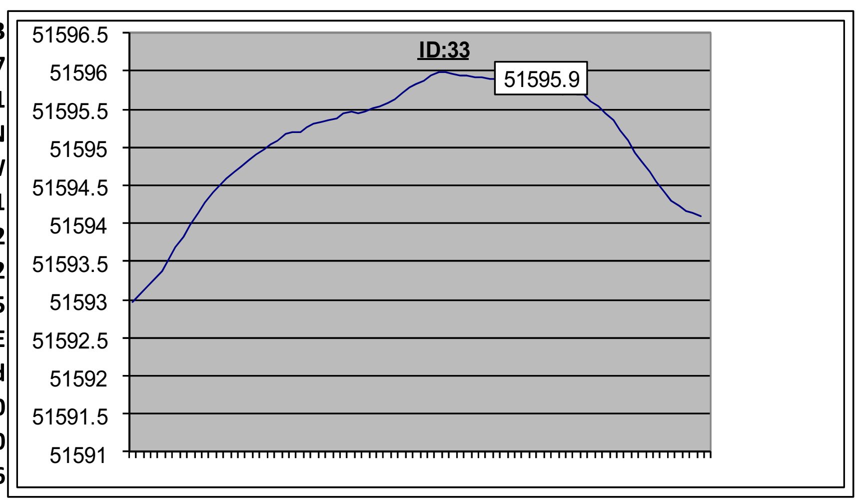
ID	**31**
Easting	**519847.01**
Northing	**4281041.27**
Latitude	**38° 40.6646' N**
Longitude	**074° 46.3097' W**
Line	**509**
Gamma	**51596.29**
Peak-to-Peak	**2.63**
Duration	**74.58**
Type	**MONOPOLE**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**3.4**



ID	**32**
Easting	**519823.45**
Northing	**4281054.19**
Latitude	**38° 40.6717' N**
Longitude	**074° 46.3259' W**
Line	**510**
Gamma	**51596.83**
Peak-to-Peak	**4.07**
Duration	**87.21**
Type	**DIPOLE**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**2.9**



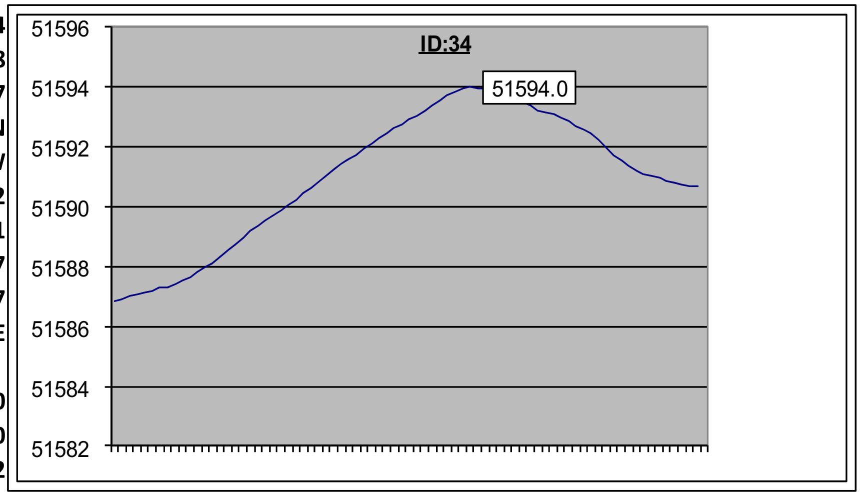
ID	**33**
Easting	**519799.87**
Northing	**4281075.71**
Latitude	**38° 40.6833' N**
Longitude	**074° 46.3422' W**
Line	**511**
Gamma	**51595.92**
Peak-to-Peak	**3.02**
Duration	**109.35**
Type	**MONOPOLE**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**2.6**



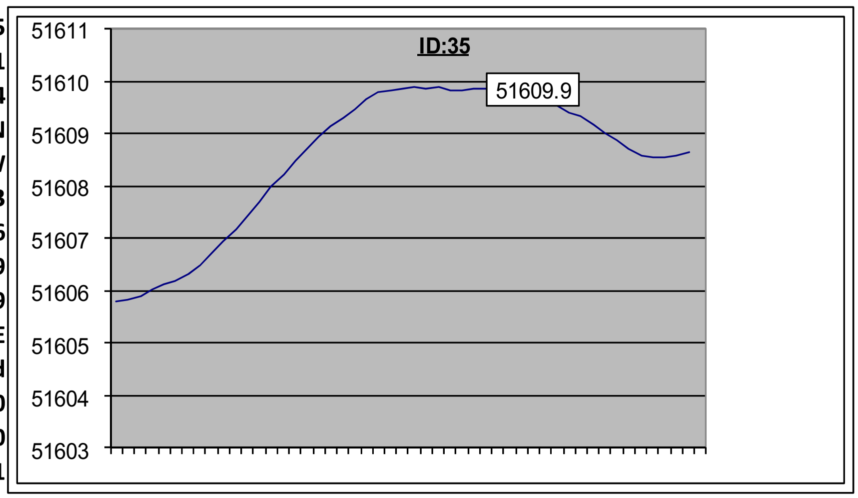
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4o

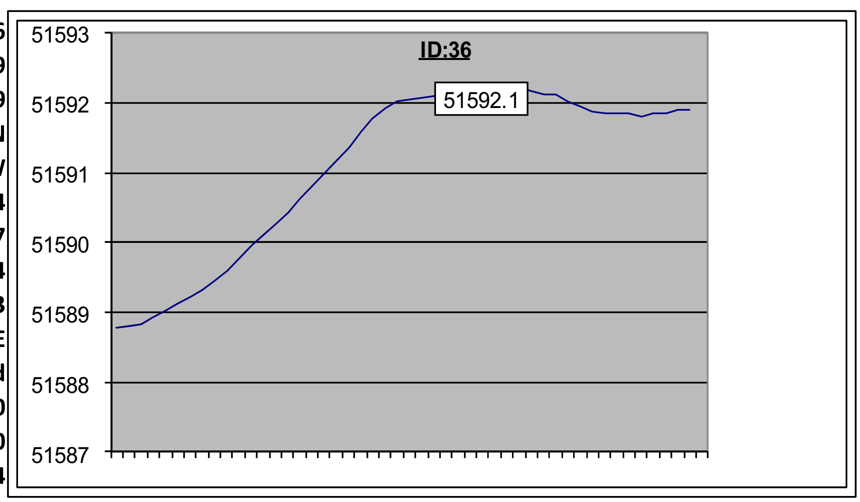
ID	**34**
Easting	**519792.48**
Northing	**4281107.57**
Latitude	**38° 40.7006' N**
Longitude	**074° 46.3472' W**
Line	**512**
Gamma	**51594.01**
Peak-to-Peak	**7.17**
Duration	**103.47**
Type	**MONOPOLE**
Description	**Debris Block #**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**2.2**



ID	**35**
Easting	**519784.21**
Northing	**4281132.54**
Latitude	**38° 40.7141' N**
Longitude	**074° 46.3529' W**
Line	**513**
Gamma	**51609.86**
Peak-to-Peak	**4.09**
Duration	**49.09**
Type	**MONOPOLE**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**4.1**



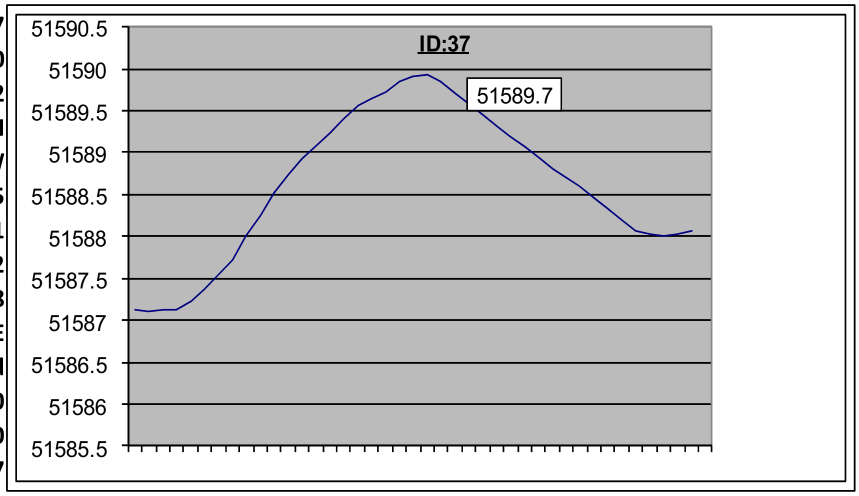
ID	**36**
Easting	**519749.79**
Northing	**4281145.09**
Latitude	**38° 40.7209' N**
Longitude	**074° 46.3766' W**
Line	**514**
Gamma	**51592.07**
Peak-to-Peak	**3.44**
Duration	**70.63**
Type	**MONOPOLE**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**4**



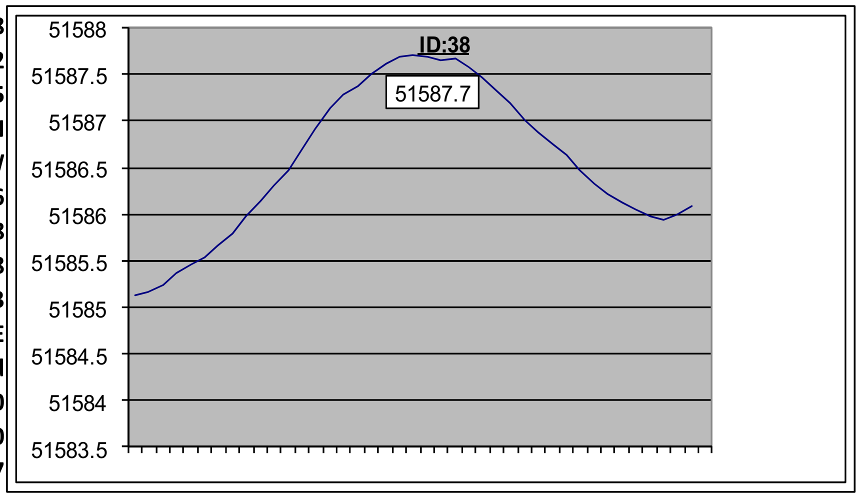
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4p

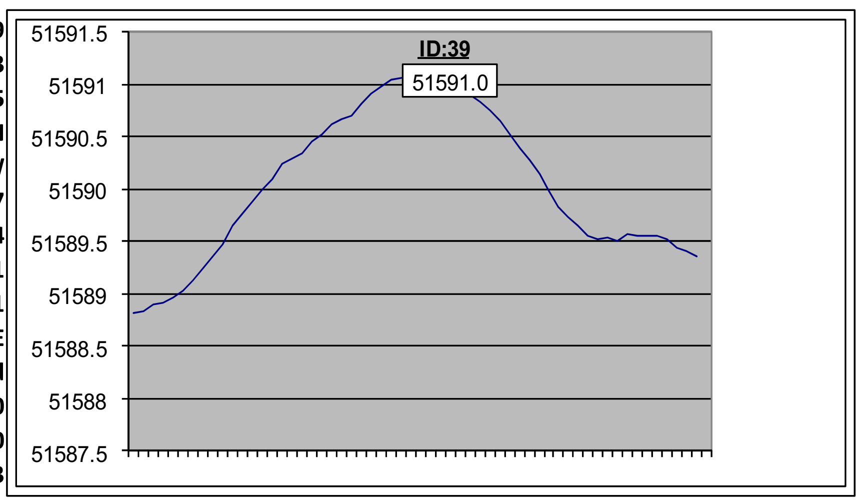
ID	37
Easting	519722.50
Northing	4281167.02
Latitude	38° 40.7328' N
Longitude	074° 46.3954' W
Line	515
Gamma	51589.71
Peak-to-Peak	2.82
Duration	62.08
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	4.7



ID	38
Easting	519706.22
Northing	4281190.25
Latitude	38° 40.7454' N
Longitude	074° 46.4066' W
Line	516
Gamma	51587.68
Peak-to-Peak	2.58
Duration	64.53
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	4.7



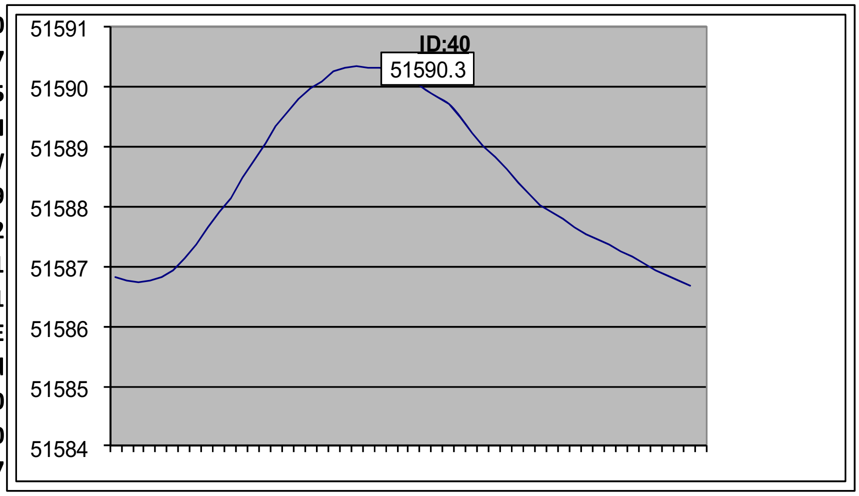
ID	39
Easting	519655.83
Northing	4281188.75
Latitude	38° 40.7446' N
Longitude	074° 46.4413' W
Line	517
Gamma	51591.04
Peak-to-Peak	2.31
Duration	99.31
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	4.3



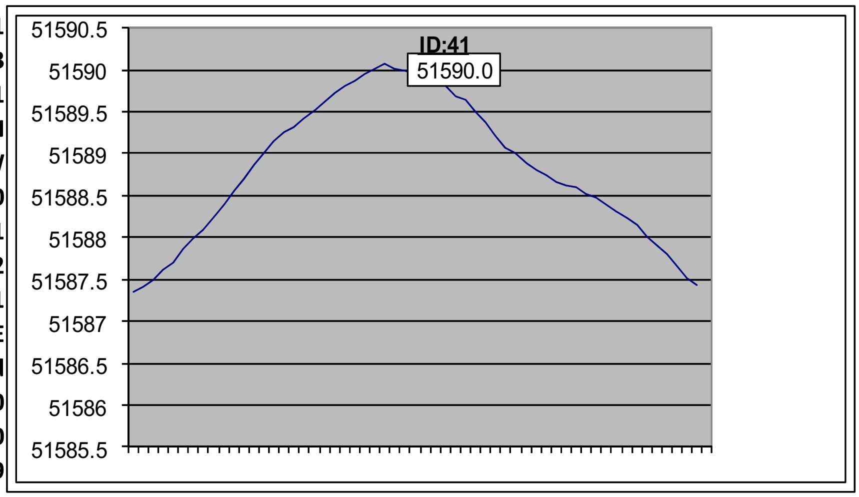
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4q

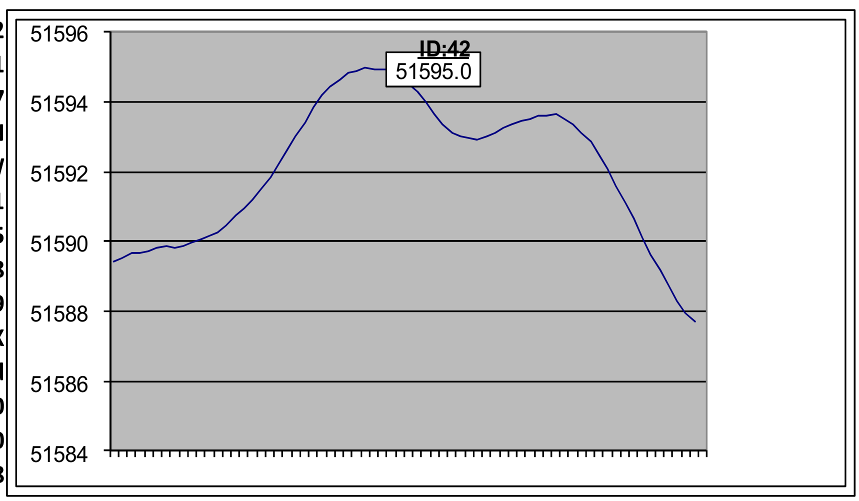
ID	40
Easting	519647.17
Northing	4281258.65
Latitude	38° 40.7824' N
Longitude	074° 46.4472' W
Line	519
Gamma	51590.32
Peak-to-Peak	3.61
Duration	80.21
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	4.7



ID	41
Easting	519635.73
Northing	4281285.81
Latitude	38° 40.7971' N
Longitude	074° 46.4550' W
Line	520
Gamma	51590.01
Peak-to-Peak	2.72
Duration	88.31
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	5.9



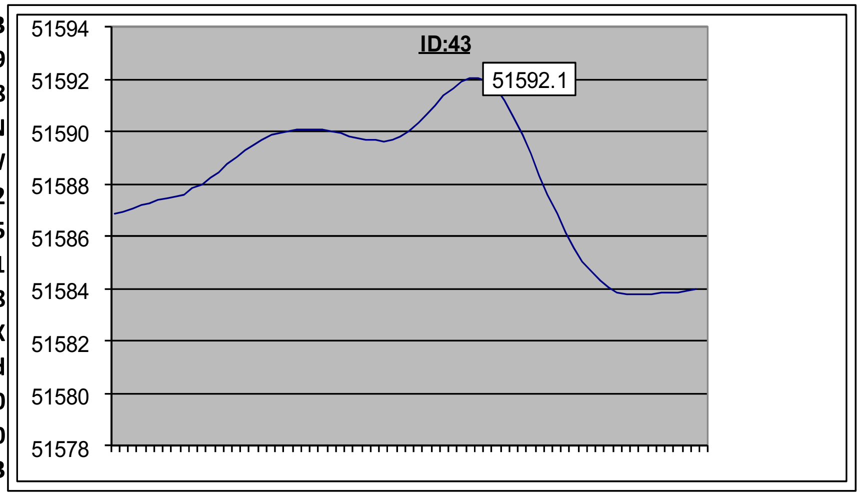
ID	42
Easting	519631.61
Northing	4281323.27
Latitude	38° 40.8174' N
Longitude	074° 46.4578' W
Line	521
Gamma	51594.95
Peak-to-Peak	6.98
Duration	102.59
Type	COMPLEX
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	3.8



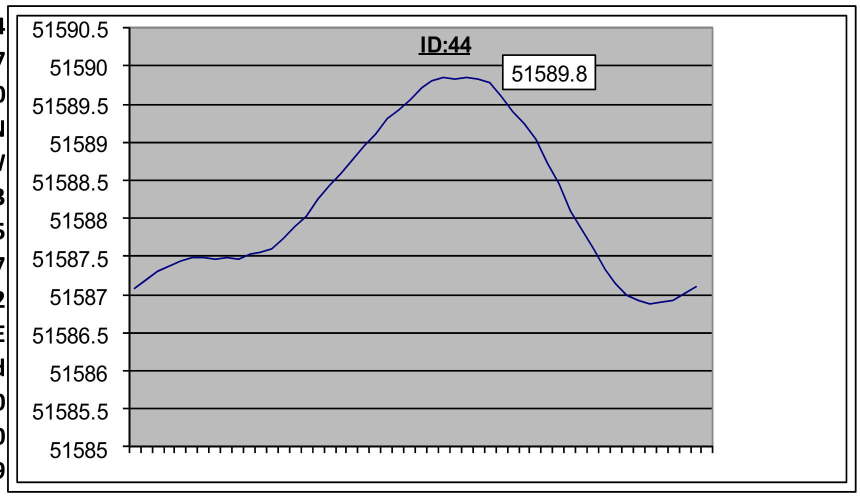
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4r

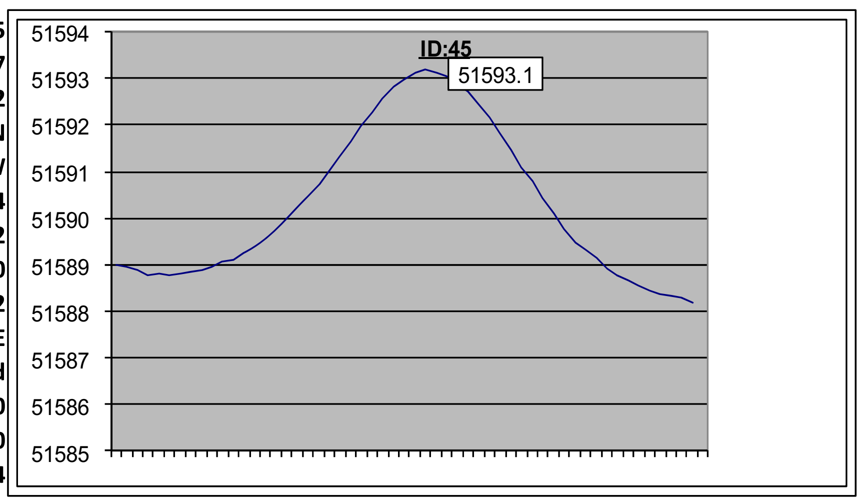
ID	43
Easting	519638.09
Northing	4281363.08
Latitude	38° 40.8389' N
Longitude	074° 46.4533' W
Line	522
Gamma	51592.05
Peak-to-Peak	8.31
Duration	101.78
Type	COMPLEX
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	4.3



ID	44
Easting	519595.37
Northing	4281371.70
Latitude	38° 40.8436' N
Longitude	074° 46.4827' W
Line	523
Gamma	51589.85
Peak-to-Peak	2.97
Duration	75.42
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	3.9



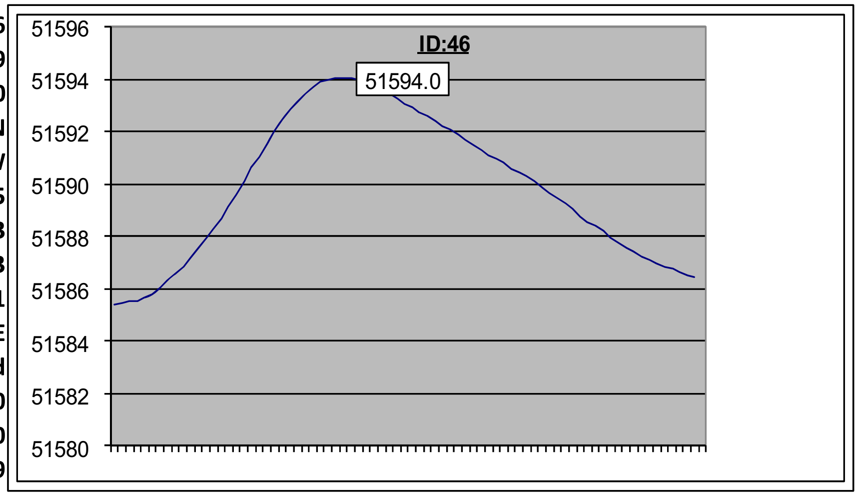
ID	45
Easting	519582.67
Northing	4281400.12
Latitude	38° 40.8590' N
Longitude	074° 46.4914' W
Line	524
Gamma	51593.12
Peak-to-Peak	4.90
Duration	77.62
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	3.4



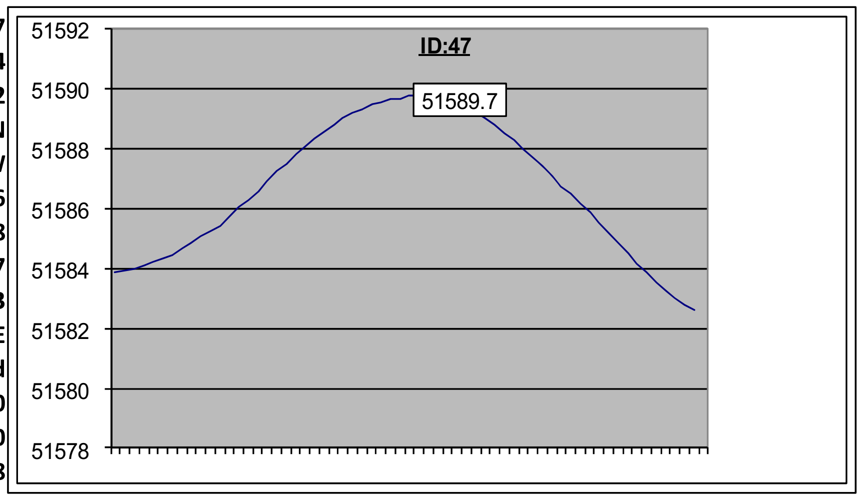
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4s

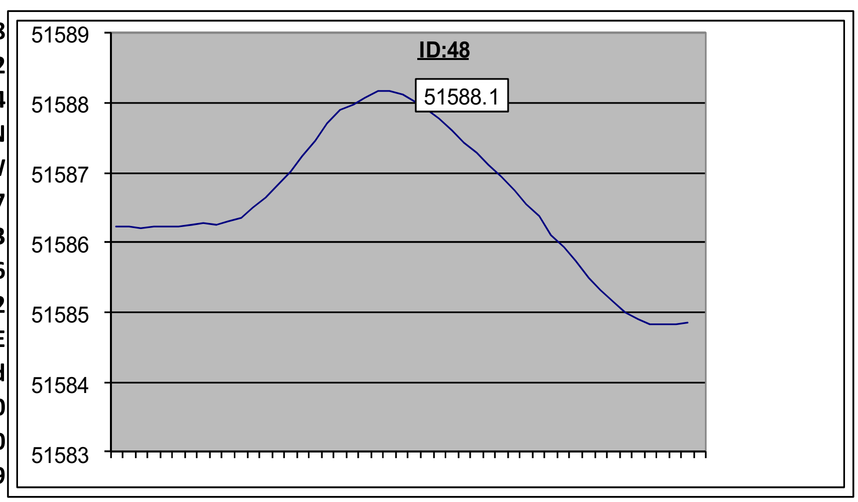
ID	46
Easting	519567.19
Northing	4281423.50
Latitude	38° 40.8717' N
Longitude	074° 46.5021' W
Line	525
Gamma	51594.03
Peak-to-Peak	8.63
Duration	106.91
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	4.9



ID	47
Easting	519549.84
Northing	4281452.02
Latitude	38° 40.8871' N
Longitude	074° 46.5140' W
Line	526
Gamma	51589.68
Peak-to-Peak	6.97
Duration	86.83
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	4.8



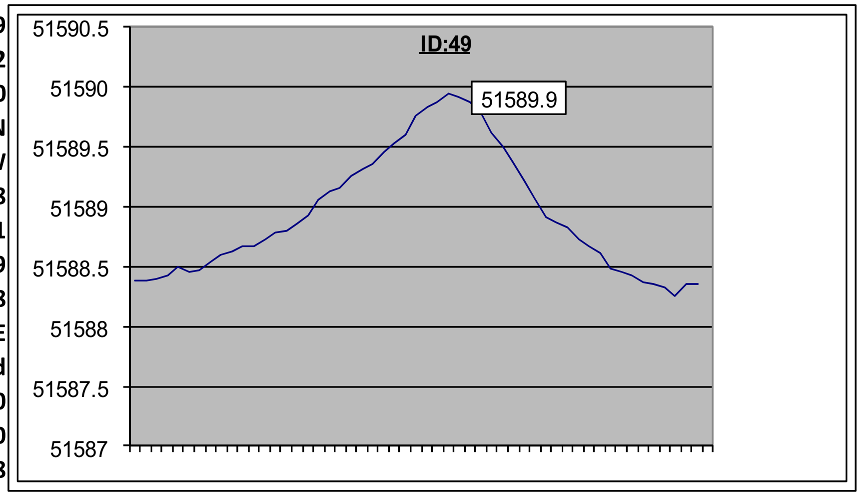
ID	48
Easting	519545.52
Northing	4281487.34
Latitude	38° 40.9062' N
Longitude	074° 46.5169' W
Line	527
Gamma	51588.13
Peak-to-Peak	3.36
Duration	69.52
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	4.9



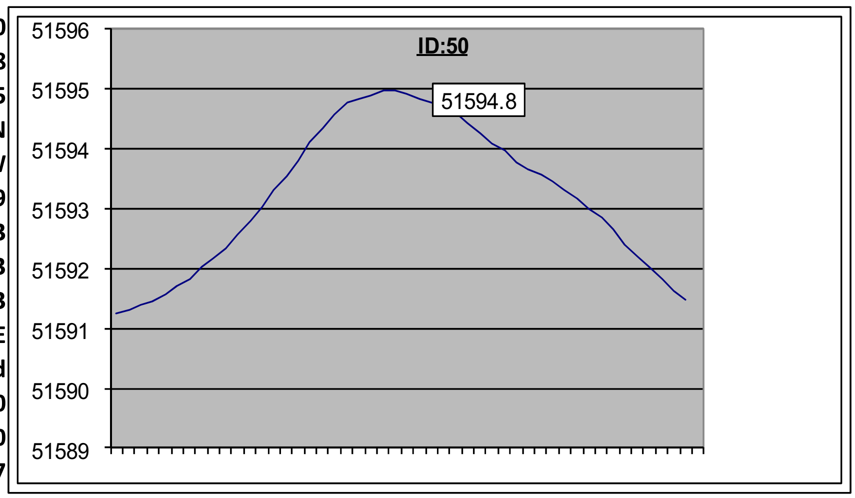
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4t

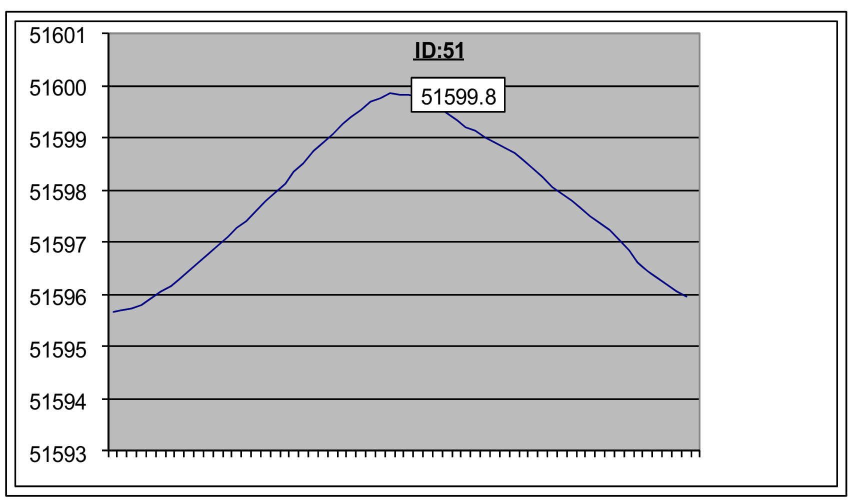
ID	**49**
Easting	**519526.72**
Northing	**4281514.90**
Latitude	**38° 40.9212' N**
Longitude	**074° 46.5298' W**
Line	**528**
Gamma	**51589.91**
Peak-to-Peak	**1.69**
Duration	**74.98**
Type	**MONOPOLE**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**4.8**



ID	**50**
Easting	**519489.78**
Northing	**4281519.45**
Latitude	**38° 40.9237' N**
Longitude	**074° 46.5553' W**
Line	**529**
Gamma	**51594.83**
Peak-to-Peak	**3.73**
Duration	**68.43**
Type	**MONOPOLE**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**4.7**



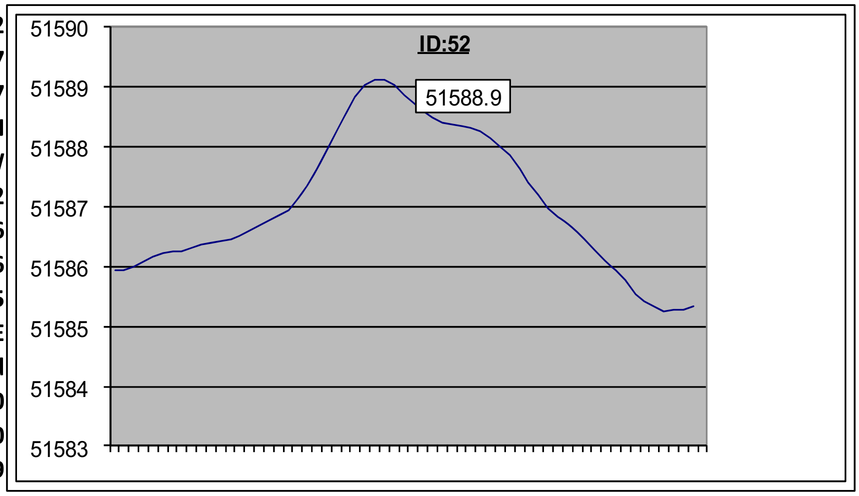
ID	**51**
Easting	**519479.54**
Northing	**4281550.45**
Latitude	**38° 40.9404' N**
Longitude	**074° 46.5623' W**
Line	**530**
Gamma	**51599.84**
Peak-to-Peak	**4.17**
Duration	**83.44**
Type	**MONOPOLE**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**4.7**



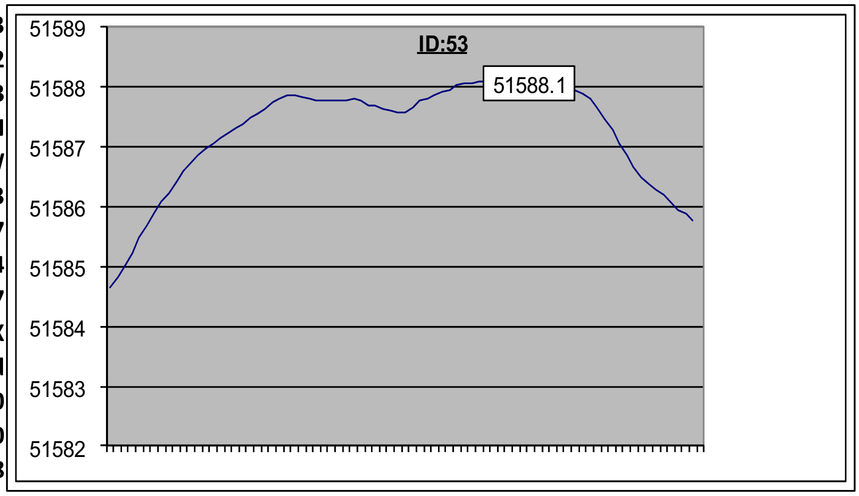
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4u

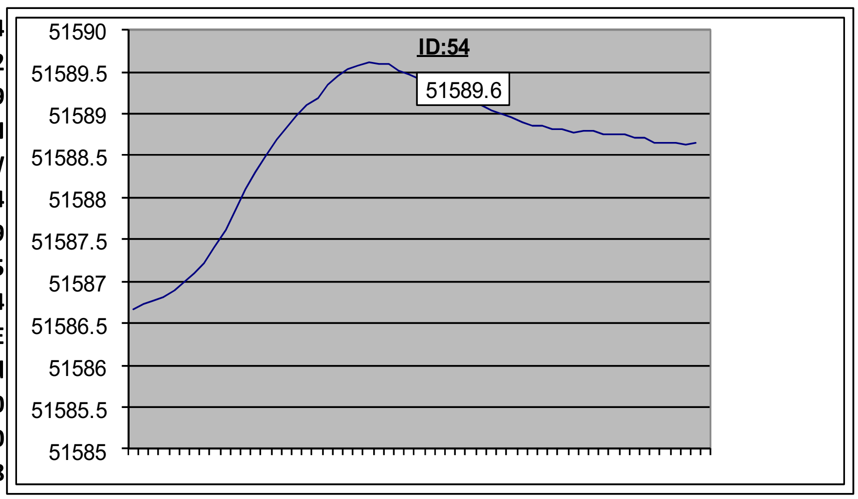
ID	52
Easting	519432.67
Northing	4281588.37
Latitude	38° 40.9610' N
Longitude	074° 46.5946' W
Line	532
Gamma	51588.86
Peak-to-Peak	3.86
Duration	98.05
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	4.9



ID	53
Easting	519431.72
Northing	4281627.63
Latitude	38° 40.9822' N
Longitude	074° 46.5952' W
Line	533
Gamma	51588.07
Peak-to-Peak	3.44
Duration	129.77
Type	COMPLEX
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	4.8



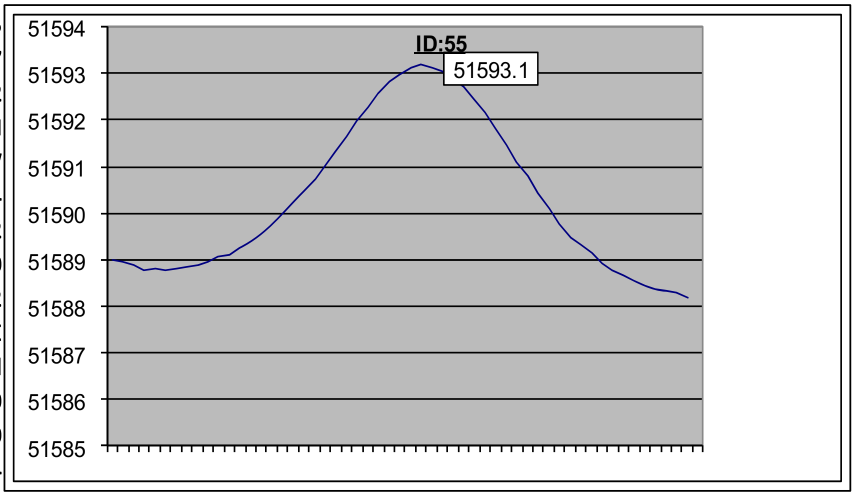
ID	54
Easting	519444.52
Northing	4281674.19
Latitude	38° 41.0074' N
Longitude	074° 46.5863' W
Line	534
Gamma	51589.59
Peak-to-Peak	2.95
Duration	90.84
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	4.8



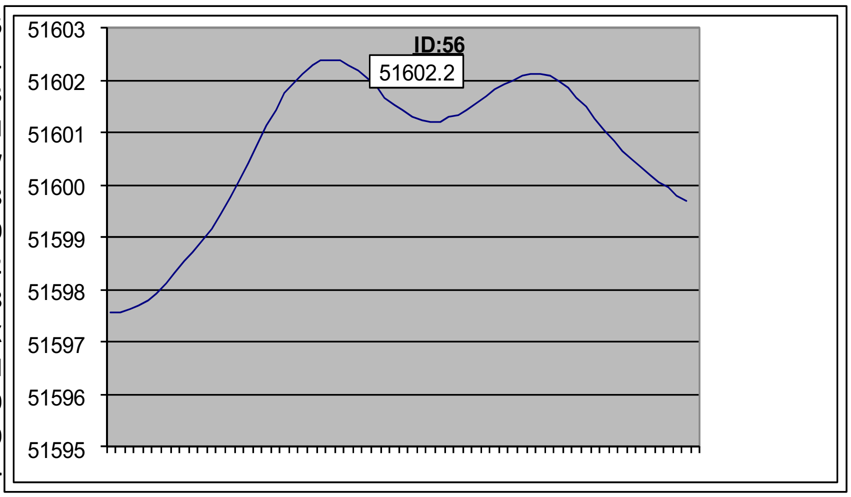
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4v

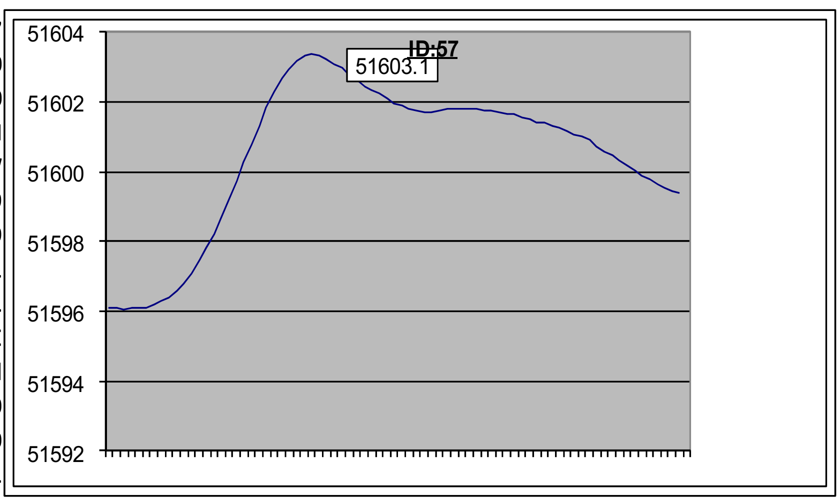
ID	**55**
Easting	**519582.67**
Northing	**4281400.12**
Latitude	**38° 40.8590' N**
Longitude	**074° 46.4914' W**
Line	**524**
Gamma	**51593.12**
Peak-to-Peak	**4.90**
Duration	**77.62**
Type	**MONOPOLE**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**5.4**



ID	**56**
Easting	**519373.71**
Northing	**4281774.63**
Latitude	**38° 41.0618' N**
Longitude	**074° 46.6350' W**
Line	**538**
Gamma	**51602.20**
Peak-to-Peak	**4.82**
Duration	**107.68**
Type	**COMPLEX**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**5.4**



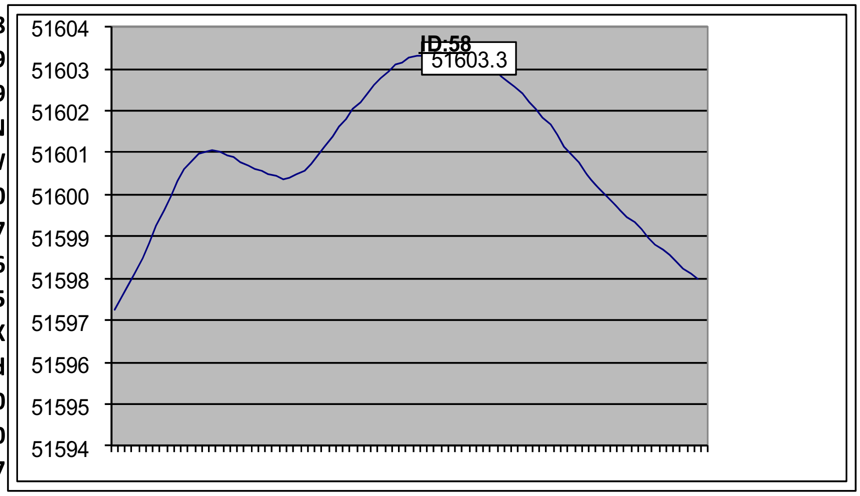
ID	**57**
Easting	**519357.80**
Northing	**4281800.30**
Latitude	**38° 41.0757' N**
Longitude	**074° 46.6459' W**
Line	**539**
Gamma	**51603.09**
Peak-to-Peak	**7.31**
Duration	**121.01**
Type	**DIPOLE**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**5.1**



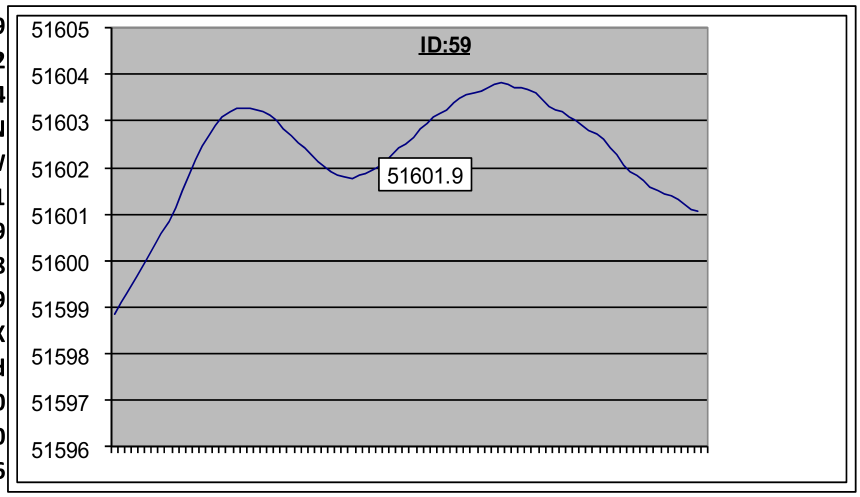
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4w

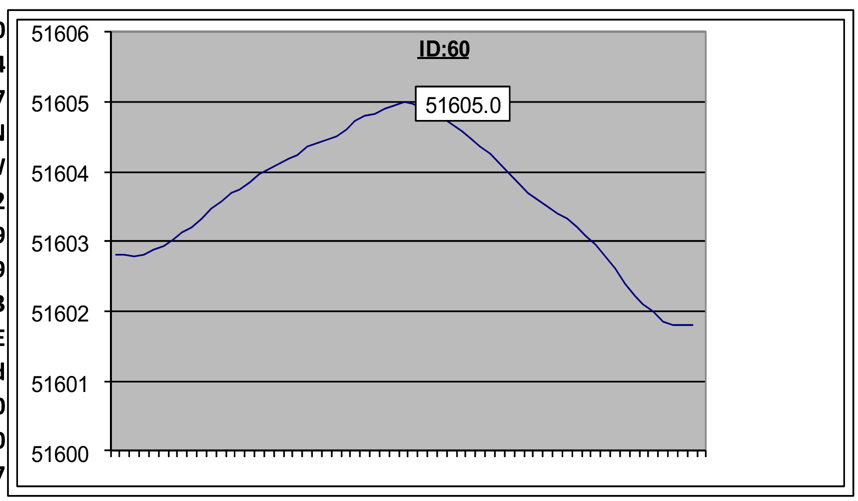
ID	58
Easting	519316.59
Northing	4281806.19
Latitude	38° 41.0789' N
Longitude	074° 46.6743' W
Line	540
Gamma	51603.27
Peak-to-Peak	6.06
Duration	132.65
Type	COMPLEX
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	5.7



ID	59
Easting	519315.22
Northing	4281845.64
Latitude	38° 41.1003' N
Longitude	074° 46.6752' W
Line	541
Gamma	51601.89
Peak-to-Peak	4.98
Duration	133.09
Type	COMPLEX
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	5.6



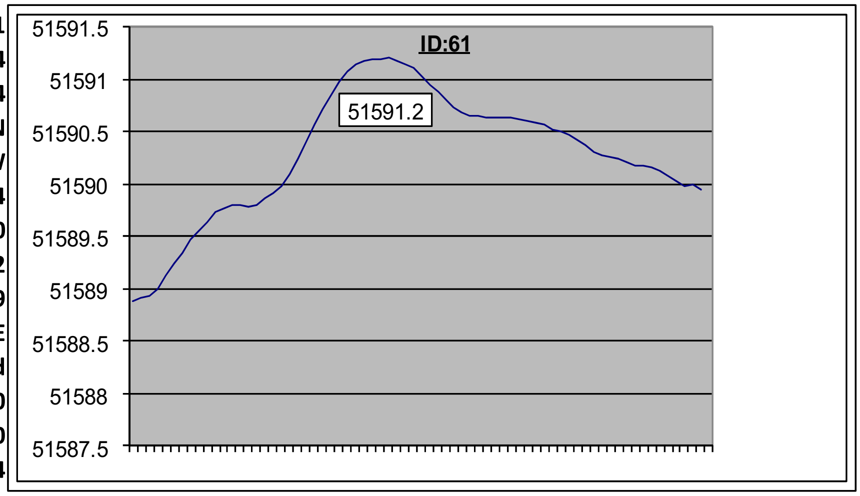
ID	60
Easting	519272.84
Northing	4281847.57
Latitude	38° 41.1014' N
Longitude	074° 46.7044' W
Line	542
Gamma	51604.99
Peak-to-Peak	3.19
Duration	89.83
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	5.7



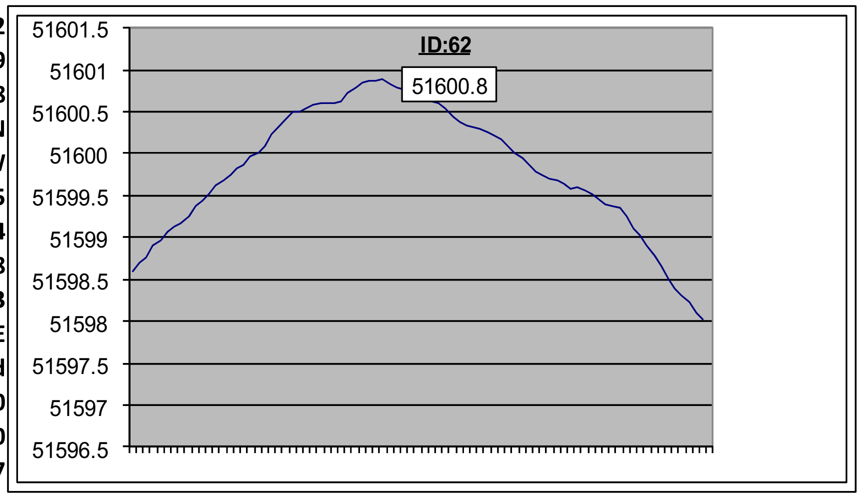
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4x

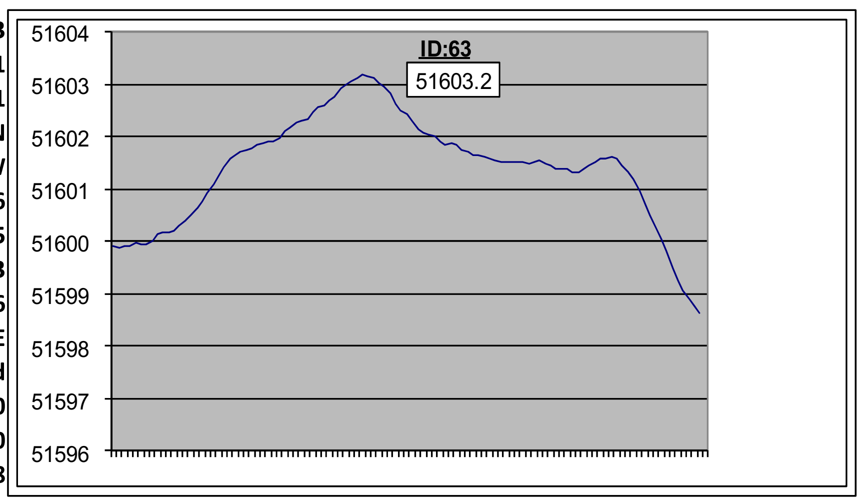
ID	61
Easting	519251.14
Northing	4281903.34
Latitude	38° 41.1316' N
Longitude	074° 46.7193' W
Line	544
Gamma	51591.20
Peak-to-Peak	2.32
Duration	96.89
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	4



ID	62
Easting	519230.89
Northing	4281930.98
Latitude	38° 41.1465' N
Longitude	074° 46.7332' W
Line	545
Gamma	51600.84
Peak-to-Peak	2.78
Duration	115.83
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	5.7



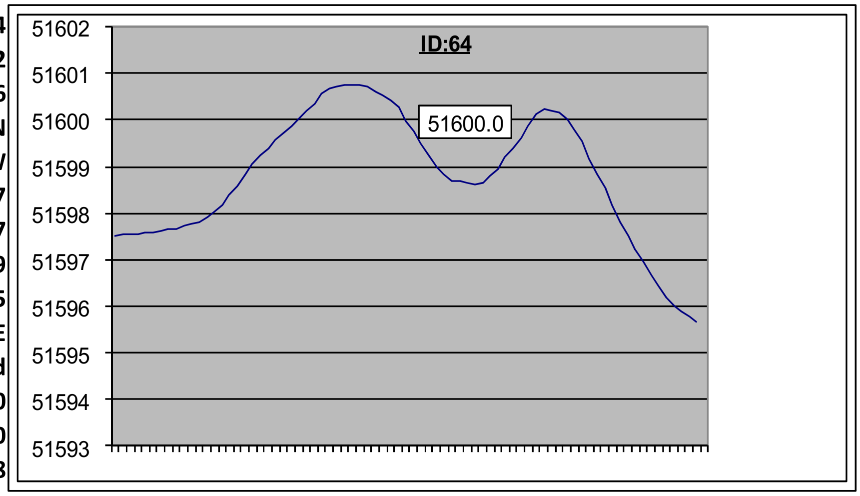
ID	63
Easting	519225.11
Northing	4281963.51
Latitude	38° 41.1641' N
Longitude	074° 46.7372' W
Line	546
Gamma	51603.15
Peak-to-Peak	4.43
Duration	132.76
Type	DIPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	5.8



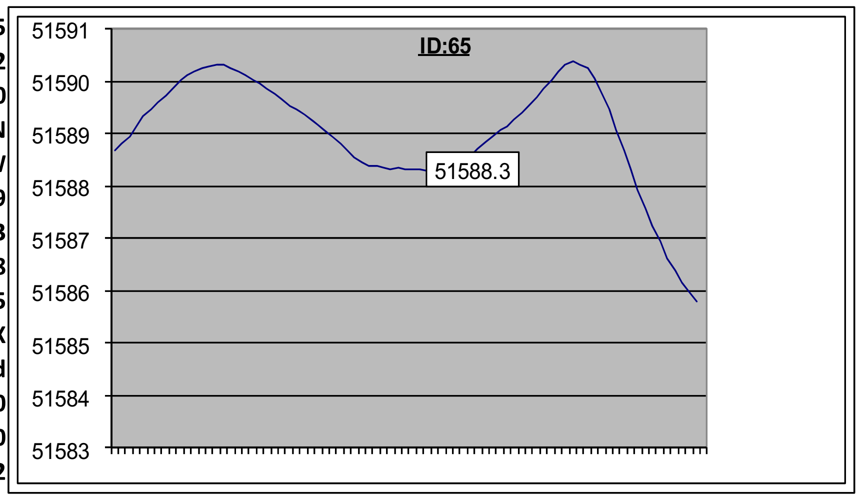
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4y

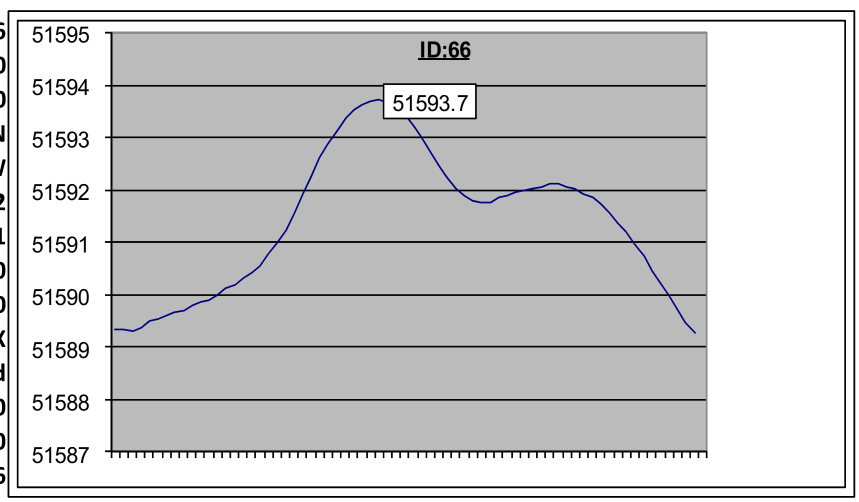
ID	**64**
Easting	**519237.32**
Northing	**4282018.06**
Latitude	**38° 41.1936' N**
Longitude	**074° 46.7286' W**
Line	**547**
Gamma	**51599.97**
Peak-to-Peak	**4.99**
Duration	**99.65**
Type	**DIPOLE**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**5.8**



ID	**65**
Easting	**519213.72**
Northing	**4282051.30**
Latitude	**38° 41.2116' N**
Longitude	**074° 46.7449' W**
Line	**549**
Gamma	**51588.33**
Peak-to-Peak	**4.38**
Duration	**122.25**
Type	**COMPLEX**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**6.2**



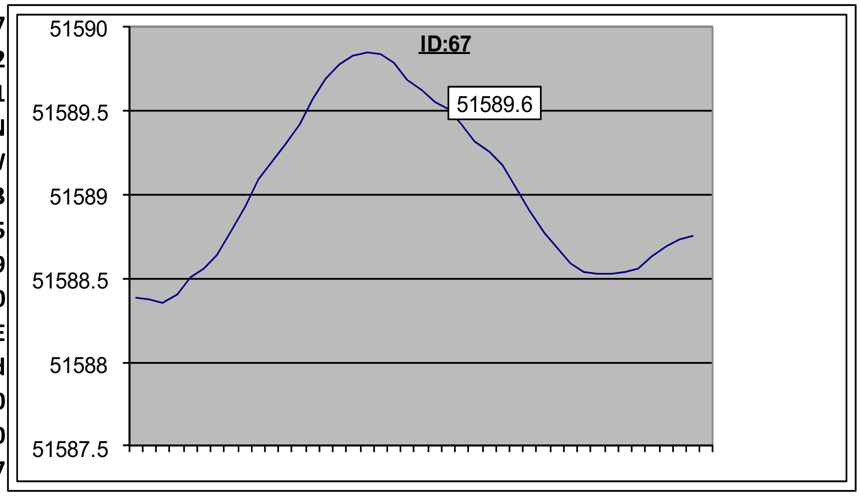
ID	**66**
Easting	**519127.00**
Northing	**4282107.00**
Latitude	**38° 41.2418' N**
Longitude	**074° 46.8046' W**
Line	**552**
Gamma	**51593.71**
Peak-to-Peak	**4.40**
Duration	**101.30**
Type	**COMPLEX**
Description	**SW Trend**
Depth	**0.0**
Sensor Depth	**0.0**
Altitude	**5.6**



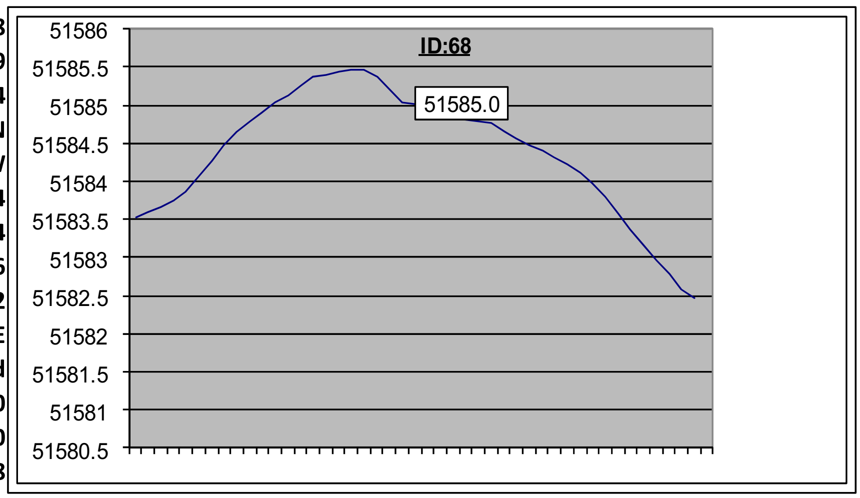
MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4z

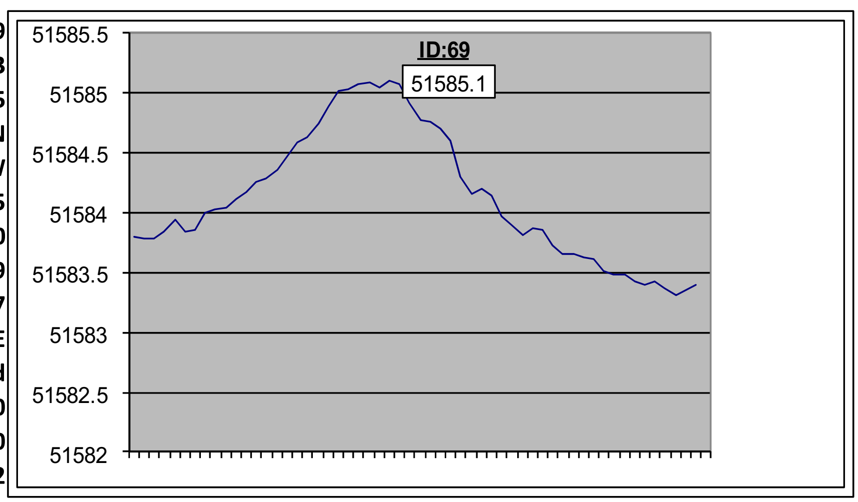
ID	67
Easting	519113.22
Northing	4282148.21
Latitude	38° 41.2641' N
Longitude	074° 46.8140' W
Line	553
Gamma	51589.55
Peak-to-Peak	1.49
Duration	59.20
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	5.7



ID	68
Easting	519107.39
Northing	4282169.34
Latitude	38° 41.2756' N
Longitude	074° 46.8180' W
Line	554
Gamma	51585.04
Peak-to-Peak	2.86
Duration	65.92
Type	DIPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	5.8



ID	69
Easting	519070.33
Northing	4282190.85
Latitude	38° 41.2873' N
Longitude	074° 46.8436' W
Line	555
Gamma	51585.10
Peak-to-Peak	1.79
Duration	66.47
Type	DIPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	6.2

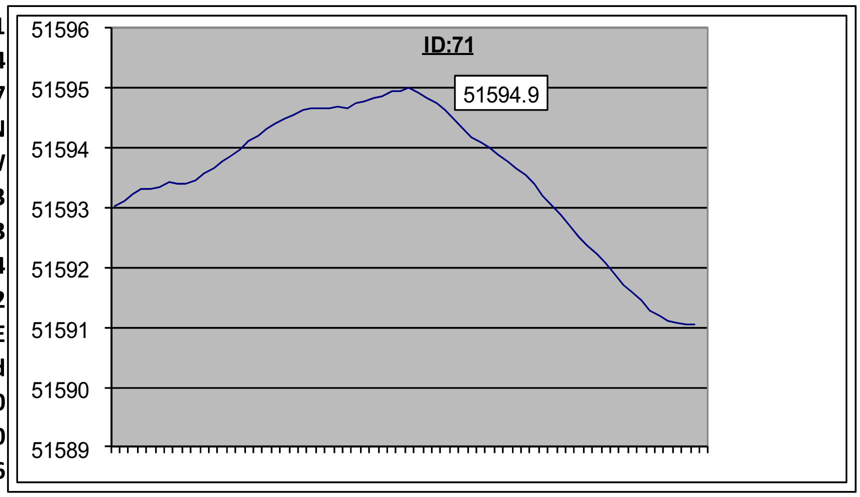


MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

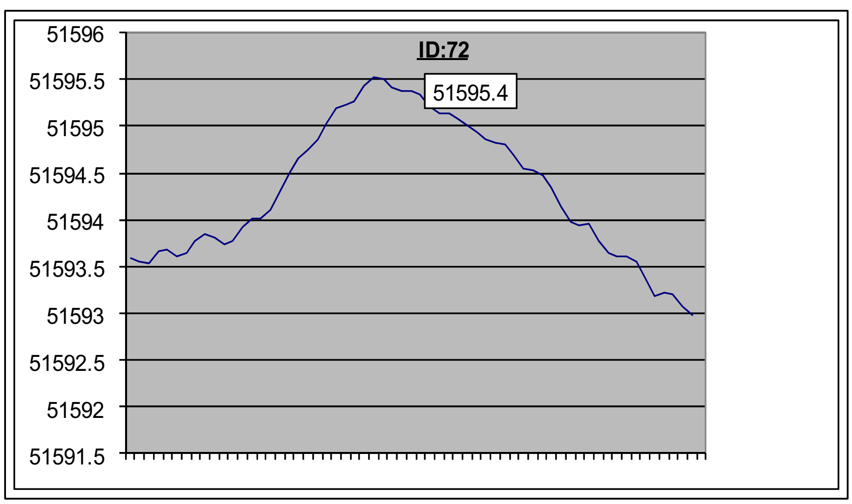
FIGURE A-4aa

ID	70
Easting	519053.61
Northing	4282210.36
Latitude	38° 41.2978' N
Longitude	074° 46.8551' W
Line	556
Gamma	51576.77
Peak-to-Peak	2.13
Duration	55.88
Type	DIPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	5.5

ID	71
Easting	520030.74
Northing	4280952.97
Latitude	38° 40.6167' N
Longitude	074° 46.1831' W
Line	1503
Gamma	51594.93
Peak-to-Peak	3.94
Duration	93.92
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	3.6



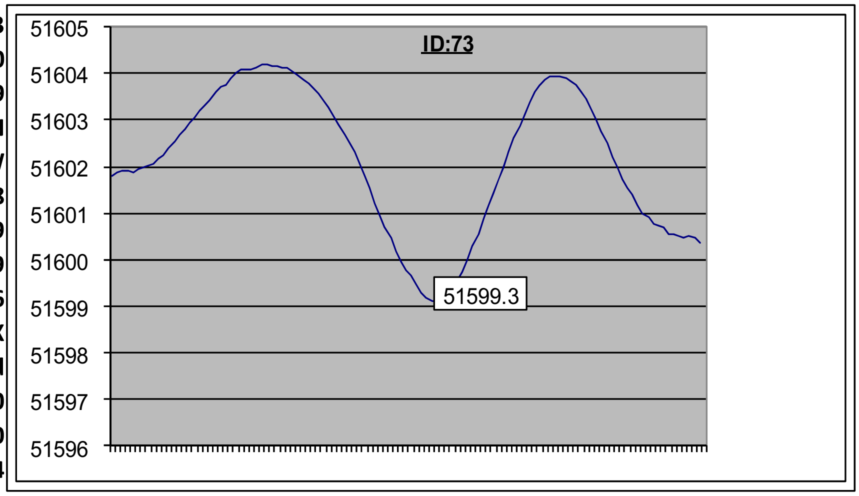
ID	72
Easting	519270.03
Northing	4281875.31
Latitude	38° 41.1164' N
Longitude	074° 46.7063' W
Line	1543
Gamma	51595.38
Peak-to-Peak	2.45
Duration	65.60
Type	MONOPOLE
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	4.2



MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4ab

ID	73
Easting	519218.40
Northing	4282038.19
Latitude	38° 41.2045' N
Longitude	074° 46.7417' W
Line	1548
Gamma	51599.29
Peak-to-Peak	5.09
Duration	150.56
Type	COMPLEX
Description	SW Trend
Depth	0.0
Sensor Depth	0.0
Altitude	5.4



MAGNETIC ANOMALIES
Fall 2010 Survey
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

FIGURE A-4ac

LINE SUMMARY LOG

Client: Bluewater Wind	Project No.: 3671.004	Page: 1 of 5
Surveyor: PN, MB, RD, HT	Vessel: Samantha Miller	Date: October 20, 2009
Client Rep: n/a	Location: Offshore Delaware	Devices: SBP, SSS, MAG, Chirp

Survey Date	Line No.	Heading	First Shot Point		Last Shot Point		Layback SSS		LaybackMag		Remarks	Sub Bottom Roll No.	Sub Bottom CD	Mag altitude SOL (m)	Mag altitude EOL (m)	SSS Range (m)	Side scan sonar altitude SOL (m)	Side scan sonar altitude EOL (m)
			Event No.	Time (UTC)	Event No.	Time (UTC)	Cable Out (M)	Time	Cable Out (M)	Time								
20-Oct	213	141	200	1330	202	1355	15		50		Abort line, bad heading input.							
20-Oct	213	141	200	1343	220	1358	15		50		Boomer interferes with Mag and MBES.			5.2	7.4	75	10.0	12.4
20-Oct	212	321	220	1404	200	1418	15		50					7.1	4.5	75	11.6	8.6
20-Oct	211	141	200	1425	220	1441	15		50					5.2	6.5	75	10.8	10.8
20-Oct	210	321	220	1446	200	1501	15		50					7.4	4.4	75	10.8	9.3
20-Oct	209	141	200	1509	220	1522	15		50					5.3	5.8	75	9.4	10.0
20-Oct	208	321	220	1527	200	1543	15		50					6.2	4.9	75	7.3	8.9
20-Oct	207	141	200	1551	220	1605	15		50					4.8	5.5	75	6.1	9.3
20-Oct	206	321	220	1612	200	1628	15		50					5.1	5.1	75	9.1	8.7
20-Oct	205	141	200	1633	180	1646	15		50					5.5	5.4	75	9.0	8.8
20-Oct	204	321	220	1652	200	1709	15		50					4.6	5.4	75	7.6	8.6
20-Oct	203	141	200	1714	220	1727	15		50					5.9	4.9	75	9.0	7.9
20-Oct	202	321	220	1732	200	1750	15		50		Possible SSS contact.			4.8	6.0	75	8.3	9.5
20-Oct	101	51	120	1800	100	1813	15		50		Boomer re-shoot			6.2	5.2	75	9.8	7.6
20-Oct	104	231	100	1819	120		15		50		G&G with SSS.			4.9	5.9	75	8.1	9.0
20-Oct	201	141	200	1900	220	1913	15		50		Tie line, boomer interference with mag.			5.7	5.5	75	7.5	8.6

FIGURE A-5a

LINE SUMMARY LOG

Client: Bluewater Wind	Project No.: 3671.004	Page: 2 of 5
Surveyor: PN, MB, RD, HT	Vessel: Samantha Miller	Date: October 21, 2009
Client Rep: n/a	Location: Offshore Delaware	Devices: SBP, SSS, MAG, Chirp

Survey Date	Line No.	Heading	First Shot Point		Last Shot Point		Layback SSS		LaybackMag		Remarks	Sub Bottom Roll No.	Sub Bottom CD	Mag altitude SOL (m)	Mag altitude EOL (m)	SSS Range (m)	Side scan sonar altitude SOL (m)	Side scan sonar altitude EOL (m)
			Event No.	Time (UTC)	Event No.	Time (UTC)	Cable Out (M)	Time	Cable Out (M)	Time								
21-Oct	110	51	120	1327	100	1341					Boomer/Chirp lines							
21-Oct	116	231	100	1347	120	1401					Boomer/Chirp lines							
21-Oct	122	51	121	1406	141	1420					Boomer/Chirp lines							
21-Oct	128	231	100	1424	120	1438					Boomer/Chirp lines							
21-Oct	134	51	120	1442	100	1456					Boomer/Chirp lines							
21-Oct	140	231	100	1501	120	1515					Boomer/Chirp lines							
21-Oct	161	51	-	1548	-	1600	15		55		MBES, Mag, SSS, Chirp			6.9	9.4	75	10.3	11.8
21-Oct	157	231	-	1604		1618	15		60		MBES, Mag, SSS, Chirp			6.8	5.2	75	10.5	9.8
21-Oct	153	51	-	1621	-	1633	15		60		MBES, Mag, SSS, Chirp			4.2	6.7	75	10.3	11.0
21-Oct	150	231	-	1637	-	1651	15		60		MBES, Mag, SSS, Chirp			4.9	4.4	75	9.5	8.6
21-Oct	147	51	-	1655	-	1707	15		60		MBES, Mag, SSS, Chirp			4.4	4.8	75	8.6	9.1
21-Oct	144	231	-	1720	-	1734	15		65		MBES, Mag, SSS, Chirp			4.0	4.5	75	7.6	8.1
21-Oct	141	51	-	1737	-	11750	15		55		MBES, Mag, SSS, Chirp			4.6	3.5	75	6.8	6.7
21-Oct	145	231	-	1753	-	1806	15		50		MBES, Mag, SSS, Chirp			4.7	5.3	75	7.6	8.3
21-Oct	148	51	-	1827	-	1840	10		48		MBES, Mag, SSS, Chirp			6.0	6.7	75	8.1	8.5
21-Oct	151	231	-	1843	-	1857	10		48		MBES, Mag, SSS, Chirp			7.1	5.9	75	9.1	8.6
21-Oct	154	51	-	1901	-	1913	10		48		MBES, Mag, SSS, Chirp			6.4	8.6	75	10.8	10.6
			-		-													
			-															

FIGURE A-5b

LINE SUMMARY LOG

Client: Bluewater Wind	Project No.: 3671.004	Page: 3 of 5
Surveyor: PN, MB, RD, HT	Vessel: Samantha Miller	Date: October 22, 2009
Client Rep: n/a	Location: Offshore Delaware	Devices: SBP, SSS, MAG, Chirp

Survey Date	Line No.	Heading	First Shot Point		Last Shot Point		Layback SSS		LaybackMag		Remarks	Sub Bottom Roll No.	Sub Bottom CD	Mag altitude SOL (m)	Mag altitude EOL (m)	SSS Range (m)	Side scan sonar altitude SOL (m)	Side scan sonar altitude EOL (m)
			Event No.	Time (UTC)	Event No.	Time (UTC)	Cable Out (M)	Time	Cable Out (M)	Time								
22-Oct	116	231	-	1305	-	1318	10		55		MBES, Mag, SSS, Chirp			4.0	5.5	75	9.3	9.5
22-Oct	119	51	-	1322	-	1335	10		45		MBES, Mag, SSS, Chirp			5.3	5.1	75	8.8	9.1
22-Oct	122	231	-	1338	-	1352	10		45		MBES, Mag, SSS, Chirp			4.0	4.8	75	8.3	8.6
22-Oct	125	51	-	1355	-	1407	10		45		MBES, Mag, SSS, Chirp			4.8	5.4	75	7.6	8.6
22-Oct	128	231	-	1411	-	1425	10		45		MBES, Mag, SSS, Chirp			4.0	4.1	75	8.3	8.5
22-Oct	131	51	-	1428	-	1440	10		45		MBES, Mag, SSS, Chirp			4.9	5.5	75	8.4	8.6
22-Oct	135	231	-	1444	-	1458	10		45		MBES, Mag, SSS, Chirp			3.7	5.3	75	8.1	9.5
22-Oct	138	51	-	1512	-	1525	15		45		MBES, Mag, SSS, Chirp			4.3	4.6	75	7.8	7.5
22-Oct	142	231	-	1529	-	1543	15		45		MBES, Mag, SSS, Chirp			3.5	4.8	75	7.5	8.3
22-Oct	146	51	-	1546	-	1559	15		45		MBES, Mag, SSS, Chirp			5.3	5.5	75	8.5	9
22-Oct	149	231	-	1602	-	1617	15		45		MBES, Mag, SSS, Chirp			5.7	4.6	75	8.6	7.6
22-Oct	143	51	-	1619	-	1631	15		45		MBES, Mag, SSS, Chirp			5.2	4.5	75	8	8
22-Oct	140	231	-	1633	-	1649	15		45		MBES, Mag, SSS, Chirp			3.5	4.6	75	7.3	6.7
22-Oct	136	51	-	1659	-	1711	15		45		MBES, Mag, SSS, Chirp			5.7	4.8	75	6.6	7.3
22-Oct	132	231	-	1713	-	1729	15		45		MBES, Mag, SSS, Chirp			4.1	4.3	75	6.1	6.4
22-Oct	127	51	-	1732	-	1744	15		45		MBES, Mag, SSS, Chirp			4.0	5.7	75	7.2	7.6
22-Oct	123	231	-	1746	-	1803	15		45		MBES, Mag, SSS, Chirp			3.9	4.6	75	6.5	6.5
22-Oct	117	51	-	1805	-	1819	15		45		MBES, Mag, SSS, Chirp			5.4	4.4	75	7.3	6.7
22-Oct	121	231	-	1822	-	1841	15		45		MBES, Mag, SSS, Chirp			4.1	4.6	75	6.8	5.7
22-Oct	126	51	-	1845	-	1855	15		45		MBES, Mag, SSS, Chirp			4.1	3.6	75	6.7	6.7
22-Oct			-		-													
22-Oct			-		-													
22-Oct			-		-													
22-Oct			-		-													
22-Oct			-		-													
22-Oct			-		-													
22-Oct			-		-													

FIGURE A-5c

LINE SUMMARY LOG

Client: Bluewater Wind	Project No.: 3671.004	Page: 4 of 5
Surveyor: PN, MB, RD, HT	Vessel: Samantha Miller	Date: October 30, 2009
Client Rep: n/a	Location: Offshore Delaware	Devices: SBP, SSS, MAG, Chirp

Survey Date	Line No.	Heading	First Shot Point		Last Shot Point		Layback SSS		LaybackMag		Remarks	Sub Bottom Roll No.	Sub Bottom CD	Mag altitude SOL (m)	Mag altitude EOL (m)	SSS Range (m)	Side scan sonar altitude SOL (m)	Side scan sonar altitude EOL (m)
			Event No.	Time (UTC)	Event No.	Time (UTC)	Cable Out (M)	Time	Cable Out (M)	Time								
30-Oct	101	231	-	1749	-	1801	15		20		MBES, Mag,Chirp			11.2	13.3			
30-Oct	106	51	-	1805	-	1819	15		20		MBES, Mag, SSS, Chirp			11.6	9.7	75	8.5	8.0
30-Oct	111	231	-	1823	-	1833	15		20		MBES, Mag, SSS, Chirp			10.0	11.4	75	9.1	9.8
30-Oct	104	51	-	1839	-	1853			20		MBES, Mag			12.8	10.5			
30-Oct	112	231	-	1856	-	1908	15		20		MBES, Mag, SSS, Chirp			10.5	11.5	75	8.6	9.8
30-Oct	107	51	-	1910	-	1923	15		20		MBES, Mag, SSS			11.9	9.9	75	9.0	8.8
30-Oct	102	231	-	1925	-	1936	15		20		MBES, Mag, SSS, Chirp			11.1	13.2	75	11.6	11.8
30-Oct	110	51	-	1940	-	1952	15		20		MBES, Mag, SSS			11.4	9.6	75	9.0	8.6
30-Oct	103	231	-	1955	-	2007	15		20		MBES, Mag, SSS, Chirp			11.0	12.9	75	11.8	11.8
30-Oct	113	51	-	2011	-	2023	15		20		MBES, Mag, SSS			10.5	9.7	75	9.8	8.6
30-Oct	105	231	-	2026	-	2037	15		20		MBES, Mag, SSS, Chirp			10.1	12.3	75	9.6	11.1
30-Oct	201	141	-	2046	-	2100			20		MBES, Mag			12.9	11.5			
30-Oct	204	321	-	2104	-	2114			20		MBES, Mag			11.7	12.5			

FIGURE A-5d

LINE SUMMARY LOG

Client: Bluewater Wind	Project No.: 3671.004	Page: 5 of 5
Surveyor: PN, MB, RD, HT	Vessel: Samantha Miller	Date: November 1, 2009
Client Rep: n/a	Location: Offshore Delaware	Devices: SBP, SSS, MAG, Chirp

Survey Date	Line No.	Heading	First Shot Point		Last Shot Point		Layback SSS		LaybackMag		Remarks	Sub Bottom Roll No.	Sub Bottom CD	Mag altitude SOL (m)	Mag altitude EOL (m)	SSS Range (m)	Side scan sonar altitude SOL (m)	Side scan sonar altitude EOL (m)
			Event No.	Time (UTC)	Event No.	Time (UTC)	Cable Out (M)	Time	Cable Out (M)	Time								
1-Nov	108	231	100	1335	1346	120	15		30		MBES, Mag,Chirp, SSS			10.5	12.3	75	11.1	11.4
1-Nov	114	51	120	1349	1401	100	15		30		MBES, Mag, SSS, Chirp			10.4	9.8	75	8.5	9.1
1-Nov	109	231	100	1404	1413	120	15		30		MBES, Mag, SSS, Chirp			10.7	12.4	75	11.3	11.0
1-Nov	120	51	120	1416	1429	100	15		30		MBES, Mag, SSS, Chirp			9.7	9.3	75	8.3	7.6
1-Nov	115	231	100	1431	1441	120	15		30		MBES, Mag, SSS, Chirp			10	10.9	75	8.6	9.8
1-Nov	124	51	120	1445	1457	100	15		30		MBES, Mag, SSS, Chirp			9.6	8.9	75	6.1	7.7
1-Nov	118	231	100	1501	1511	120	15		30		MBES, Mag, SSS, Chirp			9.9	10.5	75	8.8	9.6
1-Nov	126	51	120	1514	1527	100	15		30		MBES, Mag, SSS, Chirp			9.1	9	75	7.7	7.0
1-Nov	137	231	100	1530	1540	120	15		30		MBES, Mag, SSS, Chirp			10	10.1	75	9.0	9.8
1-Nov	129	51	120	1544	1558	100	15		30		MBES, Mag, SSS, Chirp			8.9	9.1	75	8.3	7.8
1-Nov	133	231	100	1600	1610	120	15		30		MBES, Mag, SSS, Chirp			9.9	10.3	75	7.2	8.4
1-Nov	139	51	120	1614	1627	100	15		30		MBES, Mag, SSS, Chirp			9.1	8.7	75	6.8	6.7
1-Nov	130	231	100	1631	1641	120	15		30		MBES, Mag, SSS, Chirp			10	10.1	75	9.1	8.6
1-Nov	134	51	120	1644	1658	100	15		30		MBES, Mag, SSS, Chirp			10	9.4	75	6.8	7.2
1-Nov	152	231	100	1702	1712	120	15		30		MBES, Mag, SSS, Chirp			12.6	11.6	75	10.6	9.7
1-Nov	160	51	120	1715	1728	100	15		30		MBES, Mag, SSS, Chirp			11.2	13.4	75	11.3	11.0
1-Nov	155	231	100	1730	1740	120	15		30		MBES, Mag, SSS, Chirp			13.4	11.3	75	10.0	10.1
1-Nov	159	51	120	1743	1755	100	15		30		MBES, Mag, SSS, Chirp			11.9	13.7	75	11.0	11.1
1-Nov	156	231	100	1758	1807	120	15		30		MBES, Mag, SSS, Chirp			14.2	12	75	10.8	10.8
1-Nov	158	51	120	1811	1824	100	15		30		MBES, Mag, SSS, Chirp			11.6	13.7	75	10.8	11.1
1-Nov	213	321	220	1821	1840	200			30		MBES, Mag			13.7	11.5			
1-Nov	111	231	100	1844	1854	120					Chirp							
1-Nov	206	141	200	1921	1931	220			30		MBES, Mag			12.2	12.5			
1-Nov	207	231	220	1934	1945	200			30		MBES, Mag			12.3	11.7			
1-Nov	208	141	200	1947	1958	220			30		MBES, Mag			12.2	13.1			
1-Nov	210	231	220	2002		200			30		MBES, Mag			13.5	11.5			
1-Nov	138	51		2024					30		Mag			9.4	8.1			

FIGURE A-5e

FALL 2010 LINE SUMMARY LOG

Client: Bluewater Wind	Project No.: 3671.004	Page: 1 of 7
Surveyor: Kmorris	Vessel: R/V Chinook	Date: October 11, 2010 (JD284)
Client Rep: n/a	Location: Offshore Delaware	Devices: SSS, MAG

Survey Date	Line No.	Heading	First Shot Point		Last Shot Point		Layback (SSS)		Layback (Mag)		Remarks	SOL		EOL		
			Event No.	Time (UTC)	Event No.	Time (UTC)	Cable Out (M)	Time	Cable Out (M)	Time		Mag Altitude	SSS Altitude	Mag Altitude	SSS Altitude	SSS Rng.
11-Oct-10	[500].513	51	21	16:10:43	1	16:21:10	25m	SOL	25m	EOL	Reshoot Mag data not valid	**5.5**	**8.5**	**6**	**9**	**75m**
11-Oct-10	[500].504	231	1	16:26:14	21	16:41:19	25m	SOL	25m	EOL	Reshoot Mag data not valid	**5.1**	**8.1**	**4.7**	**7.7**	**75m**
11-Oct-10	[500].508	51	21	16:46:01	1	16:59:22	30m	SOL	30m	EOL	Reshoot Mag data not valid	**4.8**	**7.8**	**5.3**	**8.3**	**75m**
11-Oct-10	[500].512	231	1	17:01:59	21	17:14:27	33m	SOL	33m	EOL	Reshoot Mag data not valid	**5.5**	**8.5**	**4.8**	**7.8**	**75m**
11-Oct-10	[500].507	51	21	17:17:58	1	17:31:02	33m	SOL	33m	EOL	Reshoot Mag data not valid	**4.5**	**7.5**	**5.9**	**8.9**	**75m**
11-Oct-10	[500].503	231	1	17:33:59	21	17:47:36	33m	SOL	33m	EOL	Reshoot Mag data not valid	**5.8**	**8.8**	**4.5**	**7.5**	**75m**
11-Oct-10	[500].509	51	21	17:52:26	1	18:06:29	33m	SOL	33m	EOL	Reshoot Mag data not valid	**4.7**	**7.7**	**6**	**9**	**75m**
11-Oct-10	[500].501	231	1	18:09:37	21	18:24:19	33m	SOL	33m	EOL	Reshoot Mag data not valid	**5.9**	**8.9**	**5**	**8**	**75m**
11-Oct-10	[500].505	51	21	18:28:11	1	18:35:59	33m	SOL	33m	EOL	Reshoot Mag data not valid	**5**	**8**	**6**	**9**	**75m**
11-Oct-10	[500].1505	231	1	18:43:30	21	18:58:24	33m	SOL	33m	EOL	Reshoot Mag data not valid	**5.6**	**8.6**	**4.7**	**7.7**	**75m**
11-Oct-10	[500].502	51	21	19:07:07	1	19:19:45	33m	SOL	33m	EOL	Reshoot Mag data not valid	**4.8**	**7.8**	**6**	**9**	**75m**
11-Oct-10	[500].510	231	1	19:24:30	21	19:38:39	33m	SOL	33m	EOL	Reshoot Mag data not valid	**5.9**	**8.9**	**4.5**	**7.5**	**75m**
11-Oct-10	[500].506	51	21	19:40:04	1	19:53:15	33m	SOL	33m	EOL	Reshoot Mag data not valid	**4.5**	**7.5**	**6**	**9**	**75m**
11-Oct-10	[500].511	231	1	19:55:40	21	20:09:19	33m	SOL	33m	EOL	Reshoot Mag data not valid	**6**	**9**	**5.6**	**8.6**	**75m**
11-Oct-10	[500].517	51	21	21:42:05	1	21:58:00	33m	SOL	33m	EOL	Reshoot Mag data not valid	**5.5**	**8.5**	**5.9**	**8.9**	**75m**

FIGURE A-5f

FALL 2010 LINE SUMMARY LOG

Client: Bluewater Wind	Project No.: 3671.004	Page: 2 of 7
Surveyor: Kmorris	Vessel: R/V Chinook	Date: October 12, 2010 (JD285)
Client Rep: n/a	Location: Offshore Delaware	Devices: SSS, MAG

Survey Date	Line No.	Heading	First Shot Point		Last Shot Point		Layback (SSS)		Layback (Mag)		Remarks	SOL		EOL		
			Event No.	Time (UTC)	Event No.	Time (UTC)	Cable Out (M)	Time	Cable Out (M)	Time		Mag Altitude	SSS Altitude	Mag Altitude	SSS Altitude	SSS Rng.
12-Oct-10	[500].513	231	21	20:42:15	1	20:58:04	27m	SOL	27m	EOL	Abort Mag Data ? Weather	**6**	**9**	**5**	**9**	**75m**
12-Oct-10	[500].518	51	1	21:01:04	21	21:14:08	27m	SOL	27m	EOL	Abort Mag Data ? Weather	**5.5**	**9**	**6**	**9**	**75m**

FIGURE A-5g

FALL 2010 LINE SUMMARY LOG

Client: Bluewater Wind	Project No.: 3671.004	Page: 3 of 7
Surveyor: Kmorris	Vessel: R/V Chinook	Date: October 14, 2010 (JD287)
Client Rep: n/a	Location: Offshore Delaware	Devices: SSS, MAG

Survey Date	Line No.	Heading	First Shot Point		Last Shot Point		Layback SSS		LaybackMag		Remarks	SOL		EOL		
			Eve nt	Time (UTC)	Event No.	Time (UTC)	Cable Out (M)	Time	Cable Out (M)	Time		Mag Altitude	SSS Altitude	Mag Altitude	SSS Altitude	SSS Rng.
14-Oct-10	[500].506	51	1	12:27:41	21	12:41:17	27m	SOL	27m	EOL		**5**	**7**	**6.3**	**8.42**	**75m**
14-Oct-10	[500].500	231	21	12:43:16	1	12:55:31	27m	SOL	27m	EOL		**6.2**	**8.2**	**5.4**	**7.52**	**75m**
14-Oct-10	[500].507	51	1	12:58:15	21	13:11:59	27m	SOL	27m	EOL		**4.8**	**6.8**	**6**	**8.12**	**75m**
14-Oct-10	[500].501	231	21	13:15:22	1	13:27:37	32m	SOL	32m	EOL		**5.8**	**7.8**	**4.5**	**6.62**	**75m**
14-Oct-10	[500].508	51	1	13:30:49	21	13:43:38	32m	SOL	32m	EOL		**5.4**	**7.4**	**6.3**	**8.42**	**75m**
14-Oct-10	[500].502	231	21	13:46:06	1	13:57:20	32m	SOL	32m	EOL	Weather Stand Down	**6.2**	**8.2**	**6**	**8.12**	**75m**
			-													

FIGURE A-5h

FALL 2010 LINE SUMMARY LOG

Client: Bluewater Wind	Project No.: 3671.004	Page: 5 of 7
Surveyor: Kmorris	Vessel: R/V Chinook	Date: October 20, 2010 (JD293)
Client Rep: n/a	Location: Offshore Delaware	Devices: SSS, MAG

Survey Date	Line No.	Heading	First Shot Point Event No.	First Shot Point Time (UTC)	Last Shot Point Event No.	Last Shot Point Time (UTC)	Layback SSS Cable Out (M)	Layback SSS Time	LaybackMag Cable Out (M)	LaybackMag Time	Remarks	SOL Mag Altitude	SOL SSS Altitude	EOL Mag Altitude	EOL SSS Altitude	SSS Rng.
20-Oct-10	[500].529	51	1	18:30:30	21	18:42:15	18m	SOL	18m	EOL		**5.3**	**6.7**	**4.5**	**6.0**	**75m**
20-Oct-10	[500].536	231	21	18:44:57	1	18:54:57	18m	SOL	18m	EOL		**4.9**	**6.3**	**5.3**	**6.8**	**75m**
20-Oct-10	[500].530	51	1	18:57:19	21	19:09:19	18m	SOL	18m	EOL		**5.1**	**6.5**	**4.6**	**6.1**	**75m**
20-Oct-10	[500].537	231	21	19:11:04	1	19:20:50	18m	SOL	18m	EOL		**5.1**	**6.5**	**5.4**	**6.9**	**75m**
20-Oct-10	[500].531	51	1	19:23:55	21	19:36:19	18m	SOL	18m	EOL		**5.1**	**6.5**	**4.7**	**6.2**	**75m**
20-Oct-10	[500].538	231	21	19:38:07	1	19:47:44	18m	SOL	18m	EOL		**5.5**	**6.9**	**5.7**	**7.2**	**75m**
20-Oct-10	[500].545	51	1	19:52:53	21	20:05:01	18m	SOL	18m	EOL		**6**	**7.4**	**5**	**6.5**	**75m**
20-Oct-10	[500].539	231	21	20:07:00	1	20:17:19	18m	SOL	18m	EOL		**5.5**	**6.9**	**5.7**	**7.2**	**75m**
20-Oct-10	[500].546	51	1	20:22:53	21	20:35:43	18m	SOL	18m	EOL		**6.1**	**7.5**	**5**	**6.5**	**75m**
20-Oct-10	[500].540	231	21	20:39:33	1	20:49:58	18m	SOL	18m	EOL		**5.4**	**6.8**	**5.5**	**7.0**	**75m**
20-Oct-10	[500].547	51	1	20:52:38	21	21:05:29	18m	SOL	18m	EOL		**6**	**7.4**	**5.1**	**6.6**	**75m**
20-Oct-10	[500].541	231	21	21:08:04	1	21:18:50	18m	SOL	18m	EOL		**5.3**	**6.7**	**5.9**	**7.4**	**75m**
20-Oct-10	[500].548	51	1	21:21:39	19	21:32:47	18m	SOL	18m	EOL	Abort Off line	**5.9**	**7.3**	**5.6**	**7.1**	**75m**
20-Oct-10	[500].542	231	21	21:40:03	1	21:51:03	18m	SOL	18m	EOL		**5.3**	**6.7**	**6.2**	**7.7**	**75m**
20-Oct-10	[500].1548	51	1	21:53:19	21	22:05:46	18m	SOL	18m	EOL		**6**	**7.4**	**4.9**	**6.4**	**75m**
20-Oct-10	[500].543	231	21	22:08:28	17	22:10:57	18m	SOL	18m	EOL	Abort off line	**5.6**	**7.0**	**5.5**	**7.0**	**75m**
20-Oct-10	[500].1543	231	21	22:13:09	14	22:17:18	18m	SOL	18m	EOL	Abort Line	**5.6**	**7.0**	**5.3**	**6.8**	**75m**

FIGURE A-5i

FALL 2010 LINE SUMMARY LOG

Client: Bluewater Wind	Project No.: 3671.004	Page: 4 of 7
Surveyor: Kmorris	Vessel: R/V Chinook	Date: October 20, 2010 (JD293)
Client Rep: n/a	Location: Offshore Delaware	Devices: SSS, MAG

Survey Date	Line No.	Heading	First Shot Point		Last Shot Point		Layback SSS		LaybackMag		Remarks	SOL		EOL		
			Event No.	Time (UTC)	Event No.	Time (UTC)	Cable Out (M)	Time	Cable Out (M)	Time		Mag Altitude	SSS Altitude	Mag Altitude	SSS Altitude	SSS Rng.
20-Oct-10	[500].503	51	1	12:20:42	21	12:32:15	25m	SOL	25m	EOL	Abort SSS no Navigation	5.2	6.78	5	6.68	75m
20-Oct-10	[500].509	231	21	12:34:47	1	12:46:17	27m	SOL	27m	EOL		5.2	6.78	3.2	4.88	75m
20-Oct-10	[500].1503	51	1	12:48:54	21	13:00:25	27m	SOL	27m	EOL	Line 503 reshoot	4	5.58	5.6	7.28	75m
20-Oct-10	[500].510	231	21	13:04:48	1	13:16:43	27m	SOL	27m	EOL		4.6	6.18	3.1	4.78	75m
20-Oct-10	[500].504	51	1	13:19:44	21	13:31:26	27m	SOL	27m	EOL		3.4	4.98	5.2	6.88	75m
20-Oct-10	[500].511	231	21	13:34:04	1	13:46:08	27m	SOL	27m	EOL		4.1	5.68	2.8	4.48	75m
20-Oct-10	[500].505	51	1	13:48:28	21	14:00:10	27m	SOL	27m	EOL		3.2	4.78	5	6.68	75m
20-Oct-10	[500].512	231	21	14:02:38	1	14:14:57	27m	SOL	27m	EOL		3	4.58	2.3	3.98	75m
20-Oct-10	[500].517	51	1	14:16:58	21	14:26:38	27m	SOL	27m	EOL		4	5.58	2.7	4.38	75m
20-Oct-10	[500].514	231	21	14:28:52	1	14:40:00	20m	SOL	20m	EOL		4.3	5.88	3.9	5.58	75m
20-Oct-10	[500].521	51	21	14:42:57	41	14:54:10	18m	SOL	18m	EOL		3.7	5.28	3.6	5.28	75m
20-Oct-10	[500].515	231	21	14:57:06	1	15:07:43	18m	SOL	18m	EOL		5.1	6.68	4.7	6.38	75m
20-Oct-10	[500].522	51	21	14:57:06	1	15:11:08	20m	SOL	20m	EOL	Abort No Nav	3	4.58	4	5.68	75m
20-Oct-10	[500].522	51	1	15:15:10	21	15:26:02	20m	SOL	20m	EOL		3.9	5.48	3	4.68	75m
20-Oct-10	[500].516	231	22	15:28:15	2	15:38:46	20m	SOL	20m	EOL		4.2	5.78	4.6	6.28	75m
20-Oct-10	[500].523	51	1	15:41:58	21	15:52:59	20m	SOL	20m	EOL		3.8	5.38	3	4.68	75m
20-Oct-10	[500].519	231	21	15:55:58	1	16:06:36	20m	SOL	20m	EOL		3.3	4.88	4.4	6.08	75m
20-Oct-10	[500].524	51	1	16:09:35	21	16:20:57	20m	SOL	20m	EOL		3.7	5.28	4.1	5.78	75m
20-Oct-10	[500].520	231	21	16:22:55	1	16:33:28	18m	SOL	18m	EOL		4.5	6.08	5.8	7.48	75m
20-Oct-10	[500].525	51	1	16:36:04	21	16:47:22	18m	SOL	18m	EOL		5	6.58	4.3	5.98	75m
20-Oct-10	[500].532	231	21	16:49:56	1	17:00:11	18m	SOL	18m	EOL		4.8	6.38	5.1	6.78	75m
20-Oct-10	[500].526	51	1	17:02:30	21	17:13:58	18m	SOL	18m	EOL		5.1	6.68	4.3	5.98	75m
20-Oct-10	[500].533	231	21	17:20:40	1	17:30:55	18m	SOL	18m	EOL		4.8	6.38	5.2	6.88	75m
20-Oct-10	[500].527	51	-1	17:35:41	-21	17:47:14	18m	SOL	18m	EOL		5.2	6.78	4.5	6.18	75m
20-Oct-10	[500].534	231	21	17:49:46	-1	18:00:21	18m	SOL	18m	EOL		4.8	6.38	5.6	7.28	75m
20-Oct-10	[500].528	51	1	18:03:43	21	18:15:17	18m	SOL	18m	EOL		5.1	6.68	4.6	6.28	75m
20-Oct-10	[500].535	231	21	18:17:44	1	18:27:44	18m	SOL	18m	EOL		5	6.58	5.1	6.78	75m

FIGURE A-5j

FALL 2010 LINE SUMMARY LOG

Client: Bluewater Wind	Project No.: 3671.004	Page: 6 of 7
Surveyor: PN, HT, RD	Vessel: Samantha Miller	Date: October 22, 2009 (JD296)
Client Rep: n/a	Location: Offshore Delaware	Devices: SSS, MAG

Survey Date	Line No.	Heading	First Shot Point		Last Shot Point		Layback SSS		LaybackMag		Remarks	SOL		EOL		
			Event No.	Time (UTC)	Eve nt	Time (UTC)	Cable Out (M)	Time	Cable Out (M)	Time		Mag Altitude	SSS Altitude	Mag Altitude	SSS Altitude	SSS Rng.
23-Oct-10	[500].1543	231	21	11:54:44	1	12:10:12	27m	SOL	27m	EOL		**3.6**	**5.35**	**4.3**	**6.05**	**75m**
23-Oct-10	[500].549	51	1	12:12:52	21	12:23:50	25m	SOL	25m	EOL		**6.1**	**7.85**	**5.1**	**6.85**	**75m**
23-Oct-10	[500].555	231	21	12:27:05	1	12:41:32	25m	SOL	25m	EOL	Weather increasing	**4.4**	**6.15**	**6.2**	**7.95**	**75m**
23-Oct-10	[500].550	51	1	12:43:21	21	12:54:07	25m	SOL	25m	EOL		**6.1**	**7.85**	**4.3**	**6.05**	**75m**
23-Oct-10	[500].556	231	21	12:58:01	1	13:13:04	25m	SOL	25m	EOL		**4.4**	**6.15**	**5.7**	**7.45**	**75m**
23-Oct-10	[500].551	51	1	13:16:22	1	13:16:22	25m	SOL	25m	EOL	Abort	**6.2**	**7.95**	**4.2**	**5.95**	**75m**
23-Oct-10	[500].557	231	21	13:30:05	1	13:45:07	25m	SOL	25m	EOL		**4.6**	**6.35**	**5.7**	**7.45**	**75m**
23-Oct-10	[500].551	51	1	13:48:03	21	13:58:48	25m	SOL	25m	EOL		**6.2**	**7.95**	**4.3**	**6.05**	**75m**
23-Oct-10	[500].558	231	1	13:48:03	22	14:02:36	25m	SOL	25m	EOL	Abort	**3**	**4.75**	**4**	**5.75**	**75m**
23-Oct-10	[500].558	231	23	14:07:17	1	14:24:13	25m	SOL	25m	EOL		**3**	**4.75**	**4**	**5.75**	**75m**
23-Oct-10	[500].552	51	1	14:27:37	21	14:38:18	25m	SOL	25m	EOL		**6**	**7.75**	**4.2**	**5.95**	**75m**

FIGURE A-5k

FALL 2010 LINE SUMMARY LOG

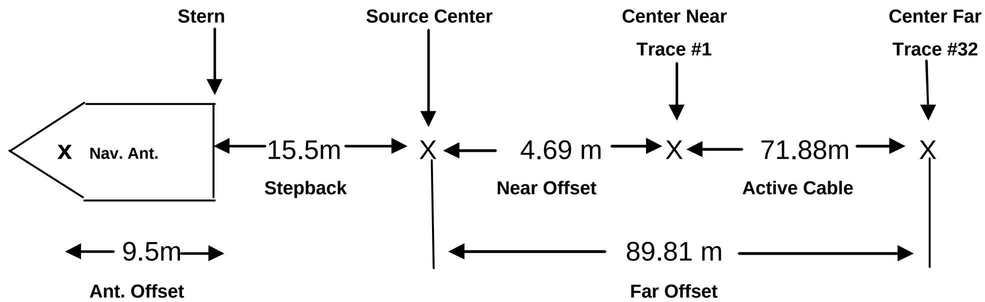
Client: Bluewater Wind	Project No.: 3671.004	Page: 7 of 7
Surveyor: Kmorris	Vessel: R/V Chinook	Date: October 22, 2009 (JD307)
Client Rep: n/a	Location: Offshore Delaware	Devices: SSS, MAG

Survey Date	Line No.	Heading	First Shot Point		Last Shot Point		Layback SSS		LaybackMag		Remarks	SOL		EOL		
			Event No.	Time (UTC)	Event No.	Time (UTC)	Cable Out (M)	Time	Cable Out (M)	Time		Mag Altitude	SSS Altitude	Mag Altitude	SSS Altitude	SSS Rng.
3 Nov 201(	[600].602	321	600	12:11:06	620	12:23:21	22m	SOL	22m	EOL		**4.6**	**6.19**	**5.8**	**7.9**	**75m**
3 Nov 201(	[500].544	231	21	12:28:26	1	12:40:21	22m	SOL	22m	EOL		**3.7**	**5.29**	**4.3**	**6.4**	**75m**
3 Nov 201(	[500].553	51	1	12:43:28	21	12:54:59	22m	SOL	22m	EOL		**6.2**	**7.79**	**4.2**	**6.3**	**75m**
3 Nov 201(	[500].560	231	21	12:58:22	1	13:10:03	22m	SOL	22m	EOL		**4.9**	**6.49**	**6.9**	**9**	**75m**
3 Nov 201(	[500].554	51	1	13:12:24	21	13:23:40	22m	SOL	22m	EOL		**5.9**	**7.49**	**4.3**	**6.4**	**75m**
3 Nov 201(	[500].559	231	22	13:26:10	42	13:38:02	22m	SOL	22m	EOL		**4.9**	**6.49**	**6**	**8.1**	**75m**
3 Nov 201(	[600].600	141	620	13:43:59	600	13:54:23	22m	SOL	22m	EOL		**4.8**	**6.39**	**6**	**8.1**	**75m**
3 Nov 201(	[600].601	321	600	14:00:46	620	14:14:40	22m	SOL	22m	EOL		**5.1**	**6.69**	**5**	**7.1**	**75m**
3 Nov 201(	[600].601	141	620	14:17:24	613	14:21:08	22m	SOL	22m	EOL	Mag Fill	**4.6**	**6.19**	**2.6**	**4.7**	**75m**
3 Nov 201(	[700].701	141.1	1	14:25:25	16	14:27:19	22m	SOL	22m	EOL	No SSS Mag Only	**3.4**	**4.99**	**3.4**	**5.5**	**75m**
3 Nov 201(	[700].703	321.1	15	14:29:23	-1	14:31:59	22m	SOL	22m	EOL	No SSS Mag Only	**3.7**	**5.29**	**3.9**	**6**	**75m**
3 Nov 201(	[700].706	141.1	1	14:33:24	19	14:35:45	22m	SOL	22m	EOL	No SSS Mag Only	**3**	**4.59**	**3.8**	**5.9**	**75m**
3 Nov 201(	[700].702	321.1	17	14:38:11	-2	14:41:18	22m	SOL	22m	EOL	No SSS Mag Only	**3.9**	**5.49**	**3.2**	**5.3**	**75m**
3 Nov 201(	[700].705	141.1	1	14:42:55	17	14:45:01	22m	SOL	22m	EOL	No SSS Mag Only	**3**	**4.59**	**3.2**	**5.3**	**75m**
3 Nov 201(	[700].704	321.1	15	14:47:53	-1	14:50:30	22m	SOL	22m	EOL	No SSS Mag Only	**3.5**	**5.09**	**2.9**	**5**	**75m**
3 Nov 201(	[800].801	231.3	1	14:58:33	12	15:00:12	22m	SOL	22m	EOL	No SSS Mag Only	**2.4**	**3.99**	**2.3**	**4.4**	**75m**
3 Nov 201(	[800].802	51.3	12	15:01:51	2	15:03:20	22m	SOL	22m	EOL	No SSS Mag Only	**2.6**	**4.19**	**2.2**	**4.3**	**75m**

FIGURE A-5I

FIELD LOG / OBSERVERS REPORT

Vessel: M/V Samantha Miller



Client	Date
BWW	11 Oct, 2009

Area and / or Block: MMS Block 6325

Line number: see below

Operator / Observer: Barth

Line Direction: see below

Instrumentation

Source type	Source power	Preamp gain	Number of	Plates	Source depth	Streamer Depth
Boomer	600j	18 db		2	0.3 m	0.3m

	Sample Int.	Record Length	No. of channels
Primary	0.25 ms.	500 ms.	32
Secondary	ms.	ms.	See group layouts

Filter Low	Slope	Filter High	Slope	60 HZ Notch	Other
Out		Out		Out	

Recording Instruments	Type	Format	Tape Drives
	Geo-Eel	SEG Y(IBM)	Hard Disk/ USB Disk

Navigation System	Primary	Secondary
	Starfix-DGPS	

Boat speed	Navigation fix interval
~4.5 Knots	100m

Near Group Layout

Near TR No.	Near offset
1	4.690 m.
Far TR No.	**Far offset**
8	15.63 m.
Group Interval.	**Shooting Interval**
1.5625 m	1.56 m.

Far Group Layout

Near TR No.	Near offset
9	17.94 m.
Far TR No.	**Far offset**
32	89.81 m.
Group Interval.	**Shooting Interval**
3.125 m	1.56 m.

File Name	** S.P. (fix) Number	File Number	Speed Rep Rate	Cable depth Meters	Remarks (Changes in weather, sea state, operator, record delays, problems, etc.)
					0530 Hrs: Underway from dock at Cape May Harbor
					0755 Hrs: Deploy gear, seas 1-2 ft, wind SE@ 5 kt
					0845 Hrs: Gear deployed
17240.sgy	100	101	4.4/0.7		SOL 101 0921 HRS HDG 231
17240.sgy	120	1117	4.4/0.7		EOL 101 0933 HRS
107.sgy	119	107	3.3/0.88		SOL 107 0953 HRS HDG 051
107.sgy	99	1438	3.3/0.88		EOL 107 1012 HRS
113.sgy	100	113	4.4/0.7		SOL 113 1019 HRS HDG 251
113.sgy	120	1371	4.4/0.7		EOL 113 1124 HRS
119.sgy	119	119	3.3/0.88		SOL 119 1041 HRS HDG 051
119.sgy	99	1397	3.3/0.88		EOL 119 1101 HRS
125.sgy	100	125	4.4/0.7		SOL 125 1109 HRS HDG 251
125.sgy	120	1397	4.4/0.7		EOL 125 1124 HRS
131.sgy	119	131	3.3/0.88		SOL 131 1130 HRS HDG 051
131.sgy	99	1468	3.3/0.88		EOL 131 1150 HRS
137.sgy	100	137	4.3/0.72		SOL 137 1156 HRS HDG 251
137.sgy	120	1392	4.3/0.72		EOL 137 1212 HRS
143.sgy	119	143	3.2/0.92		SOL 143 1219 HRS HDG 051
143.sgy	99	1423	3.2/0.92		EOL 143 1239 HRS
					Continued on Page 2

FIGURE A-6a

Fugro Atlantic

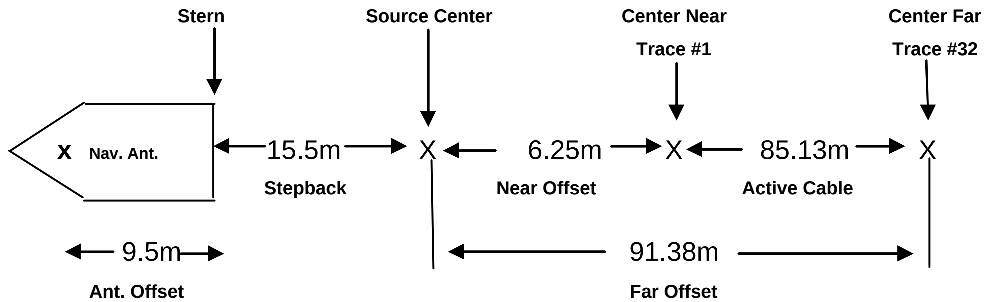
FIELD LOG / OBSERVERS REPORT

Client	Date	Area and / or Block	Operator / Observer	Line number	Line Direction
BWW	11 Oct 09	MMS Block 6325	Barth	see below	see below

File Name	** S.P. (fix) Number	File Number	Speed Rep Rate	Cable depth Meters	Remarks (Changes in weather, sea state, operator, record delays, problems, etc.)
149.sgy	100	149	4.5/0.68		SOL 149 1243 HRS HDG 251
149.sgy	120	1367	4.5/0.68		EOL 149 1258 HRS
155.sgy	119	155	3.3/0.92		SOL 155 1304 HRS HDG 051
155.sgy		419	3.3/0.92		End 155.sgy
420.sgy		420	3.3/0.92		Start 420.sgy
420.sgy		667	3.3/0.92		End 420.sgy
668.sgy		668	3.3/0.92		Start 668.sgy
155.sgy	99	1427	3.3/0.92		EOL 155 1323 HRS
161.sgy	100	161	3.3/0.92		SOL 161 1328 HRS HDG 251
161.sgy	120		3.3/0.92		EOL 161 1341 HRS
					Note: Line 161 shot at incorrect speed (too slow)
158.sgy	119	158	3.5/0.88		SOL 158 1347 HRS HDG 051
158.sgy	99	1468	3.5/0.88		EOL 158 1406 HRS
152.sgy	100	152	4.4/0.70		SOL 152 1411 HRS HDG 251
152.sgy	120	1376	4.4/0.70		EOL 152 1426 HRS
146.sgy	119	146	3.6/0.85		SOL 146 1432 HRS HDG 051
146.sgy	99	1523	3.6/0.85		EOL 146 1451 HRS
					1455 Hrs: Retrieve gear
					1510 Hrs: Gear aboard
					1525 Hrs: Underway to Cape May
					1725 Hrs: Arrive at Cape May; secure for day

FIELD LOG / OBSERVERS REPORT

Vessel: M/V Samantha Miller



Client	BWW
Date	20 Oct, 2009
Area and / or Block	MMS Block 6325
Line number	see below
Operator / Observer	Barth
Line Direction	see below

Instrumentation

Source type	Source power	Preamp gain	Number of	Plates	Source depth	Streamer Depth
Boomer	800j	18 db		2	0.3 m	0.3m

	Sample Int.	Record Length	No. of channels
Primary	0.25 ms.	500 ms.	32
Secondary	ms.	ms.	See group layouts

Filter		Filter		60 HZ Notch	Other
Low	Slope	High	Slope		
Out		Out		Out	

	Type	Format	Tape Drives
Recording Instruments	Geo-Eel	SEG Y(IBM)	Hard Disk/ USB Disk

	Primary	Secondary
Navigation System	Starfix-DGPS	

Boat speed	Navigation fix interval
~4.5 Knots	100m

Near Group Layout

Near TR No.	Near offset	Far TR No.	Far offset	Group Interval.	Shooting Interval
1	6.250 m.	8	17.19 m.	1.5625 m	1.56 m.

Far Group Layout

Near TR No.	Near offset	Far TR No.	Far offset	Group Interval.	Shooting Interval
9	18.69 m.	32	91.38 m.	3.125 m	1.56 m.

File Name	** S.P. (fix) Number	File Number	Speed Rep Rate	Cable depth Meters	Remarks (Changes in weather, sea state, operator, record delays, problems, etc.)
					0600Hrs: Underway from dock at Cape May Harbor
					0820 Hrs: Deploy gear, seas 2-3 ft, wind SW @ 10-15 kt
					0845 Hrs: Gear deployed
					Note: Change of Offsets/Power since 11 October
213.sgy	200	213	4.2/0.73		SOL 213 0943 HRS HDG 141
213.sgy	220	1465	4.2/0.73		EOL 213 0959 HRS
212.sgy	220	212	4.6/0.68		SOL 212 1005 HRS HDG 321
212.sgy	200	1497	4.6/0.68		EOL 212 1019 HRS
211.sgy	200	211	4.1/0.76		SOL 211 1026 HRS HDG 141
211.sgy	220	1481	4.1/0.76		EOL 211 1042 HRS
210.sgy	220	210	4.4/0.70		SOL 210 1048 HRS HDG 321
210.sgy	200	1489	4.4/0.70		EOL 210 1102 HRS
209.sgy	200	209	4.2/0.73		SOL 209 1108 HRS HDG 141
209.sgy	220	1457	4.2/0.73		EOL 209 1122 HRS
208.sgy	220	208	4.2/0.74		SOL 208 1128 HRS HDG 321
208.sgy	200	1518	4.2/0.74		EOL 208 1144 HRS
207.sgy	200	207	4.2/0.73		SOL 207 1151 HRS HDG 141
207.sgy	220	1410	4.2/0.73		EOL 207 1206 HRS
206.sgy	220	206	3.9/0.78		SOL 206 1212 HRS HDG 321
206.sgy	200	1514	3.9/0.78		EOL 206 1229 HRS
					Continued on Page 2

FIGURE A-6c

FIELD LOG / OBSERVERS REPORT

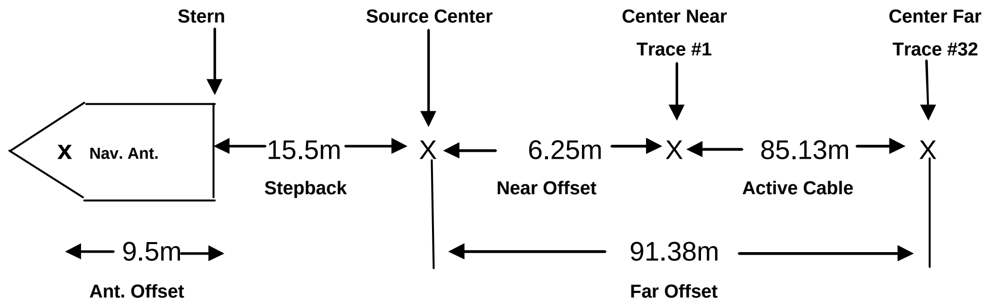
Client	Date	Area and / or Block	Operator / Observer	Line number	Line Direction
BWW	20 Oct 09	MMS Block 6325	Barth	see below	see below

File Name	** S.P. (fix) Number	File Number	Speed Rep Rate	Cable depth Meters	Remarks (Changes in weather, sea state, operator, record delays, problems, etc.)
205.sgy	200	205	4.4/0.70		SOL 205 1232 HRS HDG 141
205.sgy	180	1375	4.4/0.70		EOL 205 1247 HRS
					Speed @ EOL = 4.8 kt
204.sgy	220	204	3.7/0.82		SOL 204 1252 HRS HDG 321
204.sgy	200	1504	3.7/0.82		EOL 204 1310 HRS
203.sgy	200	203	4.8/0.65		SOL 203 1314 HRS HDG 141
203.sgy	220	1407	4.8/0.65		EOL 203 1327 HRS
202.sgy	220	202	3.5/0.87		SOL 202 1333 HRS HDG 321
202.sgy	200	1481	3.5/0.87		EOL 202 1351 HRS
101.sgy	120	101	4.6/0.67		SOL 101A 1400 HRS HDG 051
101.sgy	100	1302	4.6/0.67		EOL 101A 1414 HRS
104.sgy	100	104	3.4/0.89		SOL 104 1420 HRS HDG 231
104.sgy	120	1324	3.4/0.89		EOL 104 1438 HRS
201.sgy	200	201	4.2/0.74		SOL 201 1500 HRS HDG 141
201.sgy	220	1309	4.2/0.74		EOL 201 1515 HRS
					1516 Hrs: Retrieve Gear
					1538 Hrs: Equipment aboard
					1800 Hrs: Arrive at Dock, Cape May

FIELD LOG / OBSERVERS REPORT

Page 1

Vessel: M/V Samantha Miller



Client	BWW
Date	21 Oct, 2009
Area and / or Block	MMS Block 6325
Line number	see below
Operator / Observer	Barth
Line Direction	see below

Instrumentation

Source type	Source power	Preamp gain	Number of	Plates	Source depth	Streamer Depth
Boomer	800j	18 db		2	0.3 m	0.3m

	Sample Int.	Record Length	No. of channels
Primary	0.25 ms.	500 ms.	32
Secondary	ms.	ms.	See group layouts

Filter Low	Slope	Filter High	Slope	60 HZ Notch	Other
Out		Out		Out	

	Type	Format	Tape Drives
Recording Instruments	Geo-Eel	SEG Y(IBM)	Hard Disk/ USB Disk

	Primary	Secondary
Navigation System	Starfix-DGPS	

Boat speed	Navigation fix interval
~4.5 Knots	100m

Near Group Layout

Near TR No.	Near offset
1	6.250 m.
Far TR No.	**Far offset**
8	17.19 m.
Group Interval.	**Shooting Interval**
1.5625 m	1.56 m.

Far Group Layout

Near TR No.	Near offset
9	18.69 m.
Far TR No.	**Far offset**
32	91.38 m.
Group Interval.	**Shooting Interval**
3.125 m	1.56 m.

File Name	** S.P. (fix) Number	File Number	Speed Rep Rate	Cable depth Meters	Remarks (Changes in weather, sea state, operator, record delays, problems, etc.)
					0600Hrs: Underway from dock at Cape May Harbor
					0822 Hrs: Deploy gear, seas 2-3 ft, wind W @ 5 kt
					0842 Hrs: Gear deployed
					Note: Change of Offsets/Power since 11 October
110.sgy	120	110	4.2/0.73		SOL 110 0928 HRS HDG 051
110.sgy	100	1263	4.2/0.73		EOL 110 0942 HRS
116.sgy	100	116	4.2/0.73		SOL 116 0948 HRS HDG 231
116.sgy	120	1260	4.2/0.73		EOL 116 1001 HRS
122.sgy	120	122	4.4/0.70		SOL 122 1006 HRS HDG 051
122.sgy	100	1301	4.4/0.70		EOL 122 1020 HRS
128.sgy	100	128	4.5/0.69		SOL 128 1025 HRS HDG 231
128.sgy	120	1329	4.5/0.69		EOL 128 1038 HRS
134.sgy	120	134	4.6/0.67		SOL 134 1043 HRS HDG 051
134.sgy	100	1339	4.6/0.67		EOL 134 1056 HRS
140.sgy	100	140	4.4/0.70		SOL 140 1102 HRS HDG 231
140.sgy	120	1347	4.4/0.70		EOL 140 1115 HRS
					1116 Hrs: End Boomer Survey; Retrieve Gear
					Start Multibeam/Sidescan/Mag survey

FIGURE A-6e

Fugro Atlantic

APPENDIX B
GEOPHYSICAL MAPPING PROCEDURES

APPENDIX B - GEOPHYSICAL MAPPING PROCEDURES

CONTENTS

ILLUSTRATIONS

GEOPHYSICAL MAPPING PROCEDURES

INTRODUCTION

This appendix provides background information on the data analysis techniques and mapping procedures used in producing figures accompanying this report. The charts and data examples presented in this report reflect the interpretation of two-dimensional (2D) high-resolution seismic and bottom-charting data acquired for this project. Identification of all geologic features and stratigraphic variations is limited by the resolution of the available data.

DATA SETS

2D Seismic Data

The 2D seismic data were loaded onto a PC-based Seismic Micro-Technology (SMT) workstation where it was interpreted using the SMT Kingdom Suite 2D/3D Pak software module. The seismic data used for this study contains 0.25-millisecond sample rate data between 0.000 and 0.250 seconds two-way travel time (TWT), and 0.000 and 0.500 seconds TWT below sea surface (BSS) for the 1.56-meter group interval (mgi) and 3.125-mgi streamers, respectively.

The seismic wavelet follows the North American polarity convention and exhibits zero-phase characteristics based on analysis of the seafloor reflector and impedance contrasts at Halcrow/HPA boring location B-102. The frequency content of the 2D seismic data was assessed by analyzing acoustic frequency spectra generated using the TracePak module of the SMT Kingdom Suite software package (Figures B-1a and B-1b). The spectra are generated for specified TWT time ranges within areas specified by primary and crossline ranges. Within the TWT window analyzed, the spectral analysis determines the frequency bandwidth of the specified data subset for acoustic frequencies between 0 hertz (Hz) and the Nyquist Frequency. The frequency spectra of the seismic data were analyzed between 0.0 and 0.150 seconds TWT for the 1.56-mgi streamer and 0.0 and 0.480 seconds TWT for the 3.125-mgi streamer.

The dominant frequency range in the shallow section is approximately 143 Hz for the 1.56-mgi streamer, and between 88 Hz to 215 Hz for the 3.125-mgi streamer. The dominant frequency can be used to calculate the characteristic "limit of separability" for the seismic data volume. The limit of separability, which is a function of vertical resolution, is defined as the minimum bed thickness for which the top and bottom of the bed can be fully resolved in the seismic data, and is based on the one-quarter acoustic wavelength approximation. Based on the dominant frequency, the limit of separability is about 8 feet for the 1.56-mgi streamer and 5 to 14 feet for the 3.125-mgi streamer, assuming an average velocity of approximately 5,000 feet per second (ft/s) in the shallow section. Individual strata or other geologic features thinner than the limit of separability, which varies locally, may be detected but not resolved in true thickness or lateral extent. Small-scale topographic features and man-made obstructions such as pipelines, shipwrecks, and seafloor debris cannot be resolved in this data set.

Multibeam Echosounder

- System: Reson SeaBat 8101
- Operating Frequency: 240 kHz
- Swath coverage: 45 meters
- Processed using the Caris HIPS/SIPS processing Suite 6.1
- Estimated vertical accuracy: 15 cm
- Data was processed at a 1-meter grid spacing

Side Scan Sonar - Original, Fall 2009 Data Collection

- System: Edgetech 272-TD Side Scan Sonar
- Operating Frequency: 100 and 500 kHz
- Range: towed at an altitude between 10% and 20% of the range and provided full coverage
- Processed using SonarWiz Side Scan Sonar
- Side Scan Sonar Mosaic processed at a 0.5-meter bin spacing (high-resolution, georeferenced individual swath lines at 0.25-meter bin spacing)

Side Scan Sonar - Supplemental, Fall 2010 Data Collection

- Klein System 3000 Dual frequency Digital Towfish
- Operating Frequency: 100 and 500 kHz
- Range: towed at an altitude between 10% and 20% of the range and provided full coverage
- Side Scan Sonar was acquired with SonarPro, a product of L-3 Communications Klein Associates Inc.
- Processed using Chesapeake Technology's SonarWiz
- Side Scan Sonar Mosaic processed at a 0.25-meter bin spacing (high-resolution, georeferenced individual swath lines at 0.25-meter bin spacing)

Magnetometer

- System: Marine Magnetic Corporation SeaSPY
- Operating Frequency: 2Hz
- Absolute accuracy: 0.2ηT
- Counter sensitivity: 0.001ηT
- Processed using Chesapeake Technology's SonarWiz

Chirp Sub-Bottom Profiler

- System: Integrated Edgetech Full Spectrum Chirp Sub-Bottom Profiler
- Operating Frequency: 2 to 15 kHz
- Depth of penetration: up to 200 feet
- Estimated vertical resolution: 4 inches (10 cm)
- SEG-Y data loaded into SMT Kingdom Suite for interpretation

VELOCITY DATA

Water Column

An Applied Microsystems Limited (AML) PA-10 sound velocity and pressure smart sensor profiler was used to conduct the sounding casts. The sensor records the sound velocity in meters per second (m/sec) while being deployed downward through the water column at a rate of 10 scans per second. The data are recorded using Hyper Terminal text acquisition, and then incorporated into Caris HIPS/SIPS during processing of the multibeam data.

Sediment Column

P-wave velocity profiles were estimated from the seismic data during processing stage using semblance picking. P-wave values did not significantly vary spatially across the site. Additionally, the P-wave velocity did not vary significantly with depth for the interval that was stratigraphically mapped. This is further supported by the similar amplitude reflections observed in the seismic records when viewed at true amplitudes (all seismic data were processed without using autogain and are considered to be true amplitudes). An average P-wave velocity of 5,000 ft/sec was judged to be reasonable for converting seismic data from time to depth.

CHARTS AND FIGURES

Navigation Post-Plot Chart (Chart 1 and Chart 2)

The Navigation Post-Plot Chart for the geological and geophysical (G&G) and marine archeology surveys shows vessel navigation tracklines for the GPS antenna position. Chart 1 shows the archeology tracklines. Chart 2 shows the G&G (seismic reflection) tracklines and regional seismic tracklines (OSI, 2006). The original, fall 2009 survey post-plot is shown on Chart 1a. The supplemental, fall 2010 survey post-plot is shown on Chart 1b. The tracklines are labeled with line numbers and indicated vessel heading. Navigation event fixes are displayed and labeled every 100 meters. The charts are provided at scales of 1:6,000 with the corresponding figures (Figure 4 and 5) at scales of 1:12,000.

Bathymetry Chart (Chart 3)

Bathymetry Chart 3 and Figure 6 illustrate water depths (expressed in feet below mean lower low water [MLLW]) at scales of 1:6,000 and 1:12,000, respectively. Multibeam echosounder data were binned at 1-meter bins. The data was gridded and contoured using

ESRI's ArcMap v9.3 3D Analyst software. Water depth contours in Chart 3 and Figure 6 are presented at 1-foot intervals within the multibeam survey area and at 5-foot intervals outside the surveyed area. Figure 7 presents a three-dimensional (3D) rendering of the seafloor within the survey area. Water depth data and discussion of seafloor conditions within the survey area are based on Fugro's 2009 multibeam survey data.

We augment the 2009 multibeam survey data with regional data from two sources. The regional bathymetric data are shown on Figure 3 as contours outside the survey area in Figure 6 and Chart 3. The regional bathymetry data are from a compilation of data from National Oceanographic Atmospheric Agency (NOAA) and the New Jersey Department of Environmental Protection (NJDEP). NOAA data are comprised of multibeam data acquired between 2002 and 2004 and are located at least 3 nautical miles (Nm) landward from the survey area. The NJDEP dataset (NJDEP, 2007) is comprised of a compilation of soundings located tens to hundreds of feet apart, and spans several decades.

Side Scan Sonar Mosaic Chart (Chart 4)

The seafloor side scan sonar mosaic (Chart 4 and Figure 9) was constructed after reviewing all side scan sonar lines acquired during the surveys. Chart 4a and Figure 9a provide the mosaic from the fall 2009 original data collection. Chart 4b and Figure 9b provide the mosaic from the supplemental fall 2010 data collection.

Lines were tiled together to form a single seafloor image over the entire study area and a mosaic was processed at a 0.5-meter bin spacing. The data display good resolution and are free from distortion and interference. In general, the mosaic shows a seafloor of relatively uniform reflectivity. Minor variations in reflectivity are documented by the seafloor grab samples to indicate slight variations in the grain size of the seafloor sediment.

The seafloor features identified from the side scan sonar mosaic were digitized and exported from Chesapeake Technology's SonarWiz final map presentation shown on Chart 4 and Figure 9. The final Side Scan Sonar Mosaic Chart was generated in ArcMap v9.3 and is presented at a scale of 1:6,000 (Chart 4) and 1:12,000 (Figure 9). Detailed images of the side scan sonar targets were exported and are presented on Figure 10.

Magnetic Anomalies (Chart 5)

A graphical chart was produced for every survey line (Chart 1) and individual anomalies were interpreted from these charts. These anomalies were tabulated and entered onto a base chart in AutoCAD to correlate with the side scan sonar data (see Chart 4 and Figure 9).

A recording base station was not used to measure the changes in earth's magnetic field over the short duration of the survey. Assuming the Earth's magnetic field will change only slightly and at a nearly constant rate over the time interval of a survey line, a simple way to correct for its influence on magnetometer data is to fit them with a linear regression. Once calculated, the equation can be used to recalculate the magnetometer readings as a function of travel distance at the location of each measurement. Subtracting these calculated values from the original data set produces a new data set, wherein the values represent deviations from the (assumed) magnetic field of Earth. This method was employed on a line-by-line basis for the entire dataset. The resulting data are magnetic fluctuations relative to the survey line's baseline.

Once all the line data were corrected, they were merged into a single data file and then gridded in ArcGIS v9.3 3D Analyst. To generate a contour map, we used an inverse distance weighting calculation with a bin interval of 5.0 meters and a search radius of 35 meters. The resulting contour map is depicted on Chart 5 and Figure 11; a good correlation exists between the contoured anomalies and the hand-picked anomalies derived from the individual line charts. The colored contour image forms a background image for the Magnetic Anomalies chart (Chart 5 and Figure 11). The contour interval is five (5) gammas. Also included on this chart are the locations of the magnetic anomalies from the line-by-line interpretation.

Isopach Charts, Unit 1 (Chart 6 and Figure 27) and Unit 2 (Chart 7 and Figure 28)

Isopach maps were constructed to show the thickness of Unit 1 and Unit 2. The bounding events for Unit 1 (Seafloor and Event 10) and Unit 2 (Events 10 and 20) were mapped from the 3.125-mgi-mgi seismic data. For Unit 1, arrival times for Seafloor were subtracted from Event 10 and for Unit 2, arrival times for Event 10 were subtracted from Event 20. For each unit, these time values were converted to thickness using a P-wave velocity of 5,000 ft/sec. The resulting estimated thickness values were then gridded and contoured using ArcMap v9.3's 3D Analyst Extension. The contour interval displayed on the chart and figure is 5 feet. The chart and figure are presented at scales of 1:6,000 and 1:12,000, respectively.

Event Structure Charts, Event 10 (Chart 8 and Figure 29) and Event 20 (Chart 9 and Figure 30)

Structure charts were constructed to show depth below sea surface to Events 10 and 20. The events were mapped by selecting the peak amplitude using the seismic interpretation software from the 3.125-mgi streamer data. Seafloor arrival times were subtracted from the arrival times for Event 10 and 20, respectively, to produce time values that are representative of the thickness of the sedimentary section between each of these horizons. These time values were converted to thickness values by applying the time to depth using a P-wave velocity of 5,000 ft/sec. The resultant sediment thickness was added to the corresponding water column depths to produce the structure maps for each of these events. The resultant structure depths for Events 10 and 20 were gridded and contoured at 5-foot intervals using ArcMap v9.3's 3D Analyst extension. The structure maps are displayed at scales of 1:6,000 (charts) and 1:12,000 (figures).

Site Features Chart (Chart 10 and Figure 31)

The Site Features Chart (Chart 10) presents features at the seafloor from the bottom charting survey and sub-seafloor features identified using the seismic reflection data. The chart and figure include side scan sonar targets, magnetic anomalies, and possible shallow free-phase gas accumulations, as interpreted from amplitude anomalies in the 1.56-mgi and

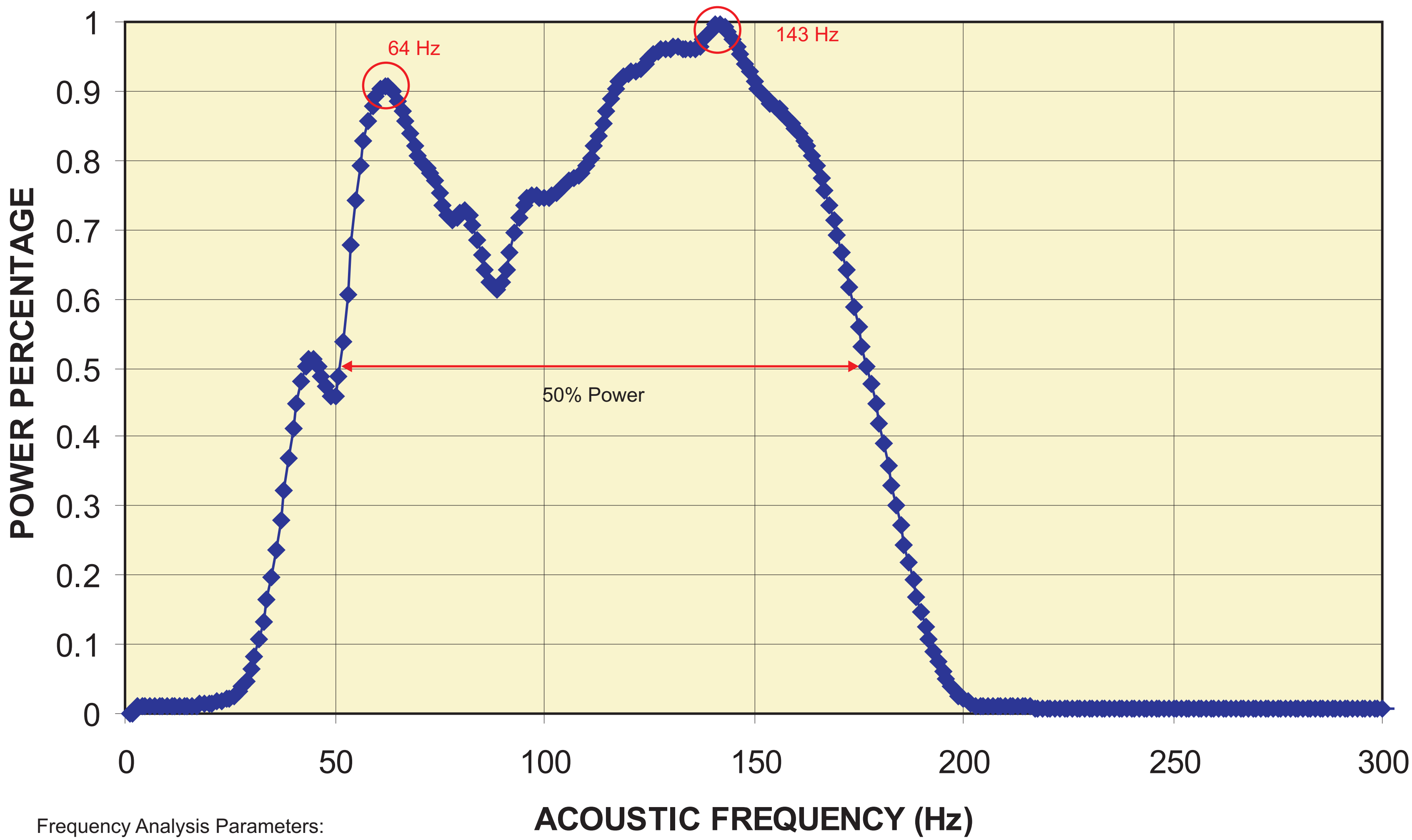
3.125-mgi seismic data, for seismic Unit 2 and Unit 3. The mapping of side scan sonar targets and magnetic anomalies is described in previous sections of this appendix.

The following evaluation was completed prior to delineation of possible shallow free-phase gas accumulations. For these data, the seafloor, which produces a high-impedance acoustic response, was displayed as a peak (positive) reflector and represented by positive-amplitude numbers. Therefore, areas of possible shallow gas below the seafloor, which produce a low impedance acoustic response, are defined as negative, high-amplitude anomalies.

Geophysical indicators of possible gas accumulations include:

- Occurrence within geologic trends indicative of channel complexes
- Presence of structural or stratigraphic traps
- Acoustic wipeout zones or loss of frequency beneath high-amplitude anomalies
- Velocity pulldown of reflectors beneath high-amplitude anomalies
- Steep amplitude gradients at margins of high-amplitude anomalies
- Polarity response opposite that of the seafloor reflector
- Polarity reversal at downdip terminations of high-amplitude anomalies
- Evidence for internal fluid contact (flatspots)

An example of an amplitude anomaly is shown in Figure 26. Figure 24 shows a tophole prognosis identifying potential shallow gas hazards for each of the mapped seismic units. High-amplitude anomalies indicative of shallow gas accumulations were evident in Unit 2 and Unit 3 and were designated as having a moderate potential for this hazard. The anomalies in Unit 2 and Unit 3 are located approximately 100 meters and 50 meters from the proposed MDCF location, respectively.



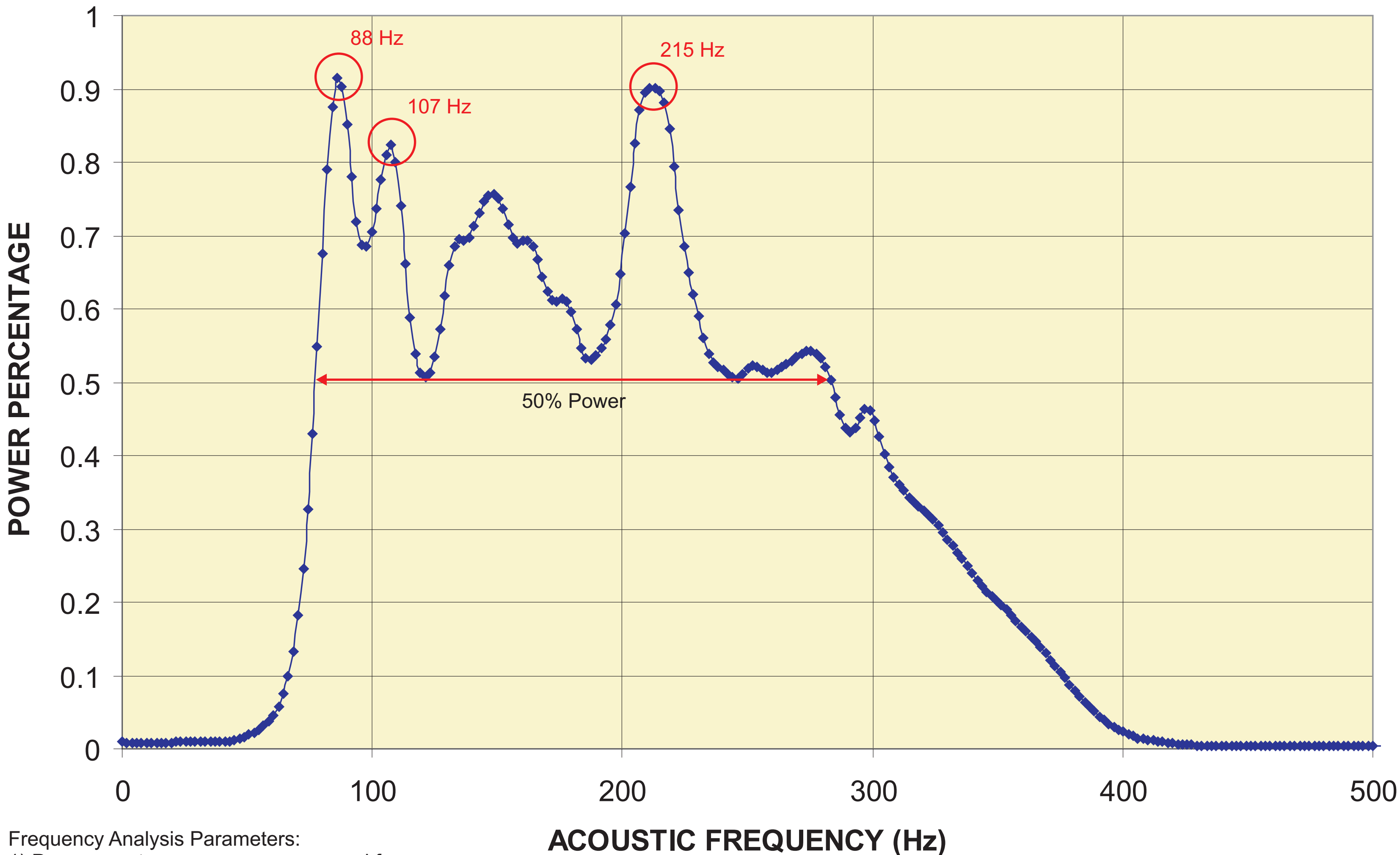
Frequency Analysis Parameters:
1) Power spectrum curves are averaged from survey lines 128, 131, 134, 206, 207, and 208.
2) Time range: 0 to 0.14975 seconds
3) Analysis tool: SMT TracePAK v.8.2
4) Dominant frequencies are shown in red.

1.56-mgi HYDROPHONE STREAMER POWER SPECTRUM CHART
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

NRG Bluewater Wind
Project No. 3671.004

FUGRO

FIGURE B-1a



Frequency Analysis Parameters:
1) Power spectrum curves are averaged from survey lines 128, 131, 134, 206, 207, and 208.
2) Time range: 0 to 0.47975 seconds
3) Analysis tool: SMT TracePAK v.8.2
4) Dominant frequencies are shown in red.

3.125-mgi HYDROPHONE STREAMER POWER SPECTRUM CHART
Bluewater Wind Meteorological Tower
Delaware Continental Shelf

NRG Bluewater Wind
Project No. 3671.004

FUGRO

FIGURE B-1b

APPENDIX D

AIR EMISSIONS CALCULATIONS

Meteorological Buoy Air Emission Calculations

Vessels/Equipment	No. of Engines per vessel	Dimensions (ft) length x breadth x depth (draft)	Propulsion	Emission Factor Used (see EFs worksheet)	Activity	Engine Rating (hp)	Fuel Type	Trips	Hrs/ trip	Operating Days	Operating Hours (hrs/day)	Total Vessel Operating Hours (hrs)	Average load (%)	Fuel Usage Gallons	VOC tons	NOX tons	CO tons	PM10 tons	PM2.5 tons	SO2 tons	HAPs tons	CO2 tons	CH4 tons	N2O tons	CO2e tons
Tug Boat - main engines	1	120' x 30' x 25 (10)	2 propellers 6 ft diam.	1	Tug the work barge for installation of lidar buoy	4000	diesel	10	4	10	20	240	31%	15,003.6	0.12	2.39	1.22	0.15	0.15	0.00	0.03	168.94	0.02	0.00	170.96
Aux. engines	1		1 bow thruster 34ft diam	2		100.0	diesel	10	4	10	20	240	43%	520.3	0.00	0.08	0.04	0.00	0.00	0.00	0.00	5.86	0.00	0.00	5.93
Work boat - main engines	1	200' x 60' x 15' (7')	4 thrusters 6 ft diam	1	Installation of lidar buoy	4000	diesel	10	4	10	20	240	43%	20,811.4	0.17	3.32	1.70	0.21	0.20	0.00	0.03	234.34	0.03	0.01	237.13
Aux. engines	1			2		200	diesel	10	4	10	20	240	43%	1,040.6	0.00	0.17	0.08	0.00	0.00	0.00	0.00	11.72	0.00	0.00	11.86
Crane	1			111		250	diesel	10	4	10	20	240	43%	1,331.7	0.01	0.12	0.02	0.00	0.00	0.00	0.00	15.07	0.00	0.00	15.20
Work boat (Maintenance) - main engines	2	47' x 14' x 8' (5')		2	Annual Maintenance of Met buoy	450	diesel	8	4	8	8	96	43%	1,873.0	0.01	0.30	0.15	0.01	0.01	0.00	0.00	21.09	0.00	0.00	21.34
Aux. engines	1			2		13	diesel	8	4	8	8	96	43%	27.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.31
Tug Boat - main engines	1	120' x 30' x 25 (10)	2 propellers 6 ft diam.	1	Decomissioning	4000	diesel	10	4	10	20	240	31%	15,003.6	0.12	2.39	1.22	0.15	0.15	0.00	0.03	168.94	0.02	0.00	170.96
Aux. engines	1		1 bow thruster 34ft diam	2		100.0	diesel	10	4	10	20	240	43%	520.3	0.00	0.08	0.04	0.00	0.00	0.00	0.00	5.86	0.00	0.00	5.93
Work boat - main engines	1	200' x 60' x 15' (7')	4 thrusters 6 ft diam	1	Decomissioning	4000	diesel	10	4	10	20	240	43%	20,811.4	0.17	3.32	1.70	0.21	0.20	0.00	0.03	234.34	0.03	0.01	237.13
Aux. engines	1			2		200	diesel	10	4	10	20	240	43%	1,040.6	0.00	0.17	0.08	0.00	0.00	0.00	0.00	11.71	0.00	0.00	11.85
Crane	1			111		250	diesel	10	4	10	20	240	43%	1,331.7	0.01	0.12	0.02	0.00	0.00	0.00	0.00	15.07	0.00	0.00	15.20
Generator on met buoy				222	Backup electric power	10	diesel					500	100%	259.9	0.00	0.04	0.04	0.00	0.00	0.00	0.00	2.92	0.00	0.00	2.95
Total Emissions (over 6 year period)														79,315.3	0.61	12.49	6.29	0.74	0.73	0.01	0.12	893.25	0.11	0.03	903.81

Notes:

1.The installation and decommissioning of the floating lidar buoy is expected to occur over 2 days for each activity; however, to account for weather and other potential issues that may occur, the air emissions estimates are assuming 10 days, 24 hours per day (which accounts for time traveling to and from the installation area) to provide a conservative estimate. Annual maintenance activities will be performed and it is estimated that 8 vessel trips per year will be required.

2.Trip constitutes the round trip transit time to and from the project site. The number of hours per trip were estimated based on the vessel's transit speed and additional time required for maneuvering and berthing.

3.Emission factors for marine vessel engines are from Table 3-8 in the ICF International report to the US EPA "Current Methodologies in Preparing Mobile Source Port-Related Emissions Inventories", April 2009. (See emission factors summary page)
Assumed all engines to be used are certified to meet EPA Tier 1 engine standards; therefore, the Tier 1 emission factors in Table 3-8 from the ICF International report was used to provide conservative estimate.

4.Emission factors for the land-based nonroad engines were estimated using USEPA report “Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling Compression-Ignition”, Report No. EPA-420-R-10-018 NR-009d, July 2010. (see emission factors summary page)

5.HAP emission factors for commercial marine vessels were determined using the methodology identified by US EPA for the latest (2011) National Emissions Inventory (NEI); i.e., they are calculated as percentages of the PM 10, PM2.5, or VOC emissions from the CMVs.
The HAP emissons for nonroad engines were based on EPA's AP-42 Volume 1, Chapters 3.3 for small diesel engines. (see HAP emission factor summary pages). The HAP emissions for the generator engine were based on the same emission factor.

6.Average load factors for marine vessels were estimated based on load factors presented in Table 3-4 of the ICF International report and the average load factors for nonroad engines were based on factors presented in Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", EPA Office of Air and Radiation Report Number NR-005b, July 2010.

7.CO2e emission rates use the following carbon equivalence factors: 25 for CH4, and 298 for N2O.

8. For met buoy generator, operating hours assumed to be 500 hours/year. Fuel consumption based on 279 g/KW output, 85% efficiency, diesel specific gravity of 0.85

9. The estimate of maximum annual emissions assumes that the annual maintenance activities and either the installation or decommissioning activities occur in the same year.

Emission Factor Summary

Commercial Marine Vessels (CMVs)

		Commercial Marine Vessel Emission Factors (g/hp-hr) a/									Fuel Cons. (gal/hp-hr) d/
EF type	Engine Type	VOC	NO_x	CO	PM/ PM10 b/, c/	PM2.5 b/	SO2 c/	CO2	CH4	N2O	
1	Category 2 engines	0.37	7.3	3.73	0.46	0.45	0.005	515	0.067	0.015	0.050
2	Category 1 engines < 1000 kW	0.20	7.3	3.73	0.19	0.19	0.005	515	0.067	0.015	0.050

a/ Emission factors for Category 1and 2 engines are from Table 3-8 from ICF International report to the US EPA "Current Methodologies in Preparing Mobile Source Port-Related Emissions Inventories", April 2009 (converted from g/kW-hr to g/hp-hr by multiplying by 0.746 kW/hp). Assumed all Category 1and 2 engines to be used are certified to meet EPA Tier 1and 2 marine engine standards respectively (providing conservative estimate for Category 1 engines); therefore the Tier 1and 2 emission factors in Table 3-8 from the ICF International report was used. Note, the CO emission factor for Category 1 Tier 2 engines is higher than what is provided for Tier 1 engines, thus the Tier 2 emission factor for CO was used to provide a conservative estimate.
b/ All PM is assumed to less than 10 µm in diameter; therefore, PM emission factor is equivalent to PM10 emission factor. PM2.5 is estimated to be 97 % of PM10 per EPA guidance in "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition," EPA420-R-10-018/NR-009d, July 2010.
c/ Emission factors for Category 1and 2 engines for SO2 and $_{PM10}$ presented in Table 3-8 of the ICF report (ICF International 2009) have been adjusted for the 15 ppmw sulfur content in ultra-low sulfur diesel fuel using the correction factors for ultra-low sulfur diesel as presented in Table 3-9 of the ICF Report. The emission factors for SO2 and PM10 were multiplied by 0.005 and 0.86 , respectively, as recommended in Section 3.4.2 of the ICF Report.
d/ Fuel consuption rate for category 1and 2 marine engines was estimated based on CO2 emission factor (g/hp-hr) and the emission factor for the mass of CO2 generated per gallon of fuel (10.21 kg CO2/gal fuel) as presented in the Table 13.1 of the “2014 Climate Registry Default Emission Factors”.

Land-based Nonroad Engines and Other Equipment

				NONROAD Emission Factors (g/hp-hour) a/							Climate Leaders (g/hp-hour) b/			NONROAD
	NONROAD Source Category			Exhaust+ Crankcase	Exhaust	Exhaust	Exhaust	Exhaust	Exhaust	Exhaust	Exhaust	Exhaust	Fuel Consumption gal/hp-hr d/	Default
	SCC	Description	Engine Size (hp)	VOC	NO_x	CO	PM10 c/	PM2.5 c/	SO2	CO2	CH4	N2O		Load Factor
EF type	Construction & Mining Subcategory (*002*)													
111	2270002045	Diesel Cranes	175 < HP <= 300	0.31	4.34	0.75	0.13	0.13	0.005	530	0.030	0.013	0.052	43%

a/ Emission factors for VOC, CO, NOx and PM10, are based on Tier 2 emission factors from Tables 4 to 7 in the USEPA report “Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling Compression-Ignition”, Report No. EPA-420-R-10-018 NR-009d, July 2010. The emission factors for CO2 and SO2 were derived based on Equations 6 and 7 presented in the USEPA report, 2010. The PM2.5 emission factor is estimated to be 97 % of PM10 per guidance presented in the USEPA report, 2010.
b/ Emission factors for CH4 and N2O are based on Table A-6 from EPA's report “Direct Emissions from Mobile Combustion Sources.” Climate Leaders: Greenhouse Gas Inventory Protocol, Core Module Guidance. EPA430-K-08-004. May 2008. (CH4 = 0.180 g/kg fuel and N20 = 0.080 g/kg fuel)
c/ Fuel consumption for each type of equipment was estimated based on CO2 emission factor (g/hp-hr) and the emission factor for the mass of CO2 generated per gallon of fuel (10.21 kg CO2/gal fuel) as presented in the Table 13.1 of the USEPA report on “2014 Climate Registry Default Emission Factors”.

Backup electric generator on met buoy

				Tier 4 Emission Factors (g/hp-hr) for engines <11 HP										
EF type		Description	Engine Size (hp)	VOC, a/	NOx, a/	CO	PM/ PM10 b/	PM2.5 b/	SO2	CO2, c/	CH4, c/	N2O, c/	Fuel consumption gal/hp-hr	Load factor
222		6 KW generator with 2-- cylinder engine	10	0.75	6.75	8	0.4	0.388	0.005	530	0.030	0.013	0.05	100%

a/ Emission factors for VOC and NOx are assumed to be equal to 10% and 90% respectively of the standard for NMHC+NOx (7.5 g/hp-hr)
b/ All PM is assumed to less than 10 µm in diameter; therefore, PM emission factor is equivalent to PM10 emission factor. PM2.5 is estimated to be 97 % of PM10
c/ Emission factors for CO2, CH4 and N2O assumed to be the same as for the crane engine (111)

EPA NEI HAP emission factors for Commercial Marine Vessels

HAP emission factors for commercial marine vessels were determined using the methodology identified by US EPA for the latest (2011) National Emissions Inventory (NEI); i.e., they are calculated as percentages of the PM10, PM2.5, or VOC emissions from the CMVs.

CMV fuel type			Diesel (distillate)	
Operating description			In Port	Underway
SCC code			2280002100	2280002200
Type			Maneuvering	Cruising
Type Code			M	C
Pollutant	HAP?*	Fraction of		
Ammonia	No	PM10	0.01	0.02
Arsenic	Yes	PM10	0.0000170	0.00003
Benzo[a]Pyrene	Yes	PM10	0.0000030	0.000005
Benzo[b]Fluoranthene	Yes	PM10	0.000005	0.00001
Benzo[k]Fluoranthene	Yes	PM10	0.0000030	0.000005
Beryllium	Yes	PM10		
Cadmium	Yes	PM10	0.00000300	0.00000500
Chromium (VI)	Yes	PM10	0.0000080	0.000017
Chromium III	Yes	PM10	0.0000170	0.000033
Cobalt	Yes	PM10		
Hexachlorobenzene	Yes	PM10	0.00000000	0.00000000
Indeno[1,2,3-c,d]Pyrene	Yes	PM10	0.000005	0.00001
Lead	Yes	PM10	0.000075	0.00015
Manganese	Yes	PM10	0.00000200	0.000001000
Mercury	Yes	PM10	0.000000000	0.00000000
Nickel	Yes	PM10	0.0005	0.001
Phosphorus	Yes**	PM10		
Polychlorinated Biphenyls	Yes	PM10	0.00000000	0.0000000
Selenium	Yes	PM10	0.00E+00	0.00E+00
Total HAP (ratioed to PM10)			**0.0006**	**0.0013**
Acenaphthene	Yes	PM2.5	0.000018	0.000015
Acenaphthylene	Yes	PM2.5	0.00002800	0.000023000
Anthracene	Yes	PM2.5	0.00002800	0.000023000
Benz[a]Anthracene	Yes	PM2.5	0.00003	0.000025
Benzo[g,h,i,]Perylene	Yes	PM2.5	0.00000700	0.000006000
Chrysene	Yes	PM2.5	0.00000500	0.000004000
Fluoranthene	Yes	PM2.5	0.0000170	0.00001400
Fluorene	Yes	PM2.5	0.00003700	0.000031000
Naphthalene	Yes	PM2.5	0.00105100	0.000876000
Phenanthrene	Yes	PM2.5	0.000042	0.000035
Pyrene	Yes	PM2.5	0.00002900	0.000024000
Total HAP (ratioed to PM2.5)			**0.0013**	**0.0011**
2,2,4-Trimethylpentane	Yes	VOC	0.0003	0.00025
Acetaldehyde	Yes	VOC	0.0557240	0.04643600
Acrolein	Yes	VOC	0.002625	0.0021880
Benzene	Yes	VOC	0.015258	0.012715
Ethyl Benzene	Yes	VOC	0.0015	0.00125
Formaldehyde	Yes	VOC	0.1122	0.0935
Hexane	Yes	VOC	0.004125	0.0034380
Propionaldehyde	Yes	VOC	0.004575	0.0038120
Styrene	Yes	VOC	0.001575	0.0013130
Toluene	Yes	VOC	0.0024	0.002
Xylenes (Mixed Isomers)	Yes	VOC	0.0036	0.003
Total HAP (ratioed to VOC)			**0.2039**	**0.1699**

*For completeness, all of the pollutants in EPA's database are shown, but not all are HAP as defined in Section 112 of the Clean Air Act and as updated in 40 CFR 63 Subpart C.
**Only elemental phosphorus (CAS #7723140) is a HAP; phosphorus-containing compounds in general are not.

Reference: US EPA, "2011 National Emissions Inventory, version 1, Technical Support Document", draft, November 2013, available from http://www.epa.gov/ttn/chief/net/2011nei/2011_neiv1_tsd_draft.pdf; Table 104 on pp. 178-179 refers to the dataset "2011EPA_HAP-Augmentation" for HAP emissions, which is available from ftp://ftp.epa.gov/EmisInventory/2011/doc; the factors above are from that dataset.

HAP Emission Factor Calculation Sheet for Small Diesel Engines

Pollutant	Emission Factor (lb/MMBtu)[a]	Emission Factor Rating	Source (AP-42 Table)
Organic Compounds			
Benzene[b]	9.33E-04	E	3.3-2
Toluene[b]	4.09E-04	E	3.3-2
Xylene[b]	2.85E-04	E	3.3-2
1,3 Butadiene	< 3.91E-05	E	3.3-2
Propylene	2.58E-03	E	3.3-2
Formaldehyde[b]	1.18E-03	E	3.3-2
Acetaldehyde[b]	7.67E-04	E	3.3-2
Acrolein[b]	< 9.25E-05	E	3.3-2
PAH			
Naphthalene[b]	8.50E-05	E	3.3-2
Acenaphthylene[b]	< 5.06E-05	E	3.3-2
Acenaphthene[b]	< 1.42E-06	E	3.3-2
Fluorene[b]	2.90E-05	E	3.3-2
Phenanthrene[b]	2.90E-05	E	3.3-2
Anthracene[b]	2.00E-06	E	3.3-2
Fluoranthene[b]	8.00E-06	E	3.3-2
Pyrene[b]	5.00E-06	E	3.3-2
Benzo(a)anthracene[b]	2.00E-06	E	3.3-2
Chrysene[b]	0.00E+00	E	3.3-2
Benzo(b)fluoranthene[b]	< 9.91E-08	E	3.3-2
Benzo(k)fluoranthene[b]	< 1.55E-07	E	3.3-2
Benzo(a)pyrene[b]	< 1.88E-07	E	3.3-2
Indeno(1,2,3-cd)pyrene[b]	< 3.75E-07	E	3.3-2
Dibenz(a,h)anthracene[b]	< 5.83E-07	E	3.3-2
Benzo(g,h,i)perylene[b]	< 4.89E-07	E	3.3-2
TOTAL PAH	1.68E-04	E	3.3-2
Metals and inorganics[c]			
Arsenic[b]	0.00E+00		
Cadmium[b]	0.00E+00		
Chromium[b]	1.20E-05		
Chromium VI[b]	2.00E-06		
Lead[b]	1.00E-06		
Mercury[b]	0.00E+00		
Nickel[b]	1.00E-06		
Selenium[b]	0.00E+00		
Total for substances identified as HAP[e]	< 3.9E-03		

The emission factors for individual organic compounds shown above are from the U.S. Environmental Protection Agency (EPA), "Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources" (AP-42), Section 3.3 for "Gasoline and Diesel Industrial Engines", rev. 10/96.

APPENDIX E

MARINE ARCHEOLOGY REPORT

(CONFIDENTIAL – PROVIDED UNDER SEPARATE COVER)

Incident Report: Protected Species Injury or Mortality

Photographs should be taken of all injured or dead animals.

Observer's full name:____

Reporter's full name:____

Species Identification:____________________________________

Activity ongoing at time of observation (e.g., transit, survey, pile driving, etc.):

____

____

Date animal observed:______________ Time animal observed: ______________________

Date animal collected:______________ Time animal collected:______________________

Environmental conditions at time of observation (i.e., tidal stage, weather):

____

____

Water temperature (°C) at site and time of observation:______________________

Describe location of animal and how it was documented (i.e., observer on boat):

____

Sturgeon Information:

Species ______________________________

Fork length (or total length) ____________________ Weight ____________________

Condition of specimen/description of animal

____

____

____

____

Fish Decomposed: NO SLIGHTLY MODERATELY SEVERELY

Fish tagged: YES / NO *Please record all tag numbers.* Tag # _______________

Photograph taken: YES / NO

(please label *species, date, geographic site* and *vessel name* when transmitting photo)

Genetics Sample taken: YES / NO

Genetics sample transmitted to: ___________________ on ____/_____/20____

Sea Turtle Species Information: *(please designate cm/m or inches.)*
Species ______________________________ Weight (kg or lbs)____________________________

Sex (circle): Male Female Unknown How was sex determined? ___________________

Straight carapace length ________________ Straight carapace width _____________________

Curved carapace length ________________ Curved carapace width ______________________

Plastron length _______________________ Plastron width _____________________________

Tail length ____________________________ Head width _______________________________

Condition of specimen/description of animal____
____

Existing Flipper Tag Information
Left _______________________________ Right __________________________________
PIT Tag # _________________________________

Miscellaneous:
Genetic biopsy taken: YES NO
Photos Taken: YES NO

Turtle Release Information:
Date ___________________________ Time _______________________________
Lat _____________________________ Long _______________________________
State __________________________ County _____________________________

Remarks: (note if turtle was involved with tar or oil, gear or debris entanglement, wounds or mutilations, propeller damage, papillomas, old tag locations, etc.)
____
____

MARINE MAMMAL INFORMATION:
Species ____

Injuries Observed ____

Condition/Description of Animal ____
____

Other Remarks ____

Time Reported to NMFS Stranding Hotline: _______________________________________

APPENDIX F

INCIDENT REPORT- PROTECTED SPECIES