

GIS Compilation of Geophysical Data on Virginia's Outer Continental Shelf

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DISCLAIMER

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GIS compilation of geophysical data on Virginia's Outer Continental Shelf

ABSTRACT

Legacy geophysical data from Virginia's Outer Continental Shelf (OCS) were compiled in an ESRI ArcGIS geodatabase to enable future spatial and resource analysis using on-line geographic information system (GIS) tools. Primary data sources included: the Virginia Institute of Marine Science (VIMS), Virginia Department of Mines, Minerals and Energy (DMME), National Oceanic and Atmospheric Administration (NOAA), National Geophysical Data Center (NGDC), Marine Geoscience Data System at Lamont-Doherty Earth Observatory (LDEO), the U.S. Bureau of Ocean Energy Management (BOEM), and the U.S. Geological Survey (USGS). The geodatabase contains location and collection details, water depth, sediment description and other available geotechnical attributes.

The VIMS sources contain seismic data, core descriptions and grab samples collected by the U.S. Army Corp of Engineers and VIMS from 1970 to present. Most of the core samples are located at the mouth of the Chesapeake Bay or within 8 nautical miles (nm) of the current coastline near Virginia Beach. The VIMS seismic data were scanned from paper archives and varies in quality from poor to excellent. The NOAA and NGDC data were downloaded from the url: <http://maps.ngdc.noaa.gov/viewers/geophysics/>. Most of these datasets were collected farther offshore than the 8 nm limit of the present study. Geophysical data acquired from the USGS included side-scan and sub-bottom profile data collected in 2014-15 as part of a broad survey covering the 1-20 mile offshore region of the Delmarva Peninsula. This dataset is of very high quality and covers nearly the entire length of the peninsula. Whereas there is good coverage for both seismic and cores in the vicinity of Virginia Beach and Sandbridge, significant data gaps are present to the north and south of this area. In particular, although the recent USGS survey collected high-quality geophysical data from the Eastern Shore, very little coring has been performed in this area, thus limiting the ability to assess the quality, extent and thickness of sand resources. The geodatabase provides an essential tool for identifying prospective sand resource areas and where there are data gaps that need to be addressed by future studies.

INTRODUCTION

The Virginia Institute of Marine Science (VIMS) and the DMME Division of Geology and Mineral Resources (DGMR) have for many years worked cooperatively with the U.S. Bureau of Ocean Energy Management (BOEM) to identify sand resources on Virginia's Outer Continental Shelf (OCS) suitable for beach nourishment and other coastal protection and restoration projects. These resources serve a vital role in sustaining economic growth and the vitality of popular tourist destinations such as Chincoteague Island and Virginia Beach. Important coastal infrastructure including NASA's Wallops Flight Facility at Wallops Island and facilities at Naval Station Oceana, Dam Neck Annex are also areas that are subject to beach degradation and sand loss as a result of periodic storms and long-term erosion.

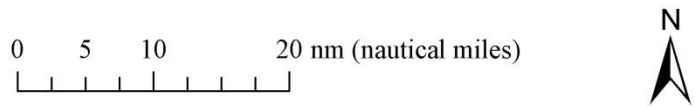
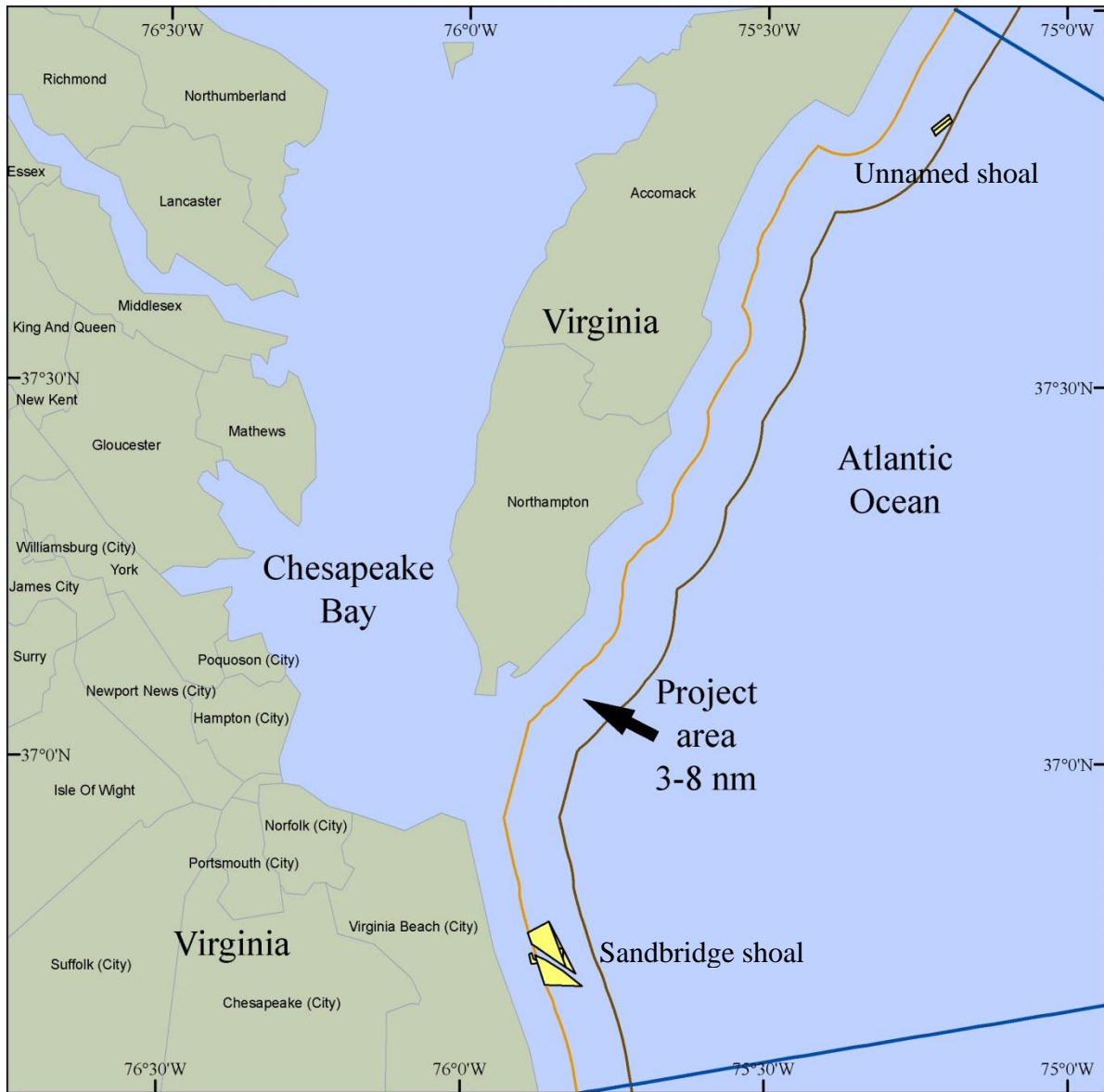
In May 2014, DGMR, VIMS and BOEM initiated a partnership as part of State Cooperative Agreement M14AC00013 on the project entitled, *Hurricane Sandy Coastal Recovery and Resiliency – Resource Identification, Delineation, and Management Practices*. The project study area encompasses the OCS region in Federal waters from 3 nm (nautical miles) to 8 nm offshore (Figure 1). The overarching goal of this project is to improve the capability for Federal, State, and local agencies to plan for cost-effective coastal protection and restoration projects utilizing marine mineral resources on Virginia’s OCS in a manner that is protective of the environment.

Achieving this goal will require a new holistic understanding of the shallow shelf geology, seafloor geomorphology, and key factors that affect sediment transport. The Virginia continental shelf has been sampled and surveyed piecemeal since the early 1970’s using a variety of techniques that have in many cases produced results using outdated technology that has limited value today (e.g., low-resolution acoustic surveys). Yet there are many spatially overlapping datasets that may provide a synergistic perspective regarding the distribution and thickness of sand deposits concentrated in major shoals, sand sheets, and submerged channels that occur at the surface and near subsurface (<10 meters) of the sea floor. These datasets may also help in mapping the underlying geology and identifying shore face attached ridges with areas of sorted bedforms that signify areas of low abundance of sand.

Given the importance of understanding the geological setting and other factors affecting the sourcing, distribution and mobility of Quaternary- to Holocene-age sand on the Virginia shelf, this report documents the results of an assessment of the spatial distribution and quality of legacy geophysical data. The main goal was to identify existing sources of publically available geophysical and core data that can be used to develop a more complete understanding of sand resources on the Virginia shelf.

PURPOSE AND RELEVANCE

Federal funding from the BOEM-Virginia Hurricane Sandy State Cooperative provided the means to complete an inventory and data quality assessment of legacy geophysical datasets for Virginia’s OCS. The work was conducted through a partnership between BOEM, DGMR, and VIMS. This report presents the findings in partial fulfilment of the work product deliverables for Cooperative Agreement M14AC00013. The results provide the foundation for continuing investigations that will identify and delineate sand resources for coastal recovery and resiliency. It is anticipated that the results of this GIS compilation will be in a format that can be readily distributed using advanced web mapping tools to better inform Federal, State, and local policy decisions on the availability of marine mineral resources on Virginia’s OCS.



Key

- Federal OCS Sand Lease Areas
- BOEM Atlantic admin boundary
- Virginia-Federal boundary
- 8 nm boundary

Figure 1. Project location map showing locations of Federal OCS sand lease areas.

METHODS AND ANALYSES

The primary objectives of this study included 1) discovery and acquisition of legacy geophysical datasets for the Virginia OCS, 2) assessment of the quality of the data, 3) GIS geodatabase compilation and digital conversion of analog data where applicable, and 4) development of a web mapping portal for on-line viewing and interpretation.

In order to ensure that the majority of significant datasets were identified, we conducted an extensive Internet search of on-line databases containing geophysical data. Organizations and researchers having a known history of data collection were directly contacted. Most of the usable and non-proprietary data were obtained from government organizations including VIMS (Virginia Institute of Marine Science), NOAA (National Oceanic and Atmospheric Administration), and the USGS (United States Geological Survey). Data that were collected prior to 1970 were generally found to be in analog format and of low quality, so these datasets were inventoried, but not acquired.

Regarding data quality, there were many varied data formats ranging from paper printouts to GIS-ready databases. File types included shapefiles (.shp), raster image files (.png, .jpeg, .tif), geodatabases (.gdb), geophysical data formats (.sgy, .h77t), and text files (.txt, .csv). Some of these types presented challenges in combining all of the data into a single consistent database.

A number of datasets contained seismic data in the .sgy file format, which requires the data to be converted before it is included in a GIS geodatabase. All of the .sgy data was downloaded for future processing and inclusion in the database. While many of the newer datasets were complete, most of the older datasets were barely readable or found to be missing important information such as navigation data. Although this data was inventoried and recorded, attempts to reconcile gaps in the field attributes of the legacy data was beyond the scope of this project.

Several web-based interactive mapping systems were evaluated for the implementation of a modern Virginia OCS web portal. As the Virginia state geological survey, DGMR currently hosts an early version of the OCS data portal built on Google Fusion Tables and Google Maps technology: https://www.dmme.virginia.gov/DGMR/ocs_map_and_data.shtml. This technology is now rather outdated and as part of the present project, DGMR planned to migrate the portal to a new platform using licensed web mapping software systems that are presently used to distribute other land-based geologic map products and services. The two software options with greatest potential include ESRI ArcGIS Online and ESRI ArcGIS Viewer for Flex version 3.7. Data formatting and upload to ArcSDE servers was accomplished for the present project with the assistance of the DMME Office of Information Systems.

RESULTS

The full inventory of datasets examined during this project is listed in Appendix A. These datasets were integrated into an ESRI ArcGIS geodatabase, which provides the means for storing metadata, available feature-specific attributes, links to original sources, and geographic coordinates for spatial mapping. The GIS geodatabase represents the primary work product deliverable for this project and is included as a separate digital data package (Appendix B).

The VIMS data sources contain seismic data and core descriptions collected by the U.S. Army Corp of Engineers and VIMS between 1970 and present. Other core and geophysical data were acquired from records archived in the Marine Geoscience Data System data hub at Lamont-Doherty Earth Observatory (LDEO). Many of the core samples are located at the mouth of the Chesapeake Bay or within the 8 nm project boundary, especially in the offshore vicinity of Virginia Beach (Figure 2). There are many vibracores that extend beyond the project boundary, but nonetheless provide valuable marine stratigraphic data.

About 590 line-miles of seismic data collected by VIMS were scanned from paper archives and varies in quality from poor to excellent. The scanned data is now available in .jpg raster image format and is accessible from links in the geodatabase. The majority of the available geophysical data is from NOAA and the National Geophysical Data Center (NGDC). Many of these datasets contain bathymetry as well as seismic data. The NOAA and NGDC data were downloaded from the url: <http://maps.ngdc.noaa.gov/viewers/geophysics/>. Data collection tracklines are shown in Figure 3. The main data collection instruments included Multibeam RESON SeaBat 7125 SV, Multibeam RESON SeaBat 8101 ER and the Odom CV200 VBES. There were a wide variety of vessels used for data collection including the M/V *Atlantic Surveyor*, S/V *Ferdinand R. Hassler*, S/V *Thomas Jefferson*, S/V *Rude*, S/V *Bay Hydrographer*, S/V *Heck*, R/V *Mt. Mitchell*, S/V *Pierce*, S/V *Whiting*, and *Skiff 560/570*. The most recent survey data available was collected in 2015 associated with the BOEM ASAP (Atlantic Sand Assessment Project). For surveys completed prior to 1970 there was generally poor quality or no on-line data to review.

DMME's on-line OCS data portal provided a secondary source for bathymetry and geophysical survey data, which was originally acquired from NOAA and BOEM data sources. These surveys were located primarily in and around the Chesapeake Bay. The main research vessels were the S/V *Bay Hydrographer*, R/V *Chinook*, S/V *Rude*, R/V *Sealth*, R/V *Theory*, and S/V *Thomas Jefferson*. These surveys were conducted between 2006 and 2012.

Geophysical data acquired from the USGS included side-scan sonar and sub-bottom profile surveys. The two most noteworthy datasets were collected in 2014 and 2015 as part of the Delmarva Peninsula Geologic Framework study covering the 1-20 mile offshore region of the Delmarva Peninsula and Assateague Island (Figure 3). The USGS logged a total of 2,568 line-miles of data collected. These datasets are of very high quality and cover nearly the entire length

of the peninsula. In total, 238 coring sites and 2,862 grab samples were logged for the entire survey that extended northward along the Virginia and Maryland coastlines.

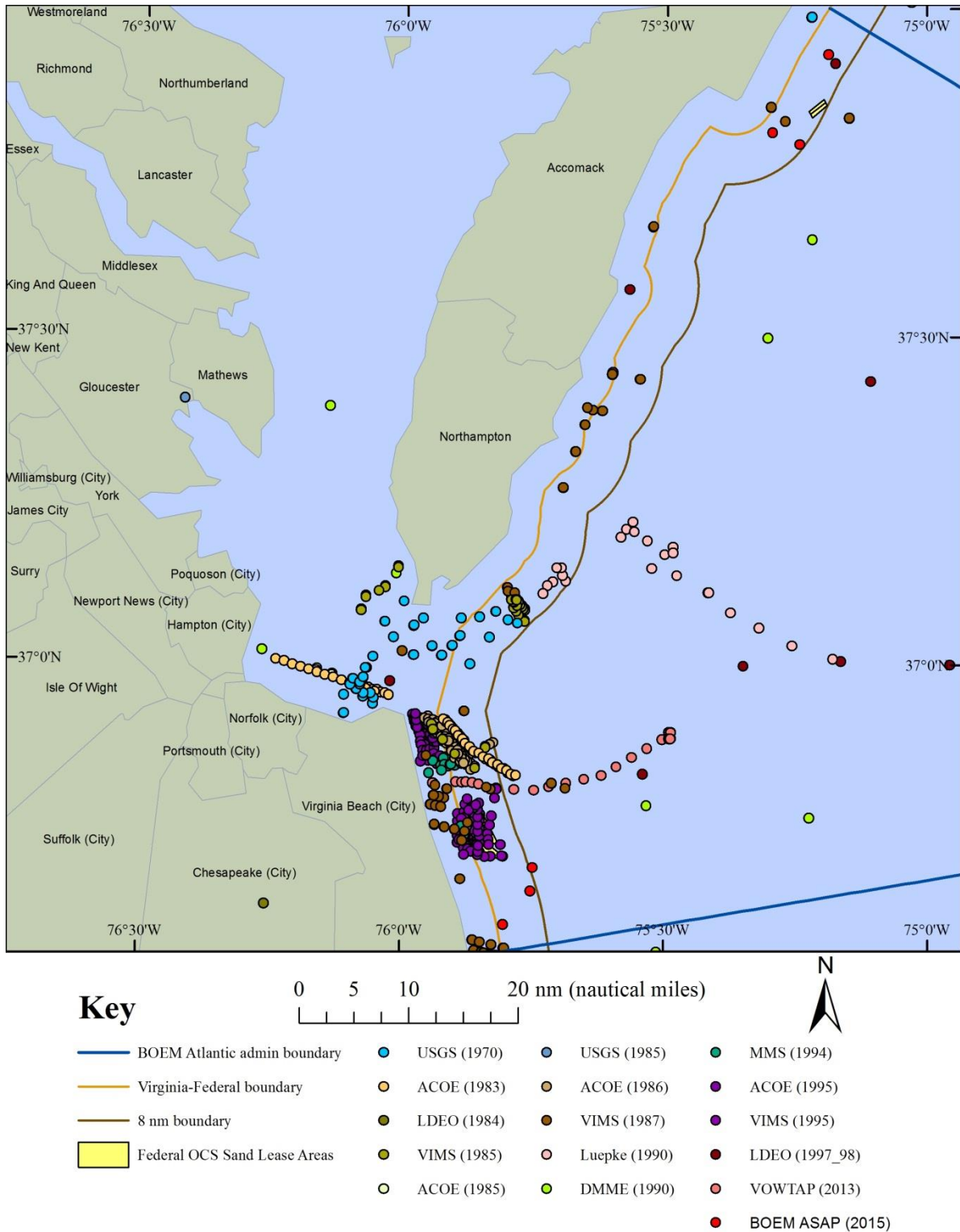


Figure 2. Map showing locations of existing vibracore datasets.

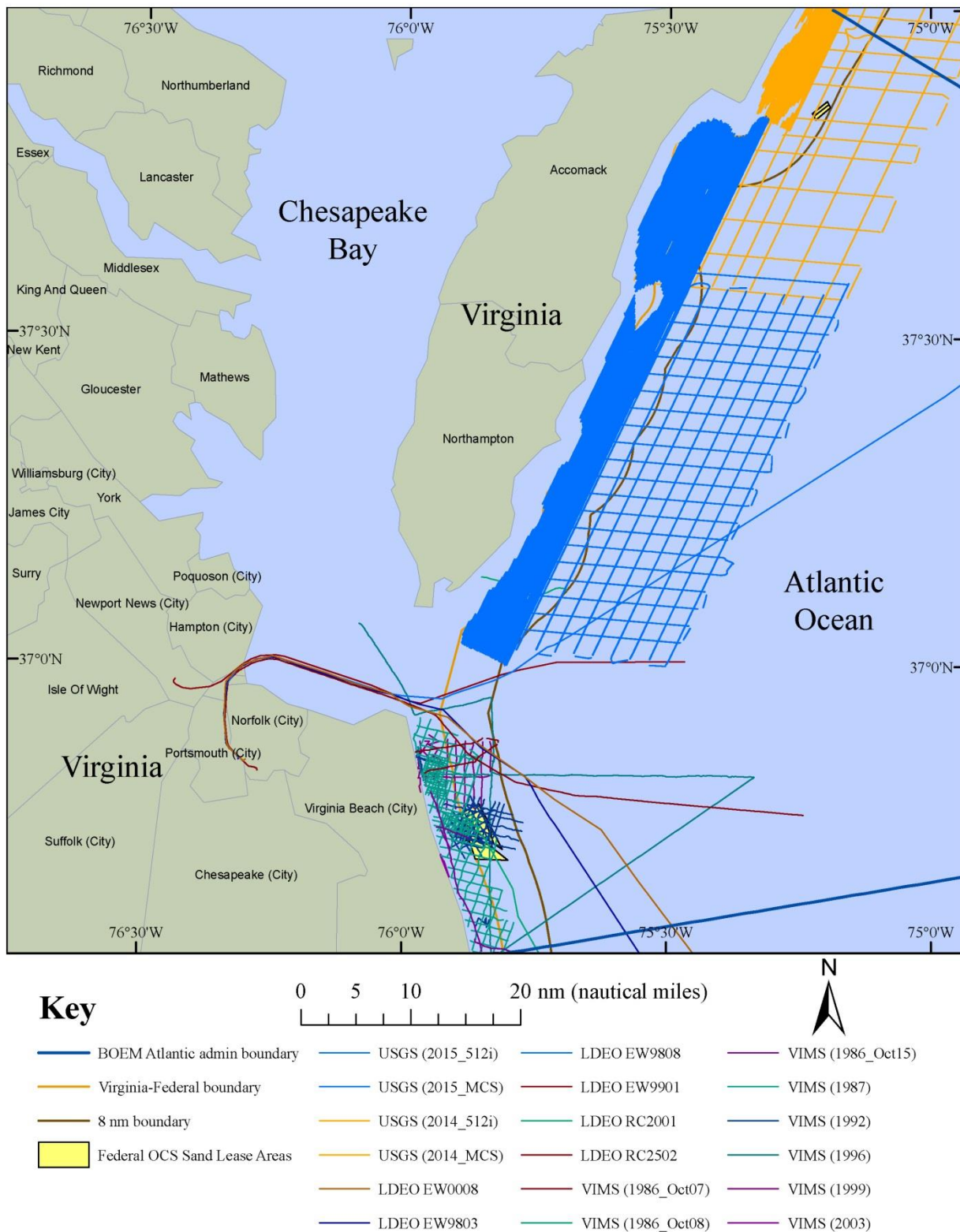


Figure 3. Map showing locations of key geophysical data collection tracklines.

The creation of a new on-line web portal for Virginia's OCS data distribution met substantial challenges during the project period. Web content and map services were developed on an internal DMME website with assistance from the DMME Office of Information Systems. At the time this report was finalized however, the full roll-out of this site to the public was not possible due to security requirements imposed by both DMME and the Virginia Information Technologies Agency (VITA) that manages IT infrastructure and services in the Commonwealth of Virginia. Despite this setback, the GIS geodatabase achieved for this project is designed to be readily incorporated in the on-line mapping system using DMME-licensed platform ESRI ArcGIS Online once all data security concerns have been addressed.

CONCLUSIONS

While there is good coverage for both seismic and cores in the region offshore of Virginia Beach and near Sandbridge shoal, significant data gaps are present to the north and south (Figure 4). In particular, within the project boundary area south of Sandbridge shoal, existing bathymetric data indicates the possibility of prospective sand shoals. Recent core and grab sampling together with new geophysical data collection that was completed in 2015 as part of the BOEM ASAP were focused in this specific area. This data, in combination with the geodatabase compiled for the present study will be valuable for evaluating the sand resources potential there.

To the north, offshore of the Delmarva Peninsula, USGS surveys collected high-quality geophysical data, yet there were only a limited number of seafloor grab samples collected and no cores off the Virginia coast. Recently acquired geophysical data and sediment samples as part of the BOEM ASAP will again provide an opportunity to validate interpretations of sand quality, thickness, and extent using the USGS geophysical data coverage. It is expected that specific target areas for additional coring will be identified in this assessment.

Two other areas recommended for additional study are located along the southern portion of the Delmarva Peninsula and at the entrance to the Chesapeake Bay (Figure 4). In these two areas, earlier studies (Berquist et al., 1990; Luepke, 1990) identified beach-quality sands containing some of the highest concentrations of co-existing heavy minerals, up to 14.7%, which may provide added economic value to sand resources that are mined for coastal resiliency projects.

Recent work offshore of the North Carolina coast has demonstrated the power of a holistic approach using modern geophysical tools (i.e., swath mapping, side-scan and high-resolution sub-bottom profiles) in understanding the distribution of mobile marine sediments (Thieler et al., 2014). We propose a similar study of the Virginia OCS as a critical first step in developing offshore resources. Furthermore, we propose that such a survey be combined with information from shallow sediment cores to verify remote observations and make direct measurements of the depth of sand resources.

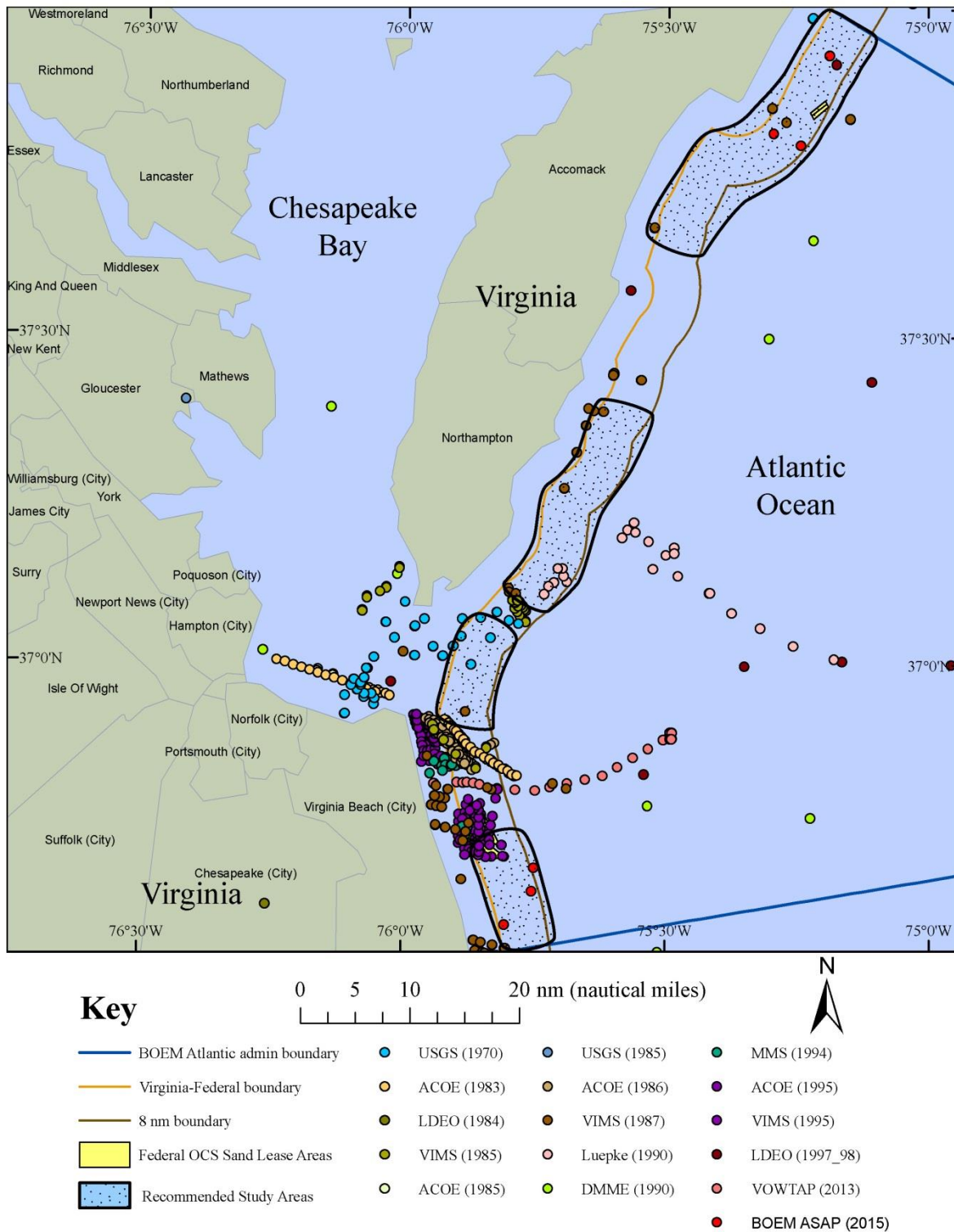


Figure 4. Map showing locations recommended for additional data collection and study.

CITED AND RELEVANT REFERENCES

- Berquist, C.R., Jr., C.T. Fischler, L.J. Calliari, S.M. Dydak, H. Ozalpasan, and S.A. Skrabal, 1990, Heavy-mineral concentrations in sediments of the Virginia Inner Continental Shelf: *in* Berquist, C.R., Jr. [ed.], 1990, Heavy-mineral studies – Virginia inner continental shelf, Virginia Division of Mineral Resources Publication 103, 124 pp.
- DMME (Department of Mines, Minerals and Energy), 2012, Sand resource evaluation on Virginia's outer continental shelf – Final Technical Report: Prepared for U.S. Bureau of Ocean Energy Management, Cooperative Agreement M10AC20021 for the performance period Sept 14, 2010 to Oct 31, 2011: 19p.
- Luepke, G., 1990, Economic heavy minerals in sediments from an offshore area east of Cape Charles, Virginia: U.S. Geological Survey Open File Report 90-451, 10 pp.
- Thieler, E.R., D.S. Foster, E.A. Himmelstoss and D.J. Mallinson, 2014, Geologic framework of the northern North Carolina, USA inner continental shelf and its influence on coastal evolution. *Marine Geology*, 348, 113-130.

APPENDIX A. List of legacy geophysical datasets for the Virginia continental shelf.

Organization	Survey	Year collected	Sublocality	Data type		Platform	Imagery by
USGS	2015-001-FA	2015	Delmarva Peninsula	Multibeam	Sidescan	-	-
USGS	2014-001-FA	2014	Assateague Island	Multibeam	Sidescan	-	-
NOAA	H12575	2013	Chesapeake Bay Traffic Separation Schemes	-	-	NOAA Ship FERDINAND R. HASSLER	Echo Sounder Backscatter
NOAA	H12559	2013	7 NM East of Sand Shoal Inlet	Multibeam	-	Leidos (formerly SAIC)	Side Scan Sonar Multibeam Echo Sounder Backscatter
NOAA	H12503	2012	25 Nautical Miles East of Cape Henry	Multibeam	Sidescan	NOAA Ship FERDINAND HASSLER (S250)	Side Scan Sonar Multibeam Echo Sounder Backscatter
NOAA	H12502	2012	30 Nautical Miles East of Cape Henry	-	-	NOAA Ship FERDINAND HASSLER (S250)	Echo Sounder Backscatter
NOAA	H12501	2012	-	-	-	NOAA Ship FERDINAND HASSLER (S250)	Echo Sounder Backscatter
NOAA	H12423	2012	10 Nautical Miles East of Smith Island	Sidescan	-	NOAA Ship FERDINAND HASSLER (S250)	Side Scan Sonar
NOAA	H12397	2012	4 Nautical Miles East of Hog Island	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam RESON SeaBat 7125 SV
NOAA	H12396	2012	6 NM East of Hog Island	Multibeam	-	SAIC	Multibeam RESON SeaBat 7125 SV
NOAA	H12395	2012	13 Nautical Miles East of Quinby Inlet	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam RESON SeaBat 7125 SV
NOAA	H12394	2012	5 Nautical Miles East of Quinby Inlet	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam RESON SeaBat 7125 SV
DMME	H12421	2012	Southern Chesapeake Bay	Sidescan	-	NOAA Ship THOMAS JEFFERSON (S222)	Multibeam RESON SeaBat 7125 SV
DMME	H12285	2012	Southern Chesapeake Bay	None	-	NOAA Ship THOMAS JEFFERSON	-
NOAA	H12346	2011	15 Nautical Miles East of Cape Charles	Unknown	-	NOAA Ship FERDINAND HASSLER (S250)	

Organization	Survey	Year collected	Sublocality	Data type		Platform	Imagery by
NOAA	H12339	2011	13 Nautical Miles East of Parramore Island	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam Reson SeaBat 7125 SV
NOAA	H12338	2011	6 Nautical Miles East of Parramore Island	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam Reson SeaBat 7125 SV
NOAA	H12337	2011	16 Nautical Miles East of Cedar Island	Multibeam	-	M/V ATLANTIC SURVEYOR	Reson 7125 Multibeam echo sounder
NOAA	H12336	2011	9 Nautical Miles East of Cedar Island	Multibeam	-	M/V ATLANTIC SURVEYOR	Reson 7125 Multibeam echo sounder
NOAA	H12316	2011	Rude Inlet to Sandbridge Beach	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Odom CV200 VBES and Reson 7125 MBES
NOAA	H12315	2011	Cape Henry to Rude Inlet	Multibeam	Sidescan	NOAA Ship THOMAS JEFFERSON (S222)	Multibeam and Sidescan Sonar
NOAA	H12309	2011	29 Nautical Miles East of Cape Henry	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125 Multibeam echo sounder
NOAA	H12308	2011	21 Nautical Miles East of Cape Henry	Unknown	-	OAA Ship THOMAS JEFFERSON (S222)	-
NOAA	H12307	2011	25 Nautical Miles Southeast of Virginia Beach	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125 Multibeam echo sounder
NOAA	H12160	2011	11 Nautical Miles East of Metompkin Island	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam RESON SeaBat 7125 SV
NOAA	F00607	2011	Fish Haven 15 Nautical Miles East Southeast of Cape Henry		-	NOAA Ship FERDINAND HASSLER (S250)	Echo Sounder Backscatter
NOAA	F00602	2011	5 Nautical Miles East of Cape Henry to Chesapeake Bay Bridge Tunnel	Unknown	-	NOAA Ship THOMAS JEFFERSON (S222)	
NOAA	D10059	2011	Hurricane Response	Multibeam	-	NOAA Ship FERDINAND HASSLER (S250)	Multibeam RESON SeaBat 7125 SV
DMME	H12343	2011	Approaches to the Chesapeake Bay	-	-	NOAA Ship THOMAS JEFFERSON (S222)	-
DMME	H12342	2011	Approaches to Chesapeake Bay	-	-	NOAA Ship THOMAS JEFFERSON (S222)	-
DMME	H12341	2011	Approaches to the Chesapeake Bay, Virginia	-	-	NOAA Ship THOMAS JEFFERSON (S222)	-
DMME	H12306	2011	Approaches to Chesapeake Bay	-	-	NOAA Ship THOMAS JEFFERSON (S222)	-

Organization	Survey	Year collected	Sublocality	Data type		Platform	Imagery by
DMME	H12286	2011	Southern Chesapeake bay	-	-	NOAA SeaArk Launch S1211	-
DMME	H12282	2011	Southern Chesapeake Bay	-	-	NOAA Ship THOMAS JEFFERSON (S222)	-
DMME	H12277	2011	Southern Chesapeake Bay	-	-	NOAA Ship THOMAS JEFFERSON (S222)	-
NOAA	H12202	2010	19 Nautical Miles Southeast of Virginia Beach	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125 Multibeam echosounder
NOAA	H12201	2010	24 Nautical Miles East of Cape Henry	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125 Multibeam echosounder
NOAA	H12200	2010	19 Nautical Miles East of Cape Henry	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125 Multibeam echosounder
NOAA	H12161	2010	18 Nautical Miles East of Metompkin Island	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam RESON SeaBat 8101 ER
NOAA	H12094	2010	5 Nautical miles Southeast of Chincoteague Inlet	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam RESON SeaBat 7125 SV
NOAA	H12093	2010	12 Nautical Miles East Southeast of Chincoteague Inlet	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam RESON SeaBat 7125 SV and Multibeam RESON SeaBat 8101 ER
NOAA	H12092	2010	5 Nautical Miles East of Assateague Island	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam Reson SeaBat 7125 SV
NOAA	H12091	2010	13 Nautical Miles East of Assateague Island	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam Reson SeaBat 7125 SV
NOAA	H12003	2010	5 Nautical Miles East of Assateague Island		-	M/V ATLANTIC SURVEYOR	Echo Sounder Backscatter
NOAA	H12002	2010	13 Nautical Miles East of Assateague Island	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam Reson SeaBat 7125 SV
DMME	H12241	2010	Central Chesapeake Bay	-	-	R/V THEORY	-
DMME	H12240	2010	Central Chesapeake Bay	-	-	R/V THEORY	-
DMME	H12239	2010	Central Chesapeake Bay	-	-	R/V THEORY	-
DMME	H12238	2010	Central Chesapeake Bay	-	-	R/V THEORY	-
NOAA	H12203	2010	22 Nautical Miles Southeast of Virginia Beach	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125 Multibeam echosounder
DMME	H12202	2010	Approaches to Chesapeake Bay	-	-	NOAA Ship THOMAS JEFFERSON (S222)	-
DMME	H12181	2010	Southern Chesapeake Bay	-	-	NOAA Ship THOMAS	-

Organization	Survey	Year collected	Sublocality	Data type		Platform	Imagery by
DMME	H12180	2010	Southern Chesapeake Bay, Virginia	-	-	JEFFERSON (S222) NOAA Ship THOMAS JEFFERSON (S222)	-
DMME	H12061	2010	Gulf of Mexico	-	-	R/V ABLE II	-
DMME	F00583	2010	Hampton Roads	-	-	NOAA SeaArk Launch S1212	-
NOAA	H12100	2009	17 Nautical miles Northeast of Cape Henry	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125 echosounder
DMME	H12045	2009	Southern Chesapeake Bay	-	-	R/V THEORY	-
DMME	H12044	2009	Southern Chesapeake Bay	-	-	R/V THEORY	-
DMME	H12043	2009	Southern Chesapeake Bay	-	-	R/V THEORY	-
DMME	H12042	2009	Southern Chesapeake Bay	-	-	R/V THEORY	-
DMME	H12041	2009	Southern Chesapeake Bay	-	-	R/V CHINOOK	-
DMME	H12040	2009	Southern Chesapeake Bay	-	-	R/V THEORY	-
NOAA	H12039	2009	Nine Foot Shoal	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125 Multibeam echosounder Odom MKII vertical beam echosounder 8101 Multibeam echo sounders
NOAA	H12038	2009	5 Nautical Miles East of Fisherman's Island	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125/8125 Multibeam echo sounders
NOAA	H12037	2009	17 Nautical Miles Northeast of Cape Henry	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125 echosounder
NOAA	H12001	2009	16 Nautical Miles East of Assateague Island	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam Reson SeaBat 7125 SV
NOAA	D00151	2009	Cape Henry to Portsmouth Marine Terminal	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125/8125 Multibeam echo sounders
NOAA	H11992	2008	13 Nautical Miles East of Assateague Island	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam RESON SeaBat 8101 ER
NOAA	H11874	2008	East of Assateague Island	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam RESON SeaBat 8101 ER
NOAA	H11873	2008	13 Nautical Miles East South East of Ocean City	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam RESON SeaBat 8101 ER
NOAA	H11872	2008	Southeast of Ocean City	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam RESON SeaBat 8101 ER
NOAA	H11789	2008	Southwest of Nautilus Shoal	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125 Multibeam echosounder Odom MKII vertical beam echosounder

Organization	Survey	Year collected	Sublocality	Data type		Platform	Imagery by
							8101 Multibeam echo sounders
DMME	H11599	2008	Tanner Point to Town Point	-	-	NOAA BAY HYDROGRAPHER (S5501)	-
DMME	H11657	2007	Central Chesapeake Bay	-	-	R/V SEALTH	-
DMME	H11656	2007	Central Chesapeake Bay	-	-	R/V SEALTH	-
DMME	H11655	2007	Central Chesapeake Bay	-	-	R/V SEALTH	-
DMME	H11653	2007	Central Chesapeake Bay	-	-	R/V SEALTH	-
DMME	H11652	2007	North Atlantic Ocean	-	-	NOAA Ship THOMAS JEFFERSON (S222)	-
NOAA	H11651	2007	Southeast End of Chesapeake Channel	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125 Multibeam echosounder Odom MKII vertical beam echosounder 8101 Multibeam echo sounders
NOAA	H11650	2007	7 Nautical Miles East of Fenwick Island	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam RESON SeaBat 8101 ER
NOAA	H11649	2007	East of Fenwick Island	Multibeam	-	M/V ATLANTIC SURVEYOR	Multibeam RESON SeaBat 8101 ER
NOAA	H11603	2007	Middle Ground to Lynnhaven Roads	Multibeam	-	NOAA Ship RUDE (S590)	ODOM Echotrak MK II and RESON 8125 echosounders
DMME	H11603	2007	Southern Chesapeake Bay	-	-	NOAA Ship RUDE (S590)	-
DMME	H11530	2007	Chesapeake Bay	-	-	NOAA Ship RUDE (S590)	-
DMME	H11295	2007	York River	-	-	NOAA Ship RUDE (S590)	-
DMME	F00540	2007	Elizabeth River	-	-	NOAA Ship THOMAS JEFFERSON (S222)	-
NOAA	H11652	2006	8 Nautical Miles Northeast of Cape Henry	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125 and Reson 8125 Multibeam echosounders
DMME	H11585	2006	North Atlantic Ocean	-	-	NOAA Ship THOMAS JEFFERSON (S222)	-
NOAA	H11568	2006	17 Nautical Miles Southeast of Cape Henry	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125 echosounder

Organization	Survey	Year collected	Sublocality	Data type		Platform	Imagery by
NOAA	H11555	2006	30 Nautical Miles Southeast of Cape Henlopen	Multibeam	-	M/V ATLANTIC SURVEYOR	8101 Multibeam reson seabat
DMME	H11535	2006	Central Chesapeake Bay	-	-	R/V SEALTH	-
DMME	H11529	2006	Southern Chesapeake Bay	-	-	NOAA Ship RUDE (S590)	-
DMME	H11505	2006	Central Chesapeake Bay	-	-	R/V SEALTH	-
DMME	H11504	2006	Central Chesapeake Bay	-	-	R/V SEALTH	-
DMME	H11503	2006	Central Chesapeake Bay	-	-	R/V SEALTH	-
DMME	H11323	2006	Chesapeake Bay	-	-	NOAA Ship THOMAS JEFFERSON (S222)	-
NOAA	H11303	2006	15 Nautical Miles Southeast of Cape Henry	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	Reson 7125, 8101 and Reson 8125 Multibeam echosounders
DMME	H11206	2006	Southern Chesapeake Bay	-	-	NOAA Ship RUDE (S590)	-
DMME	H11205	2006	Chesapeake Bay	-	-	NOAA Ship RUDE (S590)	-
NOAA	H11585	2005	15 Nautical Miles West - Northwest of Norfolk Canyon	Unknown	-	NOAA Ship THOMAS JEFFERSON (S222)	none
DMME	H11407	2005	Southern Chesapeake Bay	-	-	NOAA Ship RUDE (S590)	-
DMME	H11402	2005	Approaches to Chesapeake Bay	-	-	NOAA Ship RUDE (S590)	-
NOAA	H11401	2005	8 Nautical Miles Southeast of Cape Henry	Multibeam	-	NOAA Ship RUDE (S590)	Reson 8125 Seabat
NOAA	H11301	2005	10 Nautical Miles Southeast of Cape Henry	Multibeam	-	NOAA Ship THOMAS JEFFERSON (S222)	8101 and 8125 Seabat
DMME	H11207	2005	Southern Chesapeake Bay	-	-	NOAA Ship RUDE (S590)	-
DMME	H10945	2004	Chesapeake Bay	-	-	NOAA Ship RUDE (S590)	-
VIMS	-	2003	South of Virginia Beach	-	-	-	-
NOAA	H11302	2003	2 Nautical Miles Southeast of Cape Henry	Multibeam	-	NOAA Ship RUDE (S590)	Reson 8125 Seabat
DMME	H11028	2002	Chesapeake Bay	-	-	NOAA Ship RUDE (S590)	-

Organization	Survey	Year collected	Sublocality	Data type		Platform	Imagery by
VIMS and NOAA	chesapeakespi	2002	Catlett and Goodwin Islands	-	-	-	Side Scan Sonar
NOAA	H11027	2001	6 Nautical Miles Northeast of Cape Henry	Multibeam	-	NOAA Ship WHITING (S329)	Odom Echotrac DF3200 MK 11 Echosounder
NOAA	H11016	2000	NORTHEAST APPROACH TO CHESAPEAKE BAY	-	-	-	Reson Seabat 9003 SWMB
NOAA	H10952	2000	Chesapeake Channel	Multibeam	-	NOAA Ship RUDE (S590)	Reson Seabat 9003 SWMB
VIMS	-	1999	Virginia Beach	-	-	-	-
NOAA	F00439	1998	VICINITY OF CAPE HENRY VIRGINIA	Multibeam	-	NOAA Ship RUDE (S590)	Reson Seabat 9003 SWMB
NOAA	D00129	1998	-	None	-	NOAA BAY HYDROGRAPHER (S5501)	DSF 6000N fathometer Odom Echtrac
NOAA	H10745	1997	Nautilus Shoal	Multibeam	-	NOAA BAY HYDROGRAPHER (S5501)	echosounder
VIMS	-	1996	Chesapeake Bay to NC border	-	-	-	-
NOAA	F00412	1995	3 Nautical Miles East of Cape Henry	Multibeam	-	NOAA Ship HECK (S591)	echosounder
NOAA	F00395	1994	7 Nautical Miles Southeast of Cape Henry	Sidescan	-	NOAA Ship HECK (S591)	side scan sonar
NOAA	F00394	1994	Hampton Roads	Unknown	-	NOAA Ship HECK (S591)	not noted
VIMS	-	1992	South of Virginia Beach	-	-	-	-
NOAA	H10372	1990	Approaches to Thimble Shoal Channel	Fathometer	-	-	DSF 6000N fathometer Odom Echtrac
NOAA	H10356	1990	Northeast Approach to Chesapeake Bay	Unknown	-	NOAA Ship HECK (S591)	unknown
NOAA	H10343	1990	1.5 Nautical Miles Northeast of Cape Henry	Fathometer	-	NOAA Ship WHITING (S329)	DSF 6000N fathometer Odom Echtrac
NOAA	H10341	1990	12 Nautical Miles Southeast of Cape Henry	Fathometer	-	NOAA Ship WHITING (S329)	DSF 6000N fathometer Odom Echtrac
NOAA	H10340	1990	5 Nautical Miles East of Cape Henry	Fathometer	-	NOAA Ship WHITING (S329)	DSF 6000N fathometer Odom Echtrac
NOAA	H10337	1990	8.5 Nautical Miles	Fathometer	-	NOAA Ship WHITING	Echo sounder DSF 6000

Organization	Survey	Year collected	Sublocality	Data type		Platform	Imagery by
NOAA	F00355	1990	Southeast of Cape Henry Southeast Approaches to Chesapeake Bay	Sidescan	-	(S329) NOAA Ship HECK (S591)	side scan sonar
NOAA	F00354	1990	Southeast Approaches to Chesapeake Bay	Sidescan	-	NOAA Ship HECK (S591)	side scan sonar
NOAA	F00353	1990	Eastern Approach to Thimble Shoal	Fathometer	-	NOAA Ship HECK (S591)	Echo sounder DSF 6000
VIMS	-	1987	Virginia Beach to NC border	-	-	-	-
USGS	FRNL87	1987	Atlantic Margin	Sidescan	-	R/V Farnella	Side Scan Sonar
USGS	GLORIA	1987	-	-	-	-	-
VIMS	-	1986	South of Virginia Beach to NC border	-	-	-	-
NOAA	D0023	1984	-	-	-	-	na
NOAA	H10066	1982	EAST OF PARRAMORE BANKS	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	Ross Model 5000 echo sounder
NOAA	H10046	1982	CHINCOTEAGUE SHOALS	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	echo sounder
NOAA	H10045	1982	WALLOPS ISLAND TO METOMPKIN ISLANDS	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	Ross Digital Echo sounder
NOAA	H10044	1982	BLACKFISH BANK TO PORPOISE BANK	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	echo sounder
NOAA	H10034	1982	Parramore Banks	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	echo sounder
NOAA	H09981	1982	15 MILES EAST OF HOG ISLAND	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	echo sounder
NOAA	H09980	1981	COBB ISLAND TO HOG ISLAND	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	echo sounder
NOAA	H09978	1981	20 MILES EAST OF CAPE HENRY	Fathometer	-	NOAA Ship PEIRCE (S328)	Ross Model 5000 echo sounder
NOAA	H09972	1981	OFFSHORE - SANDBRIDE BEACH	Fathometer	-	NOAA Ship PEIRCE (S328)	Ross Model 5000 echo sounder
NOAA	H09970	1981	OFFSHORE WRECK ISLAND	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	Ross Model 5000 echo sounder
NOAA	H09969	1981	Cobb Island to Myrtle Island	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	echo sounder
NOAA	H09962	1981	OFFSHORE SMITH ISLAND	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	echo sounder

Organization	Survey	Year collected	Sublocality	Data type		Platform	Imagery by
NOAA	H09961	1981	SMITH ISLAND INLET TO LITTLE INLET	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	echo sounder
NOAA	H09959	1981	APPROACHES TO CHESAPEAKE BAY	Fathometer	-	NOAA Ship PEIRCE (S328)	Ross Model 5000 echo sounder
NOAA	H09955	1981	OFFSHORE CHESAPEAKE BAY ENTRANCE	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	Ross Model 5000 echo sounder
NOAA	H09948	1981	ALONGSHORE - SANDBRIDGE BEACH	Fathometer	-	NOAA Ship PEIRCE (S328)	Ross Model 5000 echo sounder
NOAA	H09922	1980	CAPE HENRY TO DAM NECK	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	Ross Model 5000 echo sounder
NOAA	H09919	1980	Offshore Cape Charles and Cape Henry	Fathometer	-	NOAA Ship PEIRCE (S328)	unknown
NOAA	H09905	1980	OFFSHORE CAPE HENRY	Fathometer	-	NOAA Ship PEIRCE (S328)	Ross Model 5000 echo sounder
NOAA	H09904	1980	NAUTILUS BAY	Fathometer	-	NOAA Ship PEIRCE (S328)	Ross Model 5000 echo sounder
NOAA	H09901	1980	Chesapeake Channel	Fathometer	-	NOAA Ship PEIRCE (S328)	Ross Model 5000 echo sounder
NOAA	H09814	1980	Lynnhaven Roads	Fathometer	-	NOAA Ship PEIRCE (S328)	Ross Model 5000 echo sounder
NOAA	H09796	1978	ALONGSHORE ASSATEAGUE I. & WINTER QUARTER SHOAL	Fathometer	-	NOAA Ship WHITING (S329)	echo sounder hand lead pole
NOAA	H09788	1978	ALONGSHORE ASSATEAGUE ISLAND	Fathometer	-	NOAA Ship WHITING (S329)	echo sounder hand lead pole
NOAA	H09780	1978	ASSATEAGUE ISLAND	Fathometer	-	NOAA Ship WHITING (S329)	Ross Model 5000 echo sounder
NOAA	H09764	1978	FENWICK ISLAND TO OCEAN CITY	Fathometer	-	NOAA Ship WHITING (S329)	Ross Model 5000 echo sounder
NOAA	H09759	1978	LITTLE GULLAND GREAT GULL BANKS	-	-	NOAA Launch 1255	Hand Lead
NOAA	H09715	1977	SINPUXENT BAY AND OCEAN CITY	Fathometer	-	NOAA Skiff 570	echo sounder and pole
NOAA	H09701	1977	RUDEE INLET	Fathometer	-	NOAA Skiff 560	echo sounder and pole
NOAA	H09693	1977	NAUTILUS SHOAL	Fathometer	-	NOAA Ship PEIRCE (S328)	Ross Model 5000 and Raytheon DE-719B

Organization	Survey	Year collected	Sublocality	Data type		Platform	Imagery by
NOAA	H09871	1976	CHESAPEAKE BAY ENTRNCE	-	-	NOAA Ships RUDE (S590) and HECK (S591)	wire drag and bryson gage
NOAA	H09640	1976	JACK POT	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	Ross Model 5000 echo sounder
NOAA	H09639	1976	OFFSHORE CAPE HENLOPEN	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	echo sounder and pole
NOAA	H09629	1976	OFFSHORE OCEAN CITY	Fathometer	-	NOAA Ship MT. MITCHELL (S222)	echo sounder and pole
NOAA	H09579	1975	OFFSHORE OF FENWICK I.	Fathometer	-	USC&GS Ship WHITING (S329)	Ross Model 5000 echo sounder
VIMS	-	pre 1986	Various	-	-	-	-
NOAA	MGD77	Many	-	-	-	-	-
NOAA	H12561	-	-	-	-	-	-
NOAA	H12560	-	-	-	-	-	-
NOAA	H12505	-	-	-	-	-	-
NOAA	H12504	-	-	-	-	-	-
USGS	GLORIA	-	-	Sidescan	-	-	-
NOAA	H09099	1969					
NOAA	H09098	1969					
NOAA	H08724	1963					
NOAA	H08711	1962					
NOAA	H08218	1954					
NOAA	H08217	1954					
NOAA	H07750	1950					
NOAA	H07791	1949					
NOAA	H07721	1949					
NOAA	H07703	1948					
NOAA	H07184	1947					
NOAA	H06595	1940					
NOAA	H06344	1938					
NOAA	H06220	1938					
NOAA	H05713	1938					
NOAA	H05995	1937					
NOAA	H05992	1935					
NOAA	H05991	1935					
NOAA	H05990	1935					
NOAA	H05989	1935					

Organization	Survey	Year collected	Sublocality	Data type	Platform	Imagery by
NOAA	H05988	1935				
NOAA	H05771	1934				
NOAA	H05770	1934				
NOAA	H05769	1934				
NOAA	H05716	1934				
NOAA	H05715	1934				
NOAA	H05714	1934				
NOAA	H05704	1934				
NOAA	H05703	1934				
NOAA	H05702	1934				
NOAA	H05675	1934				
NOAA	H05674	1934				
NOAA	H05673	1934				
NOAA	H05356	1934				
NOAA	H05355	1934				
NOAA	H05347	1934				
NOAA	H05358	1933				
NOAA	H05357	1933				
NOAA	H05354	1933				
NOAA	H05352	1933				
NOAA	H05351	1933				
NOAA	H05349	1933				
NOAA	H05348	1933				
NOAA	H05346	1933				

APPENDIX B. ESRI ArcGIS geodatabase file to accompany this report