Synthesis of Existing Geological and Geophysical Surveys with Suggestions for Areas for Future Research

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Stony Brook University's COAST Institute

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COAST has been called upon to assist in resolving coastal problems at home on Long Island, throughout the U.S. and in many parts of the world. COAST also provides a real world, action-learning laboratory for graduate students at MSRC. Each year students who are interested in coastal management and policy take part in gathering and analyzing data, in transforming data into information, and in synthesizing information-all targeted at identifying and evaluating management alternatives to attack the problems that COAST is helping to solve.

Synthesis of existing geological and geophysical surveys with suggestions for areas for future research

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INTRODUCTION

Coastal states such as New York have a continuing need for sand which can be used to replenish beaches and other coastal structures in response to coastal evolution, storm damage and long-term sea-level rise. Sand appropriate for this use can come from onshore areas, from the seabed near to the shoreline (the region of NY State jurisdiction extends three nautical miles into the Atlantic Ocean), or from Federal lands farther than three nautical miles offshore. The Bureau of Ocean Energy Management (BOEM, part of the U.S. Department of the Interior) has responsibility for identifying and managing sand resources in Federal waters. BOEM and the New York State Department of State (NYS DOS) have entered into a cooperative agreement entitled "Sandy Needs and Resources Offshore New York" which is supporting a range of studies including those designed to improve our understanding of the location and nature of sand resources in Federal lands, and interaction with sand resources in State waters. Those portions of the Atlantic Ocean within 3 nautical miles of the shoreline are State waters while Federal lands begin at 3 nautical miles and extend farther offshore. This report presents the results of two tasks defined for this study: (1) synthesizing existing geological and geophysical data within the nearshore portion of the DOS Atlantic Ocean offshore planning area; and (2) identifying areas to be studied with future geological and geophysical surveys.

The following synthesis and integration of existing geological (primarily core) and geophysical (primarily seismic profile) data is intended to show available data in the study area, to identify data gaps in the existing coverage, and to delineate areas with potentially desirable sand resources to be studied with future geological and geophysical surveys. This information can be used to prioritize future study areas and to develop recommendations for BOEM.

STUDY AREA

Studies to date have focused on identifying geophysical data in the nearshore portion of the DOS Atlantic Ocean planning area with water depths less than about 40 meters. Our study area extends from 3 to 8 nautical miles offshore of New York in water depths less than about 30 meters (about 90 feet; Figure 1). This is the area where present-day dredging technology is able to remove sediments from the seafloor and potentially pump them to the

shoreline. It is also the area of new BOEM ASAP (Atlantic Sand Assessment Project) geophysical and geological data acquisition that occurred during 2015.

SOURCES OF EXISTING GEOLOGICAL AND GEOPHYSICAL DATA

Geophysical data have been collected within the study area by U.S. Government agencies (including the United States Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE)), by academic institutions for research and commercial purposes, and by commercial survey companies in support of government, research and commercial purposes. While geophysical surveys have been conducted in this area since at least the 1960s, early data was collected using navigation techniques less precise than the Global Positioning System (GPS) navigation used more recently and early profiles are often of low resolution, recorded on paper and only available as the paper records themselves or photographs of those analog records. More recent geophysical surveys use GPS navigation and the profile data are recorded digitally allowing for further processing and enhanced display. Data collected for government purposes (which can include management and research projects) are often available for use by outside investigators, and government organizations such as USGS and NOAA have published data as well as analyses of data they have collected. Data collected for research purposes in the study area are sometimes collected when a research vessel passes through the study area during transit to the primary research area. Data also have been collected as part of research projects within the study area. Some of those study results have been published, but often only example profiles are available. Data collected for commercial purposes - for example, for planning for an undersea cable, pipeline, water discharge, sand mining or wind farm - generally are considered proprietary information, have not been made publicly available, and have not been used in this study.

Finding previously collected geophysical data can be a challenging task, especially when data are stored only by the investigator or organization that originally collected the data. However, the task of finding existing data has been made somewhat easier by the recent existence of several web sites which store geophysical trackline data and, in some cases, versions of the geophysical data itself. Table 1 lists several web sites where seismic tracklines and some other geological data can be found in the study area. Visits to regional oceanographic institutions and agencies may still be needed to discover other data sources in the area.

RECENT USGS DATA IN THE STUDY AREA

Systematic, high-resolution seismic data were collected along the south shore of Long Island from about 1995 through 1999 and then again in 2011 by the USGS at Woods Hole. These seismic data are generally of high resolution and high quality, and are collected with a line spacing of about 300 m. While the seismic lines from the 1990s are quite good, the seismic lines from 2011 are quite a bit better and demonstrate the evolution of seismic profiling systems in recent years. Much of these data fall within the three-mile zone of NY State jurisdiction, but some of the lines extend past three miles, especially at the western end of

Long Island (Figure 2). Dr. William Schwab and Jane Denny at USGS, Woods Hole, provided a summary of the USGS tracks and included several of the maps derived from the seismic and other survey data as ArcMap files on a CD and this trackline information was supplemented by information about tracks and seismic lines collected in 1993 and in 2011. The updated set of track lines, along with images of seismic lines that are hotlinked to the seismic track lines, are provided on the GIS project that was done to accompany this report. The digital trackline data and images of associated seismic profiles can also be viewed using the viewer for marine geology data GeoMapApp (http://www.geomapapp.org). To see the tracklines andseismic profiles on GeoMapApp, select Portal > Digital Seismic Reflection Profiles > USGS SCS. Zoom to the study area off the south shore of Long Island and click on a survey area to view the profiles in that area.

The files prepared for the GIS project also include digital data for seismic profiles in seg-y format along with the detailed navigational information for the profiles. The digital seismic and navigation data provided is detailed in Appendix 1.

We also received from USGS data from bathymetric and acoustic backscatter studies conducted south of Fire Island and south of Rockaway during 2011 and 2014. These map layers are included in the GIS project, and they supplement numerous other bathymetric surveys undertaken in the area. Most of these surveys are available through NOAA (http://ngdc.noaa.gov/mgg/bathymetry/hydro.html).

USGS provided grids and shape files for several important maps that describe sediment thickness and sub-surface sediment characteristics south of Long Island based on Foster et al. (2000), Schwab et al. (2000) and Schwab et al. (2003).

Depth of the Coastal Plain Unconformity: The Coastal Plain Unconformity is the surface that marks the transition between sediments deposited prior to glacial times and glacial-aged (Quaternary) sediments. South of Long Island, sediments beneath the Coastal Plain Unconformity may be quite old, perhaps of Cretaceous age (older than 65 million years). The coastal plain unconformity underlies Long Island as well as the continental shelf.

Quaternary Isopach Map: Quaternary sediments were deposited during the last appx. 1.8 million years which is a time of repeated glacial advances and retreats. The topography of Long Island is built of Quaternary sediments, and Quaternary sediments are present on the shelf except in some areas where Cretaceous sediments are thought to be present at the sediment surface.

Channel boundaries and thicknesses: In certain places the Quaternary sediments contain channels formed as glacial melt waters flowed over land to the sea at times when sea-level was lower. The location of these channels and the thickness of the sediments that fill the channels can be observed on seismic profiles.

Holocene Isopach Map: shows thickness of the Holocene sand layer based on seismic profile interpretation and sediment samples. Holocene sediments have been deposited during and following the post-glacial sea-level rise (during approximately the last 11,000 years). The Holocene layer is considered to be the modern sand unit and likely to be the

most compatible with existing sand and thus most suitable for purposes including beach nourishment.

Table 1. Listing of major on-line resources for geophysical and geological data	
http://ngdc.noaa.gov/mgg/	NOAA National Geophysical Data Center. This site hosts a number of viewers for specific types of data sets including seismic reflection data, NOS hydrographic data, NOS sample data and multibeam bathymetry data.
http://ngdc.noaa.gov/mgg/seismicreflection/index.html	A NGDC viewer for seismic reflection data that has been submitted to NGDC.
http://ngdc.noaa.gov/mgg/bathymetry/hydro.html	A NGDC viewer for NOS hydrographic surveys including results since the early 1800s
http://ngdc.noaa.gov/mgg/geology/geology.html	A NGDC listing of several collections of sea-bed sample locations and descriptions. Includes visual descriptions of samples collected during NOS hydrographic survey as well as data on other bottom samples submitted to NGDC for archiving.
http://www.iedadata.org/	NSF-supported Interdisciplinary Earth Data Alliance. This hosts several world-wide data collections.
http://www.marine-geo.org/portals/seismic/	Academic Seismic Portal (ASP) at LDEO, a web site of the NSF-supported IEDA which includes seismic and multibeam data sets.
http://www.ig.utexas.edu/sdc/	Academic Seismic Portal (ASP) at UTIG, a web site of the NSF-supported IEDA which includes primarily seismic data sets.
http://cmgds.marine.usgs.gov/	A web site of USGS which lists data collections by state and by survey. There are links to reports and to survey data.
http://coastalmap.marine.usgs.gov/regional/contusa/	A web site of USGS which lists several data sets, including seismic data, sediment samples and bottom photographs.
http://woodshole.er.usgs.gov/operations/ia/	A web site listing the Data Archives of the USGS Woods Hole Science Center. This site appears to include surveys, samples and bottom photographs not indexed elsewhere.
http://coastalmap.marine.usgs.gov/cmgp/rest /services/EastCoast/AtlanticCoast/MapServer	Web site listing USGS coverages for the US East Coast. Includes surveys,

	samples, maps, grids and more.
http://www.arcgis.com/home/webmap/viewer.html?url=http%3A%2F%2Fcoastalmap.marine.usgs.gov%2Fcmgp%2Frest%2Fservices%2FEastCoast%2FAtlanticCoast%2FMapServer&source=sd	Same data layers as above but accessed through a ArcGIS interface.
http://woodshole.er.usgs.gov/data/submergedlands/sf_maps.html	Maps of America's Submerged Lands, East Coast, created by USGS.
http://www.geomapapp.org	GeoMapApp provides access to many geological and geophysical data sets.

OTHER SEISMIC DATA IN THE STUDY AREA

A search of the NGDC and ASP (see Table 1) web sites results in about 75 ship tracks that collected seismic profiles while passing through the study area. These tracks were collected between the years of about 1961 and 2002. With one exception, R/V Endeavor EN370 which was collected in 2002, the lines were navigated using LORAN or transit satellites and as a result the navigation accuracy is likely to be poor. In several cases there is no digital navigation available. The EN370 seismic profiles have high resolution and fall in the area of interest, but the records exist on paper only. We anticipate getting access to these records, but they were not available in time to be included in this report. Most of the seismic records on these web sites are only available as images of microfilmed records which have limited dynamic range, and for many cruises seismic data were collected using low-resolution, deep-penetration seismic profilers. In addition, most of these tracks are transits which means they are tracks followed when the ship was leaving or returning to port and the portion of the track near the port may not have any seismic data if the primary research effort was not in our region of interest. Based on our analysis of the prior track data, only six academic cruises are thought to have seismic data that could be useful for the project: R/V Trident cruises 27 and 34 (TR27 and TR34), R/V Atlantis II, cruise 89, legs 1, 2 and 3 (A2089L01, A2089L02, and A2089L03) and R/V Endeavor cruise 370 (EN370; Figure 3). The R/V Trident studied the continental shelf in the 1960s, the R/V Atlantis II cruises studied the continental shelf for the USGS in Woods Hole in the 1970s, and the R/V Endeavor cruise was part of a study of sediment layering on the outer shelf, primarily undertaken off New Jersey, supported by the Office of Naval Research. The microfilm images of seismic lines collected during TR027 and TR034 are hotlinked to the appropriate track lines in the GIS project. The microfilm images of the seismic lines collected during A2089L01-L03 are included in the files but not hotlinked to the navigation data, and we are so far unable to obtain copies of the EN370 profiles for this project.

The Coastal Engineering Research Center (CERC, a former branch of USACE) conducted two extensive projects in the study area which collected seismic data and long cores in the early 1970s in support of offshore sand resources (Williams and Duane, 1974 and Williams, 1976). The Preface of each report says that microfilmed records of the seismic data collected for the project were deposited at a Federal data center. In spite of an extended search, we were unable to locate the microfilms at ngdc.noaa.gov, the current geophysical Federal data center.

In addition to seismic data, in the CERC studies of New York Bight and off Long Island, Willams and Duane (1974) and Williams (1976) reported on about 200 long cores they collected in the area, and also summarized a number of other borings in the area. The core locations are only known from figures in the two reports, and the locations of the cores were determined by digitizing core locations on rectified figures in the reports. The figures were stretched as needed so that the shoreline on the figure agreed with the shoreline on the map. While the positions of some of these cores may be in the USGS Sediment Sample Data Base (ECSTDB2014), our files for the TM-45 and TP-76 are more complete, and perhaps more accurate, and ensure that the results of these important cores are available to the project (Figure 4). Descriptions of these cores can be found in the tables and appendices of these CERC reports.

GAPS IN SEISMIC DATA

The relatively dense grid of seismic lines available off the south shore of Long Island is largely a result of the extensive USGS studies in the region. However, despite this dense seismic coverage there are some notable areas with little seismic data in the region from 3 to 8 nm offshore, especially towards the eastern end of Long Island (Figure 5). Also, while the quality of many of the USGS seismic lines is good considering the technology available at the time, there has been considerable advancement in technology and high-resolution seismic lines collected using more modern systems that now provide better images of sediment layering. (Comparing and contrasting the USGS seismic lines collected in the mid-1990s with those collected in 2011 provides an example of this.)

The most significant data gaps in water depths less than 30 meters are in an area that is about 30 km (16 nm) long and about 6 km (3.7 nm) wide offshore of western Fire Island, and in an area that is about 16 km by 6 km (about 8.6 by 3.7 nm) in Federal waters directly east of Montauk, NY. With the exception of one detailed USGS survey, there is much less data on water depths between 3 nm and 8 nm offshore and between 30 m and 40 m water depths off the eastern portion of Long Island. There is continuing interest in identifying sand resources in Federal waters towards the eastern end of Long Island, and these large gaps in seismic coverage should be filled to better understand sand resources in this critical area. There are very few seismic tracks available at distances more than 8 nm offshore in between 30 m and 40 m. A portion of the planning area shallower than 60 m but farther than 12nm offshore is being assessed for offshore wind turbines, including a site first proposed for an offshore wind project by the New York Power Authority (http://www.boem.gov/New-York/; accessed 10/15/2015). New York will work to integrate any seismic data, acoustic mapping data (multibeam, side-scan sonar) and sediment sampling data collected in support of offshore wind planning in this offshore sand resources analysis to the extent possible, given proprietary restrictions. This kind of data will help with our understanding of sediment sources to the coastal zone, sediment dynamics, and benthic habitat on the continental shelf.

Borrow areas in State waters are often placed in low-amplitude sand ridges of Holocene age which formed during the post-glacial sea-level rise and which appear to still be active today. These are attractive targets for dredging sand for beach renourishment since the Holocene sands are likely to have similar characteristics to present-day beach sands; however, the sands

between sand ridges may also be suitable for beach renourishment. USGS has used their high-resolution seismic data to map the distribution of Holocene sands on the inner shelf. Holocene sand deposits appear to be primarily in the form of sand ridges, and the distribution of Holocene sands appears to follow the distribution of sand ridges. It is known from sediment cores and from the geophysical data that there can be relatively thick sands in areas of no ridges (termed the flats) as well as between the ridges.

Although sand from the sand ridges is probably the best quality for beach nourishment as has been suggested by Dr William Schwab (USGS, Woods Hole), there are other resource management considerations that must be addressed when using the ridges because of their possible habitat value and because they may be conduits for an offshore source of sand feeding the beaches. Ridges can also be important areas for benthic organisms, so preferential destruction of ridges is not ideal. We will seek to understand how the new data and updated interpretations can help understand the modern-day role of these sand ridges. However, the areas between (and also underlying the sand ridges) contain sand deposits, perhaps 1000 feet thick. We seek to better understand the nature of these older, deeper sands to understand if they will meet renourishment or other sand needs.

More complete seismic data coverage, combined with repeat bathymetric surveys and sonar imaging as well as additional grab and core sampling, is needed to fully characterize the area and to better understand the present-day sedimentary processes and transport pathways and thus to understand the evolution of the sea bed in this region.

AREAS TO BE STUDIED WITH FUTURE GEOLOGICAL AND GEOPHYSICAL SURVEYS

As part of BOEM's initiative to investigate sand resources, it supported independent data acquisition termed the Atlantic Sand Assessment Project (ASAP), to collect new high-resolution seismic and other mapping data as well as new sediment samples between 3 and 8 nautical miles offshore in coastal states from Florida to Maine. As a result of this effort, new seismic data were collected along approximately 736 km of track line in Federal waters offshore New York during June and July 2015 using state-of-the-art geophysical equipment. In addition, approximately 49 new grab samples or cores have been collected in this area (Figure 6). The new ASAP seismic lines are being collected along a coarse grid which has an across-margin line spacing of 900 m and an along-margin line spacing of 1,800 m, although not all lines of this grid were surveyed during 2015. Lines were run in areas where beach sand renourishment has been common in the past and where USGS data analysis suggested possible sand accumulations, although tracks were not run close to submarine cables or pipelines. It is anticipated that a more closely spaced grid of lines could be run in the future, perhaps in a possible subsequent phase of the ASAP project, in areas where appropriate sediments are likely to exist.

The set of tracklines followed for the ASAP effort offshore New York was the result of an interaction between BOEM and New York State. Following a discussion with the USACE and State agencies including NYS DOS and the NYS Department of Environmental Conservation, we suggested some changes to the initially proposed tracks to: (1) move some of the effort towards the western end of Long Island, especially near Rockaway, where inlet

sand is not always available for use; (2) move some effort towards eastern Long Island where ridges are less common and inlet sand is not always available but where the sand need is high; and (3) remove survey lines from a shallow area adjacent to Montauk Shoals which has been classified by New York State as a significant coastal fish and wildlife habitat. BOEM accepted our first two suggestions but still proposed new seismic data and sample collection east of Montauk, though the planned fieldwork was not fully executed for various reasons.

We have not yet seen the new seismic data collected in 2015. We will reassess future data needs following the upcoming BOEM profiling and sampling study and after our careful examination of the existing geophysical and geological data. One immediate suggestion, however, is to complete the coarse grid (900 m x 1,800 m) of seismic lines started in 2015, filling in the areas over cables and pipelines. Such a grid of new, high-resolution seismic profiles will allow a better regional understanding of the sedimentary framework of the inner shelf on a coarse scale, a step which will be important for discovering new offshore sand and provide important confirmation of the regional sediment layering patterns described by USGS. Thorough examination of BOEM's ASAP data and consideration of these data in conjunction with the data that have been synthesized through this Cooperative Agreement is particularly important for confirming the existing interpretations of sediment layering and sediment distribution on the continental shelf off New York.

DATA REFERENCES

Armstrong, B.N., Warner, J.C., List, J.H., Martini, M.A., Montgomery, E.T., Voulgaris, George, and Traykovski, P.A., 2014, Coastal Change Processes Project data report for observations near Fire Island, New York, January to April 2012: U.S. Geological Survey Open-File Report 2014–1159, *http://dx.doi.org/10.3133/ofr20141159*.

Butman, B., Danforth, W.W., Schwab, W.C. and Buchholtz ten Brink, M.R.,1998, Multibeam bathymetric and backscatter maps of the Upper Hudson Shelf Valley and adjacent shelf, offshore of New York: U.S. Geological Survey Open-File Report 98-616, 4 sheets, scale 1:125,000.

Butman, B., Gutierrez, B.T., Buchholtz ten Brink, M.R., Schwab, W.C., Blackwood, D.S., and Middleton, T.J., 2003, Photographs of the sea floor offshore of New York and New Jersey: U.S. Geological Survey Open-File-Report 01-470, DVD-ROM.

Butman, B., Middleton, T.J., Thieler, E.R., and Schwab, W.C.,2003, Topography, shaded relief, and backscatter intensity of the Hudson Shelf Valley, offshore of New York : U.S. Geological Survey Open-File-Report 03-372, DVD-ROM.

Capone, M., Hammar-Klose, E., Hill, J., and Schwab, W., 2002, Archive of sidescan-sonar data and DGPS navigation data collected during USGS cruise DIAN97011 Long Island, New York inner shelf - Fire Island, New York, 5 May-26 May 1997: U.S. Geological Survey Open-File Report 2002-120. (Also available at).

Foster, D S, Swift, B A, Schwab, W C, 2000, Stratigraphic framework maps of the nearshore area of southern Long Island from Fire Island to Montauk Point, New York: U.S. Geological Survey Open-File Report 99-559, 2 sheets, scale 1:250,000.

Harris, C.K., Butman, B., and Traykovski, P., 2003, Winter-time circulation and sediment transport in the Hudson Shelf Valley: Continental Shelf Research, v. 23, no. 8.

Hill, J., Schwab, W., and Danforth, W., 2001, Archive of sidescan-sonar data and DGPS navigation data collected during USGS Cruise SEAX 96004, New York Bight, 1 May - 9 June, 1996: U.S. Geological Survey Open-File Report 01-95, 12 DVD-ROMs.

Hill, J., Schwab, W., and Foster, D., 2000, Archive of boomer and sparker data collected during USGS Cruise DIAN 97011, Long Island, New York inner shelf--Fire Island, 5-26 May, 1997: U.S. Geological Survey Open-File Report 00-241, 17 CD-ROMs.

Hill, J., Schwab, W., and Foster, D., 2000, Archive of Datasonics SIS-1000 chirp subbottom data collected during USGS Cruise DIAN 97011, Long Island, New York Inner Shelf--Fire Island, New York, 5-26 May, 1997: U.S. Geological Survey Open-File Report 00-242, 3 CD-ROMs.

Hill, J., Schwab, W., and Foster, D., 2001, Archive of Datasonics SIS-1000 chirp subbottom data collected during USGS Cruise SEAX 96004, New York Bight, 1 May - 9 June, 1996: U.S. Geological Survey Open-File Report 01-96, 3 DVD-ROMs.

Hill, J., Schwab, W., and Foster, D., 2001, Archive of datasonics SIS-1000 CHIRP subbottom data, collected during USGS Cruise SEAX 95007, New York Bight, 7-25 May, 1995: U.S. Geological Survey Open-File Report 2001-97, 2 DVD-ROMs.

Hill, J., Schwab, W., and Foster, D., 2001, Archive of water gun subbottom data collected during USGS Cruise SEAX 95007, New York Bight, 7-25 May, 1995: U.S. Geological Survey Open-File Report 2001-157, DVD-ROM.

Hill, J., Thieler, E., Foster, D., Swift, B., and O'Brien, T., 2000, Archive of Datasonics SIS-1000 chirp subbottom data collected during USGS Cruise DIAN 97032, Long Island, New York inner shelf--Fire Island, New York, 24 September - 19 October, 1997: U.S. Geological Survey Open-File Report 00-152, 11 CD-ROMs.

Hill, J., Thieler, E., Foster, D., Swift, B., and O'Brien, T., 2000, Archive of boomer and sparker subbottom data collected during USGS Cruise DIAN 97032, Long Island, New York inner shelf--Fire Island, New York, 24 September - 19 October, 1997: U.S. Geological Survey Open-File Report 00-142, 15 CD-ROMs.

Hill, J., Thieler, E., Nichols, D., and Williams, G., 2001, Archive of boomer subbottom data collected during USGS Cruise FERL 98009, New York Bight, Raritan Bay, Long Island, 26 May-2 June, 1998: U.S. Geological Survey Open-File Report 2001-47, 2 CD-ROMs.

Lentz, E., Hapke, C., Stockdon, H., and Hehre, R., 2013, Improving Understanding of Long-Term Barrier Island Evolution through Multi-Decadal Assessment of Morphologic Change: Marine Geology, v. 337, no. 1:,65–67 p.

Mecray, E.L., Reid, J.M., Hastings, M.E., and Buchholtz ten Brink, M.R., 2003, Contaminated Sediments Database for Long Island Sound and the New York Bight : U.S. Geological Survey Open-File Report 03-241.

Schwab, W.C., Baldwin, W.E., and Denny, J.F., 2014, Maps showing the change in modern sediment thickness on the Inner Continental Shelf Offshore of Fire Island, New York, between 1996–97 and 2011: U.S. Geological Survey Open-File Report 2014–1238, *http://dx.doi.org/10.3133/ofr20141238*.

Schwab, W.C., Baldwin, W.E., Hapke, C.J., Lentz, E.E., Gayes, P.T., Denny, J.F., List, J.H., and Warner, J.C., 2013, Geologic evidence for onshore sediment transport from the inner-continental shelf—Fire Island, New York: Journal of Coastal Research, v. 29, no. 3, p. 526–544.

Schwab, W.C., Denny, J.F., and Baldwin, W.E., 2014, Maps showing bathymetry and modern sediment thickness on the inner continental shelf offshore of Fire Island, New York, pre-Hurricane Sandy: U.S. Geological Survey Open-File Report 2014–1203, *http://dx.doi.org/10.3133/ofr20141203*.

Schwab, W.C., Denny, J.F., Butman, B., Danforth, W.W., Foster, D.S., Swift, B.A., Lotto, L.L., Allison, M.A. and Thieler, E.R., 2000, Sea-floor characterization offshore of the New York-New Jersey metropolitan area using sidescan sonar: U.S. Geological Survey Open-File Report 00-295.

Schwab, W.C., Denny, J.F., Foster, D.S., Lotto, L.L., Allison, A.L., Uchupi, E., Swift, B.A., Danforth, W.W., Thieler, E.R., and Butman, B., 2003, High-resolution quaternary seismic stratigraphy of the New York Bight Continental Shelf: U.S. Geological Survey Open-File Report 02-152, DVD-ROM.

Schwab, W.C., Thieler, E.R., Allen, J.R., Foster, D.S., Swift, B.A., and Denny, J.F., 2000, Influence of inner-continental shelf geologic framework on the evolution and behavior of the barrier-island system between Fire Island Inlet and Shinnecock Inlet, Long Island, New York: Journal of Coastal Research, v. 16, p. 408–422.

Schwab, W., Thieler, E., Denny, J., and Danforth, W., 2000, Seafloor sediment distribution off southern Long Island, New York: U.S. Geological Survey Open-File Report 00-243.

Thieler, E., Hill, J., Brooks, R., Gutierrez, B., Irwin, B., and Nichols, D., 2001, Archive of Datasonics SIS-1000 chirp subbottom data collected during USGS Cruise MGNM 99023, southern Long Island, NY inner shelf and Hudson Shelf Valley, 26-31 July 1999: U.S. Geological Survey Open-File Report 00-273, 5 CD-ROMs.

Thieler, E., Hill, J., Brooks, R., Gutierrez, B., Irwin, B., and Nichols, D., 2001, Archive of Boomer subbottom data collected during USGS Cruise MGNM 99023, southern Long

Island, NY inner shelf and Hudson Shelf Valley, 26-31 July, 1999: U.S. Geological Survey Open-File Report 00-274, 6 CD-ROMs.

Williams, S.J., 1976. Geomorphology, shallow subbottom structure, and sediments of the Atlantic inner continental shelf off Long Island, New York. CERC Technical Paper No. 76-2, U.S. Army Corps of Engineers Coastal Engineering Research Center.

Williams, S.J. and Duane, D.B., 1974. Geomorphology and sediments of the inner New York Bight continental Shelf. CERC Technical Memorandum No. 45, U.S. Army Corps of Engineers Coastal Engineering Research Center.

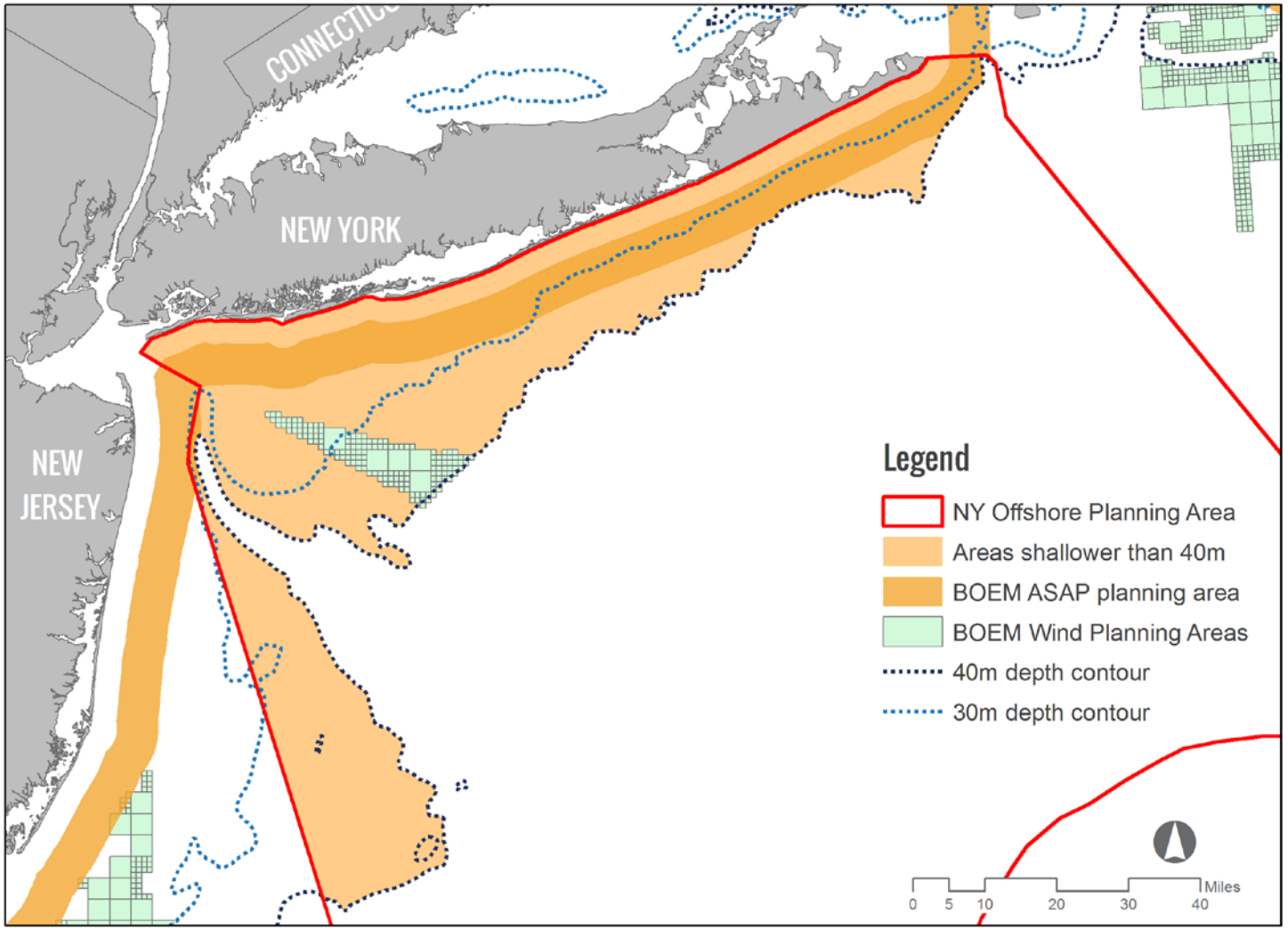

Figure 1. Map of the NY Offshore Planning Area showing areas shallower than 40 m water depth, the portion of the planning area that lines between 3 and 8 nautical miles offshore (the BOEM ASAP planning area), and the portion of the planning area that is between 3 and 8 miles offshore with a water depth less than about 30 m. Current dredging technology likely restricts sand inner-shelf sand mining to water depths less than 30 m, although recovering sand in water up to 40 m deep may be possible.

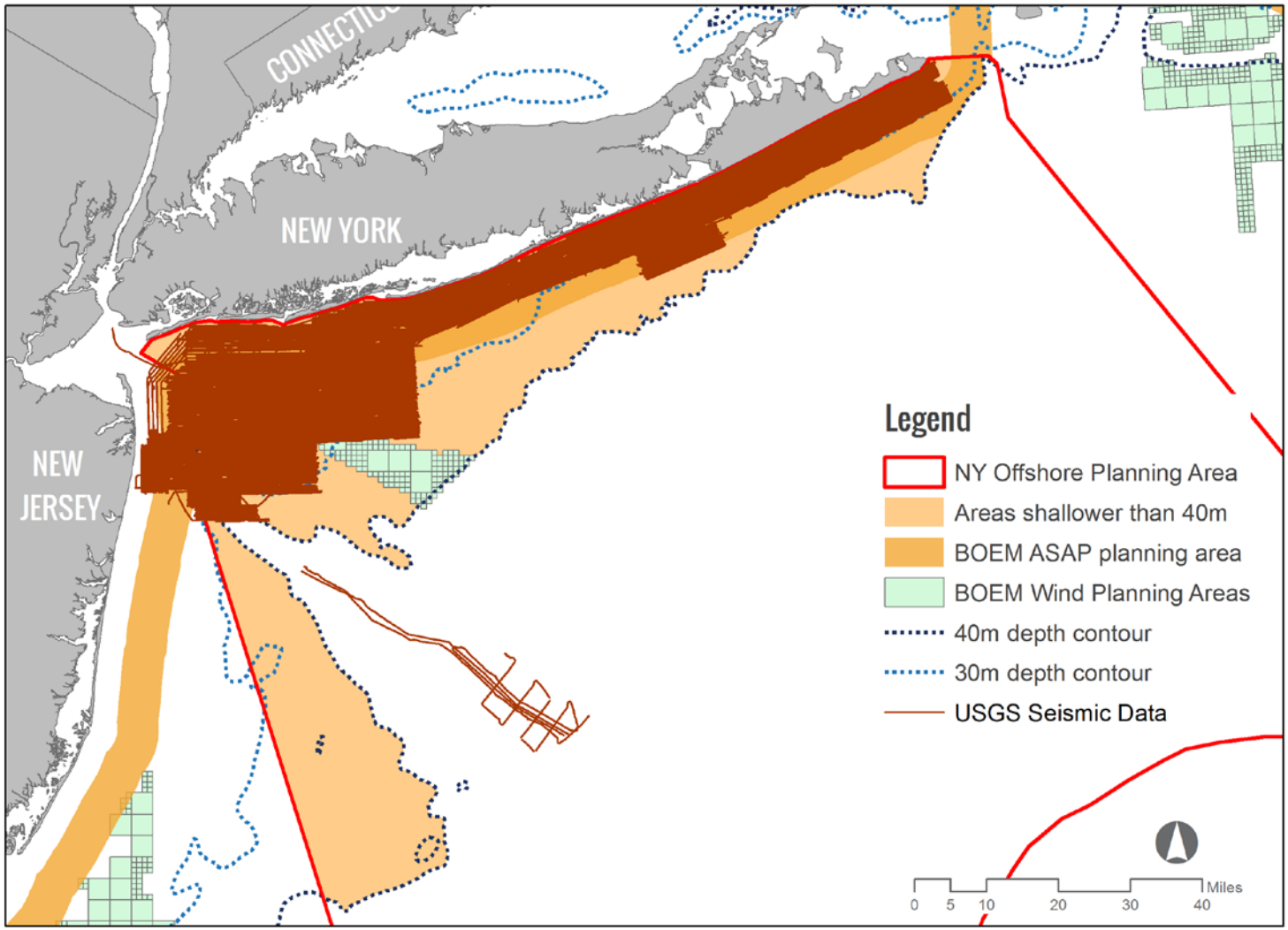

Figure 2. The locations of high-resolution seismic profiles collected by USGS Woods Hole in the area south of Long Island are shown. Chirp lines are generally spaced about 300 m apart. West of Fire Island Inlet, survey coverage extends to about 15 to 20 nautical miles offshore, while east of Fire Island Inlet, coverage extends to only 5 nautical miles offshore.

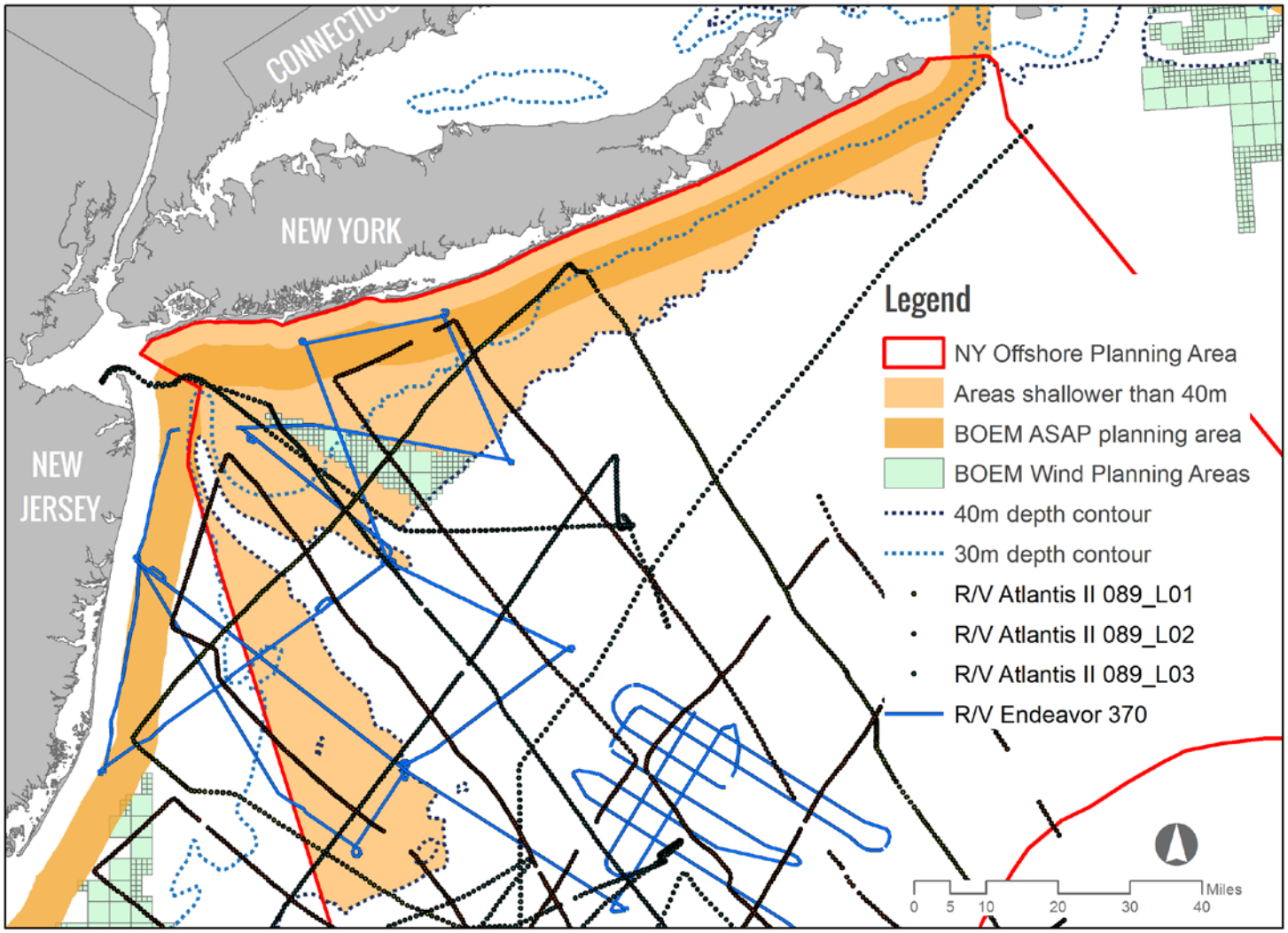

Figure 3. The locations of selected seismic profiles collected by academic institutions in the NY Offshore Planning Area which are likely to image sedimentary layering in the NY Offshore Planning Area. Additional tracks may also exist that have not been incorporated into on-line databases.

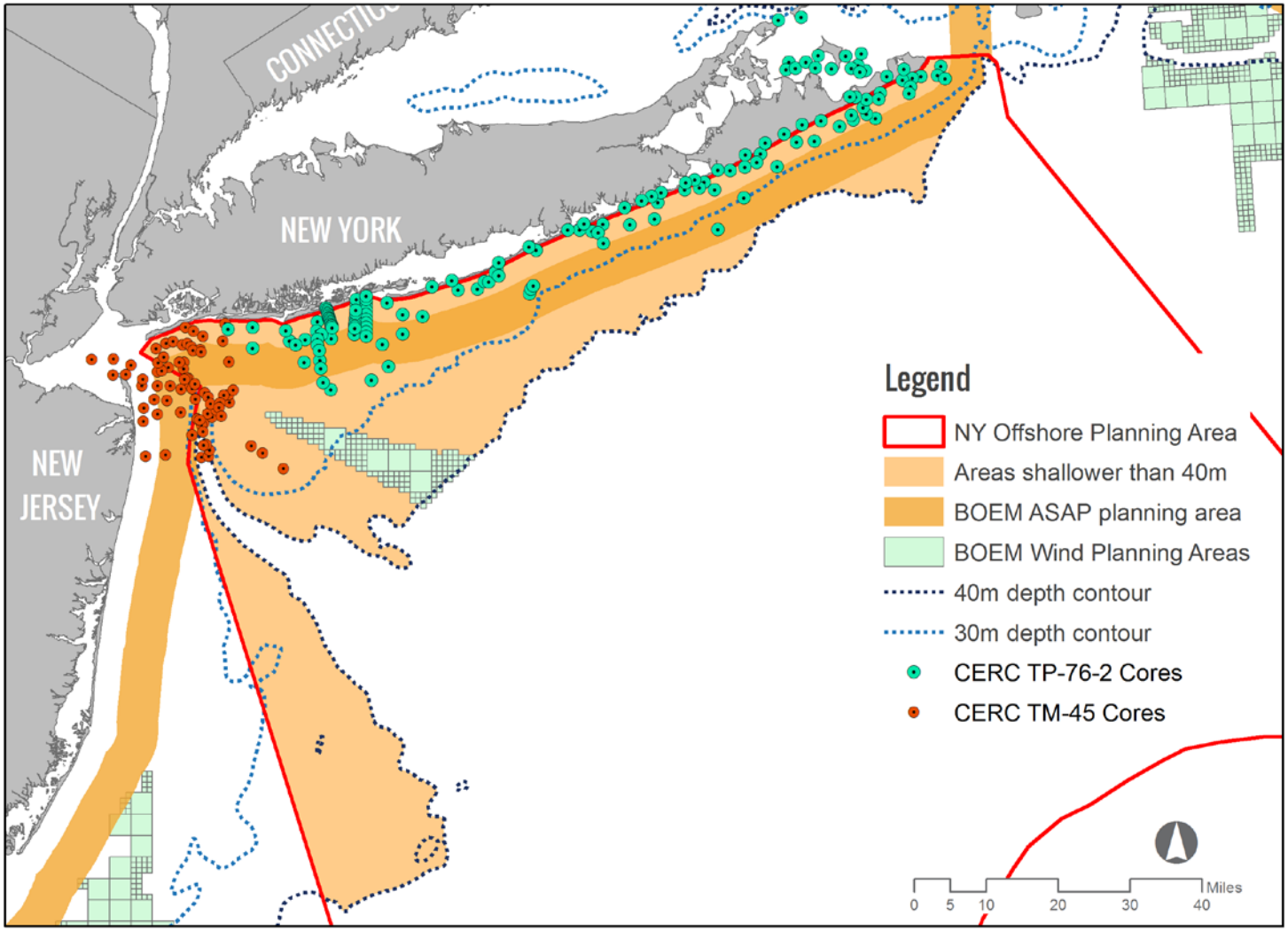

Figure 4. Locations of long cores and borings reported by Williams and Duane (1974) and Williams (1976). The sediment descriptions of these important samples are contained in their two CERC reports but may not be included in other sediment sample data bases. The site locations were digitized from maps in the reports and may not be precise.

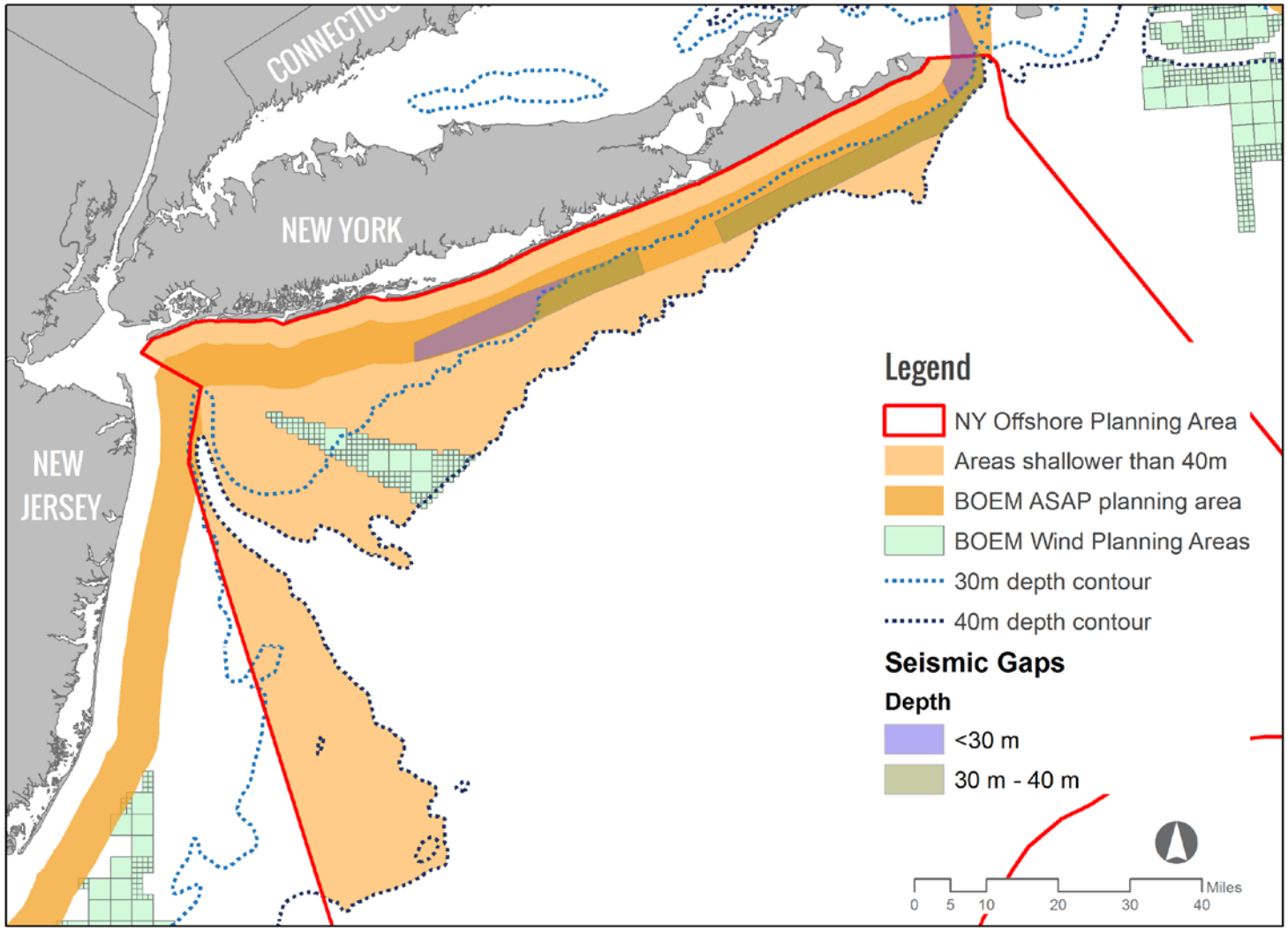

Figure 5. While the coverage of USGS seismic lines south of New York is quite dense, there are two areas in the BOEM ASAP planning area (3-8 nautical miles offshore) in water depths that are less than 30 m and between 30 m and 40 m deep. These areas with little seismic data fall offshore of areas with long-term beach renourishment needs: south of Fire Island and along the east end of Long Island.

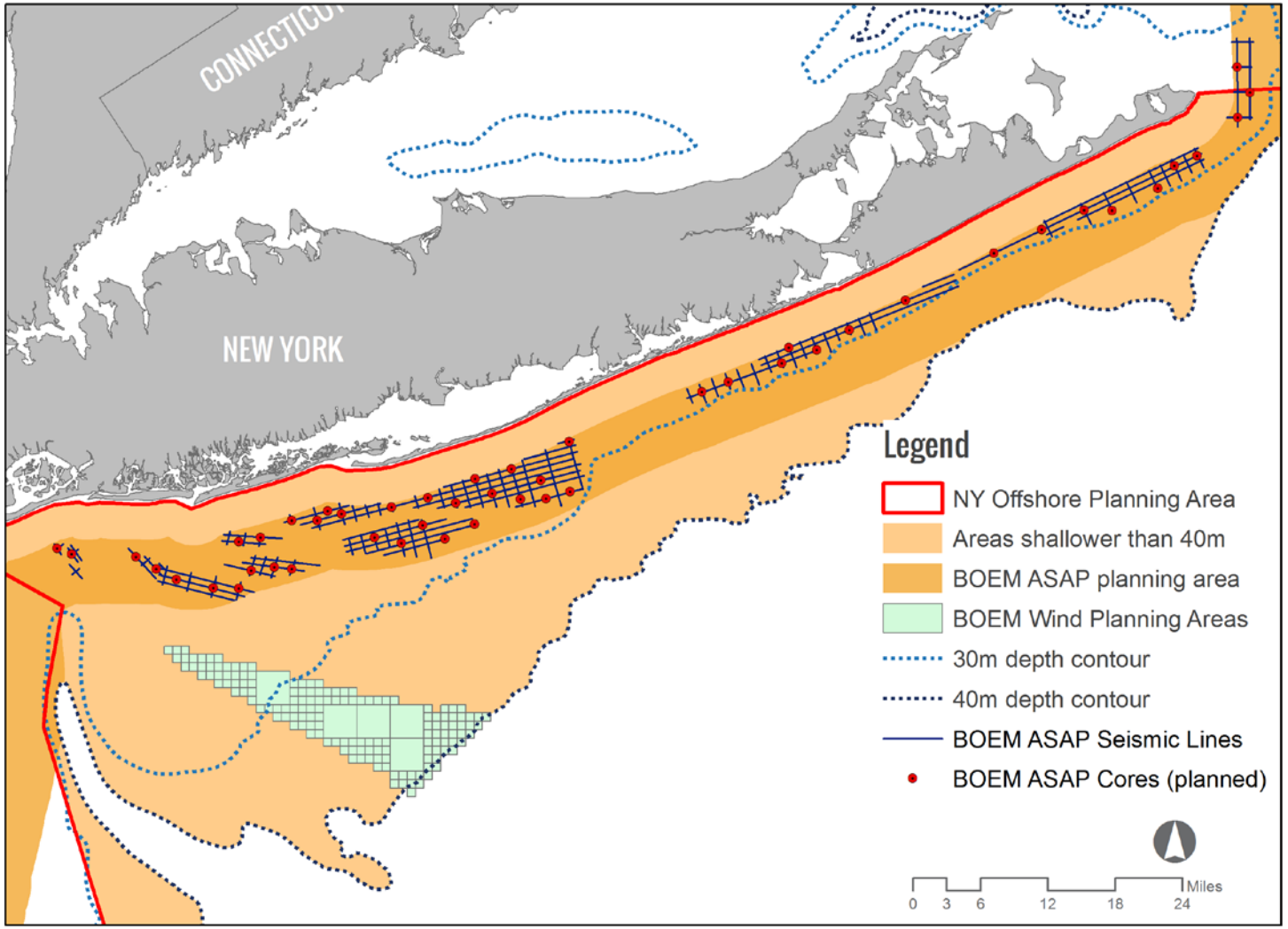

Figure 6. Locations of BOEM ASAP seismic lines and samples likely to be acquired in Summer 2015. The profile and sample locations initially proposed by BOEM were modified to ensure adequate data aquisition in areas where offshore sand resources may be important: near Rockaway, and along the eastern end of Long Island. Gaps in planned seismic coverage occur in areas where there are submarine cables that must be avoided during sediment sampling and dredging.