Cooperative Agreement: M14AC00001 to New York State Department of State and Stony Brook University – State University of New York: Assessment of Sand Needs and Resources Offshore New York

Summary Report

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NY Lead Agency:

New York State Department of State, Office of Planning and Development, in conjunction with SUNY Stony Brook University, School of Marine and Atmospheric Sciences

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Overview

The technical reports described below and developed pursuant to Cooperative Agreement M14AC00001: *Sand Needs and Resources Offshore New York* are important steps in improving understanding of and linkages between federal and State sand resources offshore New York. These reports are New York State's first attempt to compile and synthesize existing information on sand resources and transport processes, in furtherance of the State's long-standing interest in sand resources. In order to achieve the objectives of the current Cooperative Agreement with the Bureau of Ocean Energy Management (BOEM), the New York State Department of State (DOS) entered into a Cooperative Agreement with BOEM, and a Memorandum of Agreement with the State University of New York (SUNY) at Stony Brook, School of Marine and Atmospheric Sciences. The coordination of effort between these entities, and the data and information that resulted, already have measurably increased New York State's scientific knowledge base and decision-making capacity.

Superstorm Sandy provided clear evidence of the potential suddenness and severity of coastal flooding and erosion, and increased attention to sand management strategies and prioritization of coastal needs. Because the emphasis of this current Cooperative Agreement is on assembling existing data, the below products do not address the desirability of using state or federal sand resources for projects that were previously proposed or that may be under future consideration. Nor do the reports reflect a State-sponsored evaluation or prioritization of existing or potential coastal projects that may require sand resources.

The ultimate goal of the State's Cooperative Agreement efforts is to develop management strategies for offshore sand resources that will preserve the ecological function of offshore systems while helping to achieve resilience for coastal communities. To that end, the State's continued research and coordination activities with the federal government will focus on understanding: sediment transport patterns and the potential effects of removals and placement; the role of sand in natural and ecological system function; the relationships between offshore sand resources and coastal needs; and other related management priorities. This information will be critical to the development of sustainable approaches to existing and future activities seeking the use of sand in federal waters offshore New York.

BOEM-NY Cooperative Agreement M14AC00001 Project Deliverables

Technical Reports

Bokuniewicz, H.J. and Huang, H., 2016. Preliminary assessment of New York's sand needs. School of Marine and Atmospheric Sciences, Stony Brook University, Unpublished Report.

This assessment of sand needs along New York's Atlantic coast considered the volume and quality of sand demanded to support current and projected beach renourishment and dune construction projects. Three types of sand demand estimates were reviewed: (1) nourishment at historical rates for routine projects; (2) pre-"Superstorm" Sandy estimates for the Fire Island to Montauk Point Inlet Storm Damage Reduction (FIMP) Project; and (3) post-Sandy restoration projects. Approximately 2/3 of the needed sand likely has been historically supplied by routine dredging to maintain inlets for navigation. Although historical records of sand use are incomplete, the average sand demand for ordinary beach renourishment projects in the recent past has been about 1.5 million cubic yards per year (CY/yr). However, high interannual variability in sand use for renourishment exists (Figure 1), with a standard deviation (1.3 CY/yr) that nearly approximates the mean demand itself, and sea level rise plus punctuated extreme storm events could raise the annual sand demand five-fold.

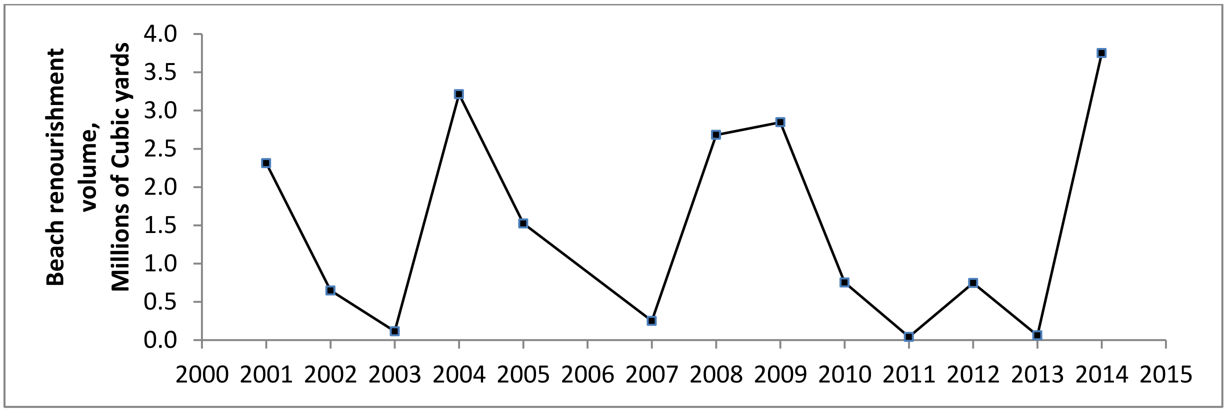

Figure 1. Renourishment volumes along the New York coast as compiled by the International Council for the Exploration of the Seas (ICES).

The Army Corps of Engineers' 2011 FIMP study called for 55 million CY of sand over 50 years, or 1.1 million CY/yr, though this assumed a relatively low rate of sea level rise that does not conform with current projections. Two major post-Sandy projects undertaken at Long Beach and Fire Island National Seashore require over 12 million CY/yr over 5 years, and plans currently are underway for additional storm-related projects. With steepening shorefaces and additional shoreline protection strategies over time, sand demand could become much higher, and delivered sand volumes may need to be up to 30% higher than the actual demand after accounting for the suitability of sand and calculating the overfill factor. Surficial sand deposits which could be dredged offshore New York include Holocene- and Pleistocene-aged sands. Holocene sand is considered most suitable for beach nourishment and is mainly found in ridges, in 3-10 ft thick discontinuous deposits, while Pleistocene sand is 30-100 ft thick deposits. Various factors must be considered in selecting offshore material, including compatibility with the onshore sand and grain size distribution, and proximity to the area of need. The suitability index was calculated from mean grain size of historical beach sampled data for native beaches, and for potential borrow site sands from previously collected vibracore samples compiled by the Long Island Needs Assessment (LISNA) Program and from sea bed samples compiled in the usSEABED database. With new and pending commitments to long-term maintenance of large projects, the routine demand will increase and additional sand sources will be sought, including from federal waters offshore New York. It would be prudent to undertake other adaptive actions to reduce risk at known vulnerable locations and to focus on uses other than those requiring buildings and infrastructure in places which are naturally vulnerable to erosion and breaching.

Bokuniewicz, H., and Huang, H., 2016. Inventory of New York's sand borrow sites along New York's ocean shoreline & their sustainable management. School of Marine and Atmospheric Sciences. Stony Brook University. Unpublished Report.

The area of sand resources in both New York State and federal waters off the Atlantic coast of Long Island covers about 1080 square miles. All sand borrow areas are in State waters; no borrow areas have been designated in federal waters off Long Island to date. There are 44 borrow areas in State waters which were used in the past or for which current use plans exist (Figure 2).

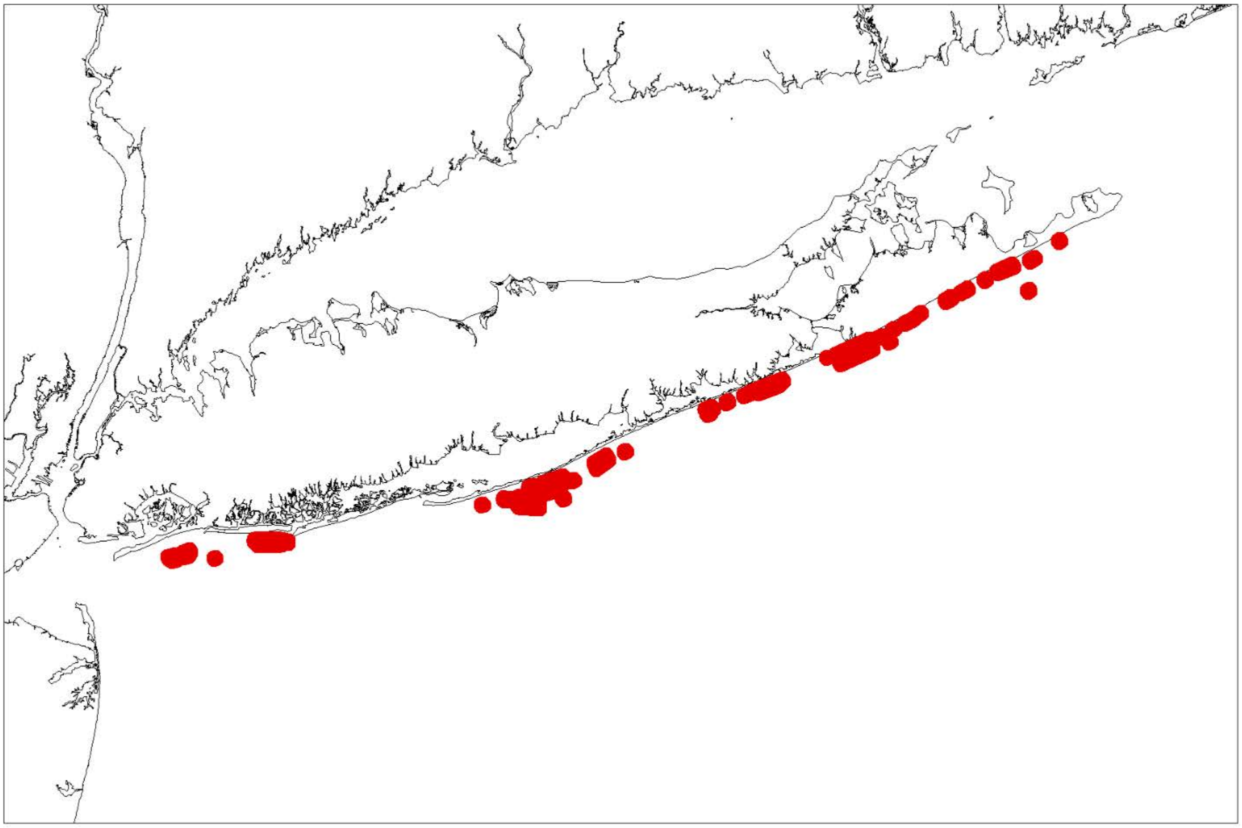

Figure 2. Distribution of 44 historical and current borrow areas off the coast of Long Island which have been designated in New York State waters. Borrow areas are not drawn to scale; the size has been exaggerated to increase visibility for illustrative purposes.

Combined, these areas contain approximately 50 to 75 million cubic yards of sand which could fulfill demand for approximately 8 -150 years depending on level of demand and future conditions. Holocene-age sand deposits on the shelf are likely to be targeted for borrow activity given the high degree of compatibility with beach sand characteristics. Much of the Holocene sand occurs in shore-attached ridges, which may serve as natural conduits for sand transport from the offshore to inshore environment. Concerns exist regarding excavation of sand from these areas given the morphological changes and potential disruption to sediment flow and transport, and natural coastal replenishment. Recovery and potential reuse of designated borrow areas depend upon the rate at which sand is redistributed on the seafloor for natural infilling of excavated areas. Data are scarce on the specific mechanisms, but evidence indicates that natural infilling seems to occur in some areas but not in others. Where natural infilling does occur, it seems to happen over the order of decades, but more research is needed on the rates and routes of sand transport on the shelf and net sediment fluxes to predict borrow area replenishment rates. Greater efforts also are needed to maintain a comprehensive inventory tracking sand use for projects permitted by the Army Corps of Engineers and the New York State Department of Environmental Conservation. Data recorded should include the location and dimensions of the exact area from which sand was dredged, the volume of material taken, the precise location of sand placement, the date of placement, and the volume of material placed onshore. More accurate data on current sand use patterns will better inform future sand demand projections and needs assessments.

Flood, R., Bokuniewicz, H., and Lashley, J. 2016. Synthesis of existing geological and geophysical surveys with suggestions for areas for future research, School of Marine and Atmospheric Sciences, Stony Brook University, Unpublished Report.

Geophysical and geological data were compiled and reassessed to support identification, characterization, and delineation of sand resources for potential use in future coastal restoration, beach nourishment, and/or wetland restoration efforts. This report presents the results of two tasks – synthesizing existing geophysical and geological data within the nearshore portion of the planning area, and identifying areas with potentially desirable sand sources to be studied with future geophysical and geological surveys. Data types analyzed primarily included seismic profiles and core samples. The focal study area is 3 to 8 nautical miles (nm) offshore and within water depths of 40 meters (the current practical dredging limit in the U.S. given current technology and vessel restrictions), though much of the existing research has also been concentrated within 3 nm. Data collected by various government agencies, academic institutions, and commercial companies from the 1960s on were reviewed and evaluated for navigation positioning, survey resolution, and overall quality. The highest-quality, most recent data available were systematic high-resolution seismic survey data collected by USGS off the south shore of Long Island from 1995 through 1999 and again in 2011 (Figure 3), and focused in part

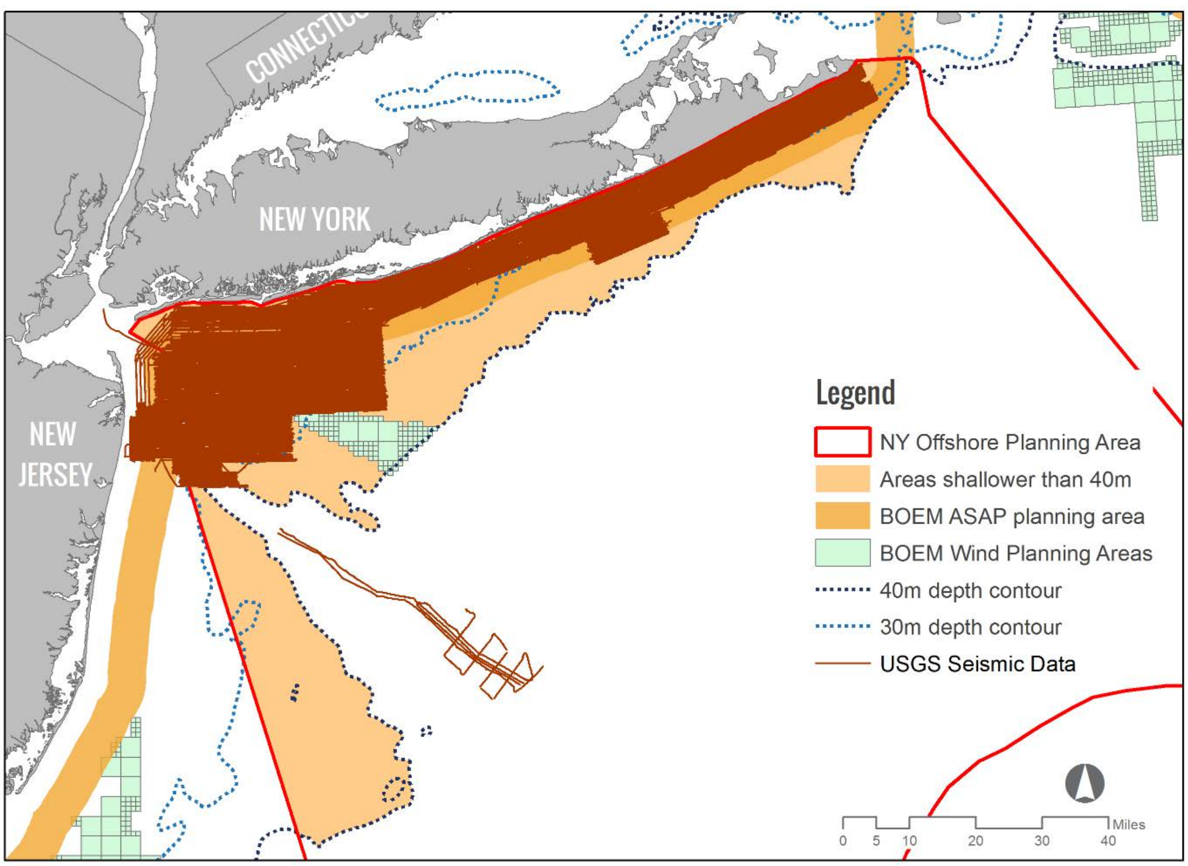

Figure 3. The locations of high-resolution seismic profiles collected by USGS Woods Hole in the area south of Long Island are shown. Chirp lines are generally spaced about 300 m apart. West of Fire Island Inlet, survey coverage extends to about 15 to 20 nautical miles offshore, while east of Fire Island Inlet, coverage extends to only 5 nautical miles offshore.

on Fire Island National Seashore. Holocene sand ridges extend at an oblique angle to the cross shore in the seaward direction. Searching archives for additional data sources resulted in approximately 75 ship tracks which collected seismic profiles between approximately 1961 and 2002. Navigation records and/or survey tracklines were of poor quality for most of these tracks; seismic profiles were deemed useful for only 6 academic surveys (Figure 4). The Coastal

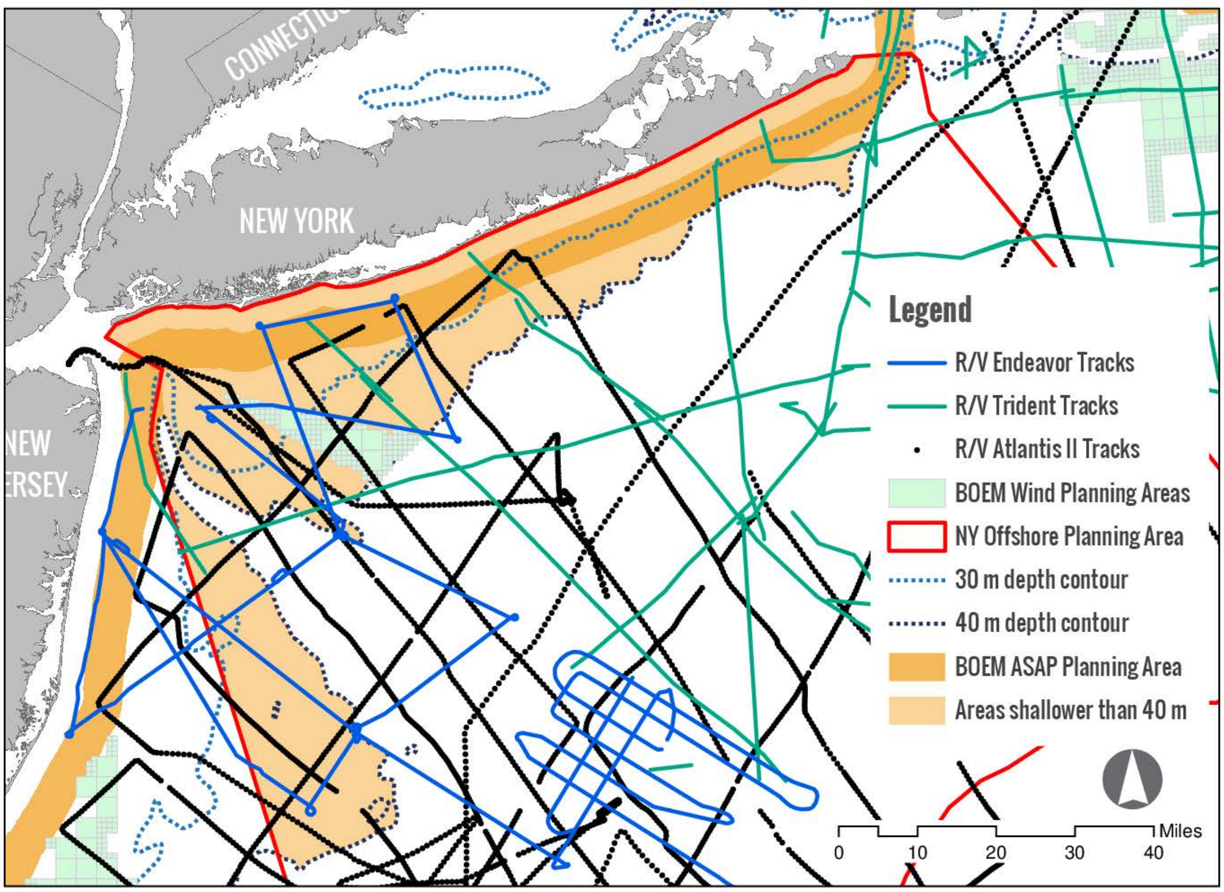

Figure 4. The locations of selected seismic profiles collected by academic institutions in the NY Offshore Planning Area which are likely to image sedimentary layering in the NY Offshore Planning Area. Additional tracks may also exist that have not been incorporated into online databases.

Engineering Research Center (a former branch of the Army Corps of Engineers) conducted two extensive projects which collected seismic survey data and approximately 200 long cores during the 1970s. Core locations were determined by digitizing core locations on rectified figures in the reports. Gaps in seismic and core data were analyzed both independently and in conjunction with BOEM to inform survey priorities for the Atlantic Sand Assessment Project data acquisition effort.

Wilson, R. and Hinrichs, C. 2016. Technical report on physical wave modeling. School of Marine and Atmospheric Sciences, Stony Brook University. Unpublished Report.

Physical wave modeling was conducted to assess the effects of establishing 4 hypothetical sediment borrow areas in federal waters off the south shore of Long Island on nearshore wave climate and longshore sediment transport rate. Borrow area locations (Figure 5) were selected in part due to proximity to coastal areas where demand for sand is expected to be high for

Figure 5. Hypothetical borrow sites in federal waters off the south shore of Long Island), distributed (from west to east) off the coasts of Long Beach, Fire Island Inlet, Fire Island, and West Hampton.

completing various federal and local projects. The dimensions of each modeled borrow area are approximately 2 km x 1 km, and 3 m depth below the ambient seafloor level. Specific objectives were to assess the effects of these hypothetical borrow areas on: (a) nearshore wave climate - including significant wave height, wave direction, and wave energy; and (b) longshore sediment transport rates and patterns in the littoral system, as changes in the divergence in longshore sand transport can be used to infer possible changes in coastal erosion or accretion. This will help identify those borrow area locations where sand removal might have minimal effect, and those locations where sand removal could have a more detrimental effect upon wave climate and longshore transport. Wave climatologies derived from offshore wave buoys were used to define forcing for the wave model SWAN, both for existing bathymetry and selected modified bathymetries representing the borrow areas. Offshore wave climatology was defined by analyzing long-term records from NOAA/National Data Buoy Center wave buoys 44025 and 44017. Wave scenarios expected to most influence coastal wave climate longshore sand transport were identified in terms of significant wave height, wave direction, wave period, and wave length. The magnitude of longshore transport depends upon wave height and the angle of approach along the shore. For each borrow area, model simulations were run first for the existing bathymetry, and then for the modified bathymetry. For the simulations for each borrow area, results for wave properties were diagnosed along cross-shore transects (Figure 6 shows a depiction of the modeling for the Long Beach borrow area and surrounding vicinity).

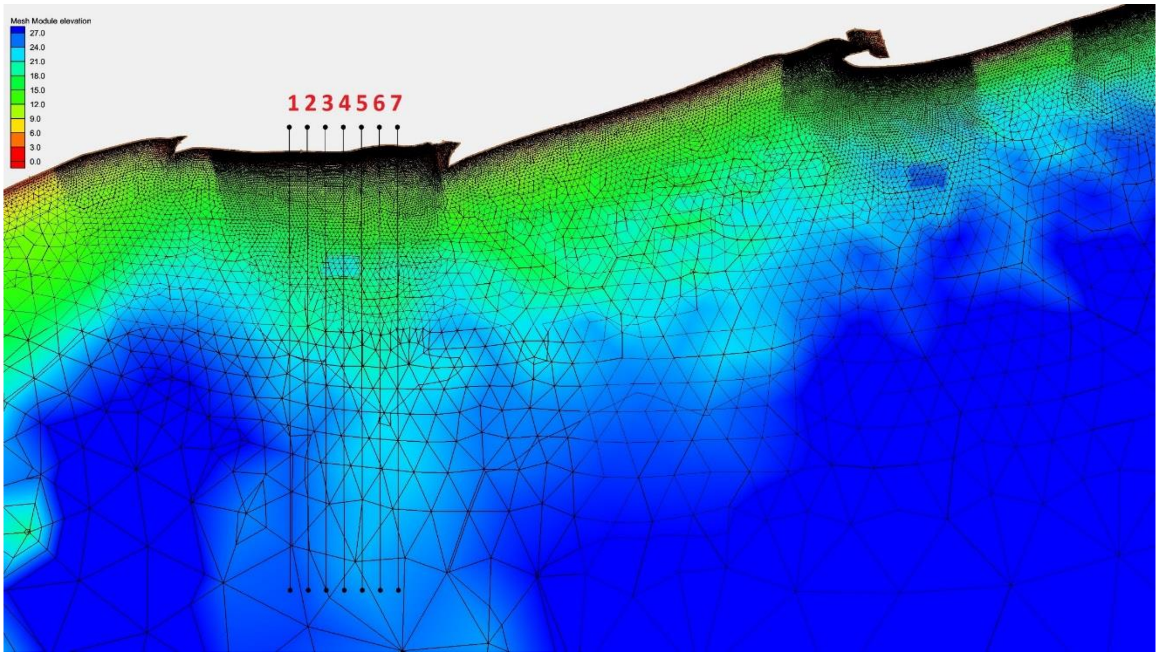

Figure 6. Example of the SWAN model wave unstructured grid and transects through the Long Beach borrow area.

Results indicated that waves with significant wave heights greater than four meters come from a markedly more easterly, more shore-parallel direction than smaller waves. The larger waves also have a longer period, and average wave period is much longer for waves over four meters high. Modeling efforts focused primarily on analyzing waves from a specific direction, instead of a mixed wave field, as this forcing allowed for clearer diagnoses of effects of borrow areas on changes in patterns of wave refraction, wave breaking, and significant wave height. Overall, observable effects of the borrow area on changes in significant wave height and direction were confined to within approximately 2 km in the vicinity of the area. Simulations indicated some possible divergence in volumetric transport inshore of the borrow area. Although ambient seafloor depths are shallowest near the Long Beach hypothetical borrow area, changes at the shoreline still were relatively small, and unlikely to be detectable from the natural variations. To estimate the net effect of hypothetical borrow areas on the offshore wave field and shoreline over a longer time period, it is necessary to incorporate a full suite of actual wave data and additional factors including those affecting bottom sand transport into the modeling efforts.

Bokuniewicz, H., Lashley, J., and Innes, W. 2016. Preliminary annotated bibliography for sand needs and resources offshore New York. School of Marine and Atmospheric Sciences, Stony Brook University. Unpublished Report.

This annotated bibliography represents literature available to the initial phase of the sand needs and resources assessment offshore New York.

The bibliography is arranged in five parts:

1. BOEM-NY Cooperative Agreement Project deliverables
2. Study-Area data publications
3. Associated regional publications
4. Methodologies
5. Geophysical survey data.

While this collection is not exhaustive, these entries represent some of the primary sources used for this initial stage of the assessment.

This assessment is intended to help in planning for future sand use and potential projects using offshore sand resources that may be desired to recover from beach erosion or needs driven by severe storms and sea level rise. Such information is needed to contribute towards coastal communities' resiliency planning, and to consider potential effects of this activity on coastal habitats and ecosystems.

Data Deliverables

Compiled data and synthetic products have been provided to BOEM for deployment on the Marine Minerals Program's MMPGIS Data Portal which is currently under development, and likely will also be deployed on DOS' Office of Planning and Development's Geographic Information Gateway Data Portal http://opdgig.dos.ny.gov/#/home .

Complementary State Efforts to Identify Needs Areas

With ninety percent of New York State's population residing in waterfront communities, management of flooding and erosion hazards is a critical concern. During Superstorm Sandy alone, the Governor's Office estimates that 305,000 homes were destroyed primarily by storm surges; over 400,000 people were evacuated; and 53 New Yorkers lost their lives.

DOS Coastal Risk Areas and Community Resilience Planning

While several products exist to help people identify flood risk, such as FEMA floodplains maps, no single product characterizes the cumulative flood risks facing coastal communities. DOS partnered with the National Oceanic and Atmospheric Administration (NOAA) and the Federal Emergency Management Agency (FEMA) to combine different pieces of information (see list below) to identify New York's most vulnerable coastal areas. The result was the "DOS Coastal Risk Areas" which classify areas of extreme, high, and moderate risk for use in future resilience planning.

To identify Coastal Risk Areas, DOS staff gathered information on the following elements of coastal risk:

- elevation
- floodplain
- sea, lake, and overland surges from hurricanes (slosh)
- sea level rise scenario
- shallow coastal flooding
- susceptible natural shoreline features

Maps that used relevant data to classify each of these elements were overlaid on top of one another using GIS. The results of this overlay analysis were used to classify New York's coastal areas into three risk categories: extreme, high, and moderate. The Extreme Risk Areas are the most vulnerable areas, which are currently at risk from frequent flooding. High Risk Areas face less risks from flooding than extreme, but more so than the Moderate Risk Area. All three areas will continue to increase in vulnerability as sea level rises.

The DOS Coastal Risk Areas help identify vulnerable community assets and areas where development is most vulnerable. Risk assessment and resilience planning is a means of evaluating risk in advance of storm events. Through resilience planning, communities have time to identify risks to social, economic, cultural and natural resources that support their quality of life. The risk area maps can be used to compile an inventory of vulnerable assets that support community functions. Once the location of vulnerable functions is known, the risk maps can help assign a general level of risk to each assets to help communities determine which are most vulnerable to prioritize resilience planning efforts and strategies.

As an immediate follow-up to Superstorm Sandy, and in recognition that communities are the most knowledgeable resources on past events and what is most at risk, New York initiated a new community resiliency planning initiative called the "New York Rising Community Reconstruction" program (NYRCR). One goal of the NYRCR Plans was to increase the future resilience of the places and/or services providing critical social, economic, and natural functions within a community (i.e., assets).

Through the NYRCR planning process, each community identified critical assets and then overlaid those assets with the DOS coastal Risk Areas in order to assign a level of risk in relation to future storm events and sea level rise. This asset risk assessment helped communities strategically plan for and identify future investments that would expedite recovery and improve future resiliency. Examples of assets include public facilities such as schools, medical facilities; emergency and public safety services including fire and police protection; as well as natural, cultural, and recreational resources such as wetlands, beaches, and parks. Assets also include critical infrastructure such as transportation roadways, utility networks, and storm water systems required to support those essential public facilities.

Other Holdings

In addition to community-wide assets, governments at various levels also own or maintain assets that may also be vulnerable. The National Park Service partnered with the Program for the

Study of Developed Shorelines (PSDS) at Western Carolina University (WCU) to begin an assessment of the level of exposure that park owned assets will face during a period of rising sea level. The first phase of this collaborative project between WCU and NPS has focused on identifying NPS assets that may be threatened by a future 1 m rise in sea level within 40 coastal units. A 1 m rise in sea level can be expected to occur in the next 100 to 150 years. Many of the assets identified are already vulnerable to existing coastal hazards (erosion and storms). Holdings identified within or adjacent to New York State include:

- Castle Clinton National Monument
- Fire Island National Seashore
- Gateway National Recreation Area
- Governors Island National Monument
- Sagamore Hill National Historic Site
- Statue of Liberty National Monument

Similarly, the New York State Office of Parks, Recreation, and Historic Preservation (OPRHP) is undergoing an effort to determine the impacts of climate change on their facilities. Specifically, OPRHP is using GIS to identify where the potential impact of storms and sea level rise will be in order to develop management plans that improve resilience and expedite recovery after storms. The DOS Coastal Risk Areas have been a key resource in this analysis, helping OPRHP assess the relative vulnerability of valuable coastal park resources, including infrastructure and natural resources.