



BOEM Cooperative Agreement Number M23AC00014

Delaware Geological Survey, University of Delaware

Assessing 21st Century Supply and Demand of Beach Sand Resources in the Mid-Atlantic

Cooperative Agreement Summary Report

Performance Period: September 26, 2023 - June 30, 2026

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Delaware Geological Survey

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Overview

This project expands upon a previous cooperative agreement (M22AC00001) between the Delaware Geological Survey (DGS) and Bureau of Ocean Energy Management (BOEM) that seeks to provide a long-term assessment of demand and supply of sand resources to support beach nourishment activities in the Mid-Atlantic United States. There is a critical need for proactive action in securing offshore sand resources, balancing offshore usage (e.g., fishing grounds, energy development), and environmental conservation in the face of rising sea levels and increasing coastal erosion hazards. Though coastal states have traditionally utilized sand resources within the 3-nautical mile buffer of state waters, there is increasing interest in and utilization of sand resources in federal waters. BOEM is tasked with sustainably managing activities on the outer continental shelf, and this research aimed to support this mission. Specific goals included:

- Forecasting long term demand for offshore sand resources: We forecasted sand resource demand based on historical usage trends and projected changes in coastal erosion risks. These forecasts span from 2025 to 2100 and assume that beach nourishment will remain the coastal stabilization strategy of choice within the region.
- Assessing current sand supply: We linked our forecasted sand demands to the estimated availability of sand contained within currently utilized sand resource borrow areas. These assessments help indicate which beaches have the most pressing need for identifying additional sand resources.
- Predicting potential high quality sand resources: Through a combination of statistical modeling and lithological interpretations, we modeled spatial distributions of potential sand resource quality across the study area.
- Fostering regional collaboration: Beach nourishment and resource security are challenges for all Mid-Atlantic states. As part of this project, the DGS hosted a Mid-Atlantic Regional Sand Resources Coordination Meeting in Newark, Delaware in 2025. This meeting provided a forum for sharing challenges and successes regarding coastal sand and sediment management across the region.

Project outputs provide estimates of past and future sand resource usage for 20 major beaches along the Atlantic coasts of Virginia, Maryland, Delaware, and New Jersey. We found that forecasted demand varied substantially among the beaches and across different projected erosion scenarios. Assessments of current and potential future resource availability showed that some beaches have much higher resource security than others. However, uncertainty in the longevity of current sand resource borrow areas is high due to an array of potential issues. We emphasize the need for enhanced offshore data collection and studies of local nearshore sand transport dynamics that may support sand backpassing and recycling efforts. Early planning is critical for successful management of habitats, mineral resources, and space on the continental shelf.

Cooperative Agreement Outputs and Deliverables for M23AC00014

The outputs of cooperative agreement M23AC00014 include a technical report, a GIS layer of predicted spatial patterns of potential sand resource quality, and tabular datasets of historical and forecasted sand usage for twenty major beaches along the Mid-Atlantic coastline of the United States.

Technical Report:

Warner DL, Mattheus CR, Wunsch DR (Delaware Geological Survey, Newark, DE). 2025.

Assessing 21st century supply and demand of beach sand resources in the Mid-Atlantic.

Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. 81 p. Agreement No.: M23AC00014

The technical report provides the motivation for this research, states project goals, details methodologies used for data generation, and provides a state-by-state, beach-by-beach assessment of current and future demand and supply for offshore sand resources. In total, the twenty study beaches used an estimated 215 million cubic yards of sand from 1990 to 2024, and an estimated 780 to 2310 million cubic yards of sand may be needed to meet regional demand by 2100. Forecasts indicate that many currently utilized sand resources may be depleted in the next several decades. The report also includes notes from the Mid-Atlantic Regional Sand Resources Coordination Meeting and summarizes key discussion points from the meeting.

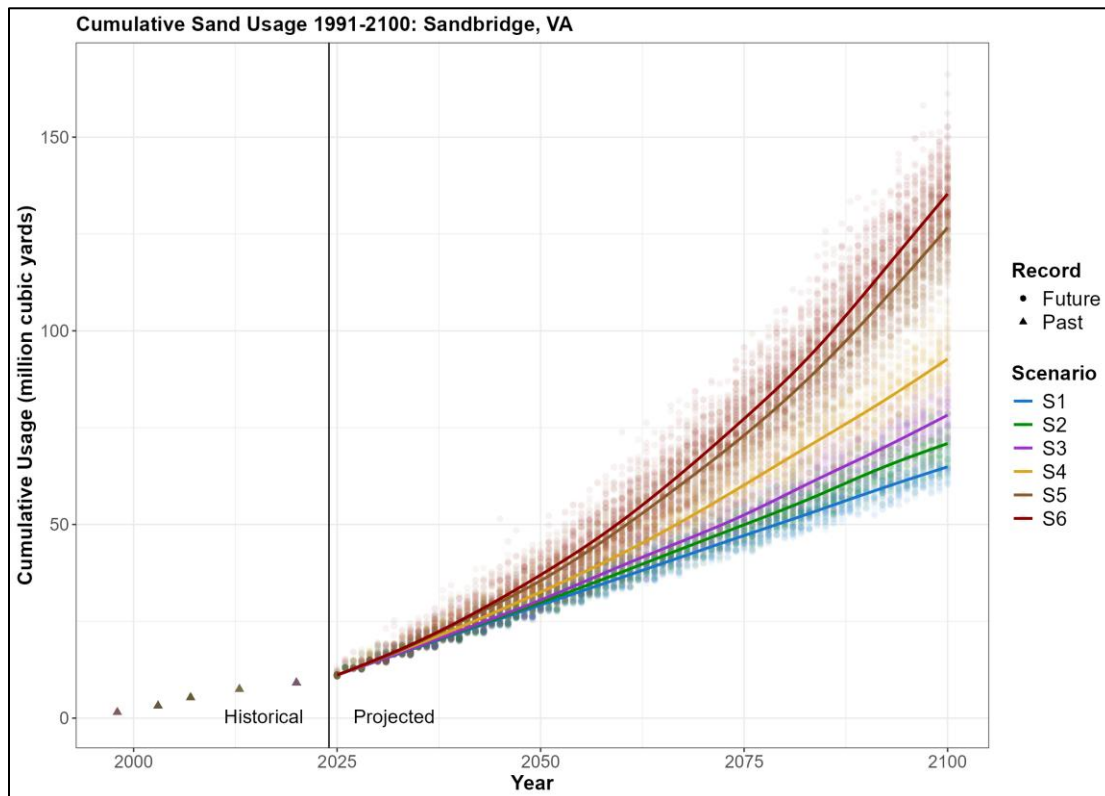


Figure 1. An example of the output of forecasted sand demand simulations for Sandbridge, Virginia

Different scenarios represent different levels of increased coastal erosion rates due to different sea level rise and storm climatology projections. S1 represents a baseline where there are no increases in coastal erosion rates from 2025 to 2100.

Geodatabase:

Warner DL, Mattheus CR, Wunsch DR (Delaware Geological Survey, Newark, DE). 2026. Supplemental Data: Assessing 21st century supply and demand of beach sand resources in the Mid-Atlantic. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. 81 p. Agreement No.: M23AC00014

This geodatabase provides tabular and geospatial data generated or used over the course of this project. Tabular data includes estimated past sand usage for each study beach from 1990 to 2024 and forecasted sand demand from 2025 to 2100 under different coastal erosion scenarios (definitions available in technical report and metadata). Geospatial data includes a gridded, classified output of potential sand resource quality within 30 miles of the study coastline. This output can be used to guide future geological and ecological surveys, as well as spatial planning for other offshore activities. Data are provided in ESRI geodatabase format as well as GeoTIFF and CSV formats.

Associated data files include:

- Grid: A raster dataset of classified model predictions of sand resource quality from classes 1 (worst) to 5 (best).
- Table: A tabular dataset of estimated past sand usage for each beach within the study area.
- Table: A tabular dataset of aggregated decadal statistics from bootstrapped sand needs scenarios. This includes the mean, standard deviation, minimum, lower quartile, upper quartile, and maximum of forecasted cumulative sand demand for each beach and scenario.
- Table: A tabular dataset of vibrocore layers used in our neural network model for predicting sand resource quality scores based on lithological descriptions.
- Table: A tabular dataset of whole vibrocore sand resource quality scores and associated values of bathymetric predictors used in our random forests model for predicting spatial distributions of sand resource quality.

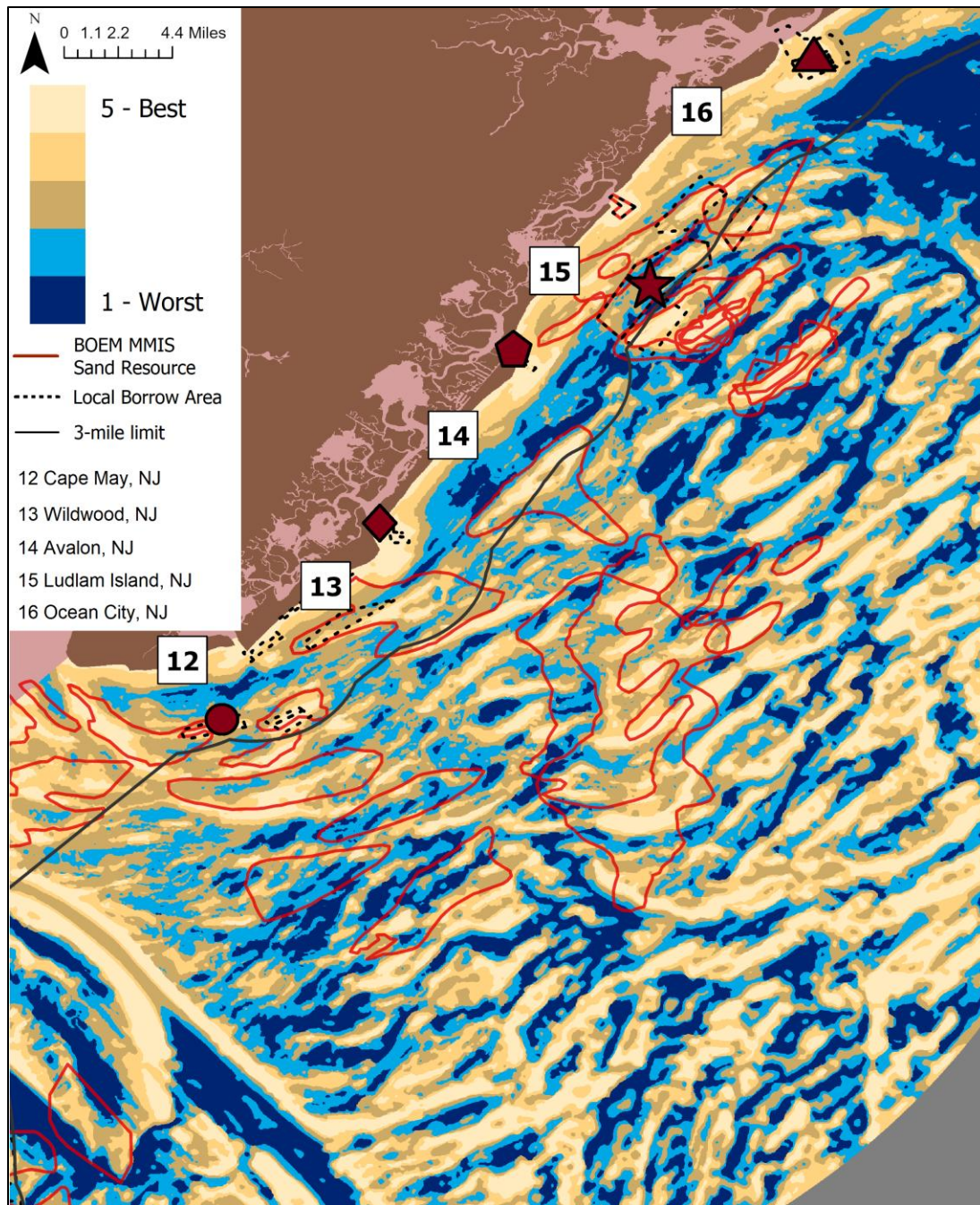


Figure 2. Example of modeled offshore sand resource potential for southern New Jersey

Light tans indicate high predicted quality resources, while blues indicate poor predicted quality. Land and bays are displayed in dark brown and pink, respectively. Current state borrow areas (black dashed) and sand resource areas from the BOEM Marine Minerals Information System (red lines) are noted. Shapes indicate borrow areas discussed in text: New Jersey Borrow Area K (circle), Hereford Inlet (diamond), Townsend Inlet (pentagon), New Jersey Borrow Areas L1 and L3 (star), and Great Egg Inlet (triangle).

Associated Cooperative Agreement Outputs

An academic manuscript detailing the processes of digesting lithological information and modeling potential sand resource quality used in this study is in development. However, it will not be available at the time of the other project deliverables.