Announcement M13AS00014: Hurricane Sandy Coastal Recovery and Resiliency – Resource Identification, Delineation and Management Practices

Agreement M14AC00002: NJGWS Post Hurricane Sandy Offshore New Jersey Sand Resources Investigation

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Summary Report

Cooperative Agreement Outputs including Project Deliverables:

Katie Diaz, NJGWS Offshore Resources Exploration Team, 2018: Data synthesis and assessment report for offshore Northern Atlantic County, NJ

New Jersey Geological and Water Survey staff performed an analysis of seismic and vibracore data to locate, characterize, and quantify sand-resource areas offshore Northern Atlantic County, New Jersey. The analysis comprises 41 seismic lines with approximately 200 nautical miles of data and 49 vibracores collected in State and Federal waters from Absecon Inlet to Little Egg Inlet. Sand deposit thickness is interpreted from sub-bottom profiles using SonarWiz™7. The data was exported into Surfer™12 software to create contour maps and calculate volumetric data. Volumes were calculated at base of sand (Z = 0), leaving a 5-foot thickness of sand behind (Z = 5), and leaving a 10-foot thickness of sand behind (Z = 10). The analysis of the site yielded 3 separate shoals with an estimated volume of almost 300 million cubic yards of sand (table 1). The northern shoal volume was calculated using seismic and vibracores north of line 9130, the central shoal using seismic and vibracores between 9090 and 9130, and the southern shoal using seismic and vibracores south of 9090 (figure 1). An additional eight vibracore locations are recommended to supplement the ongoing characterization of this resource area and are shown in Figure 1.

Shoal Name	Seismic Lines	Vibracores	0-foot Volume	5-foot Volume	10-foot Volume
			cubic yards (yd^3)		
Northern Shoal	9020, 9040, 9050, 9140, 9150, 9160, 9170, 2032, 2400, 2640, 2650, 2750	1, 2, 3, 13, 96, 101, 124, 129, NJV-628, NJV-631	118,308,255	77,894,771	37,481,187
Central Shoal	9010, 9020, 9110, 9120, 2032, 2041, 2340, 2351, 2370, 2360	4, 5, 5 Trace, 6, 6a, 94, 95, 120, 122, 123 Trace, 126, NJV-632, NJV-633, NJV-634 Trace, NJV-635	152,795,262	108,727,263	64,659,263
Southern Shoal	9010, 9020, 9070, 9080, 9090, 2300, 2310, 2330, 2280	7, 8, 89, 114, 118, 118 Trace, 119, NJV-638, NJV-640	29,360,567	17,956,122	6,551,677

Table 1. Shoals in Northern Atlantic County with corresponding seismic lines, vibracores (NJGWS and USACE), and volumetric data. Zero-foot thickness is the calculated volume of the entire shoal to the base of sand. Five-foot thickness calculation is based on a minimum thickness of 5 feet from base of sand. Ten-foot thickness calculation is based on a minimum thickness of 10 feet from base of sand.

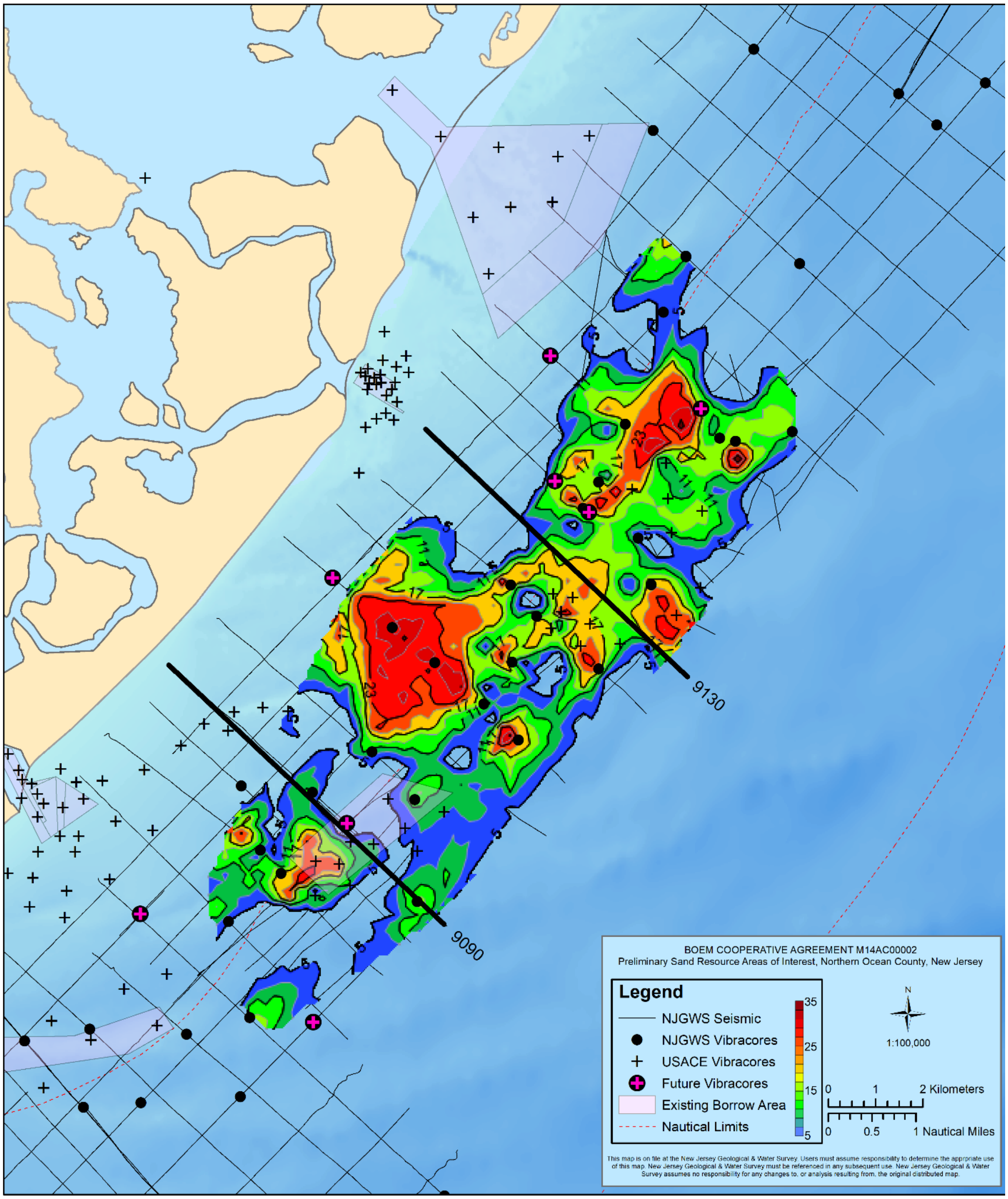

Figure 1. Northern Atlantic County Study Area contour plot overlain with vibracores (NJGWS and USACE), seismic lines, shoal features, and existing borrow areas. The contour plot shows where the calculated sand thickness is at least 5-feet thick. The northern shoal volume was calculated using seismic and vibracores north of line 9130, the central shoal using seismic and vibracores between 9090 and 9130, and the southern shoal using seismic and vibracores south of 9090.

Michael Castelli, NJGWS Offshore Resources Exploration Team, 2018: Evaluation of Optimal Seismic Line Spacing and Placement for Delineating Design Level Offshore Sand Resource Areas.

CB&I completed a design level survey of borrow area F1 by collecting 97 Chirp Sub-bottom profiles, all of which were parallel in a northwest-southeast orientation at approximately 30-meter spacing between lines. Geological data was collected from 31 locations in the form of 20-foot vibracores.

A sand volume of 15,286,148 cubic yards was calculated for area F1 using all the available data in this study. To find the most efficient line spacing of seismic lines used to calculate the volume of the shoal, the distance between the selected seismic lines was increased incrementally until a variation of greater than 10% from the original calculated volume was reached. Line spacing was increased from a fixed center point in the shoal outward toward the flanks of the shoal and was increased by approximately 30 meters for each new calculation. As shown in table 2, calculations using seismic lines spaced 270 meters apart gave a variation of 11.8% from the original calculated volume. Calculations were continued for greater line spacing and findings show that at some line spacing's greater than 270 meters, the percent variation from the original volume can drop down below 1%. This shows that it is possible to get an extremely accurate volume calculation using line spacing greater than 270 meters and that another factor was influencing the calculation. It was found that the increments of line spacing that resulted in incomplete coverage of the outskirts of the shoal were also the line spacings that resulted in greater variation from the original volume.

Based on the findings of this study, NJGWS makes a conservative recommendation for design level seismic line spacing of 720 meters (0.39 nautical mile) contingent on 1) seismic coverage of full extent of the shoal, 2) a grid of perpendicular tie lines collected throughout the study area, and 3) vibracores located on intersections of the seismic lines and on the flanks of the shoal. Greater accuracy of sand volume calculations can be achieved with closer line spacings, however the line spacing of 30 meters collected by CB&I was found to be excessive and unnecessary.

Seismic Lines Used	Calculated Volume (yds^3)	% Variation from Original Volume	Total # of Lines Used	Total # of Cores on Lines	Approx. Line Spacing (meter)
All Lines	15,286,148	0.0%	97	31	30
2nd	14,953,511	2.2%	49	14	60
3rd	15,137,765	1.0%	33	9	90
4th	15,095,694	1.2%	25	11	120
5th	14,209,655	7.0%	19	9	150
6th	15,382,307	0.6%	17	3	180
7th	13,750,252	10.0%	13	3	210
8th	14,813,704	3.1%	13	1	240
9th	13,478,186	11.8%	11	3	270
10th	13,446,090	12.0%	9	5	300
11th	13,818,711	9.6%	9	2	330
12th	15,309,217	0.2%	9	2	360
13th	12,554,422	17.9%	7	2	390
14th	13,515,488	11.6%	7	1	420
15th	14,487,745	5.2%	7	1	450
16th	15,014,638	1.8%	7	0	480
24th	15,333,470	0.3%	5	0	720
32nd	15,339,378	0.3%	4	0	960
48th	17,243,220	12.8%	3	0	1440
Recon	13,114,868	14.2%	5	2	N/A
Cores	12,643,141	17.3%	0	31	N/A

Color Code	% Variation
(green)	0% - 5%
(yellow)	5% - 10%
(pink)	> 10%

Table 2: Color-coded F1 sand volume comparisons computed in Surfer 12™ for all the varying line spacing between seismic lines. The original line spacing of the survey was 30m. To determine the most efficient line spacing, volume calculations were completed by effectively removing more and more lines. For example, the 60-meter line spacing was attained by choosing every other line and using those lines to determine a volume of sand. For the next calculation, 90-meter spacing, every third line was chosen and used to calculate the volume of sand. This process was repeated for every 4th line form the center point (120-meter spacing), 5th line (150-meter spacing), etc.

NJGWS Offshore Resources Exploration Team, 2018: Technical Report detailing the quality of the BOEM ASAP data.

This product contains a review of the quality of the geophysical data collected by CB&I. NJGWS have created a grading scale to categorize the quality of the data. This grading scale has three categories: good, fair and poor. Data was considered good if the reflector that represents the base of sand is visible and can be followed throughout the entire extent of the shoal (figure 2). There was little to no ringing or distortion of the data directly below the seafloor surface and features such as paleochannels that are present deeper than the base of sand reflector were visible with the multiple not cutting through or masking these features. Data was considered fair if the reflector that represents the base of sand was traceable and visible throughout most of the shoal (figure 3). Some distortion of the data directly below the seafloor and features below the base of sand were considered acceptable. Data that is categorized as poor does not have any visible base of sand, almost all the data below the seafloor is distorted and no features are visible in any portion of the record (figure 4).

NJGWS Offshore Resources Exploration Team, 2018: Technical Report delineating areas for future geophysical and geological surveys to fill data gaps

This product includes shapefile data and maps reporting existing offshore geophysical and geological data, and recommendations for future seismic and vibracore acquisition. These coverages are based on the anticipated future needs and requests of the U.S. Army Corps of Engineers and the New Jersey Department of Environmental Protection Division of Coastal Engineering. Figure 5 shows generalized areas where this work needs to be completed. This section also includes a technical discussion regarding seismic acquisition tools. This originated because some of the data received by the NJGWS was deemed subpar (as discussed in the previous section) and users of this equipment may benefit from a more dynamic approach to data collection, including using different sub-bottom systems, varying settings throughout the course of the survey, and modifying survey plans due to weather or ocean swell.

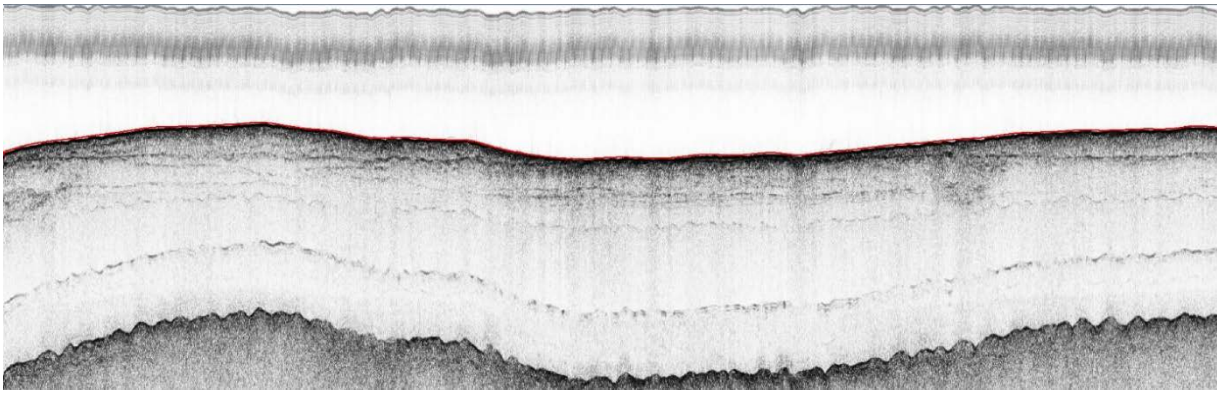

Figure 2. Example of a Chirp line collected by CB&I that is considered good-quality data.

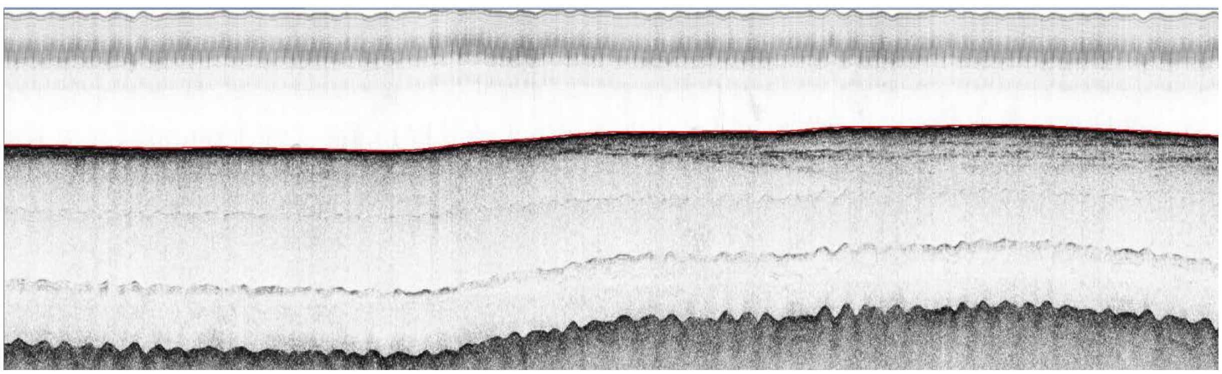

Figure 3. Example of a Chirp line collected by CB&I that is considered fair-quality data.

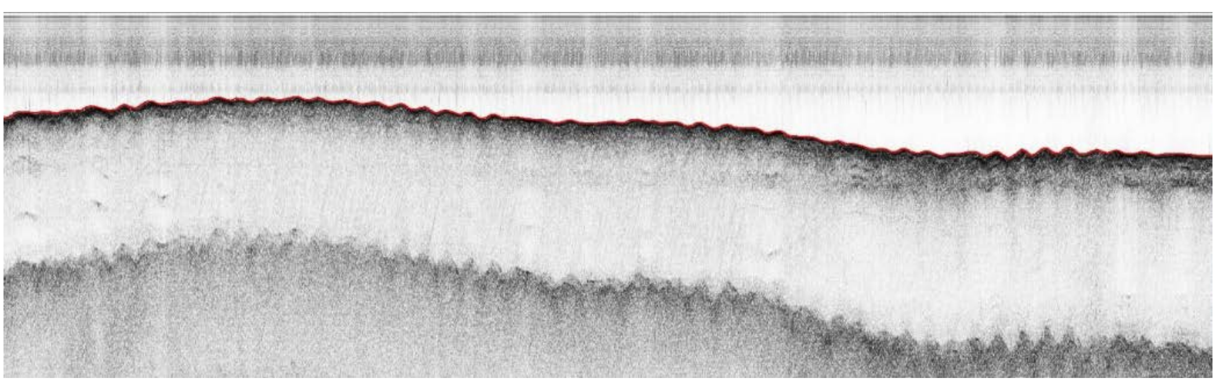

Figure 4. Example of a Chirp line collected by CB&I that is considered poor-quality data.

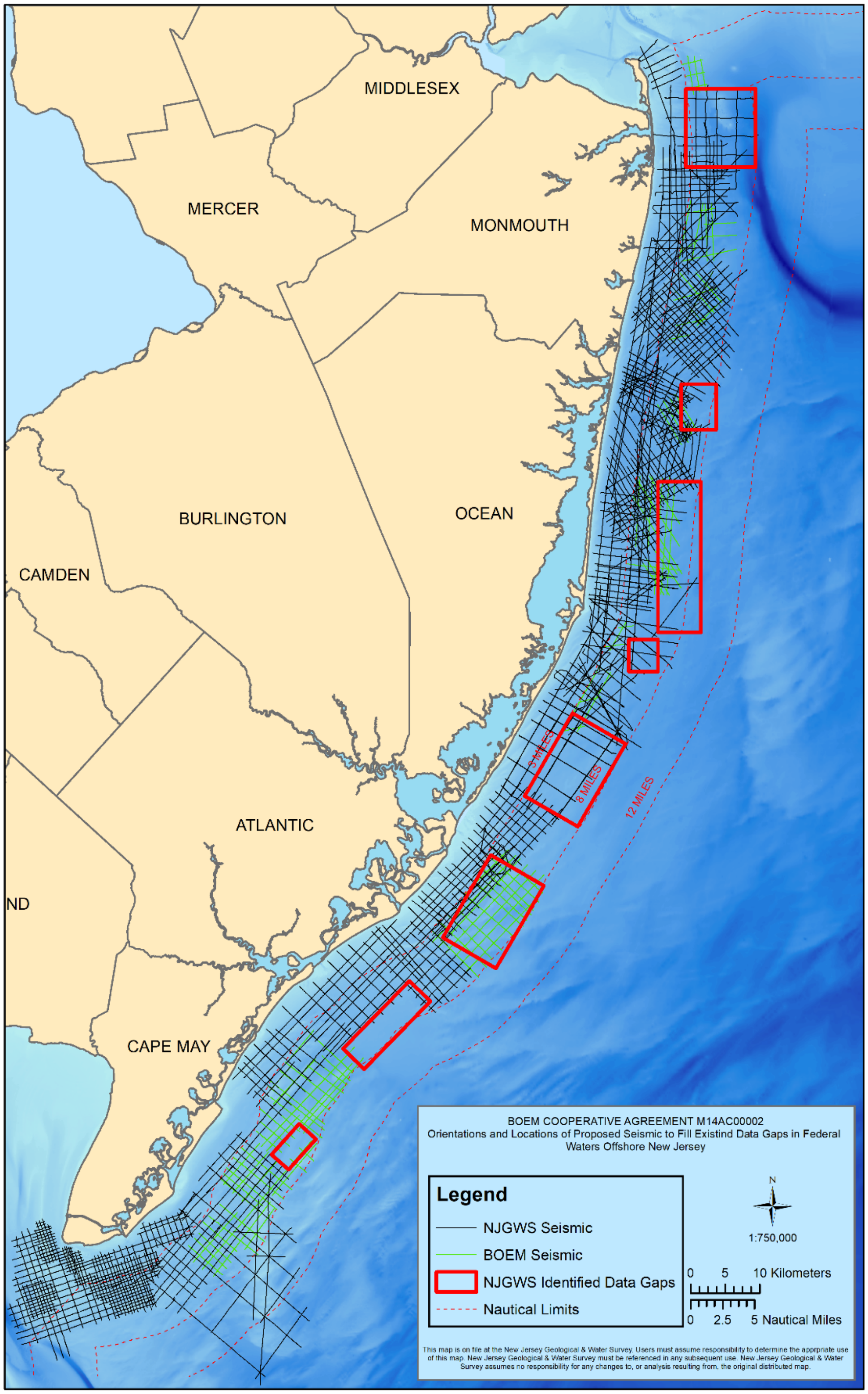

Figure 5. NJGWS identified data gaps based on existing seismic and vibracore data, and the anticipated future needs of the U.S. Army Corps of Engineers and the New Jersey Department of Environmental Protection Division of Coastal Engineering.