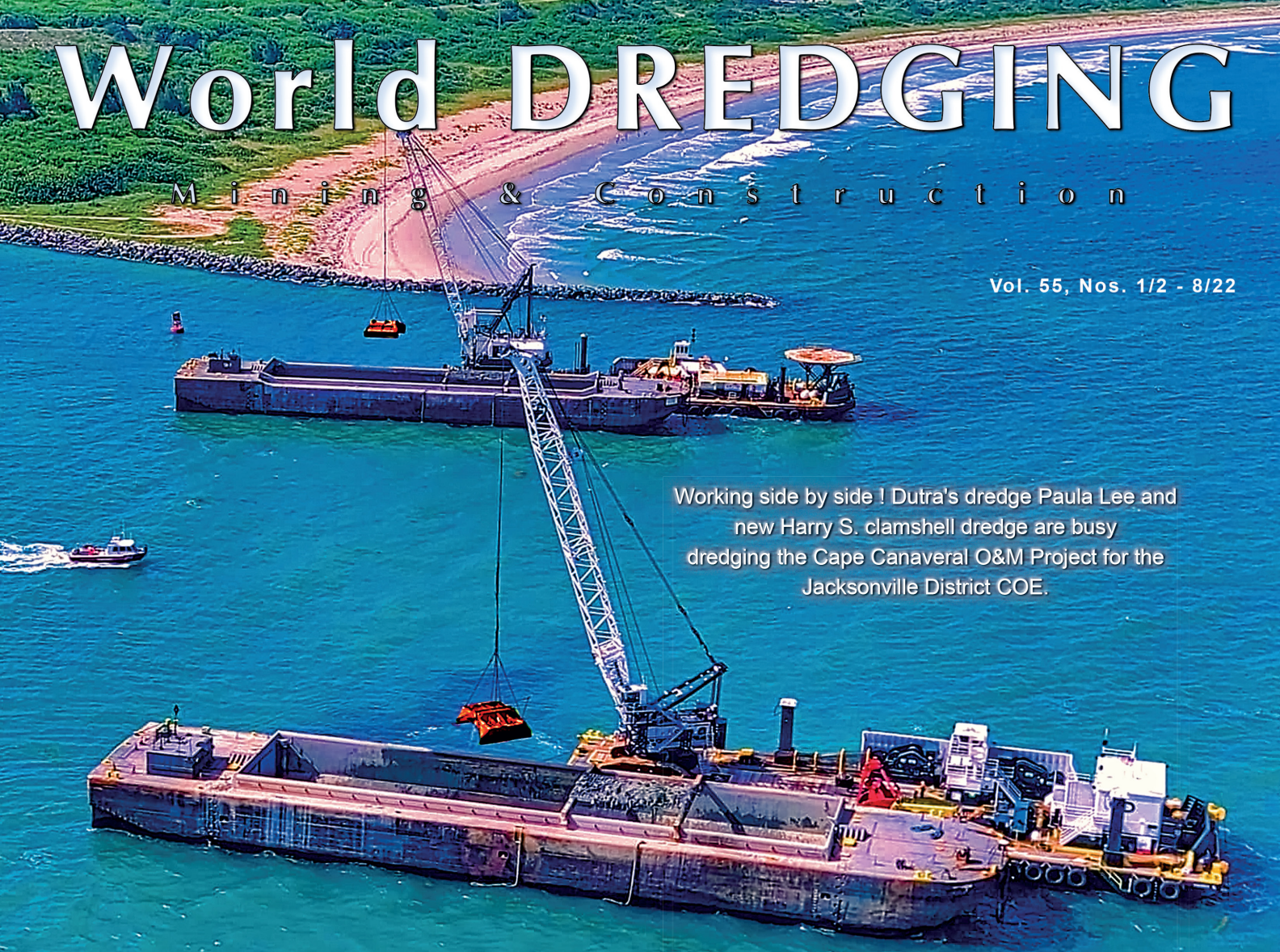
World DREDGING

Mining & Construction

Vol. 55, Nos. 1/2 - 8/22



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Mining & Construction

Volume 55, Nos. 1/2 - 8/22 | US ISSN 1045 - 0343

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World DREDGING Mining & Construction (US ISSN 1045-0343) is published bi-monthly by Placer Management Corp., PO Box 17479, Irvine, CA 92623 - 7479 USA. **ARTICLES:** Send to editor. **SUBSCRIPTION PRICES:** 1 year = $100, 2 years = $180, 3 years = $270; Airmail Outside-USA 1 year = $200. **SINGLE COPIES:** Previous 6 issues - $10/copy, Directory - $20 (shipping extra) ; Prior issues - contact us for availability & price. **ADVERTISING INSTRUCTIONS:** Send insertion orders and ad copy to Sales. **CHANGE OF ADDRESS:** Send new address with old address to Circulation, World DREDGING, PO Box 17479, Irvine, CA 92623 - 7479, USA.

COVER: Working side by side ! Dutra's dredge Paula Lee and new Harry S. clamshell dredge are busy dredging the Cape Canaveral O&M Project for the Jacksonville District COE.

Beneficial Use of Dredged Material

at Harvey Cedars New Jersey to Support the Barnegat Inlet to Little Egg Inlet Coastal Storm Risk Management Project

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Keywords
Beneficial Use of Dredged Material (BUDM), Natural and Nature Based Features (NNBF), near-shore nourishment, morphology, Coastal Storm Risk Management (CSRM)

Beneficially using dredged sediment to nourish the near-shore region of the beach is a common practice that keeps the material in the littoral system and may extend the life span of traditional sub-aerial beach nourishments. Dredged sediment with slightly more fine material than is allowed for sub-aerial beach placement is often able to be placed in the near-shore, which allows natural processes to winnow the fine grains from the placed material. Near-shore nourishments constructed as a mound or bar are often referred to as near-shore berms and can reduce the wave energy impacting the shoreline by breaking waves farther offshore (McFall et al., 2021).

The reduced wave energy on the lee side of a near-shore nourishment often provides an area conducive for capturing the long-shore transport and inducing shoreline accretion (McFall et al., 2017). The longevity of the near-shore nourishment is highly dependent on several factors including the wave climate, placement depth, and placed volume (Bain et al., 2021). To improve the understanding of the morphological evolution of a near-shore nourishment and beach response at an erosional hot-spot, a near-shore nourishment project was extensively monitored in Harvey Cedars, New Jersey. Knowledge gained from this monitoring will support future projects and advance the practice of near-shore nourishment.

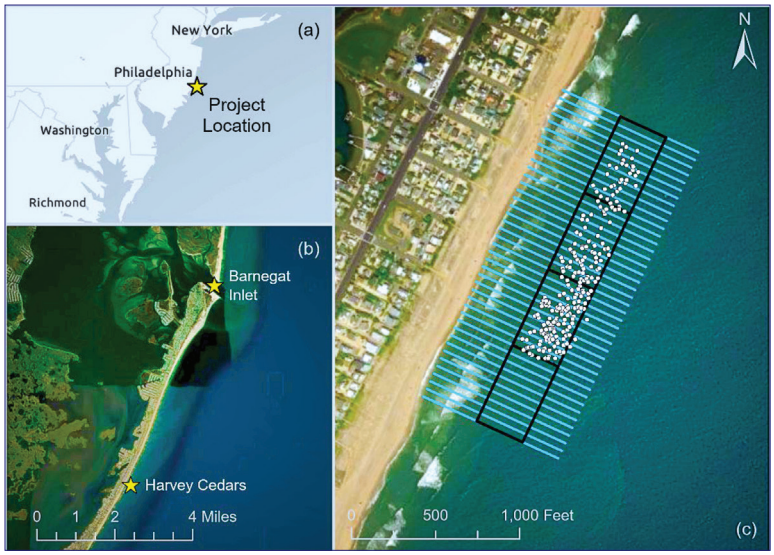

Figure 1. (a) Projection location, (b) Barnegat Inlet and Harvey Cedars, and (c) the design extent of the nourishment divided into four 500-ft wide sections. Vessel heading lines spaced at 50' shown in blue and white circles denote drop locations.

In July and August 2021, 109,000 yd^3 of sediment was dredged from Barnegat Inlet federal navigation channel with beneficial use placement in the near-shore of Harvey Cedars, NJ, as shown in Figure 1. Harvey Cedars was selected because it was identified as an erosional hot-spot area within the Federal CSRM Project which stretches for 16 miles along Long Beach Island, NJ. The Harvey Cedars portion of the beach-fill was originally completed in July of 2010 (NAP 2021). Since that time it has received periodic nourishment and undergone additional emergency beach fills to repair damages to the beach and dune system after Super-storm Sandy in 2012, and multiple severe nor'easters.

Figure 2. The Murden placing sediment in the near-shore of Harvey Cedars, NJ (July 2021).

The design consisted of four 500-ft. wide shore parallel boxes with the landward side placed at the -9 ft. NAVD88 contour line as shown in Figure 1(c). Vessel heading lines were spaced every 50-ft and the dredge was instructed to "nose in" along the placement line, and then split the hopper to place the sediment as shallow as possible given the tide. To construct the feature, the dredge began at the north end of the southern box and placed multiple loads per line before progressing north. Near the halfway mark of construction, crews reduced the number of drops per line to develop a longer feature. The construction was performed by the U.S. Army Corps of Engineers split hull hopper dredge Murden. Figure 2 shows the Murden placing sediment in the near-shore.

A combination of field sensors and a series topographic and bathymetric surveys were employed to monitor the morphologic and hydrodynamic response of the site after the near-shore nourishment. Offshore wave conditions were measured with a wave buoy placed 2 miles offshore in 50-ft. of water. Two pressure sensors were installed in the surf zone: on the lee side of the nourishment and a control was installed 2,275-ft. to north of the nourishment. Post construction, an Acoustic Doppler Current Profiler was deployed on the seaward side of the nourishment in 20-ft. of water.

Digital elevation models (DEMs) were created from the topo-bathy surveys conducted before and after the placement as shown Figure 3. The August 2021 survey (two weeks post-construction) showed the creation of a 1,400 ft. long feature with approximately 88,000 yd^3 of retained sediment in the placement area, with a majority of sediment placed within the middle boxes. Feature deflation starts to appear in the December survey (Fig. 3c) with a concurrent widening of the sub-aerial beach on the lee of the nourishment. The feature deflation continues through the March survey (Fig. 3d), and the lee side shoreline accretion of the nourishment is evident.

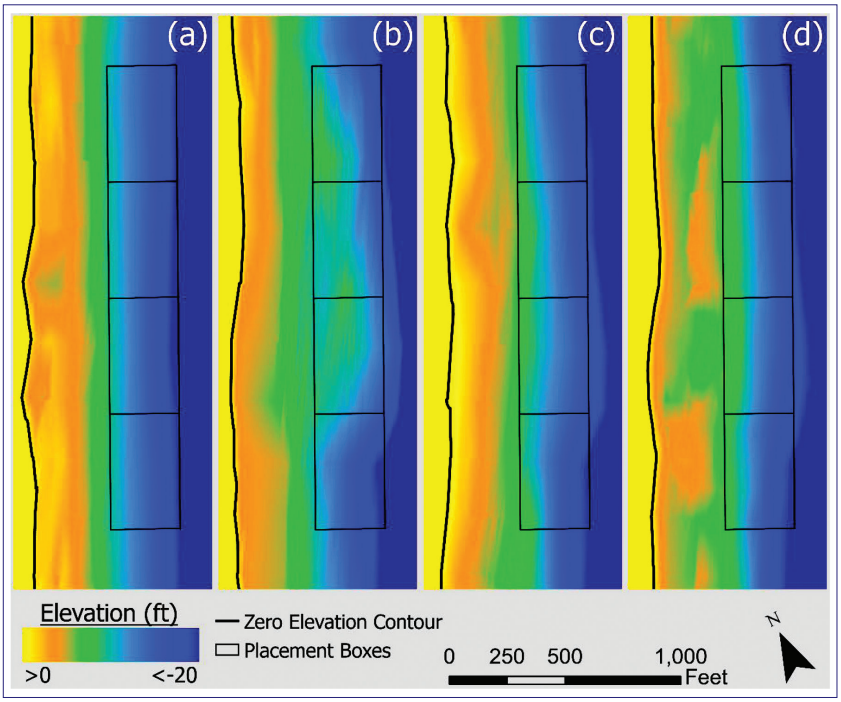

Figure 3. Digital elevation models showing the combined topographic/bathymetric surveys from (a) pre-nourishment in May 2021 and (b) post-nourishment in August 2021 (c) December 2021 and (d) March 2022.

A cross-shore profile transect from the center of the placement was extracted from the topo-bathy surveys and is shown in Figure 4. The August 2021 survey shows the feature being constructed from the 550-ft to

Continued on pg. 22

Beneficial Use of Dredged Material

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from pg. 11

950-ft marks resulting in an approximate width of 400-ft and an elevation increase of 5.5-ft across this transect. Due to the steepness of the beach slope at Harvey Cedars, the bow of the Murden was able to reach the –9-ft NAVD88 contour but the majority of sediment was deposited 50-ft farther offshore. Three and a half months later (e.g., December 2021 survey), the feature had deflated approximately 2.5-ft and elongated along the cross-shore directions. No significant changes were identified within the feature in the March 2022 survey; however, shoreline accretion was identified within the beach section of the profile. Approximately 20-ft of shoreline advance was noted in the time-frame between the December 2021 and March 2022 surveys. This is significant because this area typically loses dry beach width during the winter months due to larger wave events, which highlights the positive impact this near-shore nourishment had on the shoreline.

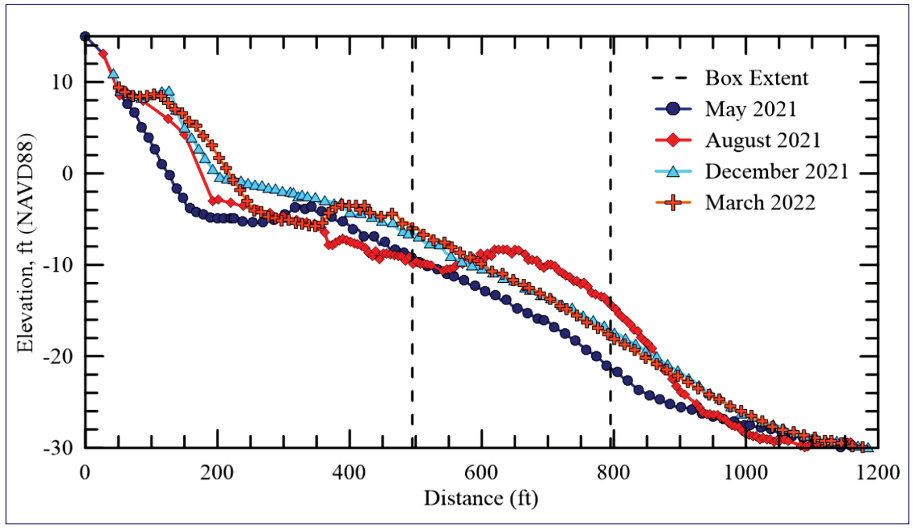
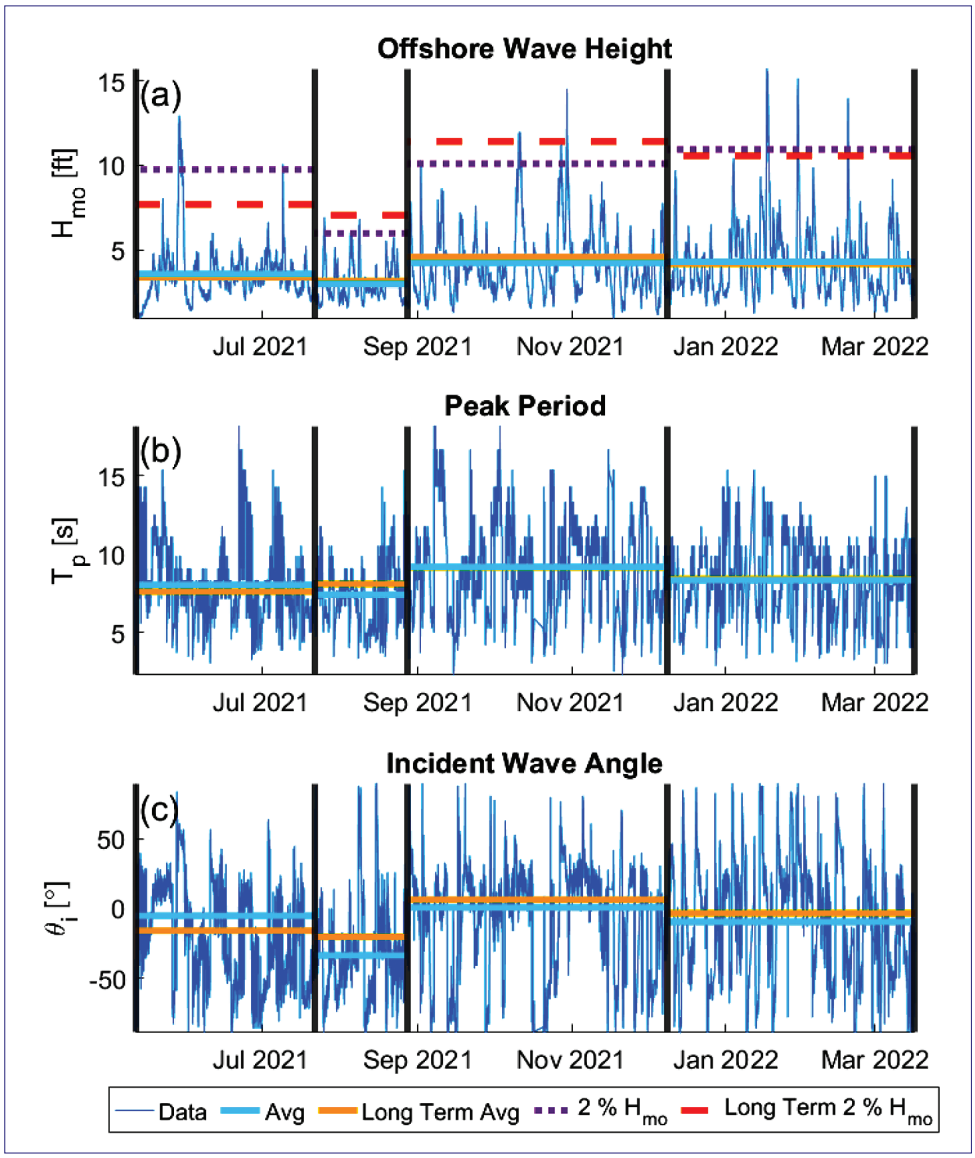


Figure 4. Elevation profiles from pre and post topography-bathymetric surveys.



Offshore significant wave height (Hmo), peak period (Tp), and incident wave angle (θi) at National Data Buoy Center (NDBC) Station 44091 had typical values and seasonal trends during and after placement as shown in Figure 5. Sediment was placed during the calmer summer months. Waves became more energetic with longer period and more shore normal between the August and December 2021 surveys.

Waves continued to be more energetic and shore normal between the December 2021 and March 2022 surveys. Several particularly energetic wave events impacted the placement area in October 2021, January 2022, and February 2022. This indicates that the observed subaerial beach accretion occurred even with the more energetic and erosive waves from several large storms.

Figure 5. Onshore directed (a) Wave height, (b) peak period, (c) and incident wave angle at NDBC Station 44091, offshore of Barnegat Inlet, NJ. Vertical grey lines show the start of placement and pre- and post-placement surveys. Averages (cyan) and 2% exceedance Hmo (purple) between surveys are compared to similar times in the 7-year record (yellow and red). Average θi are energy weighted, and positive θi approach from the north.

A 1,400-ft long near-shore nourishment was constructed at Harvey Cedars, NJ with beneficially used dredged sediment from Barnegat Inlet. Three and a half months post construction, the feature deflated from 6-ft down to 3.5-ft but remained relatively stable in the following five months. Sediment was placed during the calmer summer months, but higher energy waves impacted the site after construction, with multiple large storms.

The shoreline accretion was measured on the lee of the nourishment during the typically erosive winter months. This highlights the positive impact that the beneficial use of dredged sediment can have on beaches, supplementing shorelines and retaining sediment within the littoral system.

The design consisted of four 500-ft. wide shore parallel boxes with the landward side placed at the -9 ft. NAVD88 contour line as shown in Figure 1(c). Vessel heading lines were spaced every 50-ft and the dredge was instructed to "nose in" along the placement line, and then split the hopper to place the sediment as shallow as possible given the tide.

Acknowledgements

Planning, design and construction of this project was one of 10 pilots funded nationally through the Water Resources Development Act (WRDA) 2016 Section 1122 - Beneficial Use Pilot Project program, work conducted in partnership with the State of New Jersey. Monitoring efforts were funded through the USACE Regional Sediment Management (RSM) program and the Philadelphia District (NAP). The cooperation of the captains and crew of the USACE Dredge Murden, the NAP survey team, the State of NJ's Office of Coastal Engineering and the Borough of Harvey Cedars, NJ is graciously acknowledged.

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