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Nearshore Placement Techniques in Southern Lake Michigan

The southern shoreline of Lake Michigan is highly developed and the presence of harbor structures and shoreline armoring interrupts the natural littoral movement of sand. Remaining undeveloped areas contain valuable natural resources and provide protection for residential structures. To support the shoreline management goals of the State of Indiana, the National Park Service, and local communities, USACE regularly places sand dredged from Burns Waterway Harbor in the nearshore area along reaches that are threatened by erosion and coastal storm damages. Dredged sediments are primarily coarse sand suitable for beach nourishment, and the material is placed in a designated nearshore area that is directly accessible by the dredging scows. While this method of beneficial use of dredged material is lower cost than placement directly on the beach or closer to the shoreline, the effectiveness of these nearshore placements for shoreline protection and littoral nourishment has not been established.

To address these concerns a monitoring effort was implemented in 2016 that included the installation of 2 ADCP devices to monitor wave direction and height as well as topographic and bathymetric surveys prior to and after nearshore placement. The shoreline in the Burns Waterway Harbor study area has been analyzed using historical aerial photography, direct beach and nearshore placement records, and the U.S. Geological Survey's Digital Shoreline Analysis System (DSAS). The shoreline analysis was compared to the results of the U.S. Army Corps of Engineers (USACE) Sediment Mobility Tool. For the 45 year period from 1969 to 2014, the shoreline from the west breakwater of the Burns Small Boat Harbor to the east end of Ogden Dunes eroded an average of 40 m. The 500 m stretch west of this area, including the eastern half of Ogden Dunes, displayed an average erosion rate of 10 m over the study period. The western 3.5 km of the shoreline, roughly from Marquette Park in Gary, Indiana to the east jetty of the U.S. Steel landfill had significant accretion, with an average shoreline accretion of 107 m. The remaining center of the study area displayed modest levels of accretion.

The current nearshore placement technique consists of placing sediment in 5.5 m of water in small discrete mounds to prevent the sediment from obstructing the hanging gates of the scow from closing. The sediment may be mobilized more frequently and more energy may be dissipated if the dredged sediment is placed in shallower depths in the shape of an elongated bar or mound. This initial analysis of the current placement practices indicate an accretionary effect on the shoreline, but further analysis and monitoring is needed to quantify the shoreline response.

Bio: Katherine Brutsché is a Research Physical Scientist at the USACE Engineer Research and Development Center in Vicksburg, MS. She received her Ph.D. at the University of South Florida in 2014, where she also received her Masters of Science degree in Geology in 2011. Her Bachelor of Science degree in Geosciences, with dual emphasis in Geology and Earth Science Education, was completed at Virginia Tech in 2007. Her research is focused on nearshore berms as well as other issues pertaining to the dredging and placement of sediment in the nearshore.