

ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

Region: Atlantic

Planning Area: Mid-Atlantic

Title: Investigation of Dredging Guidelines to Maintain and Protect the Integrity of Offshore Ridge and Shoal Regimes/Detailed Morphologic Evaluation of Offshore Shoals (NT-06-02)

Total Cost: \$428,150

Period of Performance: 9/01/2006 to 5/31/2011

Conducting Organization: W.F. Baird & Associates

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Description: The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) initiated a study in 2007 to formulate and recommend offshore dredging guidelines to protect and maintain the morphologic integrity of the ridge and shoal features found on the Outer Continental Shelf (OCS) which are being targeted as sand borrow sites for beach nourishment and coastal restoration efforts. The guidelines are supported by an improved understanding of the morphologic evolution of ridge and shoal features through parametric analysis, field measurements, and numerical modeling. The objective of the guidelines is to allow dredging of ridge and shoal features, at the same time as protecting their integrity and the habitat for benthos and fish provided by these features. An analysis of shoal morphological parameters was completed as part of the above BOEMRE study and is presented here. The objectives of this effort were 1) to better understand shoal features, their genesis, evolution and maintenance, and 2) to support development of dredging guidelines. The focus was to identify possible minimums that should not be crossed (e.g. shoal height, width, length, volume, etc.) and to determine if the target shoals are special or unique in some way.

In 2008 the U.S. Army Corps of Engineers, Baltimore District released a Final Supplemental Environmental Impact Statement (USACE, August 2008) for the "Atlantic Coast of Maryland Shoreline Protection Project" to evaluate the impacts of dredging several new offshore shoals to provide sand for the project for the years 2010-2044. It is estimated that between 6,800,000 and 15,000,000 cubic yards of sand would be needed through 2044, depending on future storminess. Offshore borrow sources were thus identified to obtain up to 15,000,000 cubic yards of sand. Three offshore shoals located in Federal waters were recommended: Weaver Shoal, Isle of Wight Shoal, and Shoal "A" (see Figure 1). Several shoals recommended in USACE 2008 were considered for detailed study. The idea was to select a shoal which has morphodynamics that are representative of the wave-dominated settings of the area. For this purpose, the shoal needed to be shallow enough to be morphologically dynamic and have an overall NE-SW orientation to promote wave focusing under predominant storm events of the site. Other criteria were dredging priority and historic bathymetry data availability. The

Isle of Wight (IOW) shoal was selected as it had the most favorable rating. Therefore, references will be made to IOW and two of its neighboring shoals (i.e. Fenwick and Weaver) throughout this paper.

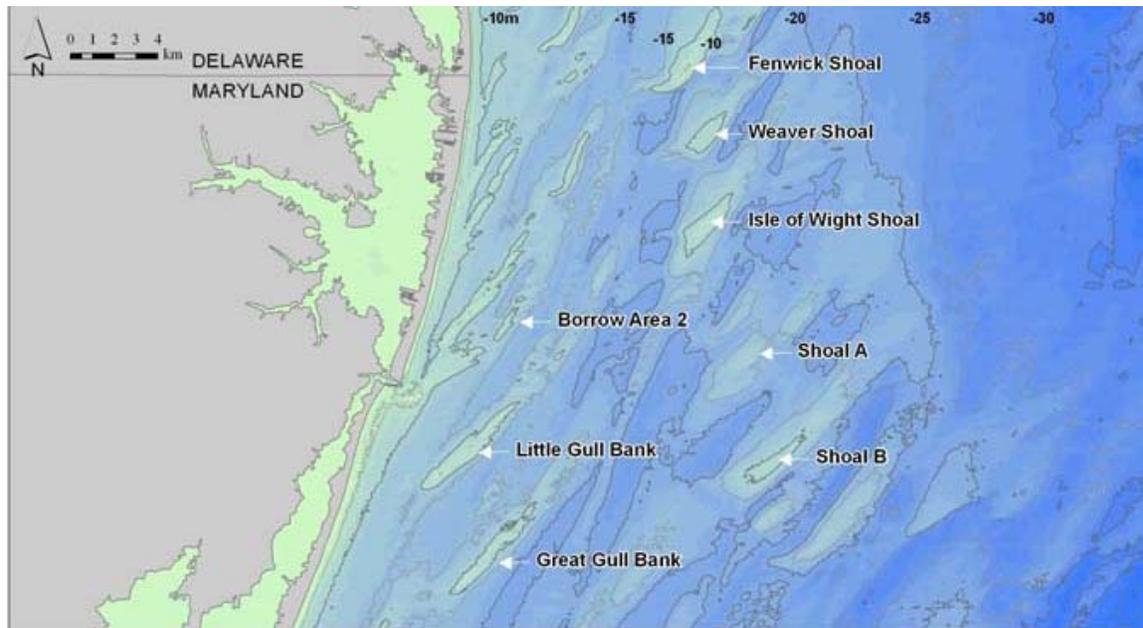


Fig. 1. Ridge and swale topography typical of the Mid-Atlantic Bight region around Isle of Wight

The Study Area and Shoal Parameters

The focus of the study was on Delmarva Atlantic Coast area, i.e. the area offshore Delaware, Maryland and Virginia between Delaware Bay and Chesapeake Bay. This is a transgressive shore on a wide, sandy continental shelf with a moderately abundant sand supply, either from riverine sources, erosion of the shoreline as the sea level rises, or from sediment brought to the shelf during periods of glaciation and/or ice melt; rising sea level over a widening shelf; and bathymetric irregularities that act as nuclei for the ridges (Hayes and Nairn, 2004). Shoals in this area may technically be regarded as sand ridges (Van Rijn, 1998). However, the more general term of “shoal” is used to refer to sand ridges throughout this paper. Offshore shoals between 10 m and 40 m depth contour were considered. In total 130 profiles were investigated and 181 offshore shoals identified. Of these, 7 are in or offshore Delaware, 50 in or offshore Maryland and 124 in or offshore Virginia waters.

Numerical modeling of long-term morphologic evolution of the shoals was completed for a total of 11 shoal dredging scenarios. In each scenario, the target shoal was partially excavated to the -10 m contour to provide sand volumes in the range of 1 to 2 million cubic meters. The model was run to predict change in morphology over a 10 to 15 year period. The results provided valuable insights on response of different dredging plans and this information was used for the development of dredging guidelines. It was found that after removal of material from a shoal, the shoal is reformed to a shoal with a smaller

volume due to removal of the sediment. Despite the reduction in volume, however, the reformed shoal may attain the same height as that of the pre-dredge shoal conditions for some dredging scenarios. Although shoals get smaller as a result of dredging, there was no indication of possible shoal diminishing/deflation after dredging.

Dredging Guidelines

A series of dredging guidelines were developed with the objective to provide dredging practices that result in a reformed shoal that has the same height as the pre-dredge shoal. The following selected guidelines are related to the discussions presented in this paper.

- The final dredging approach should be determined based on suitability of the dredged sand for nourishment as well as ecosystem services associated with the reformed shoal shape. A determination is required regarding the importance of maintaining the pre-dredge shoal Height from an ecological perspective.
- In case of Isle of Wight or other shoals in the same depth (i.e. 21 m), when dredging from the top of the shoal, removal of more than 1.3 m is not recommended or the shoal will not re-grow to the same pre-dredge height. Dredging directly from the shoal crest is thus not recommended.
- Sand should not be removed from the entire length of the shoal. Longitudinal dredging (i.e. dredging all along the longer axis) is not preferred because it affects wave focusing processes and the shoal does not recover to the same predredge height.
- In the present study area, it is recommended to dredge sand from the SW side of a shoal. This is because 1) wave focusing is concentrated on the NE side of a shoal, and 2) overall shoal migration is towards the southwest. Therefore, after removal of material from the SW side of a shoal, a new shoal crest can be formed over the excavated area by transport of material from the NE side.
- In case of Isle of Wight, dredging from SW side of the shoal above -10 m contour is recommended as it would result in creation of a smaller shoal with the same shoal height as the pre-dredge conditions.
- Dredging from shoal flanks below the -10 m contour over the SW half of the shoal is expected to have little effect on shoal integrity and little change is anticipated to happen to the dredged area. This dredging option is thus recommended if it can provide sand suitable for nourishment.
- The proposed guidelines are not universal and are dictated by the local storm wave height, storm wave direction, storm related subtidal currents. They are recommended for the shoals in the area offshore Delaware, Maryland and Virginia between Delaware Bay and Chesapeake Bay.
- Similar guidelines are expected to apply to shoals in areas other than present study area. Details, however, would be dictated by local wave and current conditions. It is

recommended that a similar study be completed for other regions when the ecological role of the shoal height/shape is very important to justify the associated study cost.

Importance to BOEMRE: To provide information for environmental review and leasing documents about how much sand can be safely removed from a Mid-Atlantic shoal, which parts of a shoal are least vulnerable to dredging, and what guidelines should be implemented to ensure best management practices of use of sand from these shoals.

Current Status: In progress

Final Report Due: 1/29/10

Publications:

Affiliated WWW Sites:

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