Delaware Sea Grant Project:
Quantifying short-term morphologic evolution and alongshore sediment transport rates at Cape Henlopen, Del., using remote sensing and rapid response GPS-equipped vehicles (R/ETE-14)

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Project Abstract:

We propose to map selected, high priority hard bottom benthic habitats in Delaware Bay using the net alongshore sediment transport on the Atlantic-fronting Delaware coast is northerly. The effect of this northerly transport is evident at Delaware's two major coastal features: Indian River Inlet and Cape Henlopen. Indian River Inlet is located at the about the center of the Atlanticfronting coast and is the only exchange between the ocean and Rehoboth and Indian River Bays. Jetties maintaining the inlet opening trap the northerly sediment transport at an estimated rate of roughly 85,000 m3/yr. A sand bypassing plant was installed in 1990 to offset some of this sediment accumulation. Sediment trapped at the inlet is important because it represents a deficit for the rest of the Delaware Coast. Cape Henlopen is located 21 km to the north at the opening of Delaware Bay and is a rapidly accreting spit. Recent estimates of the Cape growth/extension are ~5 m/yr as waves and tidal currents reshape the Cape morphology. The Cape is a major stopover for wintering birds, contains habitat for endangered wildlife and is a popular tourist destination.

It is clear that the growth of the Cape requires gradients in alongshore transport along this curved shoreline and that they result in erosion along the rest of Delaware's ocean-fronting beaches. However, the sediment transport magnitudes and gradients thereof near the Cape are unknown. The causative factors for this transport are also unclear. Delaware experiences a tidal range of 1.25 m that forces large scale flows within Delaware Bay. During flood tide, it is assumed that northerly tidal flows will exist close to the shoreline. Interestingly, as has been found on another Cape shorelines, northerly flows may also exist near the shoreline during ebb tide due to shearing of the ebb tidal jet and tidal recirculation. Present numerical models of flows near Cape Henlopen do not have the required resolution (minimum grid cell 750 m x 750 m) to determine if these northerly currents exist. In addition, the curved nature of the shoreline causes wave obliquity to change considerably along the Cape expanse. Variations in breaking wave obliquity should cause gradients in the magnitude of the wave-driven alongshore currents. However, the relative importance of tidal and wave processes being responsible for the alongshore transport gradients and continued growth of Cape Henlopen is unknown.

A multi-pronged morphological study is proposed. Rapid-response GPS vehicles will be developed and utilized to quantify the variability in the Cape roughly every 2 months. A utility vehicle will be used to collect sub-aerial topography and a personal water craft equipped with an altimeter for collecting offshore bathymetry. Interior Cape morphology will be collected with backpack-mounted GPS gear and compared to measurements collected by a novel, navigable unmanned blimp utilizing stereo-pair imaging. Morphology data will be supplemented by an 8-camera automated video imaging system arranged on an 18 m tower within the State Park. The imaging system will provide hourly shoreline and planform information as well as alongshore

variability in wave direction and intensity. Additionally, inner surf zone current meter measurements will be collected at several locations along the Cape.

Collected morphology data will be used to estimate alongshore sediment transport rates and transport gradients using inverse modeling techniques, even/odd analysis and quantification of sediment accretion south of a recently elongated and repaired jetty near the Cape. Wave direction and intensity information coupled with the in situ field data will be used to start quantifying the relative importance of waves and tides to the morphological variability of the Cape. Transport rates and data obtained from this study will be used by state program managers to better assess morphological affects on Cape wildlife and to better constrain models for sediment transport and beach nourishment design along Delaware's coast.