APPLIED COASTAL

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Project: Hydrodynamic Analysis of Slocums River and Little River, Dartmouth, Massachusetts

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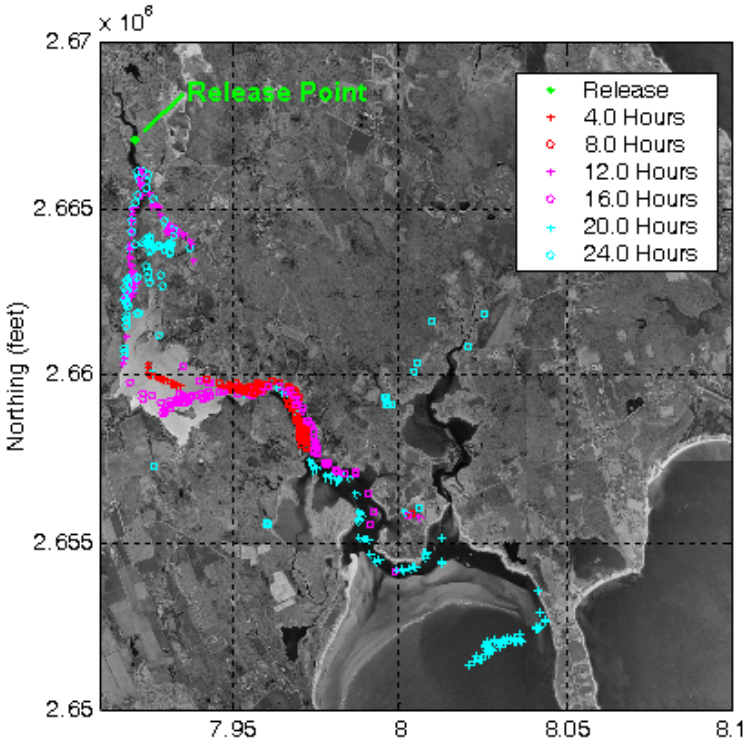
The Massachusetts Department of Environmental Protection (DEP) hired Applied Coastal Research and Engineering, Inc. (Applied Coastal) to assess the tidal flushing characteristics of Slocums River estuarine complex. This work will provide baseline information for the planned water quality assessment to be performed as part of the Southeastern Massachusetts Estuaries Project (www.state.ma.us/dep/smerp/smerp.htm) funded by the DEP. Slocums River is located the southern coastline of Buzzards Bay the town of Dartmouth, Massachusetts. The system is comprised of two major embayments: Slocums River and Little River. Circulation in both embayments is dominated by tidal exchange with Buzzards Bay; however, Slocums River also is influenced by the Paskamanset River which supplies fresh water to the upper portion of the embayment.



A data collection program was conducted as the initial phase of this study. The goal was to collect the necessary data to construct and calibrate the hydrodynamic model. The collection program included bathymetry measurements throughout the system, tidal water surface elevation measurements at six locations, Acoustic Doppler Current Profiler (ADCP) measurements, and salinity measurements. In addition, fresh water inflow data were derived from the existing gaging station on the Paskamanset River.

The next phase of the project was the development of a hydrodynamic model of the Slocums River system. Using the bathymetry data, a finite element model grid was generated for use with the hydrodynamic code. A fresh water inflow boundary condition at the northern extent of Slocums River was defined using flow data from the existing Paskamanset River gaging station. Additionally, tide data collected off of Smith's Point were used to define the open boundary condition that drives model circulation, and data from five other locations within the system were used to calibrate model performance to ensure that it accurately represents the dynamics of the system. Current measurements within the entrances of both Slocums and Little Rivers were utilized to verify model results. The calibrated hydrodynamic model was used to compute the flushing rates and residence times within the sub-embayments of the system, providing a general indication of water quality in each embayment.

The particle tracking model RMATRK was run for Slocums River and Little River to examine the movement of water throughout the system. The specific goal was to examine the potential movement of water between Slocums River and Little River. The use of a particle tracking model allowed for numerous particles to be individually tracked throughout the system to help understand pathways of water movement between the embayments. This contributed to the understanding of the flushing characteristics of the system.

RMATRK transports discrete objects (particles) through the finite element grid using the hydrodynamic solution from RMA-2. The model utilizes the water depth and velocity to compute the transverse and longitudinal mixing coefficients. The velocities used for calculation of dispersion coefficients were the average velocities from the RMA-2 solution. The mixing coefficients are used to calculate particle movements over time and space, allowing particles to be released and monitored at multiple time periods and geographical points throughout the simulation. The particle pathways can be analyzed to track water movement throughout the system.

Simulations were developed to track particle migration, with particles released both in the upper and lower portions of Slocums River, as well as in Little River. Particles released in the upper portion of the system would likely represent the high nutrient waters derived from this portion of the estuary. Water in the lower portion of Slocums River generally exhibits a lower total nitrogen concentration; therefore, water derived from this location presumably would have less impact on overall estuarine water quality.