Defining a Method to Categorize Marsh Typologies, Accretion, Elevation, and Health for use in Restoration Techniques

• Lidar Data and Processing (2002, 2013, 2020 data sets)
• Aerial Imagery Data and Processing
• Sedimentation Analysis
• Review of Green Infrastructure/Techniques Based on Sedimentation Patterns
Area of Interest: Whale Branch
Past and Present Mapping: 1875 to 2020

Nautical Charts ca. 1875

Lidar Derived Surface 2020
Changes in Habitats: 1957 to 2021:
Aerial imagery analysis using automated mapping algorithms from different imagery band combinations

Habitats - 1957

Habitats - 2021

West side of island is stable despite Sea Level Rise

East side of island continues to show conversion of marsh to mud

Teal = Vegetation to Mud  Green = Mud to Vegetation
Sedimentation Patterns 2002 to 2020

- 2002, 2013, and 2021 lidar data points calibrated to 2002
- Average sedimentation rate of 0.7 mm per year
- Marsh rate of +0.24 mm/yr on west and -3.4 mm/yr on east
- Tidal flats rate of -0.2 mm/yr on west; 2.5 mm/yr on east
- Sea Level Rise of about 7 mm/yr during the period
- Overall deficit of about 6 mm/yr of sedimentation
68% of the marsh vegetation is wet between 17% and 45% of the time.

Morris et al. highlight the range between mean sea level (50%) and mean high water (10%) wet.

Tidal flat sedimentation is related to % time wet.
Tidal Flats as Opportunity

Turn ‘Problems’ into ‘Opportunities’

1/3 of tidal wetlands (teal color) are tidal flats

Potential to reach 50% in coming decades from Sea Level Rise

Self-sustaining habitat that can be used to ‘re-establish’ marsh (purple)

Beneficial use of dredge material
Beneficial Use of Dredge Material

Several techniques available
Requiring different levels of associated infrastructure

1. Marsh Spraying
Dredged sediment is sprayed directly onto the marsh surface, which can increase accretion beyond natural rates. Also called thin-layer placement or thin lift.

2. Water Column Seeding
Sediment is released into the water column at the marsh channel entrance during an incoming tide to increase suspended sediment concentration in the water column.

3. Shallow Water Placement
Sediment is placed offshore to be resuspended by wave and tide action and then transported by tidal currents onto the marshes.

Three Strategic Placement Methods for Dredged Sediment
Illustration by Katie McKnight, SFEI
Note: These are general representations of the methods depicted. Exact placement and technique may vary.
<table>
<thead>
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<th>Take Aways - Local</th>
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<tr>
<td>Sediment deposition may not necessarily follow the common estuarine model of inland sources. Area of interest (AOI) trends point to deposition from seaward sediment sources more than upland areas.</td>
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<td>Sedimentation rates are related to elevation and time of inundation.</td>
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<td>Most of the areas supporting marsh had inundation times of 31% +/- 14%.</td>
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<td>Areas below about 50% inundation will likely become tidal flats if not so already.</td>
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<td>Tidal flats have higher sedimentation rates than marsh areas because of longer inundation than the marsh.</td>
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<td>Nearly the entire island has a negative net sedimentation rate when sea level rise is included in the calculation of rates.</td>
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<td>Man-made structures cutting across marshes can interrupt sediment deposition and create conditions that lead to marsh loss.</td>
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Vast acreage of tidal flats in Port Royal Sound provides a framework for development of future marsh if the correct elevations can be achieved. The likelihood of upland land becoming marsh, the natural cycle, maybe curtailed by current development trends in the area.

Thin layer deposition and the beneficial use of dredge material provides an avenue towards re-establishment of areas that used to be marsh. The beneficial use of dredge material program within the US Army Corps of Engineers should be a valuable source of information and potential funding.

The use of existing data, especially lidar, provides an avenue for high accuracy measurements. The existence of several decades of data facilitates the capture of yearly trends on the sub-centimeter scale. The techniques described and presented in this study can be used in many other marsh sites around the US to define trends and document changes.
Next Steps

**Phase II** will require a multi-discipline (e.g., geology, biology, ecology, and engineering) approach to marry the appropriate techniques and infrastructure to the overriding issues that are driving the loss of marsh habitat at the site and in the Port Royal Sound in general. This builds on the data that has been gathered. The engineering and material aspects can be linked to the trends and physical conditions presented within the report and documented with additional information that was not presented.

**Phase III** will help facilitate the use of the Phase I and II studies to tackle the policy, legal, planning, environmental, and funding aspects of the tremendous effort required to advance the existing techniques used in contemporary dredging practices.