Society of SAME American Military Engineers

EA Engineering, Science, and Technology, Inc., PBC

Engineering with Nature - Innovative and Emerging Techniques: Thin Layer Placement

Photo source: Bart Wilson - USFWS

Prepared for: SAME Seattle – Puget Sound Recovery & The Built Environment

Prepared by: Sam Whitin – EA Engineering, Science, & Technology, Inc. PBC

March 28, 2019

WHO WE ARE:

Improving the quality of the environment in which we live, one project at a time.
500+ Person Public Benefit Corporation

EA Engineering, Science, and Technology, Inc., PBC

- Relevant Services:
  - Stream/River & Wetland Restoration
  - Coastal Resiliency Planning
  - Coastal Marsh Restoration and Creation
  - Habitat Assessments Including Aquatic/Marine
  - Shoreline Stabilization

- EA is the largest 100% ESOP PBC in environmental space
- EcoVadis Sustainability Leadership Award: 2019 Best Performer, North America (Small and Medium Enterprises)

Failure Mechanisms Tied to Sea Level Rise

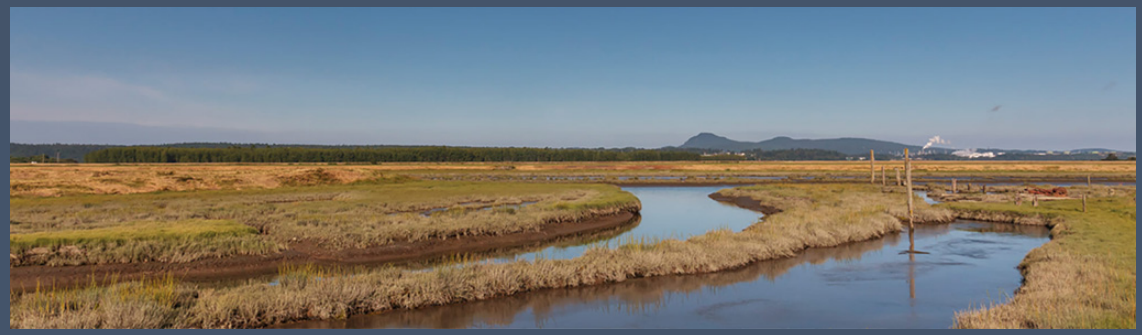

Photo source: Washington State Association of Counties

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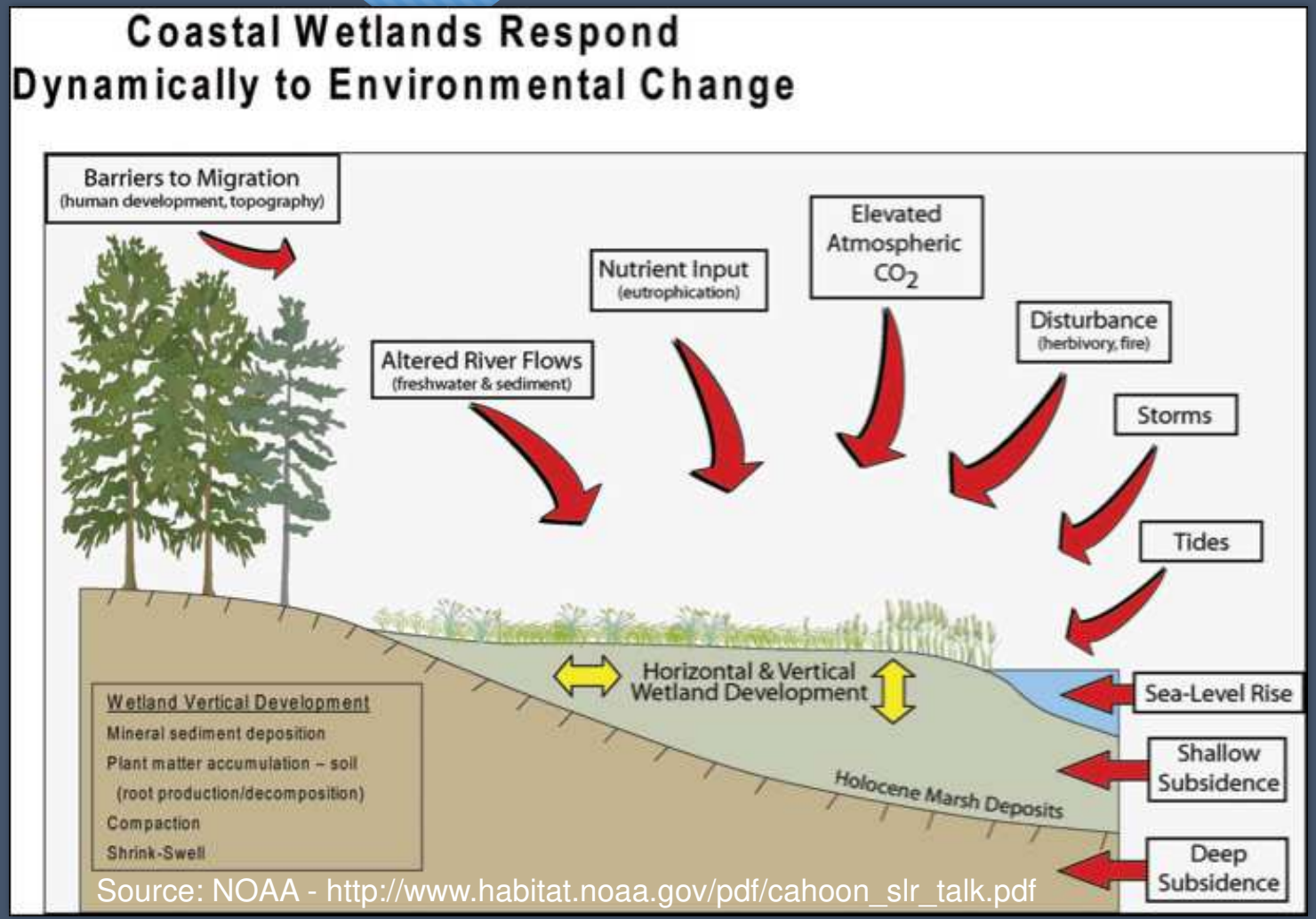


Salt marshes rely on a careful balance between multiple environmental factors

- Hydrologic Regime (tides)
- Salinity
- Nutrients
- Sediment Loading
- Surrounding Ecology
- A Host of Other Factors!

Consequences of Failure Tied to Sea Level Rise

Source: King County, Washington

Toolbox of Restoration Techniques

Beneficial Re-Use Beyond Beach Nourishment

- Why is beneficial re-use back "in style"?
  - Widespread acknowledgement that Sea Level Rise is a threat to natural and built systems
- Don't just "restore" – predict and restore for the future condition

Photo source: https://www.audubon.org/field-guide/bird/marbled-godwit

WHAT IS THIN LAYER PLACEMENT?

- Aliases
  - Beneficial Reuse
  - Sediment Enrichment
  - Thin Layer Application
  - Marsh Enhancement

Who?


USACE, USFWS, NOAA, USMC


State of NJ and TNC


State of Delaware (DNREC)


Rhode Island CRMC


Gulf States

Challenges

- Permitting
- Subsidence
- What is "thin"?
- Bulking and consolidation
- Sediment loss
- Scalability

Initial Results

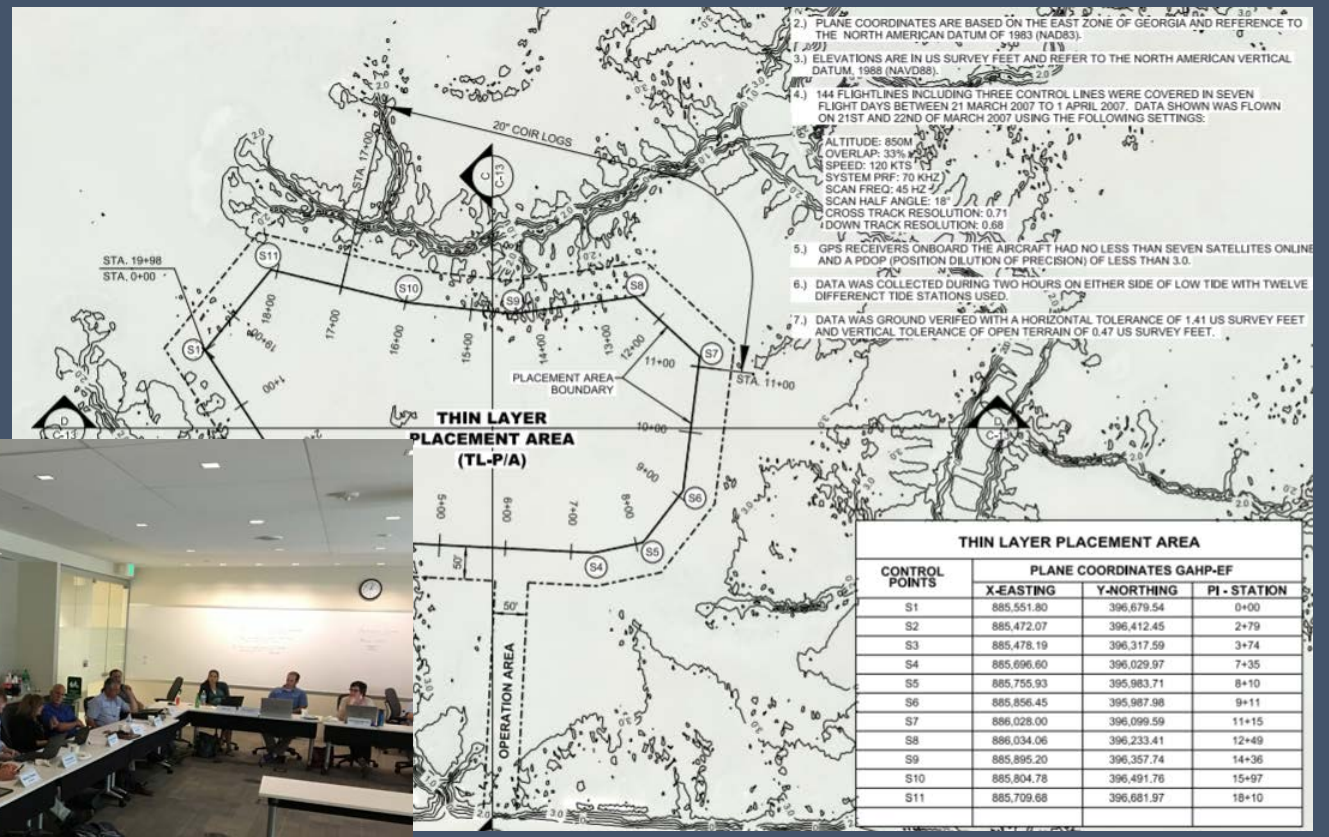

Site Specific Success

Future Re-Applications

What are our choices?

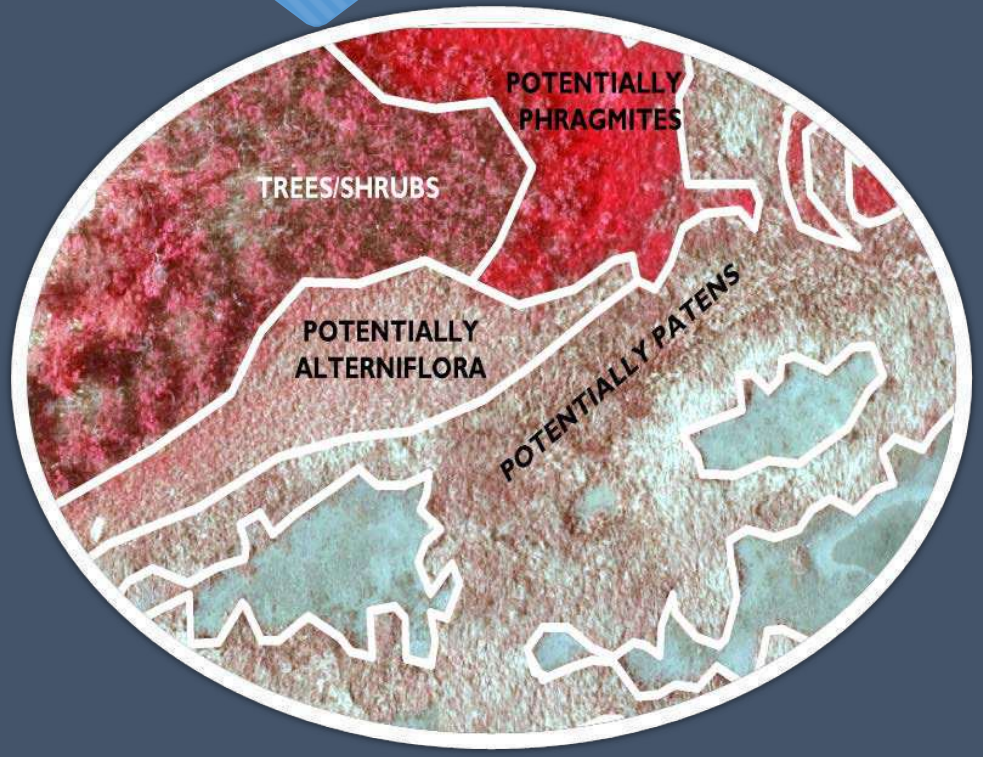
Building and Transferring Knowledge

- Regional Workshops hosted by USACE South Atlantic District in 2017
- Other workshops in held Delaware, Maryland, California, and other locations as hosted by NOAA, States, USACE, and private entities.
- Lots of other dialogue going on!



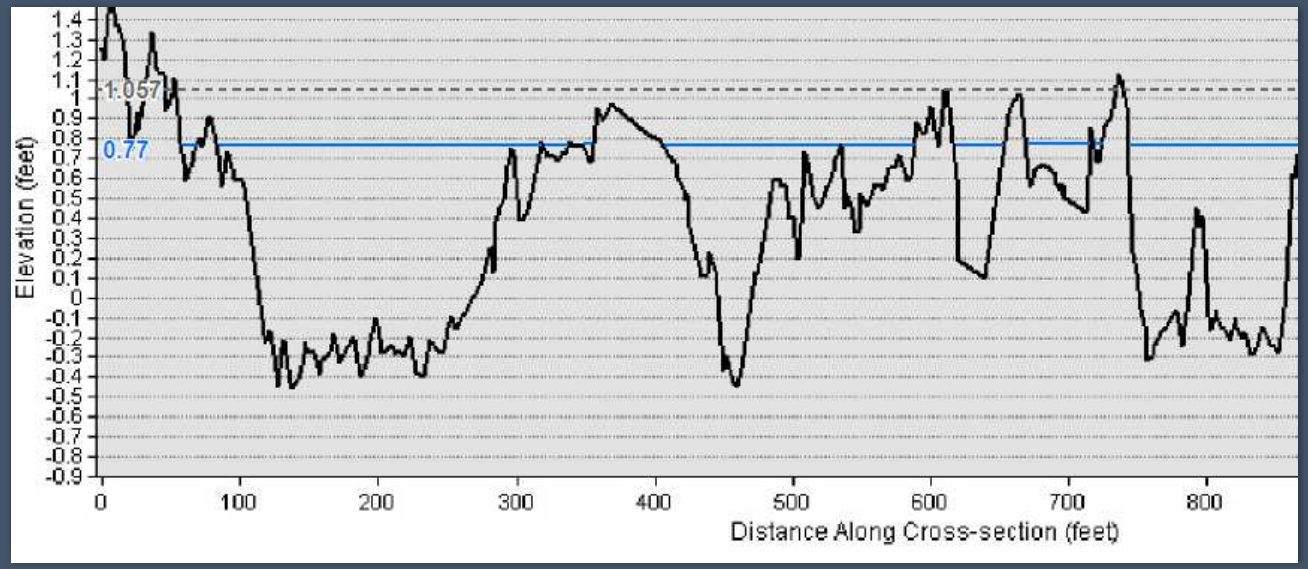
How to Execute Thin Layer Placement?

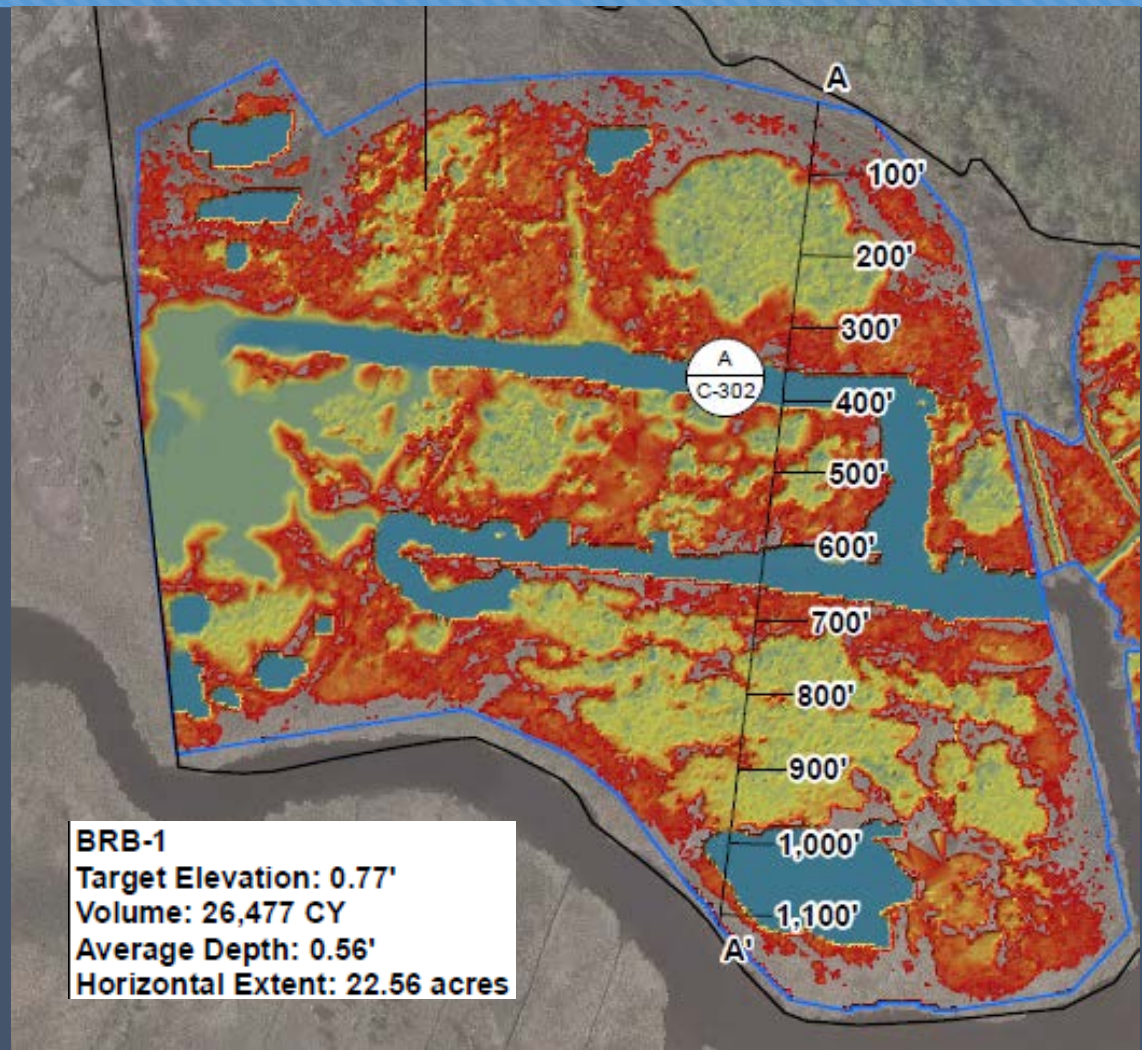
ESTABLISHING A BIOLOGICAL TARGET ELEVATION
INITIAL VEGETATION & ELEVATION SURVEYS



- Traditional aerial photointerpretation using infrared photography and LiDAR elevations
- Engineering and Design focus on permitting concerns, subsidence, vegetation success, and ELEVATION!
- Scalability and implementation with minimal unintended consequences still be worked out.

THIN LAYER DESIGN METHODS





Building Sea Level Rise into Coastal Resiliency Designs

- In consideration of sea-level rise – how do you not end up upland or undesirable habitat. Use of Multi-Criteria Decision Analysis Tool.
- How are habitat values and decisions made for the long term?

Interests and Sub-Interests	Year 0 SLR Design	Year 5 SLR Design	Year 10 SLR Design	Year 15 SLR Design
Year 0				
Mudflat	5	5	5	1
Low Salt Marsh	1	1	5	2
High Salt Marsh	5	5	2	1
Phragmites	1	5	5	5
Upland	5	5	5	5
Contruction Cost				
	3	3	3	3
Schedule Impacts				
	5	5	5	5

Thin Layer Capping as Remediation Technique

- Thin layer placement of sediment has been utilized throughout Puget Sound as a remedial technique associated with contaminated sites

- However, habitat conservation and promotion of a more resilient shoreline drives a different set of goals, and therefor the design and implementation process is different than that of remediation….but there is a lot of useful overlap!

Blackwater National Wildlife Refuge Chesapeake Bay, Maryland

- Two 0.5 acre pilot sites in 2002
- 2 separate lifts of sediment placement
- $300,000 cost (2002)
- Post placement monitoring indicated revegetation occurred immediately within the refuge
- 2016 effort is using 26,000 yd^3 of sediment to restore 40 acres

Photo Credit: https://tlp.el.erdc.dren.mil/case-studies-by-year/

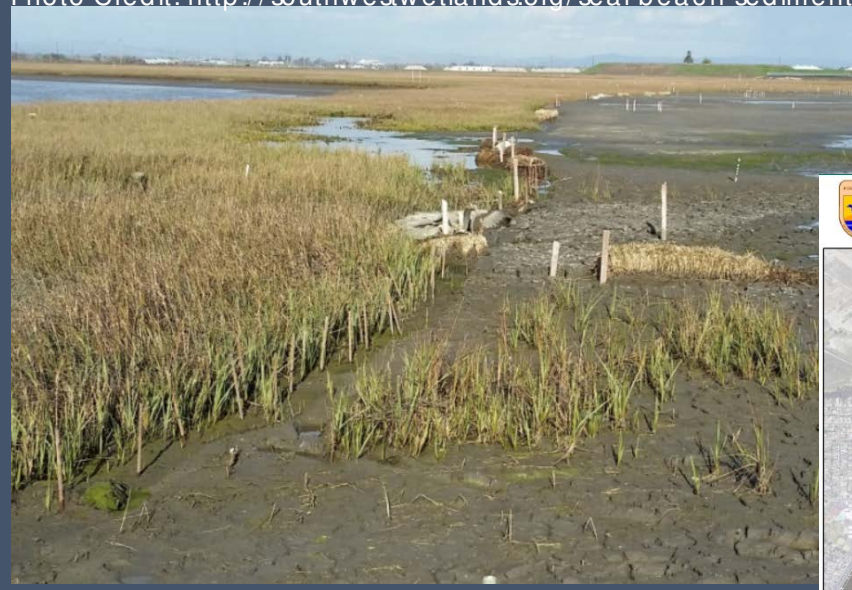
Prime Hook NWR ~ (2014-2016 $38M) Milton, Delaware

- 4,000 acre marsh restoration
- 20 miles of channel dredging
- Doesn't fit traditional TLP definition, but project is heavily studied, which will help us better understand impact of thin layering impacts

Seal Beach NWR ~ (2016-2017) Orange County, California

- ~8-10 inches over 10 acres
- Initial challenges related to re-growth of cord grass
- Focused on re-establishment of habitat for Ridgway's clapper rail
- Continuing to monitor over next 5 years

Photo Credit: http://southwestwetlands.org/seal-beach-sediment-augmentation-project/



STONE HARBOR, AVALON, AND FORTESCUE New Jersey

- USACE, State of NJ, and TNC
  - Stone Harbor: ~7,000 CY of reclaimed material over 0.5AC
  - Avalon: ~50,000 CY of sediment using aerial and ground applications
  - Fortescue: ~15,000 CY of sediment to restore 10 AC of degraded salt marsh and 3 AC of beach along Delaware Bay
- Outcome
  - Still in long term monitoring, but initial vegetation response is somewhat positive;
  - Lessons learned in regard to elevation control and more lessons learned regarding containment.

Photo Credit: Joel Pecchioli, NJDEP (Avalon)

NINIGRET POND SALT MARSH RESTORATION & ENHANCEMENT PROJECT NARRAGANSETT, RI (2016/2017)

PROJECT PARTNERS: RHODE ISLAND CRMC, USFWS, SAVE THE BAY,

- 25 AC of degraded salt marsh
- 60,000 CY of dredge material was split in half between beach nourishment and marsh restoration
- $1.4M construction effort

Photo Credit: J. F. Brennan

JEKYLL ISLAND NAVIGATIONAL AND HABITAT IMPROVEMENT PROJECTS
Project Partners: USACE Jacksonville District, State of Georgia, TNC, and Jekyll Island Authority (2019)

- $12M total bid for navigational improvements and thin layering project
- Awarded January 2019 and includes 225,000 yd^3 of dredging

US Army Corps of Engineers®
Savannah District

ATLANTIC INTRACOASTAL WATERWAY, GA & SC
JEKYLL CREEK BENEFICIAL USE OF DREDGED MATERIAL PILOT PROJECT AND SELECTIVE SITE MAINTENANCE DREDGING FY18

Thin Layer Placement Initial Challenges

- When resiliency and habitat is the driver (and not nav. channel improvements) – data collection and design/engineering is different than traditional dredge material disposal efforts.
- Building Sea-level rise into the equation becomes problematic
- Typically there is much more dredge material to be disposed of than is needed for restoration
- More pilot projects taking scalability into consideration need to occur
- Dispersal and placement phase is problematic:
    - Existing marsh impacts (vegetation and peat/soils)
    - Grains size sorting leading to consolidated/hard pack surface
    - Biogeochemical processes (sulfides) impacting vegetation success

Final Thoughts Related to Thin Layer Placement

- Marsh migration is certainly the preferred approach
- Design for what is to come – not what has already happened
  - Permitting and especially Essential Fish Habitat and USACE concerns should continue to be discussed
- Construction techniques still being worked and as always – we need more collaboration
- Sea Level Rise and implications of setting a high target elevation
- As always – Adaptive Management is essential to successful completion

Thank you!

Sam Whitin

Coastal Resilience Director

EA Engineering, Science, and Technology

401-465-2549

swhitin@eaest.com