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

THIN-LAYER PLACEMENT OF DREDGE MATERIAL FOR MARSH NOURISHMENT, RESOTRATION, AND RESPONSE TO SEA LEVEL RISE

Case studies and lesson learned regarding thin-layer deposition projects in Delaware, New Jersey, and Rhode Island

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Introduction

- Sam Whitin – EA Engineering, Science, and Technology (EA). 17 years of coastal habitat restoration experience.
- EA is focused on port improvements, mainly as they relate to environmental challenges – especially related to water resource and sediment issues.

- Presentation intends to provide information in order to provide Ports with additional options in finding additional funding and a home for dredge material.
- Thin layer placement and coastal resiliency discussions are regionally specific, so keep that in mind throughout this presentation!

WHAT IS THIN-LAYER PLACEMENT?

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

Who?


USACE & USFWS


State of NJ


State of Delaware (DNREC)


Rhode Island CRMC


The Nature Conservancy

Initial Results


Varying Degrees of Success


Future Re-Applications


What are our choices?

Engineering Challenges


Permitting


Public Perception


What is "Thin"?


Bulking and Consolidation


Sediment Loss


How Does Sea-Level Rise Fit In?

What has Changed and Why Now?

- Thin Layer idea is NOT new – what is new is the ability of the habitat restoration community to recognize that without it, there is likely to be a total loss of habitat in many coastal areas due to sea level rise.

- Acknowledgment of Sea Level Rise and renewed focus on Water Resource Adaptation and Resiliency (formerly known as Climate Change). Storm/Hurricane damage has demanded a response.

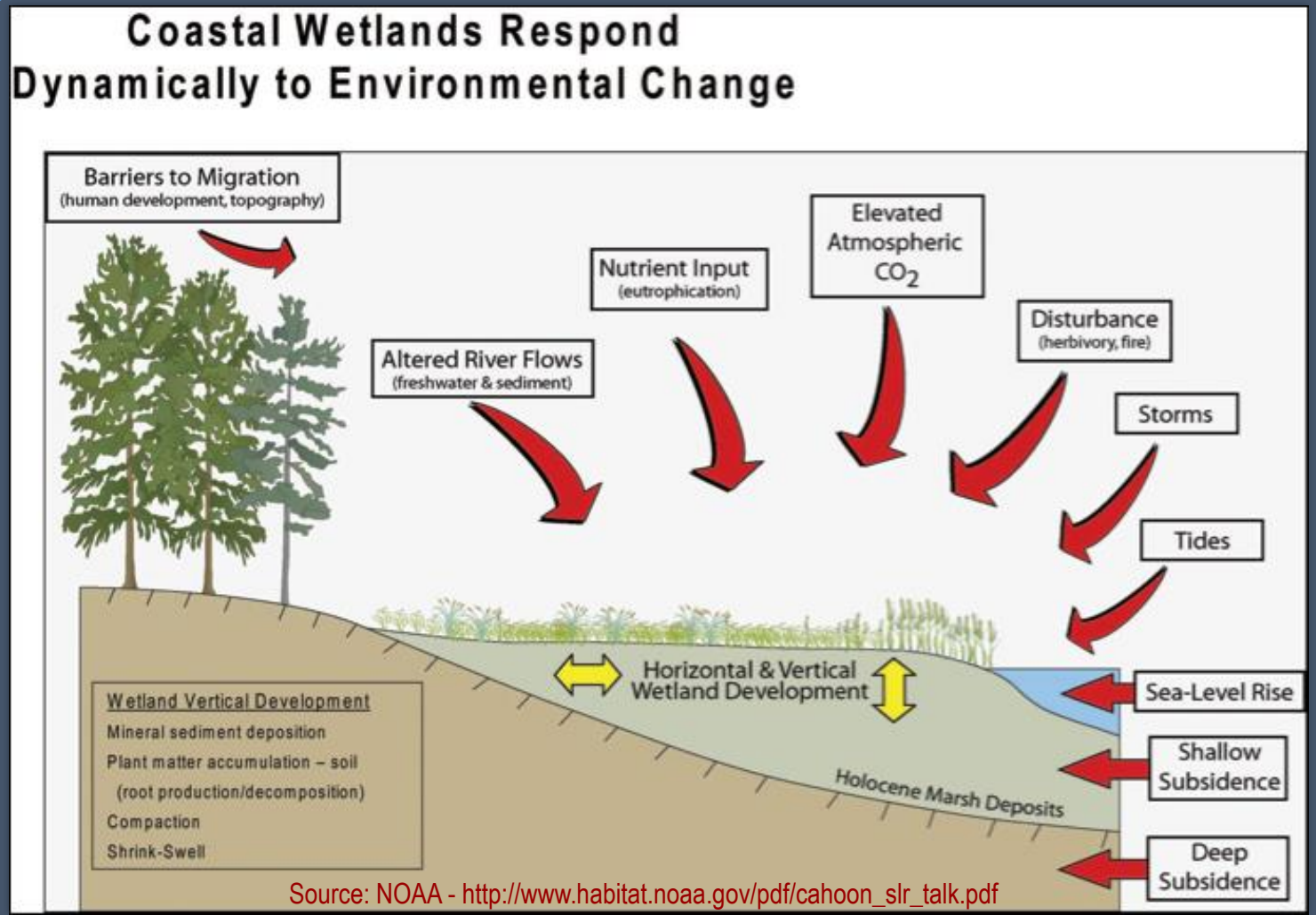
- Additional funding is now available for projects.

Adding Coastal Resiliency to the "Beneficial Re-Use" Toolbox

- Coastal Resiliency can be the primary driver – not only traditional beneficial reuse categories.
- Only will be applicable in those areas where marsh migration is not possible.

Photo source: http://www.seagrant.umaine.edu/research/projects/critical-leading-edge

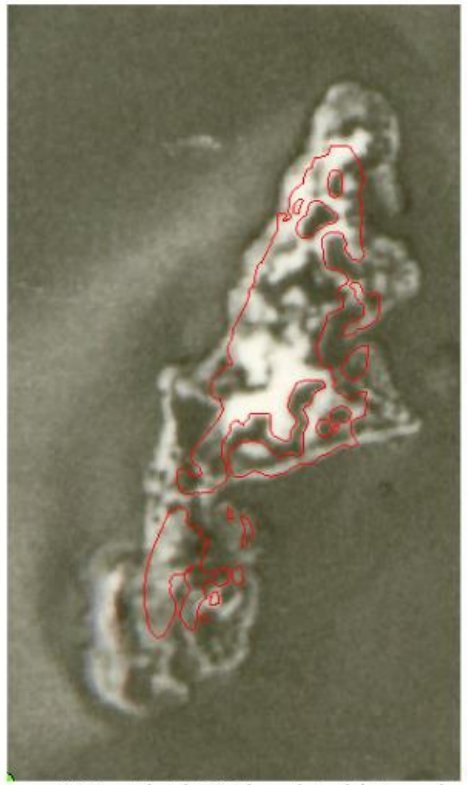
Failure Mechanisms Tied to Sea Level Rise



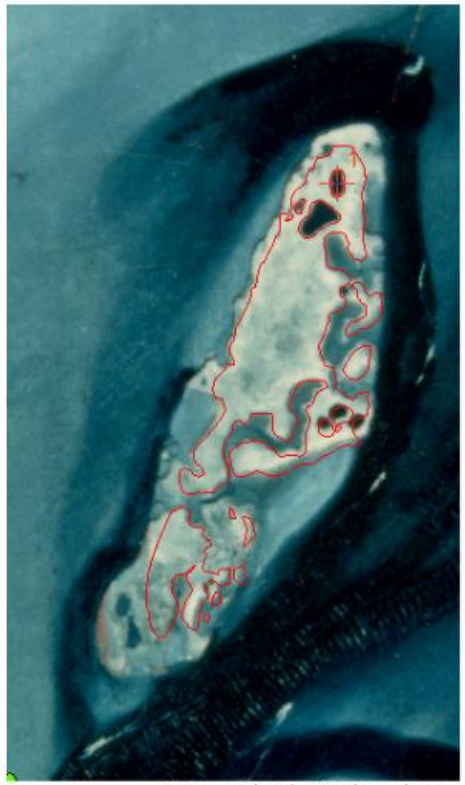
Source: NOAA - http://www.habitat.noaa.gov/pdf/cahoon_slr_talk.pdf

Failure Mechanisms Tied to Sea Level Rise

Bailey Flat imagery for three dates showing 2013 boundaries superimposed on each.
Prepared for Westport Fishermen's Association/Buzzards Bay Coalition salt marsh loss study by Joe Costa, 6/14/2016.



1938 aerial with 2013 boundaries(photograph taken 3 months after the hurricane of 1938)



1990 aerial with 2013 boundaries

2013

Source: Buzzards Bay Coalition: http://www.savebuzzardsbay.org/news/scientists-work-to-solve-westport-rivers-eroding-salt-marsh-mystery/

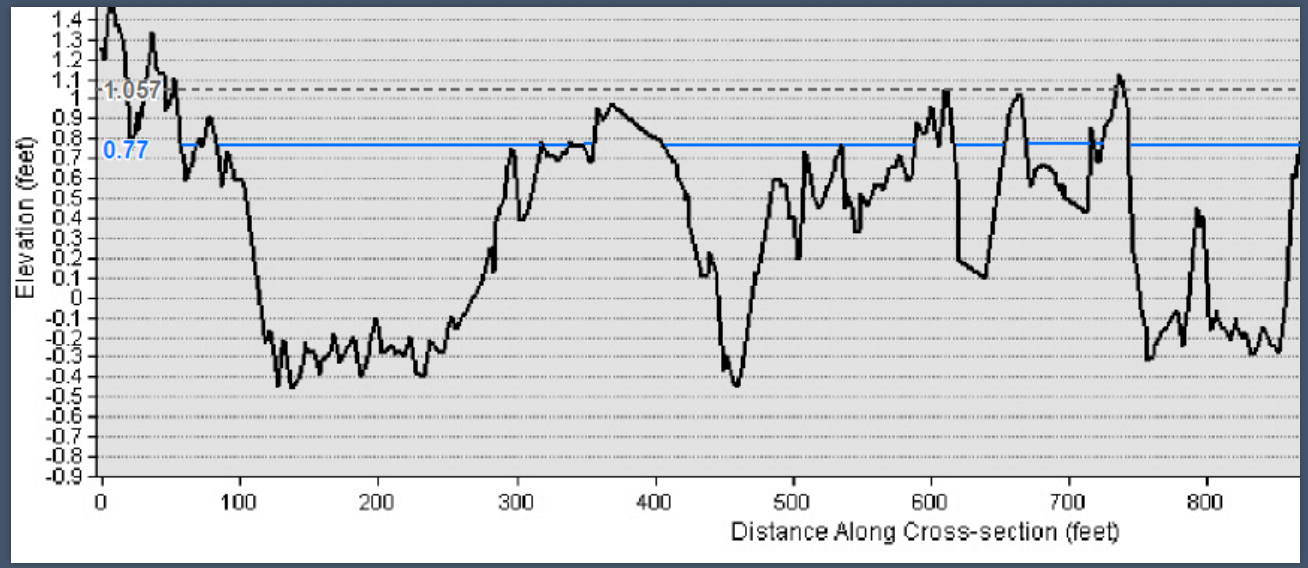
Challenges

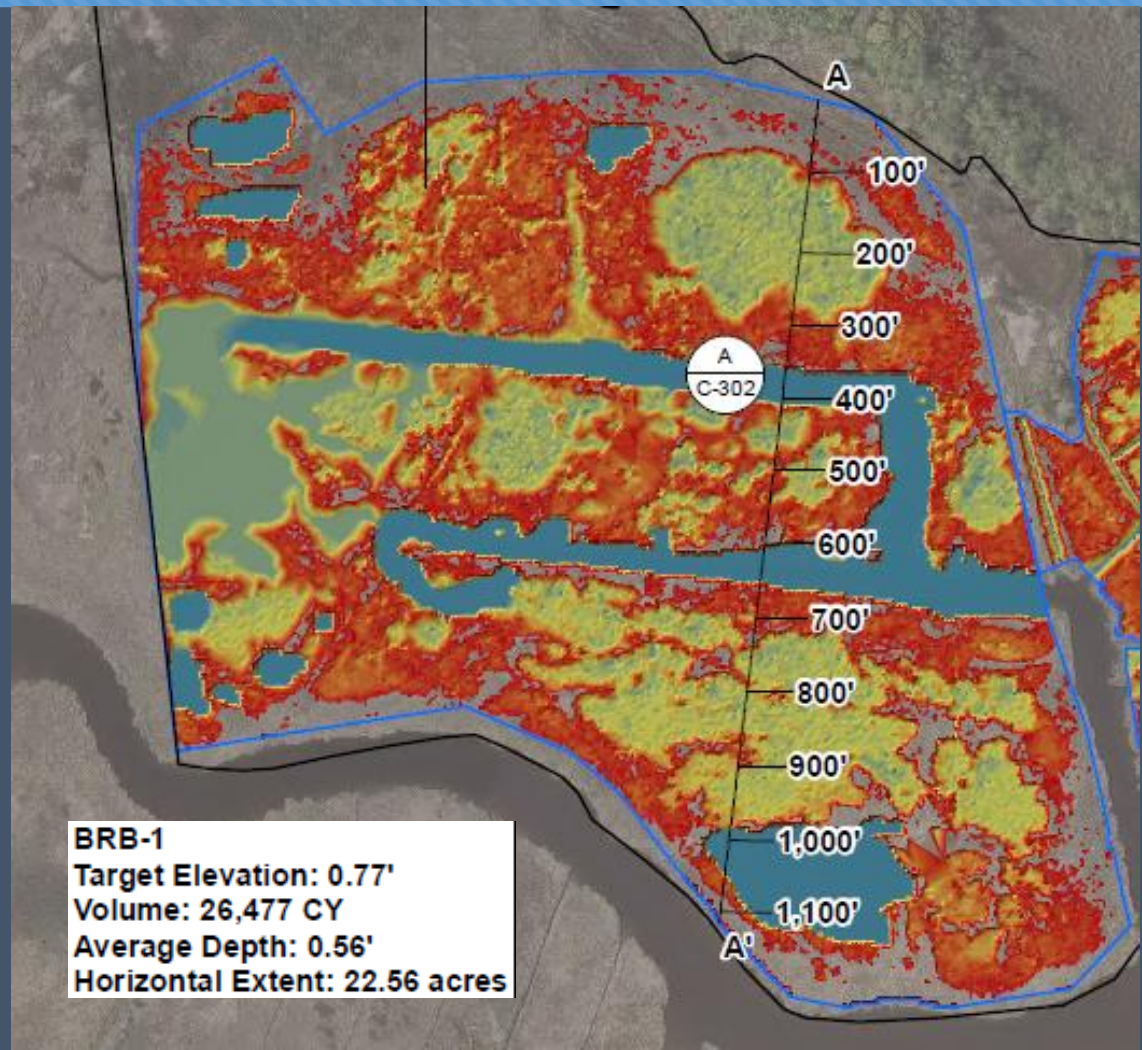
- When resiliency is the driver (and not nav. channel improvements) – data collection and design/engineering is very different than traditional dredge material disposal efforts:
  - Building Sea-level rise into the equation becomes problematic – especially in micro-tidal areas
  - Typically there is much more dredge material to be disposed of than is needed for restoration
- Dispersal is problematic:
  - Existing marsh impacts (vegetation and peat/soils)
  - Grains size sorting leading to consolidated/hard pack surface
  - The larger the marsh – the greater the impact to existing marsh surface.

THIN LAYER METHODS

- Application of <6'' (typ.) of sediment can be used in order to restore marsh surface which was unable to keep up with sea level rise.
- Typically coupled with a navigational channel dredging project
- Application can be similar to sediment remediation/capping approaches
- Primary proponents have been agencies with habitat protection mandates.

THIN LAYER METHODS





PEPPER CREEK (2013 ~ $125,000)
DAGSBORO, DE
PROJCT PARTNERS: CENTER FOR ISLAND BAYS & DNREC'S DIVISION OF WATERSHED STEWARDSHIP

- Restore 25 AC area of tidal marsh
- Material hydraulically dredged and pumped to a barge for aerial application
- Approximately 35,000 CY of dredged material was sprayed on the marsh surface at a thickness ranging from 1 to 6 inches
- Marsh is showing signs of recovery, but not a success just yet

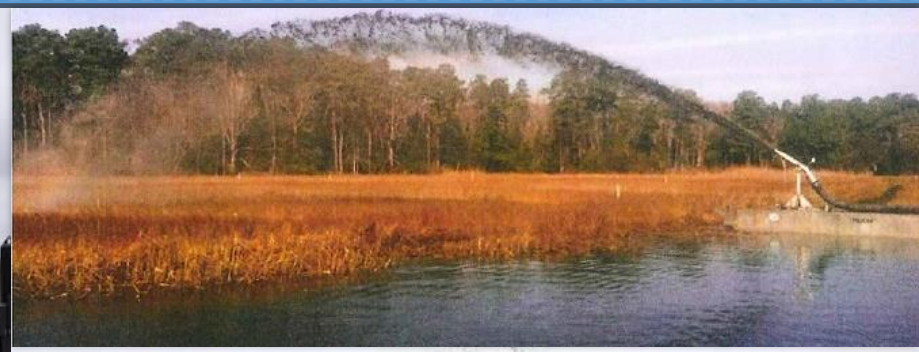


Photo Credit: Bart Wilson

USFWS PRIME HOOK (2014-2016)
MILTON, DE
PROJECT PARTNERS: USFWS, State of Delaware

- 8,000 acre marsh restoration
- 21 miles of channel dredging
- Primary reason for thin layer placement was not to elevate marsh surface, but was certainly a secondary benefit.

Photo Credit: Bart Wilson

STONE HARBOR, AVALON, AND FORTESCUE (2014-2016) NJ

PROJECT PARTNERS: USACE, STATE OF NJ, NATURE CONSERVANCY

- What
  - Stone Harbor: ~7,000 CY of sediment dispersed over 0.5 AC
  - Avalon: ~50,000 CY of sediment dispersed using aerial and ground applications
  - Fortescue: ~15,000 CY of sediment dispersed 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, containment, and sediment contamination

Photo Credit: Joel Pecchioli, NJDEP (Avalon)

JOHN H. CHAFEE NATIONAL WILDLIFE REFUGE (2016/2017 ~ $1,700,000) NARRAGANSETT, RI

PROJECT PARTNERS: USFWS, THE NATURE CONSERVANCY, RHODE ISLAND CRMC

- 24,000 CY of sediment from navigation channel
- Placement of 3,000 bags of clam and oyster shells to protect against marsh edge erosion and to hold sediment and water on the marsh platform
- Initial indications are that the project should be successful

Photo Credit: Greg Thompson/USFWS

JOHN H. CHAFEE NATIONAL WILDLIFE REFUGE (continued) NARRAGANSETT, RI

- No more than 6-inch placement thickness
- Shallow water levels made dredging and equipment transportation difficult
- Custom made machinery and in-field equipment modifications

Photo Credit: The Nature Conservancy

NINIGRET POND SALT MARSH RESTORATION & ENHANCEMENT PROJECT NARRAGANSETT, RI (2016/2017 ~ $1,400,000)

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

Photo Credit: J. F. Brennan

NINIGRET POND SALT MARSH RESTORATION & ENHANCEMENT PROJECT NARRAGANSETT, RI (continued)

- Material was placed between 0 and 12 inches higher than existing elevations
- Dredging window (winter); requires dredging activities persist 6 days a week, 24 hours a day
- Planting will occur

Photo Credit: J. F. Brennan

SACHUEST POINT NATIONAL WILDLIFE REFUGE (2016 ~ $644,000) MIDDLETOWN, RI

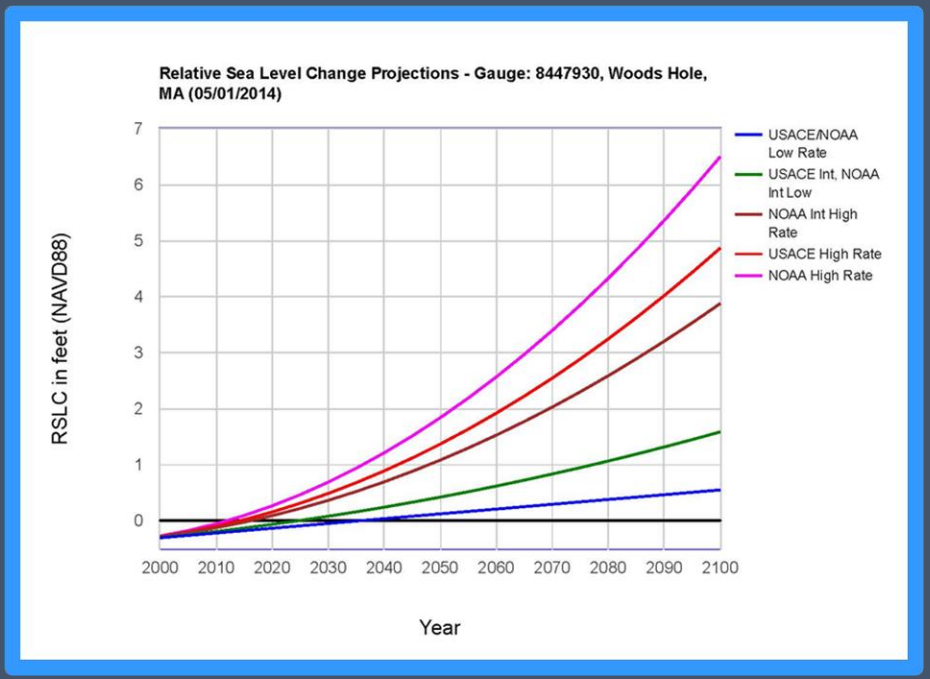
PROJECT PARTNERS: USFWS & THE NATURE CONSERVANCY

- 11,000 CY of dredged material was applied to 11 AC
- Material was dredged hydraulically and placed on the marsh platform to dry out; placement occurred by means of spreading and grading the material with a lightweight amphibious excavator
- Encouraging results with thin-layer deposition thickness from 1 to 12 inches across the marsh surface

Photo Credit: Anne Post/USFWS

TOOLS:
MULTI CRITERIA DECISION ANALYSIS (MCDA):
APPLICATION TO THIN LAYER DEPOSITION

- In consideration of sea-level rise – how do you not end up upland or undesirable habitat (i.e. *Phragmites*)
- 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

Next Steps and Applicability to Ports

- USACE ERDC is working on developing guidance
- Get prepared for sudden funding sources. From aerials, identify historic areas where coastal marsh and islands once existed.
- Open up communications and partner with nearby non-profits and groups interested in coastal adaptation and resiliency. Someone near-bye may want your dredge material!