



# An Overview of Hurricane Sandy Resiliency Restoration at the John H. Chafee NWR, Rhode Island

Nick Ernst, USFWS





# Hurricane Sandy Resiliency Funding

\$100 million awarded to federal agencies

- To promote natural resource enhancement / resiliency against storms
- Projects selected on a competitive basis

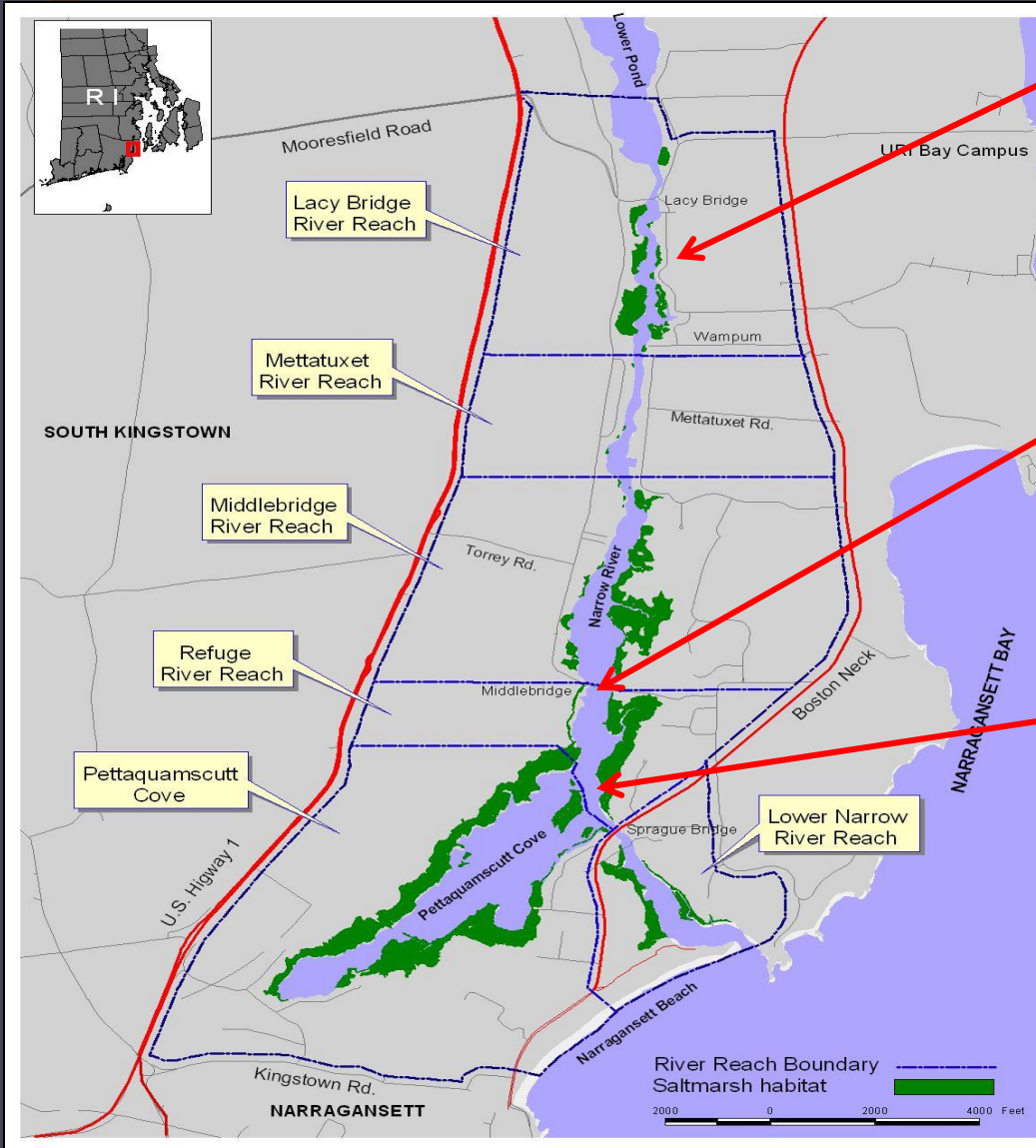
Fish and Wildlife Service in Rhode Island received \$6 million

- Coastal Program (SNEP) \$2 million
  - Aquatic habitat connectivity
- Rhode Island National Wildlife Refuge Complex \$4 million
  - Saltmarsh habitat enhancement and resiliency
    - Sachuest Point NWR
    - John H. Chafee NWR





# Project Area Boundaries



## Near Lacy (Bridgetown) Bridge

- Average Temperature:  $21.2 \pm 4.6$  °C
- Average Salinity:  $17.2 \pm 5.3$  ppt
- Average Dissolved Oxygen:  $7.7 \pm 1.7$  mg/l

## At Middlebridge

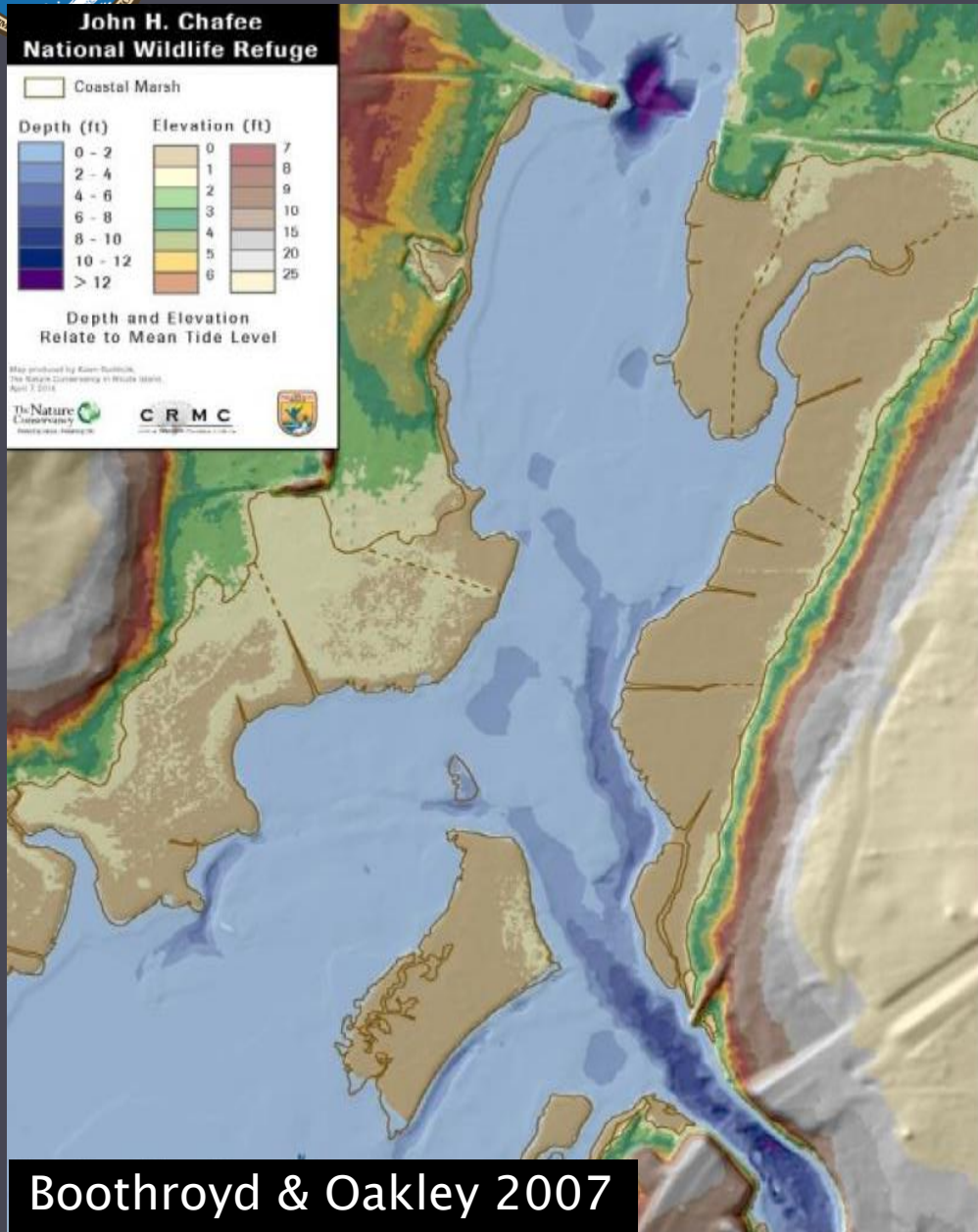
- Average Temperature:  $20.3 \pm 4.2$  °C
- Average Salinity:  $26.9 \pm 5.3$  ppt
- Average Dissolved Oxygen:  $7.6 \pm 1.3$  mg/l

## At Refuge Reach (South of Middlebridge)

- Average Temperature:  $19.9 \pm 4.0$  °C
- Average Salinity:  $27.4 \pm 4.7$  ppt
- Average Dissolved Oxygen:  $7.6 \pm 1.3$  mg/l



# Bathymetry/Eelgrass

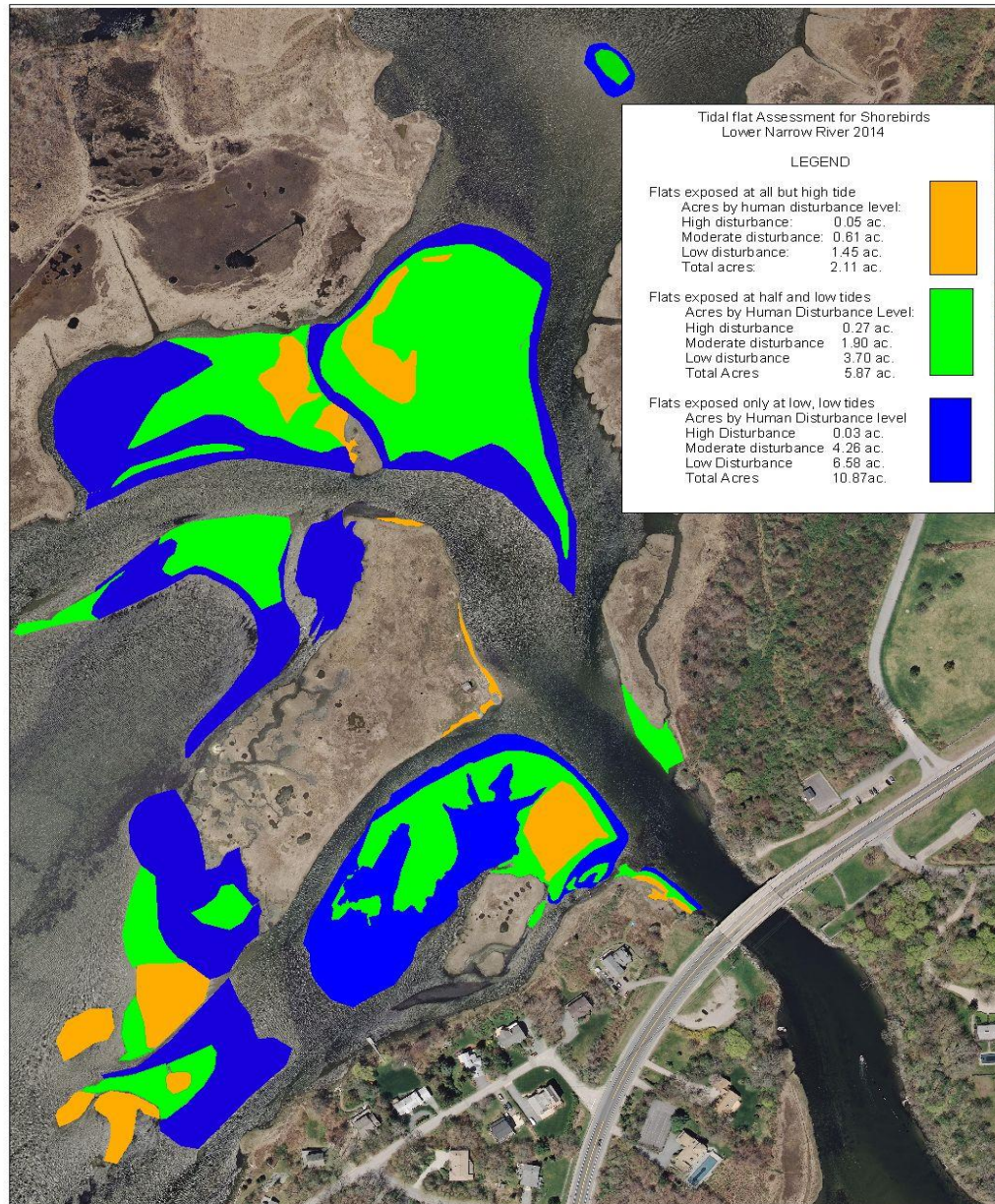


Boothroyd & Oakley 2007



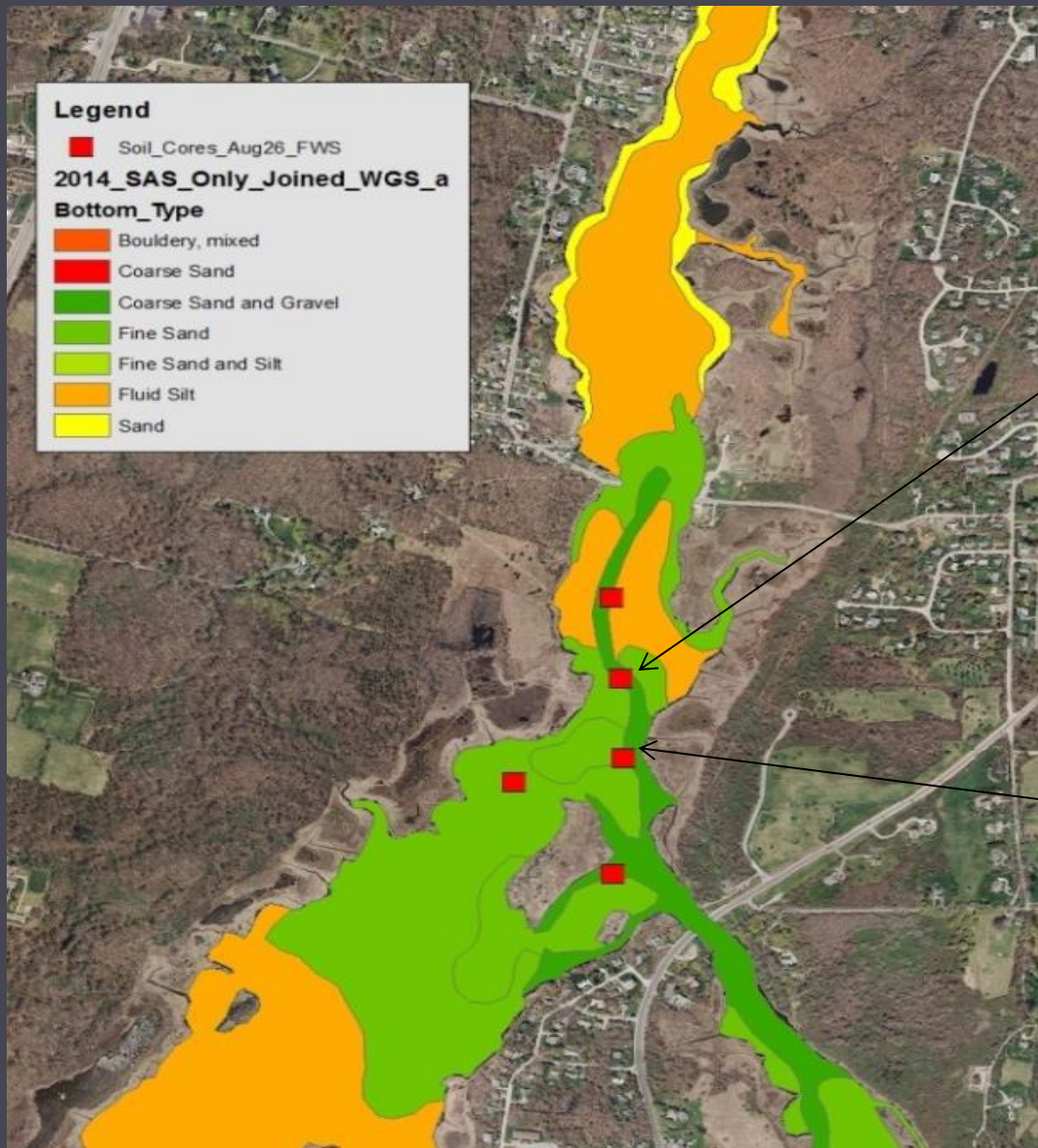


# Tidal Flats



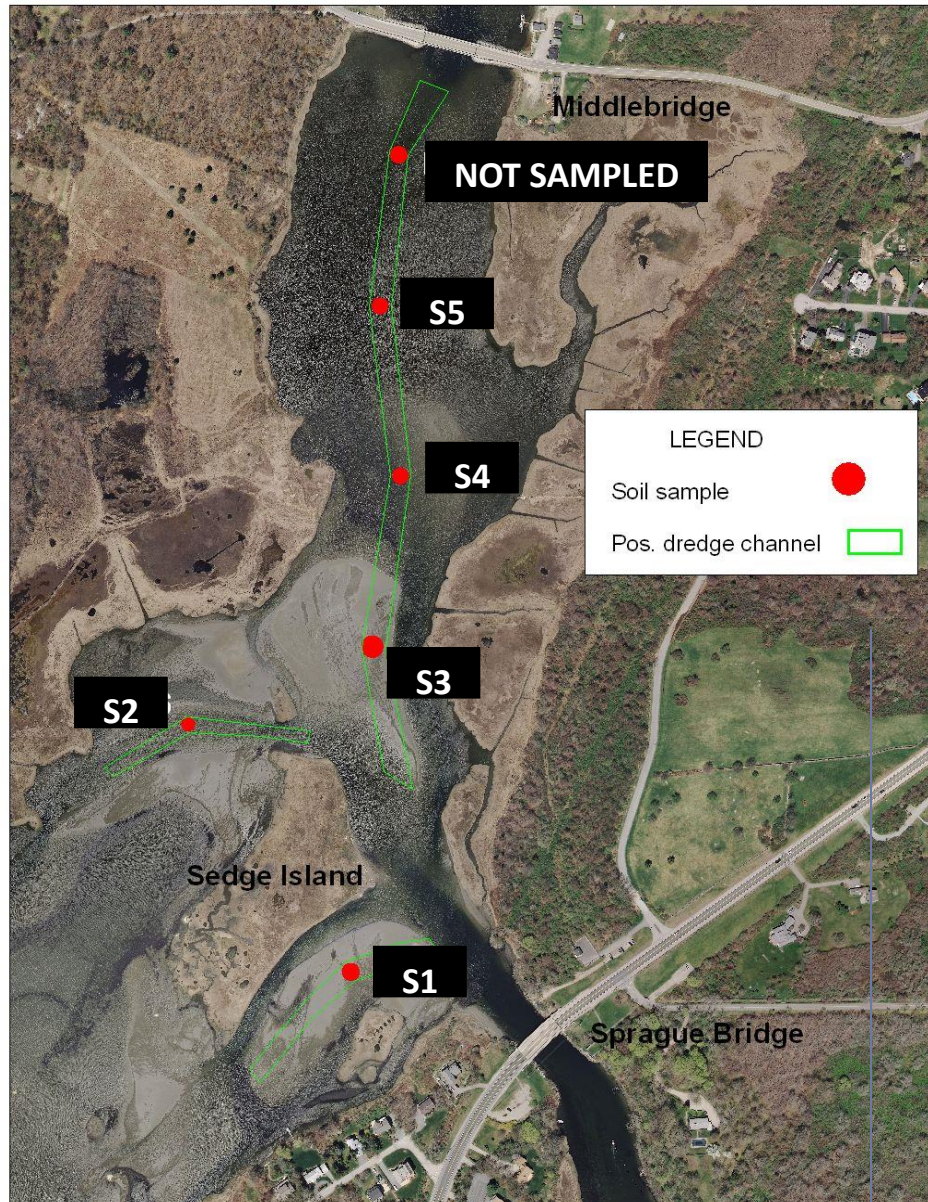


# Benthic Habitats in the Central Portion of the Estuary (NRCS 2007).





Proposed sediment soil sample collection locations, Narrow River Dredge



400 0 400 800 Feet



DEPTH (INCHES)	PERCENT FINES BY SAMPLE AND STRATA				
	S1	S2	S3	S4*	S5*
0					
5	2	13.2			
10			3.8	14.1	23.7
15	17.5	52.2			
20					41.9
25					
30		23.2		19.9	
35	10.3		4.2		47.7
40		19.1			
45	4	8.3		4.1	
50			2.8		
55					
60				2.6	
65					60.1
70			29.1		
75					
80					5.7
85					
90				15.6	
95					
100					
105					







# Saltmarsh Grasses



*Spartina alterniflora*



*Juncus gerardii*

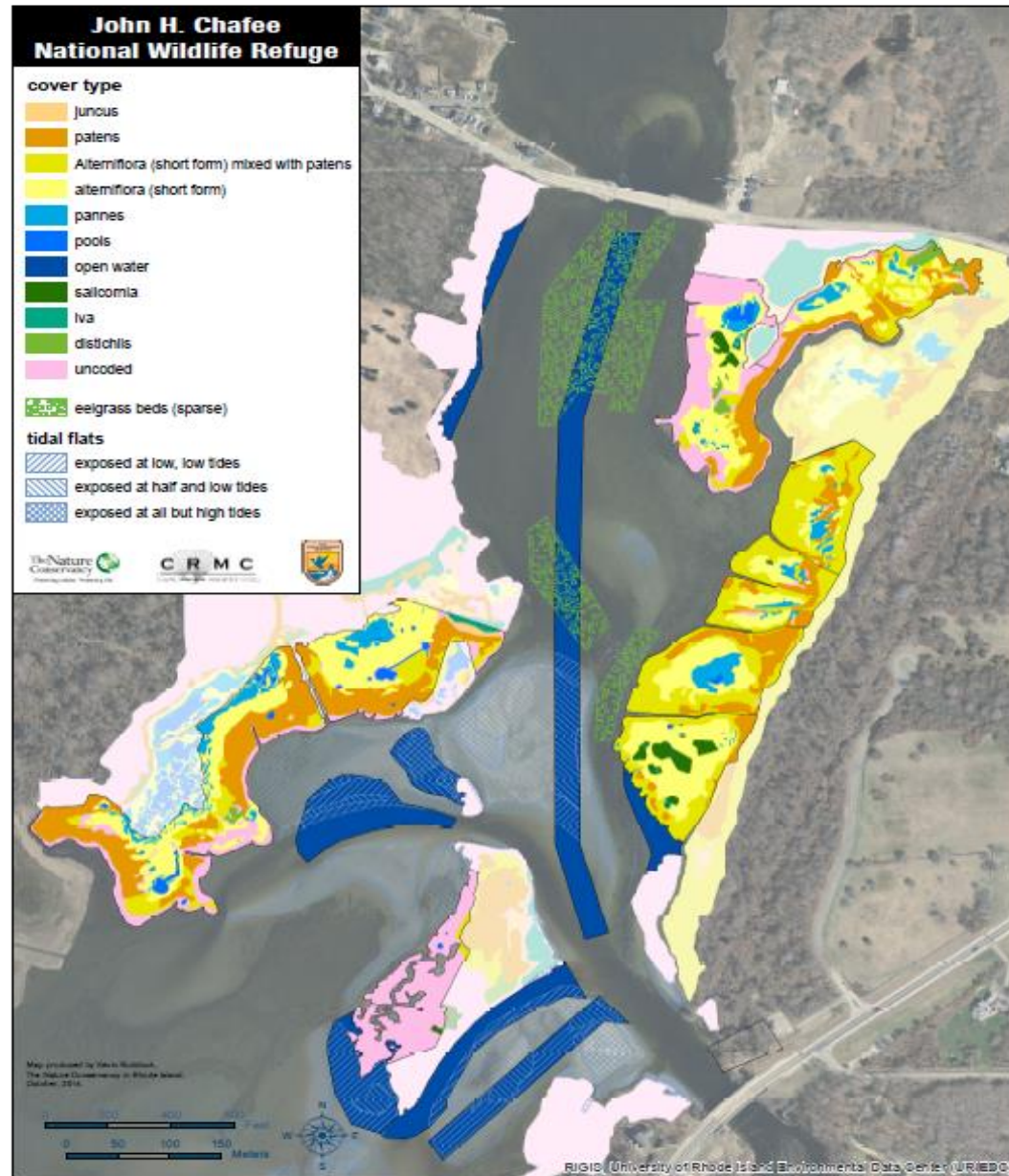
*Spartina patens*



*Distichlis spicata*



# Vegetation Cover Types





# Saltmarsh Wildlife



Brian Harris



Brian Harris



wikipedia



Brian Harris



wikipedia



wikipedia



# Saltmarsh Sparrow

- *Ammodramus caudacutus*
- Endemic to Tidal Marshes
- Limited Range and Habitat Preference
- Globally Vulnerable (IUCN)





# Natural History

- No breeding territories/ pair bonds
- Highly promiscuous mating system
- Females do all parental care
- *Spartina patens* and *Juncus gerardii* – nesting habitat
- Nesting is synchronous with the spring tides
- Tide cycle is 28 days from one peak spring tide to the next
- 26 day nest cycle :4 d nest building; 12 d incubation; 10 d nestling period





# Nests





# Reasons for Decline:

- Habitat Loss
  - Development, marsh subsidence, limited marsh migration corridors
- Climate Change
- Sea Level Rise
  - 31cm increase will cause 95% of nest failure
  - Could have complete reproductive failure as early as 2050 (assuming current accretion rates)





# Environmental Issues

- Poor water quality
- Shoreline Instability
  - Boat Wakes, wind driven waves
  - Increases sedimentation of channel (degrades habitat)
- Saltmarsh Degradation
  - Poor Drainage/pooling of water on marsh surfaces
  - Limited areas for marsh migration/lack of elevation capital (sea level rise)





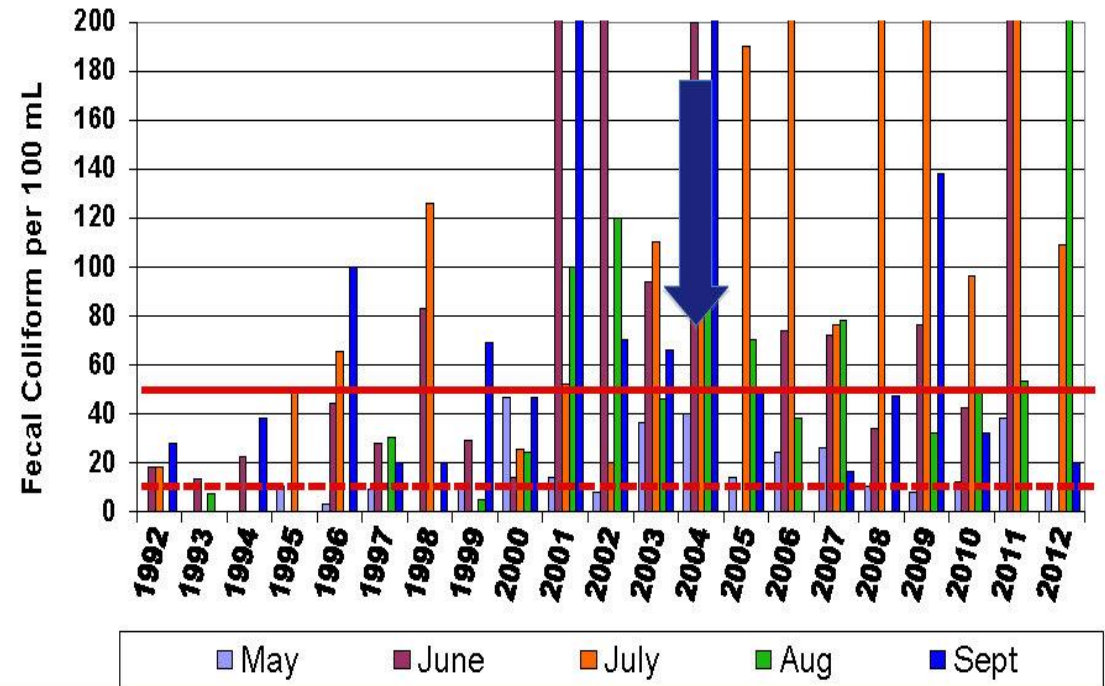


# Water Quality

- Water Monitoring for over 20 years
- Excessive Nitrogen and fecal coliform inputs
- Closed to Shellfishing since 1997

## NR-8: Middlebridge

### NR-8: Bacteria - Fecal Coliform



— Safe Swimming = 50 FC/100 mL  
- - - Shellfishing = 14 FC/100 mL





# Shoreline Erosion

- Unstable Banks
  - Throughout Narrow River
  - Sections of saltmarsh slump into river
  - Wind driven waves, boat wakes, green crabs

Cross sectional view of typical saltmarsh riverbank, Lower Narrow River

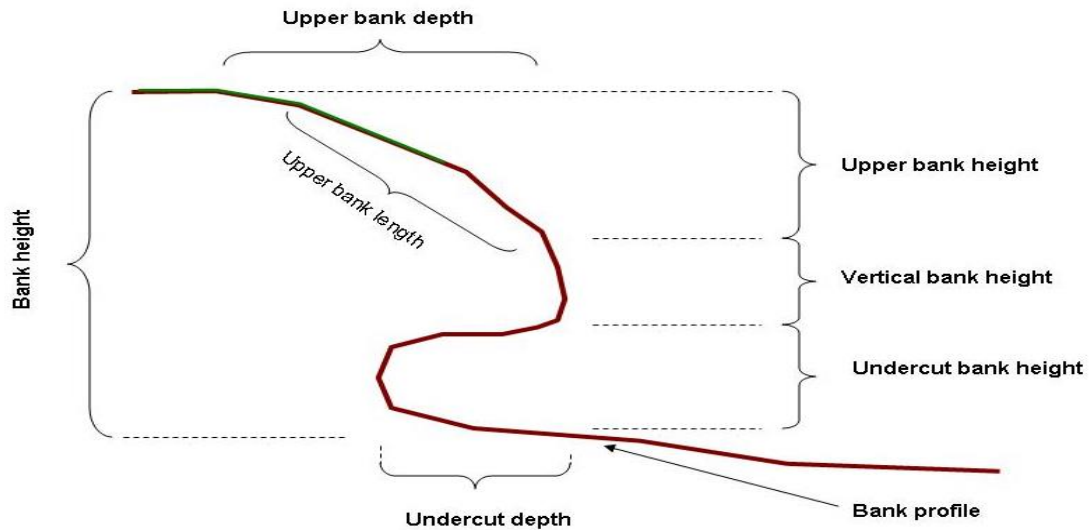
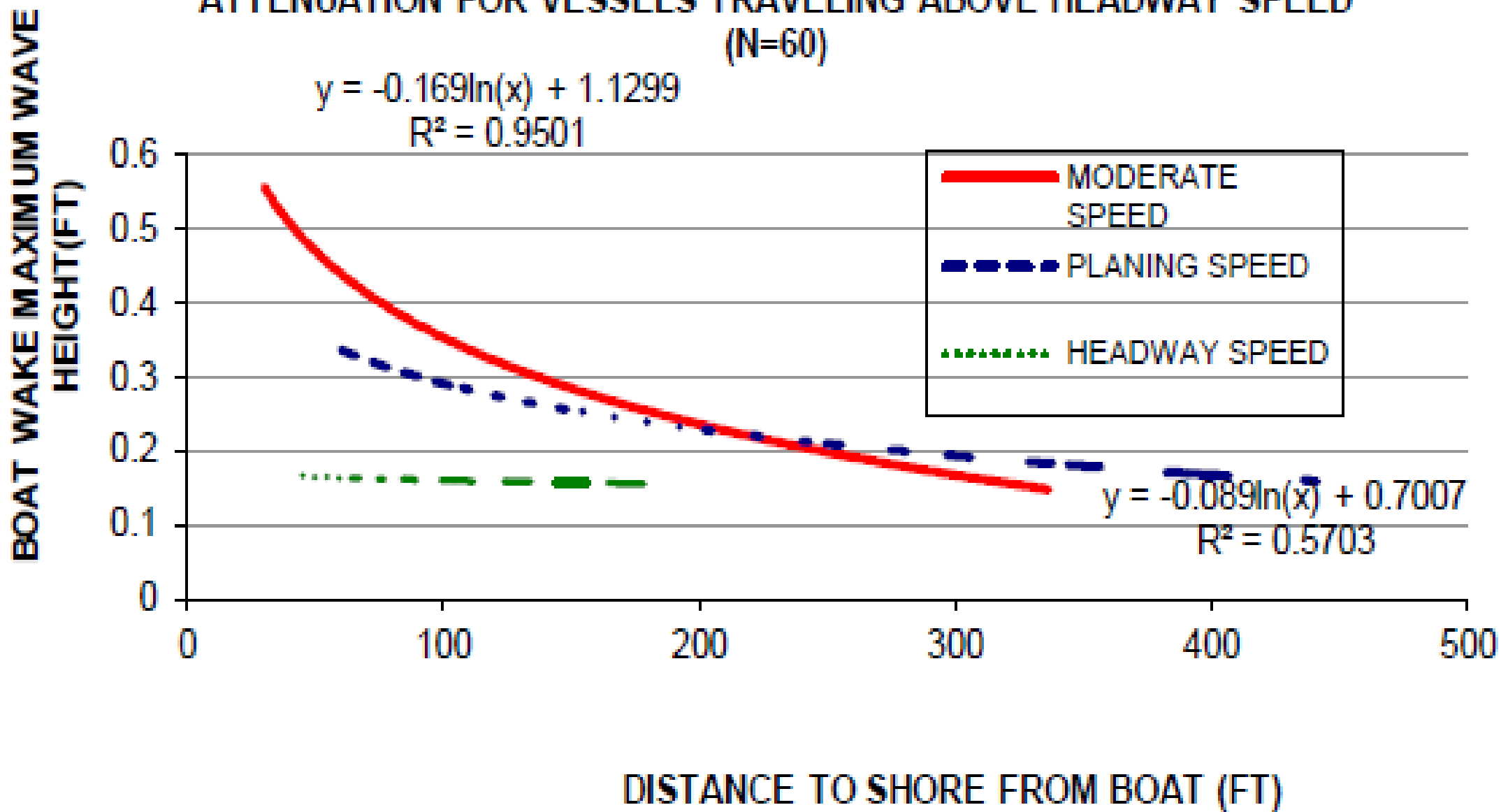


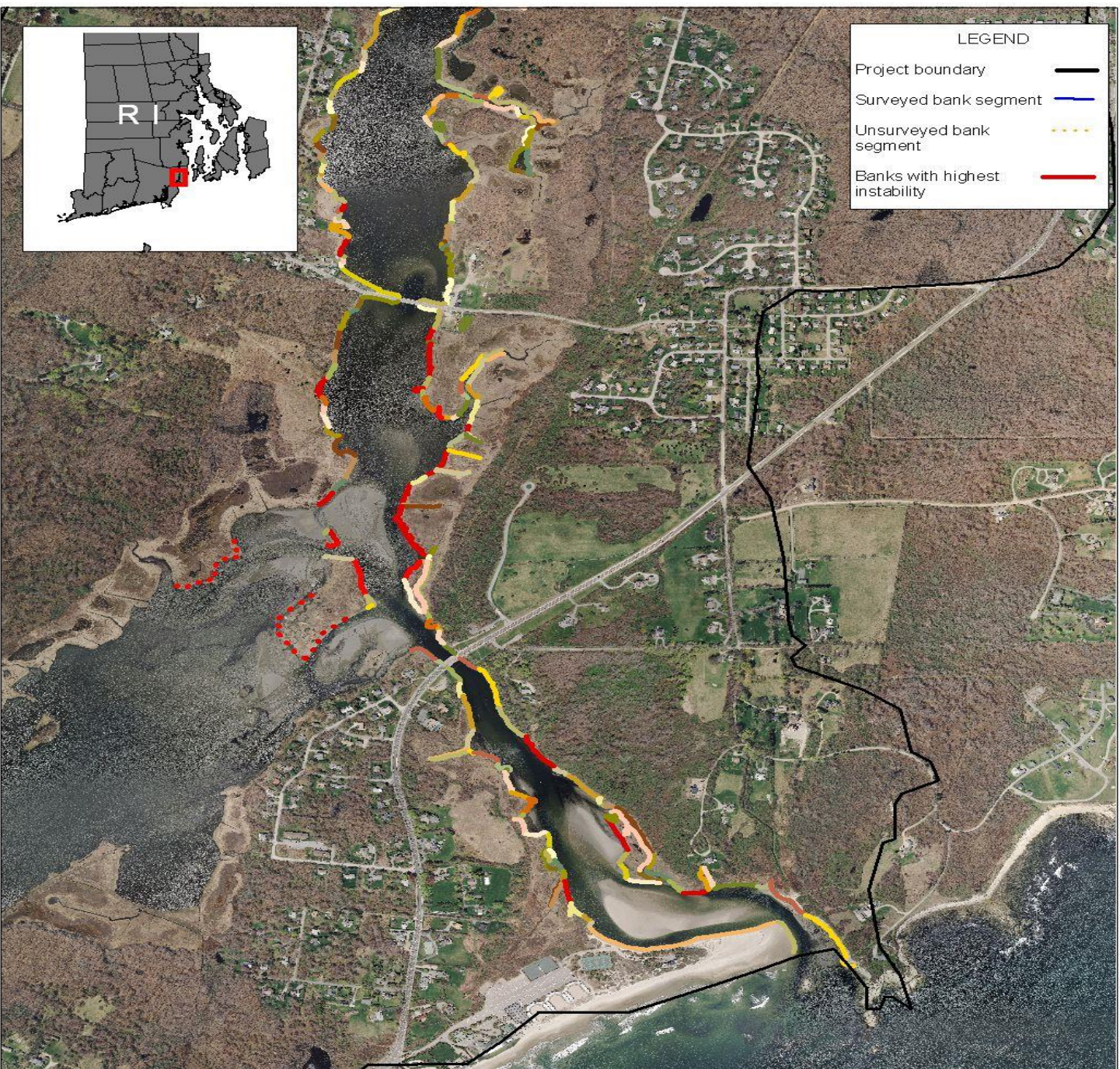


FIGURE 4. PREDICTED BOAT WAKE MAXIMUM WAVE HEIGHT ATTENUATION FOR VESSELS TRAVELING ABOVE HEADWAY SPEED (N=60)





# Saltmarsh Shoreline Stability Survey Summary, Narrow River Enhancement Project.

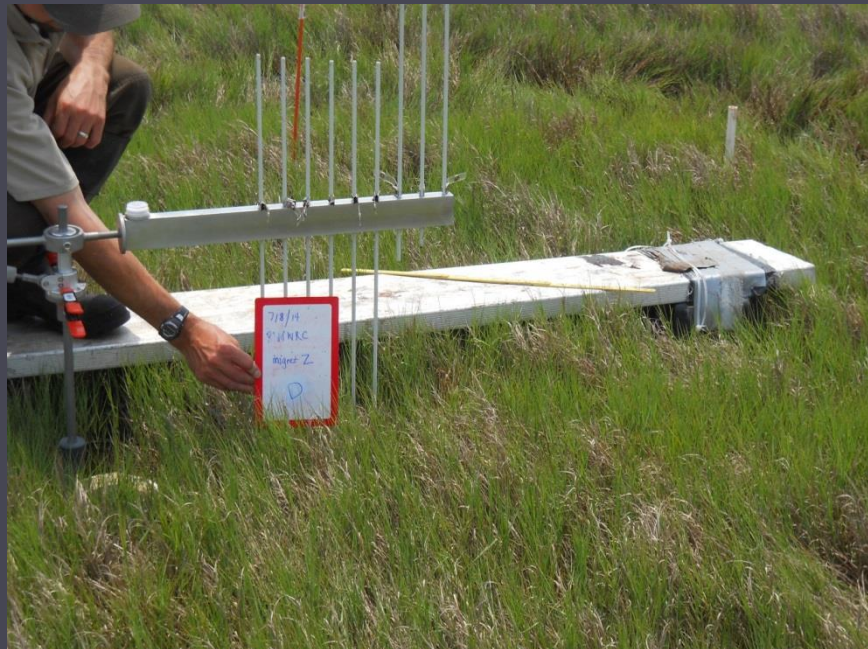


LEGEND	
Project boundary	—
Surveyed bank segment	—
Unsurveyed bank segment	- - -
Banks with highest instability	—

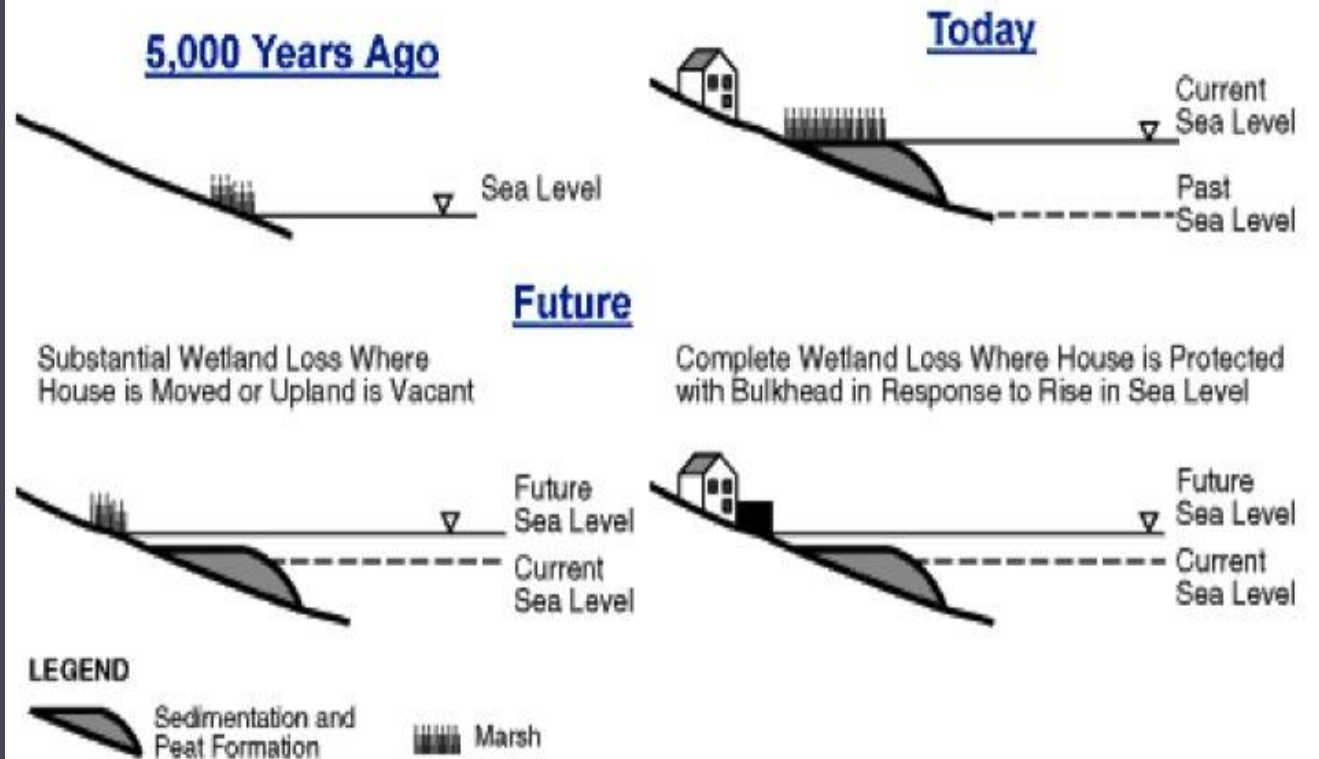


# Sea Level Rise

- Saltmarsh elevation growth about 2–3mm/year (accretion)
- Sea level rise (SLR): 4 mm/year
- SLR outpacing marsh growth



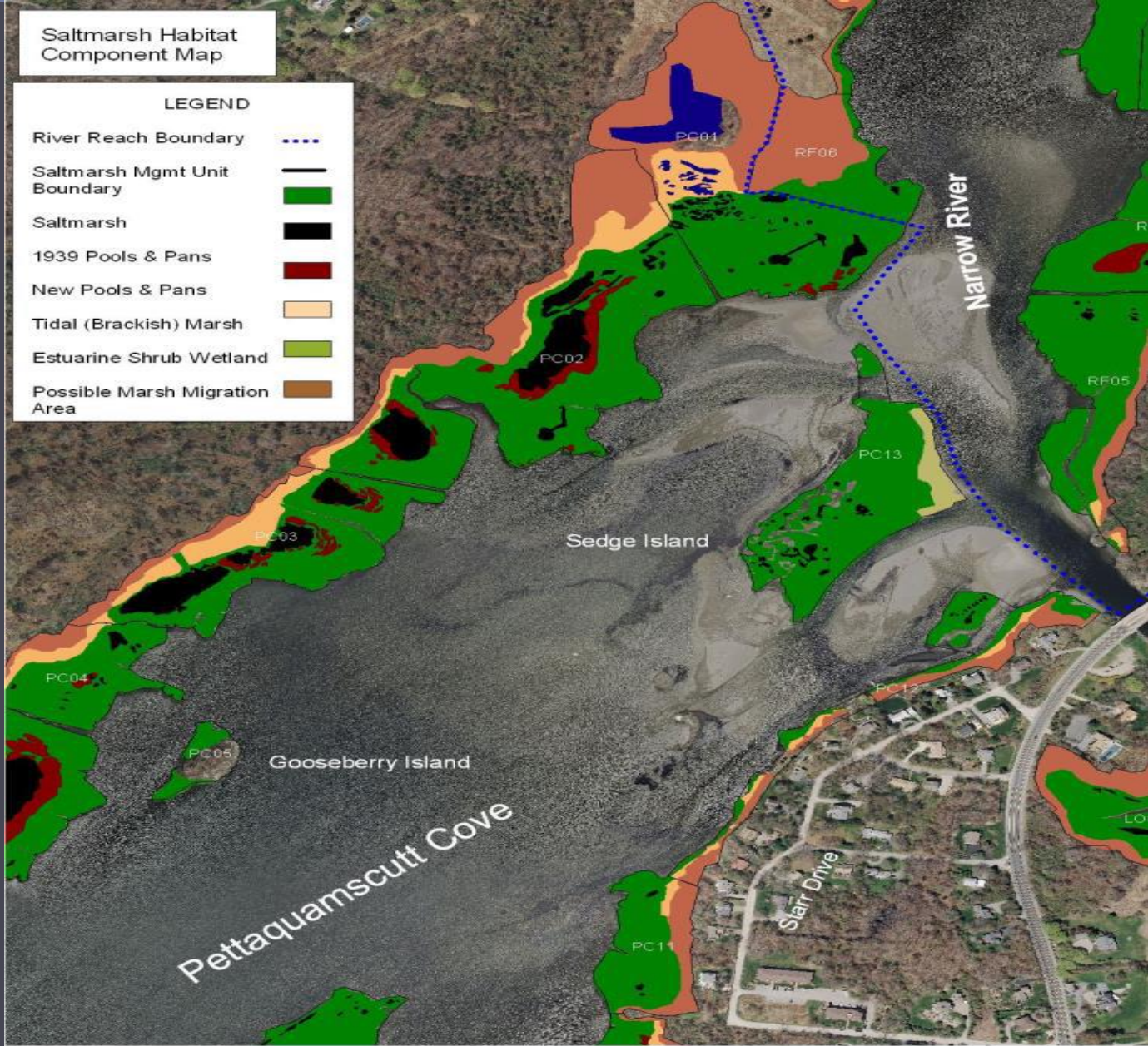
## Evolution of a Marsh as Sea Level Rises



*Credit Courtesy of the Coastal Resources Management Council*



# Limited Marsh Migration Corridors



**Not A Public  
Boat Ramp  
Restricted Use  
ONLY**





# Waterlogged Marshes

## Poor Drainage

- 39% of saltmarsh degraded by waterlogging
- Short-form *S. alterniflora*, loss of high marsh vegetation
- Unstable peat/bog-like conditions

## Increased pools and pans

- 40% increase in pools and pans since 1939
- Loss of 14 acres of saltmarsh



Saltmarsh Surface Profile Unit PC02, T10

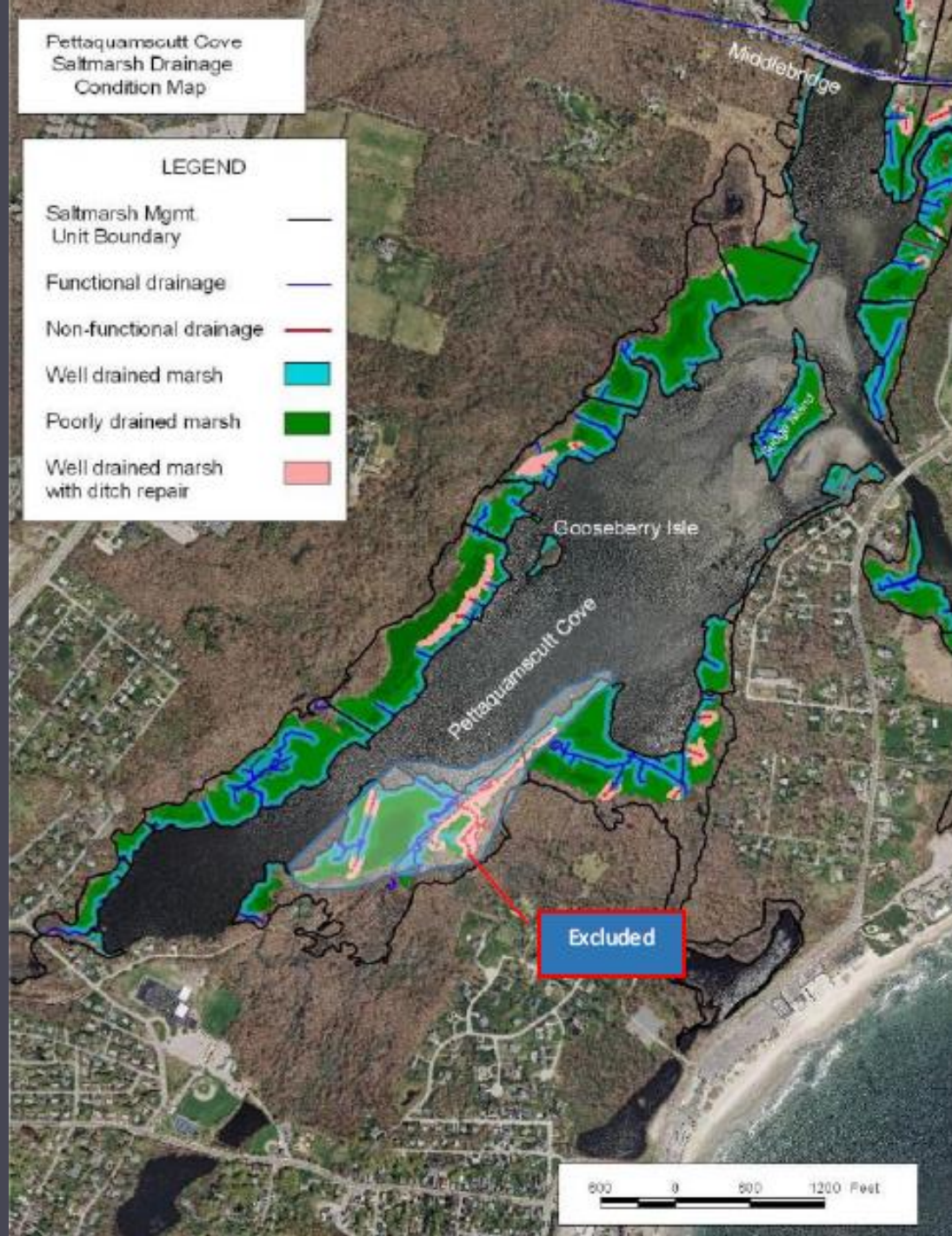




Table 2. Saltmarsh Drainage Conditions in the Narrow River Estuary

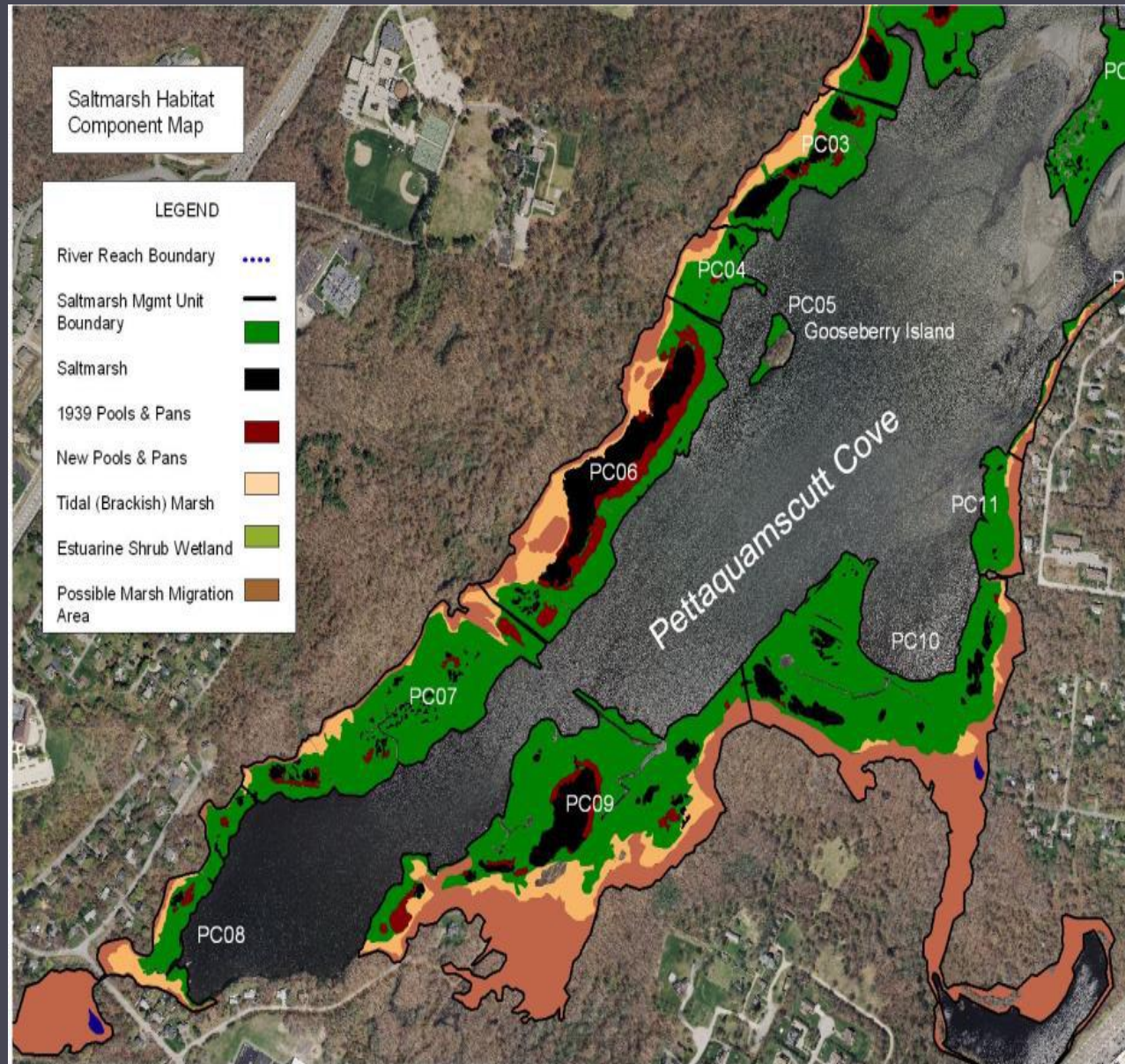
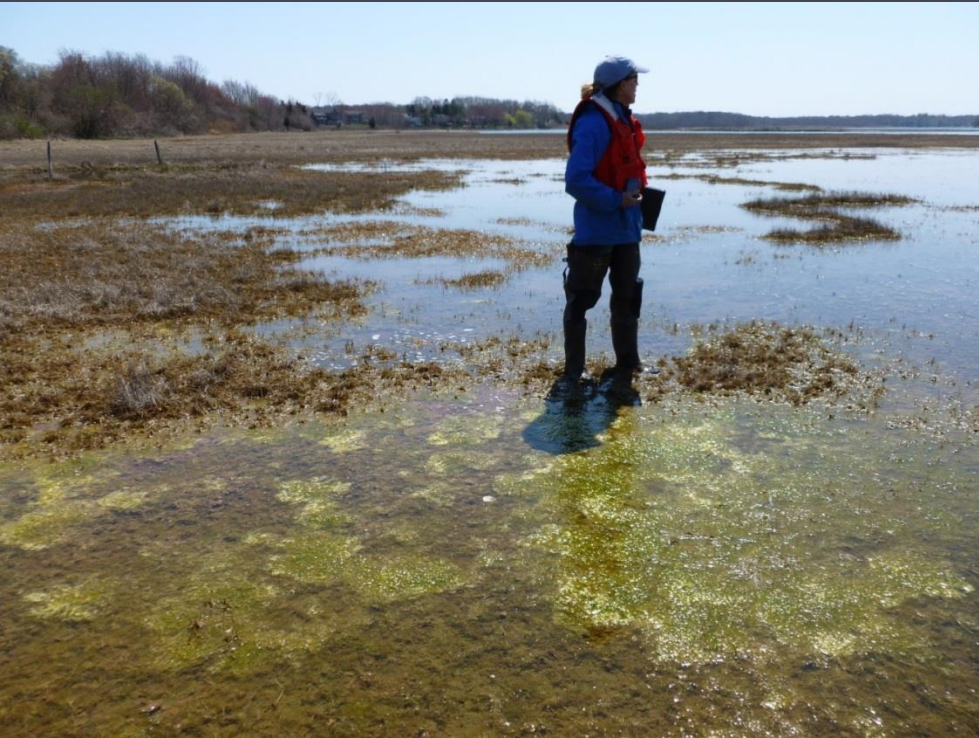
RIVER REACH	TOTAL ACRES	MARSH DRAINAGE (FT)		CONDITION OF MARSH SURFACE				SALTMARSH IMPACTED - CLOGGED DRAINAGE	
		RIVER / MARSH SHORE LINE	DITCHES & SLOUGHS		WELL DRAINED SALT MARSH HABITAT		POORLY DRAINED SALT MARSH HABITAT		
			FUNCTIONAL	NON-FUNCT.	ACRES	%	ACRES	%	ACRES
LACY BRIDGE	15.2	8,628	6,003	2,281	11.4	75	3.8	25	4.1
LOWER RIVER	14.0	6,414	7,972	58	11.3	81	2.7	19	0.1
MIDDLE-BRIDGE	31.6	8,542	12,366	1,887	17.5	56	14	44	3.4
METTATUXET	1.6	401	0	0	0.2	12	1.4	88	0.0
PET COVE	86.8	27,497	18,427	3,984	52.8	61	34	39	8
REFUGE	24.8	5,640	7,035	1,810	12.1	49	12.7	51	1.8
<b>TOTAL</b>	<b>174.0</b>	<b>57,122</b>	<b>51,803</b>	<b>10,020</b>	<b>105.4</b>	<b>61</b>	<b>68.6</b>	<b>39</b>	<b>17.4*</b>

\*1 Subset of poorly drained total acres.



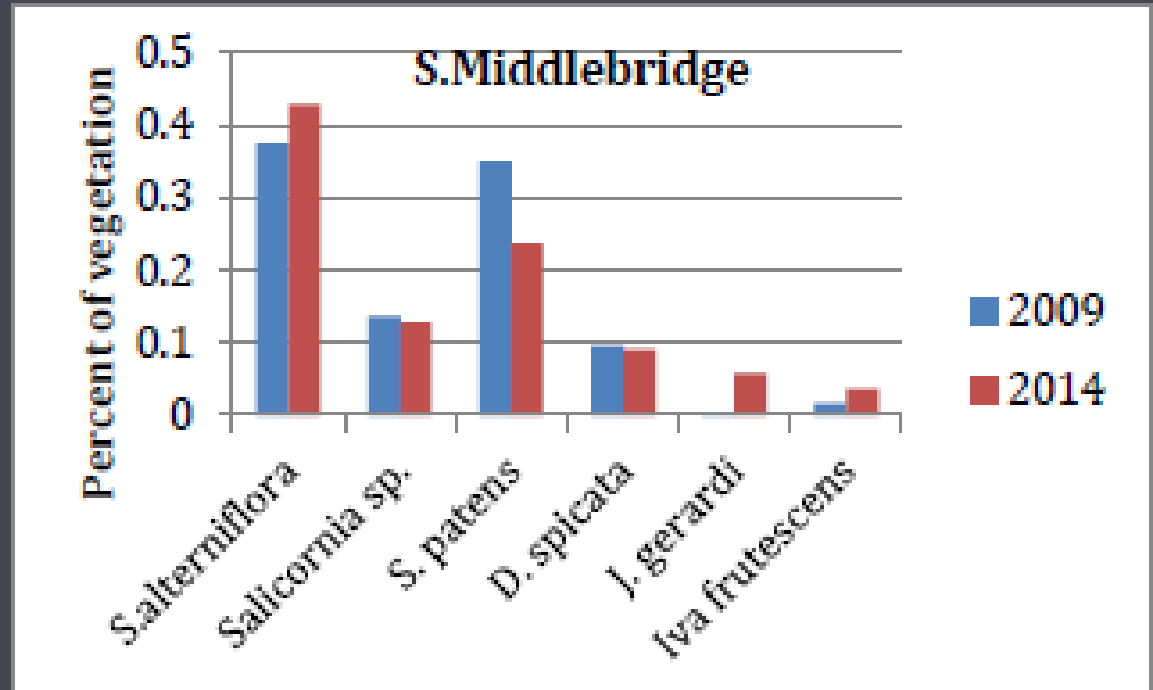
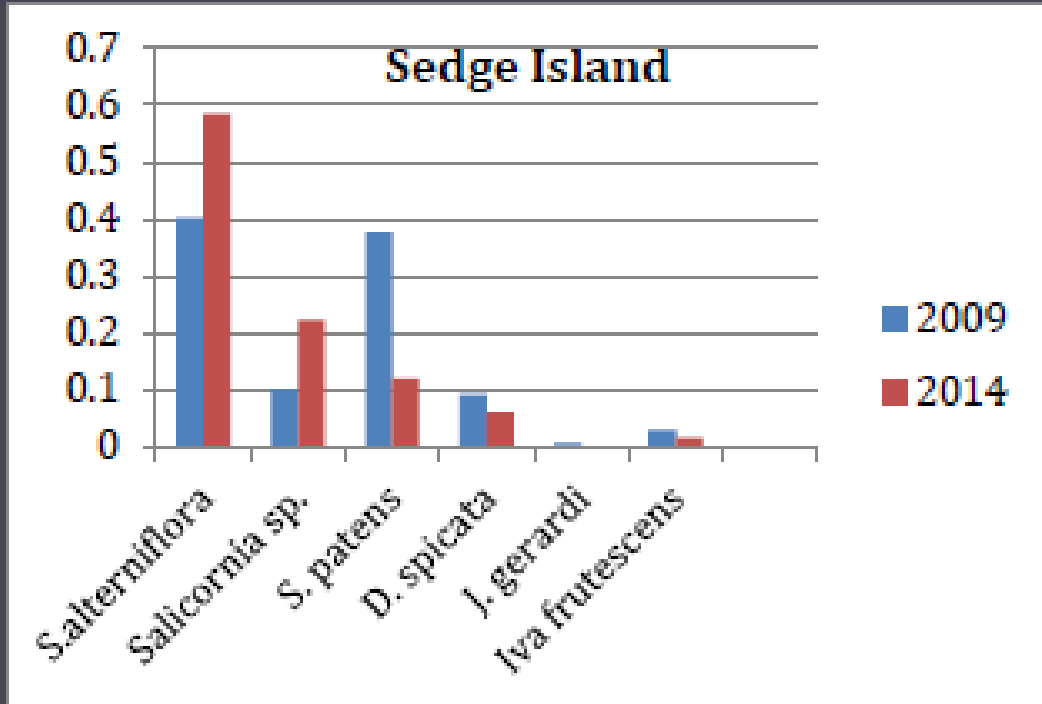


# Pan and Pool Expansion





# Vegetation Transition





# Soft Shorelines



# THE NARROW RIVER SITES



Site 4  
Sedge Island



Site 1-3 and Control



Breachway

Middle Bridge

The prevailing winds blow from the northwest in the winter and from the southwest in the summer.





# Aerial View of Living Shoreline



Photo credit: Aron Katona, TNC



# Drainage Restoration

**RUNNELS:** Excavate shallow channels ,8–12” deep, 2’ wide

- Restore growing conditions for marsh vegetation
- Provide surface drainage
- Enhance habitat for small estuarine fish
- Enhance high marsh nesting habitat
- *Reduce mosquito breeding habitat*







Photo credit: Wenley Ferguson





# Proposed Beneficial Use of Dredge Material

## Dredging

- 35,629 cubic yards of material (sandy with fines 2–60%)

## Eel Grass Enhancement

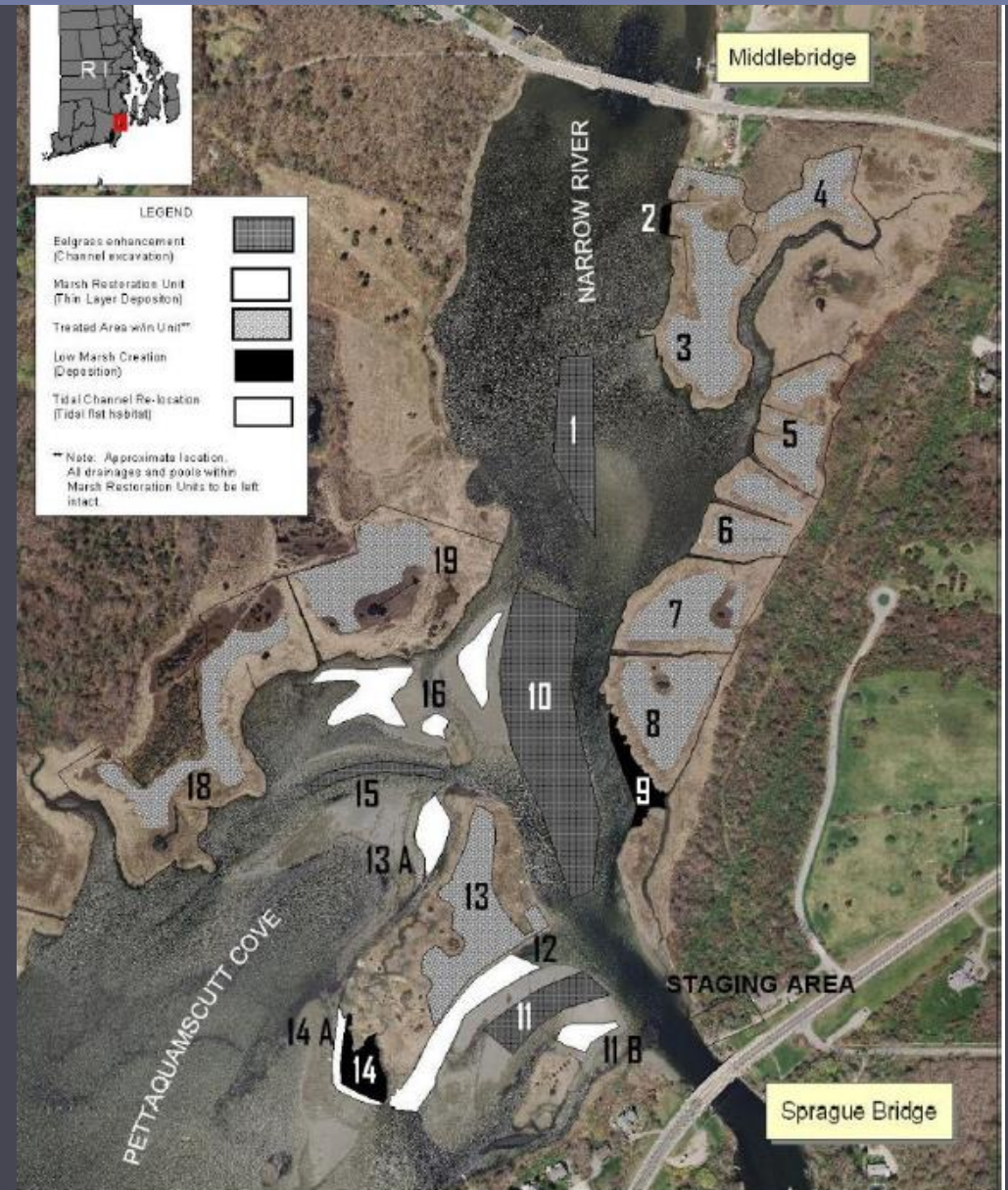
- 7 acres excavated (–5 feet NAVD88)
- Thermal refugia estuarine fish
- 3 acres of upper tidal flat create shorebird foraging

## Low Marsh Creation

- 1.2 acres of low marsh creation

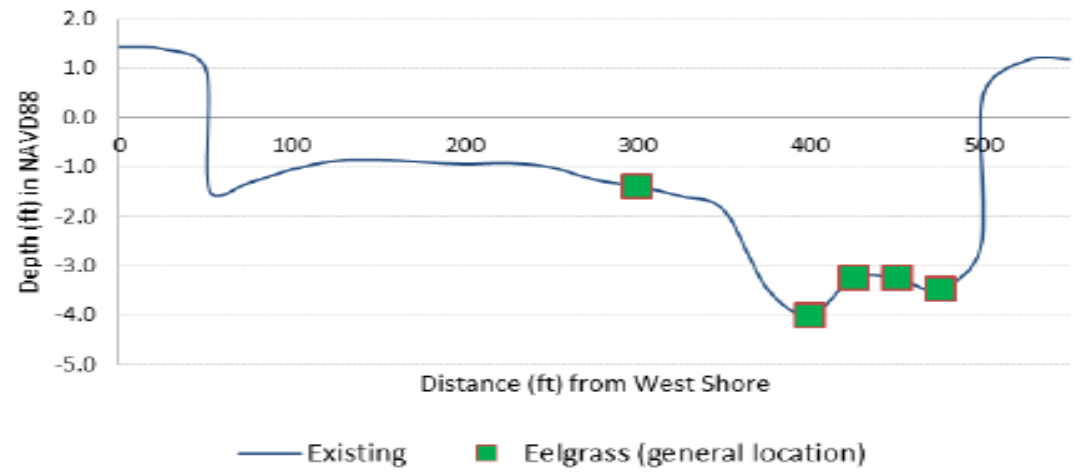
## Elevation Capital and Restoration of Degraded Marsh

- 14 acres enhanced with Thin Layer Deposition (TLD)

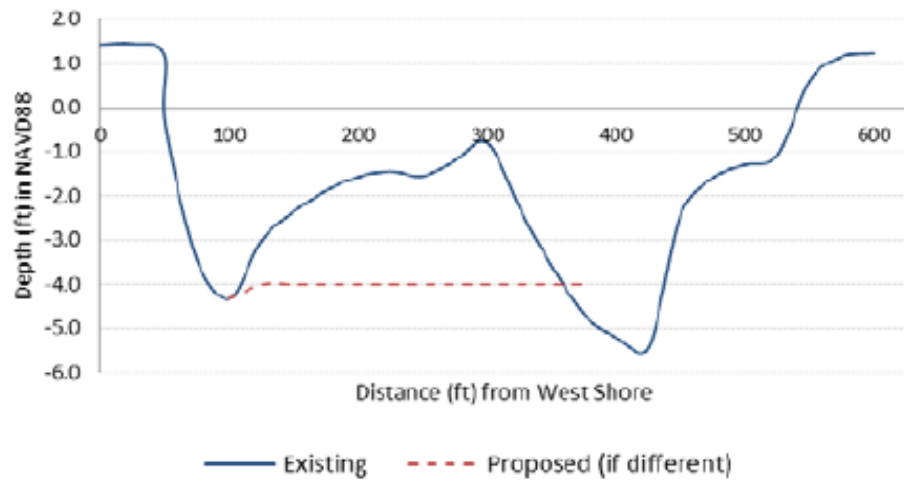




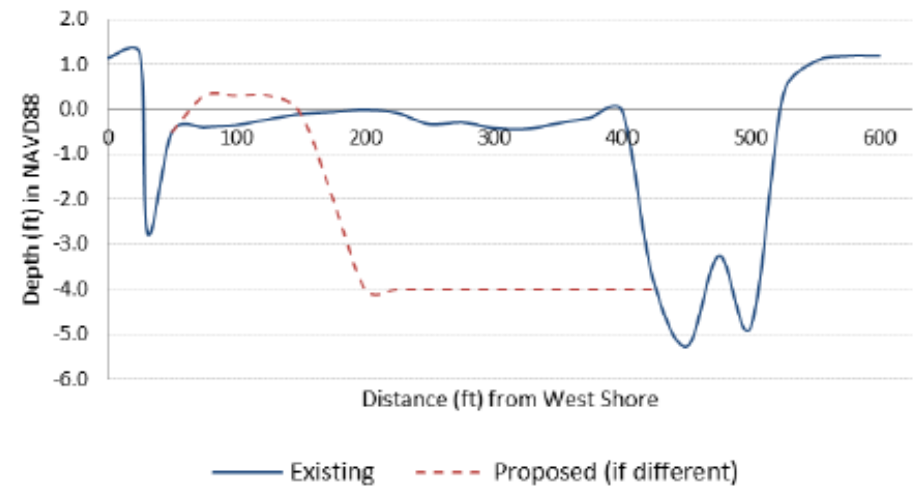
Bottom Profile, Narrow South (T1) September, 2014



Bottom Profile, Narrow South (T4) September, 2014



Bottom Profile, Narrow South (T3) September, 2014





# Thin Layer Deposition (Test)





# Thin Layer Deposition (Test)



# Slurry Treatment





# Mechanical Treatment





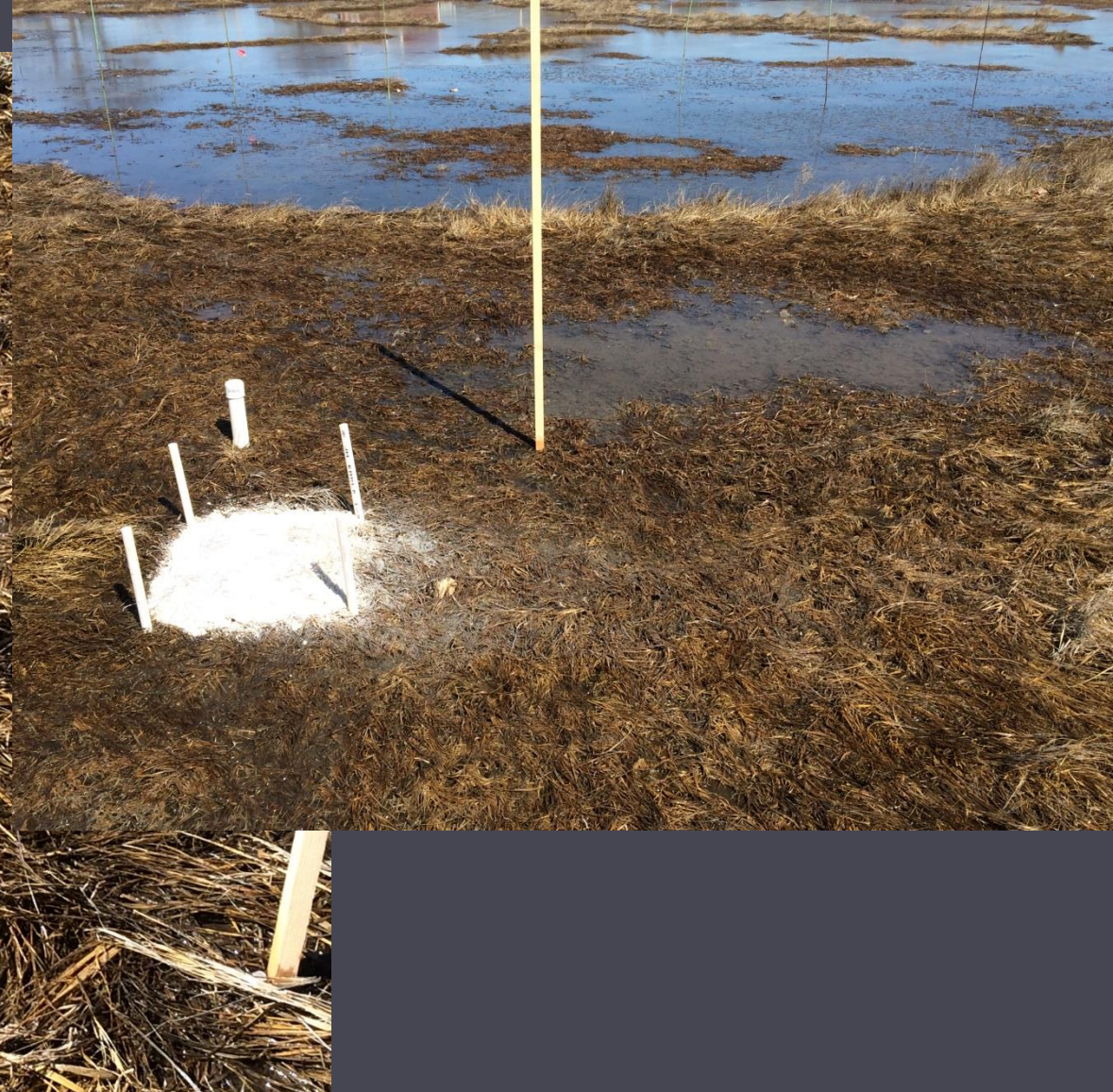


# Bulk Density





# Feldspar Plots





# Acknowledgments



**SAVE THE BAY®**

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**U.S. Army Corps of Engineers®**



**Narrow River Preservation Association**

