APPENDIX G

DETAILS OF IMPLEMENTATION FOR ALTERNATIVE 2

THE PREFFERED ALTERNATIVE AND PROPOSED ACTION

ACTION A
WATERSHED MANAGEMENT/WATER QUALITY RESTORATION

The following actions will be undertaken to address water quality management (Figure A1):

- Intensify water quality monitoring to locate priority sites for water quality abatement actions.
- Survey, design, and install (funding dependent) best management practice sites in the Mettatuxet drainage in Narragansett and at Kimberly Drive in South Kingstown. All BMP work will be conducted in upland areas. Final design of BMPS will be subject to approval by the RIDEM. Generally this entails creation of basins where runoff is captured and treated naturally prior to flowing into the Brook or Cove. Construction would entail the use of excavators, dump trucks, and backhoes. Construction traffic (trucks, light trucks cars, tractor trailers) would occur intermittently along Kimberly Drive and Mettatuxet Ave. Temporary one lane detours may be needed on Mettauxett Ave during construction. Construction scheduling would attempt to avoid the summer season, and would only occur during daylight hours. Construction may last 30 days to 60 days. Once constructed, periodic inspections would occur, and period maintenance, once every five years, may be needed to place fresh gravel or other materials in the basins.
- Improve flushing and water circulation in Upper Pettaquamscutt Cove by removing remnants of a narrow gauge line which crossed the Cove in the 1800's (fig. A2). Material will be excavated to the depth of typical bottom elevations Northeast and Southwest of the crossing. The crossing would not be widened, only deepened, to prevent loss of saltmarsh. Material (typically course gravel, small rock to 12" diameter) will be placed to the side of the channel below MHW to create a rock and gravel substrate to preserve rock/sand bottom types for EFH at elevations conducive to keeping them relatively sediment free. Profiles of the 150' x 75' x 2' deep (approx. -3 feet NAVD) which would be excavated are shown below. Fill areas total 12,085 square feet (Table A1). Excess material would be used near Sedge Island for the channel re-alignment (Action B). Both pre-project and post-project profiles will be taken should removal of the crossing remnants be found necessary.

  Excavation and placement of materials would be accomplished with the use of an excavator on a barge. Material would be removed from the bottom, placed on the barge or in containers on adjacent barges, and then spread into new locations. Activities would only occur during the winter dredging window of November 15 through January 31. A staging area would be temporarily constructed at the Northwest corner of Sprague Bridge on National Wildlife Refuge Lands. Traffic associated with both construction of the staging area, transportation of personnel, supplies, equipment (barges, excavators, etc.) and materials for the dredging operation will increase traffic and fuel emissions near the bridge. This impact will occur outside of the busy summer season.

This action is subject to the following management controls:

- Completion of water level and water flow (volume) monitoring to determine the extent this remnant crossing adversely influences flushing and circulation of flow. If flow and circulation is not significantly altered, the crossing remnants will not be removed.
- Excavation will be allowed only within the approved dredging period, typically November 15 through January 31.
- Securing necessary permits and providing supporting information including sediment core contaminant analysis. If contaminants are found, no action will be taken. Completion of consultation with the State of Rhode Island, Historic Preservation Office and the Narragansett Indian Tribe consistent with section 106 of The National Historic Preservation Act (NHPA ; Public Law 89-665; 16 U.S.C. 470 et seq.);
- No activities will occur above the mean high tide line, 3:1 slopes will be retained along each bank. Excess material will be transported and used in filling of the Sedge Island channel if excess to habitat improvement need.

Figure A1. Vicinity Map for proposed water quality improvement actions.

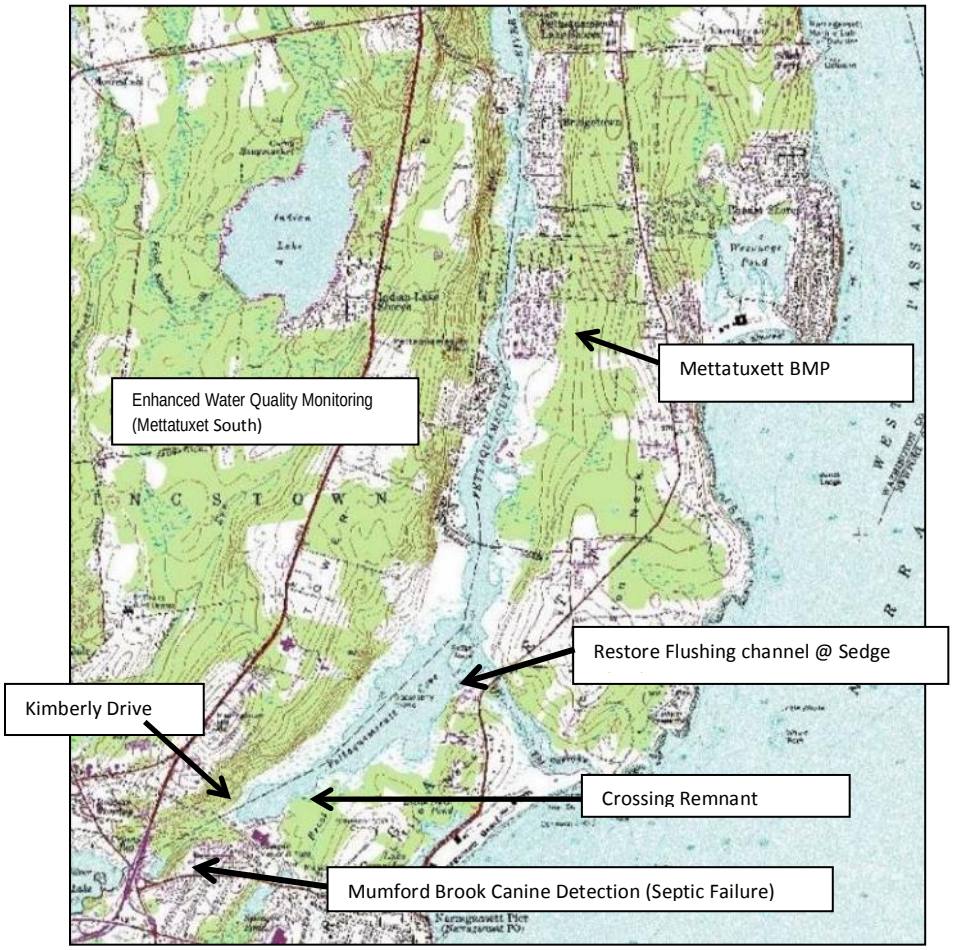
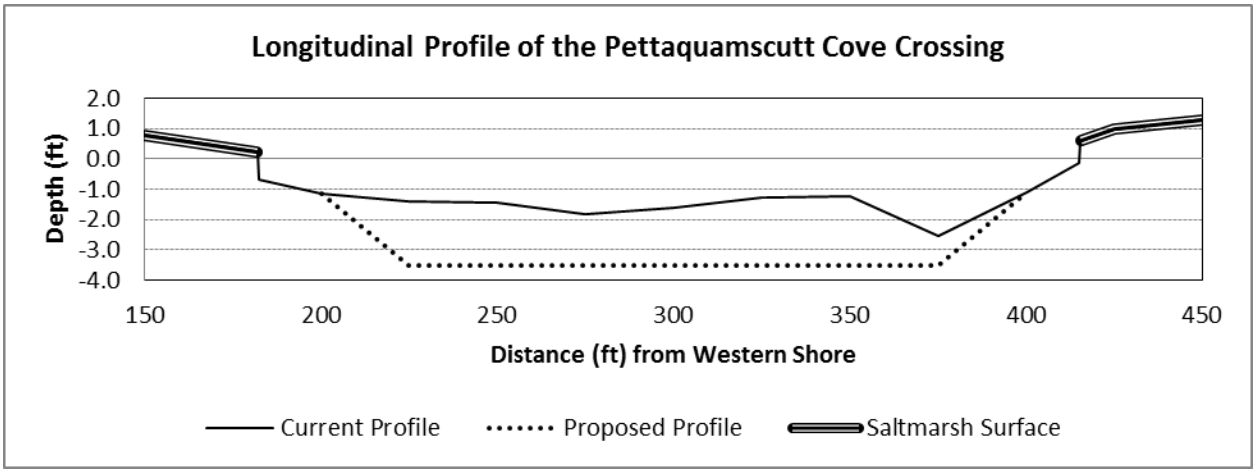
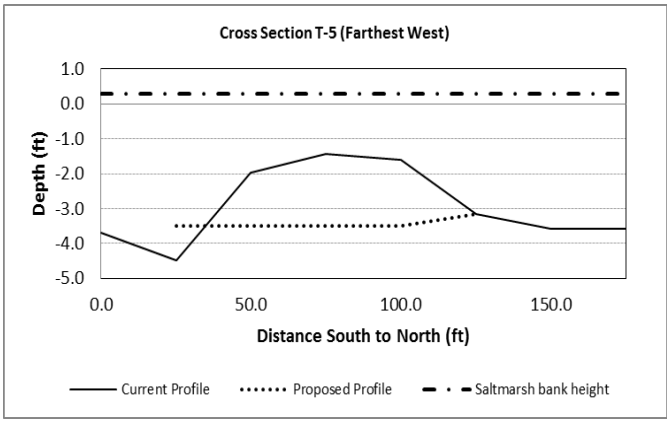


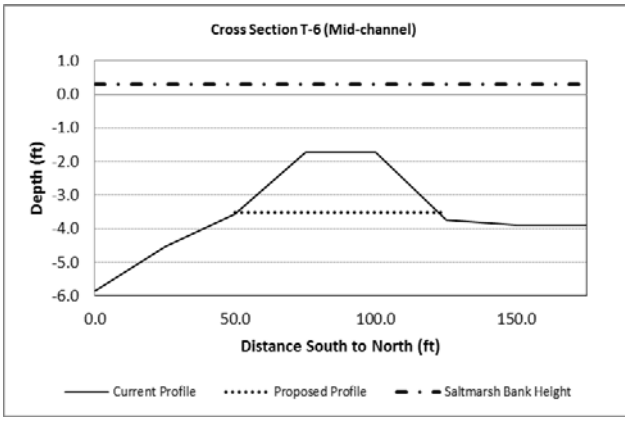
Figure A2. Vicinity map for Crossing Fill Remnant Removal.

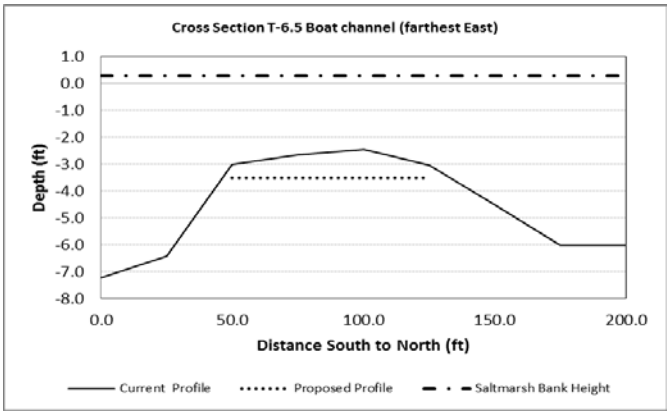
Table A1. Excavation and fill volumes											
TREAT-MENT	CURRENT CONDITIONS					PROPOSED CONDITIONS					
	AREA (SQ. FT.)	WETTED AREA ABOVE -2FT	WET. AREA BELOW -2FT	TOTAL WET. AREA (AC.)	AVE. DEPTH (FT)	TARGET DEPTH (FT)	CUT VOLUME (CYD)	FILL VOLUME (CYD)	WET. AREA ABOVE -2FT	WET. AREA BELOW -2FT	CHANGE IN WET. AREA (ACRES)
Exc.	12,612	1,016	0	0.02	-0.50	-3.00	1,120.6				0.02
Fill	1,351	0	0	0.00	-2.00	0.00		130.1	1351		0.03
Fill	10,734	0	0	0.00	-2.00	0.00		1,033.6	10734		0.25
Total		0.02	0.00	0.02	-4.50	-3.00	1,120.6	1,163.7	0.28	0.00	0.30

Figure A3 –A11. Profiles of Excavation to Remove Remnant fill (Note transect Numbers in figure A2 above).

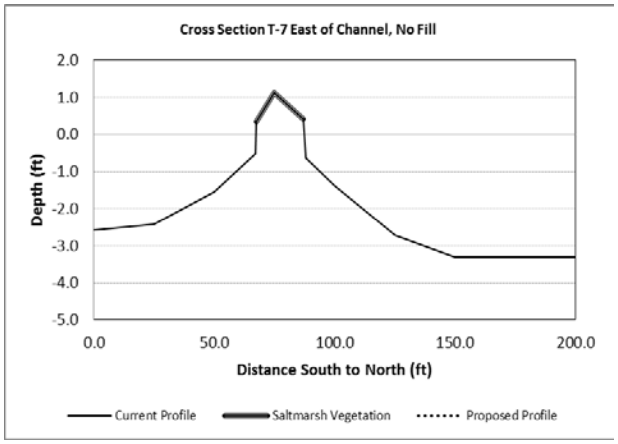


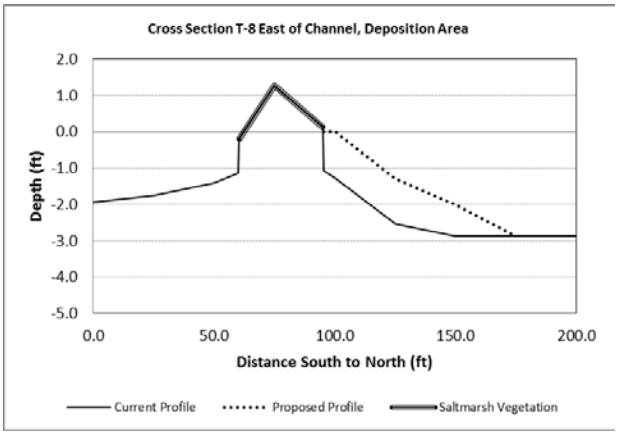


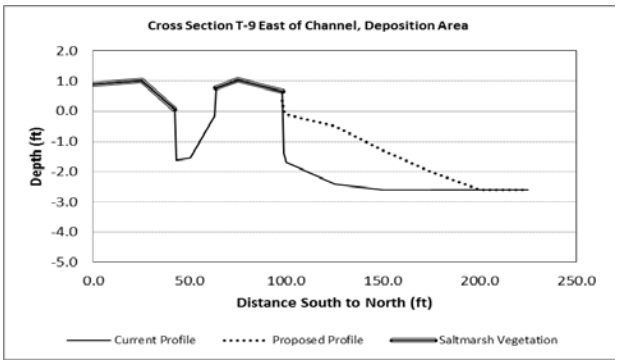


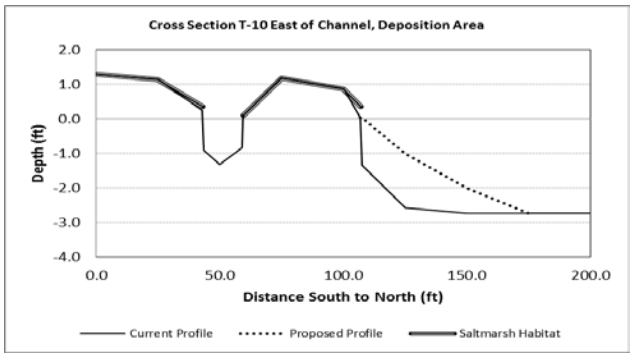


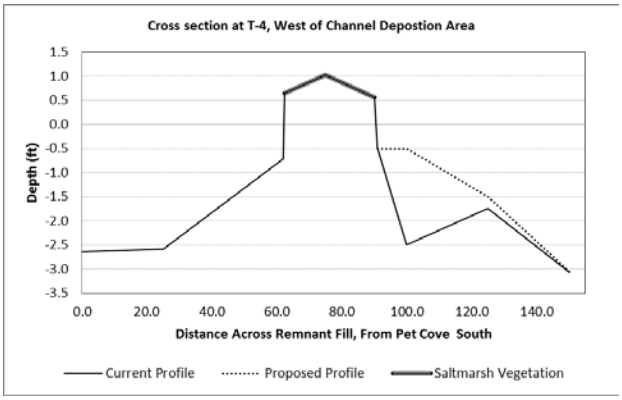
Proflies of Fill areas for Fish Sand/Cobble/Boulder Habitat











ACTION B

EELGRASS, ESTUARINE CHANNEL AND BASIN RESTORATION

Basins and channels will be deepened by removing existing sediments to a depth of approximately -4 feet NAVD88. In areas where channels were present historically. Deposition of flood and ebb tidal deltas has formed over time, shifting channels to less favorable locations for preservation of estuarine values.

Approximately 7 acres of deeper areas suitable for eelgrass habitat, thermal refugia, and foraging areas for fish species (Units 1, 10, 11, & 15 in figure B1 and table B1). Resulting depths will provide habitat for existing eelgrass beds to expand, insure depths will make beds less susceptible to prop scarring, and will provide for cooler temperatures for growth and production. Figures B2a – B2f provide sample profiles for these sites.

This action will be accomplished using small conventional construction equipment and multiple management controls in order to avoid negative impacts to estuarine and marsh habitats within the estuary. A temporary staging area will be installed with a gravel surface at the river access point on the Northwest Side of Sprague Bridge on National Wildlife Refuge Lands. A small, temporary floating dock will be installed at this location with temporary pilings and a simple access ramp. In order to avoid impacts to estuarine fish and wildlife and recreational uses, this dock will be placed no early than October 15, and removed by March 15 each year.

In order to minimize construction impacts from this work the Service intends to deploy small-scale mechanical, rather than hydraulic equipment to accomplish dredge and fill operations. Equipment will be placed on small work floats to access construction areas, and will be operated from the floats, thereby avoiding equipment impacts to marsh or tide flat surfaces.

In instances where a fill operation is adjacent to a dredge area, for example in deepening and moving the channel southeast of Sedge Island, the work will be accomplished through a simple sidecast operation, using an excavator on a float to dig the new channel, and to place the material in the old channel to be filled. Sediment re-suspension is expected to be minimal, due to the sandy nature of the material in these areas. Where needed, oyster shell bags or similar “living shoreline” materials will be used to contain the material that is being placed.

Where sediments must be moved any distance from a dredge to a fill area, they will be placed in sealed containers on floats, and barged into position adjacent to application areas. The process of applying sediments to marshes for restoration is described under Action E, below.

This action is subject to the following management controls:

- Engineering designs, approved by CRMC will be finalized and followed to insure widths, depths, and slopes are not exceeded. Excavated areas will be re-surveyed following treatments to determine whether treatments were followed and to generate “as built” drawings. Excavated areas will be re-surveyed one year following excavation to determine whether any further actions are necessary.
- Excavation will occur only during the approved dredging seasons, typically November 15 - January 31;
- Receipt of all required permit requirements (see EA Sec. 6.3);
- As directed by RIDEM, shellfish species will be removed from areas prior to excavation.
- Monitor eelgrass distribution for three years from Middlebridge downstream including Pettaquamscutt Cove;
- Monitor tidal levels for three years.

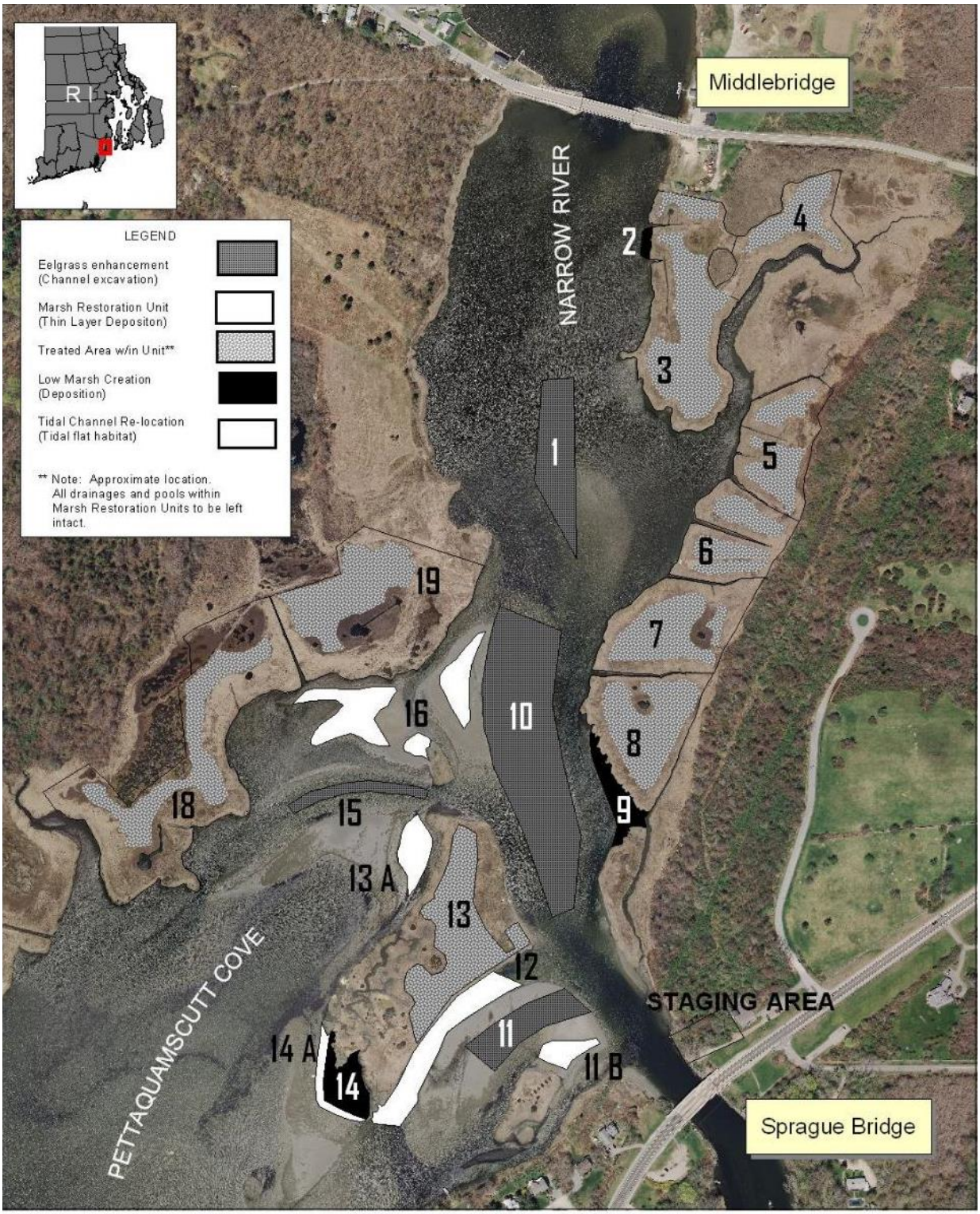
- Excavated material will be first used for tidal flat enhancements to insure no significant loss in key shorebird, wading bird, and shellfish habitats. Materials will be contained with the use of temporary coir log or similar containment devises.
- Tree clearing at the staging area will be kept to the minimum necessary; all trees will be provided protection (wooden slats) during the construction period.
- The staging area will be regularly inspected for environmental compliance for erosion control, hazardous material containment, public safety, and other items.
- Gravel placed to develop the site will be removed, topsoil will be used to resurface the area, with native vegetation re-established on the site, including grasses, shrubs, and trees.

TABLE B1. HABITAT TREATMENTS RELATED TO EXCAVATION FOR EELGRASS RESTORATION

UNIT	CURRENT CONDITIONS						PROPOSED CONDITIONS					NOTES
	AREA (SQ. FT.)	AREA (ACRES)	WETTED AREA ABOVE -2FT (1)	WETTED AREA BELOW -2FT (2)	TOTAL WETTED AREA (ACRES)	AVERAGE ELEV / DEPTH (FT)	TARGET ELEV / DEPTH (FT)	EXCAVATE VOLUME (CYD)	WETTED AREA ABOVE -2FT	WETTED AREA BELOW -2FT	CHANGE IN WETTED AREA (ACRES)	
1	56,618	1.3	58,469	0	1.34	-1.25	-3.00	3,669.7	0	56,618	-0.04	
10	194,235	4.5	197,179	2,944	4.59	-0.50	-4.00	25,510.4	2112	179,520	-0.42	Sideslope of 5:1 on western side.
11	39,462	0.9	39,842	200	0.92	0.00	-4.00	5,156.4	1552	40,352	0.04	Sideslope of 3:1
15	16,687	0.4	16,687	0	0.38	-1.00	-3.00	880.5	1724	1640	-0.31	Sideslope of 3:1 on western side.
TOTAL:	7.05	7.05	7.17	0.07	7.24	-2.75	-14.00	35,217.1	0.12	6.38	-0.73	

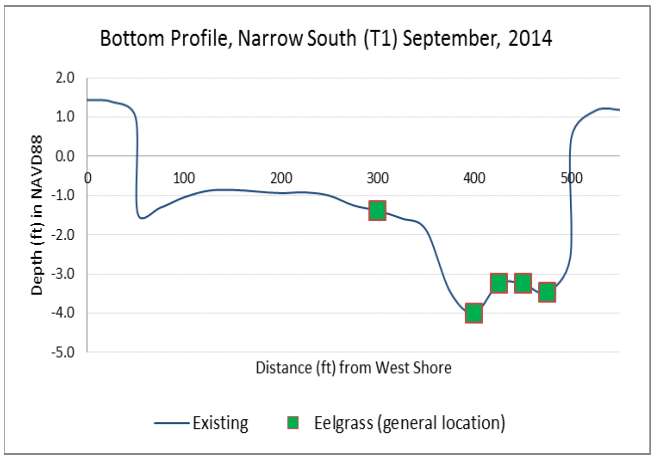
Figure B1. Excavation, fill, and Thin Layer Deposition Units Under the Proposed Action

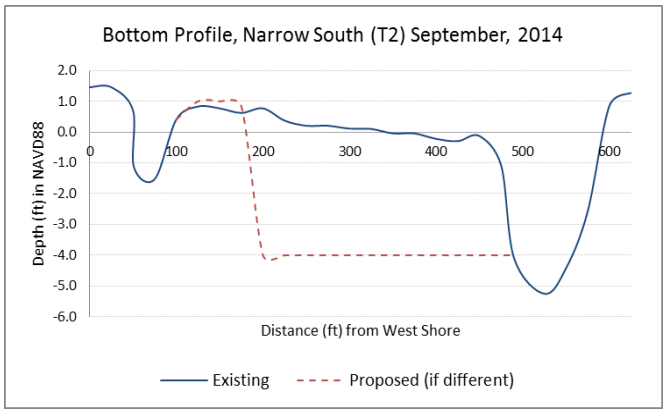
Figures B2a-B2f. Sample Profiles in Areas Excavated for Eelgrass Improvement (Note: T1 Not in proposed

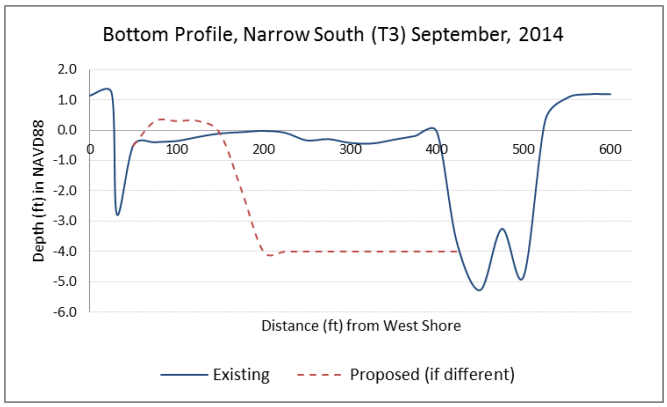


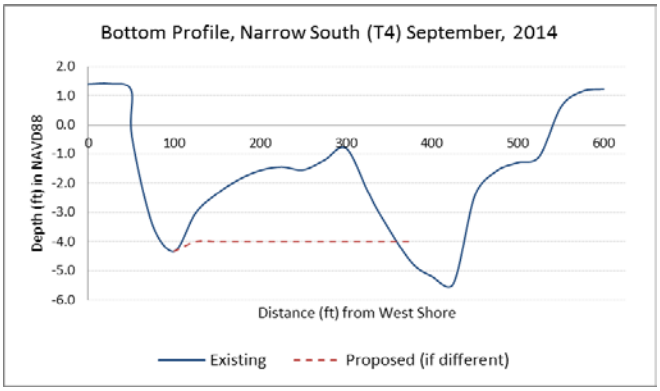
U.S. Fish and Wildlife Service
50 Bend Road, Charlestown, RI 02813
Land lines approximate

excavation area.)

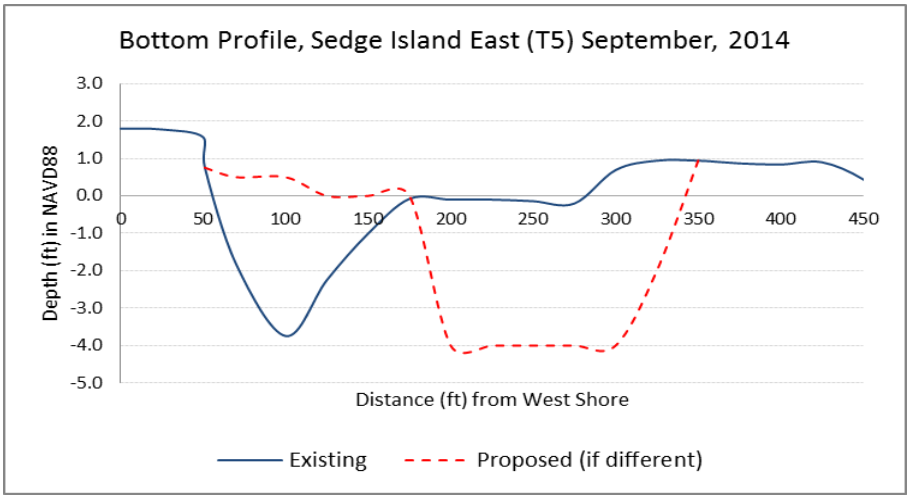


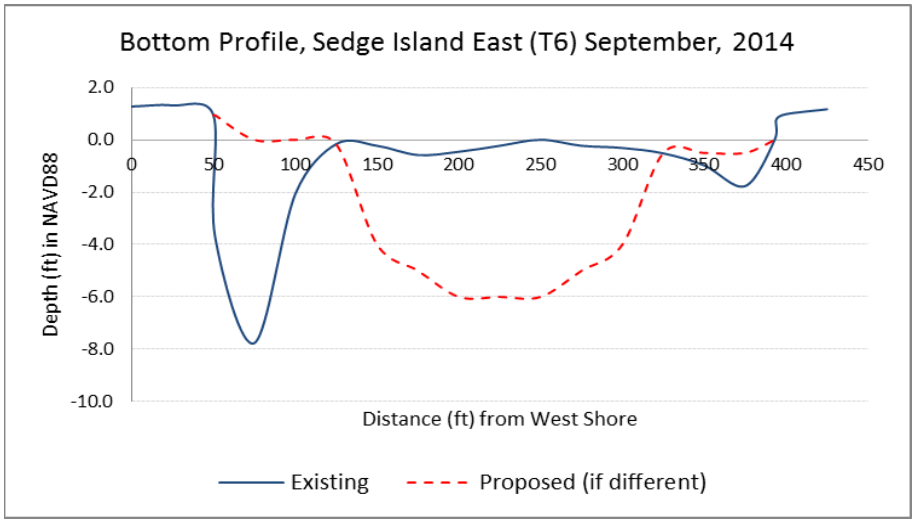






t4
t5
t6


Bottom Profile, Sedge Island East (T5) September, 2014
Depth (ft) in NAVD88
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
0
50
100
150
200
250
300
350
400
450
Distance (ft) from West Shore
Existing
Proposed (if different)


Bottom Profile, Sedge Island East (T6) September, 2014
Depth (ft) in NAVD88
2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
0
50
100
150
200
250
300
350
400
450
Distance (ft) from West Shore
Existing
Proposed (if different)

ACTION C
RESTORE SALTMARSH SHORELINES

Fiber (coir) logs and bagged oyster shell will be placed in a variety of formations along eroding marsh edges. Based on saltmarsh shoreline assessments (USFWS 2009; TNC 2014), the lengths of shoreline per saltmarsh unit in need of treatment were identified where shoreline stability is particularly poor, and bank loss could result in significant saltmarsh habitat loss. Application of living shoreline treatments is based on site specific analysis of a particular bank, with designs created based on those evaluations. Site specific locations therefore cannot be identified at this time. The lengths of shoreline to be treated does not mean that living shoreline treatments will be placed along each foot of bank there will be gaps in the areas where shoreline treatments are installed. Table C1 identifies the lengths of shoreline to be treated by saltmarsh management unit, and figure C1 – C5 show the locations of Saltmarsh Management Units where treatments will be applied. Overall, no more than 7% of the total saltmarsh shoreline in the estuary will be treated.

Installation requires transportation of materials, typically on a pontoon boat to the site from river access points. A crew or workers place the materials by hand along the bank, with rope and stakes placed to secure the materials in the arrangements needed. Installation could take place anytime during the warmer seasons, however will attempt to avoid the busiest summer months. Use of the Pollock Avenue Boat ramp would be required for loading and offloading small vessels.

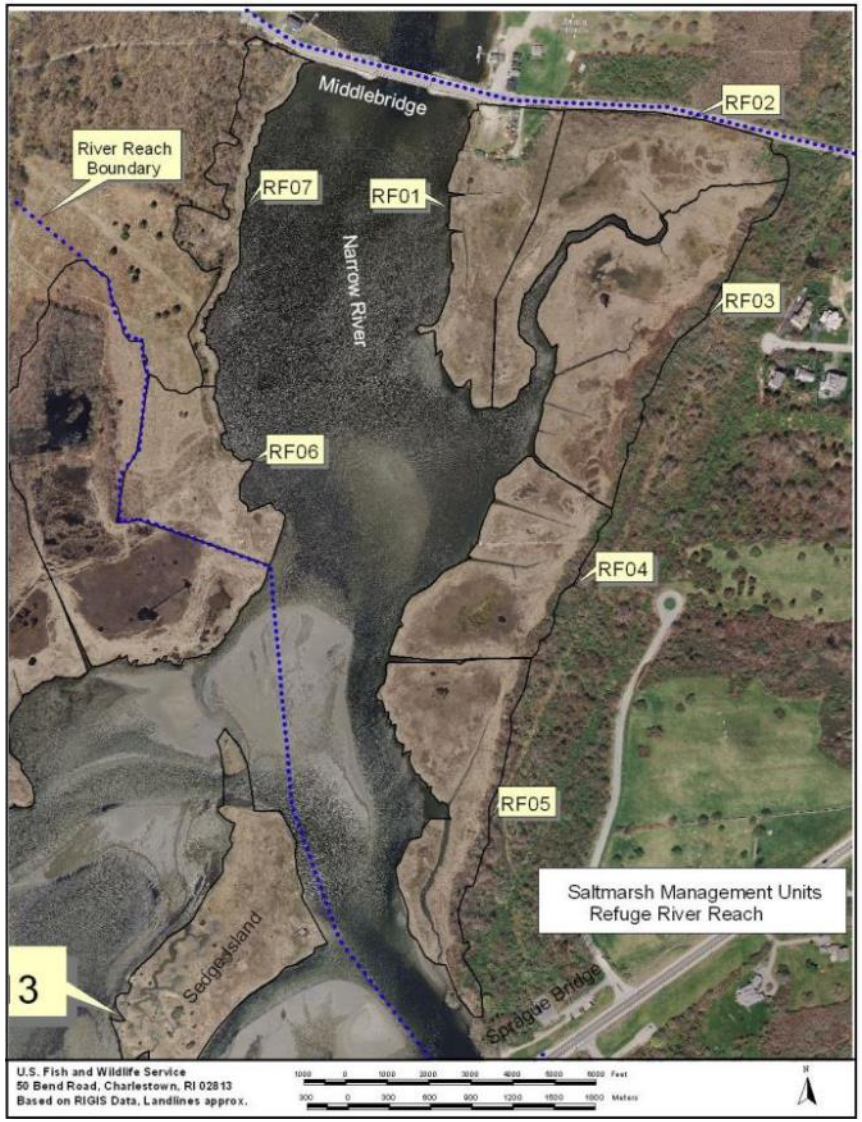
In all cases, living shoreline applications will be subject to the following management controls:

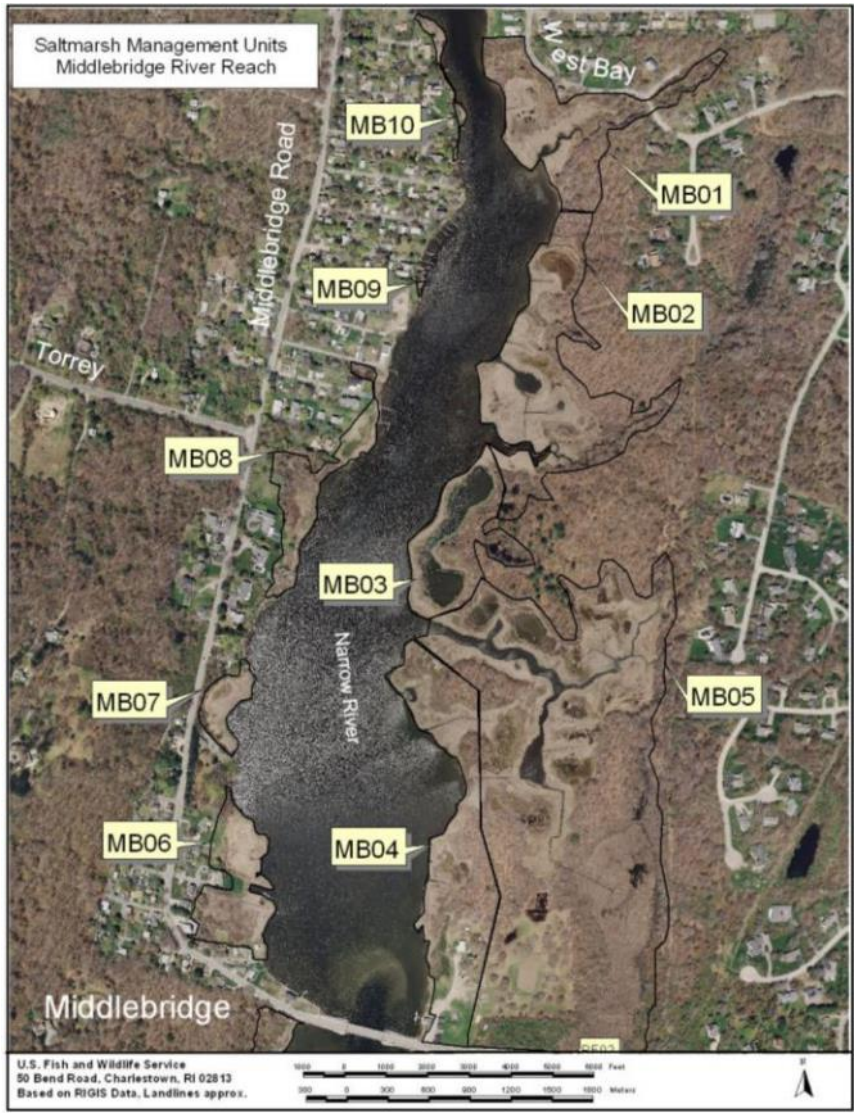
- The current installations will continue to be monitored in detail;
- All applications will be inspected at three times a year (spring, summer, fall) to determine whether structures are in good operational condition. Repairs to structures will be made promptly. As soon after major storm or flooding events, all structures will be re-inspected. Structures with recurring maintenance issues, or are clearly not meeting intended results, will be removed.
- Structures will be located as to insure provision of natural banks on both the upstream and downstream sides of the installation at lengths at least as long as the living shoreline installation. This will insure the available of control sites for monitoring effectiveness as well as preserving bank habitats as they occur currently.
- Written landowner permission will be secured prior to implementation on shorelines where adjacent lands are in non-federal or State ownership.

Table C1. Saltmarsh Shoreline Restoration Summary.

RIVER REACH AND SALT MARSH UNIT	Application of Living Shoreline Treatments by River Reach and Salt Marsh Unit								
	TOTAL SURFACE ACRES	SHORE-LINE (FT)	BANK TREATMENT (FT)	% OF SHORE-LINE	RIVER REACH AND SALT MARSH UNIT	TOTAL SURFACE ACRES	SHORE-LINE (FT)	BANK TREATMENT ACTION (FT)	% OF SHORE-LINE
LACY BRIDGE	25.9	8,628	0	0	PET. COVE	119.9	27,497	1,140	4
LOWER RIVER	14.5	6,414	1,391	22	PC01	6.5	860	43	5
LO01	3.6	3,750	750	20	PC02	13.1	2,568	385	15
LO04	4.6	1,282	641	50	PC03	8.2	1,454	145	10
MIDDLEBRIDGE	51.1	8,542	951	11	PC04	3.3	969	97	10
MB01	3.5	936	234	25	PC10	18.5	2,757	138	5
MB03	3.6	1,020	410	40	PC13	6.2	3,323	332	10
MB06	2.2	1,229	307	25	REFUGE	29.1	5,640	343	6
					RF01	3.8	1,306	131	10
METATUXET	2.3	401	0	0	RF04	5.0	840	42	5
					RF07	1.0	1,135	170	15

Figures C1-C5 Showing Saltmarsh Management Units in the Estuary Follow:


Middlebridge
RF02
River Reach Boundary
RF07
RF01
Narrow River
RF03
RF06
RF04
RF05
Saltmarsh Management Units
Refuge River Reach
3
Sedgeisland
Sprague Bridge
U.S. Fish and Wildlife Service
50 Bend Road, Charlestown, RI 02813
Based on RIGIS Data, Landlines approx.


Saltmarsh Management Units
Middlebridge River Reach
West Bay
MB10
Middlebridge Road
MB01
MB09
MB02
Torrey
MB08
MB03
Narrow River
MB07
MB05
MB06
MB04
Middlebridge
U.S. Fish and Wildlife Service
50 Bend Road, Charlestown, RI 02813
Based on RIGIS Data, Landlines approx.

Saltmarsh Management Units
Pettaquamscutt Cove
PC01
PC02
PC03
PC04
PC05
PC06
PC07
PC08
PC09
PC10
PC11
PC12
PC13
U.S. Fish and Wildlife Service
50 Bend Road, Charlestown, RI 02813
Based on RIGIS Data, Landlines approx.

Saltmarsh Management Units
Lower River Reach
Sprague Bridge
The Narrows
Boston Neck Road
LO01
LO02
LO03
LO04
The Dunes Club
U.S. Fish and Wildlife Service
50 Bend Road, Charlestown, RI 02813
Based on RIGIS Data, Landlines approx.

ACTION D

RESTORE SALTMARSH SURFACE HYDROLOGY & DRAINAGE (RUNNELS)

This action is designed to drain excess water trapped on the saltmarsh surface which is causing a loss in vegetation. Degraded salt marshes will be restored by improving surface drainage using the "runnel" method – excavating shallow (generally 8" to 12" or less in depth and less than two feet wide) channels on the surface of the marsh to provide surface drainage. The minimum number and lengths of runnels will be created, with the density based on site specific analysis. In some cases, existing pans and pools will be connected to tidal waters, but only recently developed pans will be drained. In addition, some clogged existing ditches which have filled with sediments will be cleared, but only to the extent surface drainage can be achieved (generally a foot in depth or less). In all cases, both the minimum number and minimum depths and width will be used to enhance drainage. The purpose is to allow drainage while minimizing any increased volume of flow onto the surface. Runnels will be constructed using handtools such as pulaskis and shovels. Materials removed will be placed back on the marsh surface where they will not impede drainage. In some areas, a small excavator typically used for mosquito control ditch and pool creation will be used to create runnels and clear drainages. Use of small low pressure excavator will only be used in the Middlebridge and Pettaquamscutt Cove River Reaches. Poorly drained saltmarsh surfaces which will be targeted for treatment are shown in the following images by river reach (Figures D1-D5) and summarized in Table D1.

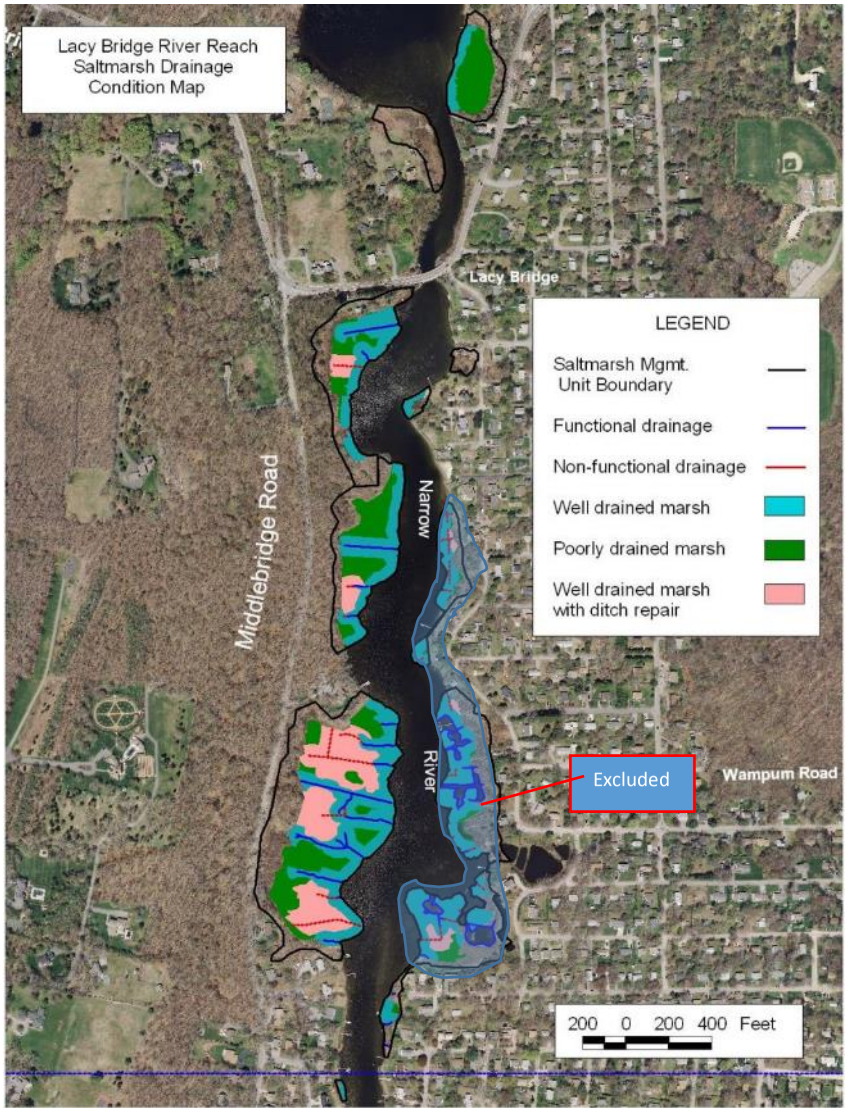
Management Constraints/Controls

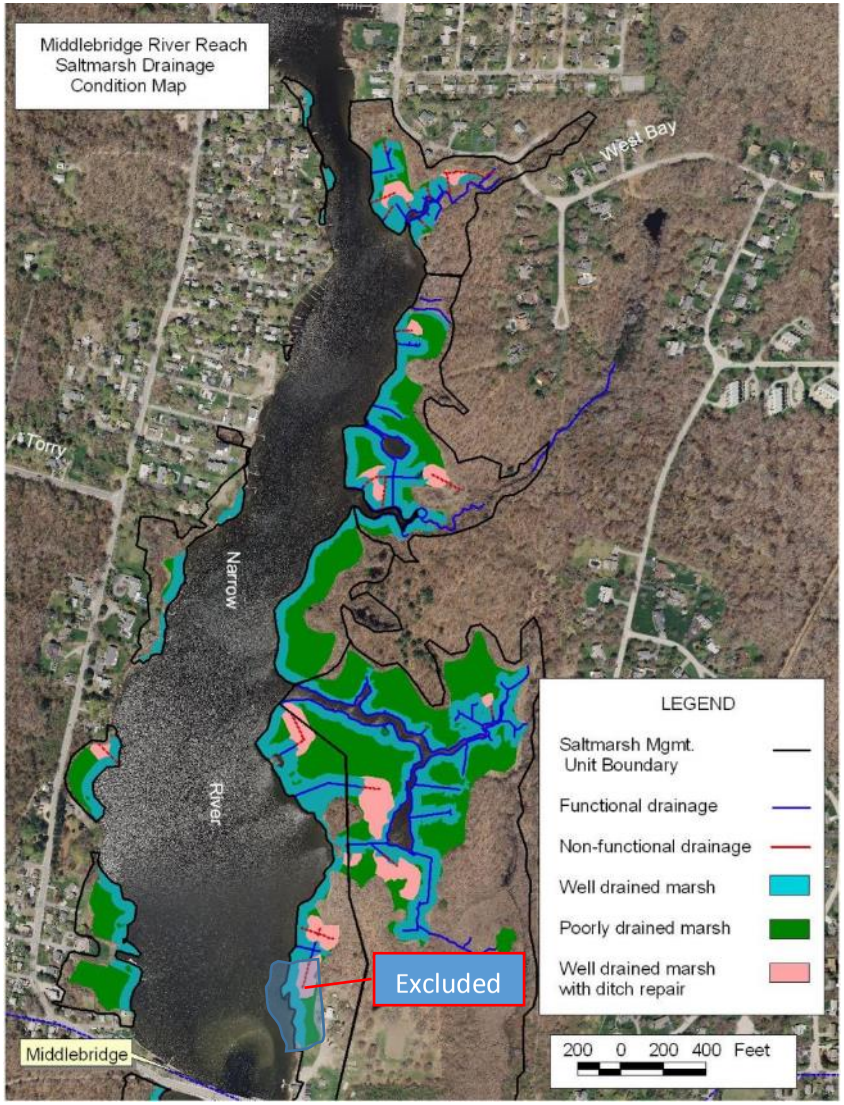
- Restoration on non-federal lands requires written landowner permission prior to any action.
- No historical pools or pans or brackish marsh will be drained, and they will be protected.
- Excavator use is limited to stable saltmarsh surfaces only.
- In locations where motorized, low pressure ground equipment is used, seasonal restrictions will limit activities outside of the May 1 – August 31 period to limit disturbance to nesting birds.
- In locations where manual runnel develop occurs, and where such use is concentrated in one area over a period of more than 1 day, seasonal restrictions will limit activities outside of the May 1 – August 31 period to limit disturbance to nesting birds.
- Runnel development North of Middlebridge, and near Canonchet will receive intensive monitoring. All sites will be inspected three times per year for a period of two years to evaluate whether the treatment is likely to meet intended objectives, whether maintenance is necessary, and the areas response to storm conditions.

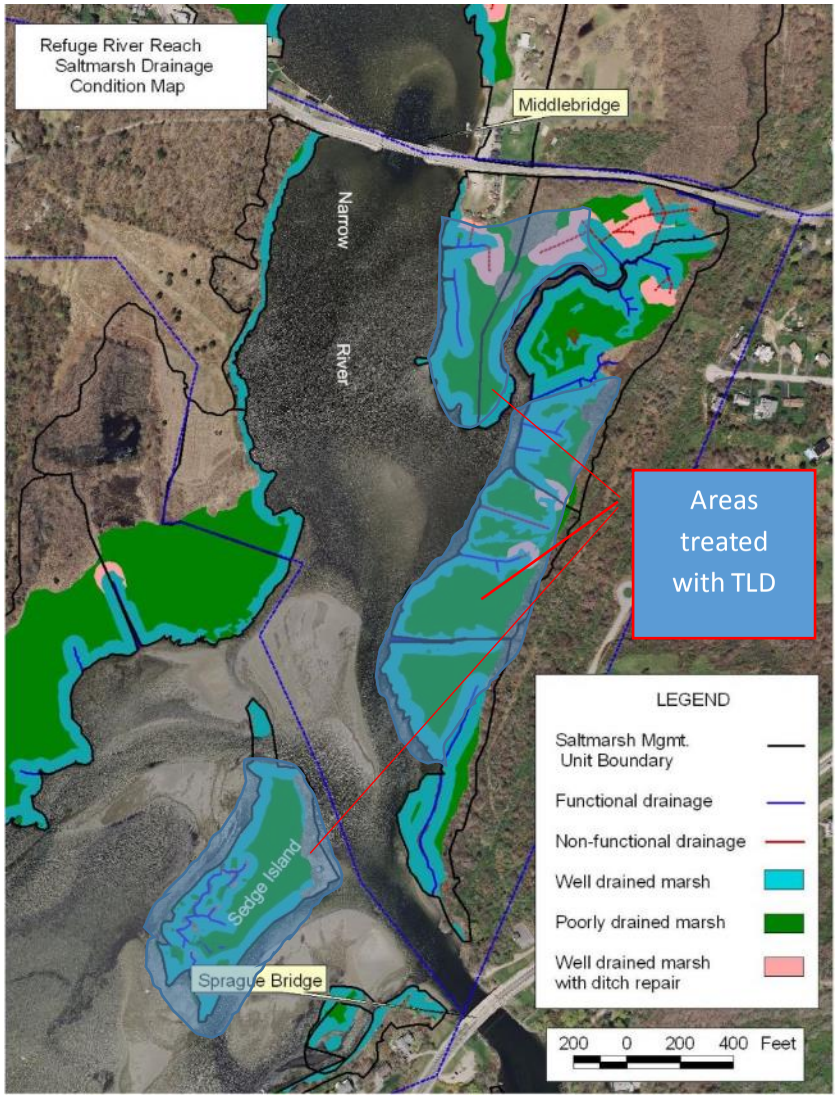
Table D1 . Areas for Saltmarsh Drainage Improvement (poorly drained and areas with clogged drainage).

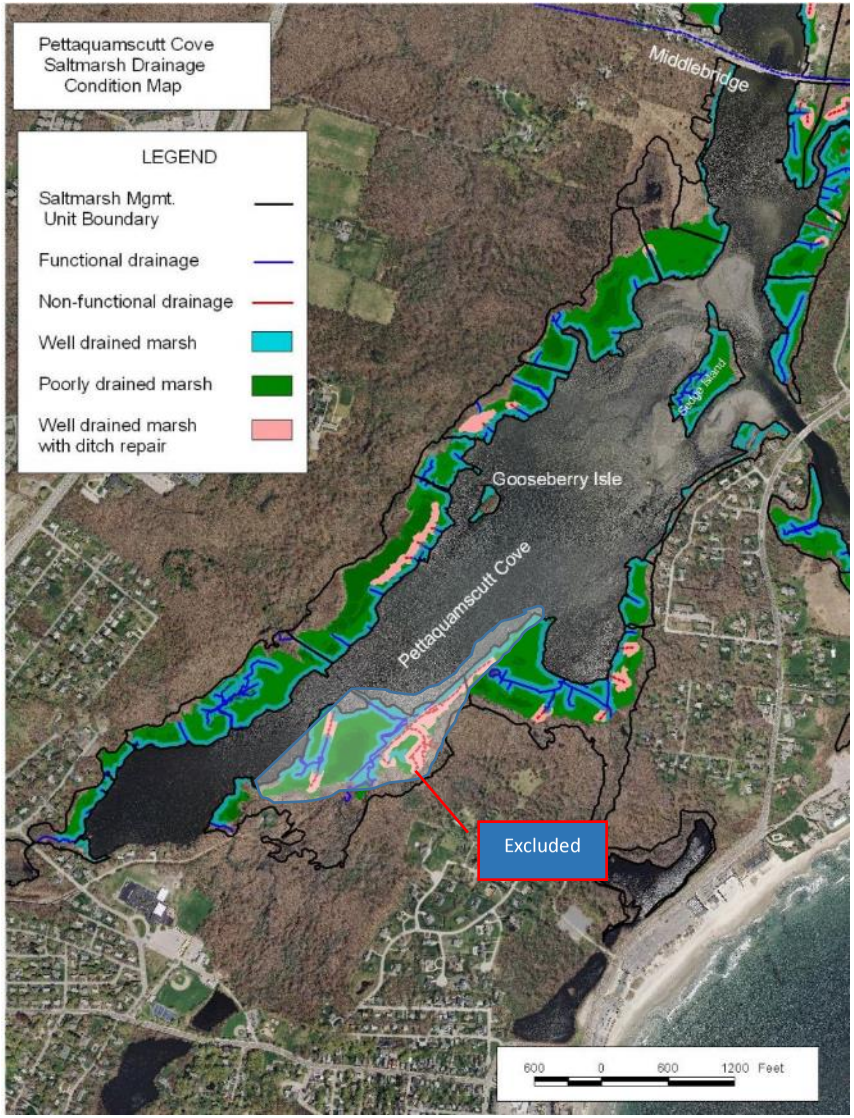
RIVER REACH	TOTAL ACRES	MARSH DRAINAGE (FT)			CONDITION OF MARSH SURFACE				SALTMARSH IMPACTED - CLOGGED DRAINAGE
		RIVER / MARSH SHORE LINE	DITCHES & SLOUGHS		WELL DRAINED SALT MARSH HABITAT		POORLY DRAINED SALT MARSH HABITAT		
			FUNCTIONAL	NON-	ACRES	%	ACRES	%	ACRES
LACY BRIDGE	15.2	8,628	6,003	2,281	11.4	75	3 (3.8)*	20	4(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	12 (14)*	38	3(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	27.8(34)*	32	3(8.0)*
REFUGE	24.8	5,640	7,035	1,810	12.1	49	0 (12.7)*	0	.5(1.8)*
TOTAL TREATED	174.0	57,122	51,803	10,020	105.4	61	46.9(68.6)	27	10.5(6.8)

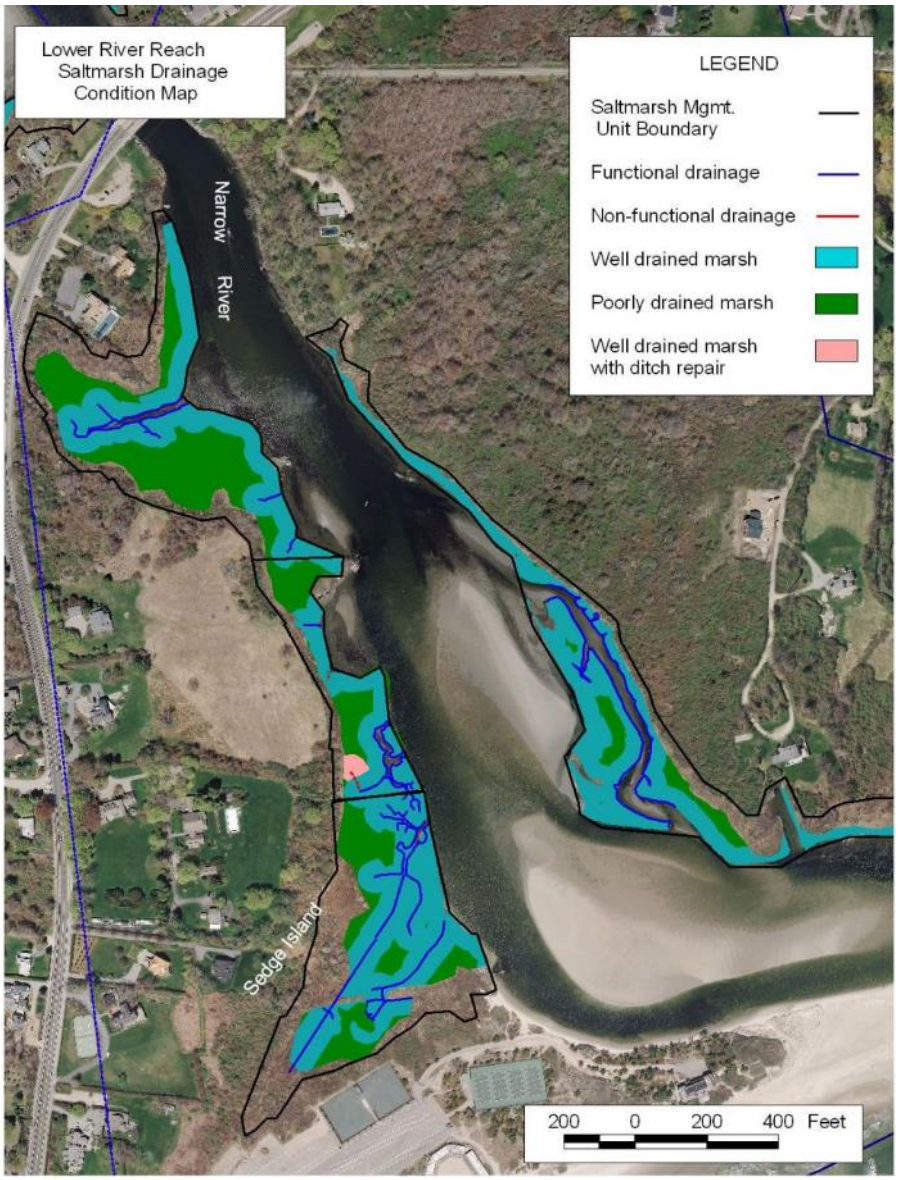
*/ Acres in Parenthesis are total poorly drained area, some areas excluded from treatment. Total of 46.9 treated (27%).


Lacy Bridge River Reach
Saltmarsh Drainage
Condition Map
Lacy Bridge
Middlebridge Road
Narrow
River
Wampum Road
Excluded
LEGEND
Saltmarsh Mgmt.
Unit Boundary
Functional drainage
Non-functional drainage
Well drained marsh
Poorly drained marsh
Well drained marsh
with ditch repair
200 0 200 400 Feet


Middlebridge River Reach
Saltmarsh Drainage
Condition Map
West Bay
Torry
Narrow
River
Middlebridge
Excluded
LEGEND
Saltmarsh Mgmt.
Unit Boundary
Functional drainage
Non-functional drainage
Well drained marsh
Poorly drained marsh
Well drained marsh
with ditch repair
200 0 200 400 Feet


Refuge River Reach
Saltmarsh Drainage
Condition Map
Middlebridge
Narrow
River
Areas
treated
with TLD
Sedge Island
Sprague Bridge
LEGEND
Saltmarsh Mgmt.
Unit Boundary
Functional drainage
Non-functional drainage
Well drained marsh
Poorly drained marsh
Well drained marsh
with ditch repair
200 0 200 400 Feet


Pettaquamscutt Cove
Saltmarsh Drainage
Condition Map
Middlebridge
LEGEND
Saltmarsh Mgmt.
Unit Boundary
Functional drainage
Non-functional drainage
Well drained marsh
Poorly drained marsh
Well drained marsh
with ditch repair
Gooseberry Isle
Pettaquamscutt Cove
Excluded
600 0 600 1200 Feet


Lower River Reach
Saltmarsh Drainage
Condition Map
LEGEND
Saltmarsh Mgmt.
Unit Boundary
Functional drainage
Non-functional drainage
Well drained marsh
Poorly drained marsh
Well drained marsh
with ditch repair
Narrow River
Sedge Island
200 0 200 400 Feet

ACTION D
RESORE LOW MARSH, DEGRADED MARSH, & INTERTIDAL ELEVATIONS

This action will create low marsh habitats and enhance elevations on saltmarsh surfaces to increase their resilience to sea level rise and improving their currently degraded habitat condition. Material generated from implementation of the eelgrass restoration (Action B) will be used here to achieve these objectives. Table D1 summarizes fill requirements and figure D1 displays the management units.

Rational for the Use of Thin Layer Deposition Techniques for Saltmarsh Enhancement

TLD Site Selection. An inventory of saltmarsh conditions was completed in the winter of 2013/2014 to detail current habitat conditions, which included broad scale vegetation community mapping and drainage conditions, saltmarsh surface drainage, and surface profiles (Appendix A). Long term vegetation monitoring data collected over the past five years (USFWS 2014) was also analyzed to determine trends in vegetation on the marsh surface, where those data were available. This information was compared to sea level rise projections (Appendix E), trends in habitat conditions by comparison to historical coastal surveys and older aerial photography, and to recent site specific studies in the estuary and Narragansett Bay (e.g. Watson and others 2014; Raposa and others (2014); Save the Bay, unpublished reports).

This information along with other data were supplied to a group of people knowledgeable of saltmarsh ecology, estuarine systems, and restoration techniques. This group, which included representatives from the US EPA, US ACOE, USDA NRCS, RIDEM, RICRMC, University of Rhode Island, Save The Bay and The Nature Conservancy, formulated restoration strategies which included the use of thin layer deposition as a method to enhance degraded saltmarsh conditions and to improve resilience to saltmarshes against sea level rise. This group advanced the notion of applying thin layer deposition to saltmarshes in the estuary, based in part on successful applications in other areas, such as Jamaica Bay in New York, and Pepper Creek in Delaware. Logistically, this could only be completed within the Refuge Reach of the River, the area between Middlebridge and Sprague Bridge, following discussions with RICRMC dredging experts. The units proposed under this action are the result of these planning efforts.

Determination of Goals. Elevation targets were assigned based on elevations where specific saltmarsh species currently occur. Since this saltmarsh community is considered inherently to be a high marsh given current surface elevations (Appendix D) and species composition, salt marsh hay (S. patens) and black grass (Juncus spp.) were identified as the target species for restoration. To target areas at higher elevations, such as those commensurate with the distribution of saltbush (I. fructescens) would increase risks of phragmites invasion of the saltmarsh surface, protection of brackish marsh would be difficult, and there had to be assurance that all elevations would be intertidal, e.g. that no wetland habitats would be lost. Additional conditions which were considered included the need to protect existing, productive stands of both low marsh (dominated by the tall form variant of S. alternaflora) and saltmarsh hay; protection of historical pools and pans, and conservation of brackish marshes.

Determination of Elevation Targets. Surface profile information, which included identification of species where elevations were taken (Appendix A), and the LIDAR evaluation of the estuary conducted by TNC (see figure 2 in EA), were used to generate initial estimates of elevation targets, in consultation with the team which identified restoration ideas to pursue. It became apparent that, as is the case in other saltmarshes, plant communities occurred at different elevations in different portions of the estuary, caused by such things as localized differences in tidal flow, drainage, water entrapment, and elevations. It appeared that clear associations could not be made to a specific elevation without refining the data available.

A professional land survey team, using RTK equipment, conducted an intensive survey of the area to determine current elevations, and collected data regarding dominant species occurrence at various points (n>900) throughout the saltmarsh. This information was bolstered by intensive mapping of the vegetation on marsh surfaces by the Service.

This mapping in combination with elevations revealed that (a) elevations and plant community arranged varied at higher elevations on the west side of the estuary than east; (b) the distribution black grass showed a distribution related to elevation, e.g. occurring only at higher elevations; and (c) the distribution of s. patens seemed dependent on both elevation and drainage (well drained areas within 50 feet of channels) in the estuary. This pattern was corroborated by Watson et al (2014) studying saltmarsh vegetation in Pettaquamscutt Cove.
Therefore, since the objective of this project is to provide elevation capital and resilience to sea level rise, targeted elevations are those where black grass occurs and in higher elevations where s. patons was dominant. The specific elevation target was determined on a unit by unit basis and for west side versus east side comparisons.
Target elevations by unit are shown in table D1. RTK elevations (NAVD88) and the results of vegetation mapping are shown figures D2 – D10. Note that in the vegetation surveys, unclassified stands are those with a co-dominance of s. alternaflora, distichlis, s. patons, and or salicornia. Degrade marsh are those areas dominated by short form variant of cordgrass, interspersed with stands of salicornia and bare soil (pans).

Operational Description

This action will be accomplished using small conventional construction equipment and multiple management controls in order to avoid negative impacts to estuarine and marsh habitats within the estuary. A temporary staging area will be installed with a gravel surface at the river access point on the Northwest Side of Sprague Bridge on National Wildlife Refuge Lands. A small, temporary floating dock will be installed at this location with temporary pilings and a simple access ramp. In order to minimize construction impacts from this work the Service intends to deploy small-scale mechanical, rather than hydraulic equipment to accomplish dredge and fill operations. All equipment and materials positioned and operated from floats in order to avoid equipment impacts on marsh surfaces.

In instances where a fill operation is adjacent to a dredge area, for example in deepening and moving the channel southeast of Sedge Island, the work will be accomplished through a simple sidecast operation, using an excavator on a float to dig the new channel, and to place the material in the old channel to be filled. Sediment re-suspension is expected to be minimal, due to the sandy nature of the material in these areas. Where needed, oyster shell bags or similar “living shoreline” materials will be used to contain the material that is being placed. Where sediments must be moved any distance from a dredge to a fill area, they will be placed in sealed containers on floats, and barged into position adjacent to application areas.

During the first construction season, expected to be winter, 2014-5, the Service will employ TLD at pilot scale in order to evaluate methods and results over the following year. Results of this experience will be used to refine and scale up methods during the second construction season, to ensure the intended restoration results are achieved with minimal impacts.

Where possible, application of materials will be accomplished through simple sidecasting, using an excavator positioned on a float. Where materials must be moved any distance from the dredging location to the application area, the Service’s contractor will place sediments from the dredging operation in small (approx. 20 cy) containers on floats, and float the materials into position adjacent to the application area. The sediments will be applied from the containers on the floats in order to avoid impacts on marsh surfaces. In restoring low marsh areas, where sediment application thicknesses will be 2-3 feet, the contractor will use oyster shell bags and coir logs as necessary to contain the applied sediments. Low marsh restoration areas will be planted with *S. alterniflora* and *D. spicata* on a *30”x30”*spacing or less where needed.

To restore degraded high marsh elevations, the Service's contractor will apply thin layers of liquefied dredged material from the floating containers onto the surface of the marsh within narrowly targeted areas. To achieve designed elevations, the contractor will position coir logs around the perimeter of restoration areas, set to target elevations. In most areas, it is expected that TLD thickness will be approximately 4-6 inches, with a maximum application thickness of approximately one foot. The contractor will also position coir logs within the restoration areas, to mimic the form of shallow natural tidal channels. The contractor will then pump or spray the sand, liquefied with a high water content, into the application area until target elevations are reached. The coir logs around the perimeter will contain the sediments and prevent sedimentation of non-target areas, while the coir logs within the restoration area will create surface drainage patterns within it. It is expected that a 4-6" pipe will be adequate for applying the dredged material.

Stable benchmarks and survey equipment will be used to ensure that target elevations are achieved, and elevational monitoring over the following year will measure compaction and establish any need for further applications of TLD. Application areas will be surveyed using RTK survey equipment to establish target elevations, and will use on-site sediment controls contain TLD sediments to target areas. Relatively thin applications will be sufficient to spur re-vegetation; TLD target thicknesses will range from a minimum of 1-3", to a maximum of 9". Areas of application greater than 3" will be replanted with native marsh species such as *Spartina alternaflora* and *Distichlis spicata.*

Within and adjacent to treated areas, hay bale swales will be installed every 200 feet within existing drainages at half of the bank height to retain sediments on site. Within treatment areas, coir logs or similar will be used and installed in a drainage pattern to retain materials sprayed on the marsh. These materials will essentially compartmentalize the treated area, where application can proceed from one compartment to the other. Survey equipment will be used to monitor whether target elevations are met. Once material has settled, the coir logs will either be removed or retained in place, as site-specific conditions dictate, to provide long-term drainage patterns on the marsh surface.
Based on applications in other areas, materials once placed on the area will be expected to settle and compact over time. Initial applications will apply material so as to accommodate this settlement, and monitoring will help insure appropriate amounts of materials will be applied to best achieve target elevations.

This action is subject to the following management controls:

- Engineering designs, approved by CRMC will be finalized and followed to insure widths, depths, and slopes are not exceeded.
- Placement of materials will occur only during the approved dredging seasons, typically November 15 - January 31;
- Receipt of all required permit requirements (see EA Sec. 6.3);
- Tree clearing at the staging area will be kept to the minimum necessary; all trees will be provided protection (wooden slats) during the construction period.
- The staging area will be regularly inspected for environmental compliance for erosion control, hazardous material containment, public safety, and other items.
- Gravel placed to develop the site will be removed, topsoil will be used to resurface the area, with native vegetation re-established on the site, including grasses, shrubs, and trees.
- Existing paths at Sprague Bridge used by the public will be kept in an open condition from March 30 through November 1 each year to the extent possible.
- Temporary docks placed in the River will be removed no later than March 15 and will not be reinstalled any earlier than October 30 each year.
- Regular inspections of the lay down area, including erosion control devises, standards for HAZMAT containment and control, and other contractual requirements will be made on a regular basis at the staging/laydown area.
- All materials placed at the staging/laydown area will be removed, with topsoil no less than six inches in depth applied and seeded/planted with a mixture of native grasses, forbs, and 2+ year shrubs.

- In order to avoid impacts to estuarine fish and wildlife and recreational uses, this dock will be placed no early than October 15, and removed by March 15 each year.
- The Pepper creek monitoring program used in Delaware will be modified for use here to evaluate how TLD applications have effected below ground and above ground features of the saltmarshes and vegetation. Data collected from treatment sites will be compared to information from control sites. Nekton Sampling will occur in adjacent pools and drainages, and compared to control sites. Vegetation monitoring will occur for a period of five years.

Figure D1. Management Units (3-8, 18, 19) for restoring low marsh and enhancing elevation capital using TLD.

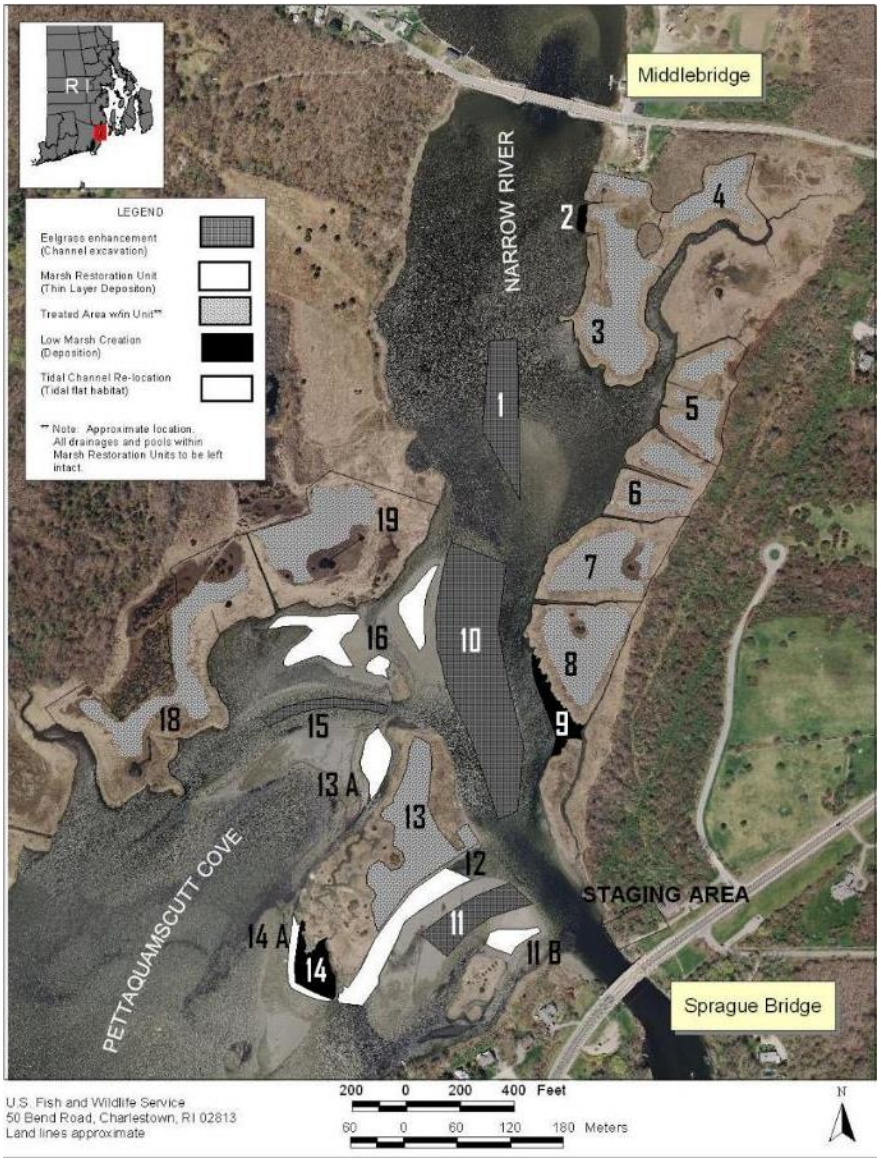
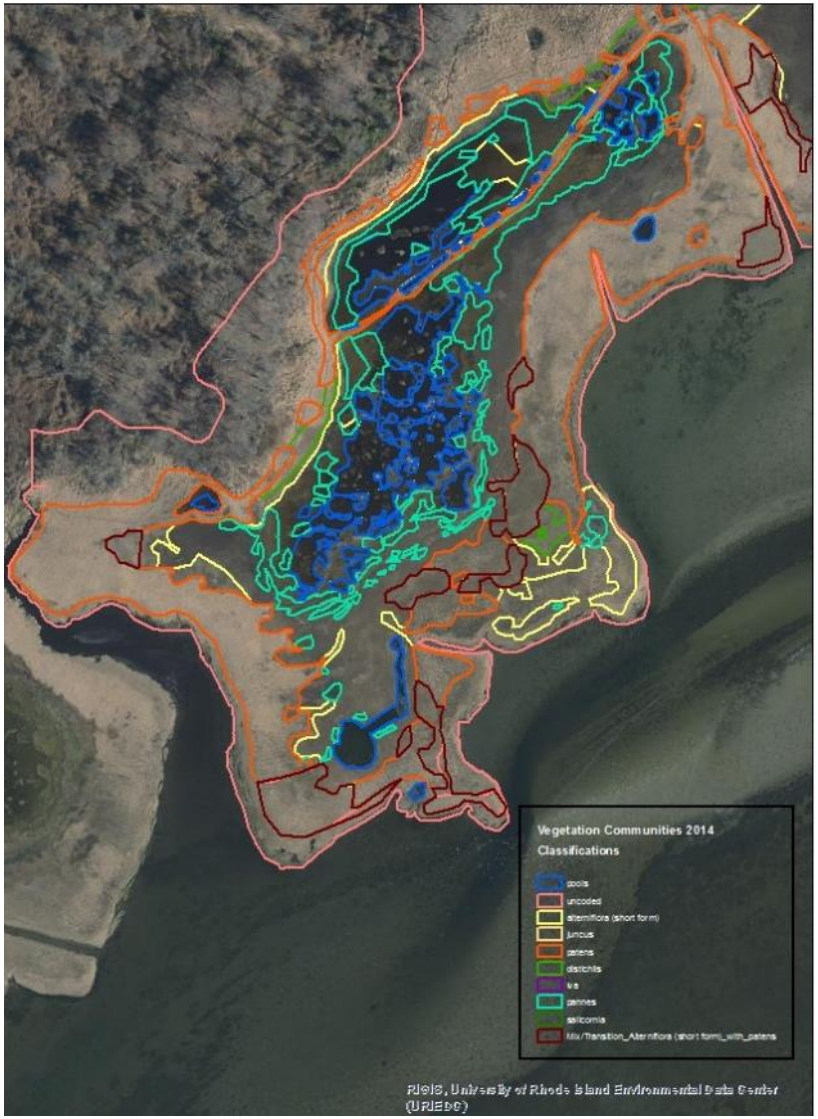


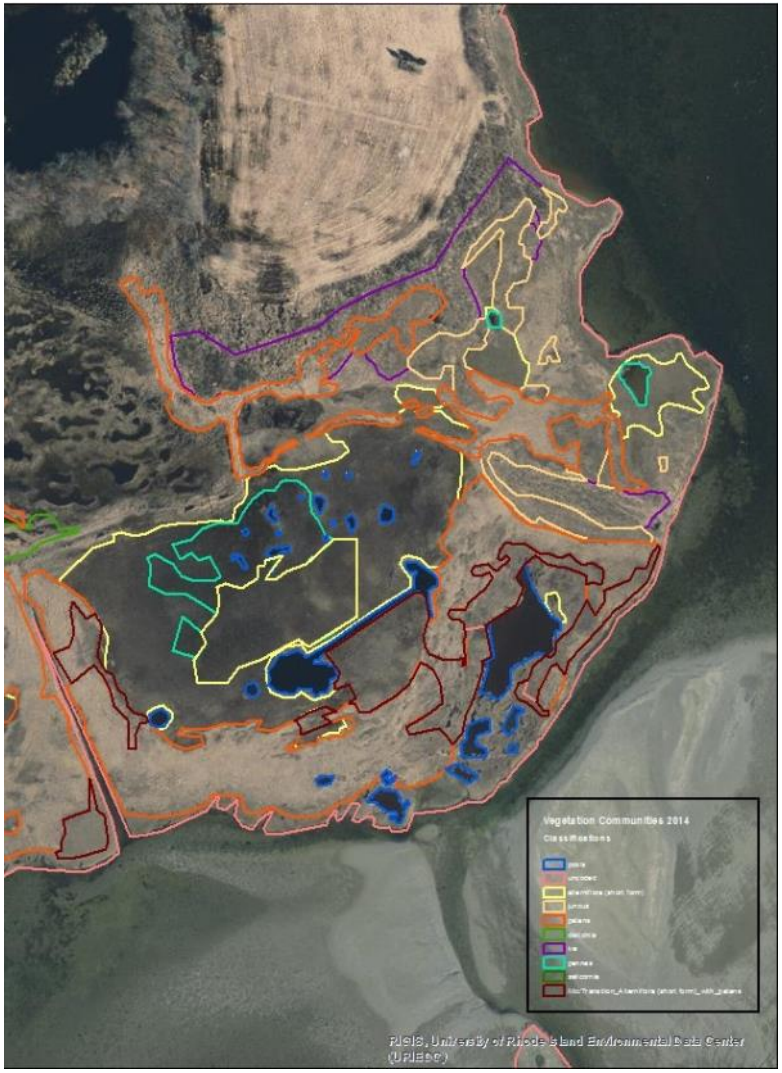
Table D1. Summary of Excavation and Fill Requirements for proposed Actions.

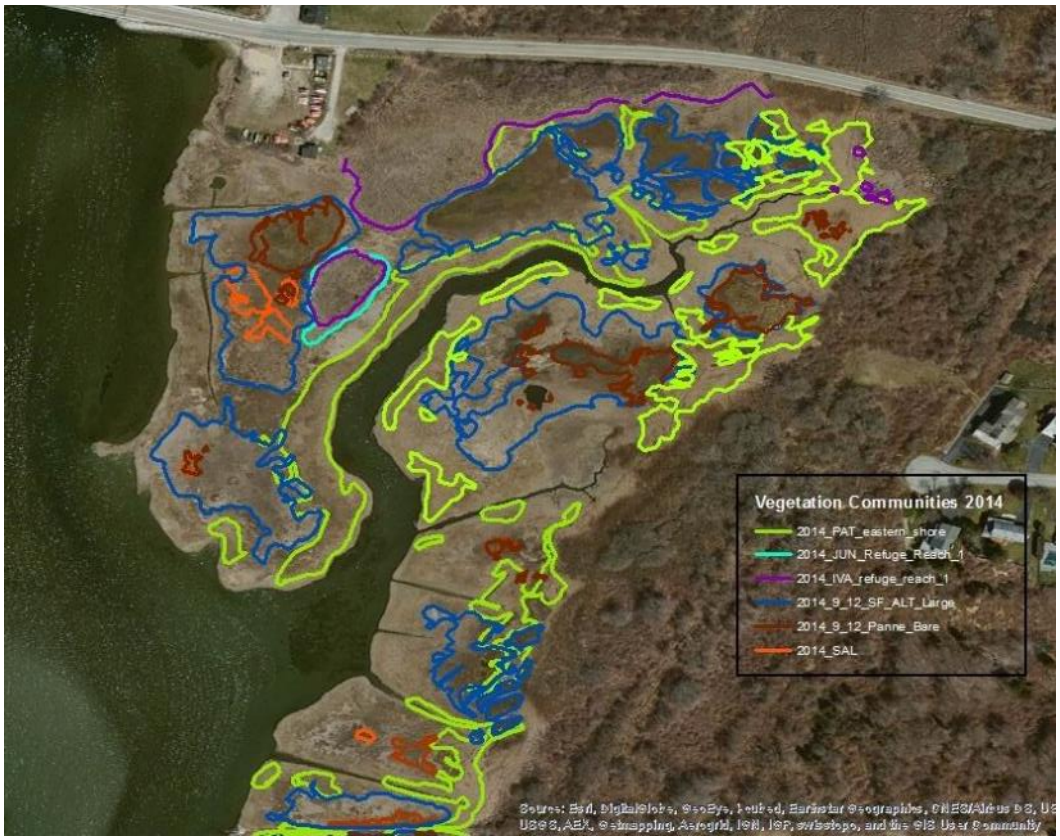
UNIT	GOAL	TREAT-MENT	CURRENT CONDITIONS						PROPOSED CONDITIONS						NOTES
			AREA (SQ. FT.)	AREA (ACRES)	WETTED AREA ABOVE -2FT (1)	WETTED AREA BELOW -2FT (2)	TOTAL WETTED AREA (ACRES)	AVERAGE ELEV / DEPTH (FT)	TARGET ELEV / DEPTH (FT)	EXCAVATE VOLUME (CYD)	FILL VOLUME (CYD)	WETTED AREA ABOVE -2FT	WETTED AREA BELOW -2FT	CHANGE IN WETTED AREA (ACRES)	
1	Eelgrass	Excavate	56,618	1.3	58,469	0	1.34	-1.25	-3.00	3,669.7		0	56,618	-0.04	
2	Low Marsh	Fill	3,015	0.1	n/a	n/a		-1.40	0.85		326.6				
3a	Marsh	Fill	85,930	2.0	n/a	n/a		1.25	1.55		1,241.2				
3b	Marsh	Fill	10,734	0.2	n/a	n/a		1.10	1.55		232.6				
4	Marsh	Fill	32,754	0.8	n/a	n/a		1.20	1.55		552.0				TLD only with clearence for saltmarsh sparrows.
5a	Marsh	Fill	39,017	0.9	n/a	n/a		1.25	1.60		657.5				
5b	Marsh	Fill	26,229	0.6	n/a	n/a		1.10	1.60		631.4				
6a	Marsh	Fill	16,382	0.4	n/a	n/a		1.10	1.55		354.9				
6b	Marsh	Fill	12,675	0.3	n/a	n/a		1.10	1.55		274.6				
6c	Marsh	Fill	8,149	0.2	n/a	n/a		1.10	1.55		176.6				
7a	Marsh	Fill	4,861	0.1	n/a	n/a		1.20	1.60		93.6				
7b	Marsh	Fill	50,277	1.2	n/a	n/a		1.00	1.60		1,452.4				
8	Marsh	Fill	67,454	1.5	n/a	n/a		1.00	1.60		1,948.7				
9	Low Marsh	Fill	20,410	0.5	n/a	n/a		-1.45	0.85		2,260.2				
10	Eelgrass	Excavate	194,235	4.5	197,179	2,944	4.59	-0.50	-4.00	25,510.4		2112	179,520	-0.42	Sideslope of 5:1 on western side.
16a	Tidal Flat	Fill	36,269	0.8	36,269	0	0.83	-0.30	0.40		1,222.4				
16b	Tidal Flat	Fill	4,969	0.1	4,969	0	0.11	-0.30	0.40		167.5				
16c	Tidal Flat	Fill	19,208	0.4	19,208	0	0.44	-0.30	0.40		647.4				
11	Eelgrass	Excavate	39,462	0.9	39,842	200	0.92	0.00	-4.00	5,156.4		1552	40,352	0.04	Sideslope of 3:1
11A	Tidal Flat	Fill	11,288	0.3	11,288	0	0.26	0.00	0.35		190.2				
12	Tidal Flat	Fill	47,496	1.1	47,496	0	1.09	-5.50	0.35		13,378.0				
13	Marsh	Fill	99,093	2.3	1,016	0	0.02	1.26	1.60		1,622.2				
14	Low Marsh	Fill	24,181	0.6	n/a	n/a		-1.45	0.85		2,677.8				
14A	Tidal Flat	Fill	9,757	0.2	9,757	0	0.22	-0.30	0.40		328.8				
13a	Tidal Flat	Fill	18,456	0.4	18,456	0	0.42	-0.30	0.40		622.0				
15	Eelgrass	Excavate	16,687	0.4	16,687	0	0.38	-1.00	-3.00	880.5		1724	1640	-0.31	Sideslope of 3:1 on western side.
18	Marsh	Fill	74,882	1.7	n/a	n/a		1.45	1.70		901.4				TLD only if runnels will not work.
19	Marsh	Fill	74,524	1.7	n/a	n/a		1.45	1.70		897.0				TLD only if runnels will not work.
17	cobble 1	Excavate	12,612	0.3	1,016	0	0.02	-0.50	-3.00	1,120.6				0.02	Current cobble/rock
17a	cobble 2	Fill	1,351	0.0	0	0	0.00	-2.00	0.00		130.1	1351		0.03	Change in sand/cobble/rock
17b	cobble 2	Fill	10,734	0.2	0	0	0.00	-2.00	0.00		1,033.6	10734		0.25	Change in sand/cobble/rock
TOTALS (AC):			25.93	25.93	10.60	0.07	10.67	-1.99	10.55	36,337.6	34,021.0	0.40	6.38	-0.43	

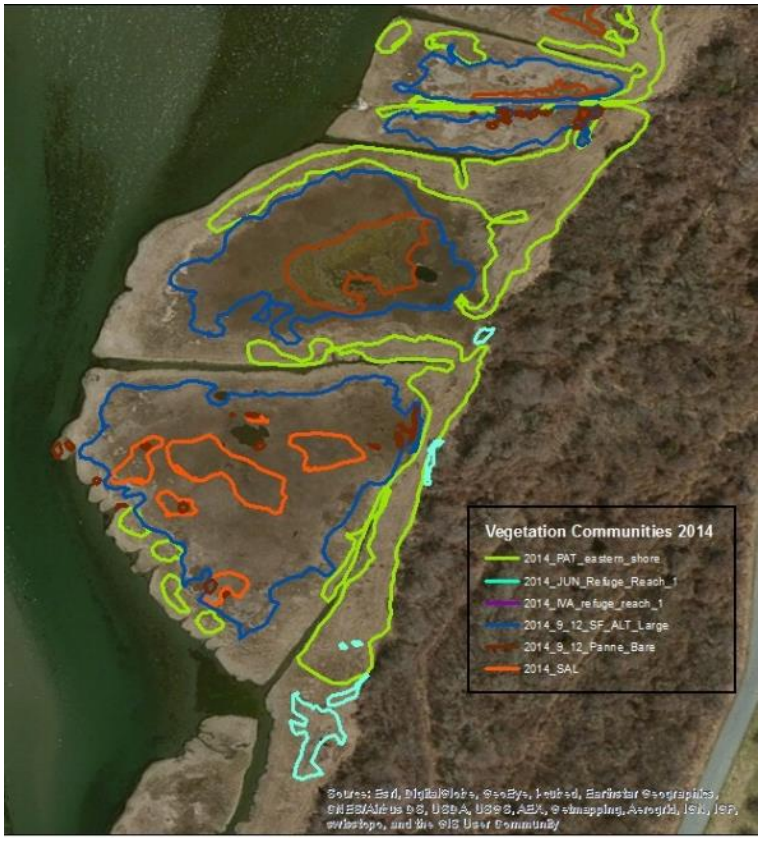
Figures D2-D3. Vegetation and RTK Data for Unit 18.



Figures D4-D5. Vegetation and RTK Data for Unit 19.



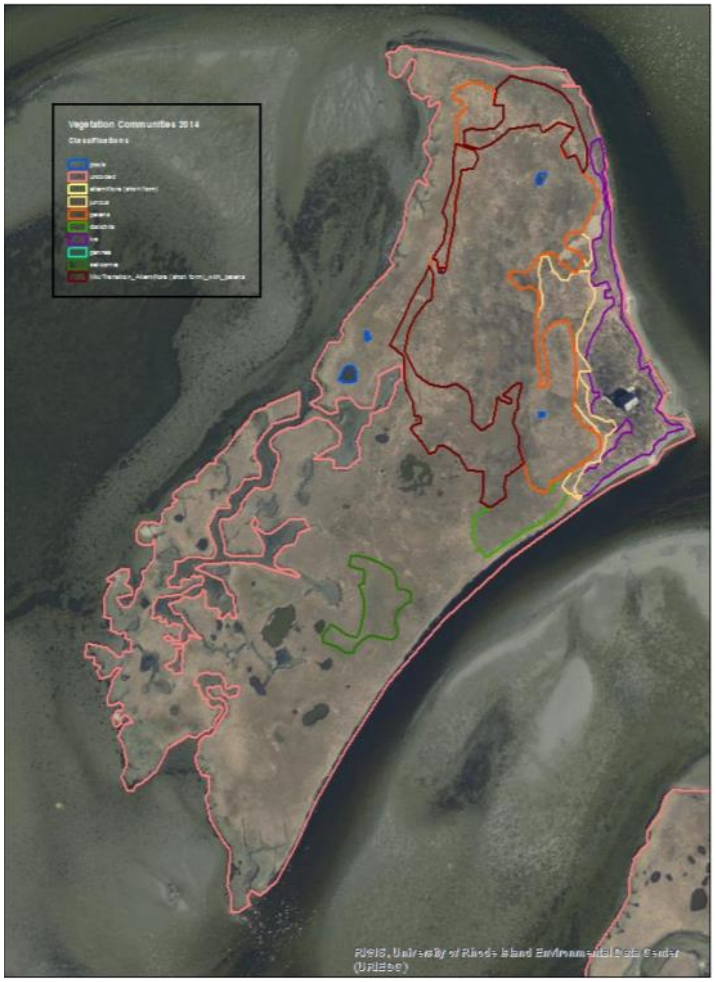




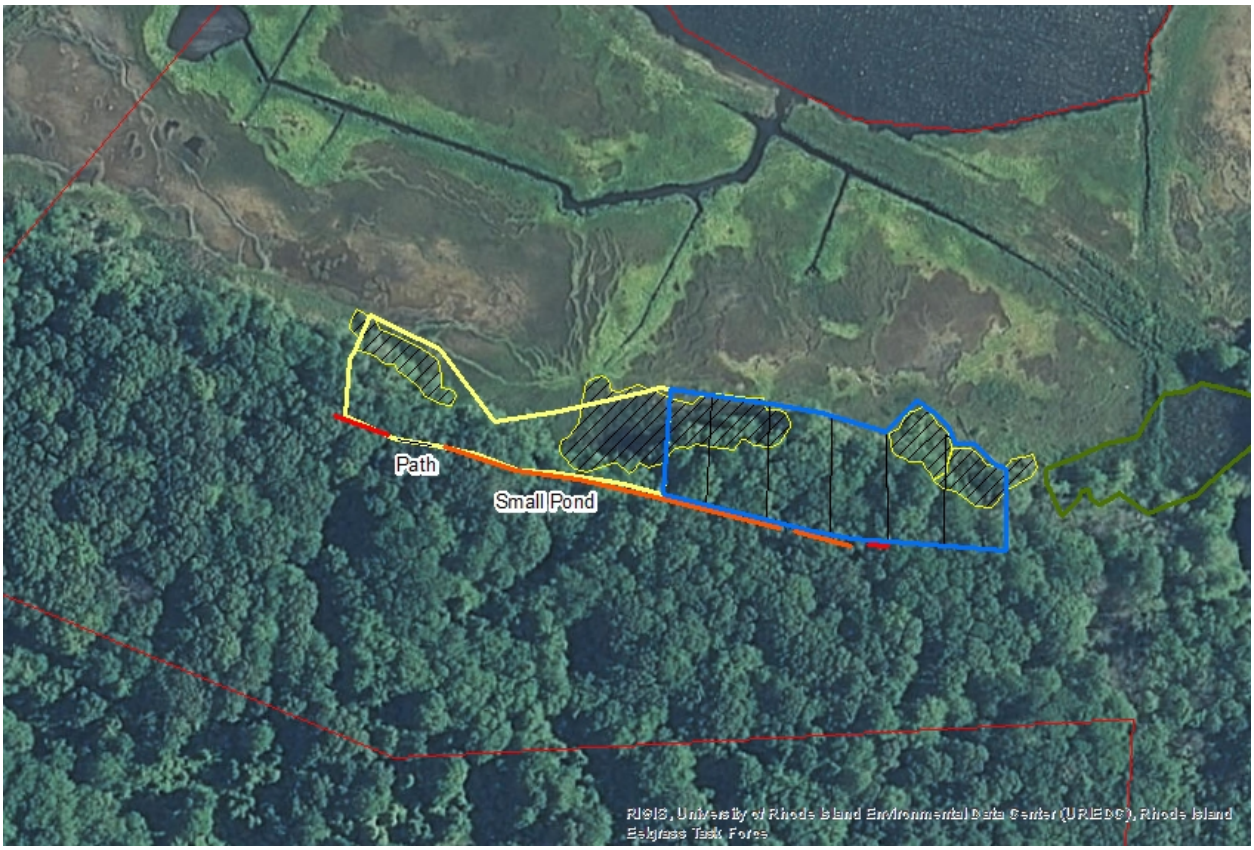
Figures D6-D7. Vegetation Data for Units 3-5.

Figure D8. RTK Data for Units 3-5.

Figures D9-D10. Vegetation and RTK Data for Unit 13.



ACTION F

TEST TREATMENTS TO ENHANCE MARSH MIGRATION

Within a two acre site currently comprised of an oak forest overstory near saltmarsh transition zones, trees will be girdled to stimulate shrub production in the understory. Adjacent control sites in untreated oak forest neat the saltmarsh transition zone will be evaluated and compared to determine whether this treatment has the potential to enhance conditions for saltmarsh migration. Within areas in blue in the figure below, approximately 24 trees will be girdled to allow understory release and determine whether this action facilitates marsh migration.