
U.S. Fish & Wildlife Service
An Inventory of Coastal Wetlands, Potential Restoration Sites, Wetland Buffers, and Hardened Shorelines for the Narragansett Bay Estuary
UMASS
UNIVERSITY OF Rhode Island
An Assessment Report from the National Wetlands Inventory Program

An Inventory of Coastal Wetlands, Potential Restoration Sites, Wetland Buffers, and Hardened Shorelines for the Narragansett Bay Estuary

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Note: In the Appendices, there are also four tables for each town (Appendix A for Rhode Island towns and Appendix B for Massachusetts towns, with towns listed alphabetically - see *Table of Contents* for town listing): Table 1 - Extent of coastal wetlands and related features; Table 2 - Potential wetland restoration sites; Table 3 - Extent of hardened shorelines; Table 4 - Land use/cover in the 500-foot buffer surrounding tidal wetlands.

Introduction

The Narragansett Bay Estuary Program's (NBEP) goal is to protect and preserve Narragansett Bay through conserving and restoring natural resources and enhancing water quality. NBEP accomplishes this through a variety of projects, including interagency partnerships and community involvement.

In 1998, NBEP identified coastal wetland restoration mapping as a priority for data collection. The U.S. Fish and Wildlife Service (FWS) and the University of Massachusetts (UMass) working together through a cooperative agreement had helped the State of Massachusetts develop a watershed-based approach to identify and classify potential wetland restoration sites using photointerpretation techniques and field investigations. The NBEP wanted to apply this type of approach to the Narragansett Bay Estuary and entered into an agreement with the FWS to conduct an inventory of estuarine wetland restoration sites with technical support from UMass. While securing the state grant funding for the project, the NBEP formed partnerships with Save the Bay, Inc. and the University of Rhode Island (URI) Environmental Data Center. Save the Bay, Inc. provided matching grant financial support through dedicating staff time to this project and other restoration initiative actions in the Bay. The URI performed the geographic information system (GIS) services and developed the project data and maps. The NBEP will use the results of this inventory as planning tools for developing a comprehensive and coordinated Bay-wide coastal habitat restoration plan. This plan will serve as a model for the State for similar initiatives in the future.

This report presents the results of this multi-agency cooperative project. It summarizes data for the entire estuary, with tabular results for each town given in the Appendices.

Study Area

The Narragansett Bay Estuary is a 147-square mile coastal embayment that dominates the Rhode Island landscape (Figure 1). It is the receiving basin for seven major watersheds in Rhode Island and Massachusetts including the Blackstone, Moshassuck, Pawtuxet, Taunton, Ten Mile, Warren, and Woonaquatucket. These watersheds cover 1,600-square miles, with 60% of the area occurring in Massachusetts. The estuarine (tidal) area of the Bay encompasses 18 municipalities in Rhode Island and 8 in Massachusetts (Table 1). For the coastal wetland restoration project, the study area was defined by the limits of tidal brackish waters and bay geomorphology (shallow water zone; Figure 2). Approximately 540 miles of shoreline were examined (Huber 2000).

Figure 1. Approximate limits of the Narragansett Bay watershed.

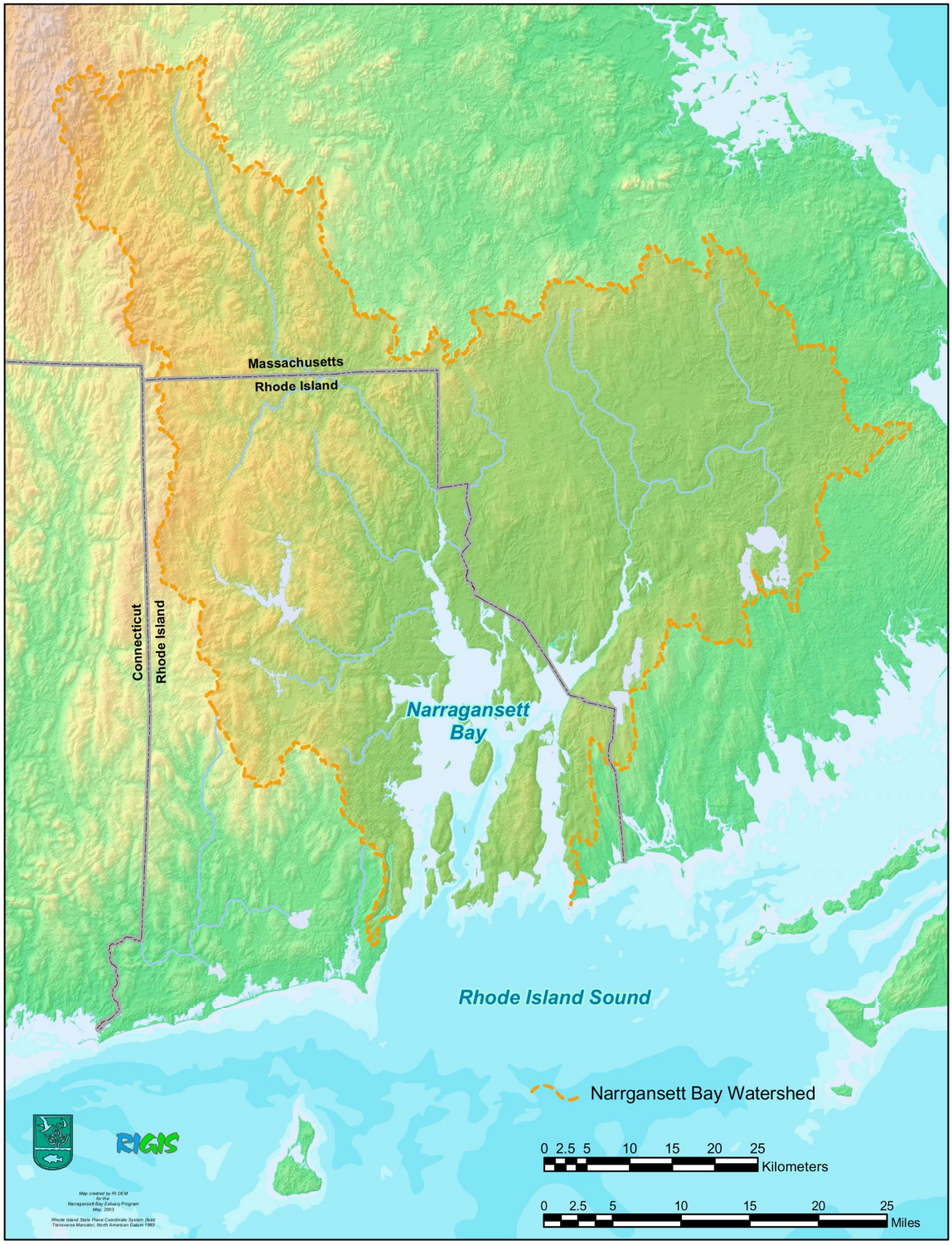

Figure 2. Location of the Narragansett Bay Estuary (study area dark gray-shaded).

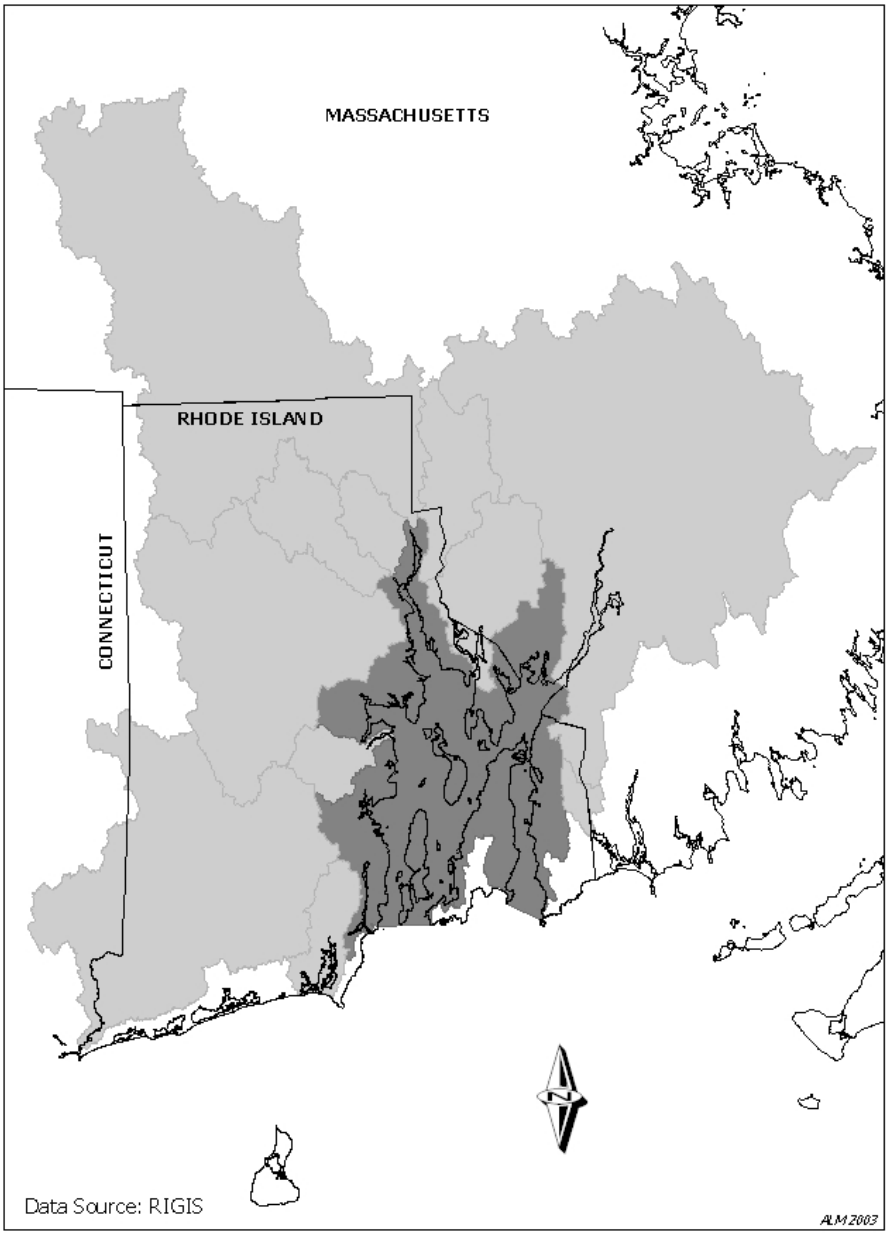

Table 1. Cities and towns in the Narragansett Bay estuarine wetland restoration project area, with their land area in this project area (i.e., within the 500-foot buffer around estuarine wetlands) given.

State	City/Town	Town Acres	Study Area Acres	% in Study Area	% of Study Area
Rhode Island					
	Barrington	5,574.6	1,561.9	28%	6%
	Bristol	6,430.0	1,286.1	20%	5%
	Cranston	18,549.3	155.8	1%	1%
	East Greenwich	10,443.2	91.5	1%	<1%
	East Providence	9,018.3	1,145.4	13%	4%
	Jamestown	6,608.4	1,797.7	27%	7%
	Little Compton	14,534.0	546.7	4%	2%
	Middletown	8,519.0	697.3	8%	3%
	Narragansett	10,021.3	1,461.0	15%	6%
	Newport	5,374.4	1,396.9	26%	5%
	North Kingstown	28,460.2	2,367.9	8%	9%
	Pawtucket	5,680.7	181.9	3%	1%
	Portsmouth	15,395.9	3,180.7	21%	12%
	Providence	12,041.5	785.1	7%	3%
	South Kingstown	38,777.3	341.3	1%	1%
	Tiverton	19,501.8	1,330.7	7%	5%
	Warren	4,535.0	839.7	19%	3%
	Warwick	23,248.9	2,681.1	12%	10%
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	Total	242,714.0	21,848.8		
Massachusetts					
	Berkley	10,622.7	528.4	5%	2%
	Dighton	14,274.1	281.8	2%	1%
	Fall River	24,768.7	579.3	2%	2%
	Freetown	22,762.8	796.4	3%	3%
	Rehoboth	30,371.2	323.0	1%	1%
	Seekonk	11,919.9	124.6	1%	<1%
	Somerset	5,376.7	920.7	17%	3%
	Swansea	15,100.0	1,062.4	7%	4%
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	Total	135,196.1	4,616.6		

Methods

Data Compiliation

Conventional photointerpretation techniques were used to identify and map the following features: potential estuarine wetland restoration sites, external sources of degradation, land use/land cover within 500-foot buffer around all estuarine wetlands, and hardened shorelines. The primary source imagery was 1:40,000 true color photographs acquired on August 11, 1996, with 1:12,000 true color photography acquired on July 6, 1996 serving as collateral data. Base data for estuarine wetlands was derived from this imagery previously by UMass's Natural Resources Assessment Group (NRAG) and the Rhode Island Department of Environmental Management's GIS Program (Huber 1999, 2000; Narragansett Bay Estuary Program 2001) and compiled in digital form by URI's Environmental Data Center (EDC).

Photointerpretation was performed using mirror stereoscopes. Interpreted data for restoration sites and buffers were delineated by pen and ink on mylar overlays registered to the 1:40,000-scale photos, with 1:12,000 photos viewed when needed (e.g., small Phragmites stands). Hardened shorelines were interpreted from the 1:12,000 photos and transferred directly to 1:24,000 frosted mylar base maps (prepared by URI) by a stereo zoom transfer scope (ZTS). Wetlands and deepwater habitats were classified according to Cowardin et al. (1979), the national digital data standard for wetlands. For this study, coastal wetlands include Cowardin's marine and estuarine intertidal wetlands - tidal wetlands with measureable traces of ocean-derived salts. A modification of Anderson et al. (1976) was used to classify land use/cover in the 500-foot buffer surrounding estuarine wetlands (Table 2). Potential estuarine wetland restoration sites were assigned to specific categories within two broad types: Type 1 - former estuarine wetlands (sites for increasing estuarine wetland acreage) and Type 2 - degraded estuarine wetlands (existing coastal wetlands whose functions may be improved through restoration). Type 1 sites were separated into two major categories:1) filled and effectively drained sites (Type 1A) and 2) submerged sites or palustrine wetlands that were formerly estuarine wetlands (Type 1B). Potential external impacts to Type 1B sites were also identified. Type 2 sites were subdivided into two broad categories: 1) sites with internal alterations (e.g., tidal restrictions, ditching, diking, excavation, vegetation changes, and minor filling) and 2) estuarine wetlands that may be threatened by off-site activities. Table 3 lists specific categories of potential restoration sites. Hardened shorelines were classified according to categories developed for this study (Table 4). For linear shores, interpretations were made on 1:12,000 photos. See Huber (2000) for a more detailed explanation of photointerpretation methods. Target mapping units for this project were: 1) 0.5 acre for land use/cover in the buffer zone, 2) 0.5 acre for potential coastal wetland restoration, 3) 0.25 acre for common reed stands, 4) approximately 125 linear feet for restoration site perimeters, and 5) 125-250 linear feet for hardened shorelines.

Upon completion of the photointerpretation, data on mylar overlays were transferred to 1:24,000 frosted mylar map bases (prepared by URI) using a ZTS. Point locations of field sites were also transferred to these bases.

Table 2. Land use/cover categories for the 500-foot buffer (modified from Anderson et al. 1976).

Level 1	**Level 2**	**Level 3**
1 Urban or Built-up Land	11 Residential	111 Single Family
		112 Multi-family
		113 Mobile Home Parks
		114 Lawns (includes non-residential lawns)
		115 Other (e.g., military barracks)
	12 Commercial and Services	121 Commercial and Institutional Structures (plazas, malls, schools, universities, military bases)
		122 Recreational structures (e.g., beach pavilions, water slides)
		123 Marinas
		124 Junkyards
		125 Paved surfaces associated with commercial and services
		126 Unpaved surfaces (sandy parking lots in beach areas)
		127 Wharves, piers & shipyards
	13 Industrial	
	14 Transportation, Communications&Utilities (includes lighthouses) (for roads, map 4-lane highway corridors; no 2-lanes)	
	15 Industrial & Commercial Complexes	
	16 Mixed Urban or Built-up Land	
	17 Other Urban or Built-up Land	171 Golf courses
		172 Cemeteries
		173 Other (zoos, urban parks, ski areas, forts)
		174 Landfills

Table 2 (continued).

Level 1	Level 2	Level 3
2 Agricultural	21 Cropland	
	22 Orchards, Nurseries, Vineyards, Ornamental Horticulture	
	23 Confined Feeding Operation	
	24 Pasture and Hayfields	
	25 Other	
3 Rangeland	31 Herbaceous Cover	
	32 Shrub and Brush Cover	
	33 Mixed	
4 Forest	41 Deciduous Forest Cover	
	42 Evergreen Forest Cover	
	43 Mixed	
5 Water, and 6 Wetlands	56 Any water or wetland polygon Use Cowardin (1979) for freshwater wetlands in the buffer zone**	
7 Barren Land	71 Dry Flats	
	72 Beaches (classified under Cowardin, 1979)	
	73 Sand Areas other than Beaches (dunes, backdunes) (Note: Dunes were mapped on original wetlands layer as "D")	
	74 Bare exposed rock	
	75 Strip Mines, Quarries and Gravel Pits	
	76 Mixed Barren Land	
	77 Transitional Areas	

Table 3. Potential estuarine wetland restoration site types and coding used for the Narragansett Bay Estuary.

Restoration SiteType	Code	Impact Type
1 (former estuarine wetland)	1f	Fill
	1fph	Fill/Phragmites-dominated
	1fsp	Fill/Dredged Spoil
	1d	Effectively Drained
	1su	Submerged
	1w	Palustrine Wetland (former estuarine wetland)
	1x	Excavated or Impounded Fresh Waterbody (former estuarine wetland)
2 (existing estuarine wetlands that are or may be degraded)	2r	Tidally Restricted
	2rs	Severely Tidally Restricted
	2d	Significantly Ditched
	2h	Diked/Impounded
	2f	Minor Filling
	2fs	Minor Filling/Dredged Spoil
	2v	Vegetation Change (also includes Phragmites-dominated estuarine wetlands)
	2vi	Vegetation Change/Iva
	2x	Excavated

Table 4. Categories of hardened shorelines identified for the Narragansett Bay Estuary.

Map Code	Hardened Shoreline Type
BA	Bridge Abutment
BK	Bulkhead
BW	Breakwater
GR	Groin
JT	Jetty
OHS	Other Hardshore
OSP	Other Significant Pier
PP	Permanent Pier
RR	Revetment

Field Investigations

Field studies were performed to collect vegetation data on reference wetlands within four categories of disturbance: 1) undisturbed/relatively undisturbed, 2) moderately disturbed, 3) severely disturbed, and 4) severely tidally restricted. Factors considered in assigning reference sites to these classes included presence of disturbance agents, the estimated severity of the disturbance, and the presence or absence of vegetation in buffer zones. The first category included wetlands free from human disturbance (internal and external) and wetlands with woody vegetation along most of their boundary. The degree of ditching was considered in rating wetlands as relatively undisturbed or moderately disturbed. The number and condition of ditches, the extent of hightide bush (Iva frutescens), and presence of other disturbance factors were used subjectively evaluated. Moderately disturbed sites generally included those with a single impairment, such as significant ditching or habitat fragmentation, and lacking a significant vegetative buffer. Tidally restricted wetlands without significant stands of common reed (Phragmites australis) were also categorized as moderately disturbed. Severely disturbed sites had multiple sources of impairment. Severely tidally restricted sites were identified by major vegetation changes from one side of a road versus the other, with the presence of typical salt marshes grasses on the seaward side and common reed located on the upstream side. Study sites were chosen based on accessibility. Field work was performed on the following dates: July 16-17, 19-20, 1997 and May 23-25, 2000. A total of 76 sites were evaluated for this project; another 42 sites had been visited for the previous project (basic coastal wetland mapping for the Narragansett Bay Estuary). Fifty-eight sites were inspected as "reference wetlands" to provide information on plant community composition and other features associated with estuarine wetlands subjected to the range of disturbances noted above (Irene Huber, pers. comm. 2003). Eighteen tidally restricted sites were evaluated with the properties of the restricting structure and its effect on the wetland recorded. All field data would be used to aid the State's future estuarine wetland restoration efforts. Copies of the completed field forms were included in a report by Huber (2000).

Geospatial Database Construction and GIS Analysis

Geospatial database construction was performed by the University of Rhode Island's Environmental Data Center (EDC). Each basemap was registered on the digitizing tablet with a RMS value $\leq$0.003. All features delineated for this project were digitized in ArcEdit and coded using ArcView 3.2 software. Data for each quad was digitized separately and joined to form one complete baywide coverage. Data for each USGS quadrangle was digitized, coded and proofed before moving onto the next quadrangle. Proofing took place in two phases: 1) on screen in ArcView 3.2 to check for coding errors as well as line errors and 2) a proof plot of the linework information was made and sent along with the mylar basemap for NRAG to proof. Any omissions or coding changes were noted on the proof plot and returned to EDC for final editing.

The landuse/landcover data were digitized into an existing coverage containing the upland shoreline features from the coastal wetlands data layer and the 500-foot buffer

line (Figure 3). Each quad was digitized and proofed separately to be *MAPJOINED* after all land use/land cover data were completed. For those polygons coded as freshwater wetland, an item ENHANCED was added and attributed with a Cowardin et al. (1979) classification.

Hardened shorelines were digitized by quadrangle into an existing coverage containing the linework from the coastal wetland datalayer. The ArcEdit *UNSPLIT* command was used on the shoreline features to create a continuous arc. The ArcEdit *SPLIT* command was then used to create most of the line features as they followed the upland shoreline.

For potential restoration sites, the internally degraded wetlands were digitized by quad into an existing coverage containing the coastal wetland features. This allowed for the splitting of wetlands where one part of the wetland may have an internal impact. In some cases, freshwater wetlands were also internally impacted; the linework for these polygons was pulled from the existing landuse/landcover dataset.

External impacts to coastal wetlands were digitized by quad into an existing coverage containing the coastal wetland features. The *SPLIT* command was used to create most of the line features as they followed existing wetland edges. In some cases, freshwater wetlands were also externally impacted; the linework for these polygons was pulled from the existing landuse/landcover dataset.

Field data points were digitized by quad with the points placed on a proof plot by NRAG staff and then heads-up digitized into ArcView. The points were coded with their corresponding site number to reference the field data sheets for specific locations.

Upon construction of the final digital database, summary tables were generated using Arc/Info *FREQUENCY* command. Tabular data are included in the Results and Appendices A and B of this report. Thematic maps showing potential coastal wetland restoration sites, hardened shorelines and coastal habitats, potential coastal wetland restoration sites and open space, and land use/cover within the 500-foot buffer of coastal habitats were also prepared (Appendix C).

Identification of Coastal Wetland Complexes

To identify focus areas for restoration efforts, potential coastal wetland restoration sites were grouped according to complexes by EDC, NBEP, and Save the Bay, Incorporated. A new digital data layer for the complex coverage was created by selecting all potential wetland restoration polygons, including all former coastal wetland polygons (Type 1 sites), coastal wetland polygons with internal sources of degradation (Type 2 sites), and coastal wetland polygons with potential external sources of degradation. These individual wetland polygons were then grouped into potential restoration project areas or "complexes" based on their location, type of impairment, ecology, field conditions, and other variables. Finally, in the digital database, each polygon was coded with its complex number, so that all potential restoration sites within one complex had the same complex

code. This process identified 236 wetland restoration complexes for the Narragansett Bay Estuary (Helen Cottrell, pers. comm. 2003).

Figure 3. Aerial photograph showing approximate limits of 500-foot buffer area along Greenwich Bay. (Source: RIGIS).

Results

Status of Coastal Wetlands and Related Resources[1]

The Narragansett Bay Estuary encompasses almost 230,000 acres of tidal and subtidal saltwater-influenced habitats (Table 5). The Bay itself predominates this tidal ecosystem, accounting for 97% of this acreage (22,207.9 acres). There is 1.5 times as much marine water as estuarine water in the Bay. Intertidal habitats occupy only 3% of the Estuary. Estuarine tidal marshes and swamps comprise 58% (3,558.8 acres) of this habitat, with the remainder made up mostly of nonvegetated intertidal shores. The latter includes sandy beaches, sand and mud flats, and cobble-gravel shores. Nine acres of oyster reefs were inventoried.

Irregularly flooded emergent wetlands dominate the tidal marshes, representing 92% (3,281.5 acres) of these vegetated wetlands. Common reed (Phragmites australis) occurs in 473 acres and is the dominant species in over 340 acres (Figure 4). A total of 277 acres of regularly flooded emergent wetlands were inventoried.[2] Salt shrub swamps, typically dominated by hightide bush (Iva frutescens) account for only 5% of the estuarine vegetated wetlands.

Figure 4. Phragmites-dominated wetland in Narragansett Bay Estuary. (Helen Cottrell photo)

[1] Data for this subsection come from prior work conducted by the University of Massachusetts for the NBEP; tabular data were provided by URI's Environmental Data Center for this report.

[2] Based on a review of field notes, these areas included short form Spartina alterniflora which typically grows in the high marsh contiguous to the low marsh, so some areas of the lower high marsh are included in this acreage figure.

Table 5. Extent of coastal wetlands and waters in the Narragansett Bay Estuary. (Note: These data summarize totals for mapped polygons only; linear data are not included.)

Wetland or Waterbody	Type	Acreage
Estuarine Water	Eelgrass Bed	92.6
	Saline/Brackish	89,329.7
	Oligohaline	143.6
	Subtotal	89,565.9
Estuarine Marsh (Salt/Brackish Marsh)	Emergent Regularly Flooded	276.5
	Phragmites Irregularly Flooded	198.5
	Em/Phrag Irregularly Flooded	14.6
	Other Emergent Irregularly Flooded	2,360.5
	Phrag/Shrub Irregularly Flooded	3.3
	Other Em/Shrub Irregularly Flooded	6.9
	Subtotal	2,860.3
Estuarine Oligohaline Marsh (Slightly Brackish Marsh)	Emergent Regularly Flooded	0.8
	Phragmites Irregularly Flooded	141.6
	Em/Phrag Irregularly Flooded	115.3
	Other Emergent Irregularly Flooded	279.1
	Subtotal	536.8
Estuarine Reef	Mollusc (Oyster)	9.3
Estuarine Rocky Shore	Bedrock Regularly Flooded	29.1
	Bedrock Irregularly Flooded	97.2
	Rubble Regularly Flooded	76.6
	Rubble Irregularly Flooded	16.1
	Subtotal	219.0
Estuarine Streambed	Sand and Mud Regularly Flooded	3.1
Estuarine Scrub-Shrub Wetland (Salt Shrub Swamp)	Deciduous Irregularly Flooded	159.8
	Shrub/Emergent Irregularly Flooded	0.7
	Subtotal	161.7

Estuarine Unconsolidated Shore	Cobble-Gravel Regularly Flooded	68.2
	Cobble-Gravel Irregularly Flooded	61.2
	Sand Irregularly Exposed	253.2
	Sand Regularly Flooded	442.2
	Sand/Cobble-Gravel Regularly Flooded	42.1
	Sand/Emergent Regularly Flooded	5.9
	Sand Irregularly Flooded	578.6
	Mud Regularly Exposed	200.4
	Mud Regularly Flooded Oligohaline	105.5
	Sand Regularly Flooded Oligohaline	7.0
	Subtotal	1,764.3
Estuarine Salt Panne	Irregularly Exposed	39.5
	Regularly Flooded	1.7
	Subtotal	41.2
Total Estuarine Habitat		***95,161.6***
Marine Water	Eelgrass Bed	2.6
	Unconsolidated Bottom	132,649.4
	Subtotal	132,652.0
Marine Rocky Shore	Regularly Flooded	145.0
	Irregularly Flooded	199.7
	Subtotal	344.7
Marine Unconsolidated Shore	Cobble-Gravel Regularly Flooded	5.9
	Cobble-Gravel Irregularly Flooded	9.6
	Sand Irregularly Exposed	2.3
	Sand Regularly Flooded	100.7
	Sand Irregularly Flooded	77.2
	Subtotal	195.7
Total Marine Habitats		***133,192.4***
Narragansett Bay Grand Total		**228,354.0**

Estuarine Wetland Plant Communities

Estuarine wetlands include both vegetated and nonvegetated types. Vegetated types are generally referred to as marshes and swamps, while the nonvegetated types include rocky shores, beaches, tidal flats, and intertidal oyster reefs (Figure 5). Rocky shores may be colonized by macrophytic algae, namely knotted wrack (Ascophyllum nodosum) and rockweeds (Fucus spp.).

The marshes are characterized by two distinct zones of vegetation: 1) low or regularly flooded marsh and 2) high or irregularly flooded marsh. The low marsh is lower in elevation and therefore subject to more frequent and prolonged tidal flooding. This zone is flooded at least once daily by the tides (regularly flooded). It extends from the mean high tide level approximately to mean sea level where emergent vegetation begins growing. The regularly flooded area extends below mean sea level and bare tidal flats cover this region (i.e., to the extreme low spring tide mark). Intertidal oyster reefs may also be found in this area. The high marsh occurs above the mean high tide level and is flooded less often than daily (irregularly flooded). Some areas are flooded weekly, while others are flooded a couple of times a month or less often by spring and storm tides, respectively.

Salt marshes are the most seaward of the tidal marshes and therefore are exposed to the highest salinities. Here the low marsh is characterized by a tall growth form of smooth cordgrass (Spartina alterniflora) (3 feet or more tall). Above the low marsh, a variety of halophytic plants grow. Immediately above the low marsh may be a zone dominated by a short form of smooth cordgrass (1.5 feet or less tall). Often, an abundance of green algae may be associated with this form. Beyond this zone, three plants tend to occupy the most area; they include salt hay grass (Spartina patens), salt grass (Distichlis spicata), and black grass or black rush (Juncus gerardii) (see Tiner 1987 for additional information on New England salt marshes). Ponds and ditches in the high marsh may be colonized by widgeon-grass (Ruppia maritima). Depressions where salt water collects and evaporates are high saline habitats with salt concentrations more than twice that of sea water. This habitat is only fit for the most salt-tolerant species. Glassworts (Salicornia spp., especially S. europaea) are the most abundant and frequently found speices in these depressions (pannes). Hightide bush (Iva frutescens) occurs along ditch banks, upper edges of salt marshes, and disturbed areas (tidally restricted and ditched sites). Switchgrass (Panicum virgatum) may be found at the upper edges of salt marshes as well as growing in brackish marshes. Common reed (Phragmites australis) ranges from common to dominant, often forming monotypic stands in severely tidally restricted sites. Table 6 presents numerous examples of wetland plant communities associated with irregularly flooded salt marshes. Note communities are arranged according to three disturbance categories.

Slightly brackish marshes are typically dominated by one of two species: common reed, narrow-leaved cattail (Typha angustifolia) (Table 7). Other dominants include soft-stemmed bulrush (Scirpus validus) and broad-leaved cattail (T. latifolia).

Figure 3. Examples of estuarine wetlands in the Narragansett Bay Estuary: a) Sapowet Marsh (Tiverton), b) 100-acre Cove Marsh (Barrington), c) Jamestown salt marsh, d) Palmer River salt marsh (Barrington), e) boulder shore at Sachuest Point (Middletown), and f) gravel beach (North Prudence Island). (Dr. Frank Golet photos)

a

d

b

e

c

f

Table 6. Examples of salt and brackish marshes found in the Narragansett Bay Estuary based on field studies by UMass personnel. An asterisk (*) designates impounded sites (typically "impounded" by roadways). Disturbance categories: U - relatively undisturbed, M - moderately disturbed, and S - severely disturbed.

Dominant Species (location - disturbance category)	**Associated Species**
Spartina patens (Tiverton - U)	Spartina alterniflora-short and tall, Salicornia europaea, Limonium nashii, Juncus gerardii, Salicornia virginica
S. alterniflora-short (Tiverton - U)	S. europaea (on overwash), L. nashii (on overwash), S. patens
S. alterniflora-short/ S. patens (Little Compton - U)	L. nashii, S. europaea
S. patens/S. alterniflora (short) (Jamestown - U)	L. nashii, Distichlis spicata, S. alterniflora-tall
J. gerardii (Jamestown - U)	L. nashii, Triglochin maritimum, S. patens, D. spicata, Solidago sempervirens, S. virginica, Panicum virgatum, Agropyron pungens, Plantago maritima
S. alterniflora-short (Jamestown - U)	S. alterniflora-tall, L. nashii, S. europaea, S. patens
S. alterniflora-short (Jamestown - U)	L. nashii
Iva frutescens (Narragansett - U)	J. gerardii, D. spicata, Atriplex patula, Baccharis halimifolia, Rosa palustris, Juniperus virginiana
S. patens (Narragansett - U)	S. alterniflora-short, Scirpus americanus, Phragmites australis, D. spicata, I. frutescens (algae in pools)
S. patens/S. alterniflora-short (Narragansett - U)	Ulva lactuca (ditch), J. gerardii, S. europaea, I. frutescens (edge)
S. patens (Wickford - U)	U. lactuca, Fucus vesiculosus, S. alterniflora, S. europaea, D. spicata, S. sempervirens, Limonium carolinianum, P. australis, I. frutescens (ditch banks/marsh edge)
S. patens (Warwick - U)	Spartina pectinata, A. patula, Puccinellia maritima, P. virgatum (upper edge), I. frutescens, (pocket of Typha latifolia, Impatiens capensis, Lythrum salicaria, Rumex crispus, and Lemna sp. at freshwater inflow point)
D. spicata (Warwick - U)	J. gerardii, S. sempervirens, P. virgatum, S. europaea, I. frutescens
S. patens (Barrington - U)	S. alterniflora, S. sempervirens, S. europaea, D. spicata, I. frutescens (edge)

Table 6. (continued)

Dominant Species (location - disturbance category)	**Associated Species**
S. patens (Jamestown - U)	D. spicata, S. sempervirens, S. alterniflora-short, P. virgatum, S. europaea, L. carolinianum, I. frutescens (edge), Scirpus spp., Toxicodendron radicans
S. patens/Scirpus pungens/P. virgatum (Jamestown - U)	D. spicata, J. gerardii, A. patula, Hibiscus moscheutos, S. semperivirens, T. radicans, Eleocharis rostellata, Carex hormathodes
J. gerardii (Tiverton - M)	T. maritimum, S. alterniflora-short, A. patula, L. nashii, D. spicata
J.gerardii/S. alterniflora-short (Middletown - M)	S. europaea, S. patens, A. patula, D. spicata, Phragmites australis, I. frutescens
S. patens (Newport - M)	A. patula, D. spicata, S. alterniflora-short, S. sempervirens (edge), S. europaea, Carex spp., L. nashii, J. gerardii, Glaux maritima, I. frutescens, Galium spp., Festuca rubra (edge), Impatiens capensis (edge), Polygonum persicaria
S. alterniflora-short (Newport - M)	P. australis
S. patens/S. alterniflora-short (Jamestown - M)	L. nashii, S. europaea
S. patens (Bristol - M)	D. spicata, S. europaea, S. alterniflora-short, L. nashii
S. patens (Narragansett - M)	U. lactuca (ditch), S. alterniflora-short, S. sempervirens, D. spicata, P. virgatum (upper border), Puccinellia maritima, Suaeda linearis, L. carolinianum, S. europaea, T. radicans (upper border), P. australis, Typha angustifolia (fringe), I. frutescens
P. australis (North Kingstown - M)	S. patens
*S. patens (Wickford - M)	U. lactuca (in open water), S. alterniflora-short, S. europaea, D. spicata, P. australis, I. frutescens
S. patens/P. australis (North Kingstown - M)	S. europaea, D. spicata, S. alterniflora-short, J. gerardii, L. carolinianum, S. sempervirens, I. frutescens (creek bank)
I. frutescens (Potowomut - M)	P. australis
S. alterniflora-short (Potowomut - M)	S. patens, D. spicata, S. europaea, J. gerardii, S. sempervirens

Table 6. (continued)

Dominant Species (location - disturbance)	**Associated Species**
P. australis/S. patens (Greenwich - M)	S. alterniflora (creek), S. sempervirens
I. frutescens (Warren - M)	S. alterniflora, J. gerardii, D. spicata, Spartina spp., S. europaea, S. sempervirens
J. gerardii (Warren - M)	D. spicata, P. australis (edge), I. frutescens (edge)
*J. gerardii (Little Compton - M/S)	Ruppia maritima (ditch), D. spicata, S. patens, S. europaea, A. patula, S. sempervirens, I. frutescens
*J. gerardii (Newport - S)	A. patula, S. sempervirens, S. europaea, S. pectinata, D. spicata, P. australis, Lythrum salicaria
S. alterniflora-short (Portsmouth - S)	S. patens, D. spicata, P. australis (edge), I. frutescens, T. radicans (edge)
*S. patens (Little Compton - S)	D. spicata, S. sempervirens, J. gerardii, P. australis (upper limits), I. frutescens, T. radicans
P. australis (Plum Pt. - S)	None
S. patens/D. spicata (Warren - S)	J. gerardii, S. alterniflora, S. europaea, I. frutescens, P. australis (lawn edge)
*S. alterniflora-short (Bristol - S)	A. patula, S. sempervirens, A. pungens, D. spicata, J. gerardii
*S. patens/I. frutescens (Bristol - S)	J. gerardii, A. patula, D. spicata, S. sempervirens, F. rubra, P. australis, Rumex crispus, Typha angustifolia
*S. patens/P. australis (Barrington - S)	R. maritima, A. patula, S. alterniflora-short, D. spicata, S. europaea, L. nashii, J. gerardii, Asparagus officinalis (upper edge), I. frutescens
*S. alterniflora-short (North Kingstown - S)	D. spicata, S. europaea, A. patula, S. patens
*S. patens/S. alterniflora-short (N. Kingstown - S)	D. spicata, S. alterniflora-tall, S. europaea, P. australis
S. alterniflora-short (North Kingstown - S)	S. patens, L. nashii, A. pungens, S. sempervirens, A. patula, J. gerardii, D. spicata, P. australis, I. frutescens
P. australis (Jamestown - S)	T. radicans, Arisaema triphyllum
*J. gerardii (Newport - S)	A. patula, S. sempervirens, S. europaea, Spartina pectinata, D. spicata, P. australis, Lythrum salicaria

Table 7. Examples of estuarine oligohaline marshes in the Narragansett Bay Estuary based on field studies by UMass personnel. An asterisk (*) indicates impounded wetland. Disturbance categories: U - relatively undisturbed, M - moderately disturbed, and S - severely disturbed.

Dominant Species (location - disturbance category)	**Associated Species**
Scirpus validus (Oakland Beach - U)	Spartina pectinata, Atriplex patula, Typha latifolia, Phragmites australis, Carex sp.
P. australis/Typha angustifolia (Narragansett - M)	Hibiscus moscheutos, Scirpus pungens, Eleocharis spp., Ludwigia palustris, Sium suave
T. latifolia (Warwick - M)	Unidentified shrubs (upper edge)
*T. angustifolia (Little Compton - S)	Impatiens capensis, Toxicodendron radicans, Polygonum cuspidatum, Cirsium arvense
*T. angustifolia (Middletown - S)	Spartina patens, A. patula, Scirpus americanus, Iva frutescens, H. moscheutos
*P. australis (Barrington - S)	Spartina alterniflora-tall and short, S. patens, Lythrum salicaria, Calystegia sepium, Peltandra virginica, Boehmeria cylindrica
*T. angustifolia/P. australis (Narragansett - S)	S. patens, Scirpus robustus
T. angustifolia/P. australis (Swansea - S)	None
T. angustifolia (Portsmouth - S)	None
P. australis (Portsmouth - S)	T. radicans
*T. angustifolia (Little Compton - S)	P. australis

Estuarine Restoration Sites

A total of 236 restoration complexes were inventoried (Helen Cottrell, pers. comm. 2003). Over 4,000 acres (4,020.6 acres) were identified as having some potential for restoration of estuarine wetlands (Table 8). Most (78%) of this acreage was represented by Type 2 sites - existing coastal wetland degraded by human actions, such as ditch construction, impoundment by roads (and inadequate culvert sizing), and excavation (Table 8).

Type 1 potentially restorable acreage amounted to 888 acres (Table 8). Roughly half (46%) of this acreage is now open fresh water, whereas 43% is freshwater wetland. Much of the conversion to freshwater wetland resulted from impoundment by roads. Filled former estuarine wetlands that may be restorable accounted for 91 acres; 36% of this acreage was represented by dredged spoil disposal sites. When arranged by size class as in Table 9, it is apparent that most (47%) of the Type 1 sites are small (less than 1 acre), while about one-third (34%) are in the 1-5 acres range. About 71% of the filled sites are less than 1 acre. Of the submerged sites, nearly two-thirds are less than 5 acres in size (36% 1-5 acres; 27% <1 acre), while six sites (27%) were 10 acres or more. Most of the Type 1 sites represent freshwater wetlands and waterbodies that were once estuarine habitats. Of these, about three-quarters of the sites are less than 5 acres in size, being almost evenly divided between sites 1-5 acres and <1 acre in size.

Type 2 acreage was about 3.5 times that of Type 1 acreage (3,132 acres vs. 888 acres; Table 8). The wetlands identified as potential Type 2 restoration sites represent about 65% of the existing vegetated coastal wetland acreage in the Narragansett Bay estuary. Ditching and tidal restriction were the primary disturbances, impacting 1,665 acres and 1,507 acres, respectively. Of the Type 2 acreage, 53% was partly drained due to ditching, while 48% was tidally restricted (Figure 6); many Type 2 sites experienced multiple impacts. Significant vegetation change (i.e., increase in common reed and/or hightide bush) occurred in 480 acres, with over three-quarters of this change attributed to invasion by common reed. About half of the Type 2 potential restoration sites was sites less than 1 acre in size, while one-third was in the 1-5 acre range (Table 10).

Most of the Type 1 and Type 2 potential restoration sites occurred on private property (Tables 11 and 12). Sixty-one percent of the Type 1 sites occurred solely on private land, while 30% was on a combination of public and private land. Only 9% was entirely on public land. Slightly more than half of the Type 1 sites had adverse external impacts (90 sites vs. 88 with no such impacts). Ownership of Type 2 sites was nearly the same proportions as the Type 1 sites (61% private, 31% public/private, and 8% public only). Fifty-five percent of the Type 2 sites had negative external impacts (358 sites), whereas 445 had no external impacts (283 sites). Tables 13 and 14 show distribution of Type 1 and Type 2 sites by a combination of ownership, the presence of external impacts, and size classes.

Table 8. Potential estuarine wetland restoration opportunities for the Narragansett Bay Estuary. Type 1 = former wetlands that may be restorable; Type 2 = possibly degraded wetlands that may be restorable. The # of areas represent number of distinct wetland areas within potential restoration sites. *- includes deepwater habitat.

Type	Current Status	# of Areas	Acreage
1	Filled	58	90.7
	(Filled-nonwetland)	(53)	(57.7)
	(Filled-Phragmites)	(1)	(0.1)
	(Filled-spoil)	(4)	(32.9)
	Impounded-fresh waterbody	23	406.6
	Excavated-fresh waterbody/wetland	7	6.6
	Freshwater Vegetated Wetland	90	384.3
	(Aquatic Bed)	(15)	(133.6)
	(Emergent-tidal)	(50)	(150.8)
	(Emergent-nontidal)	(6)	(11.8)
	(Scrub/Shrub-tidal)	(16)	(78.0)
	(Scrub/Shrub-nontidal)	(2)	(7.6)
	(Forested-tidal)	(1)	(2.5)
	---	---	---
	Total	178	888.2
2	Ditched	88	1,212.5
	Ditched/Tidally Restricted	26	295.9
	Ditched/Tidally Restricted/Iva	6	17.2
	Ditched/Severely Tidally Restricted	15	18.6
	Ditched/Severely Tidally Restricted/Phrag	4	10.0
	Ditched/Phragmites	20	40.3
	Ditched/Iva	21	34.6
	Ditched/Impounded	1	35.5
	*Impounded (deepwater habitat)	3	10.9
	Impounded (vegetated wetland)	4	2.2
	Impounded (nonvegetated wetland)	1	0.6
	Impounded/Phragmites	5	7.0
	*Tidally Restricted (open water habitat)	44	712.0
	Tidally Restricted (nonvegetated wetland)	39	69.0
	Tidally Restricted (vegetated wetland)	122	194.5
	Tidally Restricted/Phragmites	2	4.2
	Tidally Restricted/Iva	6	4.2
	Severely Tidally Restricted	31	100.5
	Severely Tidally Restricted/Phragmites	21	80.6
	Vegetation change-Phragmites	143	223.1
	Vegetation change - Iva	37	55.5
	Vegetation change - Iva & Phragmites	1	3.3
	*Excavated/Tidally Restricted	1	0.2
	---	---	---
	Total	641	3,132.4

Figure 6. Aerial view of tidally restricted wetland in Bristol. Note road crossings at mouth and Phragmites marsh (gray-green color) in upper estuary. (Photo courtesy of Narragansett Bay Estuary Program)

Table 9. Type 1 wetland restoration sites for the Narragansett Bay Estuary arranged by size class.

Site Type	**# of Sites**	**Size Classes (acres)**				
		<1	**1-5**	**5-10**	**10-25**	**>25**
Filled	53	39	11	1	2	0
Filled/Phragmites	1	1	0	0	0	0
Filled/Spoil	4	1	2	0	0	1
Submerged	22	6	8	2	1	5
Freshwater Wetland	91	33	36	13	6	3
Excavated	7	4	3	0	0	0
Total	178	84	60	16	9	9

Table 10. Type 2 potential wetland restoration sites for the Narragansett Bay Estuary arranged by size class.

Site Type	# of Sites	Size Classes (acres) <1	1-5	5-10	10-25	>25
Ditched	88	13	26	15	19	15
Ditched/Tidal Restriction	26	0	13	3	7	3
Ditched/SevereTidal Restriction	1	1	0	0	0	0
Ditched/Tidal Restriction/Iva	6	1	4	1	0	0
Ditched/Severe Tidal Restriction	14	7	7	0	0	0
Ditched/Severe Tidal Restriction/ Phragmites	4	3	0	1	0	0
Ditched/Phragmites	20	10	8	1	1	0
Ditched/Iva	21	13	7	0	1	0
Impounded	8	7	0	1	0	0
Ditched/Impounded	1	0	0	0	0	1
Impounded/Phragmites	5	3	2	0	0	0
Tidal Restriction	205	103	74	1	9	8
Tidal Restriction/Phragmites	2	1	1	0	0	0
Tidal Restriction/Iva	6	6	0	0	0	0
Severe Tidal Restriction	31	15	11	3	1	1
Severe Tidal Restriction/Phragmites	21	10	8	2	0	1
Vegetation Change Phragmites	143	100	35	3	4	1
Vegetation Change Iva	37	16	19	2	0	0
Vegetation Change Iva&Phragmites	1	0	1	0	0	0
Excavated/Tidal Restriction	1	1	0	0	0	0
Total	641	310	216	43	42	30

Table 11. Type 1 wetland restoration sites for the Narragansett Bay Estuary arranged by ownership and the presence of external impacts.

Site Type	Ownership	# of Sites	External Impact?
Filled	Private	16	yes
	Private	23	no
	Public	4	yes
	Public	2	no
	Public/Private	6	yes
	Public/Private	2	no
Filled/Phragmites	Private	1	no
Filled/Spoil	Private	1	yes
	Private	2	no
	Public/Private	1	no
Submerged	Private	2	yes
	Private	9	no
	Public	2	yes
	Public	2	no
	Public/Private	4	yes
	Public/Private	3	no
Freshwater Wetland	Private	20	yes
	Private	31	no
	Public	1	yes
	Public	3	no
	Public/Private	28	yes
	Public/Private	8	no
Excavated	Private	2	yes
	Private	1	no
	Public	2	yes
	Public/Private	2	yes

Table 12. Type 2 potential wetland restoration sites for the Narragansett Bay Estuary arranged by ownership and the presence of external impacts.

Site Type	Ownership	# of Sites	External Impact?
Ditched	Private	21	yes
	Private	24	no
	Public	2	no
	Public/Private	29	yes
	Public/Private	12	no
Ditched/Tidal Restriction	Private	9	yes
	Private	2	no
	Public	1	no
	Public/Private	13	yes
	Public/Private	1	no
Ditched/Severe Tidal Restriction	Public/Private	1	yes
Ditched/Tidal Restriction/Iva	Private	2	yes
	Public	2	yes
	Public/Private	1	yes
	Public/Private	1	no
Ditched/Severe Tidal Restriction	Private	1	yes
	Private	5	no
	Public/Private	3	yes
	Public/Private	5	no
Ditched/Severe Tidal Restriction/Phragmites	Private	2	yes
	Private	1	no
	Public/Private	1	yes
Ditched/Phragmites	Private	11	yes
	Private	6	no
	Public/Private	3	yes
Ditched/Iva	Private	2	yes
	Private	16	no
	Public	1	no
	Public/Private	1	yes
	Public/Private	1	no
Impounded	Private	3	yes
	Private	1	no
	Public	1	yes
	Public	1	no
	Public/Private	1	yes
	Public/Private	1	no

Table 12 (continued).

Site Type	Ownership	# of Sites	External Impact?
Ditched/Impounded	Public/Private	1	yes
Impounded/Phragmites	Private	1	yes
	Private	1	no
	Public	1	no
	Public/Private	2	yes
Tidal Restriction	Private	61	yes
	Private	70	no
	Public	5	yes
	Public	4	no
	Public/Private	32	yes
	Public/Private	33	no
Tidal Restriction/Phrag	Private	2	yes
Tidal Restriction/Iva	Public	1	yes
	Public	2	no
	Public/Private	2	yes
	Public/Private	1	no
Severe Tidal Restriction	Private	2	yes
	Private	13	no
	Public	1	yes
	Public/Private	8	yes
	Public/Private	7	no
Severe Tidal Restriction/ Phragmites	Private	10	yes
	Public	3	yes
	Public/Private	8	yes
Vegetation Change/Phrag	Private	60	yes
	Private	40	no
	Public	10	yes
	Public	6	no
	Public/Private	16	yes
	Public/Private	11	no
Vegetation Change/Iva	Private	13	yes
	Private	8	no
	Public	10	yes
	Public	1	no
	Public/Private	3	yes
	Public/Private	2	no
Vegetation Change/Iva & Phragmites	Public/Private	1	no
Excavated/Tidal Restriction	Private	1	no

Table 13. Type 1 wetland restoration sites for the Narragansett Bay Estuary arranged by ownership, the presence of external impacts, and size class.

Site Type	Ownership	# of Sites	External Impact?	Size Classes (acres)				
				< 1	1-5	5-10	10-25	>25
Filled								
	Private	16	yes	10	5	0	1	0
	Private	23	no	22	1	0	0	0
	Public	4	yes	2	2	0	0	0
	Public	2	no	2	0	0	0	0
	Public/Private	6	yes	2	2	1	1	0
	Public/Private	2	no	1	1	0	0	0
Filled/Phrag								
	Private	1	no	1	0	0	0	0
Filled/Spoil								
	Private	1	yes	0	0	0	0	1
	Private	2	no	0	2	0	0	0
	Public/Private	1	no	1	0	0	0	0
Submerged								
	Private	2	yes	0	1	0	0	1
	Private	9	no	3	5	1	0	0
	Public	2	yes	0	1	0	0	1
	Public	2	no	0	0	1	1	0
	Public/Private	4	yes	1	1	0	0	2
	Public/Private	3	no	2	0	0	0	1
Freshwater Wetland								
	Private	20	yes	7	7	4	2	0
	Private	31	no	15	13	2	0	1
	Public	1	yes	0	1	0	0	0
	Public	3	no	2	1	0	0	0
	Public/Private	28	yes	4	11	7	4	2
	Public/Private	8	no	5	3	0	0	0
Excavated								
	Private	2	yes	0	2	0	0	0
	Private	1	no	1	0	0	0	0
	Public	2	yes	1	1	0	0	0
	Public/Private	2	yes	2	0	0	0	0

Table 14. Type 2 potential wetland restoration sites for the Narragansett Bay Estuary arranged ownership, the presence of external impacts, and size class.

Site Type	Ownership	# of Sites	External Impact?	Size Classes (acres)				
				< 1	1-5	5-10	10-25	>25
Ditched								
	Private	21	yes	3	10	4	1	3
	Private	24	no	6	10	2	4	2
	Public	2	no	1	0	1	0	0
	Public/Private	29	yes	0	2	7	11	9
	Public/Private	12	no	3	4	1	3	1
Ditched/Tidal Restriction								
	Private	9	yes	0	5	0	4	0
	Private	2	no	0	1	1	0	0
	Public	1	no	0	1	0	0	0
	Public/Private	13	yes	0	6	1	3	3
	Public/Private	1	no	0	0	1	0	0
Ditched/Tidal/Severe Restriction								
	Public/Private	1	yes	1	0	0	0	0
Ditched/Tidal Restriction/Iva								
	Private	2	yes	1	1	0	0	0
	Public	2	yes	0	2	0	0	0
	Public/Private	1	yes	0	1	0	0	0
	Public/Private	1	no	0	0	1	0	0
Ditched/Severe Restriction								
	Private	1	yes	0	1	0	0	0
	Private	5	no	3	2	0	0	0
	Public/Private	3	yes	1	2	0	0	0
	Public/Private	5	no	3	2	0	0	0
Ditched/Severe Restriction/ Phragmites								
	Private	2	yes	2	0	0	0	0
	Private	1	no	1	0	0	0	0
	Public/Private	1	yes	0	0	1	0	0
Ditched/Phragmites								
	Private	11	yes	5	4	1	1	0
	Private	6	no	3	3	0	0	0
	Public/Private	3	yes	2	1	0	0	0

Table 14 (continued).

Site Type-Ownership	# of Sites	External Impact yes / no	Size Classes (acres) < 1	1-5	5-10	10-25	>25
Ditched/Iva							
Private	2	yes	1	1	0	0	0
Private	16	no	11	5	0	0	0
Public	1	no	1	0	0	0	0
Public/Private	1	yes	0	0	0	1	0
Public/Private	1	no	0	1	0	0	0
Impounded							
Private	3	yes	2	0	1	0	0
Private	1	no	1	0	0	0	0
Public	1	yes	1	0	0	0	0
Public	1	no	1	0	0	0	0
Public/Private	1	yes	1	0	0	0	0
Public/Private	1	no	1	0	0	0	0
Ditched/Impounded							
Public/Private	1	yes	0	0	0	0	1
Impounded/Phragmites							
Private	1	yes	1	0	0	0	0
Private	1	no	1	0	0	0	0
Public	1	no	0	1	0	0	0
Public/Private	2	yes	1	1	0	0	0
Tidally Restricted							
Private	61	yes	29	26	4	0	2
Private	70	no	45	21	2	2	0
Public	5	yes	3	2	0	0	0
Public	4	no	4	0	0	0	0
Public/Private	32	yes	8	12	2	6	4
Public/Private	33	no	14	13	3	1	2
Tidally Restricted/Phrag							
Private	2	yes	1	1	0	0	0
Tidally Restricted/Iva							
Public	1	yes	1	0	0	0	0
Public	2	no	2	0	0	0	0
Public/Private	2	yes	2	0	0	0	0
Public/Private	1	no	1	0	0	0	0

Table 14 (continued).

Site Type-Ownership	# of Sites	External Impact yes / no	Size Classes (acres) < 1	1-5	5-10	10-25	>25
Severely Tidally Restricted							
Private	2	yes	1	0	0	1	0
Private	13	no	9	3	1	0	0
Public	1	yes	1	0	0	0	0
Public/Private	8	yes	2	3	2	0	1
Public/Private	7	no	2	5	0	0	0
Severely Tidally Restricted/ Phragmites							
Private	10	yes	4	6	0	0	0
Public	3	yes	3	0	0	0	0
Public/Private	8	yes	3	2	2	0	1
Vegetation Change-Phrag							
Private	60	yes	44	13	3	0	0
Private	40	no	31	9	0	0	0
Public	10	yes	9	1	0	0	0
Public	6	no	4	2	0	0	0
Public/Private	16	yes	8	5	0	2	1
Public/Private	11	no	4	5	0	2	0
Vegetation Change-Iva							
Private	13	yes	7	6	0	0	0
Private	8	no	5	3	0	0	0
Public	10	yes	4	6	0	0	0
Public	1	no	0	1	0	0	0
Public/Private	3	yes	0	2	1	0	0
Public/Private	2	no	0	1	1	0	0
Vegetation Change-Iva & Phragmites							
Public/Private	1	no	0	1	0	0	0
Excavated/Tidally Restricted							
Private	1	no	1	0	0	0	0

Estuarine Wetland Buffers

The 500-foot buffer around the landward edge of estuarine wetlands amounted to nearly 26,000 acres. The buffer is nearly evenly divided between developed land (non-agricultural excluding barren land) and "natural" cover (i.e., forest, rangeland, and wetlands), with 48.3% for the former and 43.7% for the latter (Table 15). Agricultural land comprised only 5.8% and barren land made up only 1.8% of the buffer. Residential development alone accounted for 34.2% of the buffer, with most of this occupied by single family homes.

Table 15. Land use/cover in the 500-foot buffer surrounding estuarine wetlands in the Narragansett Bay Estuary.

Land Use/Cover Type	**Acreage**	**Percent of Buffer**
Residential Development		
Single family	7,000.3	
Multi-family	177.6	
Mobile-home	13.8	
Lawn	1,593.5	
Other	20.7	
Subtotal	8,805.9	34.2%
Commercial Development		
Commercial/Insitutional structures	1,023.6	
Recreational structures	51.0	
Marinas	197.7	
Junkyards	0.1	
Paved surfaces	260.6	
Unpaved surfaces	49.1	
Wharves, piers, and shipyards	482.8	
Other	1.2	
Subtotal	2,066.1	8.0%
Industrial Development	88.9	<0.1%
Transportation, Communication, and Utilities	744.6	2.9%
Industrial/Commercial Complexes	15.8	<0.1%
Other Urban or Built-up Land		
Golf courses	415.7	
Cemeteries	56.2	
Other areas (zoos; urban parks)	294.5	
Landfills	39.0	
Other	27.6	
Subtotal	833.0	3.2%

Table 15 (continued).

Land Use/Cover Type	Acreage	Percent of Buffer
Agriculture		
Cropland	914.0	
Orchards, Nurseries, and Vineyards	53.6	
Confined Feeding Lots	3.4	
Pastures and Hayfields	530.1	
Subtotal	1,501.1	5.8%
Rangeland		
Herbaceous Cover	449.5	
Shrub/Brush Cover	2,627.1	
Mixed Cover	866.5	
Subtotal	3,943.1	15.3%
Forest		
Deciduous Forest	2,309.2	
Evergreen Forest	14.6	
Mixed Forest	3,340.1	
Subtotal	5,663.9	22.0%
Water and Freshwater Wetland	1,643.8	6.4%
Barren Land		
Beaches	0.9	
Other Sandy Areas	124.6	
Bare Exposed Rock	3.4	
Strip Mines (sand/gravel pits)	33.4	
Mixed Barren Land	247.1	
Transitional Areas	41.5	
Subtotal	450.9	1.8%
Total Buffer Zone	25,757.1	

Hardened Shorelines

Over 133 miles of hardened shores were mapped, with more than 75% of these shores represented by bulkheads, revetments, and seawalls (Table 16). Bulkheads alone comprised nearly 43% of these artificial shoreline features. Revetments made up 24.2% and seawalls 11.3%. Hardened shorelines may occupy one-fourth of the shoreline of the Narragansett Bay estuary (based on the 540 mile shoreline figure in Huber 2000).

Table 16. Extent of hardened shorelines in the Narragansett Bay Estuary.

Structure	**Length (miles)**
Bridge Abutment	9.1
Bulkhead	57.0
Breakwater	4.5
Groin	3.4
Jetty	1.2
Other Hardened Shore	0.1
Permanent Pier	9.0
Other Significant Pier	1.6
Revetment	32.3
Seawall	15.1
Total	133.3

Summary and Conclusions

The Narragansett Bay Estuary contains almost 223,000 acres of tidal and subtidal habitats, with the Bay itself accounting for 97% of this acreage. Intertidal habitats occupy only 3% of the Estuary; tidal marshes and swamps comprise nearly 60% of this intertidal zone.

A total of 236 restoration complexes covering 4,021 acres were identified during this survey. Most of this acreage was that of existing wetlands that may be degraded. About 65% of the existing coastal wetlands in the Estuary were designated as being potential restoration sites due mostly to ditching and tidal restriction by roads. Almost 900 acres of former estuarine wetlands (now either upland, fresh waterbody, or freshwater wetland) were also identified as potential restoration sites. Nearly two-thirds of the restoration sites are located on private land, whereas about 30% are on public land and the rest are on a combination of public and private properties. Over half of the potential restoration sites had negative impacts from adjacent land uses. More than 80% of the restoration sites are less than 1 acre in size, with a good number also in the 1-5 acre range.

Slightly more than half of the 500-foot buffer zone around coastal wetlands in the Narragansett Bay Estuary is developed, while about 44% is in "natural" vegetation. Single family homes and lawns alone occupy 33% of this zone, while forests represent 22% and rangeland 15%. Eight percent and 6% of the buffer is has been developed commercially and by agriculture, respectively.

About 25% of the Bay's shoreline is armored with various structures. Bulkheads comprised nearly 43% of these artificial shorelines, while revetments made up 24% and seawalls 11%.

This study has identified hundreds of potential opportunities for coastal wetland restoration in the Narragansett Bay Estuary. Over half of the acreage designated as a potential restoration site is existing coastal wetland that is now partly drained through ditching. Plugging of ditches could be done as an attempt to restore these wetlands where this is deemed beneficial and cost effective. About 48% of the degraded wetlands are affected by tidal restrictions, typically by road crossings. These sites should be a priority for restoration as tidal flow can easily be increased in many areas by expanding the culvert size, provided there is no low-lying development surrounding the restricted marsh. If there is such development, a self-regulating tide gate may be the preferred alternative for improving tidal flow. Other restricted sites may require reducing the length of the causeway by constructing more bridgework. This is an expensive process, so a more indepth analysis of the upstream problems and the overall project benefits will be required.

While the present study identified over 800 individual sites in 236 complexes, it did not prioritize these sites. Additional field work is required to identify those complexes where restoration is practical and most urgent or desireable. Nonetheless, we would expect that the most feasible sites for coastal wetland restoration would be tidally restricted areas

where low-lying development does not exist and Type 1 sites requiring removal of fill. Both site types may be excellent sites for mitigating losses of other wetlands through the regulatory permit process. Since much of the Type 1 restoration acreage is either existing wetland (freshwater) or open fresh water, a more detail analysis of the resource trade-offs in returning such areas to coastal wetland will be required prior to commencing such restoration. This report is a first step in the restoration planning effort and should serve as a good starting point for planning coastal wetland restoration in the Narragansett Bay Estuary.

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Data collection was done by the Natural Resources Assessment Group (NRAG) in the Department of Plant and Soil Sciences, University of Massachusetts-Amherst, under the direction of Dr. Peter Veneman, principal investigator. Most of the photointerpretation and cartographic work was performed by Irene Huber and Todd Nuerminger, with Denise Siraco assisting in photointerpretation of hardened shorelines. Tracy Marion of Holyoke Community College helped with map overlay production. NRAG personnel assisting in the field were Christine Nichols, David Foulis, Linda Senn, Ms. Huber, and Mr. Nuerminger. Trisha Kipp, Ms. Siraco, and Mary Johnson helped review data entered into the restoration database.

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APPENDICES

Appendix A. Detailed Results for each Rhode Island town (towns listed alphabetically)

Four tables are presented for each town: Table 1 (extent of coastal wetlands and related features), Table 2 (estuarine wetland restoration sites), Table 3 (hardened shorelines), and Table 4 (land use/cover in the 500-foot buffer surrounding tidal wetlands).

Code symbology for Table 1 (see Cowardin et al. 1979 for definitions; posted on the Internet at: wetlands.fws.gov [listed under publications]). A code is represented by system, system, class, subclass, water regime and special modifiers as in the following examples: 1) E2EM1N - System E (Estuarine), Subsystem 2 (Intertidal), Class EM (Emergent), Subclass 1 (Persistent), Water Regime N (Regularly flooded), 2) E2EM1/5P6 - System E (Estuarine), Subsystem 2 (Intertidal), Class EM (Emergent), Subclasses 1/5 (Persistent/Phragmites), Water Regime P (Irregularly flooded), Special Modifier 6 (Oligohaline), and 3) E2SS1Pd - System E (Estuarine), Subsystem 2 (Intertidal), Class SS (Scrub-Shrub), Subclass 1 (Broad-leaved Deciduous), Water Regime P (Irregularly flooded), Special Modifier d (Partly drained)

System/Subsystem	Class/Subclass	Water Regime	Special Modifier
E1 = Estuarine Subtidal	AB3 = Aquatic Bed Vascular	L = Subtidal	d = partly drained
E2 = Estuarine Intertidal	EM1 = Emergent Persistent	M = Irregularly Exposed	h = impounded
M1 = Marine Subtidal	EM5 = Emergent Phragmites	N = Regularly Flooded	r = artificial
M2 = Marine Intertidal	RF2 = Reef Mollusc	P = Irregularly Flooded	x = excavated
	RS1 = Rocky Shore Bedrock		6 = oligohaline
	RS2 = Rocky Shore Rubble		
	SB2 = Streambed Sand		
	SB3 = Streambed Mud		
	SS1 = Scrub-Shrub Broad-leaved Deciduous		
	US1 = Unconsolidated Shore Cobble-Gravel		
	US2 = Unconsolidated Shore Sand		
	US3 = Unconsolidated Shore Mud		
	US4 = Unconsolidated Shore Organic		
	UB = Unconsolidated Bottom		

Results for Barrington

Table 1. Extent of coastal wetlands and related features in Barrington.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	**78.223**
Salt Marshes	E2EM1/5P (includes d,h,x)	0.684
	E2EM1N (includes d,h,x)	17.975
	E2EM1P (includes d,h,x)	357.301
	E2EM5P (includes d,h,x)	23.399
	Subtotal	**399.359**
Brackish Marshes	E2EM1P6 (includes d,h,x)	1.094
	E2EM5P6 (includes d,h,x)	8.690
	Subtotal	**9.784**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	**29.128**
Estuarine Cobble- Gravel Shores		
	E2US1N and E2US1/2N	3.198
	E2US1P	2.666
	Subtotal	**5.864**
Estuarine Sandy Shores and Beaches	E2US2N (includes r)	6.591
	E2US2P (includes r)	41.822
	Subtotal	**48.413**
Estuarine Mudflats	E2US3M	7.451
	E2US3N (includes d,h)	15.156
	Subtotal	**22.607**
Salt Pannes	E2US4M (includes d,h)	**19.614**
	Total Estuarine Waters and Wetlands	**612.992**

Table 2. Potential wetland restoration sites in Barrington.

Wetland Restoration Type		Current Classification	# of Sites	Acreage
1	filled (1f)	UPLAND	11	2.900
	filled-Phragmites (1fph)	UPLAND	1	0.070
	Subtotal		**12**	**2.970**
	submerged (1su)	PUBV3h	1	7.700
		PUBVh	1	0.380
	Subtotal		**2**	**8.080**
	change in vegetated wetland type (1w)	PEM1/SS1Rh	1	10.330
		PEM1Rh	2	4.920
		PEM1T	1	0.230
		PEM5Rh	5	5.620
	Subtotal		**9**	**21.100**
	change to nonvegetated wetland (1x)	PEM1Cx	**2**	**1.660**
	Total Type 1 Sites		**25**	**33.810**
2	ditched (2d)	E2EM1Nd	1	0.660
		E2EM1Pd	22	282.110
		E2US3Nd	1	2.760
	Subtotal		**24**	**285.530**
	ditched/tidally restricted (2d-2r and 2d-2r-2rs)	E2EM1Pdh	1	3.120
		E2SS1Pdh	1	1.590
		E2EM1/5Pdh	1	0.680
	Subtotal		**3**	**5.390**

ditched/veg change-Phragmites (2d-2v)	E2EM5P	1	0.480
	E2EM5Pd	8	15.700
Subtotal		**9**	**16.180**
ditched/veg change-Iva (2d-2vi)	E2SS1P	**5**	**2.390**
impounded (2h)	E2EM1Ph	**1**	**0.590**
tidally restricted (2r)	E1UBLh	5	15.960
	E2EM1P	1	0.070
	E2EM1P6	2	1.100
	E2EM1Ph	2	0.830
	PUBVh	1	0.510
Subtotal		**11**	**18.470**
severely tidally restricted (2rs)	E2EM5P6h	**1**	**1.380**
severely tidally restricted/ veg change-Phragmites (2rs-2v)	E2EM5P6h	**1**	**4.350**
vegetation change-Phragmites (2v)	E2EM5P	17	12.450
	E2EM5P6	2	2.960
Subtotal		**19**	**15.410**
vegetation change- Iva (2vi)	E2SS1P	14	21.780
Subtotal		**14**	**21.780**
Total Type 2 Sites		**88**	**371.47**
Total All Sites		**113**	**405.28**

Table 3. Extent of hardened shorelines in Barrington.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	3608.807
Bulkhead (BK)	25802.858
Pemanent Pier (PP)	277.269
Revetment (RR)	6247.896
Seawall (SW)	2109.990
Total Hardened Shoreline Length	**38046.82**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Barrington.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	460.25
Lawns (114)	119.13
Subtotal	**579.38**
Commercial	
Commercial and Institutional structures (121)	27.16
Marinas (123)	20.53
Paved surfaces (125)	7.84
Unpaved surfaces (126)	0.88
Wharves, piers, shipyards (127)	1.75
Subtotal	**58.15**
Transportation, Communications, and Utilities (14)	**19.40**
Other Urban or Built-up Land	
Golf courses (171)	67.73
Other areas (zoos; urban parks) (173)	24.36
Subtotal	**92.08**
Agriculture	
Cropland (21)	59.44
Orchards, Nurseries, Vineyards (22)	7.30
Confined Feeding Lots (23)	0.04
Pastures/hayfields (24)	5.30
Subtotal	**72.08**
Rangeland	
Herbaceous cover (31)	5.71
Shrub and brush cover (32)	55.55
Mixed (33)	13.90
Subtotal	**75.17**

Forest	
Deciduous forest (41)	130.67
Mixed (43)	99.77
Subtotal	**230.46**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	101.01
Fresh water	17.59
Subtotal	**118.60**
Other sand areas (73)	1.29
Mixed barren land (76)	1.90
Subtotal	**3.18**

Results for Bristol

Table 1. Extent of coastal wetlands and related features in Bristol.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	71.912
	Subtotal	**71.912**
Salt Marshes	E2EM1/SS1P (includes d,h,x)	3.221
	E2EM1N (includes d,h,x)	22.238
	E2EM1P (includes d,h,x)	79.659
	E2EM5P (includes d,h,x)	4.254
	Subtotal	**109.372**
Brackish Marshes	E2EM1P6 (includes d,h,x)	2.597
	E2EM5P6 (includes d,h,x)	3.439
	Subtotal	**6.036**
Oyster Reefs	E2RF2N (includes h)	3.164
Estuarine Rocky Shores	E2RS1N	2.464
	E2RS1P	1.517
	E2RS2N (includes r)	0.867
	E2RS2P (includes r)	0.747
	Subtotal	**8.759**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	10.448
	Subtotal	**10.448**
Estuarine Cobble- Gravel Shores		
	E2US1N and E2US1/2N	4.989
	E2US1P	3.665
	Subtotal	**8.654**

Estuarine Sandy Shores and Beaches		
	E2US2M	13.413
	E2US2N (includes r)	10.803
	E2US2/EM1N	3.423
	E2US2P (includes r)	36.274
	Subtotal	**63.913**
Estuarine Mudflats	E2US3M	14.533
	E2US3N (includes d,h)	4.527
	Subtotal	**19.060**
	Total Estuarine Waters and Wetlands	**298.154**

Table 2. Potential wetland restoration sites in Bristol.

Wetland Restoration Type		Current Classification	# of Sites	Acreage
1	filled (1f)	UPLAND	1	1.97
	Subtotal		**1**	**1.97**
	change in vegetated wetland type (1w)	PEM1/SS1E	1	2.99
		PSS1/EM1Rh	1	20.28
		PSS1/EM5Eh	1	6.01
		PUB/EM1Fh	1	1.82
	Subtotal		**4**	**31.10**
Total Type 1 Sites			**5**	**33.07**
2	ditched/tidally restricted (2d-2r and 2d-2r-2rs)	E2EM1/SS1Pdh	1	3.22
		E2EM1Pd	2	5.88
		E2EM1Pdh	3	51.68
	Subtotal		**6**	**60.78**
	ditched/tidally restricted/iva (2d-2r-2vi)	E2SS1Pd	2	5.35
	ditched/severely tidally restricted (2d-2rs)	E2EM5Pdh	1	4.25
	Subtotal		**3**	**9.60**
	tidally restricted (2r)	E1UBL	24	66.07
		E1UBLh	2	2.86
		E2EM1Nh	2	0.33
		E2EM1P	3	3.62
		E2EM1P6	2	1.41
		E2EM1Ph	2	3.43
		E2RF2Nh	4	3.16
	Subtotal		**39**	**80.88**

tidally restricted/ veg change-Iva (2r-2vi)	E2SS1P	5	3.39
Subtotal		**5**	**3.39**
vegetation change-Phragmites (2v)	E2EM5P6	1	3.44
Subtotal		**1**	**3.44**
Total Type 2 Sites		**54**	**158.09**
Total All Sites		**59**	**191.16**

Table 3. Extent of hardened shorelines in Bristol.

Hardened Shoreline (code)	**Length (in feet)**
Bulkhead (BK)	16231.164
Groin (GR)	1409.841
Permanent Pier (PP)	1163.435
Revetment (RR)	18180.626
Seawall (SW)	2954.72
Total Hardened Shoreline Length	**39939.79**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Bristol.

Landuse/cover (code)	**Acreage**
Residential	
Single family (lll)	318.05
Multi family (ll2)	4.96
Lawns (114)	130.55
Other (115)	13.02
Subtotal	**466.58**
Commercial	
Commercial and Institutional structures(121)	13.36
Marinas (123)	15.27
Paved surfaces (125)	13.21
Unpaved surfaces (126)	2.99
Wharves, piers, shipyards (127)	7.48
Subtotal	**52.31**
Transportation, Communications, and Utilities (14)	**10.96**
Other Urban or Built-up Land (17)	
Other areas (zoos; urban parks) (173)	75.06
Subtotal	**75.06**
Agriculture	
Cropland (21)	5.42
Orchards, Nurseries, Vineyards (22)	4.04
Pastures/hayfields (24)	55.87
Subtotal	**65.32**
Rangeland	
Herbaceous cover (31)	76.99
Shrub and brush cover (32)	60.59
Mixed (33)	30.42
Subtotal	**168.00**

Forest	
Deciduous forest (41)	48.69
Mixed (43)	322.39
Subtotal	**371.08**
Water and Freshwater Wetlands (56)	
Vegetated Freshwater Wetlands	67.12
Freshwater Wetlands	4.70
Subtotal	**71.82**
Barren Land	
Mixed barren land (76)	4.98
Subtotal	**4.98**

Results for Cranston

Table 1. Extent of coastal wetlands and related features in Cranston.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	**3.512**
Salt Marshes	E2EM1N (includes d,h,x)	0.245
	E2EM1P (includes d,h,x)	1.903
	E2EM5P (includes d,h,x)	1.346
	Subtotal	**3.494**
Estuarine Rocky Shores	E2RS1N	0.070
	E2RS2N (includes r)	0.271
	E2RS2P (includes r)	0.570
	Subtotal	**0.911**
Estuarine Sandy Shores And Beaches	E2US2M	44.927
	E2US2N (includes r)	1.598
	E2US2P (includes r)	1.026
	Subtotal	**47.551**
	Total Estuarine Waters and Wetlands	**55.468**

Table 2. Potential wetland restoration sites in Cranston.

Wetland Restoration Type		Current Classification	# of Sites	Acreage
2	ditched/veg change- Phragmites (2d-2v)	E2EM5Pd	2	1.340
	Subtotal		**2**	**1.340**
	ditched/veg change- Iva (2d-2vi)	E2SS1Pd	1	1.670
	Subtotal		**1**	**1.670**
	Total Type 2 sites		**3**	**3.010**
Total All Sites			**3**	**3.010**

Table 3. Extent of hardened shorelines in Cranston.

Hardened Shoreline	**Length (in feet)**
Bulkhead (BK)	3730.01
Breakwater (BW)	2327.64
Groin (GR)	506.43
Revetment (RR)	3036.56
Seawall (SW)	7079.89
Total Hardened Shoreline Length	**16680.53**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Cranston.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	104.90
Lawns (114)	8.09
Subtotal	**112.99**
Commercial	
Commercial and Institutional structures (121)	7.17
Marinas (123)	7.72
Wharves, piers, shipyards (127)	11.58
Subtotal	**26.49**
Other Urban or Built-up Land	
Other areas (zoos; urban parks) (173)	8.33
Subtotal	**8.33**
Rangeland	
Mixed (33)	5.73
Subtotal	**5.73**
Forest	
Deciduous forest (41)	0.89
Subtotal	**0.89**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	1.30
Subtotal	**1.30**

Results for East Greenwich

Table 1. Extent of coastal wetlands and related features in East Greenwich.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	**2.829**
Salt Marshes	E2EM1N (includes d,h,x)	2.182
	E2EM1P (includes d,h,x)	0.229
	Subtotal	**2.411**
Estuarine Mudflats	E2US3M	**2.914**
	Total Estuarine Waters and Wetlands	**8.154**

Table 2.

There are no potential restoration sites in East Greenwich.

Table 3. Extent of hardened shorelines in East Greenwich.

Hardened Shoreline (code)	**Length (in feet)**
Bulkhead (BK)	2599.10
Revetment (RR)	334.35
Total Hardened Shoreline Length	**2933.45**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in East Greenwich.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	25.85
Multi family (112)	1.69
Lawns (114)	2.55
Subtotal	**30.10**
Commercial	
Commercial and Institutional structures (121)	6.12
Marinas (123)	2.28
Paved surfaces (125)	1.67
Unpaved surfaces (126)	4.01
Wharves, piers, shipyards (127)	3.65
Subtotal	**17.75**
Industrial (13)	**8.92**
Rangeland	
Shrub and brush cover (32)	2.23
Subtotal	**2.23**
Forest	
Deciduous forest (41)	7.81
Subtotal	**7.81**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	2.66
Subtotal	**2.66**
Barren Land	
Mixed barren land (76)	9.63
Transitional Areas (77)	12.39
Subtotal	**22.03**

Results for East Providence

Table 1. Extent of coastal wetlands and related features in East Providence.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	116.619
	E1UBL6 (includes h,x)	15.605
	Subtotal	**132.224**
Salt Marshes	E2EM1N (includes d,h,x)	8.530
	E2EM1P (includes d,h,x)	61.928
	E2EM5P (includes d,h,x)	3.122
	Subtotal	**73.580**
Brackish Marshes	E2EM1/5P6 and E2EM5/1P6 (d,h,x)	5.120
	E2EM1N6 (includes d,h,x)	0.523
	E2EM1P6 (includes d,h,x)	1.342
	E2EM5P6 (includes d,h,x)	4.767
	Subtotal	**11.752**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	**5.533**
Estuarine Sandy Shores and Beaches		
	E2US2N (includes r)	13.457
	E2US2P (includes r)	4.051
	Subtotal	**17.508**
Estuarine Mudflats	E2US3M	**1.695**
Salt Pannes	E2US4M (includes d,h)	0.918
	E2US4N	1.535
	Subtotal	**2.453**
	Total Estuarine Waters and Wetlands	**244.745**

Table 2. Potential wetland restoration sites in East Providence.

Wetland Restoration Type (code)			Current Classification	# of Sites	Acreage
1	filled (1f)	upland	UPLAND	1	2.06
		Subtotal		**1**	**2.06**
	filled-spoil (1fsp)		UPLAND	1	26.80
		Subtotal		**5**	**26.80**
	submerged (1su)		L1UBVh	1	32.11
			PUBHh	1	4.28
			PUBVh	1	3.42
		Subtotal		**3**	**39.81**
	change in vegetated wetland type (1w)		PAB4Fh	1	1.09
			PEM5/1Rh	2	4.12
			PEM5/SS1Ch	1	3.48
			PUSAh	1	3.37
		Subtotal		**4**	**10.97**
	change to nonvegetated wetland (1x)		PUBFx	1	1.63
			PUSCx	1	1.84
		Subtotal		**2**	**3.47**
		Total Type 1 Sites		**15**	**83.11**
2	ditched	(2d)	E2EM1Pd	3	51.73
		Subtotal		**3**	**51.73**
	ditched/severely tidally restricted (2d-2rs)		E2EM5P6dh	1	1.370
		Subtotal		**1**	**1.37**

ditched/severely tidally restricted/ veg change - Phragmites (2d-2rs-2v)	E2EM5P6dh	2	1.10
Subtotal		**2**	**1.10**
ditched/veg change- Phragmites (2d-2v)	E2EM5/1P6d	1	4.37
Subtotal		**1**	**4.37**
tidally restricted (2r)	E1UBL	12	56.49
	E1UBL6	1	23.62
	E1UBL6h	1	14.88
	E2EM1N	4	1.34
	E2EM1N6h	1	0.45
	E2EM1Nh	1	0.36
	E2EM1P	5	1.99
	E2EM1P6	4	5.84
	E2EM1P6h	1	1.81
Subtotal		**30**	**106.78**
severely tidally restricted (2rs)	E2EM5P6	1	1.41
Subtotal		**1**	**1.41**
vegetation change- Phragmites (2v)	E2EM5/1P6	2	0.74
	E2EM5P	5	2.05
	E2EM5P6	1	0.49
Subtotal		**8**	**3.28**
vegetation change- Iva (2vi)	E2SS1P	5	5.54
Subtotal		**5**	**5.54**
Total Type 2 Sites		**51**	**175.58**
Total All Sites		**66**	**258.69**

Table 3. Extent of hardened shorelines in East Providence.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	12394.01
Bulkhead (BK)	13680.93
Jetty (JT)	513.47
Pemanent Pier (PP)	1745.22
Other Significant Pier (OSP)	1349.21
Revetment (RR)	10864.95
Total Hardened Shoreline Length	**40547.81**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in East Providence.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	305.87
Multi family (112)	42.04
Lawns (114)	31.74
Subtotal	**379.66**
Commercial	
Commercial and Institutional structures (121)	70.81
Marinas (123)	54.72
Paved surfaces (125)	2.44
Wharves, piers, shipyards (127)	8.25
Subtotal	**136.23**
Industrial (13)	**16.11**
Transportation, Communications, and Utilities (14)	**64.29**
Other Urban or Built-up Land (17)	25.90
Golf courses (171)	29.32
Cemeteries (172)	8.00
Other areas (zoos; urban parks) (173)	0.60
Subtotal	**63.83**
Agriculture	
Pastures/hayfields (24)	0.44
Subtotal	**0.44**
Rangeland	
Herbaceous cover (31)	20.27
Shrub and brush cover (32)	66.42
Mixed (33)	12.62
Subtotal	**99.32**

Forest	
Deciduous forest (41)	169.73
Mixed (43)	22.73
Subtotal	**192.46**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	45.95
Nonvegetated freshwater wetlands	12.67
Subtotal	**58.63**
Barren Land	
Other sand areas (73)	2.55
Bare exposed rock (74)	0.11
Mixed barren land (76)	101.67
Transitional Areas (77)	21.57
Subtotal	**125.91**

Results for Jamestown

Table 1. Extent of coastal wetlands and related features in Jamestown.

Wetland or Water Feature	Map Code	Acreage
Eelgrass Beds	E1AB3L (includes d, e)	**33.811**
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	**284.291**
Salt Marshes	E2EM1/US1N and E2EM1/US3N	2.368
	E2EM1N (includes d,h,x)	7.128
	E2EM1P (includes d,h,x)	104.023
	E2EM5P (includes d,h,x)	2.121
	Subtotal	**115.640**
Brackish Marshes	E2EM1P6 (includes d,h,x)	2.714
	E2EM5P6 (includes d,h,x)	1.820
	Subtotal	**4.534**
Estuarine Rocky Shores	E2RS1N	12.717
	E2RS1P	34.987
	E2RS2N (includes r)	5.013
	E2RS2P (includes r)	11.360
	Subtotal	**64.077**
Estuarine Cobble- Gravel Shores	E2US1N and E2US1/2N	13.461
	E2US1P	6.949
	Subtotal	**20.410**
Estuarine Sandy Shores and Beaches	E2US2M	3.311
	E2US2N (includes r)	28.598
	E2US2/1N	39.316
	E2US2P (includes r)	27.697
	Subtotal	**98.922**
	Total Estuarine Waters and Wetlands	**621.685**

Marine Eelgrass Beds	M1AB3L (includes d,e)	**0.778**
Marine Waters	M1UBL	**11.254**
Marine Rocky Shores	M2RS1N and M2RS2N (includes r)	6.701
	M2RS1P and M2RS2P (includes r)	36.028
	Subtotal	**42.729**
Marine Sandy Shores and Beaches	M2US2P	**0.633**
	Total Marine Waters and Wetlands	**43.362**

Table 2. Potential wetland restoration sites in Jamestown.

Wetland Restoration Type (code)			Current Classification	# of Sites	Acreage
1	**Total Type 1 Sites**			**0**	**0**
2	ditched	(2d)	E2EM1P6d	1	0.68
			E2EM1Pd	7	52.55
		Subtotal		**8**	**53.23**
	ditched/tidally restricted (2d-2r and 2d-2r-2rs)		E2EM1P6d	1	1.01
			E2EM1Pd	1	43.14
		Subtotal		**2**	**44.15**
	ditched/severely tidally restricted (2d-2rs)		E2EM5P6d	1	1.82
		Subtotal		**1**	**1.82**
	tidally restricted (2r)		E1UBL	1	8.77
		Subtotal		**1**	**8.77**
	vegetation change- Phragmites (2v)		E2EM5P	3	2.12
		Subtotal		**3**	**2.12**
	Total Type 2 Sites			**15**	**110.09**
Total All Sites				**15**	**110.09**

Table 3. Extent of hardened shorelines in Jamestown.

Hardened Shoreline (code)	**Length (in feet)**
Bulkhead (BK)	3171.01
Groin (GR)	1092.56
Pemanent Pier (PP)	2398.62
Other Significant Pier (OSP)	765.02
Revetment (RR)	6041.56
Seawall (SW)	5197.29
Total Hardened Shoreline Length	**18666.09**

Table 4. Land use/ cover in the 500-foot buffer surrounding tidal wetlands in Jamestown.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	413.36
Multi family (112)	3.46
Mobile home (113)	13.56
Lawns (114)	130.74
Subtotal	**561.12**
Commercial	
Commercial and Institutional structures (121)	9.33
Marinas (123)	4.45
Paved surfaces (125)	3.54
Wharves, piers, shipyards (127)	5.58
Subtotal	**22.90**
Transportation, Communications, and Utilities (14)	**35.30**
Other Urban or Built-up Land	
Golf courses (171)	16.14
Other areas (zoos; urban parks) (173)	3.86
Subtotal	**20.00**
Agriculture	
Cropland (21)	48.14
Pastures/hayfields (24)	66.96
Subtotal	**115.10**
Rangeland	
Herbaceous cover (31)	17.22
Shrub and brush cover (32)	600.85
Mixed (33)	16.52
Subtotal	**634.59**

Forest	
Deciduous forest (41)	179.14
Mixed (43)	132.89
Subtotal	**312.03**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	91.49
Nonvegetated freshwater wetlands	3.62
Subtotal	**95.11**
Barren Land	
Bare exposed rock (74)	1.53
Subtotal	**1.53**

Results for Little Compton

Table 1. Extent of coastal wetlands and related features in Little Compton.

Wetland or Water Feature	Map Code	Acreage
Eelgrass Beds	EIAB3L (includes e)	0.311
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	12.546
	Subtotal	**12.857**
Salt Marshes	E2EM1N (includes d,h,x)	1.573
	E2EM1P (includes d,h,x)	34.849
	E2EM5P (includes d,h,x)	4.077
	Subtotal	**40.499**
Brackish Marshes	E2EM1P6 (includes d,h,x)	3.885
	E2EM5P6 (includes d,h,x)	2.509
	Subtotal	**6.394**
Estuarine Rocky Shores	E2RS1N	6.396
	E2RS1P	11.838
	E2RS2N (includes r)	18.405
	Subtotal	**36.639**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	0.800
	Subtotal	**0.800**
Estuarine Cobble- Gravel Shores		
	E2US1N and E2US1/2N	10.610
	E2US1P	12.961
	Subtotal	**23.571**
Estuarine Sandy Shores and Beaches		
	E2US2N (includes r)	8.348
	E2US2P (includes r)	52.097
	Subtotal	**60.445**

Estuarine Mudflats	E2US3N (includes d,h)	16.361
	Subtotal	**16.361**
	Total Estuarine Waters and Wetlands	**197.566**
Marine Waters	M1UBL	**35.758**
Marine Rocky Shores	M2RS1N and M2RS2N (includes r)	1.995
	M2RS1P and M2RS2P (includes r)	1.085
	Subtotal	**3.080**
	Total Marine Waters and Wetlands	**38.838**

Table 2. Potential wetland restoration sites in Little Compton.

Wetland Restoration Type		Current Classification	# of Sites	Acreage
1	filled (1f)	UPLAND	3	0.810
	Subtotal		**3**	**0.810**
	change in vegetated wetland type (1w)	PEM1Rh	1	4.290
		PSS1Rh	1	1.060
	Subtotal		**2**	**5.350**
	change to nonvegetated wetland (1x)	PUB/AB4Hx	1	0.630
	Subtotal		**1**	**0.630**
	Total Type 1 Sites		**6**	**7**
2	ditched/tidally restricted (2d-2r and 2d-2r-2rs)	E2EM1Pdh	1	4.600
	Subtotal		**1**	**4.600**
	ditched/severely tidally restricted (2d-2rs)	E2EM5P6d	2	1.700
	Subtotal		**2**	**1.700**
	tidally restricted (2r)	E1UBL	1	0.960
	Subtotal		**1**	**0.960**
	tidally restricted/ veg change-Iva (2r-2vi)	E2SS1P	1	0.800
	severely tidally restricted (2rs)	E2EM5P6d	1	0.710
	Subtotal		**2**	**1.510**

vegetation change-Phragmites (2v)	E2EM5P	3	4.070
Subtotal		**3**	**4.070**
Total Type 2 sites		**9**	**13**
Total All Sites		**15**	**20**

Table 3. Extent of hardened shorelines in Little Compton.

Hardened Shoreline (code)	**Length (in feet)**
Bulkhead (BK)	3353.775
Breakwater (BW)	1421.613
Groin (GR)	242.099
Revetment (RR)	6056.464
Seawall (SW)	632.947
Total Hardened Shoreline Length	**11706.90**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Little Compton.

Landuse/landcover (code)	**Acreage**
Residential	
Single family (lll)	130.73
Lawns (114)	24.75
Subtotal	**155.48**
Commercial: Marinas (123)	**4.84**
Other Urban or Built-up Land (17)	
Golf courses (171)	11.29
Subtotal	**11.29**
Agriculture	
Cropland (21)	115.59
Orchards, Nurseries, Vineyards (22)	10.00
Pastures/hayfields (24)	37.27
Subtotal	**162.86**
Rangeland	
Herbaceous cover (31)	18.01
Shrub and brush cover (32)	52.91
Mixed (33)	13.24
Subtotal	**84.17**
Forest	
Deciduous forest (41)	11.21
Mixed (43)	27.07
Subtotal	**38.27**
Water and Freshwater Wetlands (56)	
Vegetated Freshwater Wetlands	85.63
Freshwater Wetlands	0.75
Subtotal	**86.38**
Barren Land: Other sand areas (73)	**0.74**

Results for Middletown

Table 1. Extent of coastal wetlands and related features in Middletown.

Wetland or Water Feature	Map Code	Acreage
Eelgrass Beds	E1AB3L (includes e)	**4.228**
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	**17.694**
Salt Marshes	E2EM1N (includes d,h,x)	0.063
	E2EM1P (includes d,h,x)	17.052
	Subtotal	**17.115**
Brackish Marshes	E2EM1P6 (includes d,h,x)	**29.354**
Estuarine Rocky Shores	E2RS1P	14.645
	E2RS2N (includes r)	1.040
	Subtotal	**15.685**
Estuarine Cobble- Gravel Shores	E2US1N and E2US1/2N	**0.728**
Estuarine Sandy Shores and Beaches	E2US2N (includes r)	1.450
	E2US2P (includes r)	16.520
	Subtotal	**17.970**
	Total Estuarine Waters and Wetlands	**102.774**
Marine Waters	M1UBL	**4.583**
Marine Rocky Shores	M2RS1N and M2RS2N (includes r)	30.546
	M2RS1P and M2RS2P (includes r)	30.887
	Subtotal	**61.433**
Marine Cobble-Gravel Shores	M2US1N	**5.904**
Marine Sandy Shores and Beaches	M2US2M	
	M2US2N	23.170
	M2US2P	17.633
	Subtotal	**40.803**
	Total Marine Waters and Wetlands	**108.140**

Table 2. Potential wetland restoration sites in Middletown.

Wetland Restoration Type (code)			Current Classification	# of Sites	Acreage
1	filled (1f)	upland	UPLAND	5	21.04
		Subtotal		**5**	**21.04**
	submerged (1su)		L1UBHh	1	100.96
			L1UBVh	1	83.39
		Subtotal		**2**	**184.350**
	change in vegetated wetland type (1w)		L2AB4Vh	1	23.49
			PEM1/SS1Rh	1	0.76
			PEM1Rh	2	3.62
			PEM5/1Rh	1	20.14
			PEM5Rh	3	9.21
		Subtotal		**7**	**33.73**
	Total Type 1 Sites			**14**	**239.12**
2	ditched/tidally restricted (2d-2r and 2d-2r-2rs)		E2EM1Pd	2	16.43
		Subtotal		**2**	**16.43**
	tidally restricted (2r)		E1UB4L	2	0.59
			E2EM1P	1	0.62
			E2EM1P6h	1	29.35
		Subtotal		**4**	**30.56**
	Total Type 2 Sites			**6**	**46.99**
Total All Sites				**20**	**286.11**

Table 3. Extent of hardened shorelines in Middletown.

Hardened Shoreline (code)	**Length (in feet)**
Bulkhead (BK)	4484.35
Breakwater (BW)	8793.30
Groin (GR)	620.189
Pemanent Pier (PP)	8860.67
Revetment (RR)	4737.59
Seawall (SW)	2617.23
Total Hardened Shoreline Length	**30113.33**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Middletown.

Landuse/landcover (code)	**Acreage**
Residential	
Single family (111)	129.986
Lawns (114)	52.365
Subtotal	**182.351**
Commercial	
Commercial and Institutional structures (121)	63.662
Recreational structures (122)	4.293
Paved surfaces (125)	16.324
Unpaved surfaces (126)	7.757
Wharves, piers, shipyards (127)	8.744
Subtotal	**100.780**
Transportation, Communications, and Utilities (14)	**4.693**
Other Urban or Built-up Land	
Golf courses (171)	17.187
Cemeteries (172)	0.526
Landfills (174)	12.952
Subtotal	**30.665**
Agriculture	
Cropland (21)	1.145
Orchards, Nurseries, Vineyards (22)	4.2670
Pastures/hayfields (24)	12.596
Subtotal	**18.008**
Rangeland	
Herbaceous cover (31)	11.288
Shrub and brush cover (32)	180.666
Mixed (33)	19.988
Subtotal	**211.942**

Forest	
Deciduous forest (41)	45.354
Mixed (43)	3.468
Subtotal	**48.822**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	25.129
Nonvegetated freshwater wetlands	12.500
Subtotal	**37.629**
Barren Land	
Other sand areas (73)	27.233
Bare exposed rock (74)	0.715
Subtotal	**27.948**

Results for Narragansett

Table 1. Extent of coastal wetlands and related features in Narragansett.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	130.850
	E1UBL6 (includes h,x)	67.005
	Subtotal	**197.855**
Salt Marshes	E2EM1N (includes d,h,x)	0.592
	E2EM1P (includes d,h,x)	131.011
	E2EM5P (includes d,h,x)	4.986
	Subtotal	**136.589**
Brackish Marshes	E2EM1/5P6 & E2EM5/1P6 (d,h,x)	4.614
	E2EM1P6 (includes d,h,x)	5.828
	E2EM5P6 (includes d,h,x)	14.366
	Subtotal	**24.808**
Estuarine Rocky Shores	E2RS1N	1.889
	E2RS1P	8.502
	E2RS2N (includes r)	8.290
	E2RS2P (includes r)	0.444
	Subtotal	**19.125**
Estuarine Streambeds	E2SB2N AND E1SB3N	**1.162**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	**5.852**
Estuarine Cobble-Gravel Shores	E2US1N and E2US1/2N	**2.380**
Estuarine Sandy Shores/Beaches	E2US2N (includes r)	3.053
	E2US2P (includes r)	7.462
	Subtotal	**10.515**
Estuarine Mudflats	E2US3M	**23.296**

Salt Pannes	E2US4M (includes d,h)	**0.893**
	Total Estuarine Waters and Wetlands	**422.475**
Marine Waters	M1UBL	**16.833**
Marine Rocky Shores	M2RS1N and M2RS2N (includes r)	41.019
	M2RS1P and M2RS2P (includes r)	54.503
	Subtotal	**95.522**
Marine Cobble-Gravel Shores	M2US1P	**6.746**
Marine Sandy Shores and Beaches	M2US2N	36.778
	M2US2P	38.061
	Subtotal	**74.839**
	Total Marine Waters and Wetlands	**177.107**

Table 2. Potential wetland restoration sites in the Town of Narragansett

Wetland Restoration Type (code)		Current Classification	# of Sites	Acreage
1	submerged (1su)	PUBHh	1	5.35
	Subtotal		**1**	**5.35**
	change in vegetated wetland type (1w)	PAB4/EM2Fh	1	8.78
		PAB4Fh	1	0.46
		PEM1Rh	1	6.99
		PEM5Eh	1	1.72
		PSS1Rh	1	2.28
	Subtotal		**4**	**11.45**
	Total Type 1 Sites		**5**	**16.80**
2	ditched (2d)	E2EM1Pd	7	101.83
		E2SS1Pd	1	0.39
	Subtotal		**8**	**102.22**
	tidally restricted (2r)	E1UBL6h	2	66.67
		E2EM1P6h	2	5.11
		E2EM5P6h	1	2.23
	Subtotal		**5**	**74.01**
	severely tidally restricted (2rs)	E2EM1/5P6h	1	3.99
		E2EM5P6h	3	12.14
	Subtotal		**4**	**16.13**
	severely tidally restricted/ veg change- Phragmites (2rs-2v)	E2EM5P6h	1	0.38
	Subtotal		**1**	**0.38**
	vegetation change- Phragmites (2v)	E2EM5P	10	3.86
	Subtotal		**10**	**3.86**
	Total Type 2 Sites		**28**	**196.60**
Total All Sites			**33**	**213.40**

Table 3. Extent of hardened shorelines in Narragansett.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	5185.267
Bulkhead (BK)	3968.184
Breakwater (BW)	618.104
Groin (GR)	2562.649
Other Significant Pier (OSP)	265.348
Revetment (RR)	6584.245
Seawall (SW)	10074.275
Total Hardened Shoreline Length	**29258.07**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Narragansett.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	616.618
Multi family (112)	14.145
Mobile home (113)	109.526
Lawns (114)	7.178
Subtotal	**747.467**
Commercial	
Commercial and Institutional structures (121)	68.610
Recreational structures (122)	23.067
Marinas (123)	0.635
Paved surfaces (125)	43.322
Unpaved surfaces (126)	2.090
Wharves, piers, shipyards (127)	0.774
Subtotal	**138.498**
Transportation, Communications, and Utilities (14)	**30.015**
Agriculture	
Pastures/hayfields (24)	6.984
Subtotal	**6.984**
Rangeland	
Herbaceous cover (31)	7.611
Shrub and brush cover (32)	93.878
Mixed (33)	41.804
Subtotal	**143.293**
Forest	
Deciduous forest (41)	84.161
Evergreen forest (42)	0.550
Mixed (43)	165.255
Subtotal	**249.966**

Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	123.374
Nonvegetated freshwater wetlands	6.140
Subtotal	**129.514**
Barren Land	
Other sand areas (73)	10.911
Mixed barren land (76)	4.387
Subtotal	**15.298**

Results for Newport

Table 1. Extent of coastal wetlands and related features in Newport.

Wetland or Water Feature	Map Code	Acreage
Eelgrass Beds	EIAB3L (includes c, d, e)	36.385
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	50.558
	Subtotal	**86.943**
Salt Marshes	E2EM1N (includes d,h,x)	1.237
	E2EM1P (includes d,h,x)	23.465
	E2EM5P (includes d,h,x)	5.717
	Subtotal	**30.419**
Estuarine Rocky Shores	E2RS2P (includes r)	**1.048**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	**0.821**
Estuarine Sandy Shores and Beaches	E2US2M	4.582
	E2US2N (includes r)	8.727
	E2US2P (includes r)	5.856
	Subtotal	**19.165**
	Total Estuarine Waters and Wetlands	**138.396**
Marine Eelgrass Beds	M1AB3L (includes d,e)	**1.834**
Marine Waters	M1UBL	**26.461**
Marine Rocky Shores	M2RS1N and M2RS2N (includes r)	63.122
	M2RS1P and M2RS2P (includes r)	75.030
	Subtotal	**138.152**
Marine Cobble-Gravel Shores	M2US1P	**2.813**
Marine Sandy Shores and Beaches	M2US2M	2.277
	M2US2N	40.761
	M2US2P	20.900
	Subtotal	**63.938**
	Total Marine Waters and Wetlands	**204.903**

Table 2. Potential wetland restoration sites in Newport.

Wetland Restoration Type (code)		Current Classification	# of Sites	Acreage
1	submerged (1su)	L1UBHh	1	10.04
		L1UBVh	2	121.18
	Subtotal		**3**	**131.22**
	change in vegetated wetland type (1w)	L2AB4Vh	2	57.07
		PEM1Rh	1	4.05
		PEM5Rh	2	8.21
		PSS1/EM5Rh	1	16.14
	Subtotal		**6**	**85.47**
	Total Type 1 Sites		**9**	**216.69**
2	ditched (2d)	E2EM1Pd	1	2.01
	Subtotal		**1**	**2.01**
	ditched/tidally restricted (2d-2r and 2d-2r-2rs)	E2EM1Pd	1	6.15
		E2EM1Pdh	1	2.22
	Subtotal		**2**	**8.37**
	ditched/severely tidally restricted (2d-2rs)	E2EM5Pdh	1	2.19
	Subtotal		**1**	**2.19**
	ditched/veg change- Phragmites (2d-2v)	E2EM5Pd	1	1.49
	Subtotal		**1**	**1.49**
	tidally restricted (2r)	E1UBLh	2	32.64
		E2EM1Nh	1	0.66
		E2EM1P	1	3.29
		E2EM1Ph	4	9.53
	Subtotal		**8**	**46.12**

severely tidally restricted (2rs)	E2EM5Ph	4	1.51
Subtotal		**4**	**1.51**
severely tidally restricted/veg change-Phragmites (2rs-2v)	E2EM5Ph	1	0.93
Subtotal		**1**	**0.93**
vegetation change- Iva (2vi)	E2SS1P	1	0.82
Subtotal		**1**	**0.82**
Total Type 2 Sites		**19**	**63.44**
Total All Sites		**28**	**280.13**

Table 3. Extent of hardened shorelines in Newport.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	966.886
Bulkhead (BK)	29860.473
Groin (GR)	980.00
Pemanent Pier (PP)	12501.47
Other Significant Pier (OSP)	606.199
Revetment (RR)	10726.175
Seawall (SW)	24258.084
Total Hardened Shoreline Length	**79899.29**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Newport.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	193.866
Multi family (112)	21.185
Lawns (114)	272.005
Subtotal	**487.056**
Commercial	
Commercial and Institutional structures (121)	194.814
Recreational structures (122)	5.166
Paved surfaces (125)	39.136
Unpaved surfaces (126)	11.092
Wharves, piers, shipyards (127)	52.825
Subtotal	**303.033**
Transportation, Communications, and Utilities (14)	**35.278**
Other Urban or Built-up Land	
Golf courses (171)	17.751
Other areas (zoos; urban parks) (173)	17.284
Subtotal	**35.035**
Agriculture	
Orchards, Nurseries, Vineyards (22)	0.691
Pastures/hayfields (24)	8.940
Subtotal	**9.631**
Rangeland	
Herbaceous cover (31)	69.031
Shrub and brush cover (32)	163.20
Mixed (33)	7.946
Subtotal	**240.177**

Forest	
Deciduous forest (41)	181.794
Mixed (43)	4.685
Subtotal	**186.479**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	21.538
Nonvegetated freshwater wetlands	7.118
Subtotal	**28.656**
Barren Land	
Other sand areas (73)	4.287
Mixed barren land (76)	0.632
Subtotal	**4.919**

Results for North Kingstown

Table 1. Extent of coastal wetlands and related features in North Kingstown.

Wetland or Water Feature	Map Code	Acreage
Eelgrass Beds	EIAB3L	**8.590**
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	174.372
	E1UBL6 (includes h,x)	8.873
	Subtotal	**183.245**
Salt Marshes	E2EM1N (includes d,h,x)	21.053
	E2EM1P (includes d,h,x)	131.657
	E2EM5P (includes d,h,x)	27.359
	Subtotal	**180.069**
Brackish Marshes	E2EM1/5P6 and	
	E2EM5/1P6 (includes d,h,x)	0.501
	E2EM1P6 (includes d,h,x)	16.427
	E2EM5P6 (includes d,h,x)	6.066
	Subtotal	**22.994**
Estuarine Rocky Shores	E2RS1P	1.448
	E2RS2N (includes r)	6.830
	E2RS2P (includes r)	0.583
	Subtotal	**8.861**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	**4.689**
Estuarine Sandy Shores and Beaches	E2US2N (includes r)	16.763
	E2US2P (includes r)	63.994
	Subtotal	**80.757**
Estuarine Mudflats	E2US3M	**15.271**
	Total Est. Waters and Wetlands	**504.476**

Table 2. Potential wetland restoration sites in North Kingstown.

Wetland Restoration Type (code)			Current Classification	# of Sites	Acreage
1	filled (1f)	upland	UPLAND	1	1.01
		Subtotal		**1**	**1.01**
		Total Type 1 Sites		**1**	**1.01**
2	ditched	(2d)	E2EM1Pd	**7**	**28.65**
	ditched/veg change- Iva (2d-2vi)		E2SS1Pd	**1**	**4.39**
	tidally restricted (2r)		E1UBL	14	20.48
			E1UBLh	3	2.97
			E2EM1Nh	3	4.53
			E2EM1P	3	3.61
			E2EM1P6	1	6.15
			E2EM1Ph	7	14.01
			E2SS1P	1	0.16
		Subtotal		**32**	**51.91**
	severely tidally restricted (2rs)		E2EM5P6	1	4.10
			E2EM5Ph	2	1.40
		Subtotal		**3**	**5.50**
	severely tidally restricted/ veg change- Phragmites (2rs-2v)		E2EM5P	**3**	**1.36**
	vegetation change- Phragmites (2v)		E2EM1/5P6	1	0.50
			E2EM5P	15	18.00
			E2EM5P6	1	1.88
			E2EM5Ph	1	6.84
		Subtotal		**18**	**27.22**
	Total Type 2 Sites			**64**	**119.03**
Total All Sites				**65**	**120.04**

Table 3. Extent of hardened shorelines in North Kingstown.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	1850.046
Bulkhead (BK)	25013.418
Breakwater (BW)	1571.475
Groin (GR)	3107.350
Jetty (JT)	3715.436
Pemanent Pier (PP)	6325.197
Other Significant Pier (OSP)	538.526
Revetment (RR)	16176.371
Seawall (SW)	6924.210
Total Hardened Shoreline Length	**65222.03**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in North Kingstown.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	542.949
Multi family (112)	26.594
Lawns (114)	139.808
Other (115)	0.529
Subtotal	**709.88**
Commercial	
Commercial and Institutional structures (121)	55.636
Marinas (123)	8.384
Paved surfaces (125)	64.496
Unpaved surfaces (126)	1.149
Wharves, piers, shipyards (127)	74.651
Subtotal	**204.316**
Transportation, Communications, and Utilities (14)	**70.121**
Other Urban or Built-up Land	
Golf courses (171)	54.465
Other areas (zoos; urban parks) (173)	0.855
Landfills (174)	14.870
Subtotal	**70.19**
Agriculture	
Cropland (21)	2.612
Pastures/hayfields (24)	10.774
Subtotal	**13.386**
Rangeland	
Herbaceous cover (31)	11.741
Shrub and brush cover (32)	80.933
Mixed (33)	152.699
Subtotal	**245.373**

Forest	
Deciduous forest (41)	372.642
Mixed (43)	458.384
Subtotal	**831.026**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	182.053
Nonvegetated freshwater wetlands	5.976
Subtotal	**188.029**
Barren Land	
Other sand areas (73)	13.261
Bare exposed rock (74)	0.612
Mixed barren land (76)	11.672
Transitional Areas (77)	3.885
Subtotal	**29.43**

Results for Pawtucket

Table 1. Extent of coastal wetlands and related features in Pawtucket.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	**12.215**
Salt Marshes	E2EM1N (includes d,h,x)	**0.542**
Brackish Marshes	E2EM1P6 (includes d,h,x)	**0.085**
	Total Estuarine Waters and Wetlands	**12.842**

Table 2. Potential wetland restoration sites in Pawtucket.

Wetland Restoration Type (code)		Current Classification	# of Sites	Acreage
2	ditched (2d)	E2EM1P6d	1	0.09
	Subtotal		**1**	**0.09**
	Total Type 2 Sites		**1**	**0.09**
Total All Sites			**1**	**0.09**

Table 3. Extent of hardened shorelines in Pawtucket.

Hardened Shoreline (code)	**Length (in feet)**
Bulkhead (BK)	2897.533
Total Hardened Shoreline Length	**2897.53**

Table 4. Land use/ cover in the 500-foot buffer surrounding tidal wetlands in Pawtucket.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	7.000
Multi family (112)	0.994
Lawns (114)	4.790
Subtotal	**12.784**
Commercial	
Commercial and Institutional structures (121)	54.443
Paved surfaces (125)	2.564
Subtotal	**57.007**
Transportation, Communications, and Utilities (14)	**14.921**
Other Urban or Built-up Land	
Cemeteries (172)	7.234
Other areas (zoos; urban parks) (173)	11.127
Subtotal	**18.361**
Rangeland	
Herbaceous cover (31)	1.451
Shrub and brush cover (32)	12.976
Mixed (33)	21.562
Subtotal	**35.989**
Forest	
Deciduous forest (41)	31.169
Mixed (43)	10.040
Subtotal	**41.209**
Barren Land	
Mixed barren land (76)	1.650
Subtotal	**1.650**

Results for Portsmouth

Table 1. Extent of coastal wetlands and related features in Portsmouth.

Wetland or Water Feature	Map Code	Acreage
Eelgrass Beds	EIAB3L (includes d,e)	**9.255**
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	134.102
	E1UBL6 (includes h,x)	9.986
	Subtotal	**144.088**
Salt Marshes	E2EM1N (includes d,h,x)	34.605
	E2EM1P (includes d,h,x)	303.789
	E2EM5P (includes d,h,x)	8.219
	E2EM5/SS1P	3.267
	Subtotal	**349.88**
Brackish Marshes	E2EM1P6 (includes d,h,x)	7.977
	E2EM5P6 (includes d,h,x)	54.227
	Subtotal	**62.204**
Oyster Reefs	E2RF2N (includes h)	**0.945**
Estuarine Rocky Shores	E2RS1N	4.620
	E2RS1P	16.727
	E2RS2N (includes r)	20.924
	E2RS2P (includes r)	0.142
	Subtotal	**43.358**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	**38.405**
Estuarine Cobble- Gravel Shores	E2US1N and E2US1/2N	30.889
	E2US1P	32.911
	Subtotal	**63.80**

Estuarine Sandy Shores and Beaches	E2US2M	3.671
	E2US2N (includes r)	135.558
	E2US2/1N	2.818
	E2US2P (includes r)	127.734
	Subtotal	**269.781**
Estuarine Mudflats	E2US3M	**18.450**
Salt Pannes	E2US4M (includes d,h)	3.858
	E2US4N	0.180
	Subtotal	**4.038**
	Total Estuarine Waters andWetlands	**1003.26**

Table 2. Potential wetland restoration sites in Portsmouth.

Wetland Restoration Type (code)			Current Classification	# of Sites	Acreage
1	filled (1f)	upland	UPLAND	9	16.31
		Subtotal		**9**	**16.31**
	filled-spoil (1fsp)		UPLAND	2	6.04
		Subtotal		**2**	**6.04**
	submerged (1su)		PUBHh	1	0.65
			PUBVh	1	1.00
		Subtotal		**2**	**1.65**
	change in vegetated wetland type (1w)		PABHh	1	0.54
			PEM1R	1	0.67
			PEM5/SS1Rh	2	1.29
			PEM5Ch	1	0.48
			PEM5Rh	4	10.83
			PSS1Eh	1	1.60
			PSS1R	1	2.59
			PSS1Rd	1	10.41
			PSS1Rh	1	0.14
		Subtotal		**12**	**28.01**
	change to nonvegetated wetland (1x)		PUBFx	1	0.36
			PUBVx	1	0.52
		Subtotal		**2**	**0.88**
		Total Type 1 Sites		**27**	**52.89**
2	ditched	(2d)	E2EM1Pd	12	188.52
			E2US4Md	2	0.94
		Subtotal		**14**	**189.46**
	ditched/tidally restricted (2d-2r and 2d-2r-2rs)		E2EM1Pd	1	10.41
		Subtotal		**1**	**10.41**

ditched/veg change- Iva (2d-2vi)	E2SS1P	4	7.08
Subtotal		**4**	**7.08**
impounded (2h)	E1UBL6	1	9.99
	E2EM1P6	2	1.09
Subtotal		**3**	**11.08**
impounded/veg change- Phragmites (2h-2v)	E2EM5P6	2	1.07
	E2EM5Ph	1	1.61
Subtotal		**3**	**2.68**
tidally restricted (2r)	E1UBL	1	6.16
	E1UBLh	1	1.14
	E2EM1P6h	1	2.29
	E2EM1Ph	2	3.86
Subtotal		**5**	**13.45**
severely tidally restricted/veg change- Phragmites (2rs-2v)	E2EM5P6	2	44.11
	E2EM5P6h	1	1.55
	E2EM5Ph	1	0.66
Subtotal		**4**	**46.32**
vegetation change- Phragmites (2v)	E2EM5P	15	9.53
	E2EM5P6	2	7.50
Subtotal		**17**	**17.03**
vegetation change- Iva (2vi)	E2SS1P	12	20.08
	E2SS1Pd	1	1.74
Subtotal		**13**	**21.82**
veg change-Iva and Phragmites (2vi-2v)	E2EM5/SS1P	1	**3.27**
excavated/tidally restricted (2x-2r)	E1UBLx	1	**0.22**
Total Type 2 Sites		**66**	**322.82**
Total All Sites		**93**	**375.71**

Table 3. Extent of hardened shorelines in Portsmouth.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	2663.031
Bulkhead (BK)	22303.860
Breakwater (BW)	2300.275
Groin (GR)	1825.570
Other Hardened Shore (OHS)	705.035
Pemanent Pier (PP)	6576.662
Other Significant Pier (OSP)	3093.767
Revetment (RR)	12662.039
Seawall (SW)	10083.160
Total Hardened Shoreline Length	**37246.51**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Portsmouth.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	687.309
Multi family (112)	7.679
Lawns (114)	127.267
Subtotal	**822.255**
Commercial	
Commercial and Institutional structures (121)	13.038
Marinas (123)	9.175
Junkyards (124)	0.053
Paved surfaces (125)	5.974
Unpaved surfaces (126)	5.563
Wharves, piers, shipyards (127)	22.480
Other (12)	1.205
Subtotal	**57.4880**
Transportation, Communications, and Utilities (14)	**53.740**
Other Urban or Built-up Land	
Golf courses (171)	88.229
Other areas (zoos; urban parks) (173)	9.338
Subtotal	**97.567**
Agriculture	
Cropland (21)	45.727
Orchards, Nurseries, Vineyards (22)	2.323
Pastures/hayfields (24)	18.354
Subtotal	**66.404**
Rangeland	
Herbaceous cover (31)	40.732
Shrub and brush cover (32)	802.732
Mixed (33)	134.466
Subtotal	**977.9300**

Forest	
Deciduous forest (41)	261.349
Evergreen forest (42)	11.510
Mixed (43)	556.858
Subtotal	**829.717**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	163.938
Nonvegetated freshwater wetlands	7.148
Subtotal	**171.086**
Barren Land	
Other sand areas (73)	31.051
Bare exposed rock (74)	0.166
Mixed barren land (76)	27.862
Transitional Areas (77)	2.588
Subtotal	**61.667**

Results for Providence

Table 1. Extent of coastal wetlands and related features in Providence.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	38.051
	E1UBL6 (includes h,x)	13.828
	Subtotal	**51.879**
Salt Marshes	E2EM1N (includes d,h,x)	0.582
	E2EM1P (includes d,h,x)	4.839
	Subtotal	**5.421**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	**0.174**
Estuarine Sandy Shores and Beaches	E2US2M	0.467
	E2US2N (includes r)	1.124
	Subtotal	**1.591**
	Total Estuarine Waters and Wetlands	**59.065**

Table 2. Potential wetland restoration sites in Providence.

Wetland Restoration Type (code)		Current Classification	# of Sites	Acreage
1	submerged (1su)	PUBHh	1	0.630
	Subtotal		**1**	**0.630**
	change in vegetated wetland type (1w)	PAB4Vh	1	0.970
		PSS1Rh	1	0.230
	Subtotal		**2**	**1.200**
	Total Type 1 Sites		**3**	**1.83**
Total All Sites			**3**	**1.83**

Table 3. Extent of hardened shorelines in Providence.

Hardened Shoreline (code)	**Length (in feet)**
Bulkhead (BK)	31507.044
Pemanent Pier (PP)	2330.256
Other Significant Pier (OSP)	1905.028
Revetment (RR)	14201.848
Total Hardened Shoreline Length	**18437.13**

Table 4. Land use/ cover in the 500-foot buffer surrounding tidal wetlands in Providence.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	28.092
Lawns (114)	14.501
Subtotal	**42.593**
Commercial	
Commercial and Institutional structures (121)	242.390
Marinas (123)	0.966
Paved surfaces (125)	18.469
Wharves, piers, shipyards (127)	178.115
Subtotal	**439.940**
Industrial (13)	**10.194**
Transportation, Communications, and Utilities (14)	**75.925**
Other Urban or Built-up Land	
Cemeteries (172)	23.962
Other areas (zoos; urban parks) (173)	45.819
Subtotal	**69.781**
Rangeland	
Herbaceous cover (31)	1.082
Shrub and brush cover (32)	2.704
Mixed (33)	28.762
Subtotal	**32.548**
Forest	
Deciduous forest (41)	65.101
Mixed (43)	32.344
Subtotal	**97.445**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	4.279
Nonvegetated freshwater wetlands	1.370
Subtotal	**5.649**
Barren Land Mixed (76)	**11.026**

Results for South Kingstown

Table 1. Extent of coastal wetlands and related features in South Kingstown.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x) E1UBL6 (includes h,x)	9.265
	Subtotal	**9.265**
Salt Marshes	E2EM1P (includes d,h,x)	65.421
	E2EM5P (includes d,h,x)	0.666
	Subtotal	**66.087**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	**2.983**
Estuarine Mudflats	E2US3M	**1.621**
Salt Pannes	E2US4M (includes d,h)	**0.639**
	Total Estuarine Waters and Wetlands	**80.595**

Table 2. Potential wetland restoration sites in South Kingstown.

Wetland Restoration Type (code)			Current Classification	# of Sites	Acreage
1	**Total Type 1 Sites**			**0**	**0**
2	ditched	(2d)	E2EM1Pd	5	24.07
		Subtotal		**5**	**24.07**
	vegetation change- Phragmites	(2v)	E2EM5P	3	1.37
		Subtotal		**3**	**1.37**
	Total Type 2 Sites			**8**	**25.44**
Total All Sites				**8**	**25.44**

Table 3. Extent of hardened shorelines in South Kingstown.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	84.266
Bulkhead (BK)	2101.646
Revetment (RR)	374.198
Total Hardened Shoreline Length	**2560.11**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in South Kingstown.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	40.842
Lawns (114)	1.619
Subtotal	**42.461**
Agriculture	
Pastures/hayfields (24)	10.518
Subtotal	**10.518**
Rangeland	
Shrub and brush cover (32)	6.055
Subtotal	**6.055**
Forest	
Mixed (43)	168.263
Subtotal	**168.263**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	14.761
Nonvegetated freshwater wetlands	0.308
Subtotal	**15.069**

Results for Tiverton

Table 1. Extent of coastal wetlands and related features in Tiverton.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	**80.930**
Salt Marshes	E2EM1/5P (includes d,h,x;	1.629
	E2EM5/1P (includes d,h,x)	0.464
	E2EM1N (includes d,h,x)	11.488
	E2EM1P (includes d,h,x)	215.241
	E2EM5P (includes d,h,x)	46.833
	Subtotal	**275.655**
Brackish Marshes	E2EM1P6 (includes d,h,x)	1.252
	E2EM5P6 (includes d,h,x)	6.861
	Subtotal	**8.113**
Estuarine Rocky Shores	E2RS1N	0.940
	E2RS1P	1.643
	E2RS2N (includes r)	1.344
	Subtotal	**3.927**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	**9.922**
Estuarine Sandy Shores and Beaches	E2US2N (includes r)	57.423
	E2US2P (includes r)	42.510
	Subtotal	**99.933**
Estuarine Mudflats	E2US3M	1.053
	E2US3N (includes d,h)	11.733
	Subtotal	**12.786**
Salt Pannes	E2US4M (includes d,h)	**6.966**
	Total Estuarine Waters and Wetlands	**498.232**

Table 2. Potential wetland restoration sites in Tiverton.

Wetland Restoration Type (code)			Current Classification	# of Sites	Acreage
1	filled (1f)	upland	UPLAND	2	2.61
		Subtotal		**2**	**2.61**
	change in vegetated wetland type (1w)				
			PAB4Hh	1	0.54
		PAB	PEM1/UBTh	1	0.58
		Subtotal		**2**	**1.12**
	Total Type 1 Sites			**4**	**3.73**
2	ditched	(2d)	E2EM1Pd	3	113.04
		Subtotal		**3**	**113.04**
	tidally restricted (2r)		E1UBL	3	5.75
			E1UBLh	1	1.71
			E2EM1N	4	1.09
			E2EM1P	2	2.88
			E2SS1Ph	1	0.34
			E2US2N	1	0.89
		Subtotal		**12**	**12.66**
	severely tidally restricted (2rs)		E2EM5P6h	1	6.21
		Subtotal		**1**	**6.21**
	vegetation change- Phragmites (2v)		E2EM1/5P	1	1.63
			E2EM5/1P	1	0.46
			E2EM5P	16	46.37
			E2EM5P6	1	0.65
		Subtotal		**19**	**49.11**
	Total Type 2 Sites			**35**	**181.02**
Total All Sites				**39**	**184.75**

Table 3. Extent of hardened shorelines in Tiverton.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	3961.598
Bulkhead (BK)	7908.229
Breakwater (BW)	266.699
Groin (GR)	1870.021
Pemanent Pier (PP)	1256.381
Revetment (RR)	9790.379
Seawall (SW)	1288.894
Total Hardened Shoreline Length	**26342.20**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Tiverton.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	295.321
Mobile home (113)	0.21
Lawns (114)	90.477
Subtotal	**386.008**
Commercial	
Commercial and Institutional structures(121)	6.04
Marinas (123)	2.844
Wharves, piers, shipyards (127)	20.359
Subtotal	**29.243**
Transportation, Communications, and Utilities (14)	**13.584**
Other Urban or Built-up Land	
Cemeteries (172)	4.811
Subtotal	**4.811**
Agriculture	
Cropland (21)	281.159
Orchards, Nurseries, Vineyards (22)	2.422
Pastures/hayfields (24)	59.368
Subtotal	**342.949**
Rangeland	
Herbaceous cover (31)	18.283
Shrub and brush cover (32)	134.726
Mixed (33)	64.146
Subtotal	**217.155**
Forest	
Deciduous forest (41)	116.894
Mixed (43)	102.946
Subtotal	**219.84**

Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	73.271
Nonvegetated freshwater wetlands	3.695
Subtotal	**76.966**
Barren Land	
Other sand areas (73)	9.822
Mixed barren land (76)	25.95
Subtotal	**35.772**

Results for Warren

Table 1. Extent of coastal wetlands and related features in Warren.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	**14.761**
Salt Marshes	E2EM1N (includes d,h,x)	16.223
	E2EM1P (includes d,h,x)	227.227
	E2EM5P (includes d,h,x)	7.657
	Subtotal	**251.107**
Brackish Marshes	E2EM1P6 (includes d,h,x)	0.496
	E2EM5P6 (includes d,h,x)	7.432
	Subtotal	**7.928**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	**13.172**
Estuarine Sandy Shores and Beaches	E2US2M	0.736
	E2US2N (includes r)	1.031
	E2US2P (includes r)	18.553
	Subtotal	**20.320**
Estuarine Mudflats	E2US3N (includes d,h)	**3.868**
Salt Pannes	E2US4M (includes d,h)	**0.289**
	Total Estuarine Waters and Wetlands	**311.445**

Table 2. Potential wetland restoration sites in Warren.

Wetland Restoration Type (code)			Current Classification	# of Sites	Acreage
1	filled (1f)	upland	UPLAND	10	3.85
		Subtotal		**10**	**3.85**
	change in vegetated wetland type (1w)		L2AB4Vh	2	2.59
			PEM1T	1	0.46
			PEM5R	2	4.05
			PSS1/EM1Rh	1	6.25
		Subtotal		**6**	**13.35**
	Total Type 1 Sites			**16**	**17.20**
2	ditched	(2d)	E2EM1Pd	14	152.47
		Subtotal		**14**	**152.47**
	ditched/tidally restricted (2d-2r and 2d-2r-2rs)		E2EM1Pd	1	10.98
		Subtotal		**1**	**10.98**
	ditched/veg change- Iva (2d-2vi)		E2SS1P	7	6.06
			E2SS1Pd	1	0.60
		Subtotal		**8**	**6.66**
	tidally restricted (2r)		E1UBL	1	0.66
			E2EM1P	1	1.77
		Subtotal		**2**	**2.43**
	severely tidally restricted (2rs)		E2EM5P	1	0.14
		Subtotal		**1**	**0.14**

severely tidally restricted/veg change-Phragmites (2rs-2v)	E2EM5P	2	0.51
Subtotal		**2**	**0.51**
vegetation change- Phragmites (2v)	E2EM5P	9	10.39
	E2EM5P6	1	7.43
Subtotal		**10**	**17.82**
vegetation change- Iva (2vi)	E2SS1P	4	4.60
Subtotal		**4**	**4.60**
Total Type 2 Sites		**42**	**195.61**
Total All Sites		**58**	**212.81**

Table 3. Extent of hardened shorelines in Warren.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	848.611
Bulkhead (BK)	12498.309
Groin (GR)	361.440
Pemanent Pier (PP)	621.907
Revetment (RR)	1113.804
Seawall (SW)	3206.787
Total Hardened Shoreline Length	**18650.86**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Warren.

Landuse/landcover (code)	**Acreage**
Residential	
Single family (lll)	223.919
Multi family (ll2)	12.161
Lawns (114)	52.56
Subtotal	**288.64**
Commercial	
Commercial and Institutional structures(121)	35.89
Paved surfaces (125)	4.12
Wharves, piers, shipyards (127)	20.825
Subtotal	**60.835**
Industrial (13)	**18.52**
Transportation, Communications, and Utilities (14)	**6.735**
Other Urban or Built-up Land	
Golf courses (171)	15.38
Cemeteries (172)	2.959
Other areas (zoos; urban parks) (173)	23.602
Landfills (174)	
Subtotal	**41.941**
Agriculture	
Cropland (21)	43.60
Pastures/hayfields (24)	46.951
Subtotal	**90.551**
Rangeland	
Herbaceous cover (31)	12.63
Shrub and brush cover (32)	24.128
Mixed (33)	4.642
Subtotal	**41.40**

Forest	
Deciduous forest (41)	26.347
Mixed (43)	120.774
Subtotal	**147.121**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	97.394
Nonvegetated freshwater wetlands	6.852
Subtotal	**104.246**
Barren Land	
Bare exposed rock (74)	0.276
Mixed barren land (76)	1.124
Transitional Areas (77)	0.395
Subtotal	**1.795**

Results for Warwick

Table 1. Extent of coastal wetlands and related features in Warwick.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	106.161
	E1UBL6 (includes h,x)	4.104
	Subtotal	**110.265**
Salt Marshes	E2EM5/1P (includes d,h,x)	2.712
	E2EM1/SS1P (includes d,h,x)	1.238
	E2EM1/US2P	0.266
	E2EM1N (includes d,h,x)	44.222
	E2EM1P (includes d,h,x)	153.202
	E2EM5P (includes d,h,x)	7.819
	Subtotal	**209.459**
Brackish Marshes	E2EM1N6 (includes d,h,x)	0.282
	E2EM1P6 (includes d,h,x)	22.763
	E2EM5P6 (includes d,h,x)	3.222
	Subtotal	**26.267**
Estuarine Rocky Shores	E2RS1P	1.720
	E2RS2N (includes r)	2.207
	E2RS2P (includes r)	0.918
	Subtotal	**4.845**
Salt Shrub Swamps	E2SS1/EM1P (includes d,h,x)	0.648
	E2SS1P (includes d,h,x)	15.836
	Subtotal	**16.484**
Estuarine Sandy Shores and Beaches	E2US2M	179.64
	E2US2N (includes r)	50.622
	E2US2P (includes r)	35.229
	Subtotal	**265.491**
Estuarine Mudflats	E2US3N (includes d,h)	5.387
	E2US3N6 (includes h)	0.592
	Subtotal	**5.979**
Salt Pannes	E2US4M (includes d,h)	**2.693**
	Total Estuarine Waters and Wetlands	**641.483**

Table 2. Potential wetland restoration sites in Warwick.

Wetland Restoration Type (code)			Current Classification	# of Sites	Acreage
1	filled (1f)	upland	UPLAND	2	0.49
		Subtotal		**2**	**0.49**
	filled-spoil (1fsp)		UPLAND	1	0.08
		Subtotal		**5**	**0.08**
	submerged (1su)		PUBVh	4	5.31
		Subtotal		**4**	**5.31**
	change in vegetated wetland type (1w)		PEM1/SS1Rh	1	1.97
			PEM1R	1	0.20
			PEM1Rh	3	6.13
			PSS1/EM1R	1	1.62
			PSS1/EM1Rh	1	2.55
			PSS1R	1	0.17
		Subtotal		**8**	**12.64**
		Total Type 1 Sites		**19**	**18.52**
2	ditched	(2d)	E2EM1Pd	2	26.18
		Subtotal		**2**	**26.18**
	ditched/veg change- Phragmites (2d-2v)		E2EM5P6d	1	1.32
		Subtotal		**1**	**1.32**
	ditched/veg change- Iva (2d-2vi)		E2SS1Pd	1	10.64
		Subtotal		**1**	**10.64**
	impounded (2h)		E1UBLh	2	0.91
			E2EM1Ph	1	0.47
			E2US4Mh	1	0.61

Subtotal		**4**	**1.99**
tidally restricted (2r)	E1UBL	11	15.96
	E2EM1Nh	1	1.26
	E2EM1P	2	1.39
	E2EM1P6	2	0.12
Subtotal		**16**	**18.73**
severely tidally restricted (2rs)	E2EM5P	2	0.35
Subtotal		**2**	**0.35**
vegetation change- Phragmites (2v)	E2EM1P6	2	1.99
	E2EM5/1P	1	2.71
	E2EM5P	19	9.14
	E2EM5P6	3	1.91
Subtotal		**25**	**15.75**
Total Type 2 Sites		**51**	**74.96**
Total All Sites		**70**	**93.48**

Table 3. Extent of hardened shorelines in Warwick.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	471.514
Bulkhead (BK)	35516.126
Breakwater (BW)	4637.135
Groin (GR)	2421.270
Jetty (JT)	296.843
Revetment (RR)	17773.618
Seawall (SW)	1238.284
Total Hardened Shoreline Length	**62354.79**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Warwick.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	1277.545
Multi family (112)	29.232
Lawns (114)	139.806
Subtotal	**1446.583**
Commercial	
Commercial and Institutional structures (121)	24.267
Recreational structures (122)	17.993
Marinas (123)	48.155
Paved surfaces (125)	8.095
Unpaved surfaces (126)	12.752
Wharves, piers, shipyards (127)	5.439
Subtotal	**116.701**
Industrial (13)	**1.898**
Transportation, Communications, and Utilities (14)	**30.738**
Other Urban or Built-up Land	
Golf courses (171)	16.176
Cemeteries (172)	4.874
Other areas (zoos; urban parks) (173)	26.696
Subtotal	**47.746**
Agriculture	
Cropland (21)	0.361
Pastures/hayfields (24)	98.264
Subtotal	**98.625**
Rangeland	
Herbaceous cover (31)	42.816
Shrub and brush cover (32)	111.253
Mixed (33)	27.125
Subtotal	**181.194**

Forest	
Deciduous forest (41)	307.028
Mixed (43)	294.848
Subtotal	**601.876**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	56.178
Nonvegetated freshwater wetlands	9.203
Subtotal	**65.381**
Barren Land	
Other sand areas (73)	8.288
Mixed barren land (76)	16.922
Transitional Areas (77)	0.585
Subtotal	**25.795**

Appendix B. Detailed Results for each Massachusetts town (towns listed alphabetically)

Four tables are presented for each town: Table 1 (extent of coastal wetlands and related features), Table 2 (estuarine wetland restoration sites), Table 3 (hardened shorelines), and Table 4 (land use/cover in the 500-foot buffer surrounding tidal wetlands).

Code symbology for Table 1 (see Cowardin et al. 1979 for definitions; posted on the Internet at: wetlands.fws.gov [listed under publications]). A code is represented by system, system, class, subclass, water regime and special modifiers as in the following examples: 1) E2EM1N - System E (Estuarine), Subsystem 2 (Intertidal), Class EM (Emergent), Subclass 1 (Persistent), Water Regime N (Regularly flooded), 2) E2EM1/5P6 - System E (Estuarine), Subsystem 2 (Intertidal), Class EM (Emergent), Subclasses 1/5 (Persistent/Phragmites), Water Regime P (Irregularly flooded), Special Modifier 6 (Oligohaline), and 3) E2SS1Pd - System E (Estuarine), Subsystem 2 (Intertidal), Class SS (Scrub-Shrub), Subclass 1 (Broad-leaved Deciduous), Water Regime P (Irregularly flooded), Special Modifier d (Partly drained).

System/Subsystem	Class/Subclass	Water Regime	Special Modifier
E1 = Estuarine Subtidal	AB3 = Aquatic Bed Vascular	L = Subtidal	d = partly drained
E2 = Estuarine Intertidal	EM1 = Emergent Persistent	M = Irregularly Exposed	h = impounded
M1 = Marine Subtidal	EM5 = Emergent Phragmites	N = Regularly Flooded	r = artificial
M2 = Marine Intertidal	RF2 = Reef Mollusc	P = Irregularly Flooded	x = excavated
	RS1 = Rocky Shore Bedrock		6 = oligohaline
	RS2 = Rocky Shore Rubble		
	SB2 = Streambed Sand		
	SB3 = Streambed Mud		
	SS1 = Scrub-Shrub Broad-leaved Deciduous		
	US1 = Unconsolidated Shore Cobble-Gravel		
	US2 = Unconsolidated Shore Sand		
	US3 = Unconsolidated Shore Mud		
	US4 = Unconsolidated Shore Organic		
	UB = Unconsolidated Bottom		

Results for Berkley

Table 1. Extent of coastal wetlands and related features in Berkley.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	24.692
	E1UBL6 (includes h,x)	
	Subtotal	**24.692**
Salt Marshes	E2EM5/1P (includes d,h,x)	2.151
	E2EM1N (includes d,h,x)	2.825
	E2EM1P (includes d,h,x)	52.548
	E2EM5P (includes d,h,x)	0.336
	Subtotal	**57.860**
Brackish Marshes	E2EM1P6 (includes d,h,x)	49.678
	E2EM5P6 (includes d,h,x)	1.244
	Subtotal	**50.922**
Estuarine Streambeds	E2SB2N AND E1SB3N	0.317
Salt Shrub Swamps	E2SS1P (includes d,h,x)	3.246
	Subtotal	**3.563**
Estuarine Sandy Shores and Beaches	E2US2N (includes r)	1.573
	E2US2P (includes r)	3.398
	Subtotal	**4.971**
Estuarine Mudflats	E2US3N (includes d,h)	0.958
	Subtotal	**0.958**
	Total Estuarine Waters and Wetlands	**142.966**

Table 2. Potential wetland restoration sites in Berkley.

Wetland Restoration Type (code)		Current Classification	# of Sites	Acreage
1	filled (1f)	UPLAND	1	0.22
	Subtotal		**1**	**0.22**
	change in vegetated wetland type (1w)	PAB4/UBVh1	1	1.37
		PEM1Rh	1	0.13
	Subtotal		**2**	**1.50**
	Total Type 1 Sites		**3**	**1.72**
2	ditched (2d)	E2EM1Pd	2	33.91
	Subtotal		**2**	**33.91**
	ditched/tidally restricted (2d-2r and 2d-2r-2rs)	E2EM1Pdh6	1	2.54
	Subtotal		**1**	**2.54**
	ditched/severely tidally restricted (2d-2rs)	E2EM5P6dh	1	0.56
	Subtotal		**1**	**0.56**
	ditched/impounded (2h-2d)	E2EM1Pd	7	0.34
	Subtotal		**7**	**0.34**
	impounded/veg change-Phragmites (2h-2v)	E2EM5/1P	1	2.15
		E2EM5P	1	0.34
	Subtotal		**2**	**2.49**
	vegetation change- Phragmites (2v)	E2EM5P6	2	1.24
	Subtotal		**2**	**1.24**
	Total Type 2 Sites		**15**	**41.08**
Total All Sites			**18**	**42.80**

Table 3. Extent of hardened shorelines in Berkley.

Hardened Shoreline (code)	**Length (in feet)**
Bulkhead (BK)	2157.76
Revetment (RR)	345.27
Total Hardened Shoreline Length	**2503.03**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Berkley.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	83.110
Lawns (114)	18.707
Subtotal	**101.817**
Commercial Paved surfaces (125)	**0.520**
Other Urban or Built-up Land	
Other areas (zoos; urban parks) (173)	3.690
Subtotal	**3.69**
Agriculture	
Cropland (21)	37.474
Pastures/hayfields (24)	18.139
Subtotal	**55.613**
Rangeland	
Herbaceous cover (31)	6.928
Shrub and brush cover (32)	25.269
Mixed (33)	4.881
Subtotal	**37.078**
Forest	
Deciduous forest (41)	12.677
Mixed (43)	289.085
Subtotal	**301.762**
Vegetated Freshwater Wetlands (56)	**27.215**
Barren Land	
Other sand areas (73)	0.585
Transitional Areas (77)	0.094
Subtotal	**0.679**

Results for Dighton

Table 1. Extent of coastal wetlands and related features in Dighton.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x) E1UBL6 (includes h,x)	77.587
	Subtotal	**77.587**
Salt Marshes	E2EM1N (includes d,h,x)	1.795
	E2EM1P (includes d,h,x)	73.363
	E2EM5P (includes d,h,x)	5.639
	Subtotal	**80.797**
Brackish Marshes	E2EM1P6 (includes d,h,x)	2.114
	E2EM5P6 (includes d,h,x)	1.823
	Subtotal	**3.937**
Estuarine Streambeds	E2SB2N AND E1SB3N	1.555
Salt Shrub Swamps	E2SS1P (includes d,h,x)	8.575
	Subtotal	**10.13**
Estuarine Sandy Shores and Beaches	E2US2P (includes r)	0.232
	Subtotal	**0.232**
Estuarine Mudflats	E2US3N (includes d,h)	3.428
	Subtotal	**3.428**
	Total Estuarine Waters and Wetlands	**176.111**

Table 2. Potential wetland restoration sites in Dighton.

Wetland Restoration Type (code)		Current Classification	# of Sites	Acreage
1	change in vegetated wetland type (1w)	PEM1/5Rd	1	0.22
		PEM1Rd	1	1.14
		PEM1Rh	1	0.64
		PEM5/SS1Ch	1	1.36
		PEM5Rh	1	0.54
		PSS1Rh	2	7.40
	Subtotal		**7**	**11.30**
	Total Type 1 Sites		**7**	**11.30**
2	ditched/tidally restricted (2d-2r and 2d-2r-2rs)	E2EM1Pd	**3**	**64.95**
	ditched/tidally restricted/iva (2d-2r-2vi)	E2SS1Pd	**3**	**10.18**
	ditched/severely tidally restricted (2d-2rs)	E2EM5Pd	**3**	**0.41**
	tidally restricted (2r)	E1UBL	1	58.40
		E2EM1N	2	0.36
		E2EM1P	1	1.42
		E2EM1P6	1	0.48
		E2EM1Ph	1	0.18
		E2US3N	1	3.43
	Subtotal		**7**	**64.27**
	severely tidally restricted (2rs)	E2EM5P	**1**	**4.23**
	severely tidally restricted/ veg change- Phragmites (2rs-2v)	E2EM5P	1	1.41
		E2EM5P6	1	1.82
	Subtotal		**2**	**3.23**
	vegetation change- Phragmites (2v)	E2EM5P	**1**	**0.25**
	Total Type 2 Sites		**20**	**147.52**
Total All Sites			**27**	**158.82**

Table 3. Extent of hardened shorelines in Dighton.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	1698.40
Bulkhead (BK)	3444.99
Pemanent Pier (PP)	310.282
Revetment (RR)	1272.49
Total Hardened Shoreline Length	**6726.16**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Dighton.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	66.824
Lawns (114)	10.963
Subtotal	**77.787**
Commercial	
Marinas (123)	2.778
Subtotal	**2.778**
Other Urban or Built-up Land	
Other areas (zoos; urban parks) (173)	4.685
Subtotal	**4.685**
Agriculture	
Cropland (21)	33.980
Orchards, Nurseries, Vineyards (22)	4.027
Pastures/hayfields (24)	7.594
Subtotal	**45.601**
Rangeland	
Herbaceous cover (31)	13.670
Shrub and brush cover (32)	8.822
Mixed (33)	15.416
Subtotal	**37.908**
Forest	
Deciduous forest (41)	21.709
Evergreen forest (42)	1.050
Mixed (43)	56.124
Subtotal	**78.883**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	33.676
Nonvegetated freshwater wetlands	0.221
Subtotal	**33.897**

Results for Fall River

Table 1. Extent of coastal wetlands and related features in Fall River.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x) E1UBL6 (includes h,x)	88.337
	Subtotal	**88.337**
Salt Marshes	E2EM1N (includes d,h,x)	10.077
	E2EM1P (includes d,h,x)	1.570
	Subtotal	**11.647**
Estuarine Rocky Shores	E2RS2N (includes r)	0.452
	E2RS2P (includes r)	0.314
	Subtotal	**0.766**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	1.427
	Subtotal	**1.427**
Estuarine Cobble- Gravel Shores	E2US1N and E2US1/2N	0.514
	Subtotal	**0.514**
Estuarine Sandy Shores and Beaches	E2US2N (includes r)	16.121
	E2US2P (includes r)	6.325
	Subtotal	**22.446**
Estuarine Mudflats	E2US3N (includes d,h)	1.255
	Subtotal	**1.255**
	Total Estuarine Waters and Wetlands	**126.392**

Table 2.

There are no potential wetland restoration sites for Fall River.

Table 3. Extent of hardened shorelines in Fall River.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	3169.82
Bulkhead (BK)	18730.81
Breakwater (BW)	1841.373
Groin (GR)	841.23
Pemanent Pier (PP)	2591.01
Revetment (RR)	7930.62
Total Hardened Shoreline Length	**35104.86**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Fall River.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	60.840
Multi family (112)	13.400
Lawns (114)	2.688
Subtotal	**76.928**
Commercial	
Commercial and Institutional structures (121)	57.704
Marinas (123)	10.010
Paved surfaces (125)	10.106
Wharves, piers, shipyards (127)	53.503
Subtotal	**131.323**
Industrial (13)	**28.493**
Transportation, Communications, and Utilities (14)	**102.230**
Industrial/Commercial Complexes (15)	**4.456**
Other Urban or Built-up Land (17)	1.684
Golf courses (171)	43.776
Other areas (zoos; urban parks) (173)	20.655
Subtotal	**66.115**
Rangeland	
Herbaceous cover (31)	9.980
Shrub and brush cover (32)	19.951
Mixed (33)	56.380
Subtotal	**86.311**
Forest	
Deciduous forest (41)	42.705
Mixed (43)	33.715
Subtotal	**76.42**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	2.529
Nonvegetated freshwater wetlands	4.531
Subtotal	**7.060**

Results for Freetown

Table 1. Extent of coastal wetlands and related features in Freetown.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x) E1UBL6 (includes h,x)	47.266
	Subtotal	**47.266**
Salt Marshes	E2EM1N (includes d,h,x)	15.988
	E2EM1P (includes d,h,x)	110.239
	E2EM5P (includes d,h,x)	4.812
	Subtotal	**131.039**
Brackish Marshes	E2EM1/5P6 and E2EM5/1P6 (includes d,h,x)	2.432
	E2EM1P6 (includes d,h,x)	5.392
	E2EM5P6 (includes d,h,x)	0.409
	Subtotal	**8.233**
Oyster Reefs	E2RF2N (includes h)	3.431
	Subtotal	**3.431**
Estuarine Sandy Shores and Beaches	E2US2N (includes r)	2.577
	Subtotal	**2.577**
Estuarine Mudflats	E2US3M	2.124
	E2US3N (includes d,h)	15.651
	Subtotal	**17.775**
	Total Estuarine Waters and Wetlands	**210.321**

Table 2. Potential wetland restoration sites in Freetown.

Wetland Restoration Type (code)			Current Classification	# of Sites	Acreage
1	filled (1f)	upland	UPLAND	1	0.09
		Subtotal		**1**	**0.09**
	submerged (1su)		PUBVh	1	1.07
		Subtotal		**1**	**1.07**
	change in vegetated wetland type (1w)		PAB4/SS1Fh	1	0.51
			PAB4/SSFh	1	2.50
			PAB4/UBVh1	1	0.91
			PEM1Rh	2	1.19
			PFO1Rh	1	2.52
		Subtotal		**6**	**7.63**
	Total Type 1 Sites			**8**	**8.79**
2	ditched (2d)		E2EM1Pd	10	16.11
		Subtotal		**10**	**16.11**
	ditched/tidally restricted (2d-2r + 2d-2r-2rs)		E2EM1Pd	2	22.64
		Subtotal		**2**	**22.64**
	ditched/impounded (2h-2d)		E2EM1Pd	**1**	**35.23**
	impounded/veg change-Phragmites (2h-2v)		E2EM5/1P	1	1.63
			E2EM5P	1	0.24
		Subtotal		**2**	**1.87**
	tidally restricted (2r)		E2US3N	**1**	**0.97**
	tidally restricted/veg change-Phragmites (2r-2v)		E2EM5P	**1**	**3.41**
	severely tidally restricted/veg change-Phragmites (2rs-2v)		E2EM5P	**1**	**0.57**
	vegetation change- Phragmites (2v)		E2EM5/1P6	1	2.43
			E2EM5P	1	0.59
		Subtotal		**2**	**3.02**
	Total Type 2 Sites			**20**	**83.82**
Total All Sites				**28**	**92.61**

Table 3. Extent of hardened shorelines in Freetown.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	938.51
Bulkhead (BK)	2093.69
Revetment (RR)	333.39
Total Hardened Shoreline Length	**3365.59**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Freetown.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	186.365
Lawns (114)	34.890
Subtotal	**221.255**
Commercial	
Commercial and Institutional structures(121)	3.384
Paved surfaces (125)	4.646
Unpaved surfaces (126)	0.798
Subtotal	**8.828**
Transportation, Communications, and Utilities (14)	**8.209**
Cemeteries (172)	**3.834**
Agriculture	
Cropland (21)	64.203
Pastures/hayfields (24)	10.576
Subtotal	**74.779**
Rangeland	
Herbaceous cover (31)	6.344
Shrub and brush cover (32)	12.542
Mixed (33)	21.407
Subtotal	**40.293**
Forest	
Deciduous forest (41)	38.351
Mixed (43)	325.973
Subtotal	**364.324**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	29.376
Nonvegetated freshwater wetlands	1.221
Subtotal	**30.597**
Barren Land	
Mixed barren land (76)	22.154
Subtotal	**22.154**

Results for Rehoboth

Table 1. Extent of coastal wetlands and related features in Rehoboth.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	6.989
	E1UBL6 (includes h,x)	23.406
	Subtotal	**30.395**
Salt Marshes	E2EM1P (includes d,h,x)	32.949
	E2EM5P (includes d,h,x)	6.031
	Subtotal	**38.980**
Brackish Marshes	E2EM1/5P6 and E2EM5/1P6 (includes d,h,x)	74.707
	E2EM1P6 (includes d,h,x)	15.740
	E2EM5P6 (includes d,h,x)	1.331
	Subtotal	**91.778**
Estuarine Mudflats	E2US3N (includes d,h)	1.843
	E2US3N6 (includes h)	6.422
	Subtotal	**8.265**
	Total Estuarine Waters and Wetlands	**169.418**

Table 2. Potential wetland restoration sites in Rehoboth.

Wetland Restoration Type (code)		Current Classification	# of Sites	Acreage
1	change in vegetated wetland type (1w)	PSS1R	1	1.470
	Subtotal		**1**	**1.470**
	Total Type 1 Sites		**1**	**1.47**
2	ditched (2d)	E2EM1Pd	1	6.430
	Subtotal		**1**	**6.430**
	ditched/tidally restricted (2d-2r and 2d-2r-2rs)	E2EM1Pdh	2	23.880
	Subtotal		**2**	**23.880**
	ditched/severely tidally restricted (2d-2rs)	E2EM5Pdh	1	1.840
	Subtotal		**1**	**1.840**
	ditched/severely tidally restricted/veg change - Phragmites (2d-2rs-2v)	E2EM5Pdh	1	1.260
	Subtotal		**1**	**1.260**
	tidally restricted (2r)	E1UBL6h	2	23.400
		E1UBLh	2	6.980
		E2EM1P6h	6	15.500
		E2EM1Ph	1	0.140
		E2US3N6	3	1.290
		E2US3N6h	7	5.120
		E2US3Nh	2	1.440
	Subtotal		**23**	**53.870**
	severely tidally restricted (2rs)	E2EM1/5P6	2	3.170
		E2EM1/5P6h	6	53.860
		E2EM5P6h	3	1.070
	Subtotal		**11**	**58.100**

severely tidally restricted/veg change - Phragmites (2rs-2v)	E2EM5/1P6	1	3.750
	E2EM5/1P6h	2	13.930
	E2EM5P	1	2.070
	E2EM5P6h	1	0.260
	E2EM5Ph	1	2.930
Subtotal		**6**	**22.940**
vegetation change- Phragmites (2v)	E2EM5P	1	0.430
Subtotal		**1**	**0.430**
Total Type 2 Sites		**46**	**168.75**
Total All Sites		**47**	**170.22**

Table 3. Extent of hardened shorelines in Rehoboth.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	1061.144
Total Hardened Shoreline Length	**1061.14**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Rehoboth.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	5.129
Lawns (114)	2.511
Subtotal	**7.640**
Transportation, Communications, and Utilities (14)	**19.742**
Industrial/Commercial Complexes (15)	**11.365**
Agriculture	
Cropland (21)	129.159
Orchards, Nurseries, Vineyards (22)	5.048
Subtotal	**134.207**
Rangeland	
Herbaceous cover (31)	2.534
Shrub and brush cover (32)	7.872
Subtotal	**10.406**
Forest	
Deciduous forest (41)	56.045
Mixed (43)	5.621
Subtotal	**61.666**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	74.384
Nonvegetated freshwater wetlands	1.128
Subtotal	**75.512**
Barren Land	
Mixed barren land (76)	2.480
Subtotal	**2.480**

Results for Seekonk

Table 1. Extent of coastal wetlands and related features in Seekonk.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	1.404
	E1UBL6 (includes h,x)	0.787
	Subtotal	**2.191**
Salt Marshes	E2EM1P (includes d,h,x)	20.785
	Subtotal	**20.785**
Brackish Marshes	E2EM1/5P6 and E2EM5/1P6 (includes d,h,x)	27.909
	E2EM1P6 (includes d,h,x)	5.203
	E2EM5P6 (includes d,h,x)	14.246
	Subtotal	**47.358**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	0.937
	Subtotal	**0.937**
	Total Estuarine Waters and Wetlands	**71.271**

Table 2. Potential wetland restoration sites in Seekonk.

Wetland Restoration Type (code)		Current Classification	# of Sites	Acreage
	submerged (1su)	PUBVh	2	1.110
	Subtotal		**2**	**1.110**
	change in vegetated wetland type (1w)	PEM5/1Rh	2	14.150
		PEM5/SS1Rh	1	5.790
		PSS1/EM5Rh	1	3.870
	Subtotal		**4**	**23.810**
	Total Type 1 Sites		**6**	**24.92**
2	ditched (2d)	E2EM1Pd	1	20.750
	Subtotal		**1**	**20.750**
	ditched/veg change-Phragmites (2d-2v)	E2EM5/1P6d	2	0.010
	Subtotal		**2**	**0.010**
	vegetation change-Phragmites (2v)	E2EM5/1P6	2	27.900
		E2EM5P6	1	14.250
	Subtotal		**3**	**42.150**
	vegetation change- Iva (2vi)	E2SS1P	2	0.940
	Subtotal		**2**	**0.940**
	Total Type 2 Sites		**6**	**63.85**
Total All Sites			**12**	**88.77**

Table 3.

There are no hardened shorelines in Seekonk.

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Seekonk.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	15.174
Lawns (114)	3.697
Subtotal	**18.871**
Agriculture	
Cropland (21)	11.989
Pastures/hayfields (24)	15.947
Subtotal	**27.936**
Rangeland	
Shrub and brush cover (32)	2.630
Mixed (33)	5.447
Subtotal	**8.077**
Forest	
Deciduous forest (41)	24.924
Subtotal	**24.924**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	43.657
Nonvegetated freshwater wetlands	1.112
Subtotal	**44.769**

Results for Somerset

Table 1. Extent of coastal wetlands and related features in Somerset.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	129.131
	Subtotal	**129.131**
Salt Marshes	E2EM5/1P (includes d,h,x)	4.659
	E2EM1N (includes d,h,x)	18.326
	E2EM1P (includes d,h,x)	34.218
	E2EM5P (includes d,h,x)	6.496
	Subtotal	**63.699**
Brackish Marshes	E2EM1P6 (includes d,h,x)	7.315
	E2EM5P6 (includes d,h,x)	9.121
	Subtotal	**16.436**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	5.089
	Subtotal	**5.089**
Estuarine Cobble- Gravel Shores	E2US1N and E2US1/2N	1.444
	Subtotal	**1.444**
Estuarine Sandy Shores and Beaches	E2US2N (includes r)	14.517
	E2US2/EM1N	2.502
	E2US2P (includes r)	16.852
	Subtotal	**33.871**
Estuarine Mudflats	E2US3M	7.557
	E2US3N (includes d,h)	7.153
	Subtotal	**14.710**
	Total Estuarine Waters and Wetlands	**264.380**

Table 2. Potential wetland restoration sites in Somerset.

Wetland Restoration Type (code)		Current Classification	# of Sites	Acreage
1	filled (1f)	UPLAND	**4**	**3.14**
	submerged (1su)	PUBVh	**1**	**8.04**
	change in vegetated wetland type (1w)	PEM1Rh	2	5.700
		PEM5Rh	1	6.860
	Subtotal		**3**	**12.56**
	Total Type 1 Sites		**8**	**23.74**
2	ditched (2d)	E2EM1Pd	**2**	**10.20**
	ditched/tidally restricted (2d-2r and 2d-2r-2rs)	E2EM1P6d	1	7.320
		E2EM1Pd	1	7.850
	Subtotal		**2**	**15.170**
	ditched/tidally restricted/iva (2d-2r-2vi)	E2SS1Pd	**1**	**1.640**
	ditched/severely tidally restricted (2d-2rs)	E2EM5Pd	**2**	**0.490**
	ditched/veg change- Iva (2d-2vi)	E2SS1Pd	**1**	**1.770**
	tidally restricted (2r)	E1UBL	4	78.120
		E2EM1N	3	0.660
		E2EM1P	5	5.210
		E2US3M	1	7.560
		E2US3N	1	0.540
	Subtotal		**14**	**92.090**
	severely tidally restricted (2rs)	E2EM5P6h	1	4.790
	Subtotal		**1**	**4.790**
	vegetation change- Phragmites (2v)	E2EM5/1P	1	4.660
		E2EM5P	3	6.500
		E2EM5P6	1	4.330
	Subtotal		**5**	**15.490**
	Total Type 2 Sites		**28**	**141.64**
Total All Sites			**36**	**165.38**

Table 3. Extent of hardened shorelines in Somerset.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	4923.361
Bulkhead (BK)	14311.891
Revetment (RR)	11580.313
Total Hardened Shoreline Length	**30815.57**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Somerset.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	336.804
Lawns (114)	26.092
Subtotal	**362.90**
Commercial	
Commercial and Institutional structures (121)	42.371
Marinas (123)	2.042
Paved surfaces (125)	4.723
Wharves, piers, shipyards (127)	6.771
Subtotal	**55.91**
Transportation, Communications, and Utilities (14)	**115.86**
Other Urban or Built-up Land	
Other areas (zoos; urban parks) (173)	13.741
Landfills (174)	11.143
Subtotal	**24.88**
Agriculture	
Cropland (21)	9.288
Pastures/hayfields (24)	12.686
Subtotal	**21.97**
Rangeland	
Herbaceous cover (31)	10.692
Shrub and brush cover (32)	54.263
Mixed (33)	91.762
Subtotal	**156.72**
Forest	
Deciduous forest (41)	36.726
Mixed (43)	26.755
Subtotal	**63.48**

Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	41.795
Nonvegetated freshwater wetlands	22.061
Subtotal	**63.86**
Barren Land	
Beaches (72)	0.879
Other sand areas (73)	14.629
Strip mines (sand/gravel pits) (75)	33.366
Mixed barren land (76)	1.402
Subtotal	**50.276**

Results for Swansea

Table 1. Extent of coastal wetlands and related features in Swansea.

Wetland or Water Feature	Map Code	Acreage
Estuarine Waters	E1UBL (includes E1UB4L and h,x)	**221.143**
Salt Marshes	E2EM1/SS1P (includes d,h,x)	2.423
	E2EM1/US1N and E2EM1/US3N	3.423
	E2EM1N (includes d,h,x)	18.638
	E2EM1P (includes d,h,x)	143.058
	E2EM5P (includes d,h,x)	27.581
	Subtotal	**195.123**
Brackish Marshes	E2EM1/5P6 and E2EM5/1P6 (includes d,h,x)	0.706
	E2EM1P6 (includes d,h,x)	5.467
	Subtotal	**6.173**
Oyster Reefs	E2RF2N (includes h)	**1.755**
Salt Shrub Swamps	E2SS1P (includes d,h,x)	**2.791**
Estuarine Sandy Shores and Beaches	E2US2M	2.419
	E2US2N (includes r)	18.229
	E2US2P (includes r)	14.076
	Subtotal	**34.724**
Estuarine Mudflats	E2US3M	45.995
	E2US3N (includes d,h)	17.502
	Subtotal	**63.497**
Salt Pannes	E2US4M (includes d,h)	**3.655**
	Total Estuarine Waters and Wetlands	**528.861**

Table 2. Potential wetland restoration sites in Swansea.

Wetland Restoration Type (code)			Current Classification	# of Sites	Acreage
1	filled (1f)	upland	UPLAND	2	1.12
		Subtotal		**2**	**1.12**
	submerged (1su)		L1UBVh	1	14.97
			PUBHh	1	1.67
		Subtotal		**2**	**16.64**
	change in vegetated wetland type (1w)		L2AB4Vh	1	22.30
			PAB4/EM1Fh	1	2.86
			PAB4Hh	1	6.72
			PAB4Vh	1	0.89
			PEM1Rh	1	5.41
			PEM5Rh	1	0.37
			PSS1Rh	1	1.58
		Subtotal		**7**	**40.13**
		Total Type 1 Sites		**11**	**57.89**
2	ditched	(2d)	E2EM1Pd	9	94.70
			E2EM5Pd	1	1.69
		Subtotal		**10**	**96.39**
	ditched/tidally restricted (2d-2r and 2d-2r-2rs)		E2EM1Pdh	1	3.30
			E2EM1Ph	1	3.00
		Subtotal		**2**	**6.30**
	ditched/severely tidally restricted (2d-2rs)		E2EM5Pd	1	3.24
		Subtotal		**1**	**3.24**
	ditched/severely tidally restricted/veg change - Phragmites (2d-2rs-2v)		E2EM5/1Pd	1	0.71
			E2EM5Pdh	1	6.93
		Subtotal		**2**	**7.64**

ditched/veg change- Phragmites (2d-2v)	E2EM5Pd	6	14.92
Subtotal		**6**	**14.92**
tidally restricted (2r)	E1UBL	8	191.28
	E1UBLh	1	9.01
	E2EM1/SS1P	2	2.42
	E2EM1N	15	10.95
	E2EM1P	16	36.30
	E2EM1P6	2	2.20
	E2EM1Ph	1	0.00
	E2RF2N	1	1.76
	E2SS1P	1	1.87
	E2US2P	2	2.33
	E2US3M	8	28.86
	E2US3N	9	9.71
	E2US3Nh	3	1.96
Subtotal		**69**	**298.65**
tidally restricted/veg change -Phragmites (2r-2v)	E2EM5P	1	0.80
vegetation change- Phragmites (2v)	E2EM5P	1	0.01
Subtotal		**2**	**0.81**
vegetation change- Iva (2vi)	E2ESS1P	1	0.71
	E2SS1P	37	57.77
	E2SS1Pd	1	1.74
Subtotal		**39**	**60.22**
Total Type 2 Sites		**131**	**487.37**
Total All Sites		**142**	**546.06**

Table 3. Extent of hardened shorelines in Swansea.

Hardened Shoreline (code)	**Length (in feet)**
Bridge Abutment (BA)	4192.284
Bulkhead (BK)	13562.230
Groin (GR)	329.303
Jetty (JT)	1660.116
Pemanent Pier (PP)	520.011
Revetment (RR)	3926.532
Seawall (SW)	2021.940
Total Hardened Shoreline Length	**26212.42**

Table 4. Land use/cover in the 500-foot buffer surrounding tidal wetlands in Swansea.

Land use/cover (code)	**Acreage**
Residential	
Single family (111)	443.603
Lawns (114)	41.695
Subtotal	**485.30**
Commercial	
Commercial and Institutional structures (121)	27.343
Recreational structures (122)	0.483
Marinas (123)	2.897
Paved surfaces (125)	9.384
Subtotal	**40.11**
Industrial (13)	**4.722**
Transportation, Communications, and Utilities (14)	**32.842**
Other Urban or Built-up Land	
Golf courses (171)	38.239
Other areas (zoos; urban parks) (173)	4.830
Subtotal	**43.07**
Agriculture	
Cropland (21)	24.743
Orchards, Nurseries, Vineyards (22)	13.483
Confined Feeding Lots (23)	3.312
Pastures/hayfields (24)	26.580
Subtotal	**68.12**
Rangeland	
Herbaceous cover (31)	44.455
Shrub and brush cover (32)	43.940
Mixed (33)	75.668
Subtotal	**164.06**

Forest	
Deciduous forest (41)	35.875
Evergreen forest (42)	1.504
Mixed (43)	80.097
Subtotal	**117.48**
Water and Freshwater Wetlands (56)	
Vegetated freshwater wetlands	66.574
Nonvegetated freshwater wetlands	37.102
Subtotal	**103.68**
Barren Land	
Mixed barren land (76)	1.654
Subtotal	**1.654**

Appendix C. Thematic maps

Potential Coastal Wetland Restoration Sites Sorted by Size

Cranston, East Providence, Pawtucket, and Providence
East Greenwich and Warwick
North Kingstown
Narragansett and South Kingstown
Jamestown
Newport and Middletown
Barrington, Warren, Bristol, Seekonk, Swansea, and Rehoboth
Portsmouth
Tiverton
Little Compton
Berkley, Dighton, Fall River, Freetown, and Somerset

Hardened Shorelines, Coastal Habitats, and Field Sites

Cranston, East Providence, Pawtucket, and Providence
East Greenwich and Warwick
North Kingstown
Narragansett and South Kingstown
Jamestown
Newport and Middletown
Barrington, Warren, Bristol, Seekonk, Swansea, and Rehoboth
Portsmouth
Tiverton
Little Compton
Berkley, Dighton, Fall River, Freetown, and Somerset

Potential Coastal Wetland Restoration Sites and Open Space Condition

Cranston, East Providence, Pawtucket, and Providence
East Greenwich and Warwick
North Kingstown
Narragansett and South Kingstown
Jamestown
Newport and Middletown
Barrington, Warren, Bristol, Seekonk, Swansea, and Rehoboth
Portsmouth
Tiverton
Little Compton
Berkley, Dighton, Fall River, Freetown, and Somerset

Land Use/Cover Within 500-foot Buffer of Coastal Habitats

Cranston, East Providence, Pawtucket, and Providence
East Greenwich and Warwick
North Kingstown
Narragansett and South Kingstown
Jamestown
Newport and Middletown
Barrington, Warren, Bristol, Seekonk, Swansea, and Rehoboth
Portsmouth
Tiverton
Little Compton
Berkley, Dighton, Fall River, Freetown, and Somerset