Subaqueous Soils in a Rhode Island Estuary: Case Study

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Our Contributions

- Shallow-Subtidal Wetlands
- Evaluating Methods to Map the Submerged Topography
- Subaqueous Soil Survey in Southern New England
- Subaqueous Soil-Eelgrass Relationships

❖Spatial Context of Shallow-Subtidal Habitats

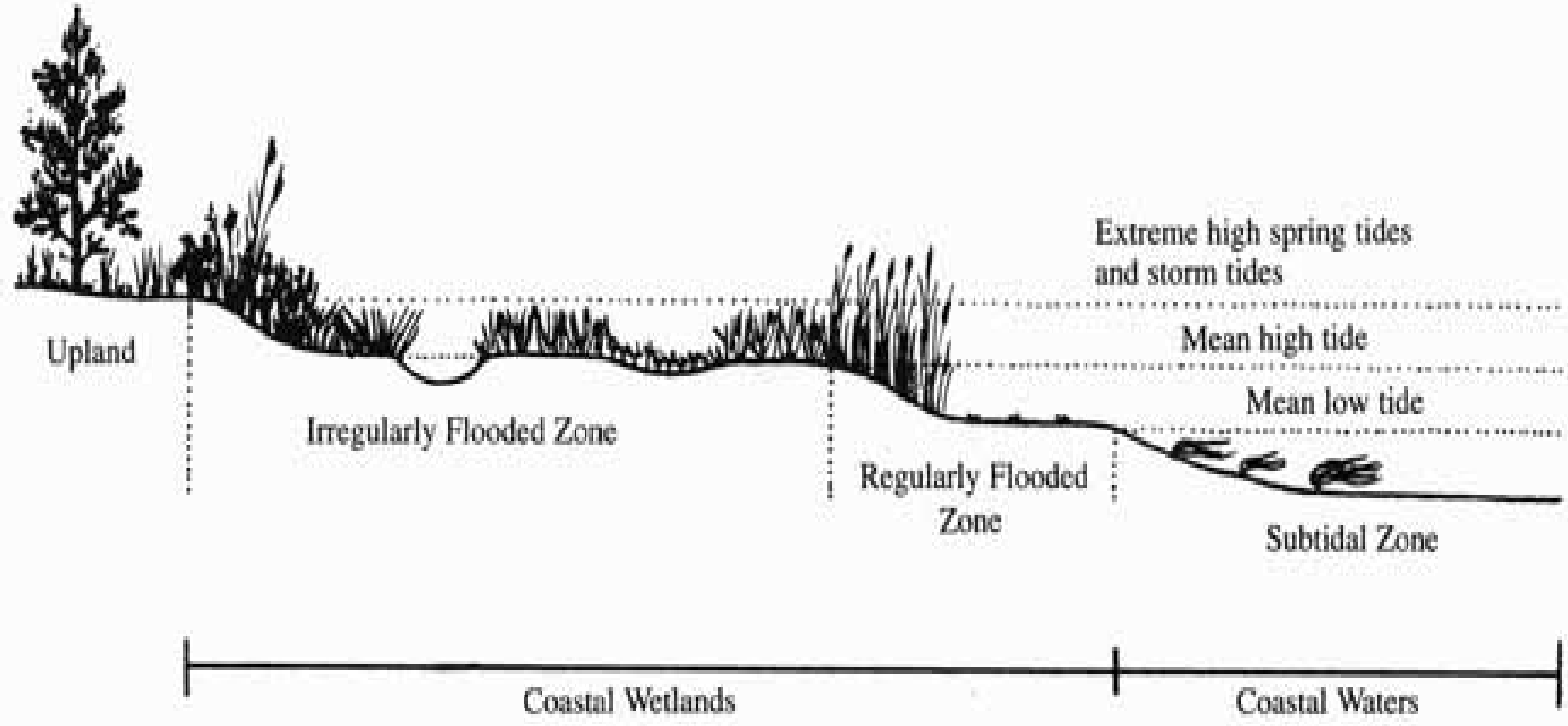


Figure 10. Hydrology of coastal wetlands showing different zones of flooding. The regularly flooded zone is flooded at least once daily by the tides, while the irregularly flooded zone is flooded less often. (Source: Tiner 1987)

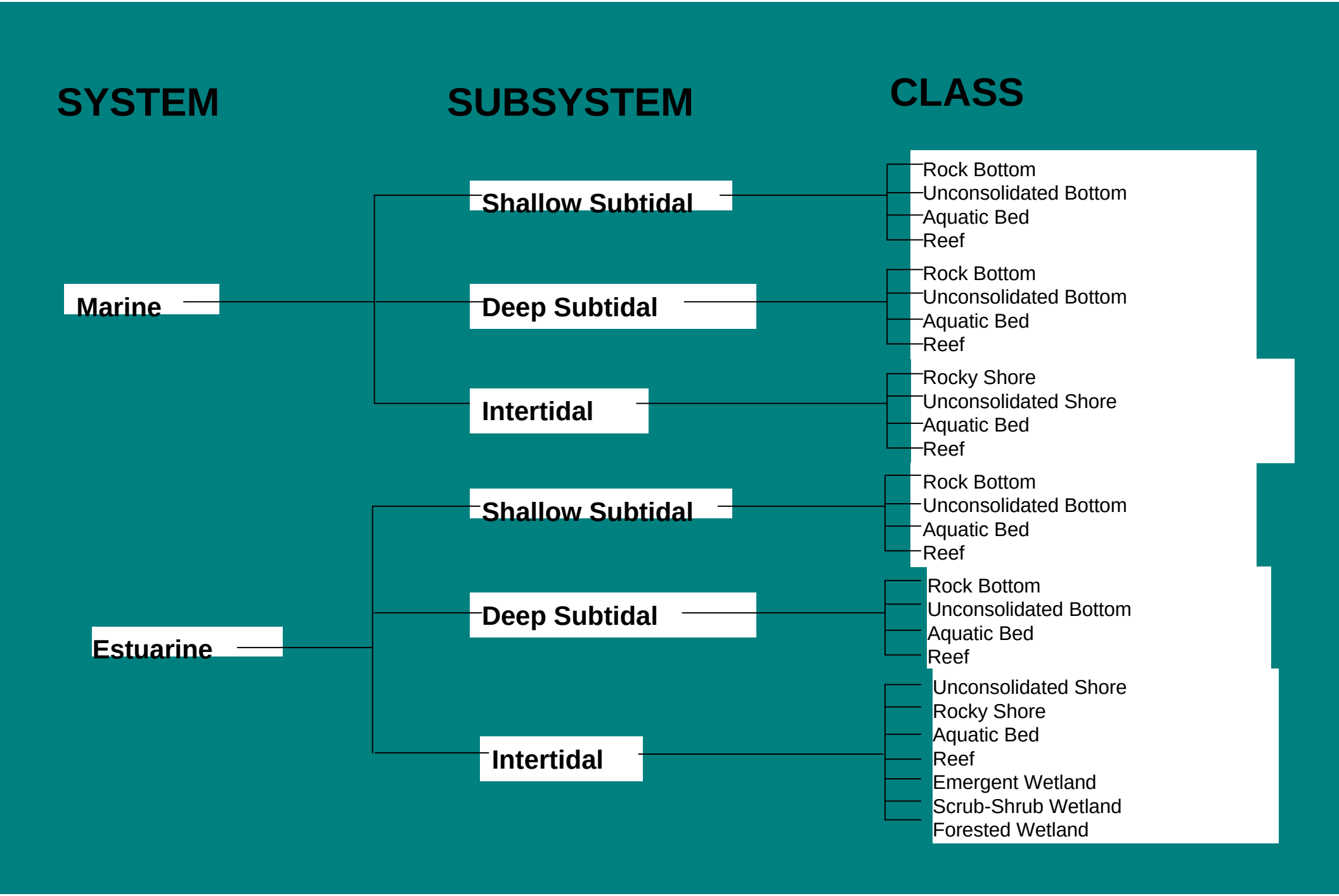

Hydric Soils + Hydrophytic Vegetation + Wetland
Hydrology = Wetland

Functions and Values of Shallow-Subtidal Habitats

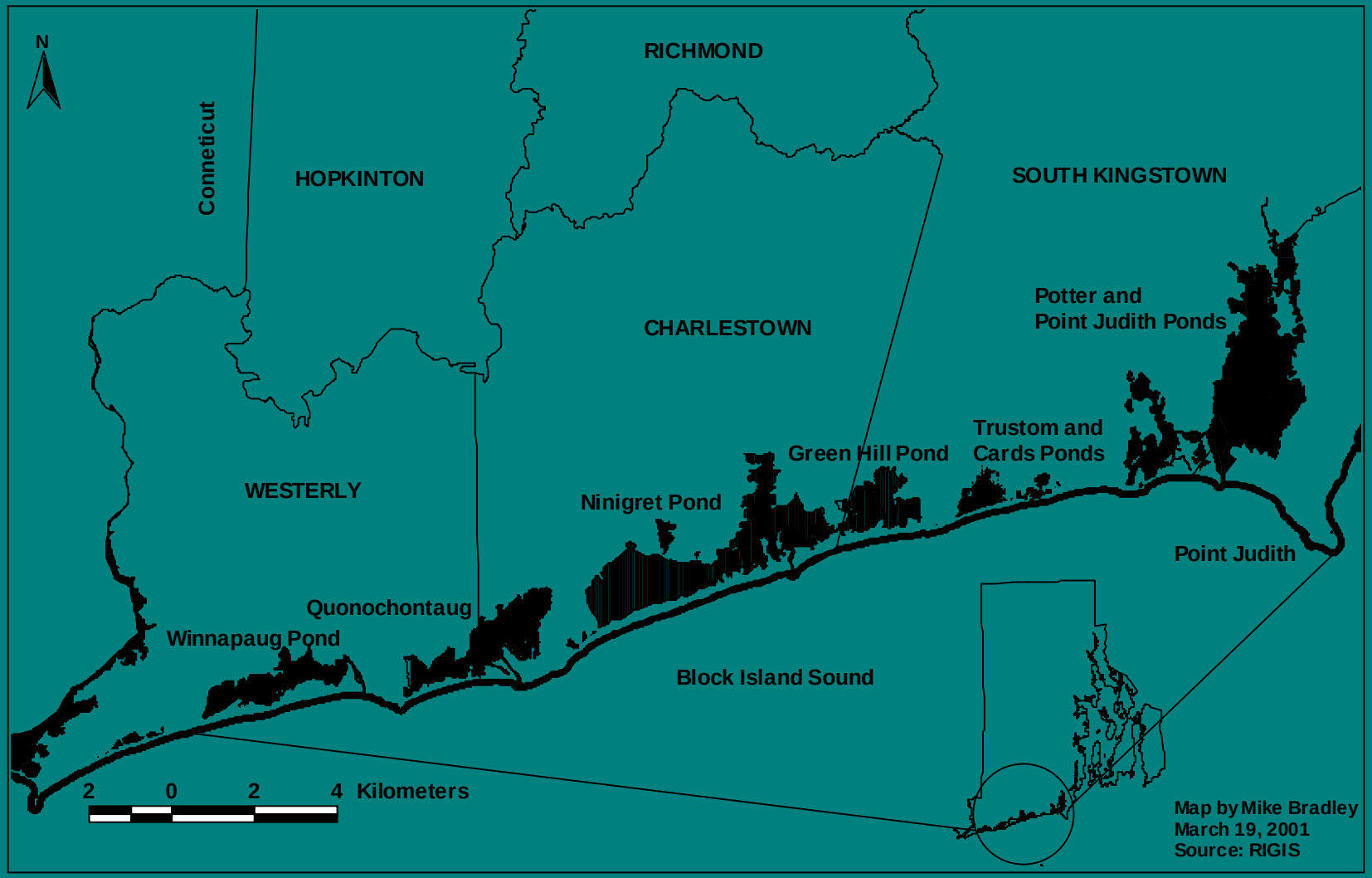
- Particularly when vegetated by seagrasses, the functions and values of these areas include as habitat for finfish and shellfish, shoreline stabilization, water quality enhancement, and they have high productivity rates.

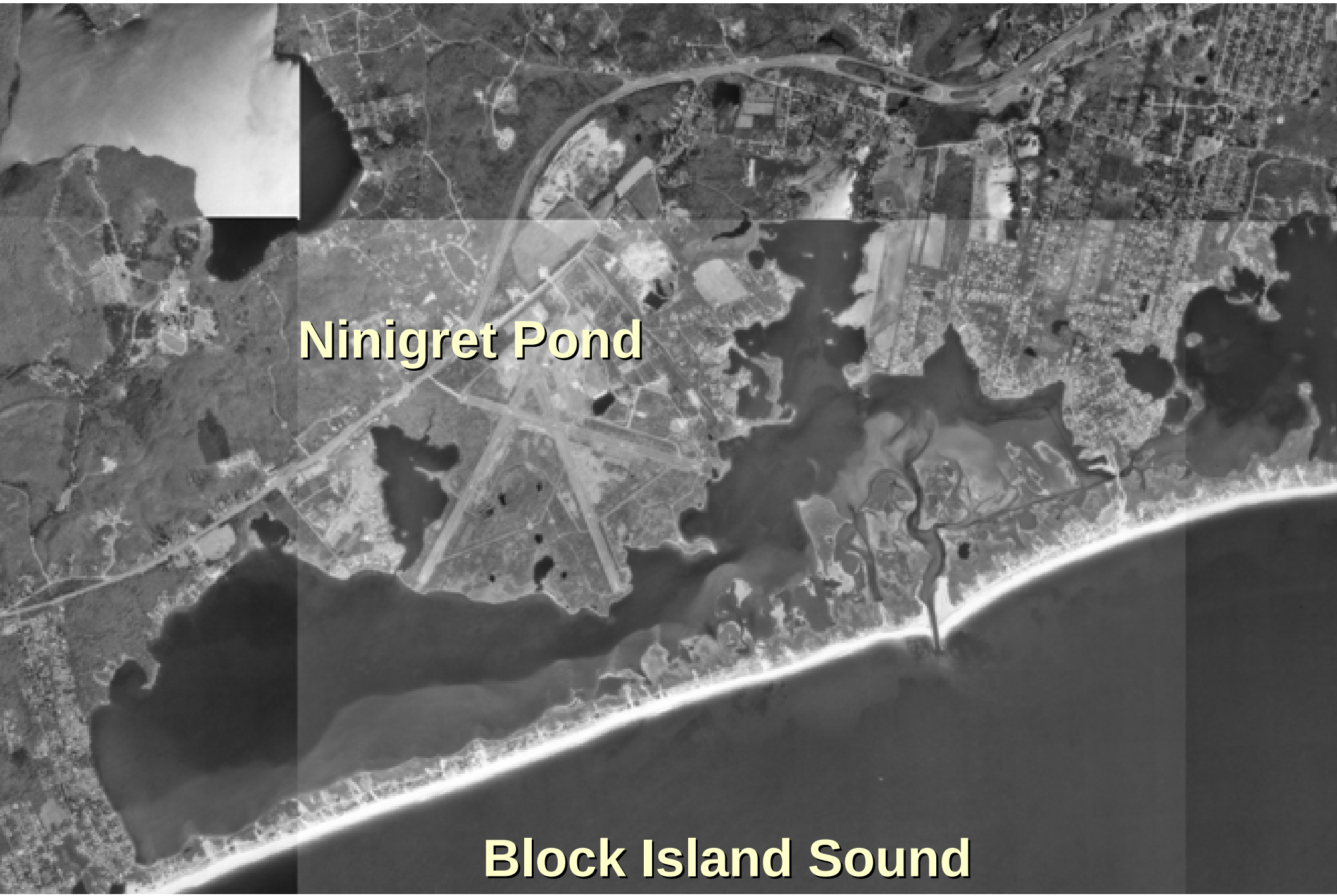
Shallow-Subtidal Wetlands

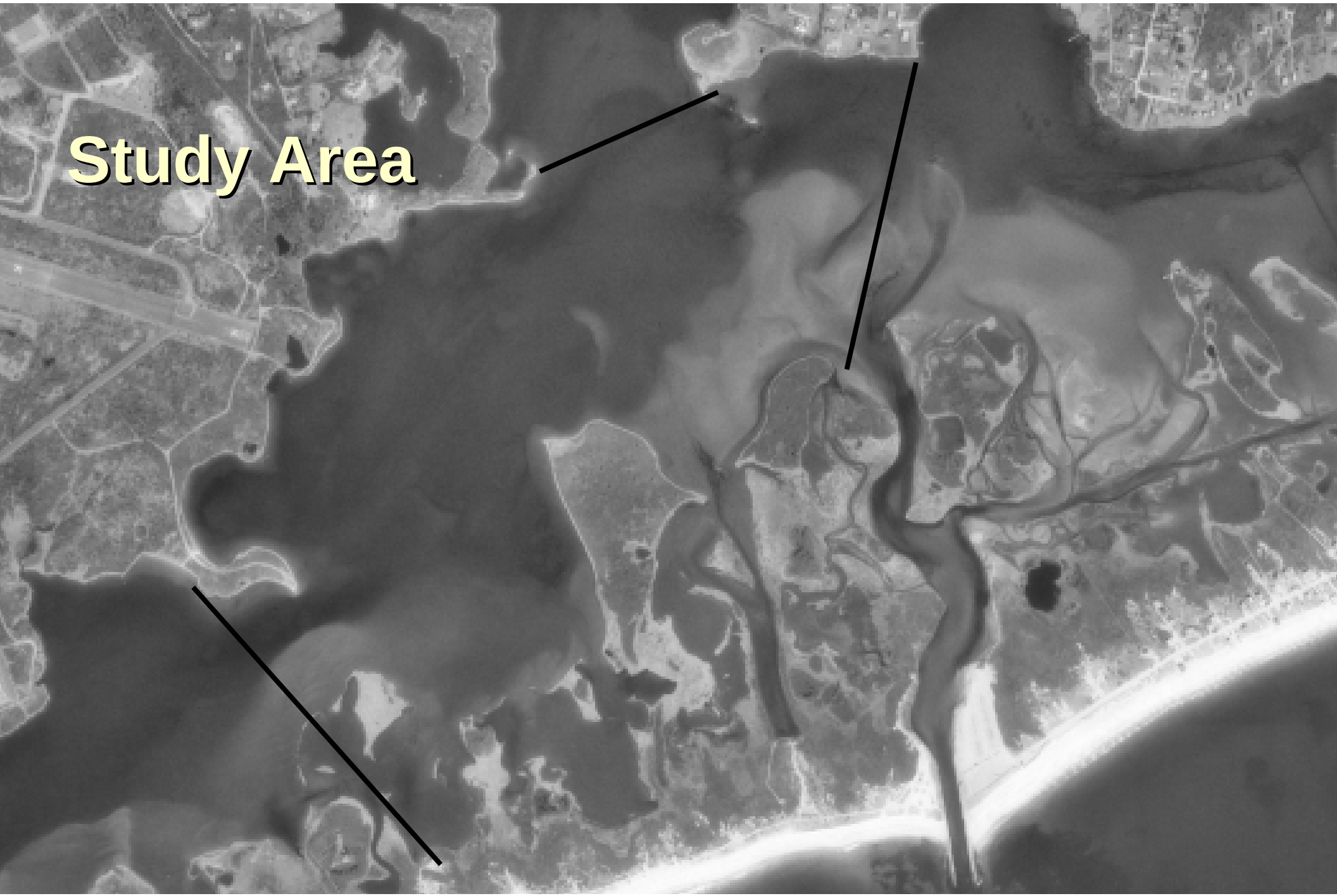
- They have all the necessary components to be identified as a coastal wetland type.
  - -hydric soils
  - -hydrophytic vegetation
  - -wetland hydrology
- These wetland types need a new Cowardin subsystem to facilitate the recognition of these wetland types


SYSTEM
SUBSYSTEM
CLASS
Marine
Shallow Subtidal
Rock Bottom
Unconsolidated Bottom
Aquatic Bed
Reef
Deep Subtidal
Rock Bottom
Unconsolidated Bottom
Aquatic Bed
Reef
Intertidal
Rocky Shore
Unconsolidated Shore
Aquatic Bed
Reef
Estuarine
Shallow Subtidal
Rock Bottom
Unconsolidated Bottom
Aquatic Bed
Reef
Deep Subtidal
Rock Bottom
Unconsolidated Bottom
Aquatic Bed
Reef
Intertidal
Unconsolidated Shore
Rocky Shore
Aquatic Bed
Reef
Emergent Wetland
Scrub-Shrub Wetland
Forested Wetland

Coastal Ponds of the South Shore of Rhode Island

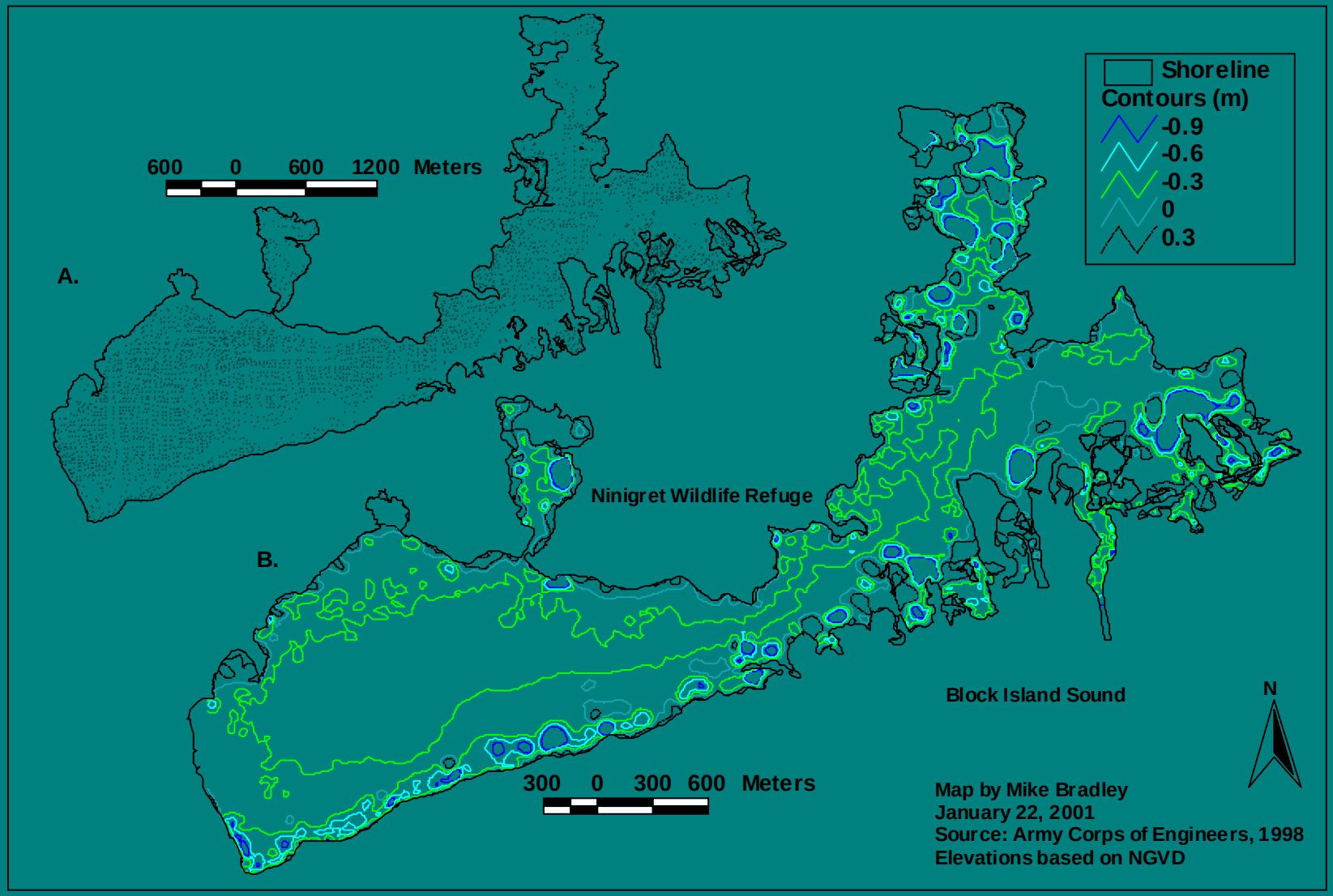



Ninigret Pond
Block Island Sound

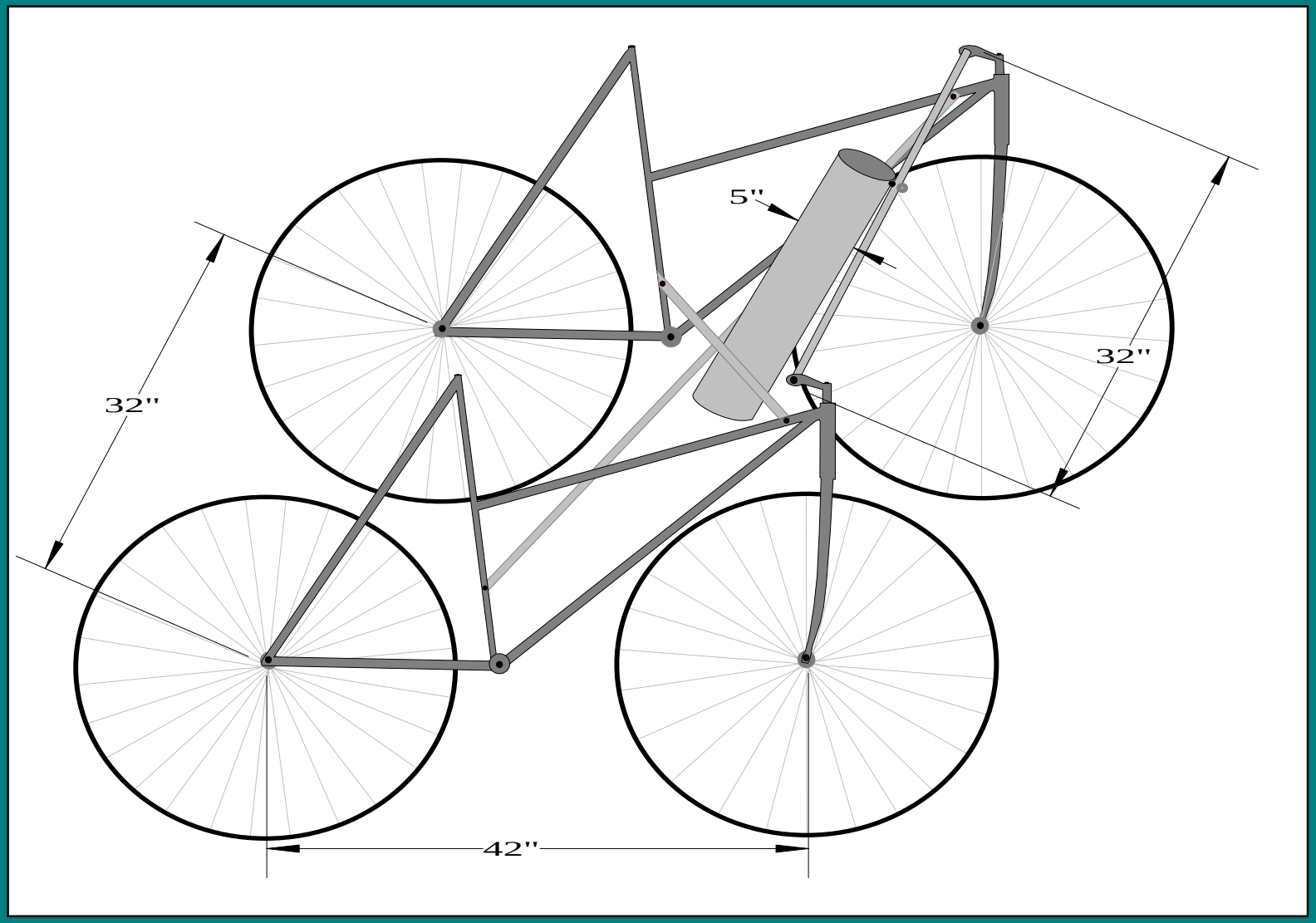

Study Area

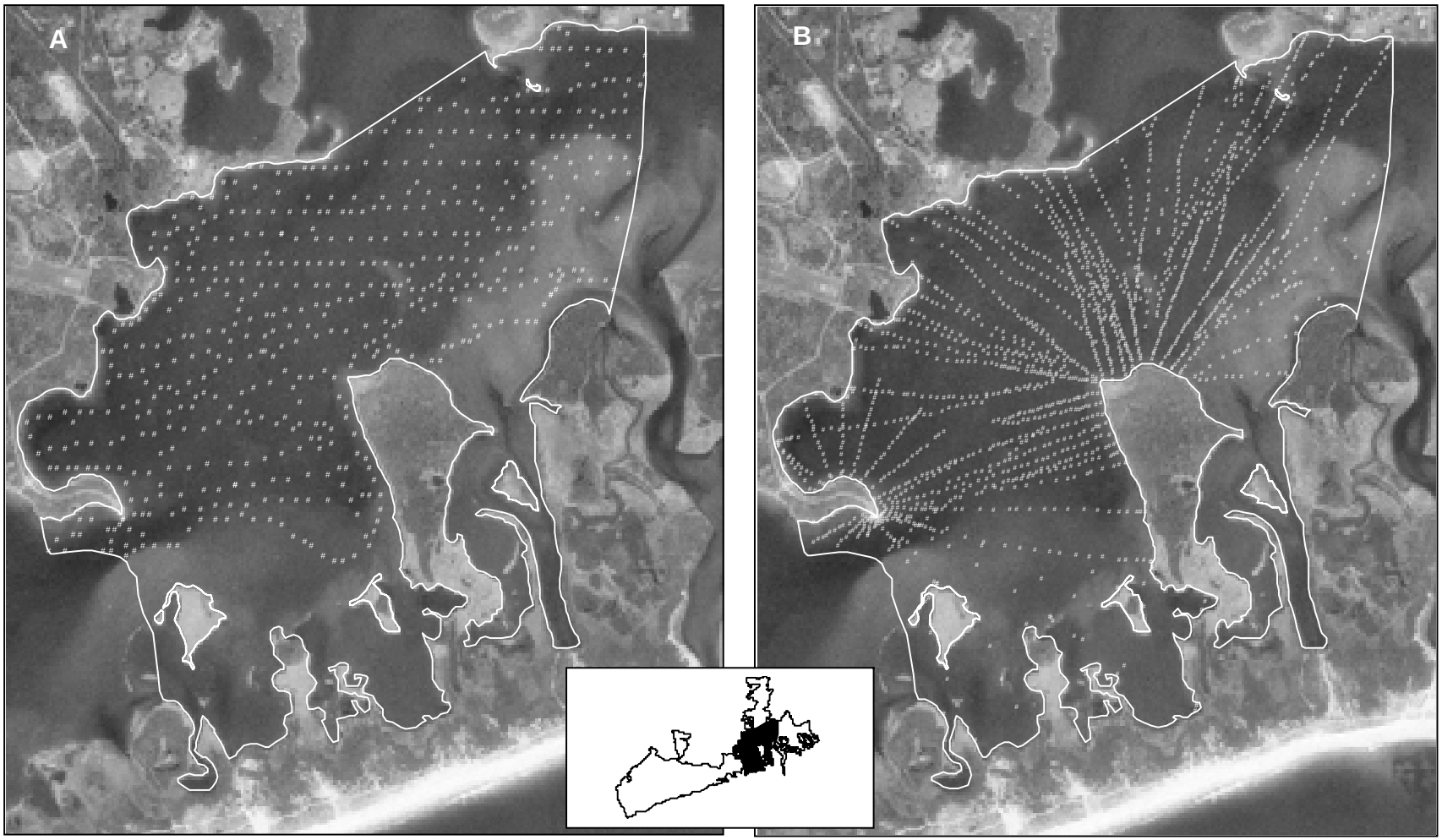
Evaluating Methods to Map the Submerged Topography

Evaluate and compare existing data (NOAA and ACOE) to data we collected using surveying

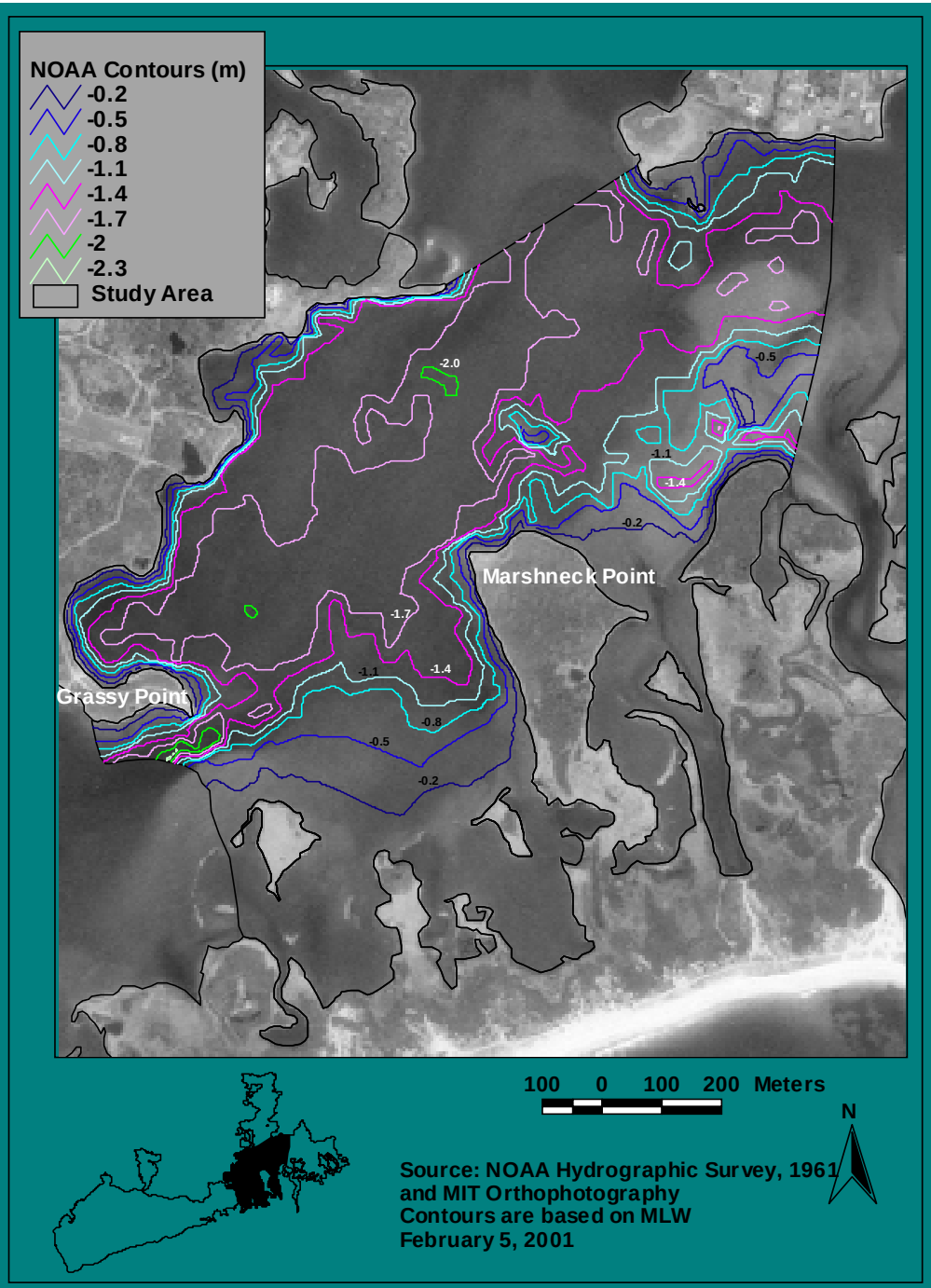

Shoreline
Contours (m)
-0.9
-0.6
-0.3
0
0.3
600 0 600 1200 Meters
A.
B.
Ninigret Wildlife Refuge
Block Island Sound
N
300 0 300 600 Meters
Map by Mike Bradley
January 22, 2001
Source: Army Corps of Engineers, 1998
Elevations based on NGVD

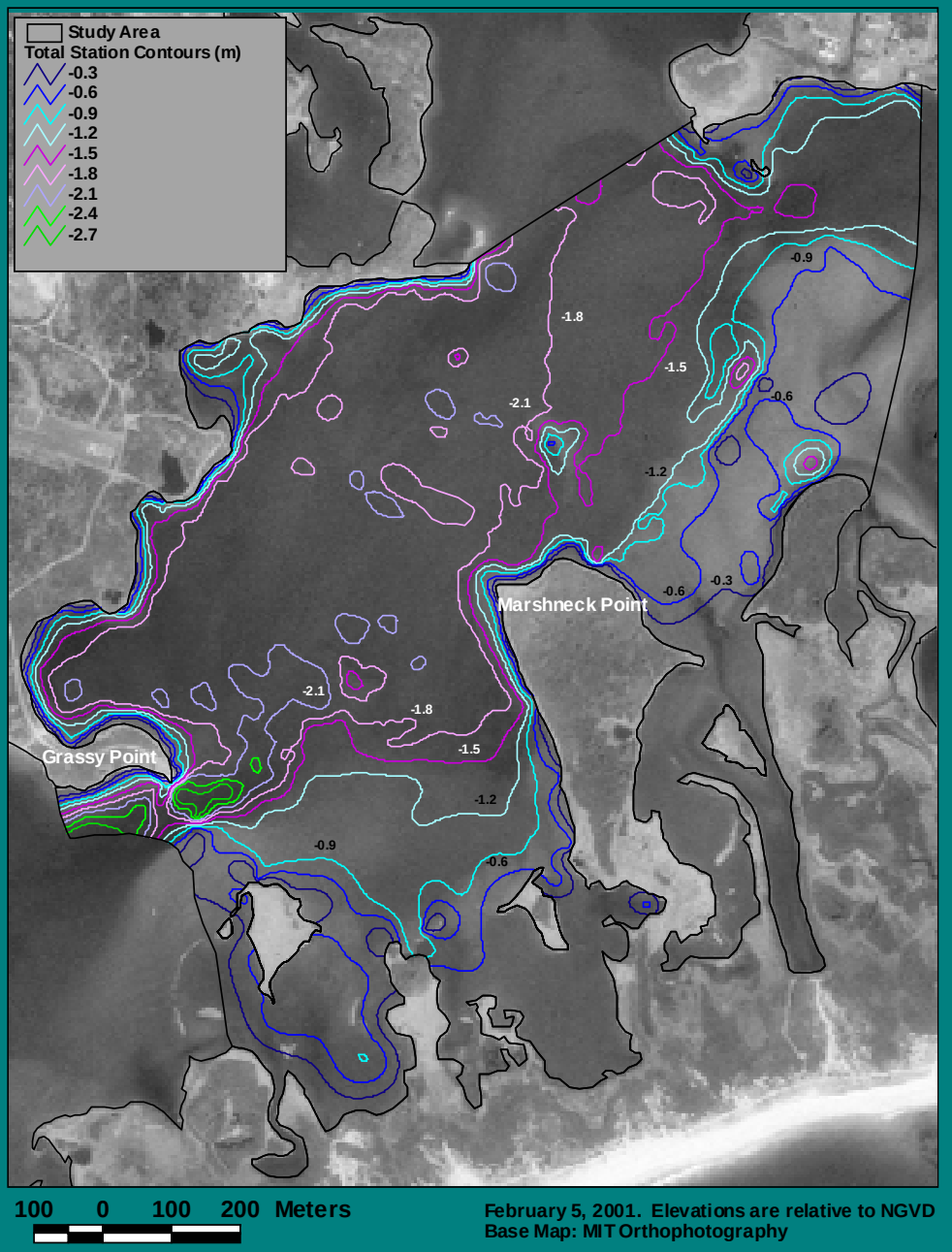
The Aquatic Cart





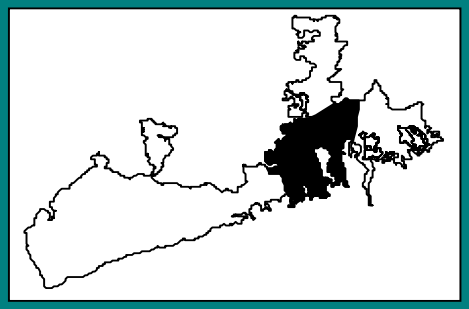
March 7, 2001
Base Map: MIT Orthophotography


NOAA Contours (m)
-0.2
-0.5
-0.8
-1.1
-1.4
-1.7
-2
-2.3
Study Area
Marshneck Point
Grassy Point
100 0 100 200 Meters
N
Source: NOAA Hydrographic Survey, 1961
and MIT Orthophotography
Contours are based on MLW
February 5, 2001


Study Area
Total Station Contours (m)
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
-2.1
-2.4
-2.7
Marshneck Point
Grassy Point
100 0 100 200 Meters
February 5, 2001. Elevations are relative to NGVD
Base Map: MIT Orthophotography

Landscape Units

Bc	Barrier Cove
Bbe	Barrier-Submerged Glacial Beach
Ftd	Flood-Tidal Delta
FtdS	Flood-Tidal Delta Slope
LB	Lagoon Bottom
Mc	Mainland Cove
Msc	Mainland-Shallow Cove
Mbe	Mainland-Submerged Erosional Beach
Mch	Mid-lagoon Channel
Sl	Saltmarsh Island
Sh	Shoal
Bb	Storm-Surge Platform
BbS	Storm-Surge Platform Slope

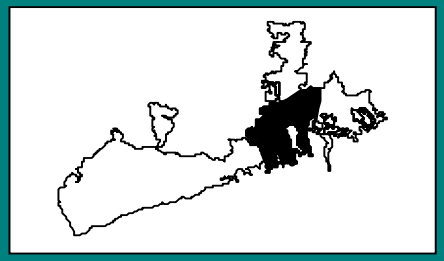


Base Map: MIT Orthophotography
Depths are relative to NGVD
March 21, 2001

r Boulders
Ñ Vibra-Cores
Soil Samples

Soil-Landscape Units

Bc	Barrier Cove
GBb(C)	Glacial Barrier Submerged Beach
Ftd	Flood-Tidal Delta
FtdS(A)	Flood-Tidal Delta Slope
I	Intertidal Sand Flat
LB	Lagoon Bottom
Mc	Mainland Cove
GMs(B)	Mainland Submerged Beach (Sand Phase)
GMb(C)	Mainland Submerged Erosional Beach
Gch(D)	Mid-lagoon Channel
LBs	Shallow Lagoon Bottom
Bb	Back-Barrier
BbS(A)	Back-barrier Slope
Gi(B)	Glacial Fluvial Outcrop Island
Gfb	Glacial Fluvial Bar



Base Map: MIT Orthophotography
March 21, 2001

Coarse-loamy, Typic Fluvaquent

A1 0-13 cm sil

A2 13-26 cm vfsl

C 26-44 cm s

2Ab 44-62 cm vfsl

2C 62-69 cm sl

3Ab 69-86 cm fsl

3C1 86-93 cm ls

3C2 93-100 cm ls

4Ab 100-108 sl

Coarse-silty over sandy skeletal, Typic Hydraquent

A1 0-13 cm sil

AC 13-26 cm fsl

C1 26-39 cm sil

C2 39-50 cm sil

C3 50-60 cm sl

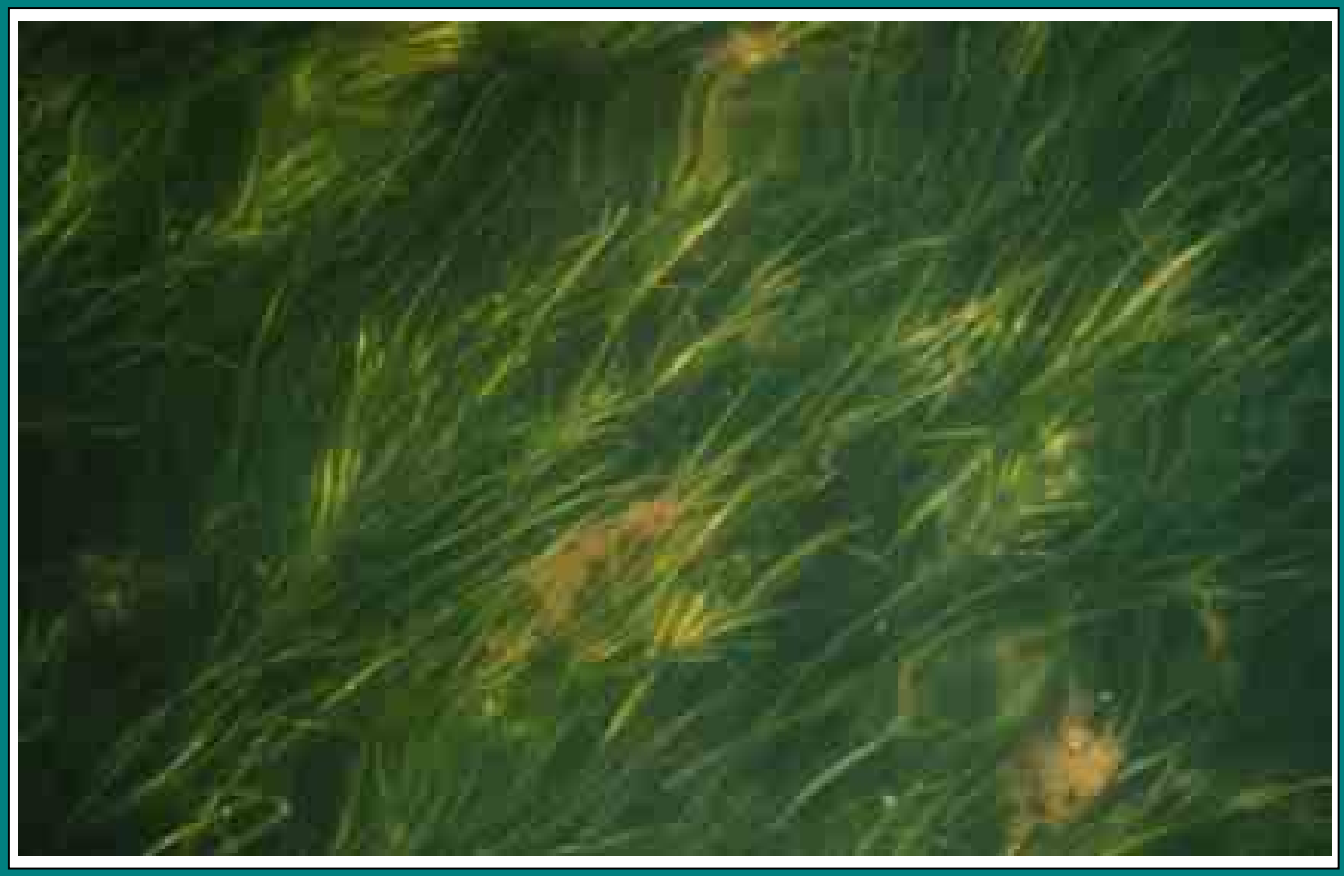
50% shells

2C4 60-88 cm vgrcos, 50% gravel.

Subaqueous Soil Classifications

Subgroup Classifications
Typic Hydraquents
Typic Fluvaquents
Typic Sulfaquents
Typic Psammaquents
Typic Endoaquents
Thapto-Histic Hydraquents

Subaqueous Soil-Landscape Units and Eelgrass Relationships



Mike Bradley with an eelgrass plant

- Boulders
- Vibra-Cores
- Soil Samples

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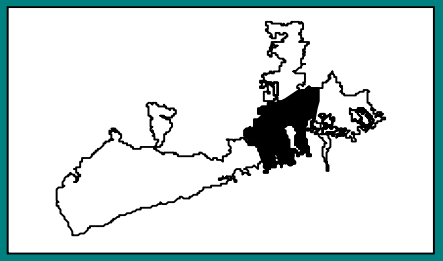
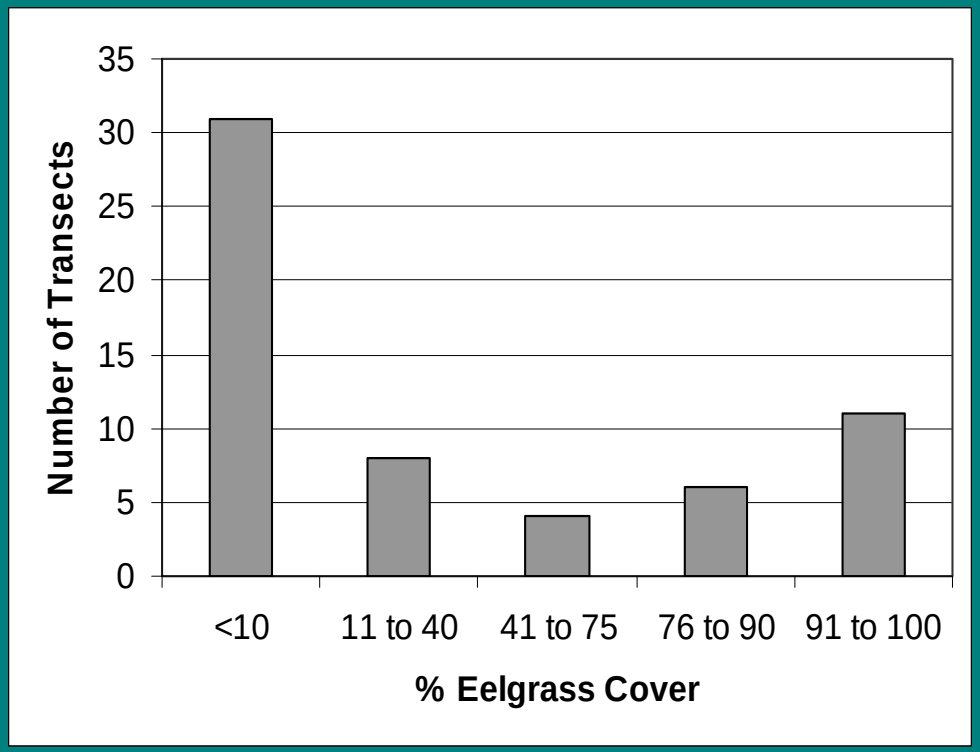
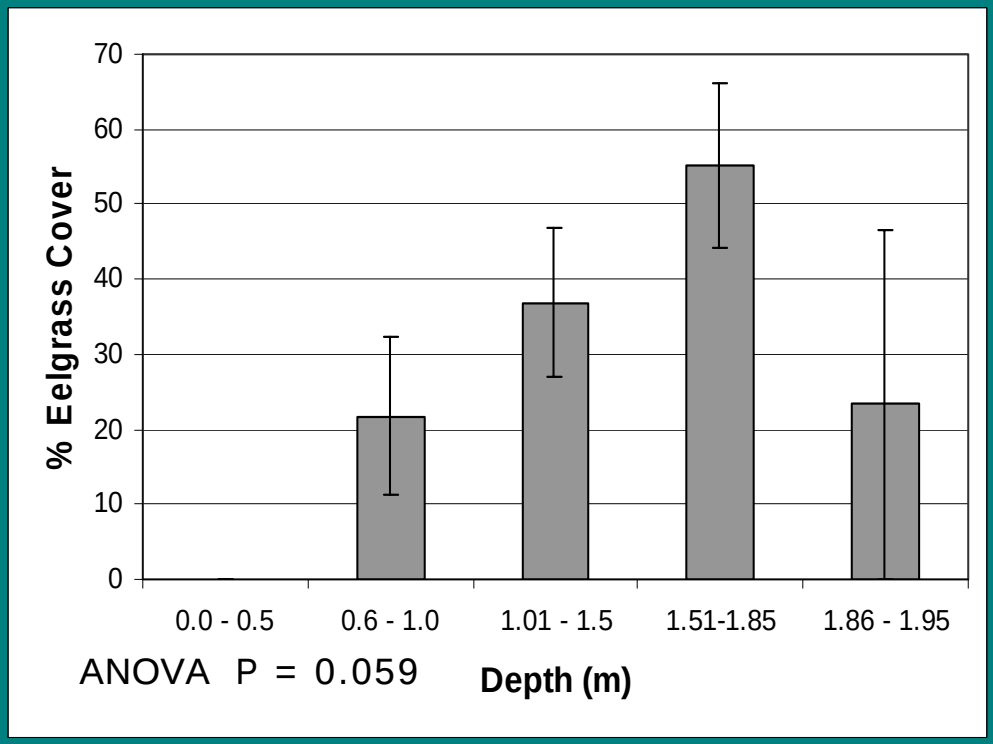


Base Map: MIT Orthophotography
March 21, 2001

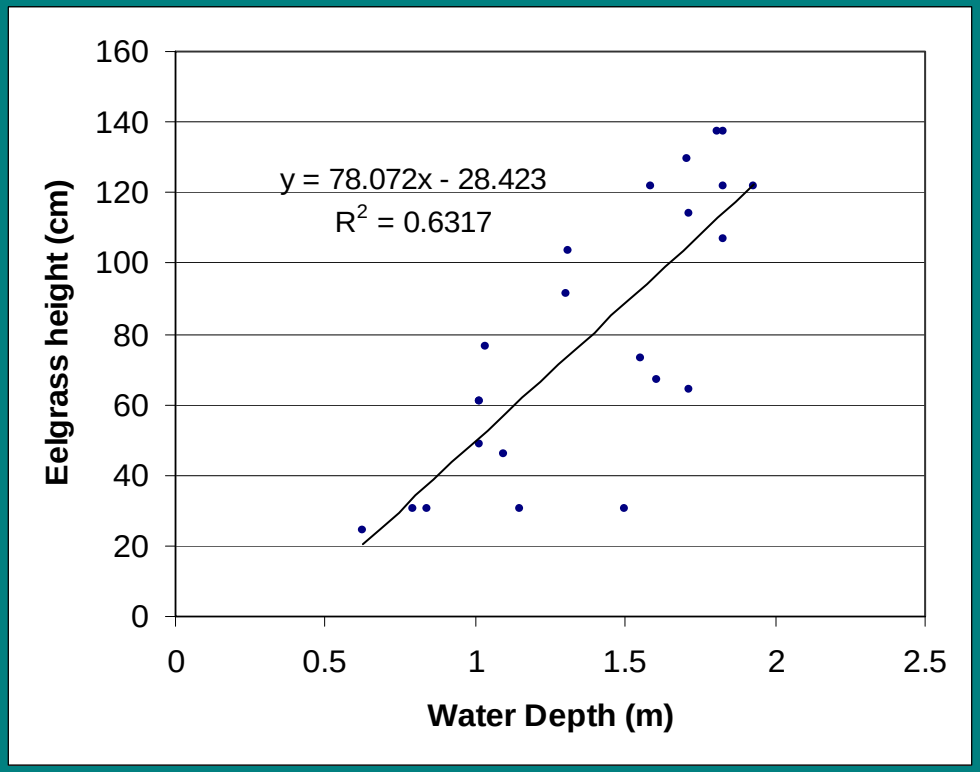
Eelgrass distribution in the study area

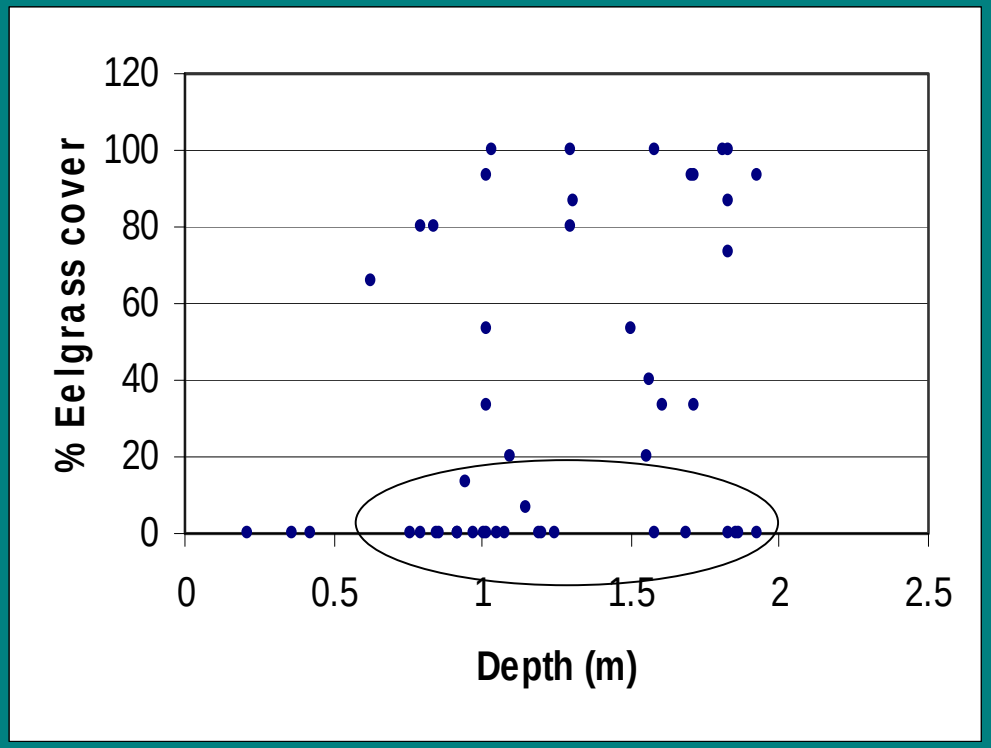


Eelgrass cover related to depth



Eelgrass and water depth relationships





Subaqueous Soil Map Unit	Average Eelgrass Cover % ± sd (N)	USDA Soil Texture Classification
Barrier Cove (Bc)	100 ± 0 (2)	very fine sandy loam
Shallow Lagoon Bottom (LBs)	89 ± 3.81 (3)	silt loam
Flood-tidal Delta Slope (FtdS A)	82 ± 14 (4)	silt loam
Lagoon Bottom (LB)	66 ± 37.9 (15)	silt loam
Barrier Submerged Glacial Beach (GBb C)	13 ± 21.3 (7)	fine sand
Glacial Fluvial Outcrop Island (Gi B)	8 ± 14.4 (5)	gravelly coarse sand
Mainland Submerged Beach (Sand Phase) (GMs B)	5 ± 10 (4)	very fine sand
Glacial Fluvial Point Bar (Gfb)	5 ± 10 (4)	loamy sand
Flood-tidal Delta Flat (Ftd)	0 (2)	very fine sand
Back-barrier Flat (Bb)	0 (4)	sand
Mainland Submerged Erosional Beach (GMb C)	0 (9)	coarse sand
Back-barrier Slope (BbS A)	0 (2)	coarse sand
Mainland Cove (Mc)	0 (1)	silt loam
Mid-lagoon Channel (Gch D)	0 (2)	gravelly coarse sand

carbonate, and CRS = chromium reducible sulfides).

	High Eelgrass Cover (mean ± sd) N = 4**	**Low Eelgrass Cover (mean ± sd) N = 4**	**No Eelgrass (mean ± sd) N = 9**	**ANOVA P-value**
Eelgrass Cover	84.0 ± 14.4^{a}	11.8 ± 6.0^{b}	0 ± 0^{c}	<0.001*
AVS (ug/g)	99.0 ± 5.3^{a}	7.25 ± 2.1^{b}	19.9 ± 2.5^{b}	0.001*
Salinity (ppt)	39.8 ± 4.6^{a}	25.5 ± 5.54^{b}	27.4 ± 5.9^{b}	0.004*
Silt %	46.9 ± 17.7^{a}	7.2 ± 2.3^{b}	12.3 ± 17.7^{b}	0.004*
Sand %	38.4 ± 18.6^{a}	90.6 ± 3.6^{b}	82.0 ± 25.0^{b}	0.005*
Clay %	14.6 ± 5.9^{a}	2.2 ± 1.8^{b}	5.7 ± 7.2^{ab}	0.031*
Total Nitrogen %	0.24 ± 0.1^{a}	0.03 ± 0.03^{b}	0.1 ± 0 .1^{ab}	0.038*
pH	7.54 ± 7.17^{a}	7.95 ± 0.34^{ab}	7.95 ± 0.26^{b}	0.045*
Organic Carbon %	2.8 ± 1.2	0.6 ± 0.2	1.5 ± 2.1	0.218
Rock Fragments %	0	14.5 ± 16.2	8.0 ± 13.6	0.302
$CaCO_3$ %	1.1 ± 0.3	0.5 ± 0.3	0.9 ± 1.0	0.558
Shell Fragments %	0	4.9 ± 7.6	5.8 ± 12.2	0.621
Total Sulfur (ug/g)	560.1 ± 770	254.0 ± 46.4	421.8 ± 722.6	0.804
CRS (ug/g)	461.5 ± 816.7	247.3 ± 46.0	402.2 ± 698.8	0.888

Sequential linear regression model

Model	R	R-square	Adjusted R-square	Std. Error of the estimate
AVS	.790	.624	.599	22.8858
AVS, TN	.793	.629	.576	23.5216
AVS, TN, OC	.922	.851	.816	15.4947

Y Eelgrass transects
Ñ Vibra-Cores
$ Soil Samples

Eelgrass

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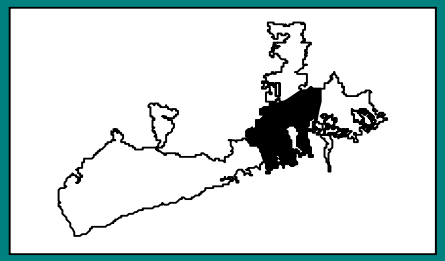

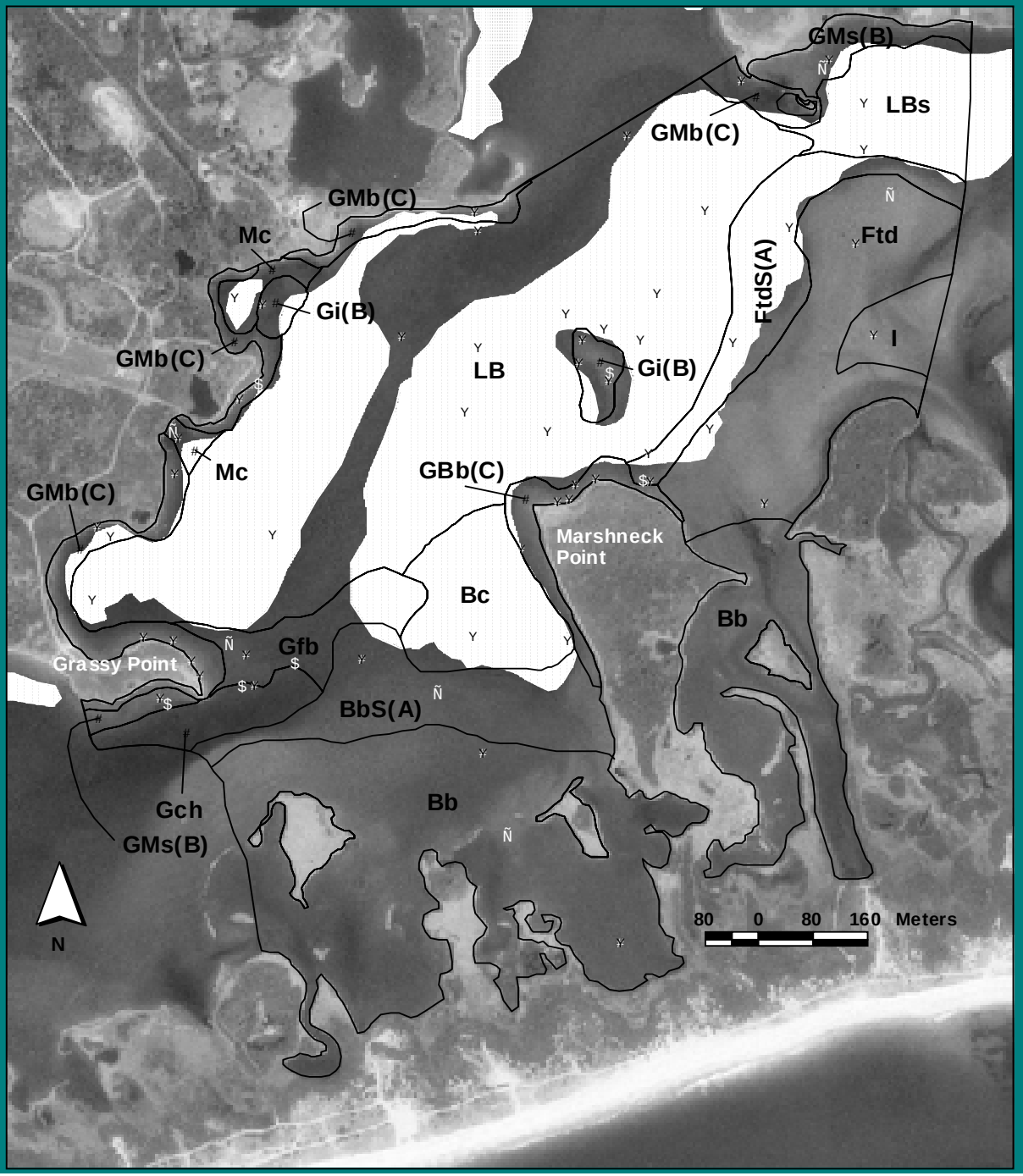

Base Map: MIT Orthophotography
March 21, 2001