Massachusetts Estuaries Project
Estuarine Restoration and Management

Overview:
Nitrogen Loading & Management Thresholds Madaket & Nantucket Harbors

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Town of Nantucket
Board of Selectmen Workshop
August 10, 2011

Town of Nantucket partnership with Massachusetts Estuaries Project

- Nantucket Harbor: N Threshold – Complete
- Madaket Harbor: N Threshold – Complete
- Long Pond: N Threshold - Complete
- Sesachacha Pond: N Threshold – Complete
- Hummock Pond: N Threshold - ??
- Nantucket Harbor: Bacterial Assessment
- Sesachacha Pond: Bacterial Assessment

Linked Watershed-Embayment Management Modeling Approach used for MEP

Management Aspects:

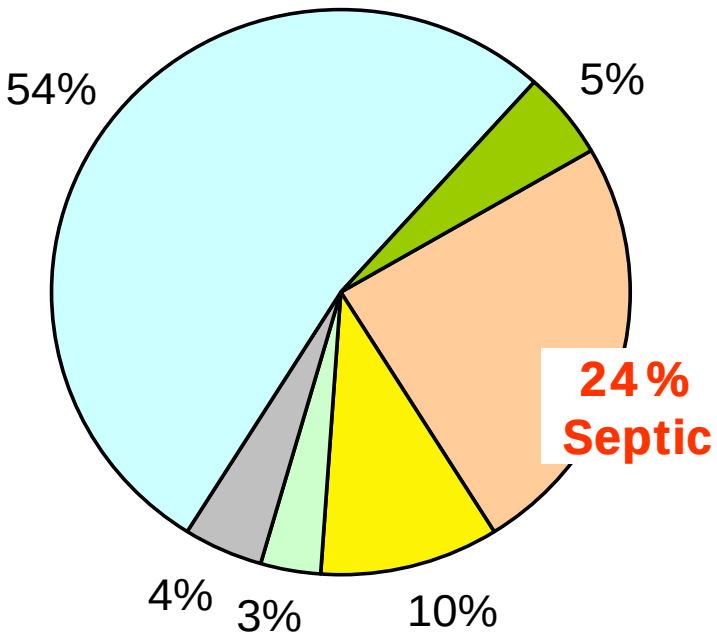
✓ Supports refined nitrogen management targets, to restore estuary without "excess" management action ($ savings).

✓ As Town develops restoration plan, model can be run for "what if" scenarios (through SMAST Municipal Service Center).

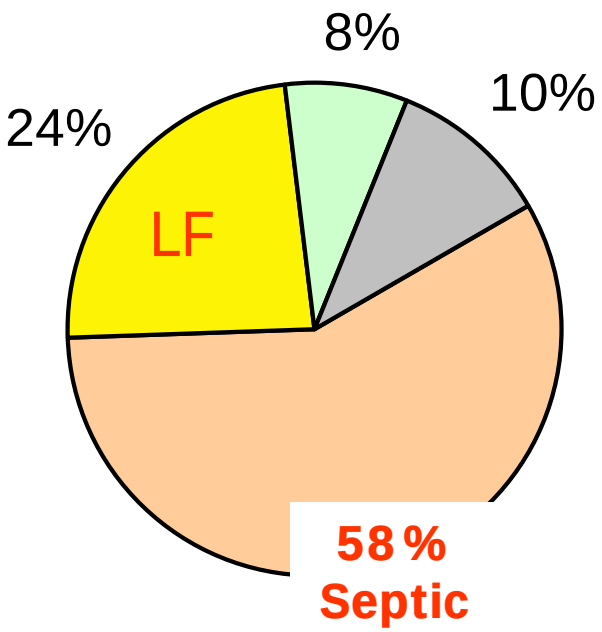
Town of Nantucket
Madaket - Long Pond Estuarine System

Madaket Harbor / Long Pond System
Total Watershed N Load

- Wastewater
- Landfill
- Fertilizers
- Impervious Surfaces
- Water Body Surface Area
- "Natural" Surfaces



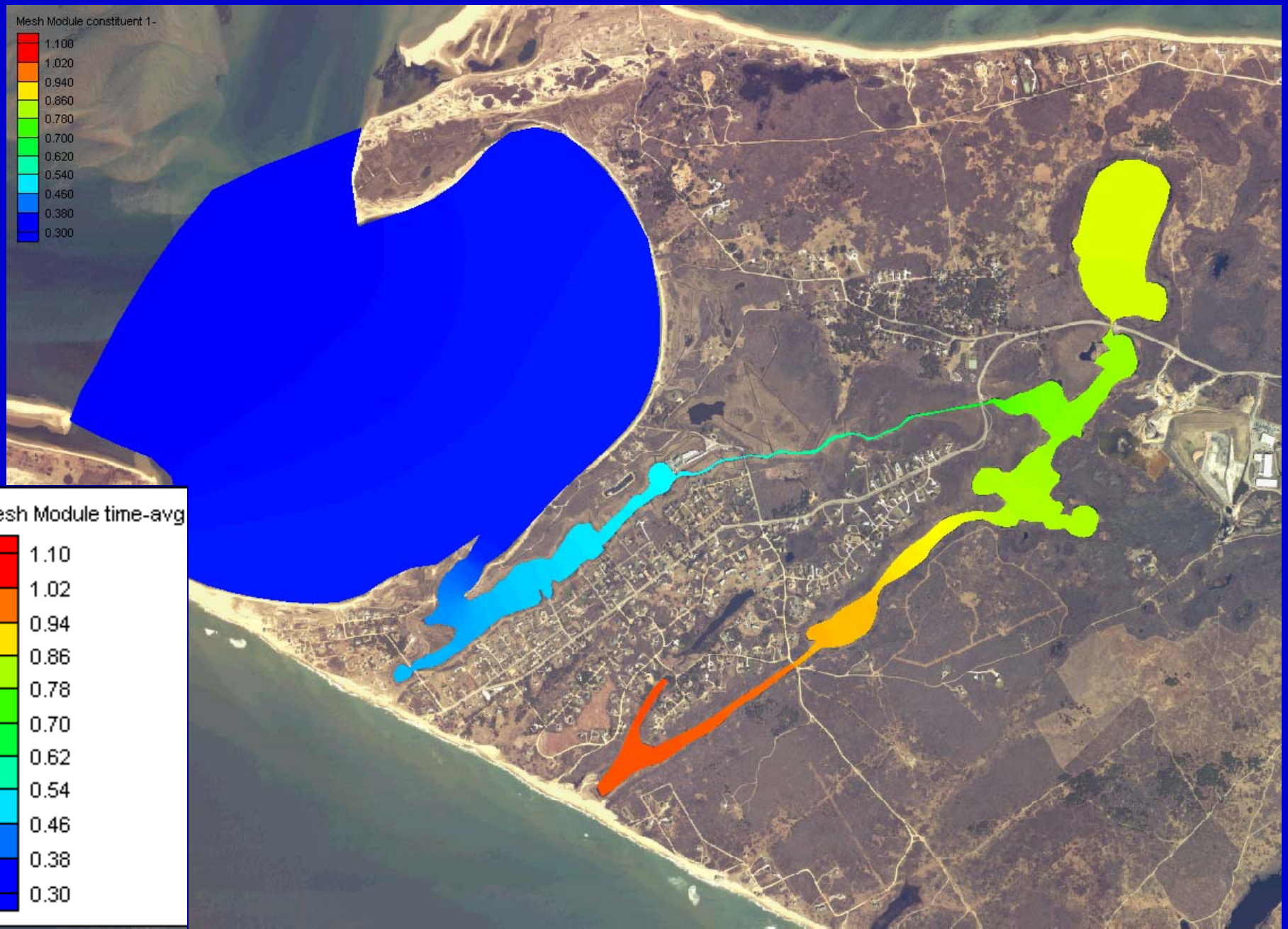
Overall Load



Local Controllable Load

Total Nitrogen Gradient Present N Loading

Tidally Averaged TN (mg/L)



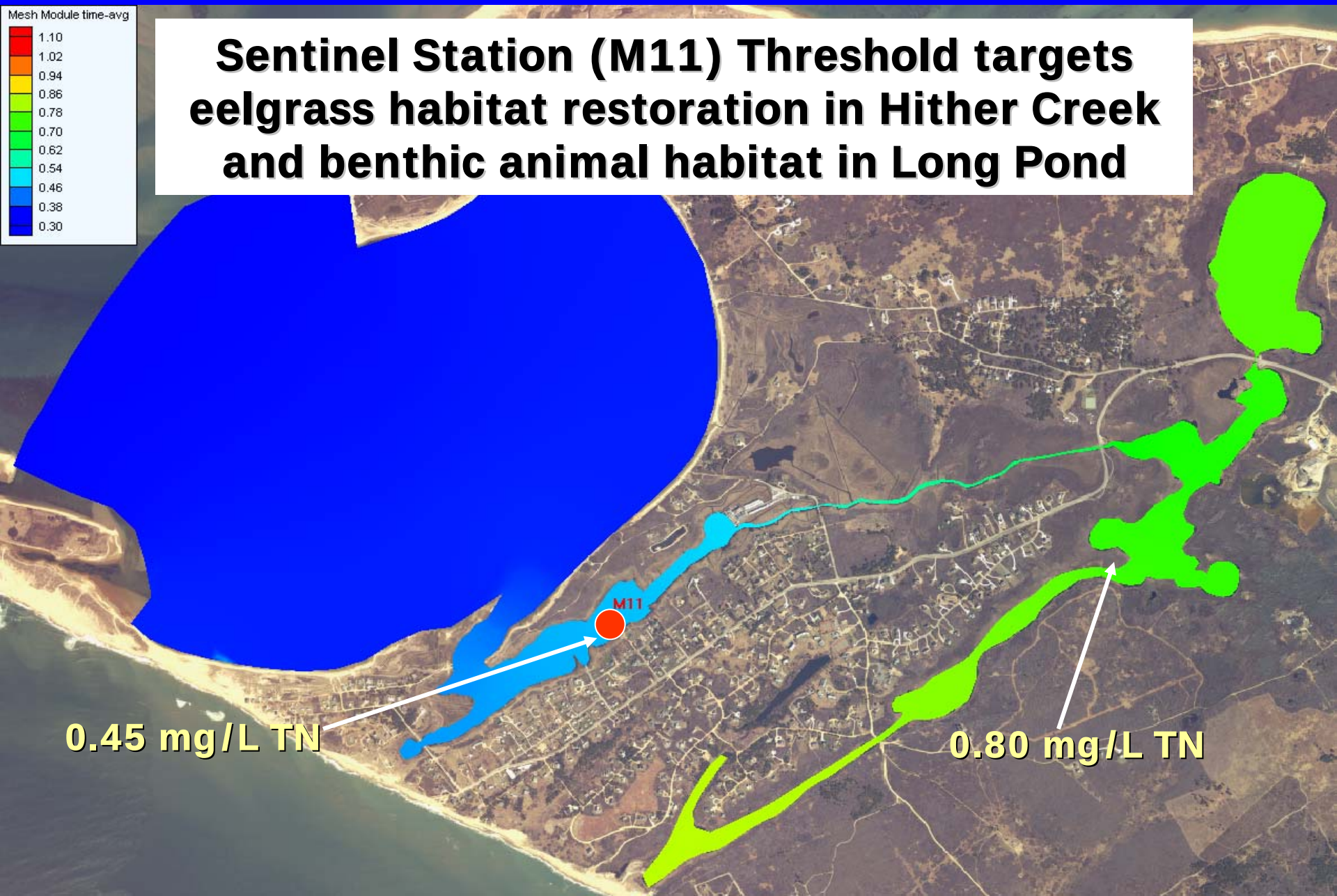
Status: Madaket Harbor / Long Pond Estuary

Status: Significantly Impaired

Primary Restoration Goal: Eelgrass Habitat in region of Hither Creek

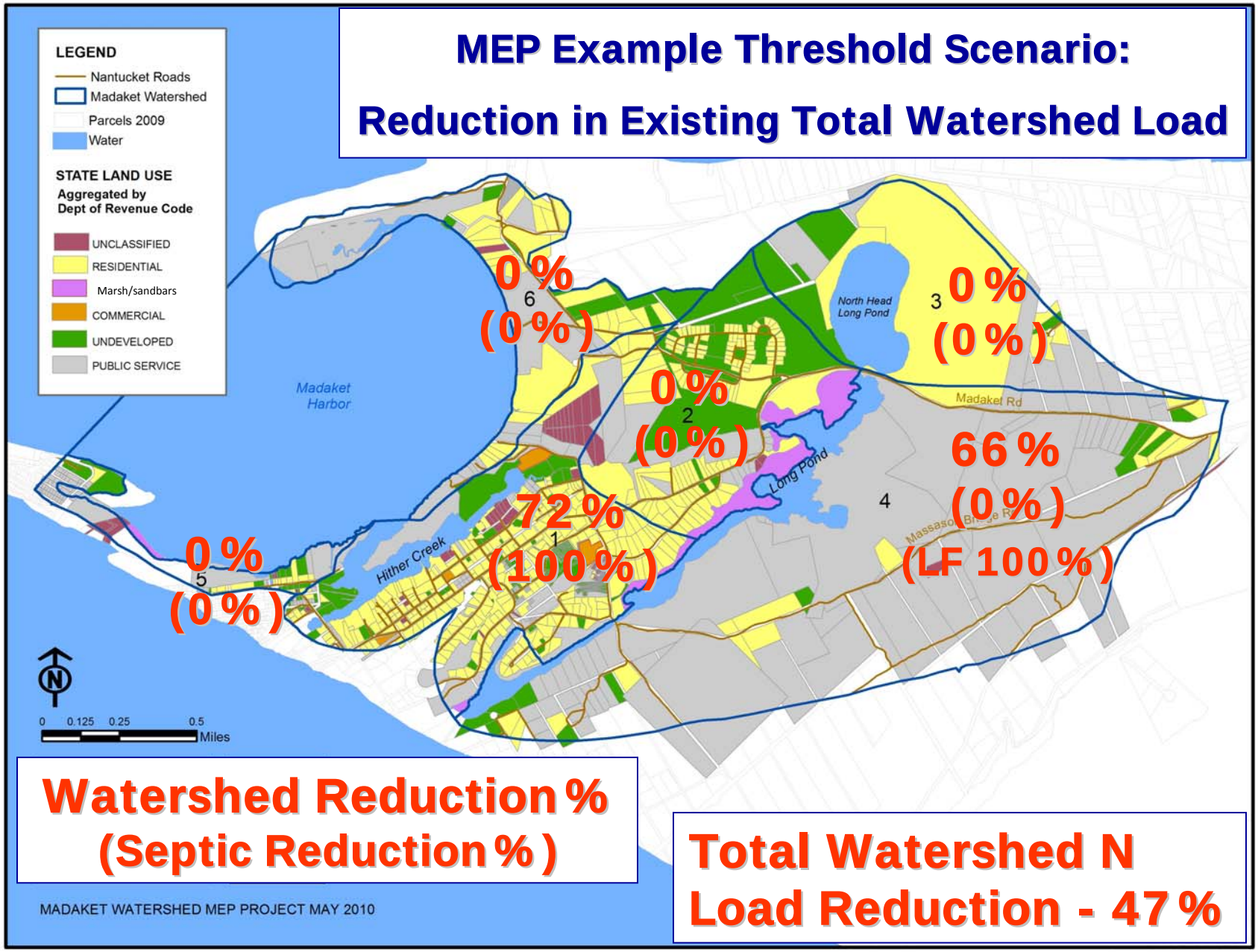
Secondary Restoration Goal: Animal Habitat in Long Pond

MEP TN Thresholds to Achieve Restoration

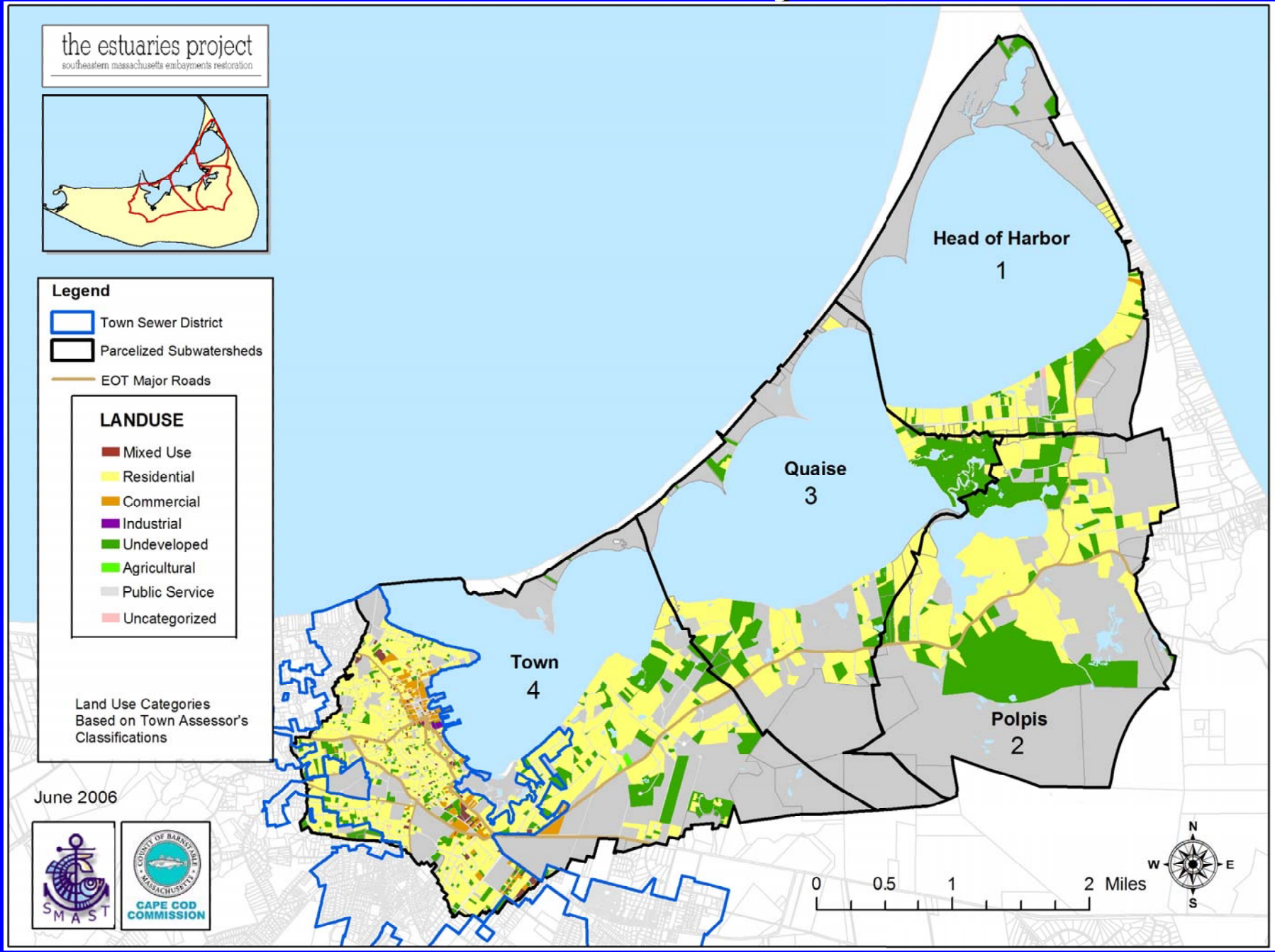


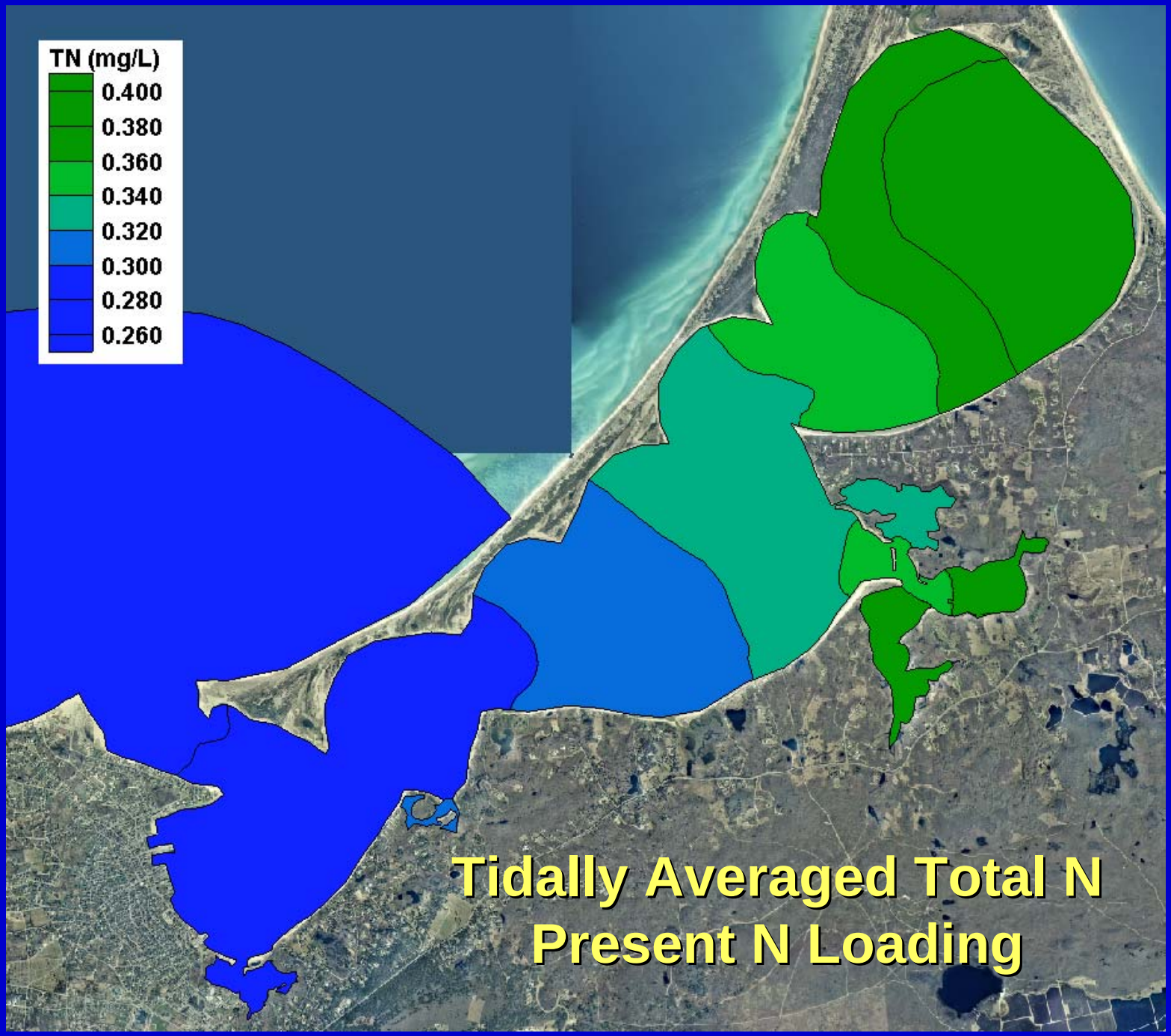
Sentinel Station (M11) Threshold targets eelgrass habitat restoration in Hither Creek and benthic animal habitat in Long Pond

Madaket / Long Pond System: Threshold Analysis



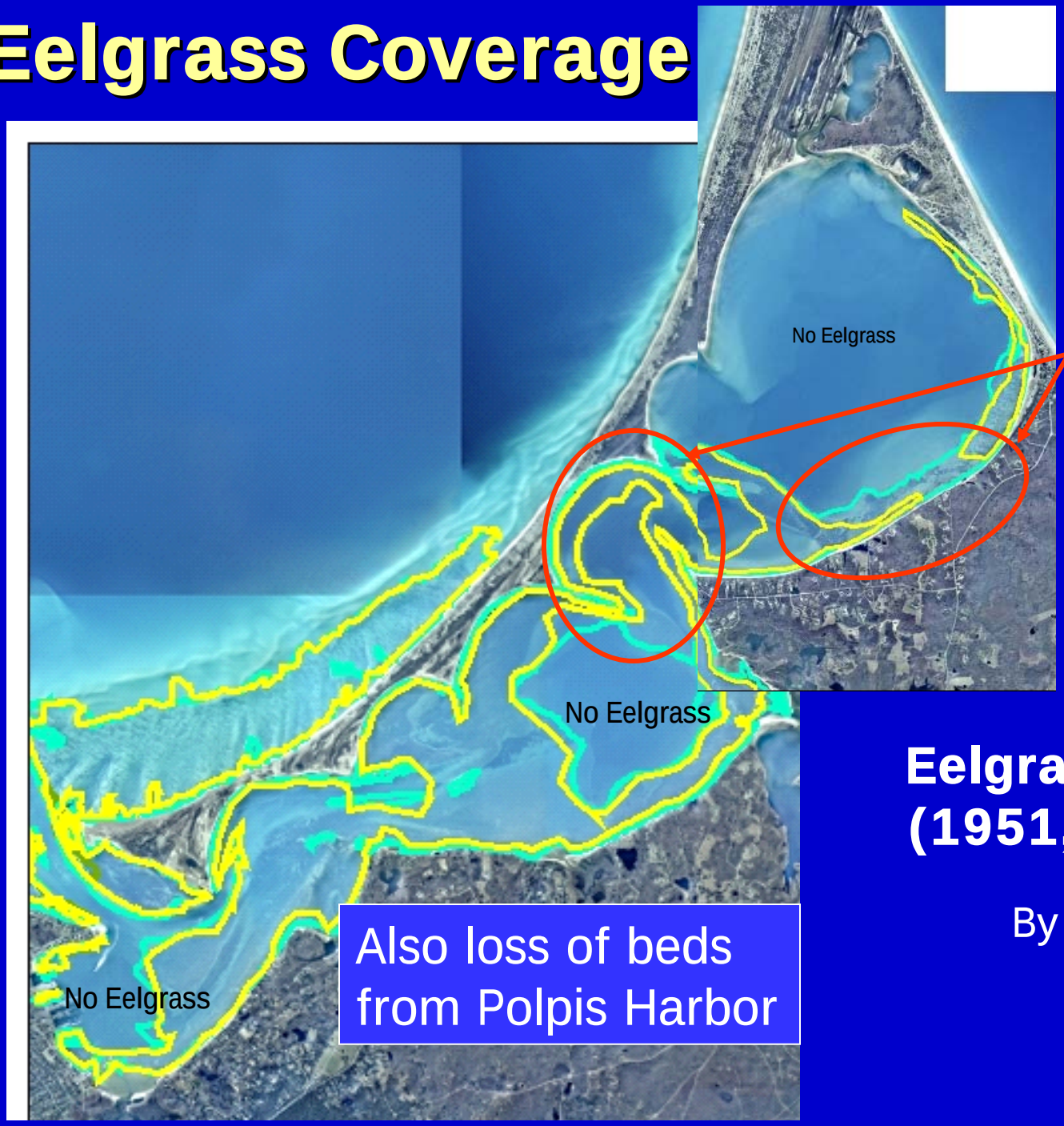
Harbor Watershed: Parcel by Parcel Land-Use





Tidally Averaged Total N
Present N Loading

Eelgrass Coverage



Recent Loss

Also loss of beds from Polpis Harbor

Eelgrass Distribution (1951, 1995, 2001)

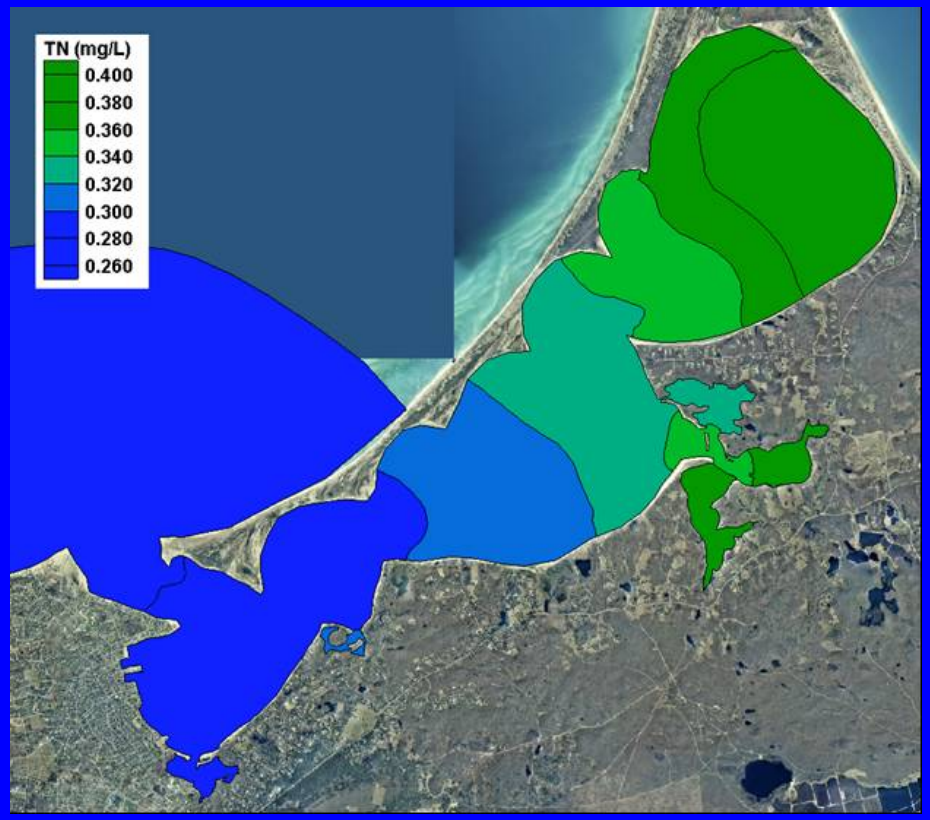
By MassDEP

Massachusetts Estuaries Project: Assessment of Habitat Health

Table VIII-1. Summary of Nutrient Related Habitat Health within the Nantucket Harbor Estuarine System on Nantucket Island within the Town of Nantucket, MA., based upon assessment data presented in Chapter VII. The bilobate Polpis Harbor is an enclosed sub-system tributary to the Quaise basin.

Health Indicator	**Nantucket Harbor Estuarine System**				
	Head of Harbor	**Quaise**	**Town Basin**	**Polpis Harbor**	
				East	**West**
Dissolved Oxygen	H[2]/MI[1]	H[2]/MI[1]	H[2]	H/MI[3]	H/MI[3]
Chlorophyll	H[6,7]	H[6,7]	H[6,7]	H[6,7]	H[6,7]
Macroalgae	--[4]	--[4]	--[4]	--[4]	--[4]
Eelgrass	MI[13]	H	H	SI[12]	--[11]
Infaunal Animals	H[8]/MI[9]	H[8]/MI[9]	H[5]	H/MI[10]	H/MI[10]
Overall:	**H[8]/MI[9]**	**H**	**H**	**MI[14]**	**H/MI**

Present Loading



Threshold Loading A

Threshold TN for Restoration of Eelgrass & Infauna: 0.349 mg/L at Sentinel Station 2.1 (HOH Lower), 0.356 mg/L at Sentinel Station 4 (Polpis)

Nitrogen Management Options
Generally via CWMP and TMDL Processes:

- Hydrodynamic options
  - Tidal flushing/circulation enhancement & management
- Natural attenuation options
  - Nitrogen source location to maximize natural attenuation
  - Wetland/riparian zone restoration to increase attenuation
  - Pond restoration to create zones of natural attenuation
- Nitrogen source reductions
  - Fertilizer education, Landfill Management
- Wastewater options (what, where, how much)
  - Centralized and decentralized systems

Massachusetts Estuaries Project for Estuarine Restoration

Questions & Discussion

CAPE COD COMMISSION

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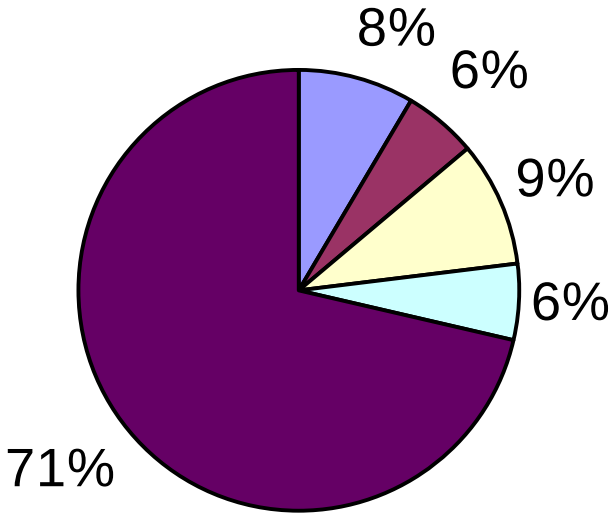
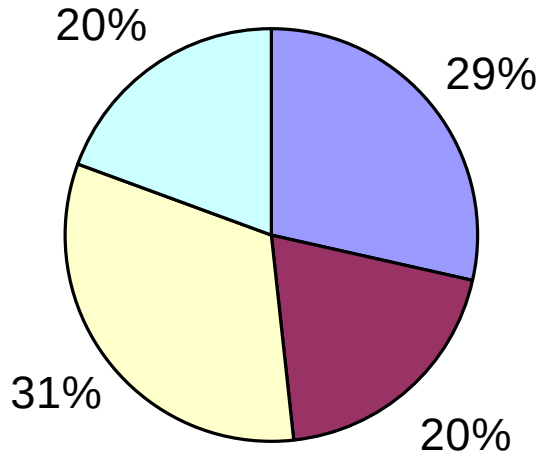
Total System



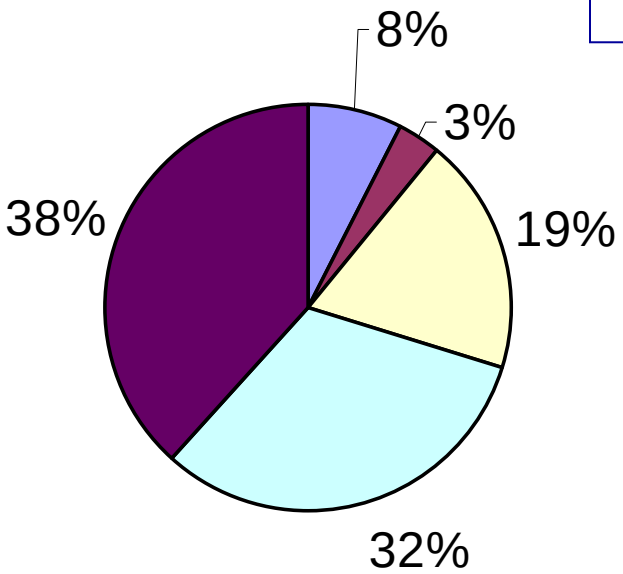
Overall N Load

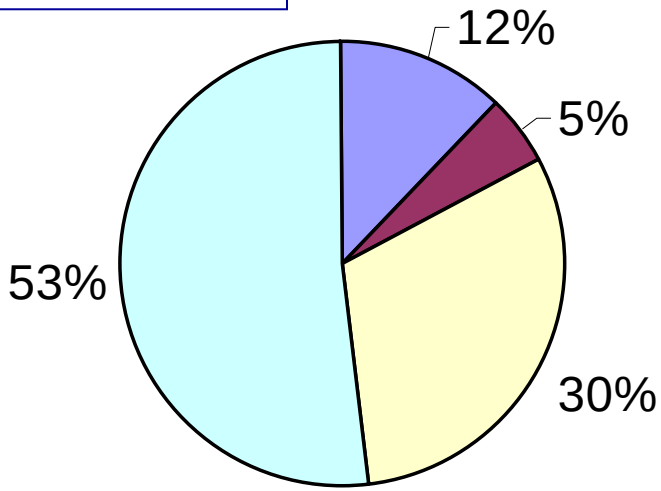


Local N Load

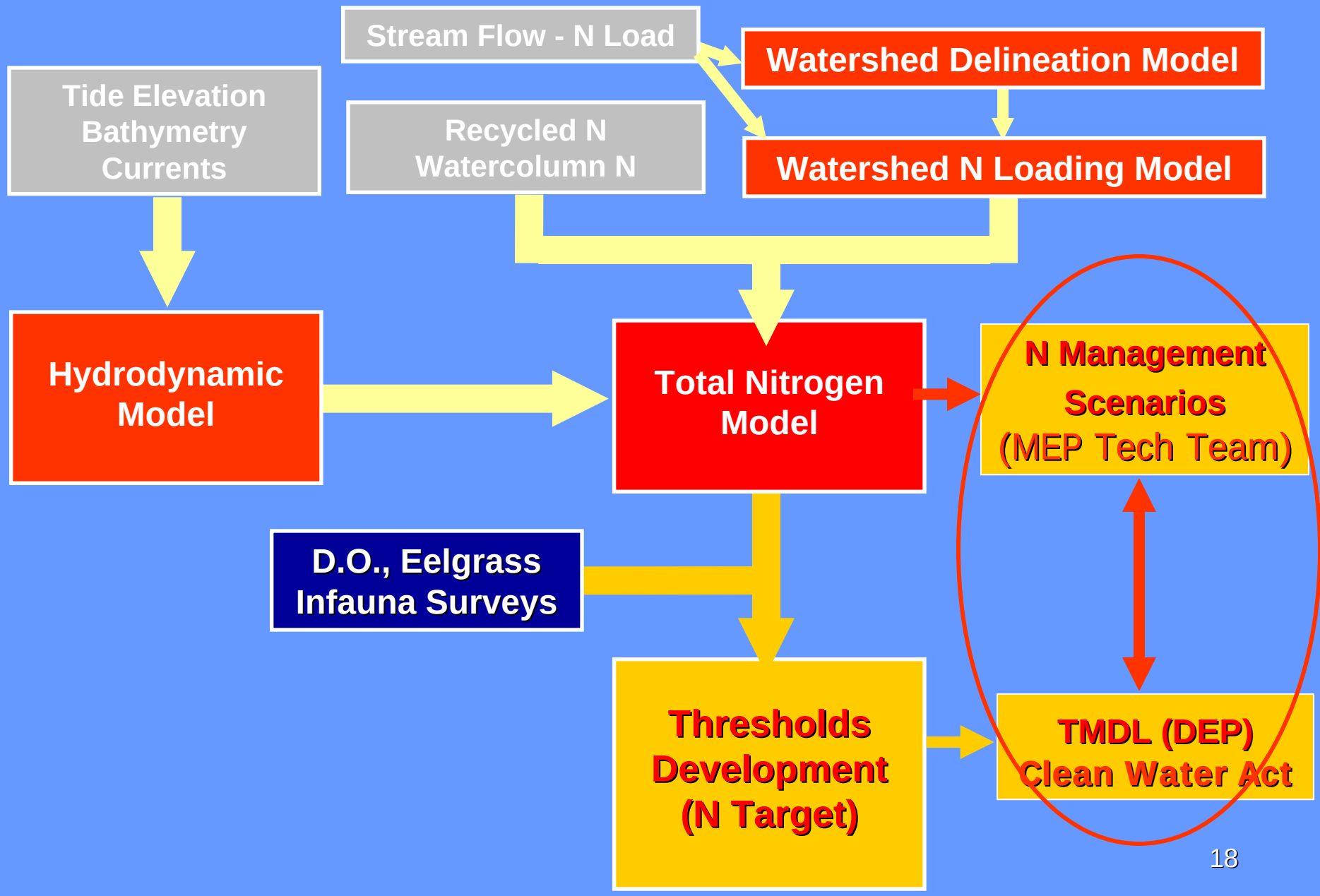
- Septic
- Fertilizer
- Impervious
- Natural
- Atmospheric

Polpis Harbor





Linked Watershed-Embayment Approach



Historic Eelgrass Distribution

1951 - photoanalysis

1995 - field verified

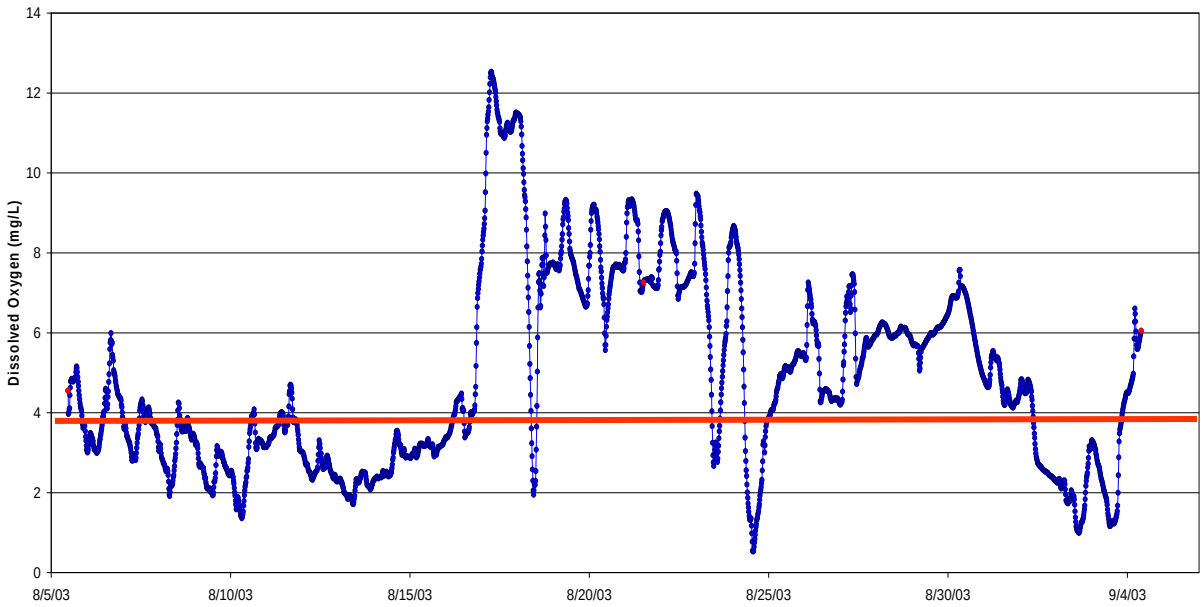
2001 - field verified

2003 - field verified

2006 - photoanalysis

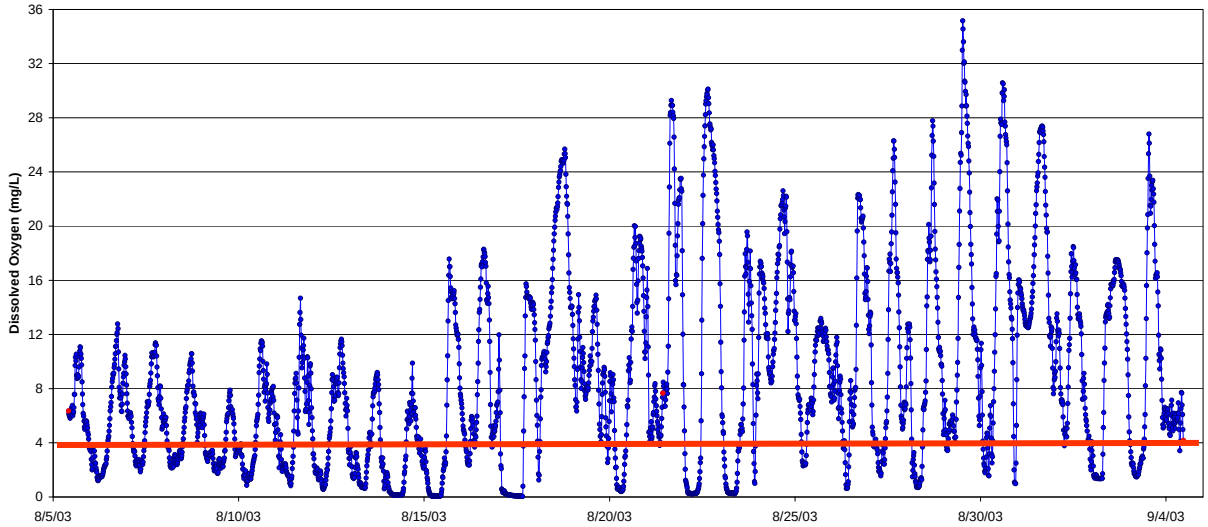
No Record of Eelgrass Habitat within the Long Pond Basin or Long Pond Head

Dissolved Oxygen (bottom water)



Hither Creek

Stress to Infaunal Animals



Long Pond Middle

Stress to Infaunal Animals

Massachusetts Estuaries Project: Assessment of Benthic Animal Habitat Quality

Basin	Total Actual Species	Total Actual Individuals	Species Calculated @75 Indiv.	Weiner Diversity (H')	Evenness (E)	Stations MAD & LPN[3]
Madaket Harbor - Long Pond Estuary						
Madaket Harbor			--[1]			
Mean =	8	666	8	2.23	0.72	MAD:3-5,7,14,15
S.E. =	1	145	1	0.29	0.07	
N =	6	6	6	6	6	
Hither Creek						
Mean =	4	123	5	1.36	0.69	MAD:9,11,12
S.E. =	1	82	1	0.46	0.17	
N =	3	3	3	3	3	
North Head Long Pond						
Mean =	5	181	5	1.59	0.68	LPN: 1
S.E. =	--	--	--	--	--	
N =	1	1	1	1	1	
Long Pond						
Mean =	5	947	6	1.19	0.60	LPN:4,5,7,8
S.E. =	2	583	1	0.47	0.10	
N =	4	4	4	4	4	

Massachusetts Estuaries Project: Assessment of Habitat Health

Health Indicator	Madaket Harbor - Long Pond Embayment System				
	Madaket Harbor	Hither Creek	Long Pond		North Head Long Pond
			Mid	Lower	
Dissolved Oxygen	H[1]	SI[2]	MI-SI[3]	MI[4]	H[5]
Chlorophyll	H[6]	MI/SI[7]	SI[8]	MI/SI[9]	H/MI[10]
Macroalgae	H[11]	SI[12]	--[13]	--[13]	--[14]
Eelgrass	H[15]	SI[16]	--[17]	--[17]	--[17]
Infaunal Animals	H[18]	SI[19]	MI[20]	MI[20]	H-MI[21]
Overall:	**H[22]**	**SI[23]**	**MI[24]**		**H/MI[25]**