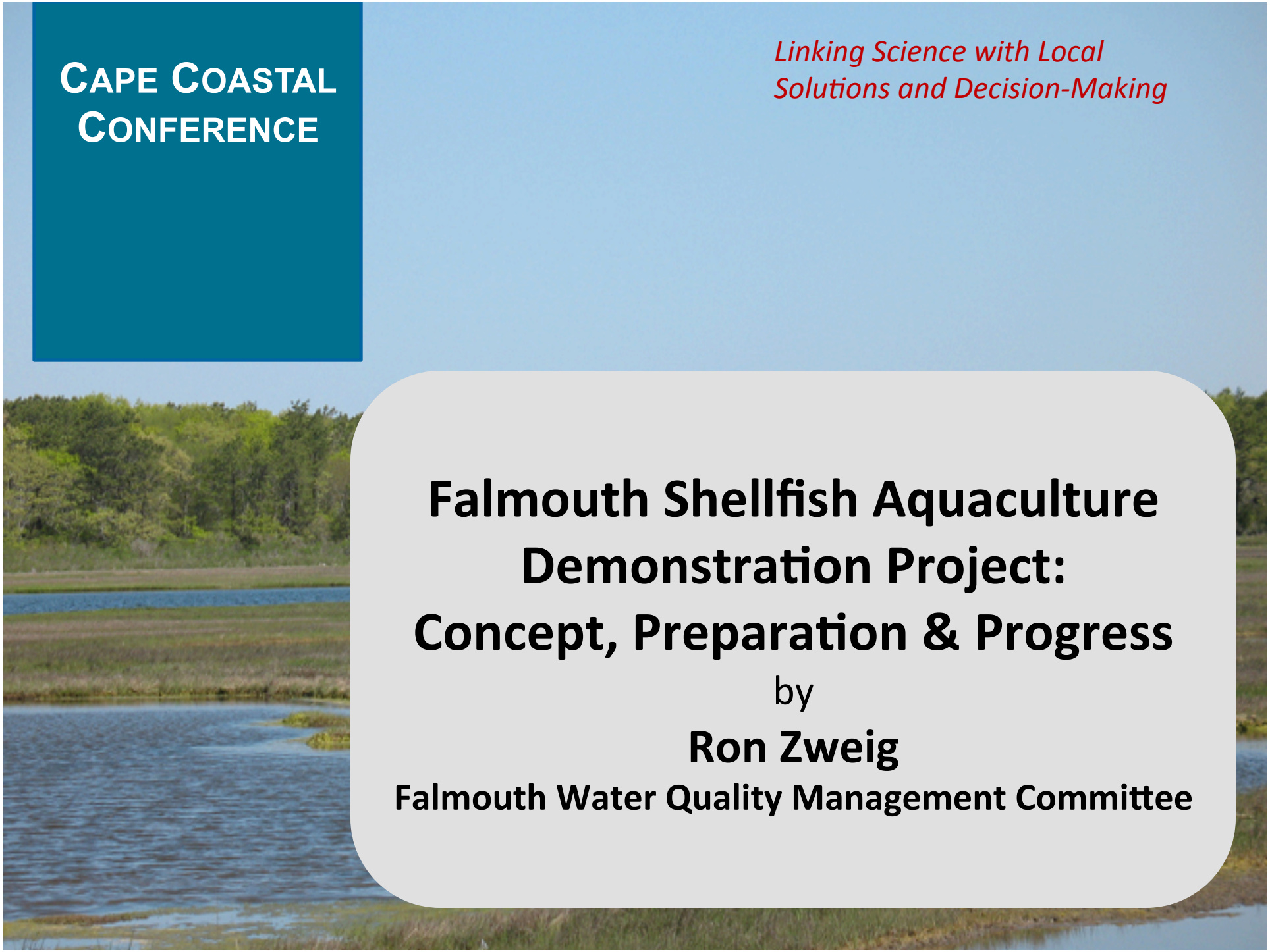
CAPE COASTAL CONFERENCE

Linking Science with Local Solutions and Decision-Making



Falmouth Shellfish Aquaculture Demonstration Project: Concept, Preparation & Progress

by

Ron Zweig

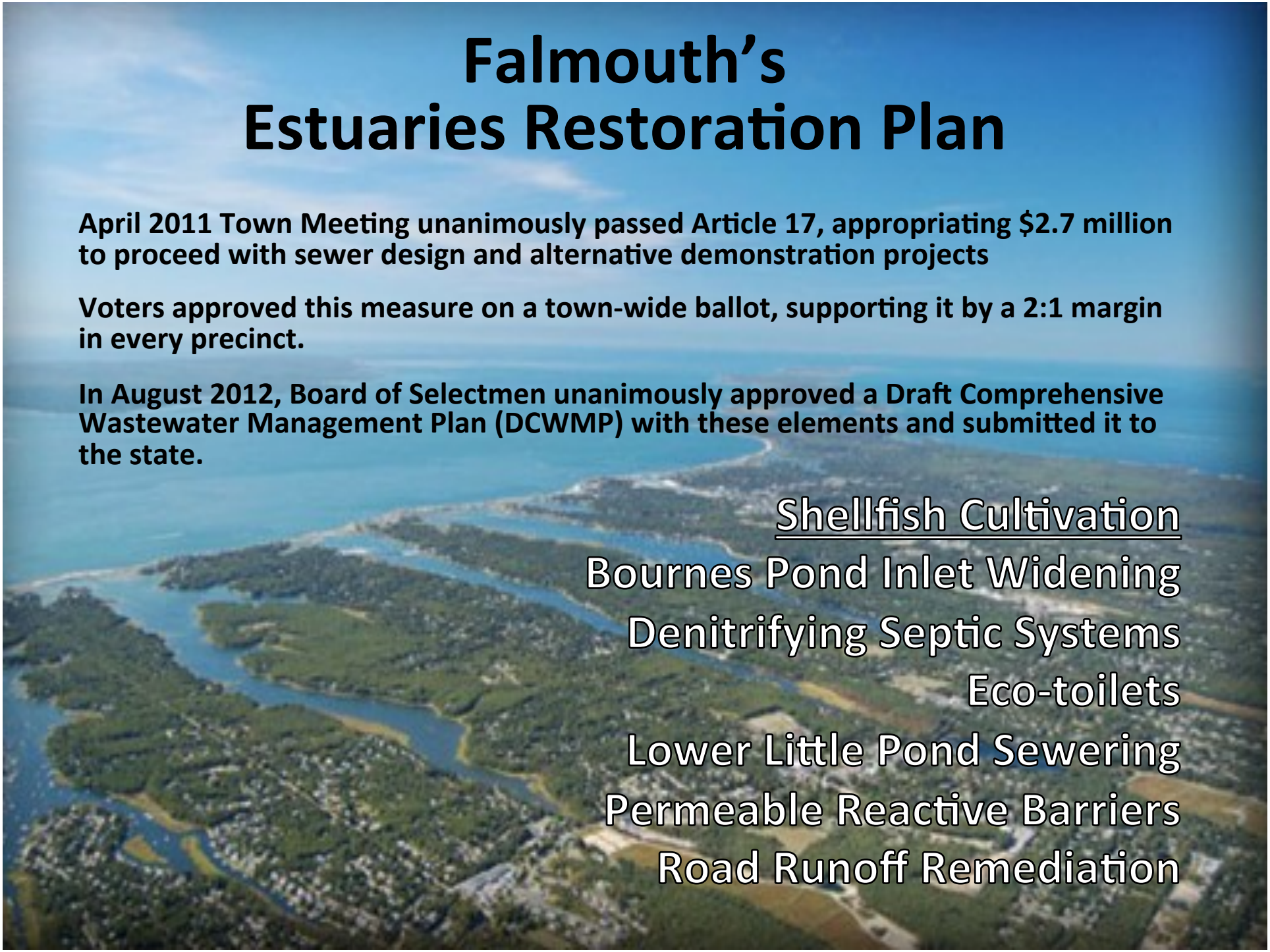
Falmouth Water Quality Management Committee

Falmouth's Estuaries Restoration Plan

April 2011 Town Meeting unanimously passed Article 17, appropriating $2.7 million to proceed with sewer design and alternative demonstration projects

Voters approved this measure on a town-wide ballot, supporting it by a 2:1 margin in every precinct.

In August 2012, Board of Selectmen unanimously approved a Draft Comprehensive Wastewater Management Plan (DCWMP) with these elements and submitted it to the state.



Steps Toward the Demonstration Project

- ✓ Spring 2010 – Concept outlined and developed
- ✓ March 2011 – Shellfish Regulation Workshop

Regulations – Federal, State and Local

Application #: NAE-2009-1217
Applicant: General Public in the Commonwealth of Massachusetts

Effective Date: January 21, 2010
Expiration Date: January 21, 2015

DEPARTMENT OF THE ARMY
GENERAL PERMIT
COMMONWEALTH OF MASSACHUSETTS

The New England District of the U.S. Army Corps of Engineers (Corps) hereby issues this General Permit (GP) for activities in waters of the United States (U.S.) that have minimal individual and cumulative adverse effects on the aquatic environment within the Commonwealth of Massachusetts.

I. GENERAL CRIT
In order for activities to qua
(Pages 1 - 4), general condit
qualify for authorization un

Under this GP, projects may
- Category 1: No applicat
- Category 2: Application

If you determine that your p
However, you must submit

If your project is ineligible
must submit an application
A. This GP does not affect
regulation.

II. ACTIVITIES CO
- Work and structures that
that affect the course, loca
depositing of material in
Harbors Act of 1899);
- The discharge of dredged
under Section 404 of the
- The transportation of dred
under Section 103 of the

[1] Defined at 33 CFR 328
[2] When there is a regulated disch
secondary impacts, which are da

MA GP

Massachusetts Division of Marine Fisheries

Shellfish Planting Guidelines

Executi
M

March 18, 2011 CFF Workshop –
(46 participants)

Falmouth BOS, BOH, DPW, ConCom, FinCom, DNR, Coastal Management
Mass Fish &Game, DMF & DEP
CC Coop Extension, Bourne FinCom
Mashpee Shellfish Warden
CLF, UMass Boston, OPET, WHG, Nature Conservancy
Oyster growers, Shellfishers, private

TOWN OF FALMOUTH
Chapter 235. WETLANDS PROTECTION
[HISTORY: Adopted by the Town of Falmouth Annual Town Meeting 4-2-1979, Art. 32; amended in its entirety by Annual Town Meeting 4-5-1993, Art. 41, approved 7-16-1993. Subsequent amendments noted where applicable.]
GENERAL REFERENCES
Conservation Commission — See Charter, § C7-6.
Watershed protection — See Ch. 227.

Demonstration Project Overview

- ✓ Preliminary 2012 Field Test
- ✓ Demonstration Project Description
- ✓ Monitoring Plan
- ✓ Roles and Responsibilities:

  Water Quality Management Committee and
  Marine and Environmental Services Department

2012 WQMC Oyster Survival Test in Green and Little Ponds, Falmouth

(Stocked - 07-30: Removed 09-21)

		Green Pond		
Site	Count	Total Weight (kg)	Average Weight (g)	# Dead Found*
Rowe's Dock (Lower East)	455	4.77	10.5	1
Sandcastle Dock (Middle)	397	4.43	11.1	2
Head of Pond	429	4.43	10.3	5
Total	1,281	13.63	10.6	8

*One larger but others stocking size – Survival = 99.4%

		Little Pond		
Site	Count	Total Weight (kg)	Average Weight (g)	# Dead Found*
Near Inlet - East	244	2.72	11.2	0
Near Inlet - West	504	5.00	9.9	0
Narragansett Street	498	5.45	10.9	1
Total	1,246	13.17	10.6	1

*One larger but others size at stocking – Survival = 99.9%

Demonstration Project Purpose

Evaluate shellfish as one of the tools for estuary restoration

- ✓ May be an important tool when used in combination with other measures, or on its own
- ✓ If successful, any future implementations would be evaluated separately

Project Goals:

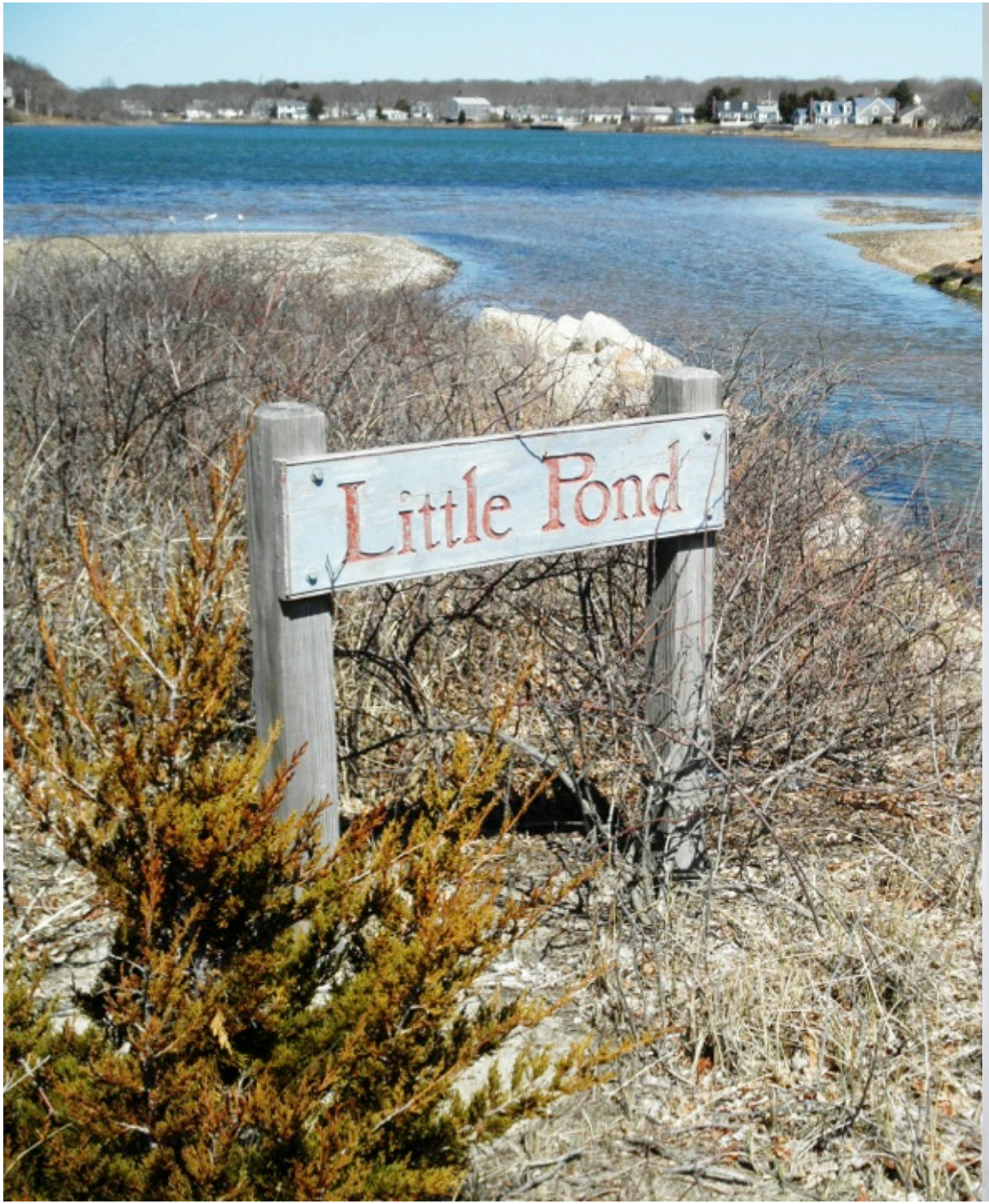
- ✓ Install a quantity of oysters that will create a DETECTABLE change in water quality
- ✓ Measure public acceptance
- ✓ Evaluate implementation logistics
- ✓ Monitor and Measure water quality over the three year demonstration period per MassDEP requirements.
- ✓ Measure nitrogen uptake to establish TMDL-credit for oysters from MassDEP
- ✓ Monitoring and Measure for Resource Protection goals of Conservation Commission


Priority Estuaries to Control
Excessive Nitrogen Pollution
In Falmouth, Massachusetts
East Falmouth
Great
Pond
Little
Pond
Green
Pond
Bournes
Pond
© 2010 Europa Technologies
Image © 2010 DigitalGlobe
© 2010 Google
41°33'41.54" N 70°34'18.20" W elev 16 ft

Why is Too Much Nitrogen a Problem for Estuaries?

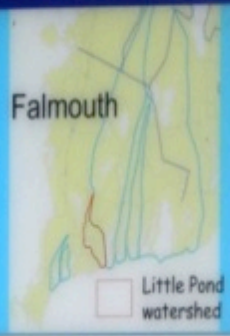
- It causes excessive growth of microscopic plants that shades bottom plants -- eelgrass.
- This phytoplankton dies and settles.
- Settled plankton decomposes and smothers bottom life.
- Toxic and foul smelling chemicals are emitted (e.g., hydrogen sulfide) – low oxygen/fish kills.
- A cascading decline to death of estuary life


Little Pond



Water Quality of Falmouth's Coastal Ponds

The clean water of Vineyard Sound, beautiful beaches, and coastal ponds have long made Falmouth a destination for vacationers, retirees, and year-round residents. Yet the very qualities that attract people to Falmouth are now threatened by increasing nitrogen pollution. All of the estuaries and coastal ponds along Falmouth's south shore have been degraded -some severely - by excess nitrogen entering the water. The entire watershed of each estuary contributes to this problem.



THE PROBLEM OF NITROGEN POLLUTION

While nitrogen is a natural and essential part of marine ecosystems, too much nitrogen can lead to poor water quality and degraded habitat.

Excess nitrogen causes heavy algae growth in the water, which blocks sunlight and reduces oxygen needed by fish and shellfish. This results in loss of eelgrass and marine animal species. Other negative impacts such as murky waters, bad odors, and decline in property values can follow.

The main source of nitrogen pollution in Falmouth's coastal waters is septic systems (even Title 5 systems do not remove nitrogen), followed by lawn and agricultural fertilizer run-off, atmospheric deposition, and stormwater run-off.

WHAT YOU CAN DO

We can all help improve the health of our coastal waters by getting involved:

- Reduce or eliminate fertilizer use at home (see tips from the Falmouth Friendly Lawn program on FACES' website.)
- Support town efforts to develop a Town-wide Wastewater Management Plan. This will include sewering parts of town.

FACES

FACES (Falmouth Associations Concerned with Estuaries and Salt Ponds) is a non-profit, membership organization dedicated to educating and inspiring citizens to preserve the natural environment of estuaries and salt ponds in Falmouth. Visit us on the web at:

http://www.preservefalmouthbays-ponds.org/

HOW HEALTHY IS YOUR LOCAL WATERWAY?

Nutrient Related Habitat Health

Little Pond	
Upper	Lower
Poor	Poor

Nutrient related habitat health is a summary of nitrogen-related measures of habitat quality including dissolved oxygen, chlorophyll, macroalgae, eelgrass, and infaunal animals.

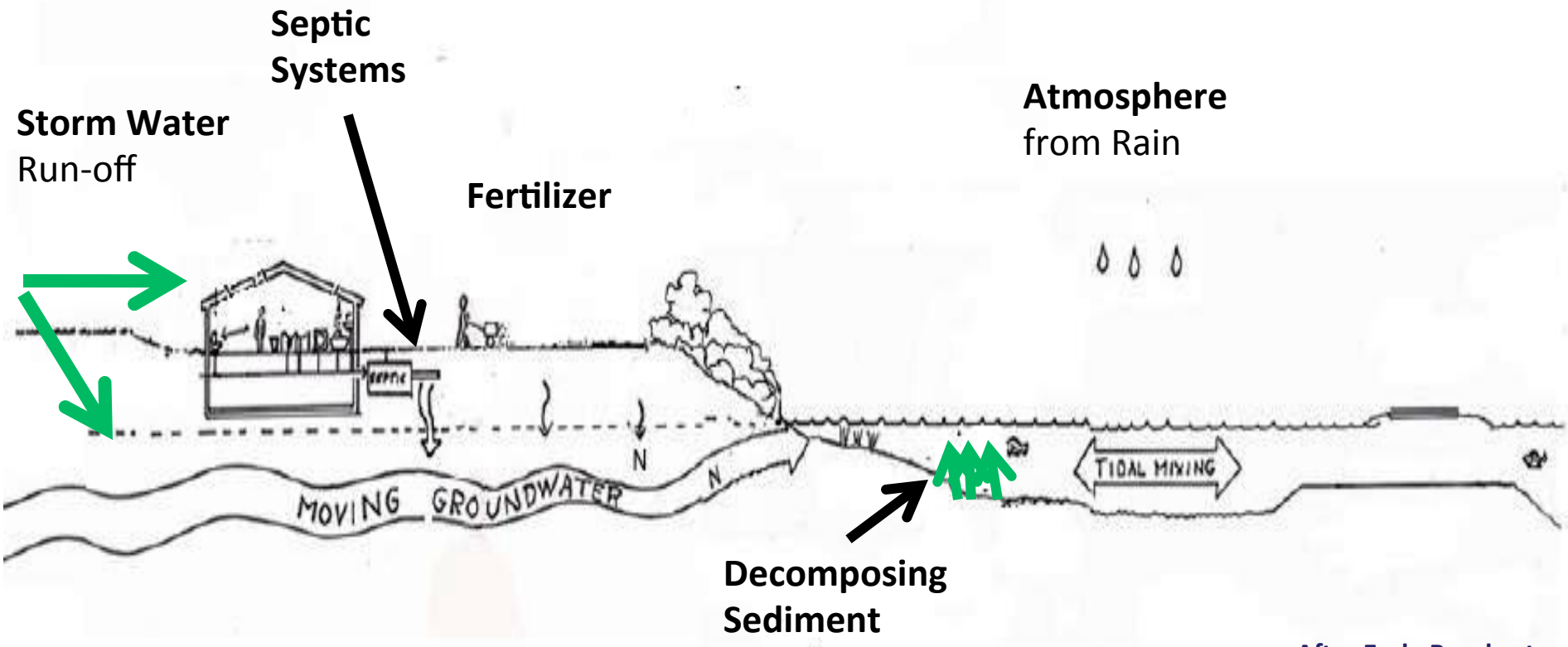
Poor = Significant impairment to severe degradation
Fair = Moderate Impairment
Good = Healthy habitat conditions

Habitat health does not include bacteria monitoring and is not an index of public health safety.

Index adapted from the Massachusetts Estuaries Project

Format and text adapted from signs by: The Coalition For Buzzards Bay

Sources of Nitrogen

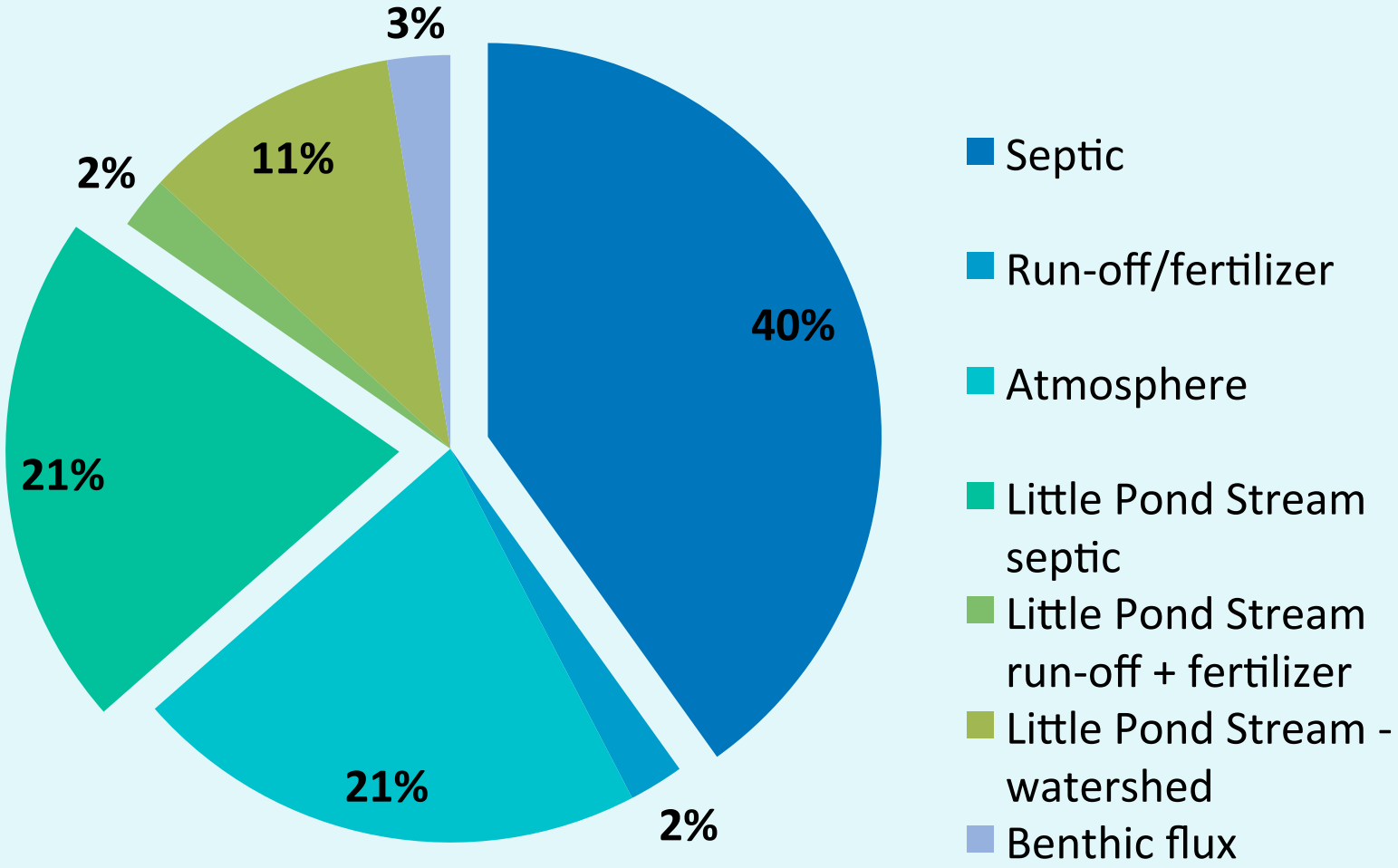


After Earle Barnhart

Sources of Nitrogen Entering Little Pond

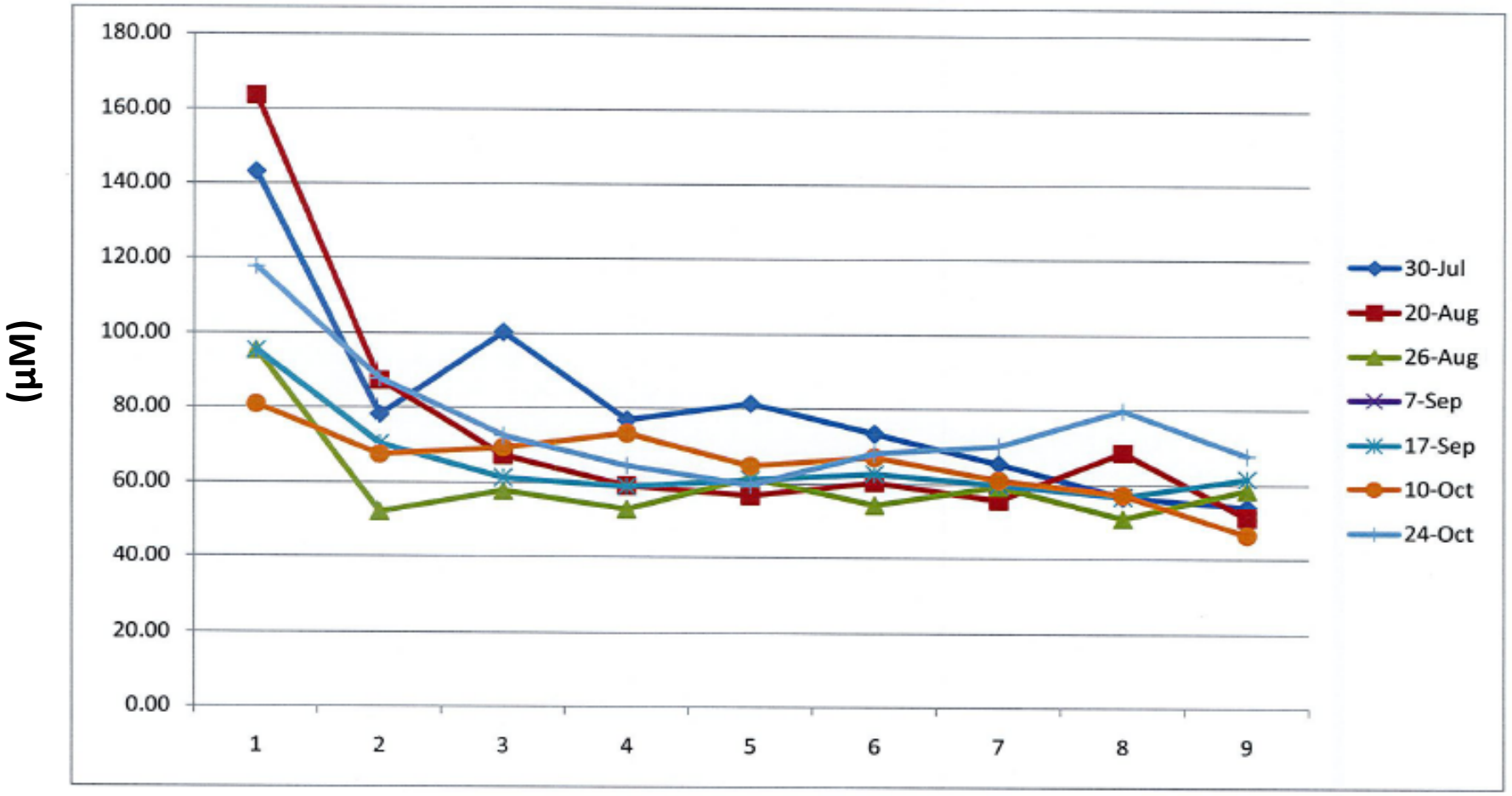
-- Sources from Septic Systems Pulled Out --

Total Load = 23.1 kg-N/day



Source : SMAST/DEP MEP 2006 Report

All profiles for total nitrogen
for all days in 2012
when salinity at LP-1 was greater than 25 ppt in Little Pond



From northern head of pond to southern point LP-3

Source: UMass/SMAST

Nursery/Grow-Out Approach
Floating Bag Systems

Each row shown here is 100 floating bags (50 lengths long).

Nursery/Grow-Out Approach

Upweller Nursery

Floating Bag System

- Economical
- Easily to manipulate
- Workable from small craft
- Efficient to deploy and mobilize

Oyster Growing Location

Approximately 2 acres is necessary to grow a crop of 2 million (with minimal spacing)

Closed to Shellfishing Due to High Coliform Bacteria Concentrations

Potential Seasonal Nitrogen Removal
-- Little Pond --

	2013	2014
Early Seed (#)	1.25 million	1.25 million
Late Seed (#)	1.25 million	0
Nitrogen Removed (kg)	194	766
% Seasonal Load	6.6	26.0

Only from shell and tissue. Denitrification estimates not included.
From Woods Hole Group's Project Specifications and Cost Estimate

Hydrodynamics of Little Pond

Mean Volume = 6,986,660 ft^3

Annual Freshwater Input = 79,709,430 ft^3/year

-- Little Pond Stream Input = 0.83 ft^3/sec

-- Groundwater Input = 1.45 ft^3/sec

-- Direct Precipitation Input = 0.25 ft^3/sec

-- does not include adjacent surface run-off

Freshwater Exchanges/Year = 11.4 or about once per month

****

Tidal Prism = 785,605 ft^3/cycle

-- 4.6 days BUT mainly affects southern portion

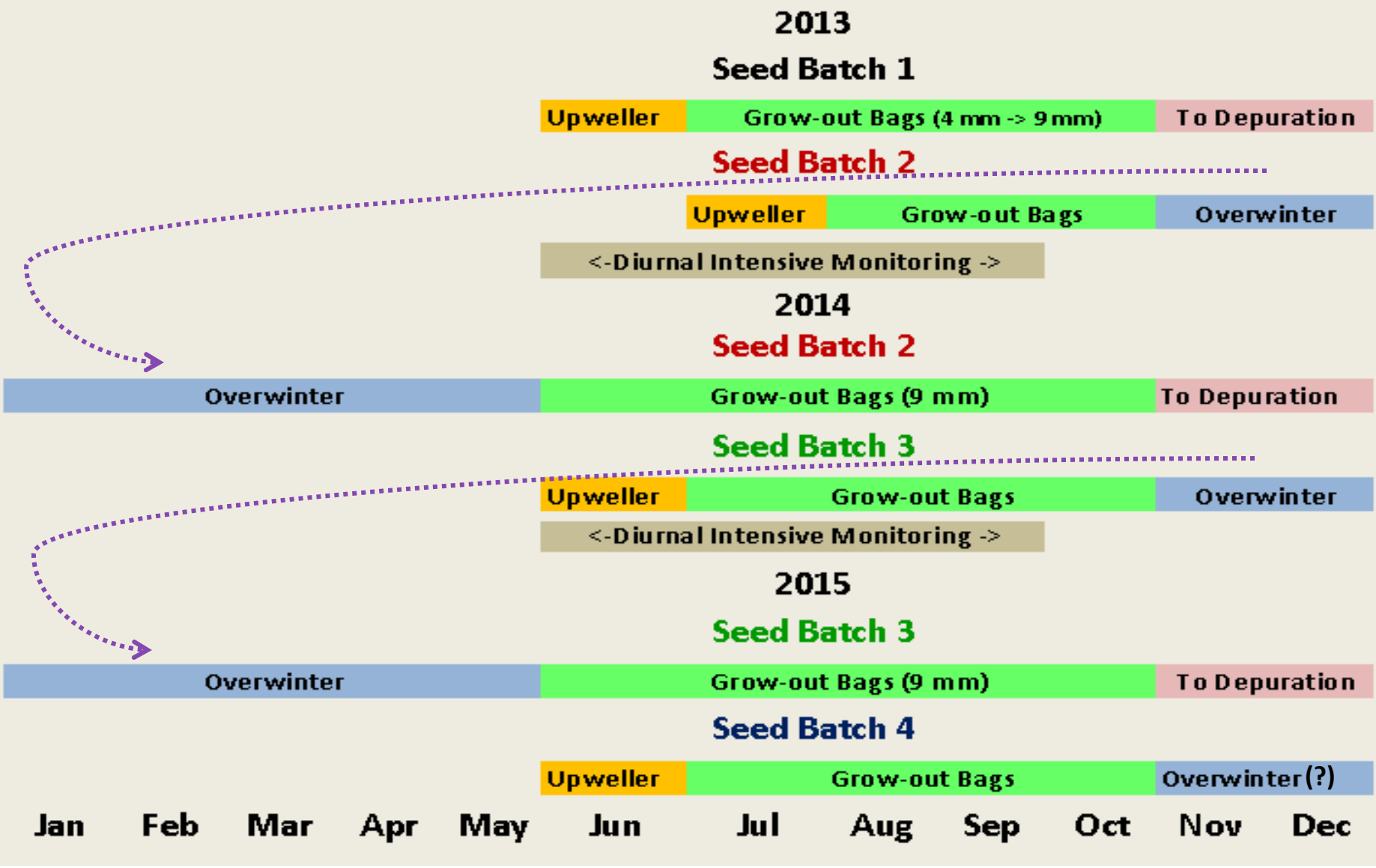
Sources : SMAST/DEP MEP 2006 Report plus Precipitation Data

Freshwater Exchange in Four Esturaries

Estuary	Mean Volume (ft^3)	FW Input (ft^3/yr)	Exchanges/ Year
Little Pond	6,986,660	79,709,43	11.4
Great Pond	54,452,700	619,426,230	11.4
Green Pond	22,471,900	197,020,900	8.8
Bournes Pond	22,408,300	227,572,700	10.2

Sources : SMAST/DEP MEP Reports plus Precipitation Data

Proposed Management Approach 2013 – 2015
(1.25 million seed per batch to upweller)



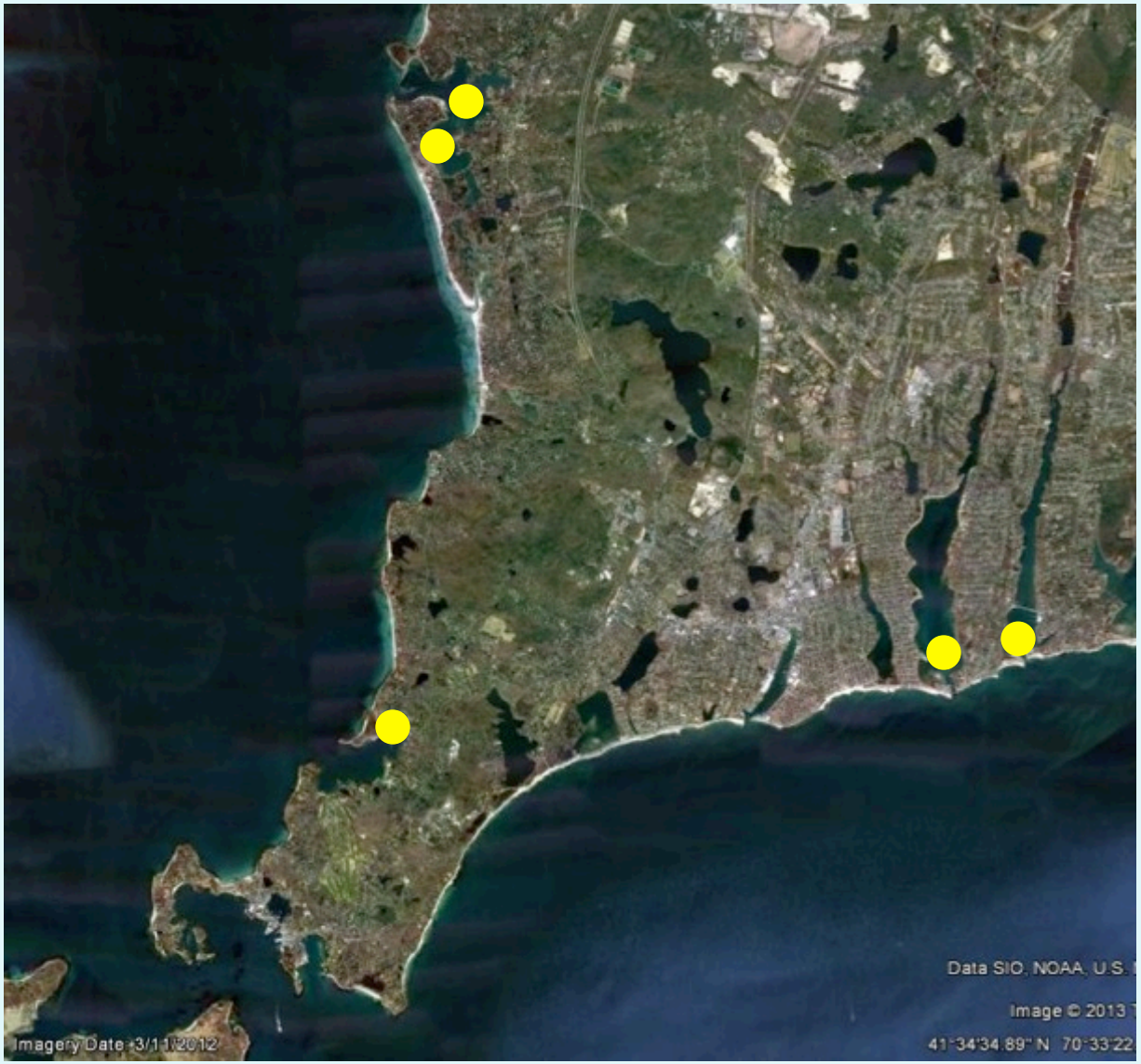
Range of Relay/Depuration Locations

West Falmouth Harbor

Quisset Harbor

Great Pond

Green Pond



Monitoring Plan for MA DEP and ConCom

Meeting Needs of Ma DEP for TMDL-compliance and Nitrogen-credit:

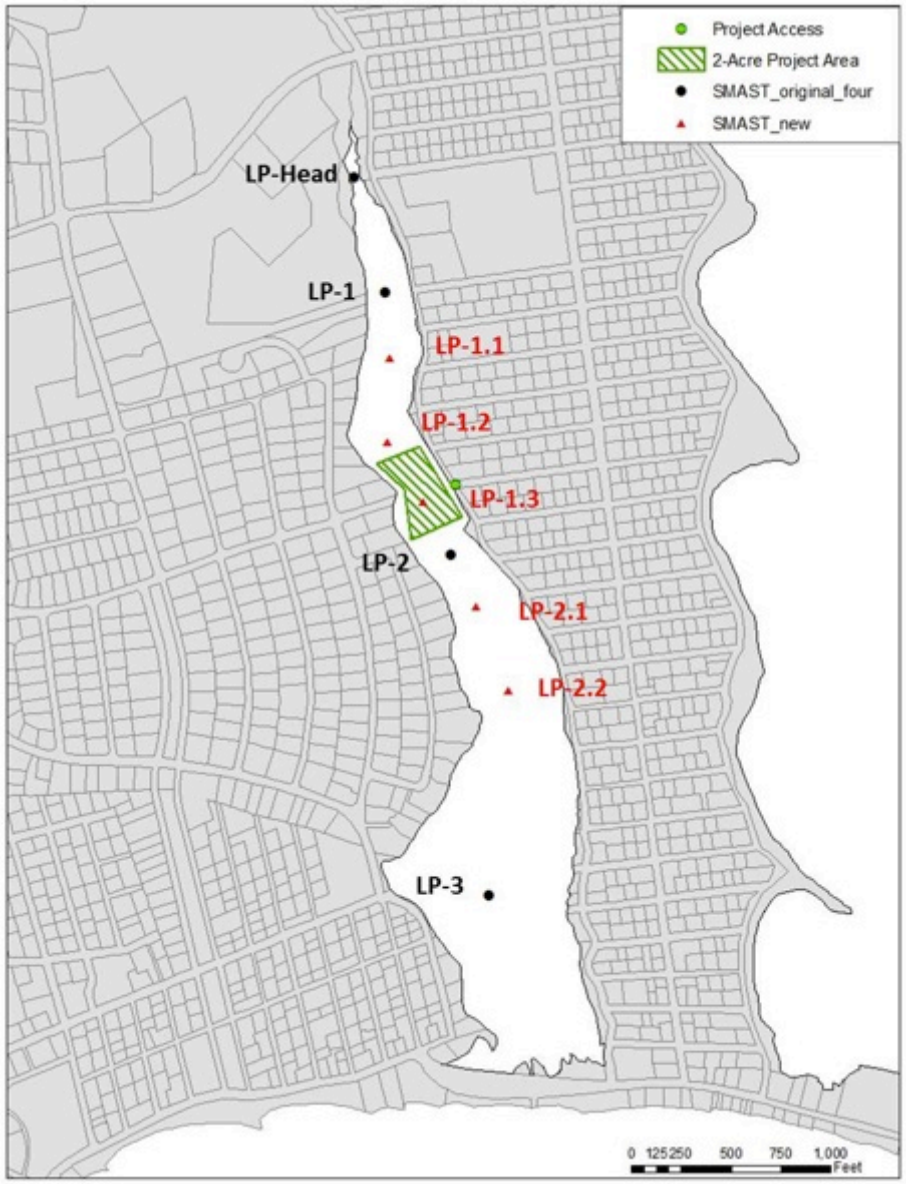
- ✓ Consistent with MEP Reports
- ✓ Sampling complies with Quality Assurance Project Plan (QAPP)

Meeting Needs of the Conservation Commission

- ✓ Diurnal Intensive Monitoring
- ✓ High Temporal Resolution
- ✓ In-situ sensors

Spatial Layout: MA DEP Monitoring

Figure 1. Sampling locations for Oyster Project in Little Pond (Growing Season 2013).



Bi-weekly Sampling Frequency
230 samples per growing season

Table 3. Summary of YEAR 1 Oyster Project sampling (2013 growing season). Total number of stations increased to 9 in order to quantify the "local" effect of the aquaculture experiment. Four stations are PondWatch stations (LP-Head, LP-1, LP-2, LP-3) and five stations are additional sampling sites to quantify more localized effects of oyster aquaculture (LP-1.1, LP-1.2, LP-1.3, LP-2.1, LP-2.2).

Station	May 1-15	May 16-31	June 1-15	June 16-30	July 1-15	July 16-31	Aug 1-15	Aug 16-31	Sept 1-15	Sept 16-30	Oct 1-15	Oct 16-31	Total Samples
LP-Head	OP-2	OP-2	OP-2	OP-2	PW	PW	PW	PW	OP-2	OP-2	OP-2	OP-2	24
LP-1	OP-2	OP-2	OP-2	OP-2	PW	PW	PW	PW	OP-2	OP-2	OP-2	OP-2	24
LP-1.1	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	24
LP-1.2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	24
LP-1.3	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	24
LP-2	OP-2	OP-2	OP-2	OP-2	PW	PW	PW	PW	OP-2	OP-2	OP-2	OP-2	24
LP-2.1	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	24
LP-2.2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	OP-2	24
LP-3	OP-2	OP-2	OP-2	OP-2	PW	PW	PW	PW	OP-2	OP-2	OP-2	OP-2	24
PW Stations are sampled surface and bottom									Total Samples for Oyster Project Monitoring =				216
												QA Samples (field duplicates) =	24
OP-2 stations are sampled surface and bottom												Cost =	$24,000

MA DEP sign-off prior to finalization

Bi-weekly Parameters

Total nitrogen
(nitrate + nitrite, ammonia, dissolved organic nitrogen, particulate organic nitrogen)
Temperature
Chlorophyll-a
Pheophytin-a
Orthophosphate
Salinity
Dissolved oxygen
Transparency (Secchi depth)
Benthic Condition (Periodical)
other parameters as specified in the QAAP

Shellfish weight (Periodical)

As outlined in SMAST monitoring plan, in compliance with QAPP

Monitoring for Conservation Commission

To determine potential localized effects of the project on:

- Dissolved oxygen (DO)
- Turbidity
- Chlorophyl *a* (via fluorescence)
- Water temperature

Consistent with sampling done by MEP (2002):

- Mid-July – Mid-August (2 tidal cycles during critical period/warmest water)
- Same parameters
- Data collected in 15-minutes intervals
- Same Sampling Stations (Upper and Lower)
- Bottom Sampling

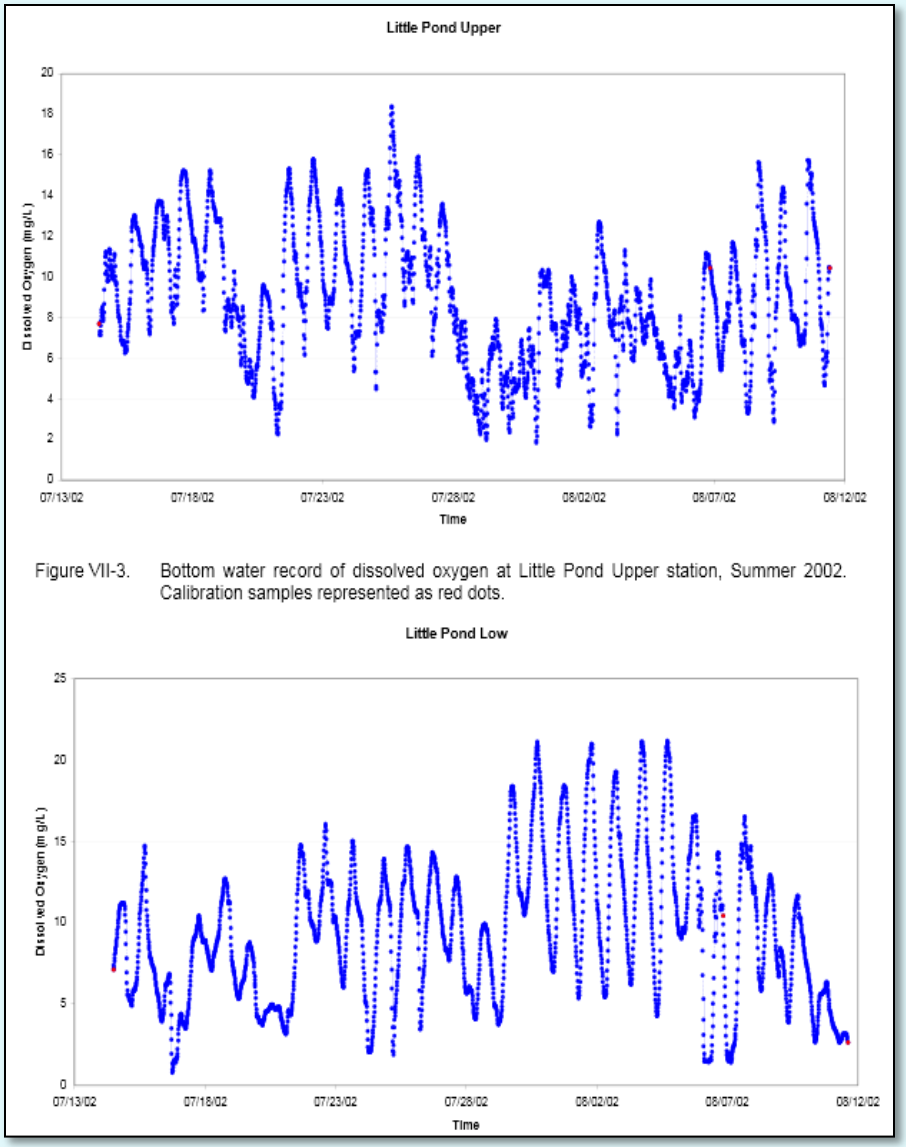


Figure VII-3. Bottom water record of dissolved oxygen at Little Pond Upper station, Summer 2002. Calibration samples represented as red dots.

Analysis of Intensive Monitoring Data:

Impact of project on localized conditions

Dissolved Oxygen (DO):

- Mean, median, range, net production
- Cycles/overall metabolism of system

Hypoxia (DO <3 mg/L):

- Localized impacts
- Frequency and duration
- Number of events

Chlorophyl *a* (via fluorescence):

- Trends expected to be downward

Turbidity:

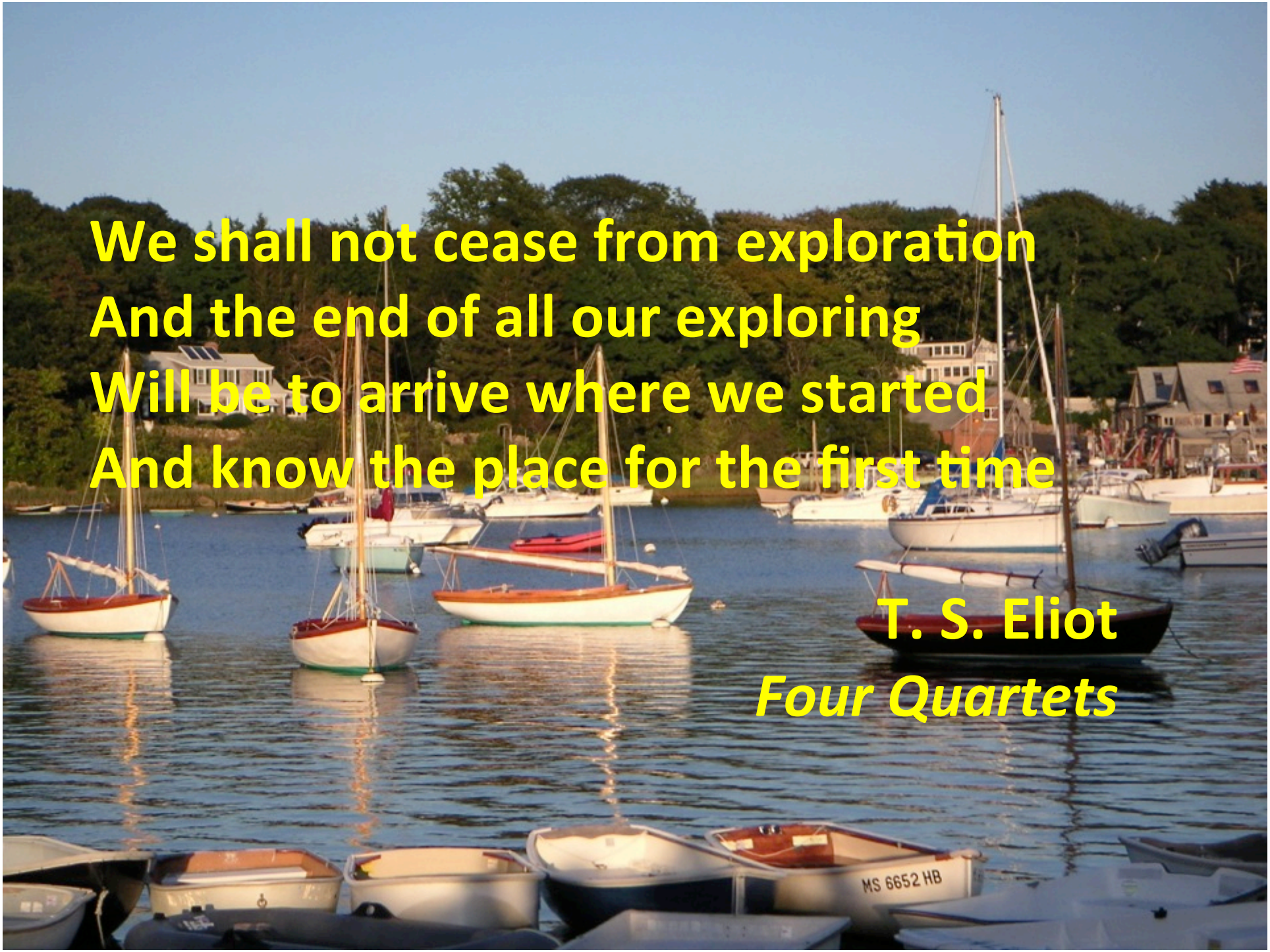
- Correlate to tides and weather

Water temperature, salinity:

- Actual conditions

Compare with MEP data from 2002


Other Shellfish
and Ancillary Estuary Management Options
✓Quahog Seeding – separately or
beneath floating oyster units
✓Mussel Culture
✓Oyster Reefs – protected biodiversity areas
✓Complementary Restorative Dredging
✓Eelgrass Planting


We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time
T. S. Eliot
Four Quartets
MS 6652 HB

Questions and Discussion