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# Implementing Local Solutions: Projects Across the Cape

Moderator: Heather McElroy, Cape Cod Commission

Speakers: Sia Karplus, Consultant to Falmouth

Lindsey Counsell, Three Bays Preservation, Inc.

George Heufelder, Barnstable County Department of Health & Environment

Ray Cody, US Environmental Protection Agency

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# Sia Karplus

DIRECTOR OF RESEARCH AT SCIENCEWARES, INC., CONSULTANT TO FALMOUTH

Panel| Implementing Local Solutions: Projects Across the Cape


Little Pond Oysters
00:01
HD

# Shellfish and Water Quality Planning: A Team Effort

## Falmouth Division of Marine and Environmental Services

**Falmouth Water Quality Management Committee**
**Department of Public Works/Wastewater Division**
**School for Marine Science and Technology (SMAST)**

**Presented to OneCape by:**
**Sia Karplus, Science Wares, Inc.**
**June 23, 2016**

# 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**

**January 10, 2014, Secretary of Office of Energy and Environmental Affairs issued a Certificate of Adequacy for Falmouth's Final Comprehensive Wastewater Management Plan (FCWMP). The Secretary's Certificate endorses sewering Lower Little Pond watershed and gives the Town 5 years to evaluate alternatives elsewhere**

**<u>Shellfish Cultivation</u>**

**Permeable Reactive Barriers**

**Bournes Pond Inlet Widening**

**Denitrifying Septic Systems &Eco-toilets**

**Road Runoff Remediation**

# It all started with Little Pond:

**Let's watch the video!**

**2 acres in Little Pond off Narragansett St.**
**Alternate area off Brockton St.**

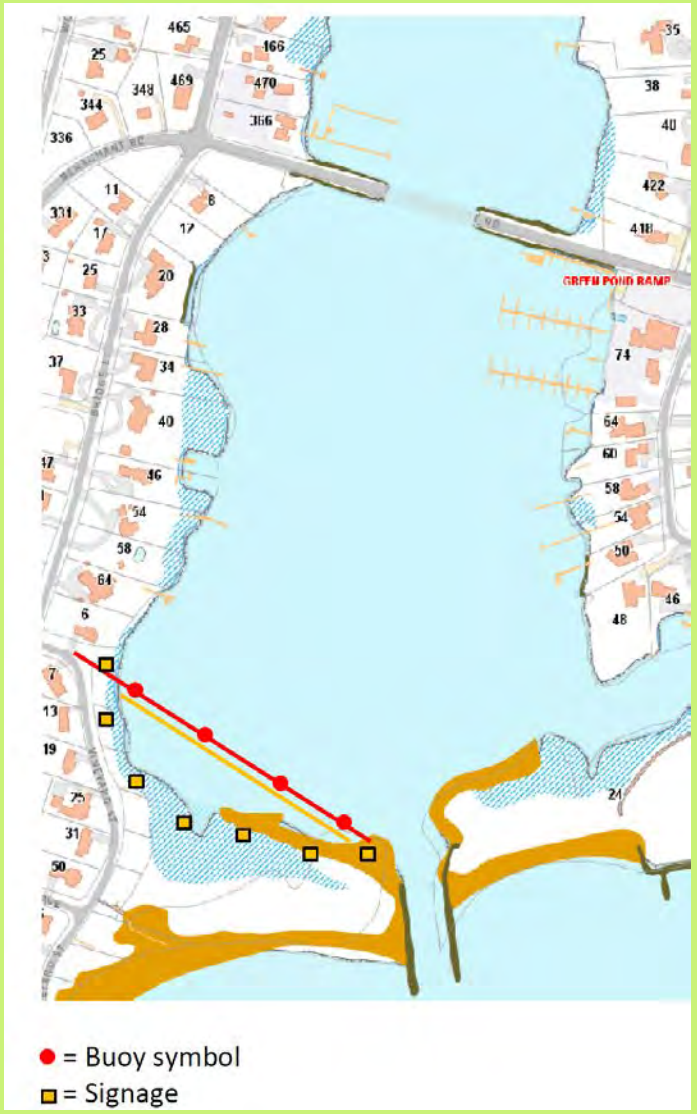

# Little Pond Project Goals:

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

# 2015 Project Implementation


- June 2015: 2 million oyster seed installed in upweller
- July  2015: 2 million oyster seed planted in Little Pond
- August 29, 2015: Oysters moved to second growing location due to prolonged anoxic event
- November 2015:  Division of Marine Fisheries (DMF)-approved Relay to West Falmouth Harbor, Green Pond

# 2015 Green Pond Relay Location



# 2015 West Falmouth Relay Locations

# Little Pond Monitoring Plan
# for MA DEP and Conservation Commission

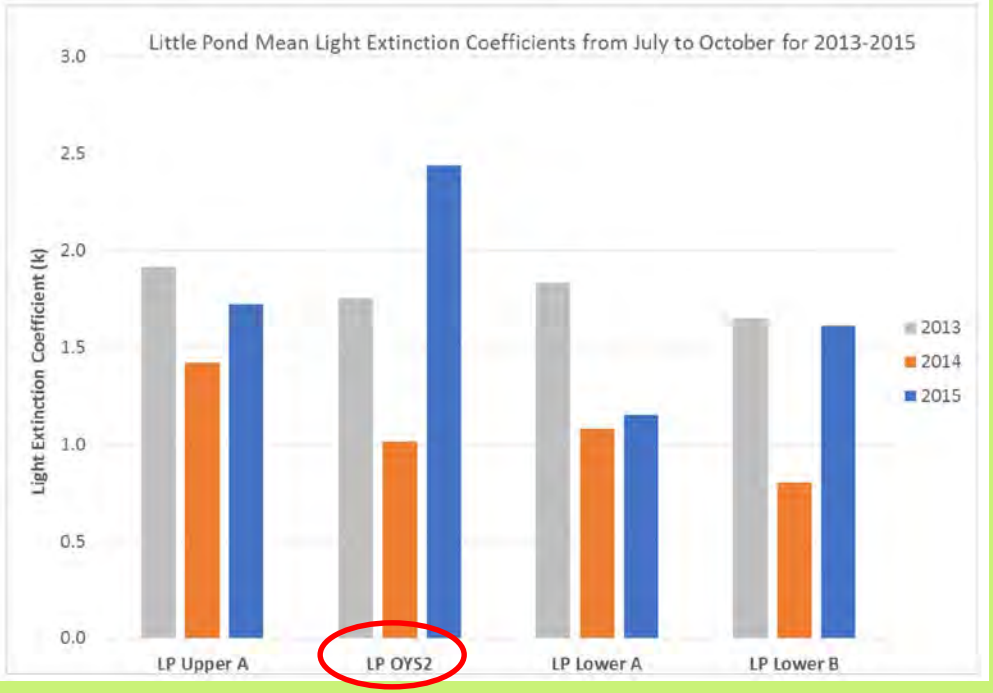
- Water Quality “Grab-sampling” at 10 locations
- Turbidity
- In-situ sensors for data with high temporal resolution
- Flora and fauna
- Buffer to wetlands

# 2013 - 2015 Turbidity Data Analysis:

## Oysters increase clarity of the water

- In 2013, 2014, light penetration increased at the site closest to the oyster rack, LP OYS2, and then increased at the site directly below LP OYS2
- Linear trend of decreasing light extinction coefficients from the head to the mouth of Little Pond when excluding the site closest to the oyster rack (r2=0.99)
- Data more pronounced in 2013, associated with lower chlorophyll pigment concentration

**2015 showed marked DECREASE in water clarity – oysters removed in August**



# Conclusions:

- **Absolute TN levels in in Little Pond did not change significantly from 2006 MEP findings**
- **Hypoxic conditions (low DO) in 2012 – 2015 consistent with conditions from 2006 MEP findings**
- **Deployment of oysters in Little Pond produced modest LOCALIZED water quality improvements**
  - *The primary mechanism of this water quality improvement appears to be the uptake of phytoplankton*
- **Several independent measurements support this conclusion:**
  - Turbidity, Pigments and TN increased when oysters were removed for September and October
  - In 2013, 2014, grab samples for chlorophyll $\alpha$ shows reduced phytoplankton at LP-1.3 on the ebbing tide
  - In 2013, 2014, grab samples for pheophytin a show an increase within the deployment area
  - In 2013, 2014, nutrient data show a decrease in total nitrogen (TN) at LP-1.3, within the Demo Site, compared to upgradient sites, on the ebbing tide
  - In 2013, 2014, nutrient data shows lower POC and PON at LP-1.3 than in stations above the Demo Site

# Conclusions, ctd:

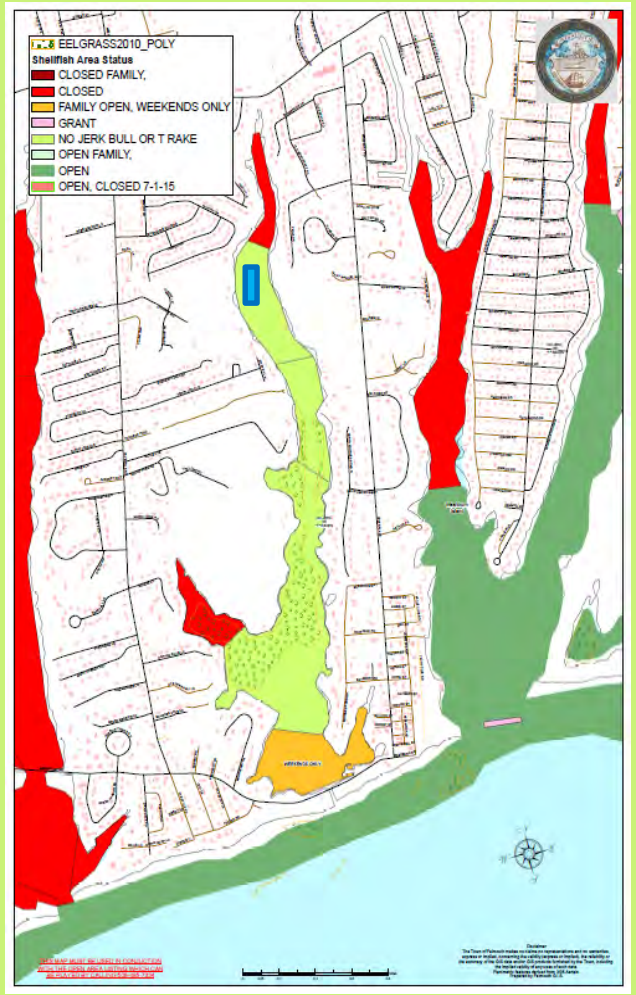
- **Deployment of oysters in Little Pond did not have negative impacts to biota, water quality, buffer to resource areas**

- **Removal of oysters is correlated with decreased water clarity and increased pigments**

# Next Steps: Continue to evaluate shellfish potential in Falmouth's 13 other estuaries

# Bournes Pond Shellfish Planning

- Bournes Pond is 153 acres
- 15 acres available for shellfish gear per Army Corps of Engineers rule
- Growing 500,000 oysters this summer
- Evaluating maximum numbers of oysters and quahogs




= Approximately 2 acres

# Other initiatives:

- Continued use of Little Pond as a nursery for growing oysters for one season
- Relay of oysters to other estuaries for harvest
- Budget neutral approach to municipal propagation:
  - Sale of larger (2”) seed that would be too large for harvest at end of second growing season
- Oyster bed in West Falmouth Harbor
- Additional upweller (9 total)
- Quahog propagation

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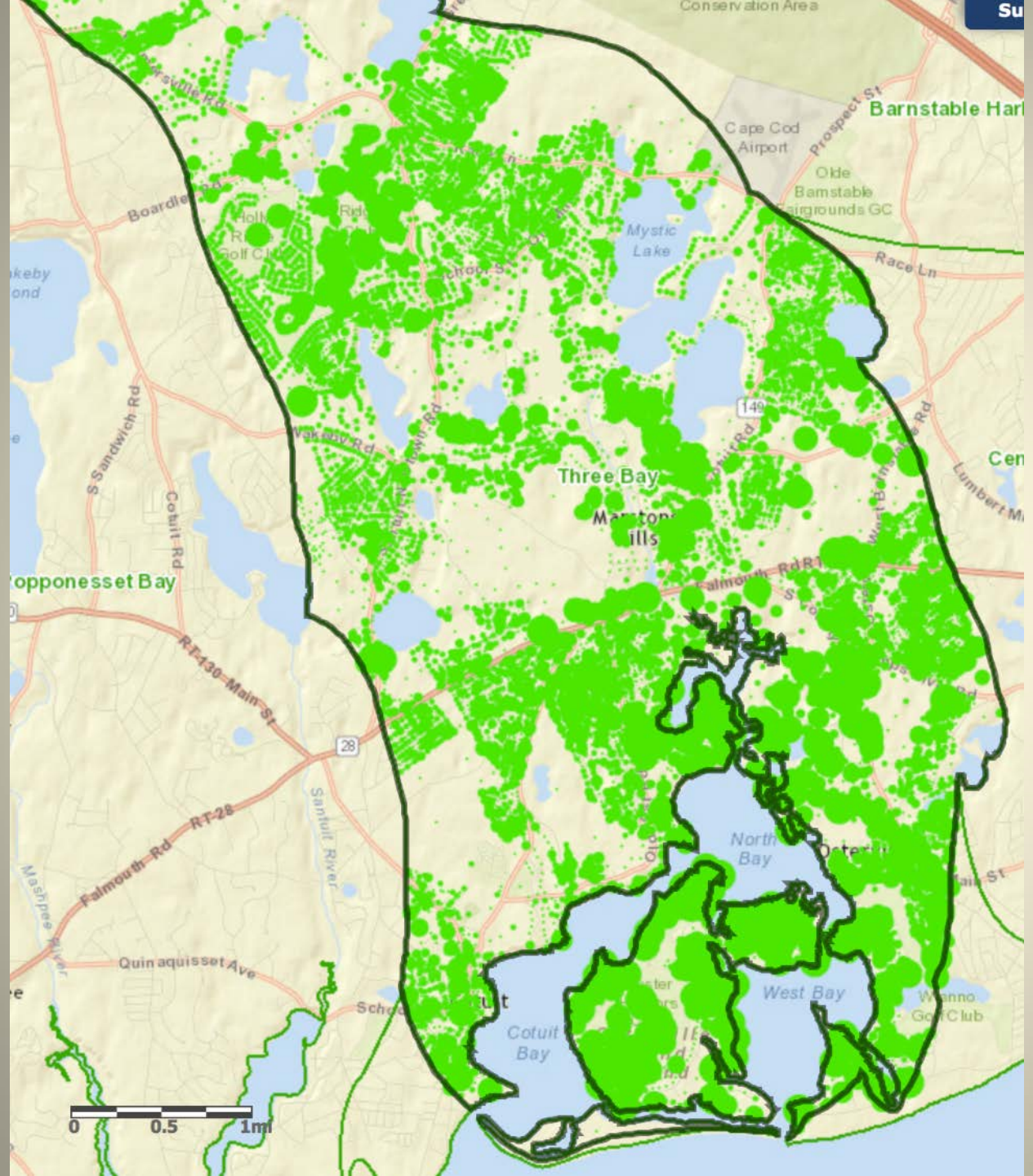
# Lindsey Counsell

EXECUTIVE DIRECTOR, THREE BAYS PRESERVATION, INC.

Panel| Implementing Local Solutions: Projects Across the Cape



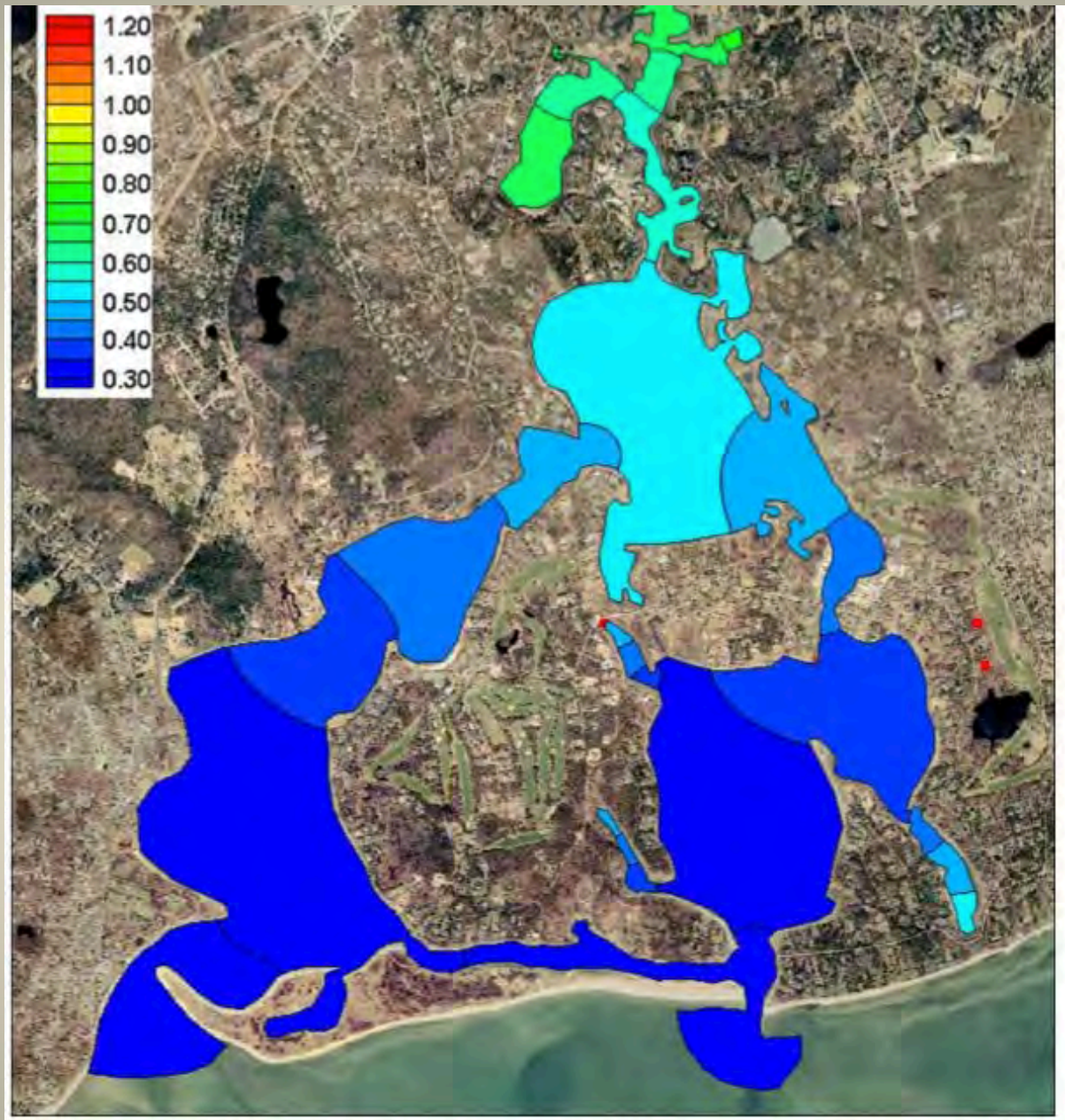

# Three Bays Restoration Implementation Project

**Lindsey B. Counsell**

**Executive Director**

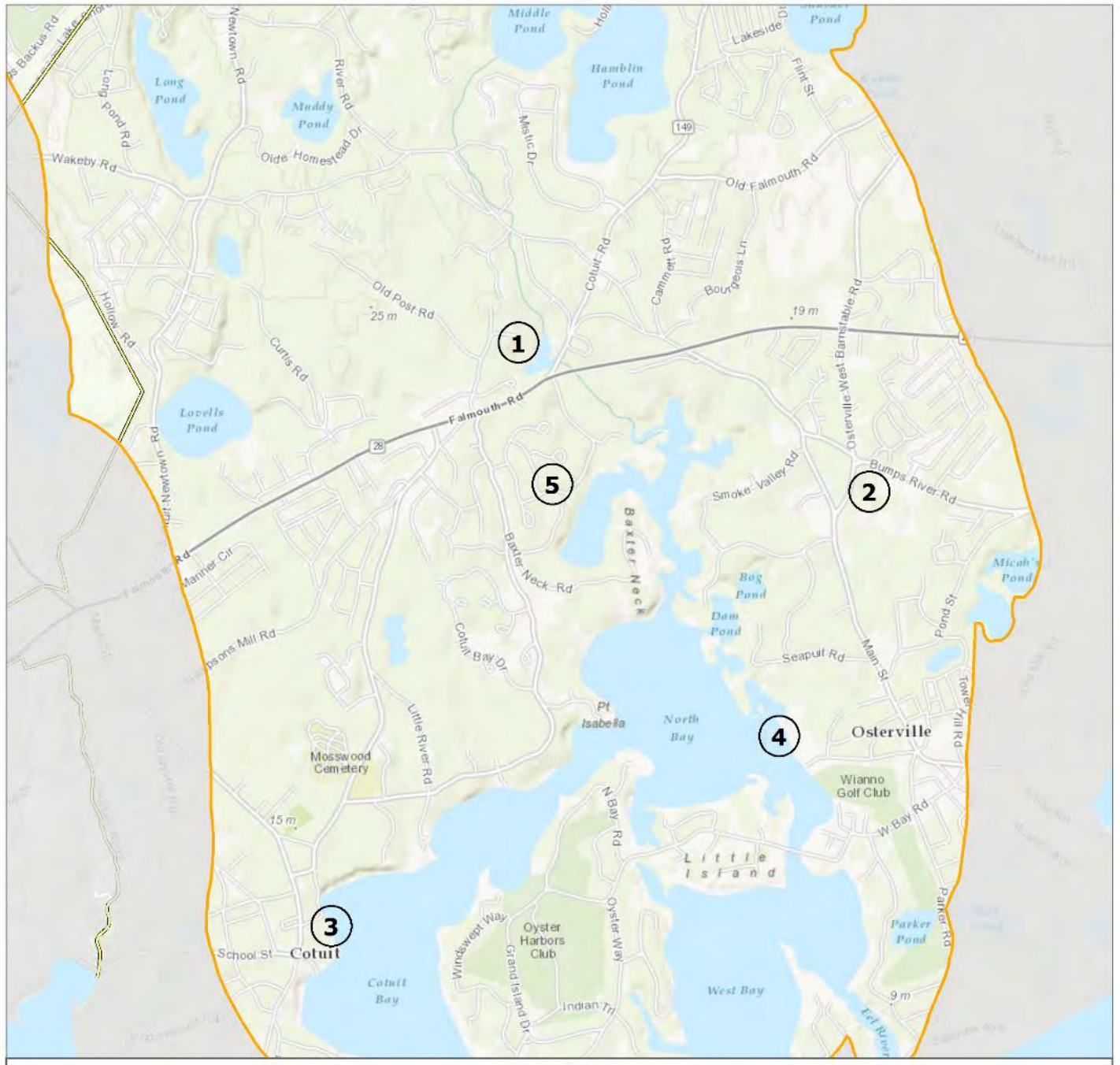
**Three Bays Preservation, Inc.**

**www.3bays.org**

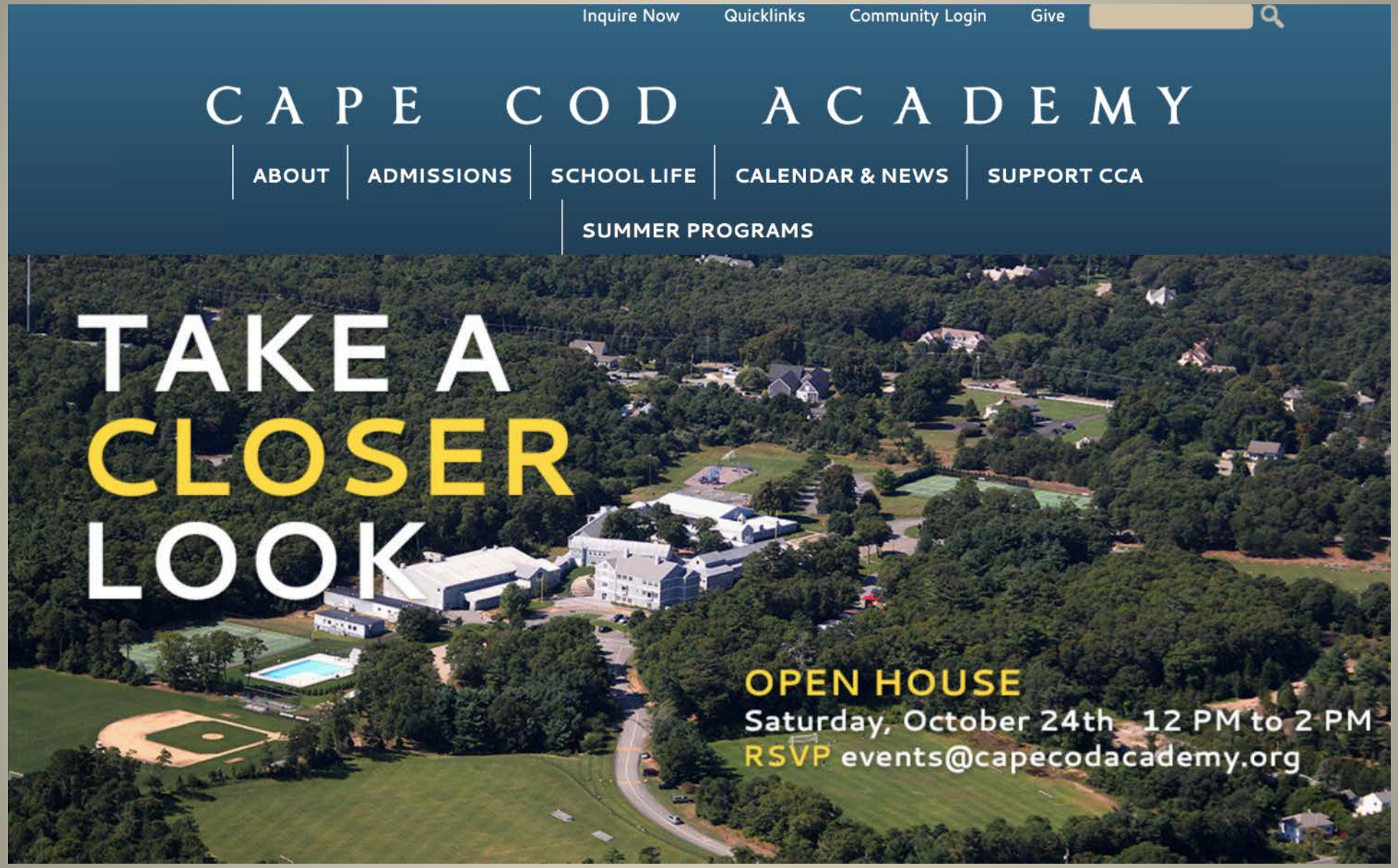


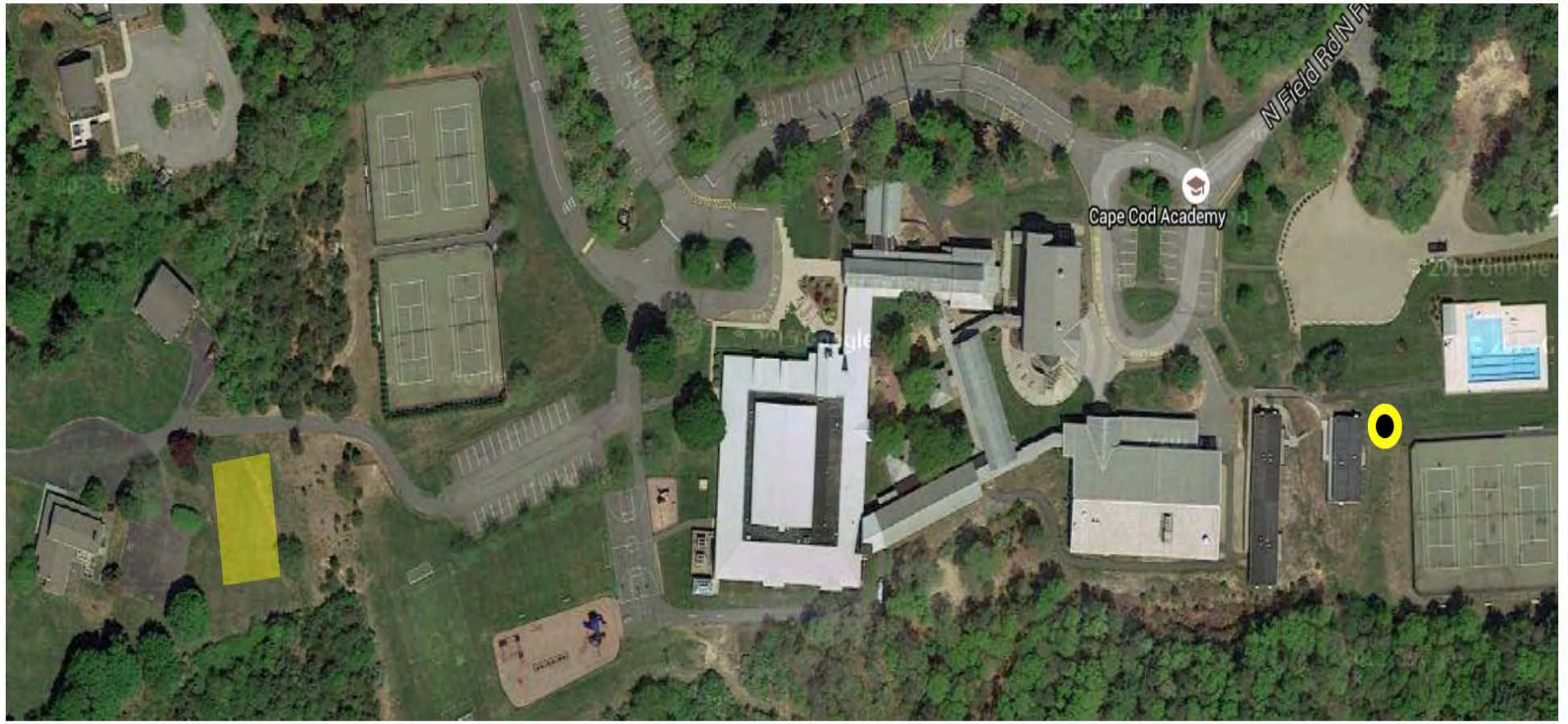

e VI-4. Contour plot of average total nitrogen concentrations from results of the present conditions loading scenario, for the Three Bays system.

# Massachusetts Estuaries Project's Threshold is the ideal level of nitrogen for a healthy water body




Three Bays -
Pilot Areas


Inquire Now
Quicklinks
Community Login
Give
CAPE COD ACADEMY
ABOUT
ADMISSIONS
SCHOOL LIFE
CALENDAR & NEWS
SUPPORT CCA
SUMMER PROGRAMS
TAKE A CLOSER LOOK
OPEN HOUSE
Saturday, October 24th 12 PM to 2 PM
RSVP events@capecodacademy.org




urine collection system

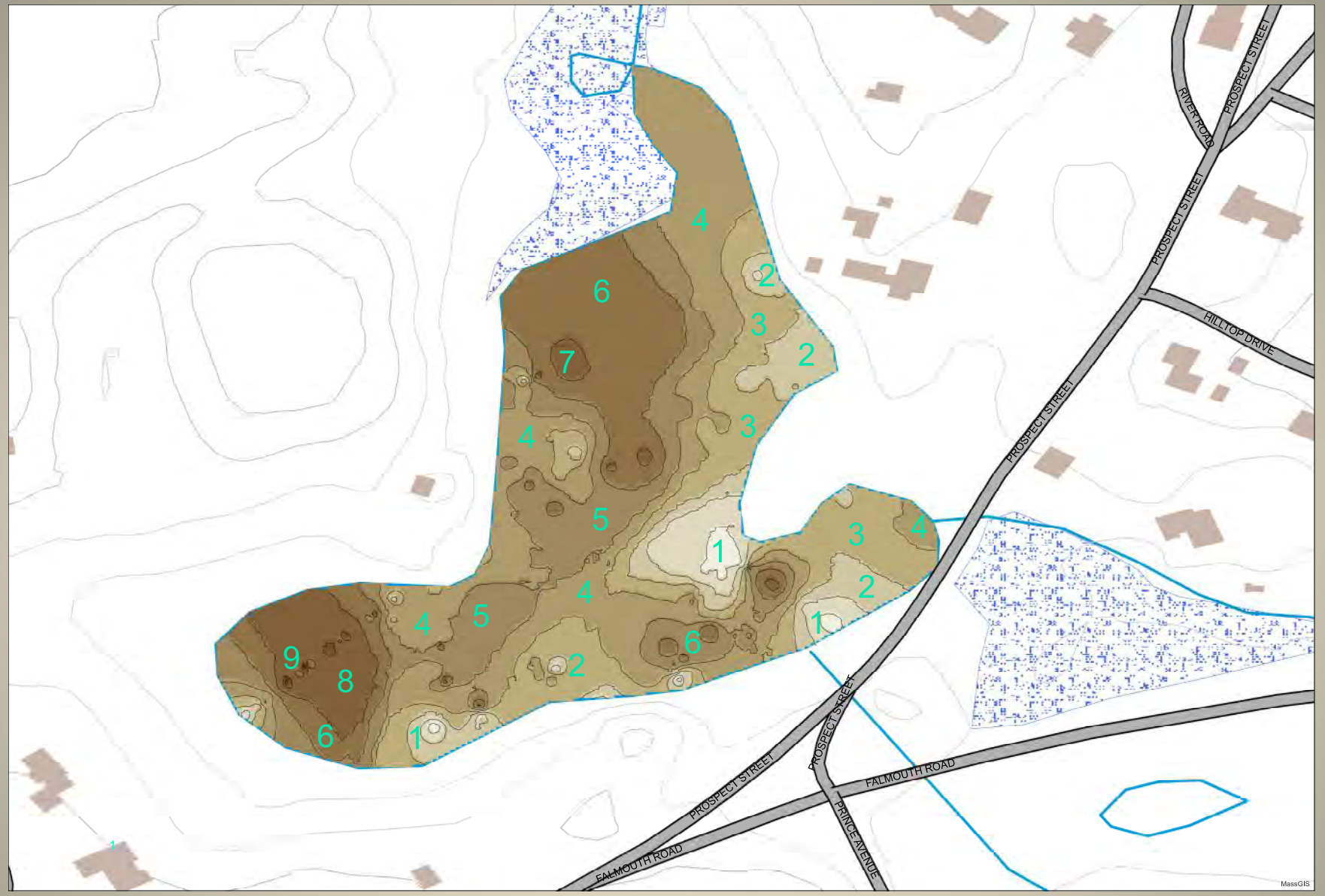
fertigation application area


Figure 3: Front View (Booms Down)


7
5
9
2
Mill Pond
4
1
3
149
8
6

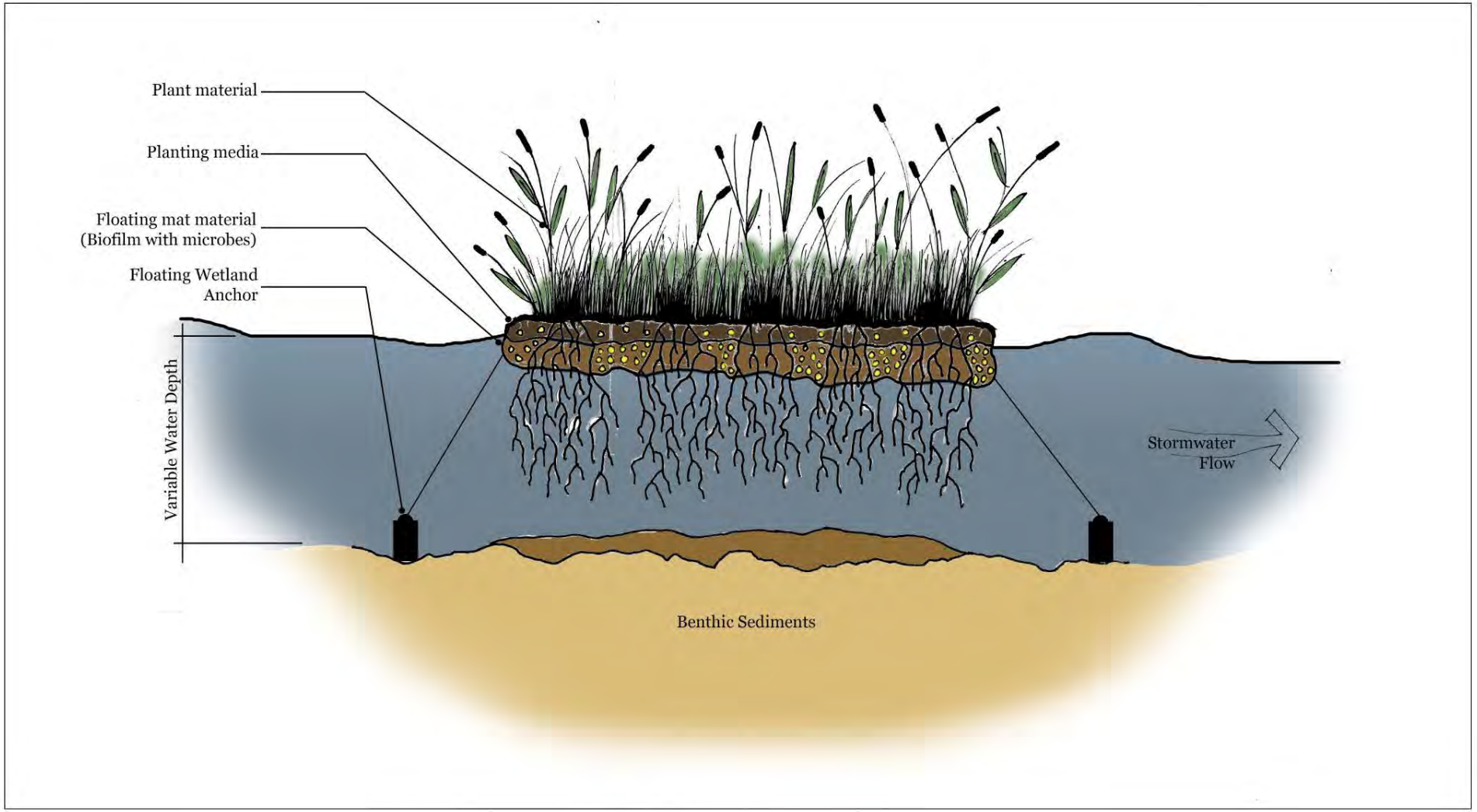

0-1 1-2 2-3 3-4 4-5 5-6

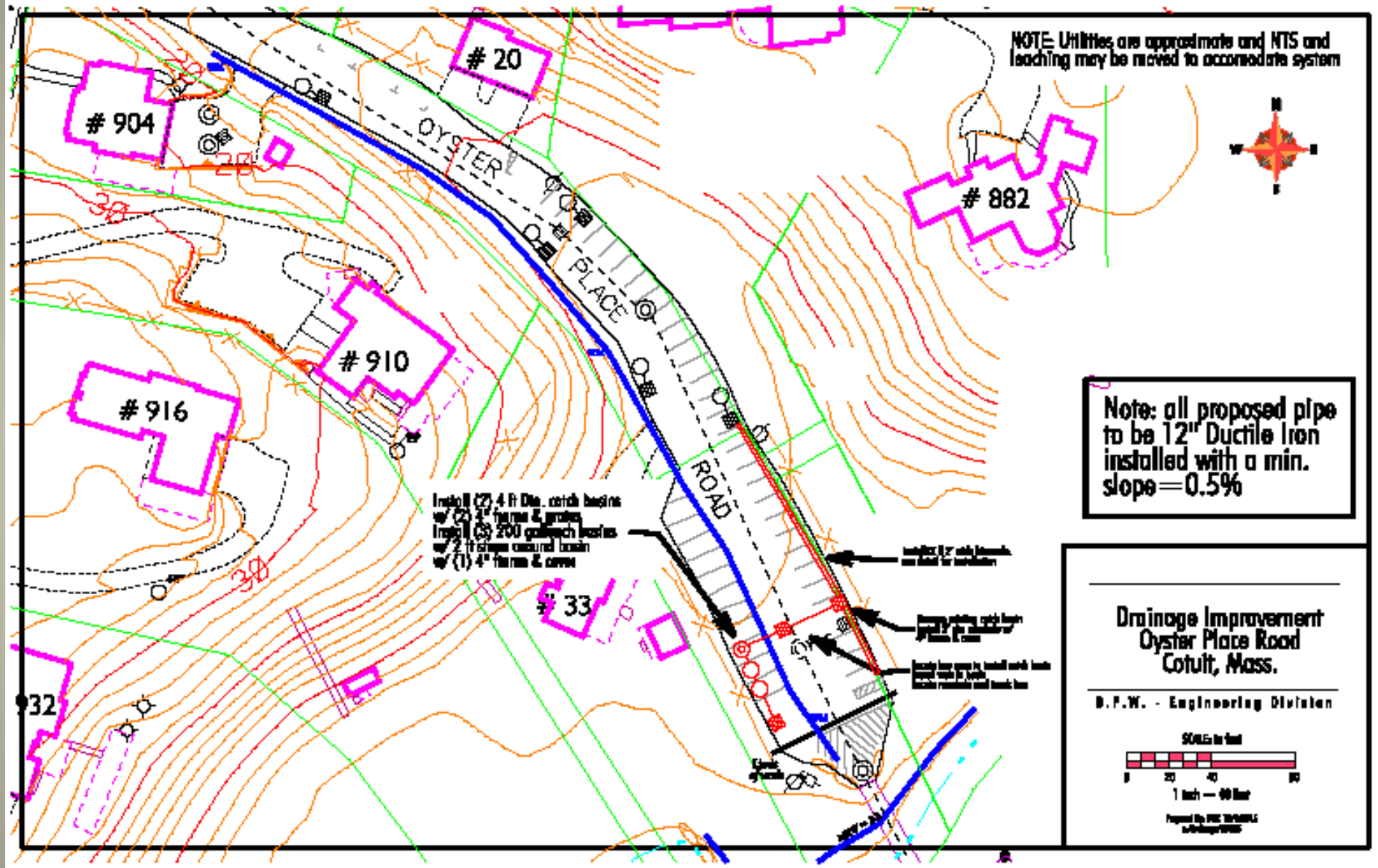
sDOT, & MassGIS



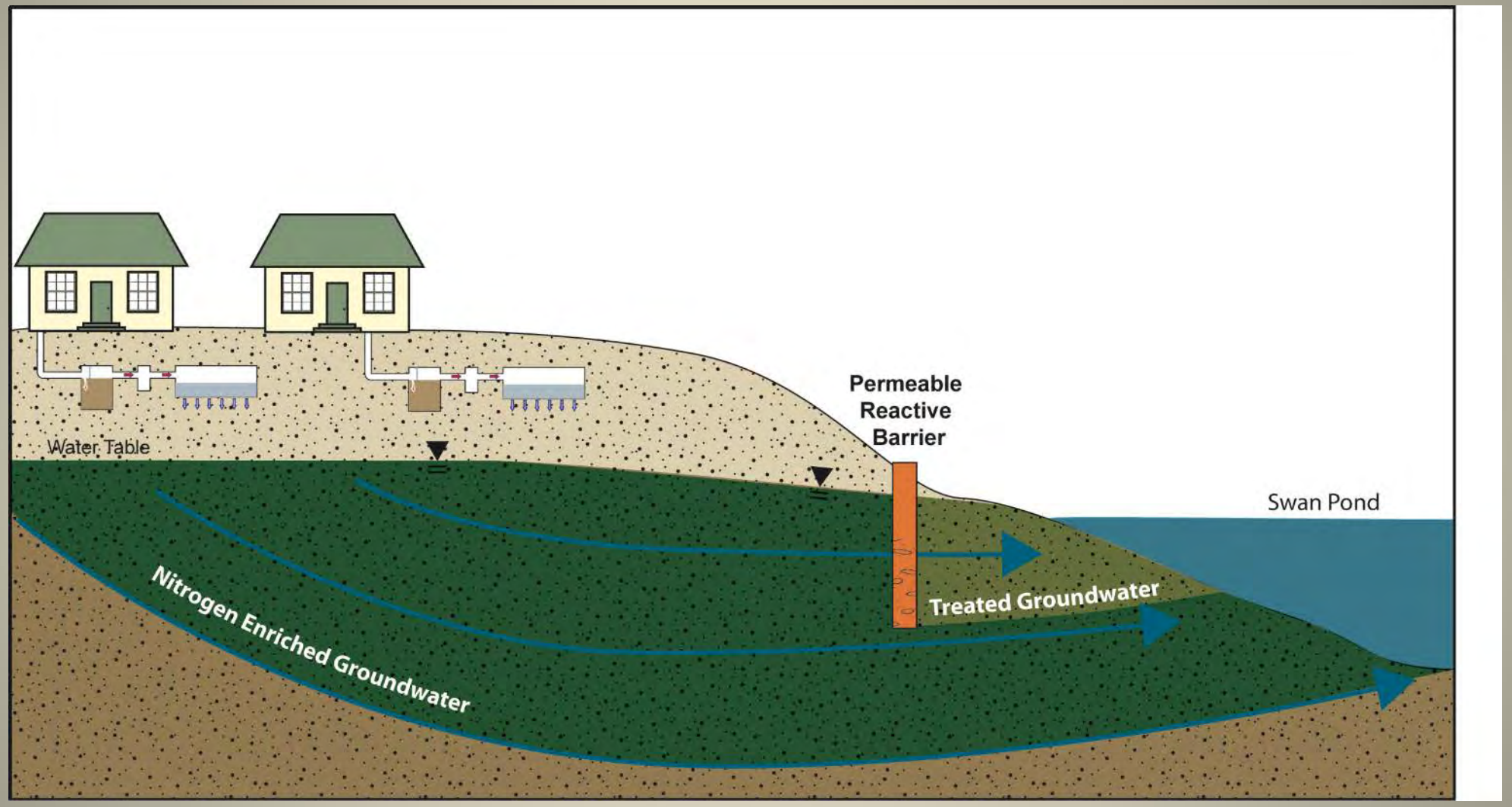

0-1 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10

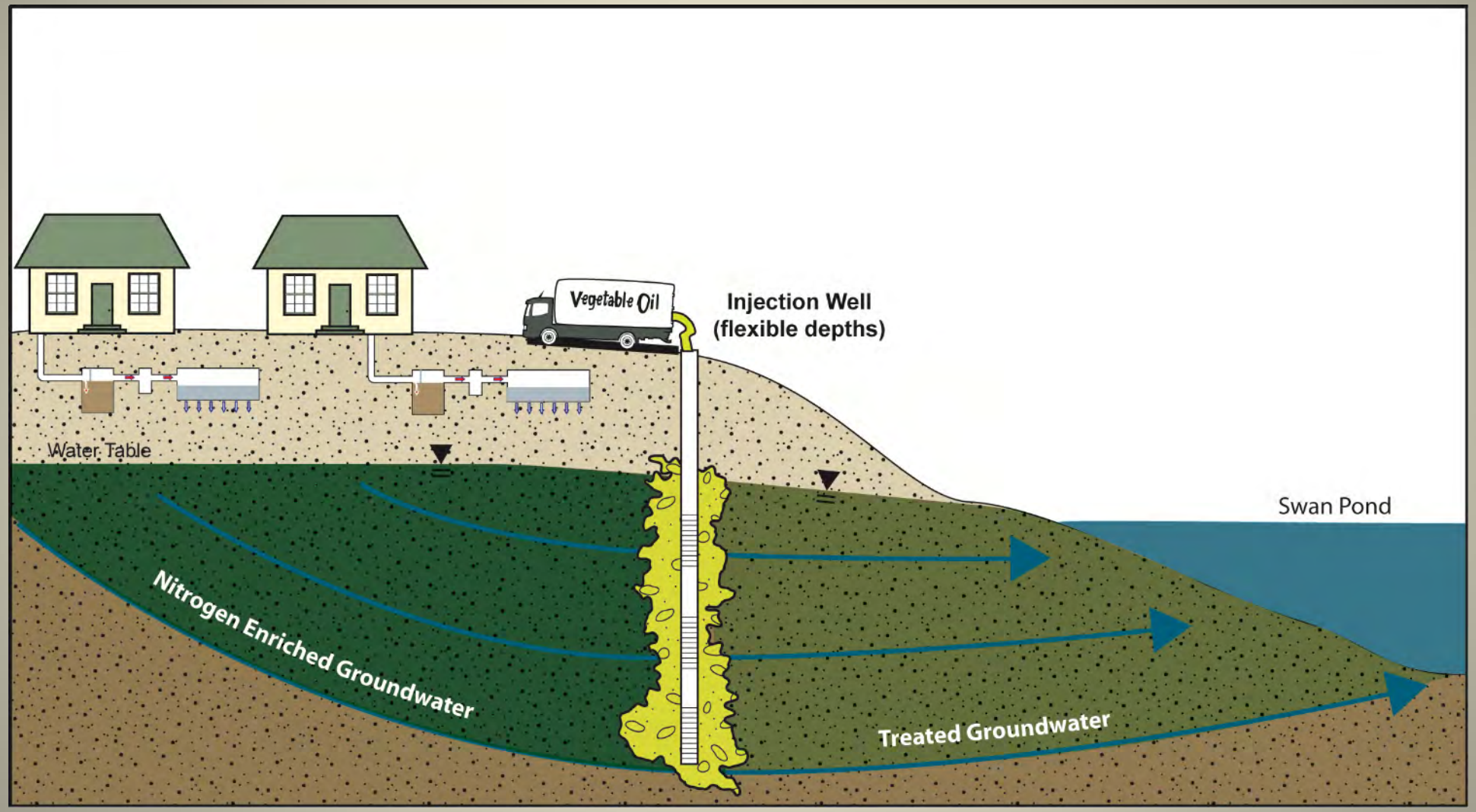
Sources: MassDEP, MassDEP, MassDOT, & MassGIS

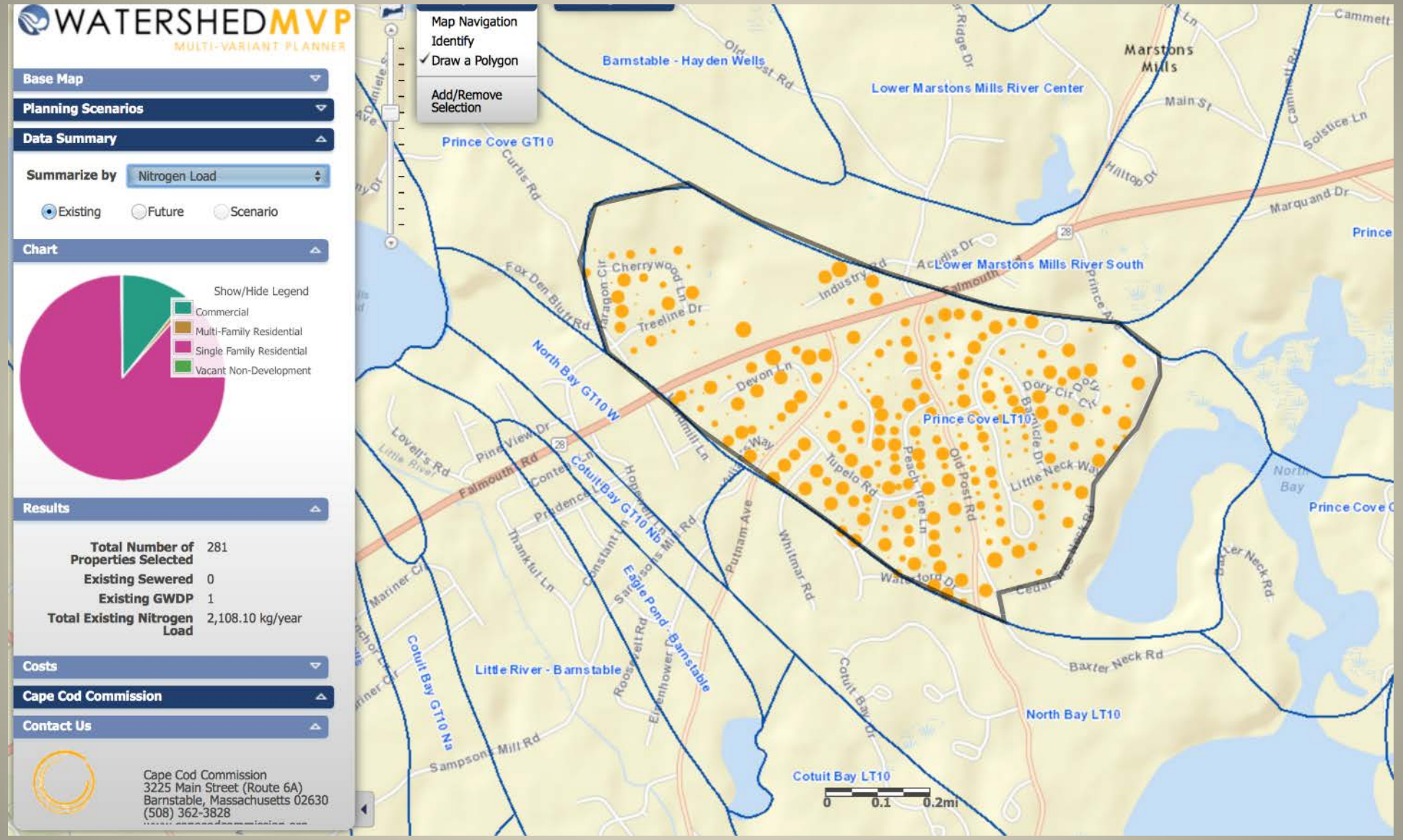

Plant material
Planting media
Floating mat material
(Biofilm with microbes)
Floating Wetland
Anchor
Variable Water Depth
Stormwater
Flow
Benthic Sediments


NOTE: Utilities are approximate and MTS and leaching may be moved to accomodate system
# 20
# 904
# 882
# 910
# 916
# 33
932
OYSTER
PLACE
ROAD
30
Note: all proposed pipe to be 12" Ductile Iron installed with a min. slope=0.5%
Drainage Improvement
Oyster Place Road
Cotuit, Mass.
D.P.W. - Engineering Division


PEAT MOSS


Permeable
Reactive
Barrier
Water Table
Swan Pond
Nitrogen Enriched Groundwater
Treated Groundwater


Vegetable Oil
Injection Well
(flexible depths)
Water Table
Swan Pond
Nitrogen Enriched Groundwater
Treated Groundwater


WATERSHEDMVP
MULTI-VARIANT PLANNER
Base Map
Planning Scenarios
Data Summary
Summarize by
Nitrogen Load
Existing
Future
Scenario
Chart
Show/Hide Legend
Commercial
Multi-Family Residential
Single Family Residential
Vacant Non-Development
Results
Total Number of Properties Selected 281
Existing Sewered 0
Existing GWDP 1
Total Existing Nitrogen Load 2,108.10 kg/year
Costs
Cape Cod Commission
Contact Us
Cape Cod Commission
3225 Main Street (Route 6A)
Barnstable, Massachusetts 02630
(508) 362-3828
Map Navigation
Identify
Draw a Polygon
Add/Remove Selection
Barnstable - Hayden Wells
Lower Marstons Mills River Center
Marstons Mills
Prince Cove GT10
Lower Marstons Mills River South
Prince Cove LT10
North Bay GT10 W
Cotuit Bay GT10 Nb
Cotuit Bay GT10 Na
Little River - Barnstable
North Bay LT10
Cotuit Bay LT10
Eagle Pond - Barnstable
Falmouth Rd
Baxter Neck Rd
Sampsons Mill Rd
0 0.1 0.2mi


Questions

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# George Heufelder

DIRECTOR, BARNSTABLE COUNTY DEPARTMENT OF HEALTH & ENVIRONMENT

Panel| Implementing Local Solutions: Projects Across the Cape

BCDHE
Barnstable County Department of Health and Environment
Promote - Protect - Support
90 YEARS OF SERVICE
1926 - 2016

MASSTC
Massachusetts Alternative Septic System Test Center
A division of Barnstable County Department of Health and Environment

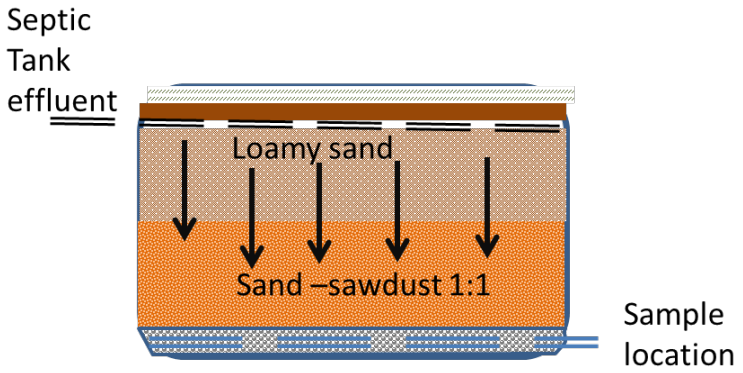
# Could sawdust play a role in saving our marine embayments?

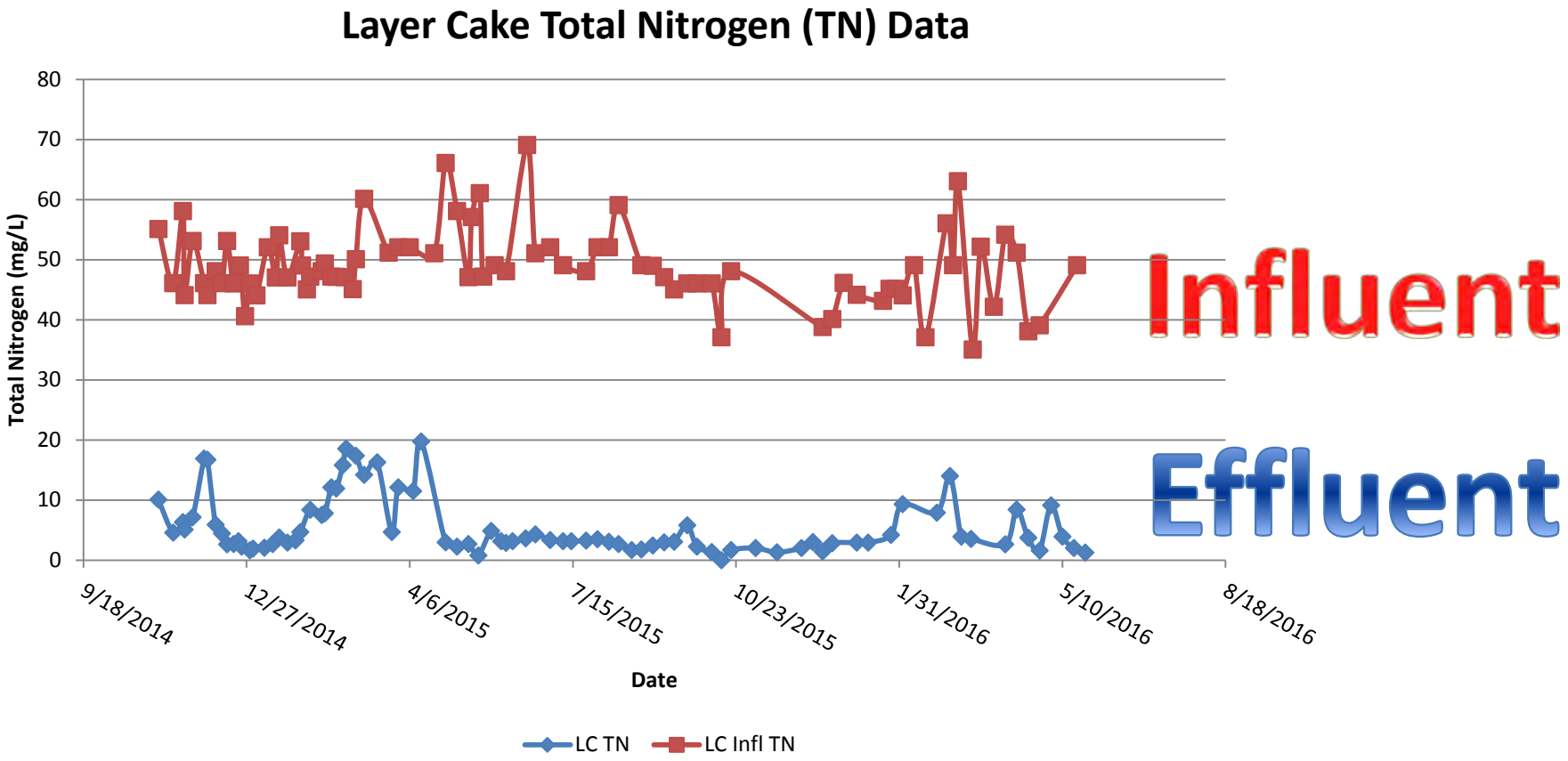
*George Heufelder, Director*
*Barnstable County Department of Health and Environment*
gheufelder@barnstablecounty.org


## Sawdust = Carbon

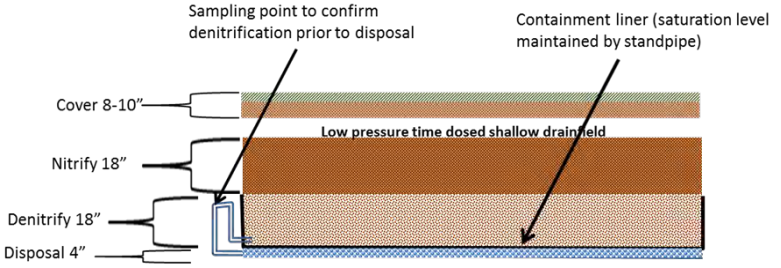
It appears that incorporating a source of carbon into the soil profile of a leachfield to support denitrification can significantly reduce the amount of nitrogen entering the groundwater from septic systems.

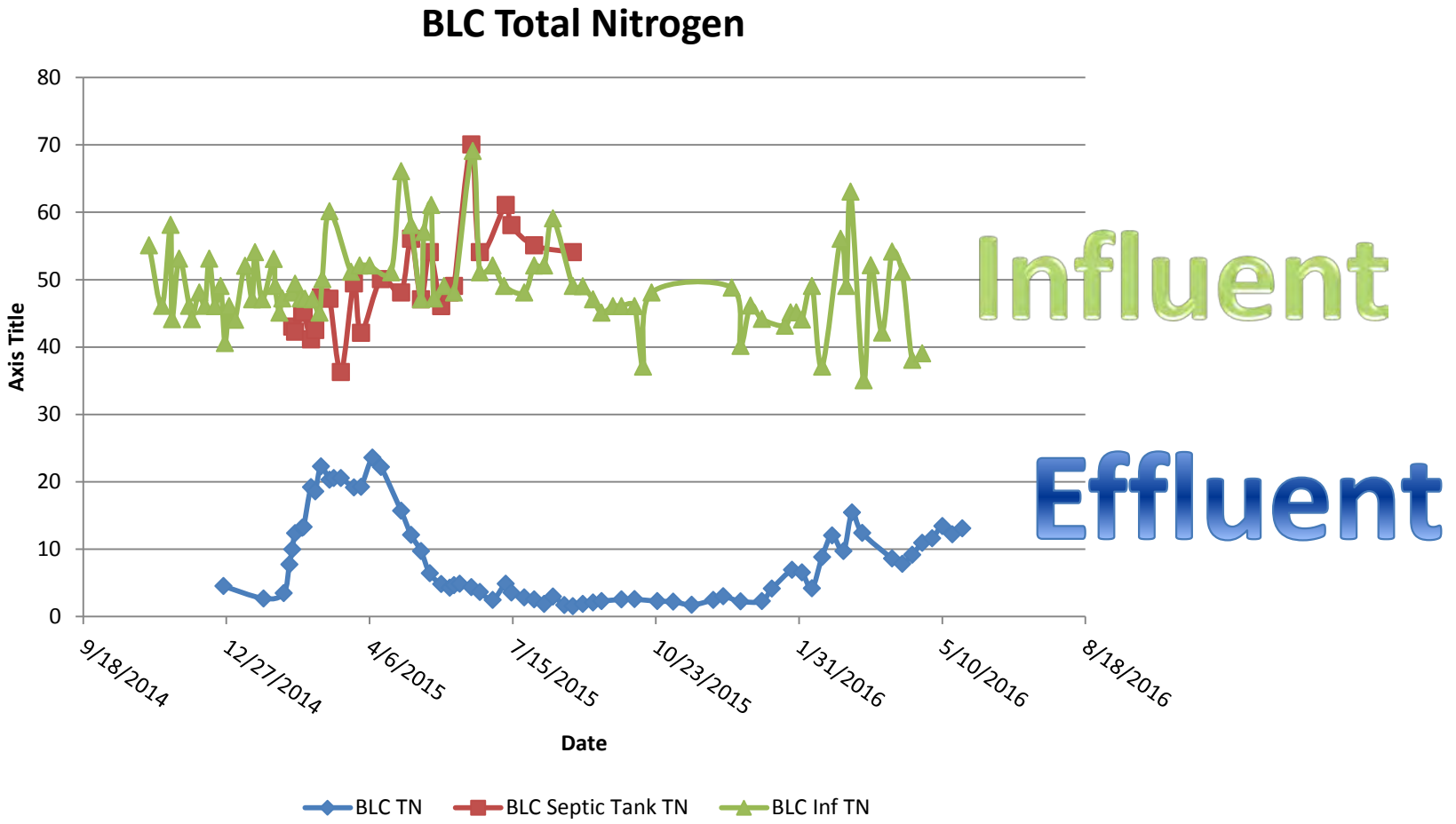
# “unsaturated” design



# “saturated” design

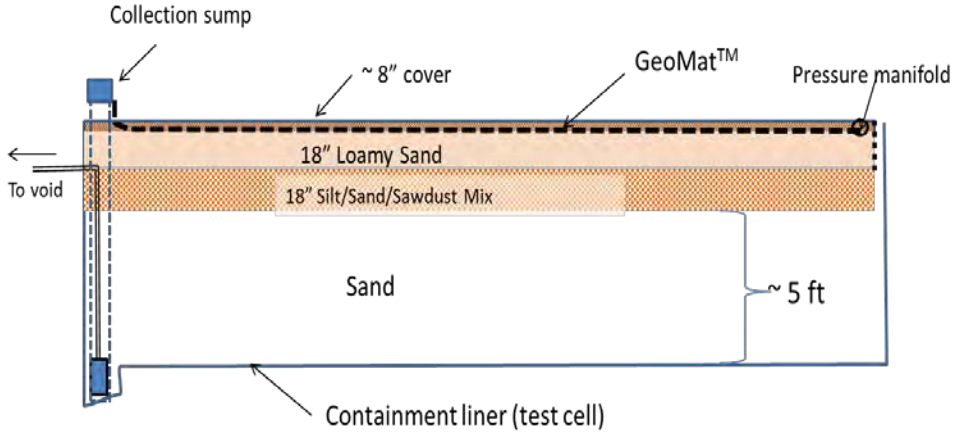


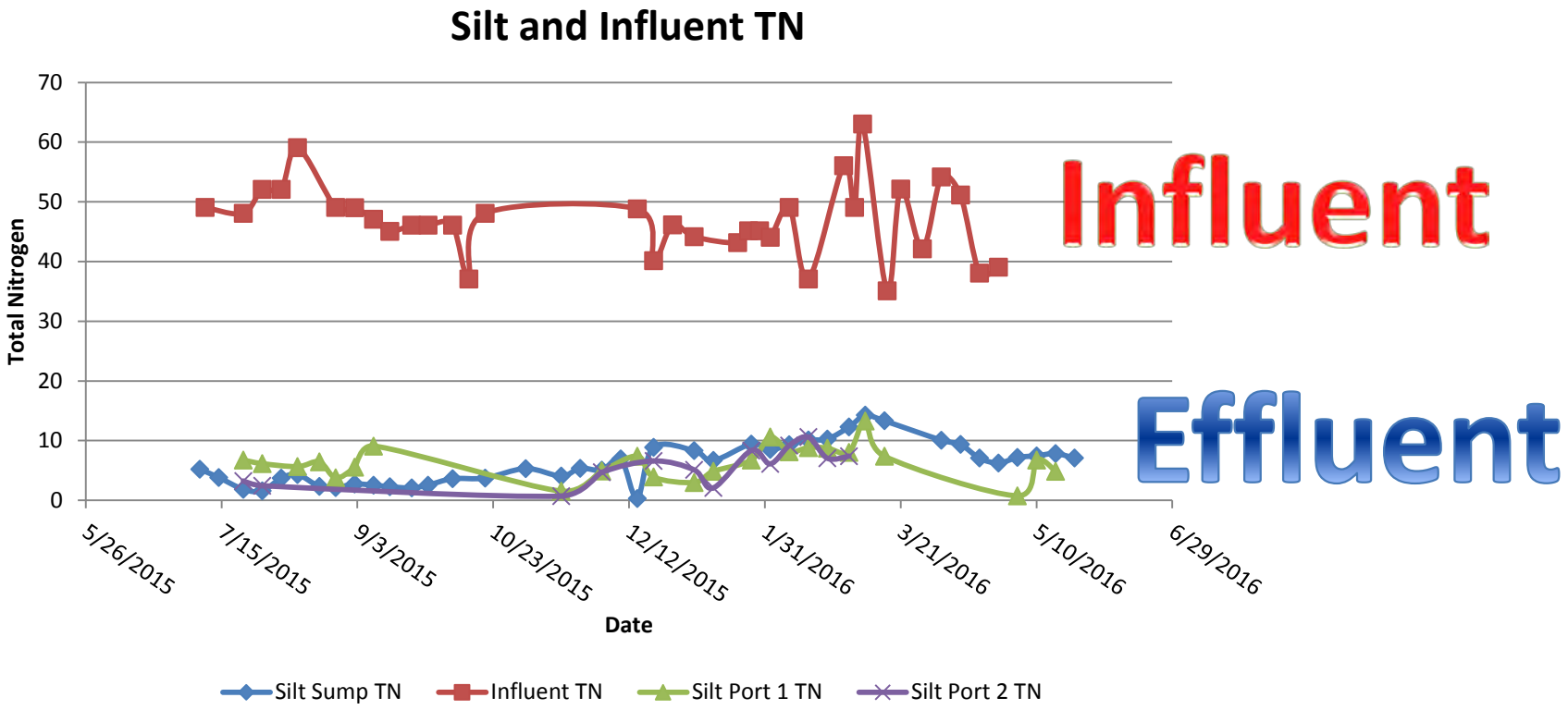




Influent

Effluent

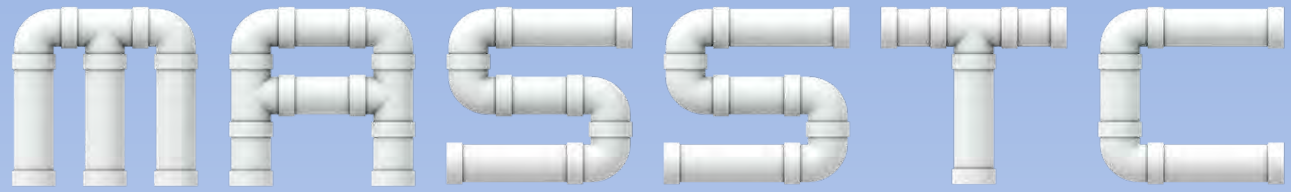
# “silt” design




Influent

Effluent




*The project is a collaborative effort that draws upon the combined expertise and ideas of many individuals including: Damann L. Anderson, P.E., a researcher of passive nitrogen removal systems for the State of Florida Onsite Sewage Nitrogen Reduction Study (FOSNRS); George Loomis, an onsite septic system specialist and published author from the University of Rhode Island; Dr. Will Robertson of the University of Waterloo; Jose Amador, a soil scientist at the University of Rhode Island; John Eliasson with the Wastewater Management Section of Washington State Department of Health's Division of Environmental Public Health; Dave Potts of Geomatrix LLC; and Rob Jamieson, Ph.D., P.Eng, Associated Professor and Canada Research Chair in Cold Regions Ecological Engineering with Dalhousie University's Environmental Engineering Program. More recently, Barnstable County Department of Health and Environment is collaborating with Suffolk County Health Department and New York and Stony Brook University, Center for Clean Water Technology.*

*This project was funded in part by a grant from the Massachusetts Department of Environmental Protection and the U.S. Environmental Protection Agency under the 319(b) Competitive Grant Program. Mention of any product or procedure does not constitute an endorsement and the opinions expressed herein do not necessarily reflect those of the supporting agencies. Partial funding was also supplied though MADEP as part of the Section 208 Project.*

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# Ray Cody

SENIOR STORMWATER POLICY ANALYST, US ENVIRONMENTAL PROTECTION AGENCY

Panel| Implementing Local Solutions: Projects Across the Cape

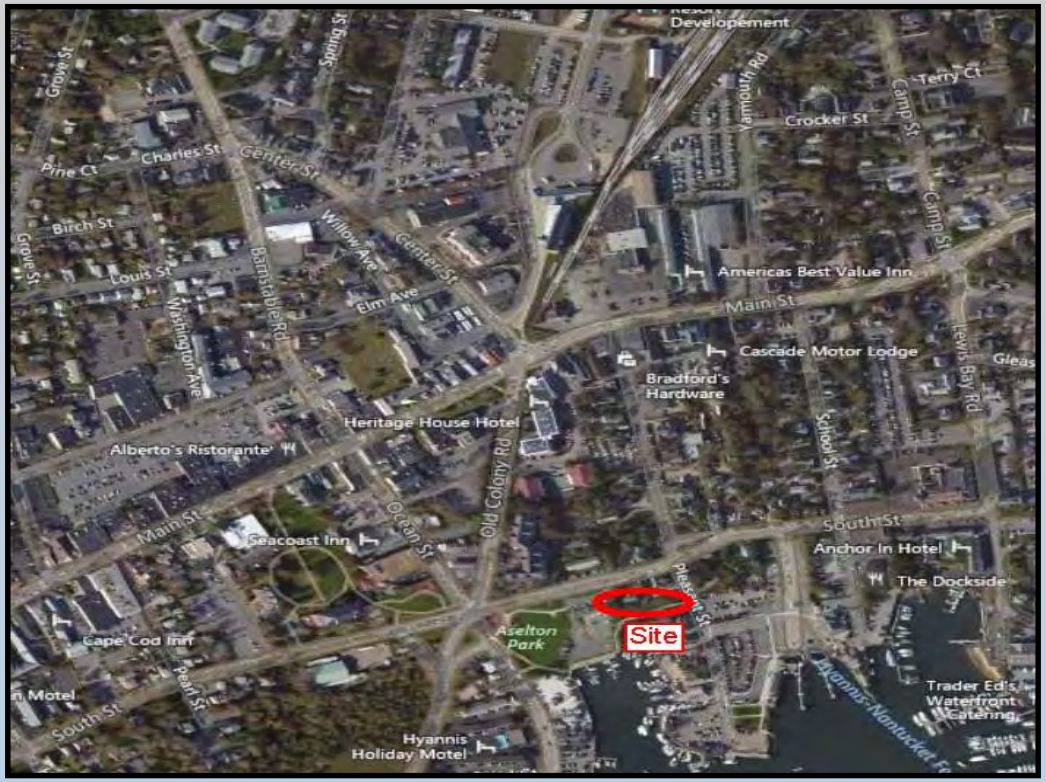
# Green Infrastructure Implementation Case Study: Design and Construction of Stormwater Best Management Practice Retrofits for the Control of Nitrogen on Cape Cod

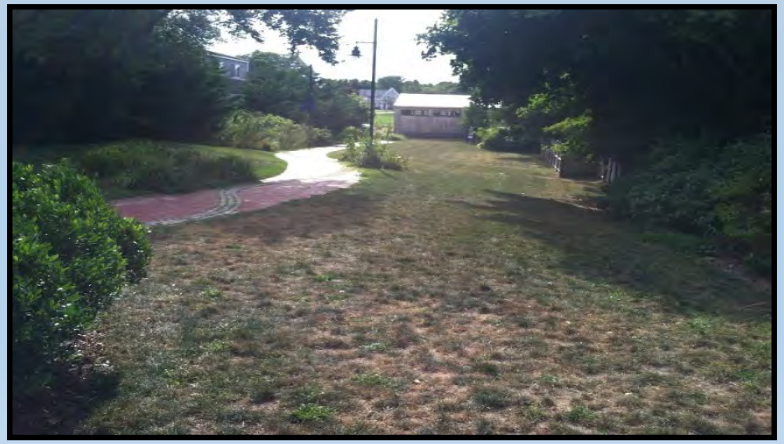
R. Cody
Surface Water Branch
U.S. EPA – Region 1

# Site 1: Town of Barnstable

**Hyannis Inner Harbor, Barnstable, MA**

- parcel: 0.35 acres
- drainage area: 6.9 acres
- IC: 3.5 acres (~ 51% IC)
- MS4 trunk line runs through the site
- drains to Hyannis Inner Harbor
  impaired for TN and fecal coliform
- Total attenuated watershed N load: 41.5%
- subwatershed N load reduction target (NRT): 19.6-52.8%
- percent NRT due to stormwater / IC: 21%

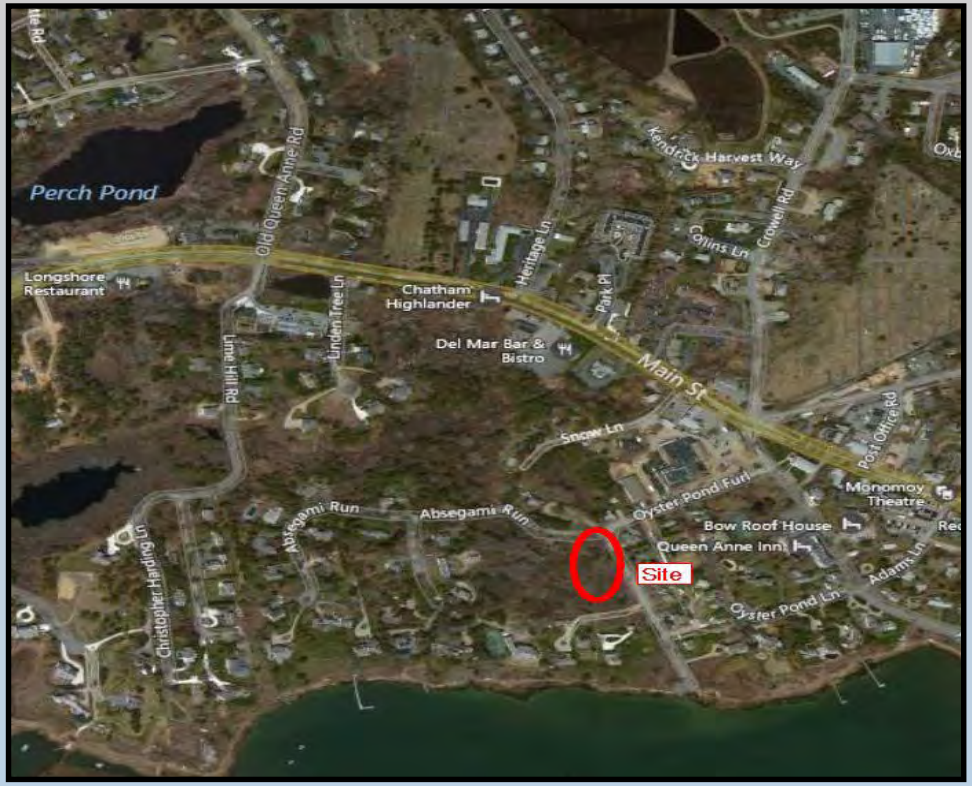


# Site 2: Town of Chatham

**Undeveloped Town parcel near Oyster Pond, Chatham, MA**

- parcel: 3.19 acres
- drainage area: 16.9 acres
- IC: 5.7 acres (34% IC)
- MS4 trunk line runs by the site
- drains to Oyster Pond,
  impaired for TN and fecal coliform
- watershed/subwatershed N load reduction target (NRT): 74-88.2%
- percent NRT due to stormwater: 15%




# Site Constraints

**Hyannis Inner Harbor, Barnstable, MA**

- parcel:  0.35-ac, 0.19-ac available (54%)
- park site, high traffic area
- very shallow groundwater


**Oyster Pond, Chatham, MA**

- parcel:  3.19-ac, 0.33-ac available (10%)
- wetland complex
- shallow groundwater
- deep drain line

# Barnstable N BMP Retrofit Construction


MS4 Trunk Line

# Barnstable N BMP Retrofit Construction

Initial Excavation

Logistics: Materials Mngt

# Barnstable N BMP Retrofit Construction


Bottom Liner Install

# Barnstable N BMP Retrofit Construction


ISR Stone Delivery


Installing Top Liner and Biosoil over ISR

# Barnstable Retrofit Completed; During Storm

# Chatham N BMP Retrofit Construction

Existing Conditions

Site Clearing

# Chatham N BMP Retrofit Construction

Site Clearing [cont.]

Rough Excavation

# Chatham N BMP Retrofit Construction

Bottom Liner – ISR Stone


Diversion Structure

# Chatham N BMP Retrofit Construction


Delivering ISR Stone

Biosoil Grading; Outlet Structure Array

# Chatham N BMP Retrofit Construction

BMP Inlet and Structure Array


Access Road Gate

# Chatham N BMP Retrofit

Completed BMP Retrofit

# Performance Assessment

To Be Determined . . .

Approach: allow BMP anerobe populations to establish over ~1-year, then install monitoring equipment:

- -sample inlet to BMP, outlet from BMP, existing drainage system bypass.
- -sample each for flow and nutrients with auto-samplers and volunteers

Monitoring Plan and Quality Assurance Project Plan (QAPP) currently under development

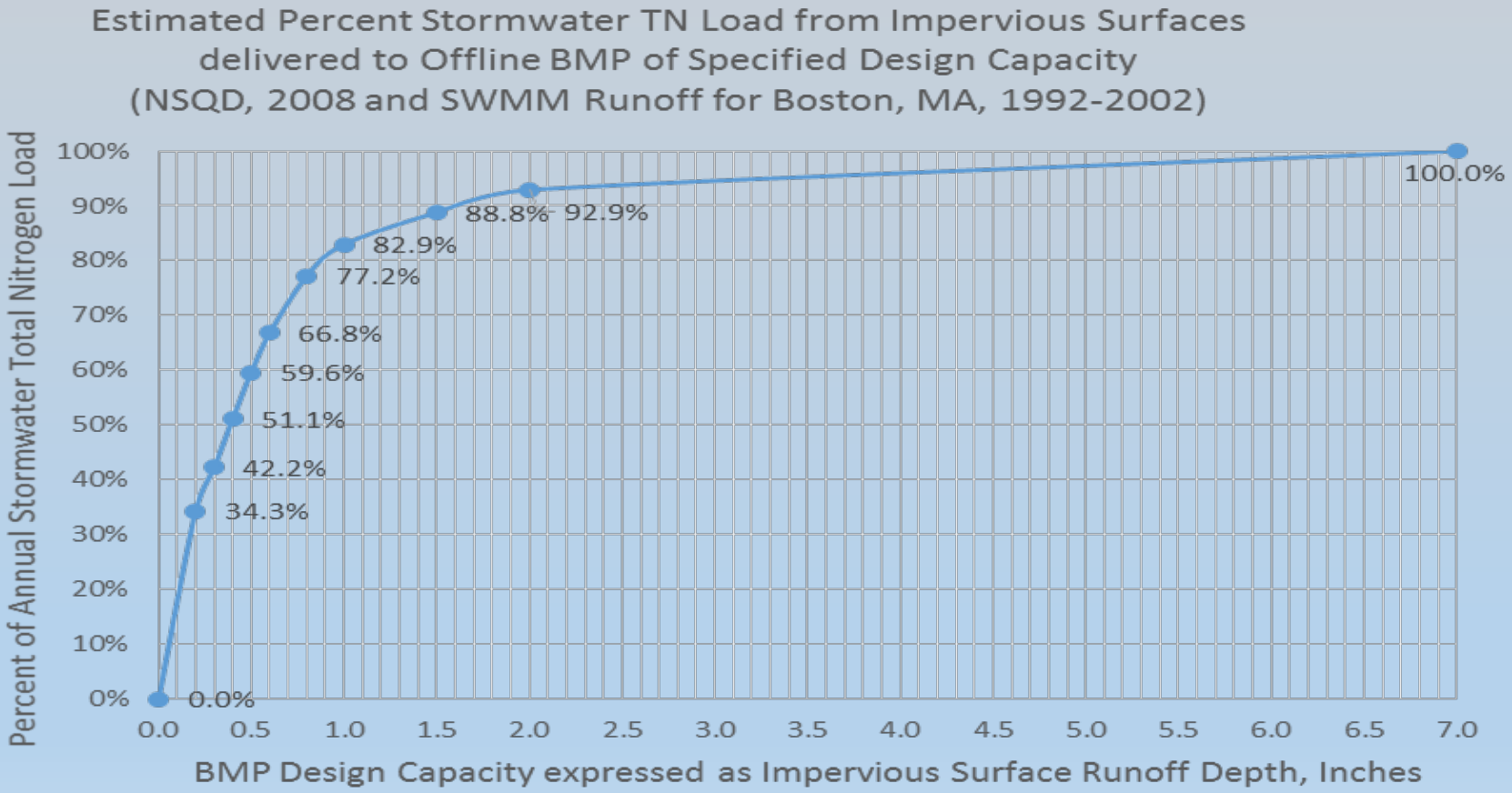
Schedule:

- start fall 2016
- ~ 20 storm events per year
- 3+ years of performance monitoring

Complication: Barnstable – observed base flow; 17.5 gal/min; spring only?

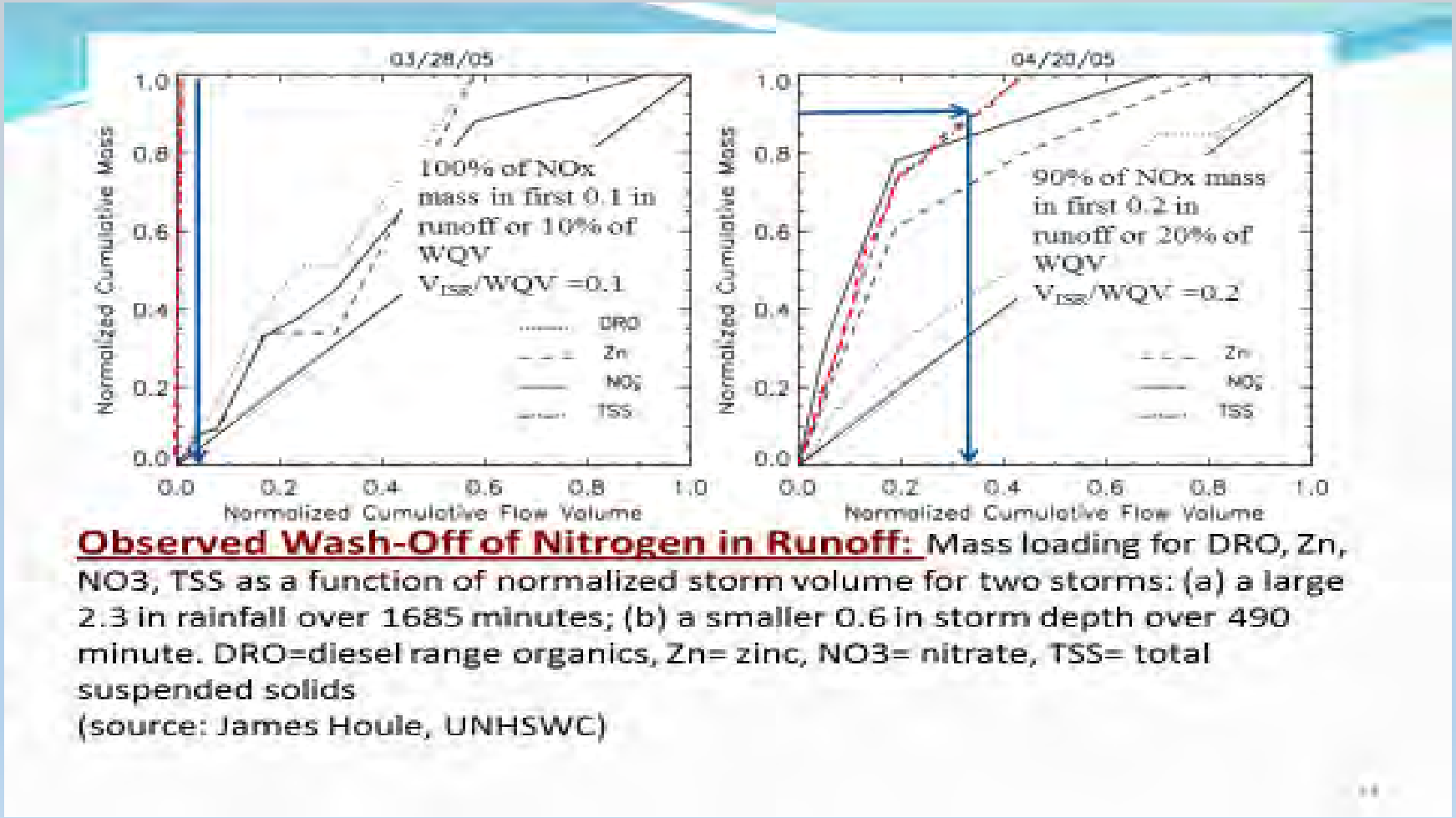
# Performance Assessment

## Anticipated Performance:



# Performance Assessment

## Anticipated Performance:




**Observed Wash-Off of Nitrogen in Runoff:** Mass loading for DRO, Zn, NO3, TSS as a function of normalized storm volume for two storms: (a) a large 2.3 in rainfall over 1685 minutes; (b) a smaller 0.6 in storm depth over 490 minute. DRO=diesel range organics, Zn= zinc, NO3= nitrate, TSS= total suspended solids
(source: James Houle, UNHSWC)

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# Questions?

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June 23-24 | Resort and Conference Center at Hyannis