Pond Summit 2023

June 16, 2023

Hosted By
The Brewster Ponds Coalition
and The Town Of Brewster

Brewster Ponds Coalition Mission Statement

Protecting and improving the health of Brewster's ponds through science, education and advocacy.

Pond Summit 2023 Agenda

- Opening Remarks
- I. Introduction - John Keith, Griffin Ryder
- II. Scientific Research Planned or In Progress - John Keith, Chris Miller, Erin Perry
- Q&A
- Break
- III. Title 5 Regulations - Mark Nelson

Pond Summit 2023 Agenda (continued)

- IV. Regulatory Management Entities (RMEs) for Alternative Septic Systems - Brian Baumgaertel
- V. State and Local Funding Sources - Peter Lombardi
- Q&A
- VI. What About PFAs and Other Toxics? - Kim Pearson
- Q&A
- Thank You and Adjournment

Brewster Ponds Coalition

Introduction on Pond Pollution

John Keith, PE
Environmental Engineer
Vice-President, Brewster Ponds Coalition

Most Cape Ponds Are Kettlehole Ponds

- Depths often >10m
- Often bowl shaped, w/ steep side slopes
- Small surface watershed areas
- Often no outlet
- Fed by rain and groundwater
- Slow water turnover
- Possible past agriculture pollution
- Some cranberry bogs
- Slow accumulation of organic matter, Phos.
- **Water quality sensitive to small changes in input**

Kettlehole ponds are glacial potholes where the land dips below the water table

- Natural background water quality was very good:
  - Low pH (<6.5) - Soft
  - Low Phosphorus - Low Nitrogen
  - Low Algae - High Clarity (>15 feet)

Ponds Are a Complicated Ecosystems

Pollutants Enter and Leave Ponds in Various Ways – A Dynamic Process

Rain deposition

Bird waste

Deposition of vege-tation (leaves, etc.)

Storm runoff in

Surface flow in

(Bogs and streams on some ponds)

Groundwater flow in (including from septic

Stream flow out

Groundwater flow out

Uptake and release by water plants and algae

Deposition to and uptake from sediments (major factor in varying nutrient levels through year)

Uptake and release by fish and other animals

Types of Pond Impairment

Red – Also important for well water quality

Types of Impairment	Indicators	Causes
Low Dissolved Oxygen (DO)	- Low DO, especially near bottom - Fish kills	- **High nutrients (esp. Phosphorus)** and resulting algae growth - Stratification
Poor Clarity	- Cloudy or "murky" water - Floating particles in water	- Storm runoff with lots of silt - Algae blooms
High Nutrients (Phosphorus, Nitrogen)	- Algae blooms - Cyanobacteria (blue-green algae) - High chlorophyl (indicates algae)	- Septic systems upgradient of ponds - Fertilizer runoff from lawns, bogs
Harmful Bacteria	- E. Coliform, indicator of pollution with fecal matter, sewage	- Poorly operating septic systems - Animal waste
Chemicals – PFAs, oils, pesticides, pharma-ceuticals, detergents	- Oil sheens, detergent foams - Testing for specific chemicals	- Septic systems if close to ponds & wrong disposal practices - Pesticides from lawns, bogs, trees
Invasive Species	- Invasive water plants, mussels	- Introduction by boats, plantings
Nuisance Level of Plants	- Excessive spread of water plants	- **High nutrients, esp. phosphorus**

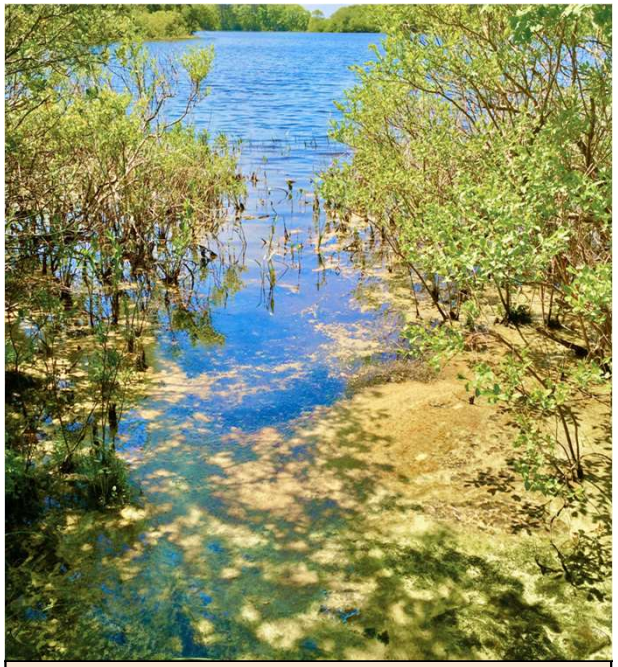
Some ponds have brownish color due to natural tanins – not a pollution problem.

Pollution Sources for Cape Cod Ponds

- **Septic tanks often the major source for nutrients**
  - Phophorus and nitrogen
  - Also for toxic chemicals like PFAs and pharmaceuticals
- Other important human-related sources:
  - Road and driveway runoff during rain – silt, salts, oil
  - Lawns and gardens near ponds - fertilizers runoff
  - Cranberry bogs – nutrients, pesticides? – contribution unclear
  - Animal waste – especially from dogs
- Sources that add nutrients with little ability to control:
  - Plant deposition (leaves, pollen, etc.)
  - Birds, other wildlife
  - Rainfall deposition
- Sediments often a critical factor in pond impairment
  - Low DO (<2 ppm) at pond bottom releases P from sediments

Why the Concern About Phosphorus?

- Two major nutrients impact ponds – phosphorus and nitrogen
- Impact of high nutrients on ponds:
  - Lower clarity – largely due to algae
  - Algae – green masses on water
  - Increased risk of cyanobacteria (blue-green algae)
    - Can release toxics making water unsafe for people and pets
- Higher algae depletes oxygen in water
  - Called “anoxia”
  - Can lead to fish kills
  - Decreases fauna in sediments, causing imbalance



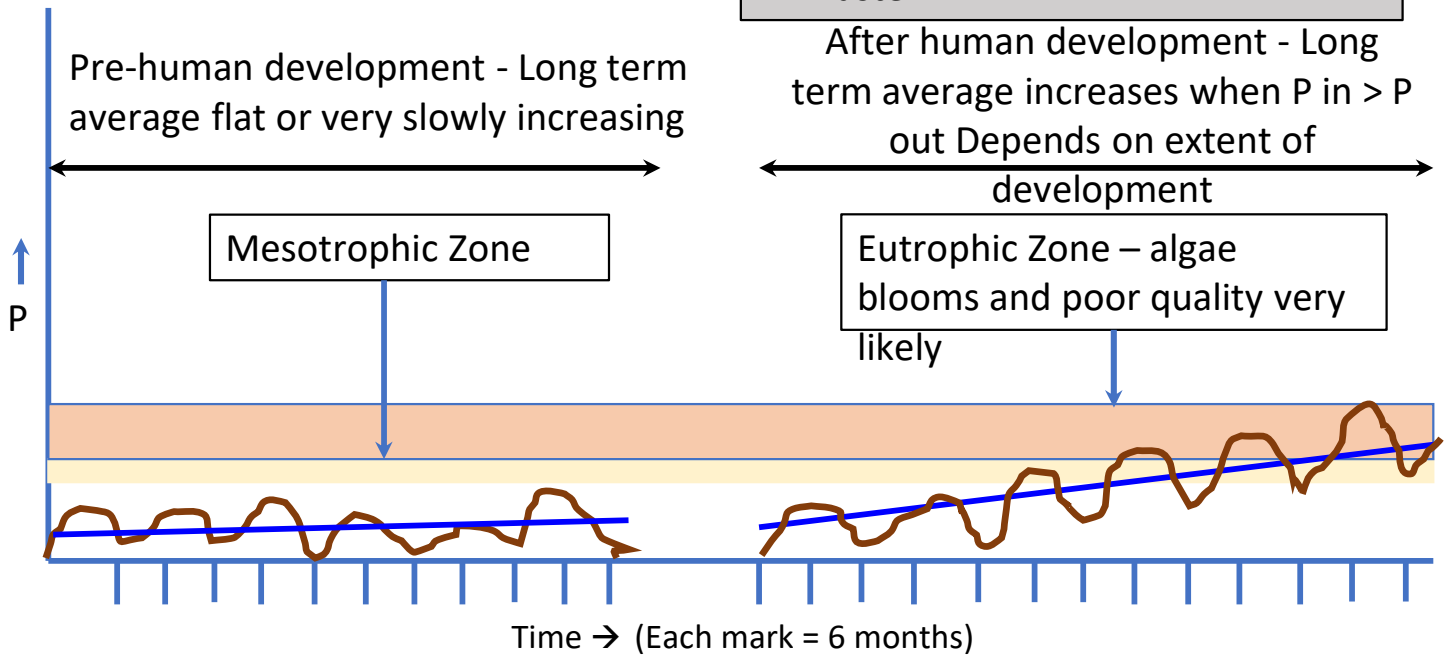
Phosphorus is usually the limiting nutrient with respect to algae growth in Cape ponds

Phosphorus Accumulates in Ponds Over Time

- Higher P = more algae bloom risk (though nitrogen levels also important)

Natural Phosphorus Sources:
- Vegetation detritus, birds, wildlife

Human Phosphorus Sources:
- **Septic Systems,** fertilizer, pet waste

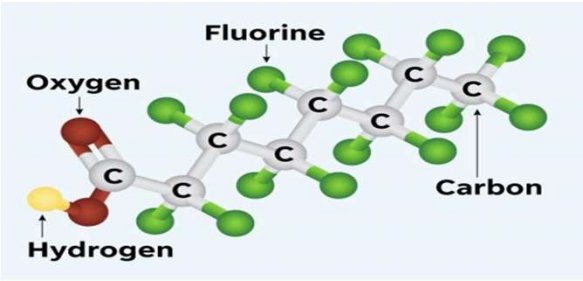


Sediments store P from year to year and release P in summer if DO is low

Problems occur when P rises, even if only in summer

What About PFAs and Other Toxic Chemicals?

("Pollutants of Emerging Concern")



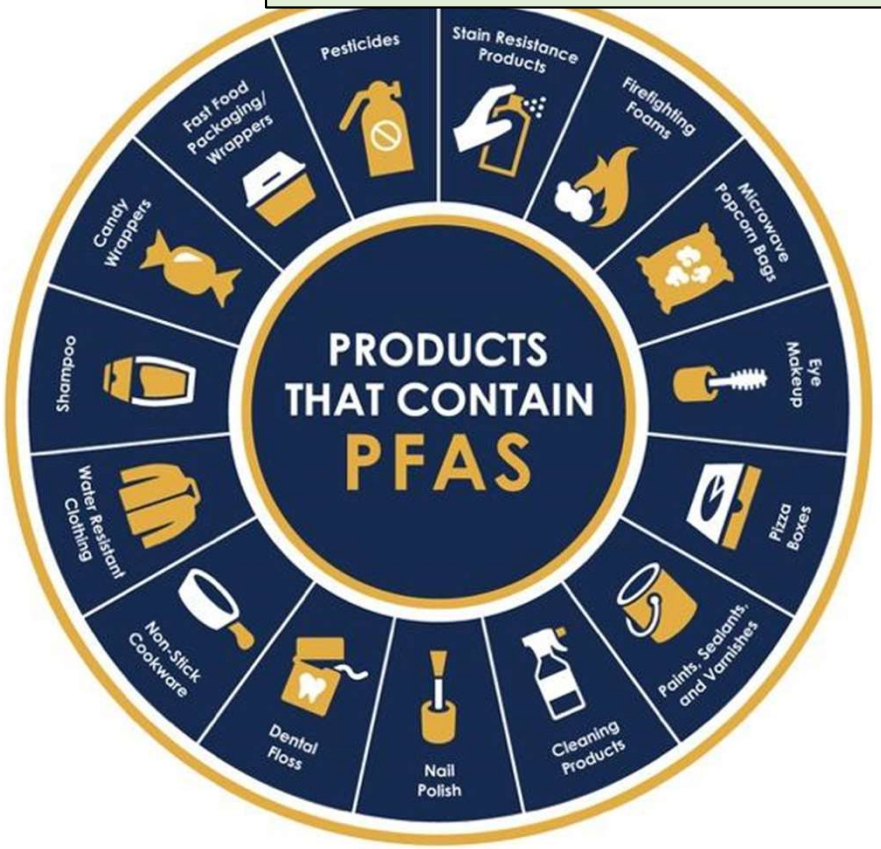
Polyflouroalkyl Substances

- PFAs, pharmaceuticals, BPA & other plasticizers, pesticides, paints & coatings
- Research suggests that high levels of certain PFAS may lead to:
  - Increased risk of high blood pressure or pre-eclampsia in pregnant women
  - Increased cholesterol levels
  - Decreased vaccine response in children
  - Decreases in infant birth weights
  - Increased risk of kidney or testicular cancer
- **Septic systems can be a significant source of groundwater contamination if discharged into them**
  - Septic systems do not remove them
  - No practical way to upgrade to remove them
  - Need to keep them out of septic systems!

What About PFAs and Other Toxic Chemicals?

- Ingestion is the primary pathway for PFAs into the body
- A primary PFA exposure concern for Cape Cod is drinking water

- Key: prevent discharges
  - Never dispose of medicines to wastewater
  - Bring hazardous materials to collection centers
  - Encourage bans of PFAs in household items
  - End use in fire fighting foam (a major source of groundwater contamination)



Conclusion

- Septic systems can be a major source of nutrients and chemicals impacting ponds
- If septic system discharges and other sources are not addressed, water quality in our ponds will get worse
  - More algae and cyanobacteria blooms
  - Possible fish kills, reduced animal life
  - More pond closures to protect health
  - Risks to wells and drinking water – public and private
- Solutions require:
  - Understanding of nutrient and biological conditions in ponds
  - Understanding which septic systems impact ponds
  - Evaluation of options in terms of cost, time and effectiveness
  - Broad support from the people of Cape Cod
  - Sound funding
  - A good number of years to implement and show effects

Town of Brewster Water Quality Actions

JUNE 2023

- Agenda
  - Stormwater Management Bylaw
  - Municipal Separate Storm Sewer System (MS4) Permit
  - Examples of Stormwater Control Measures (SCMs) or Best Management Practices (BMPs)
  - BPC & DPW coordination
  - Fertilizer Bylaw

Chapter 272- Stormwater Management Bylaw

- Effective March 2022 (adopted Fall TM 2021)
- Regulations also adopted
- Water quality protection- primary purpose (MS4)
- Requires permit for certain activities (minor/ major)
  - Net new impervious 500 sq ft or greater
  - Total land disturbance 10k sq ft or greater
- Conscom authority w/in wetlands jurisdiction
- Enforceable performance standards (“BMPs”)
  - MA Stormwater Handbook minimum
  - Heightened treatment standards in Brewster
  - Hydrology report
  - Requires LID/ nature-based elements
- Construction and post-construction BMPs

JUNE 2023

Chapter 272- Stormwater Management Bylaw

JUNE 2023

- Permits applied for or issued since inception
  - 2022
    - 3 Major
    - 15 Minor
  - 2023 (as of 6.9.2023)
    - 13 Major
    - 13 Minor
  - Limited number of waivers included with approvals

Municipal Separate Storm Sewer System (MS4) Permit

JUNE 2023

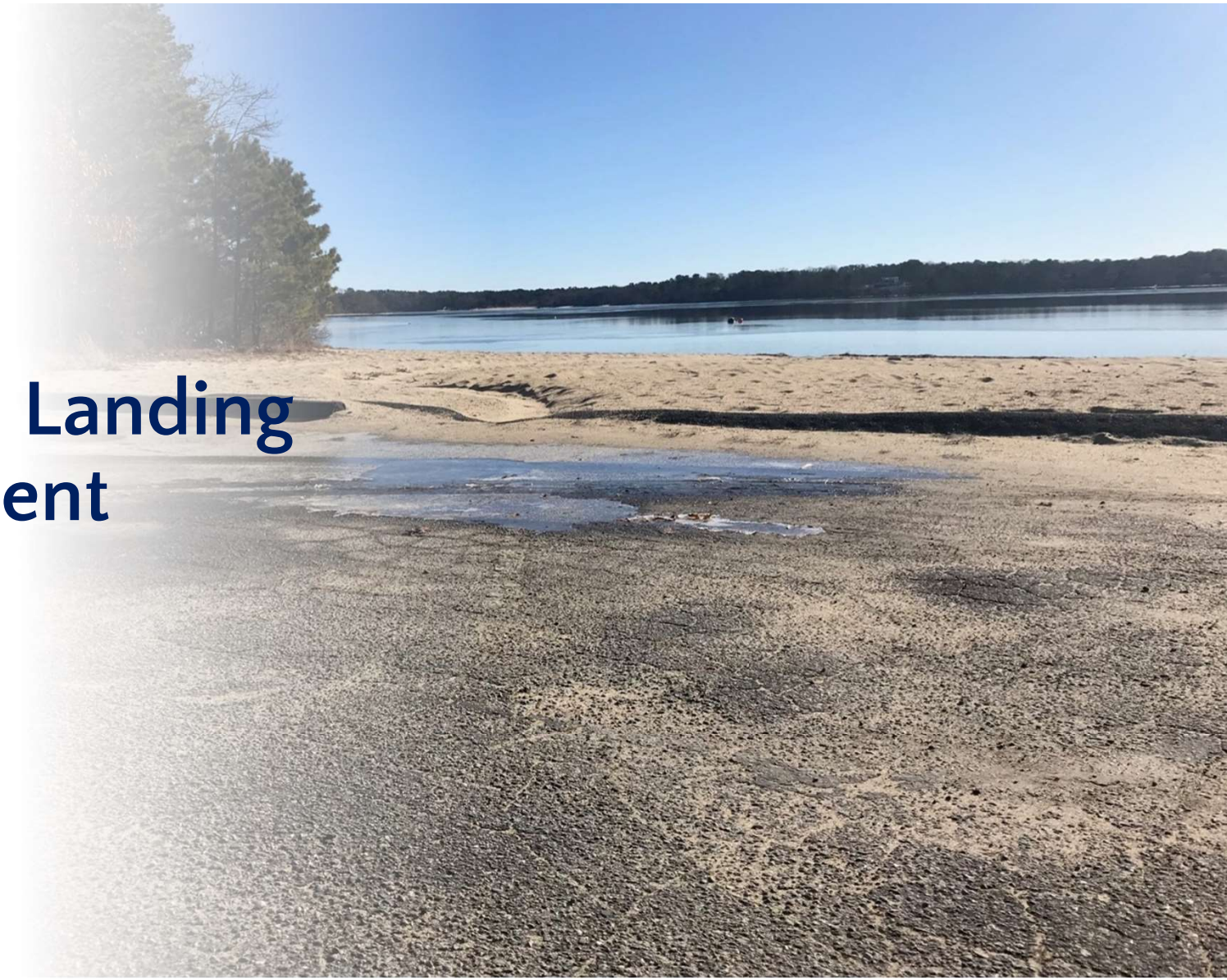
- Administered by the US Environmental Protection Agency (US EPA) in conjunction with Mass Department of Environmental Protection (MassDEP).
  - Initially born out of the need to separate sewer systems from stormwater
  - Permit has evolved with the focus now being on stormwater water quality
  - In Year 5 of 5 of the permit
  - Anticipate a new permit to come forward in the near future (no major changes anticipated)
  - Required tasks within each permit year are generally defined
  - Education/Public Outreach is a major component
  - Working with new consultant, Woodard & Curran.

Municipal Separate Storm Sewer System (MS4) Permit

JUNE 2023

- Stormwater Mapping On-going
  - Identifying and locating stormwater discharge points
    - The permit is focused on discharge points
    - Many discharge points in Brewster are not formalized
    - Not only discharge points need to be looked at especially due to the nature of the soils in Brewster.
  - Locating and identifying Stormwater Control Measures (SCMs)
    - A more holistic approach (approx. 30 identified to date)
    - Developing Operation and Maintenance Procedures for each SCM
- Inventory helps to create a baseline for identifying the stormwater infrastructure in Town and where Retro-Fit projects may be implemented.

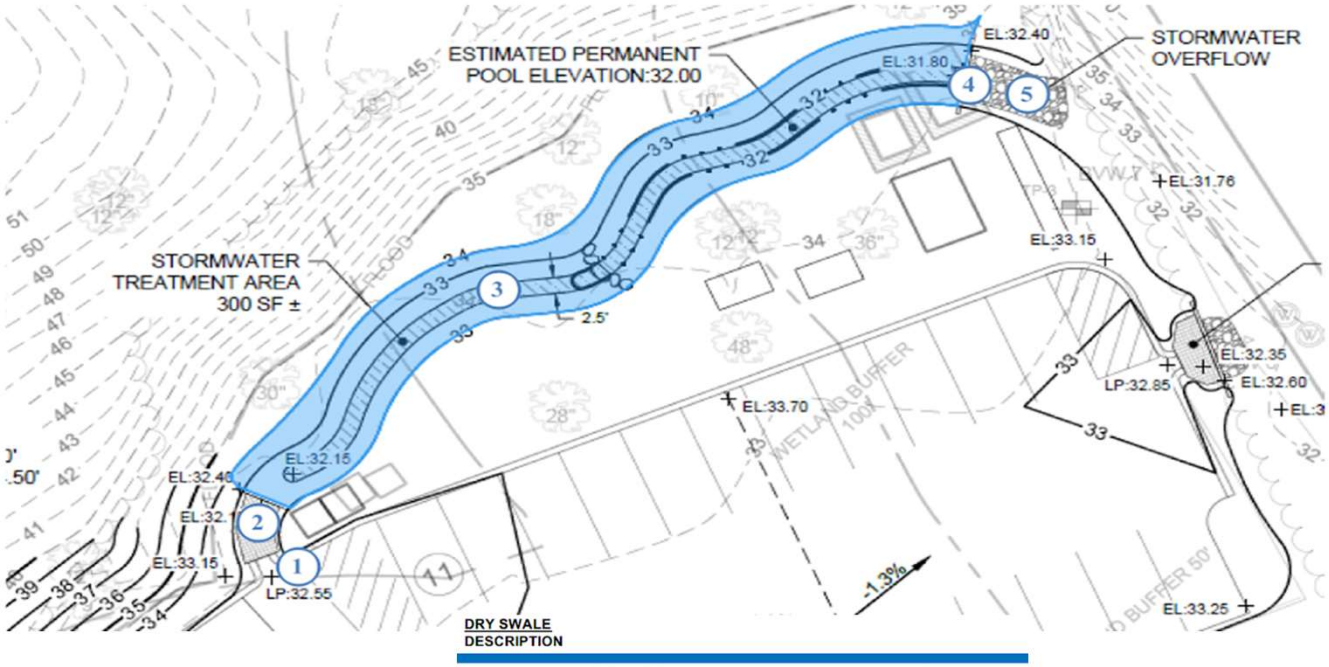
Long Pond Landing Improvement Project

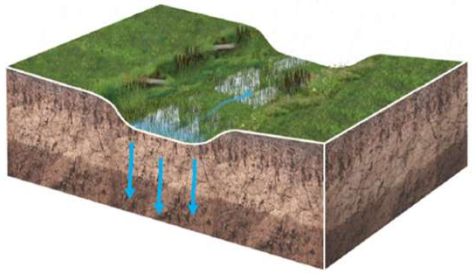


June 2023

Long Pond Landing Improvement Project

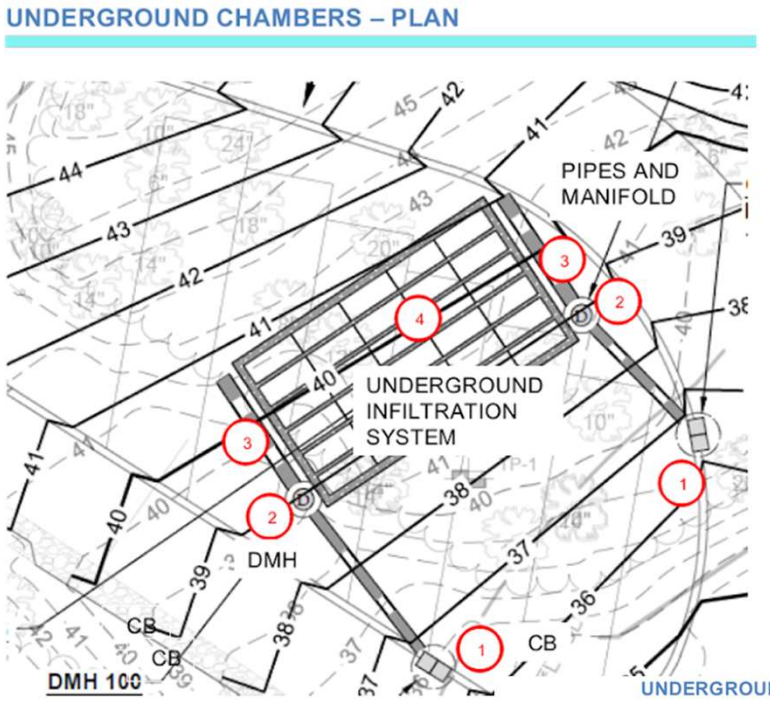
Stormwater Areas

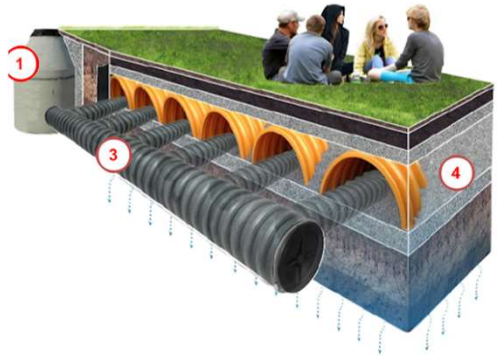




June 2023

Long Pond Landing Improvement Project





June 2023

First Light Beach Parking Lot

June 2023

First Light Beach Parking Lot

June 2023

Brewster Community Pool Parking Lot

June 2023

Brewster Dog Park

June 2023

Foster Road Paving & Drainage Improvements

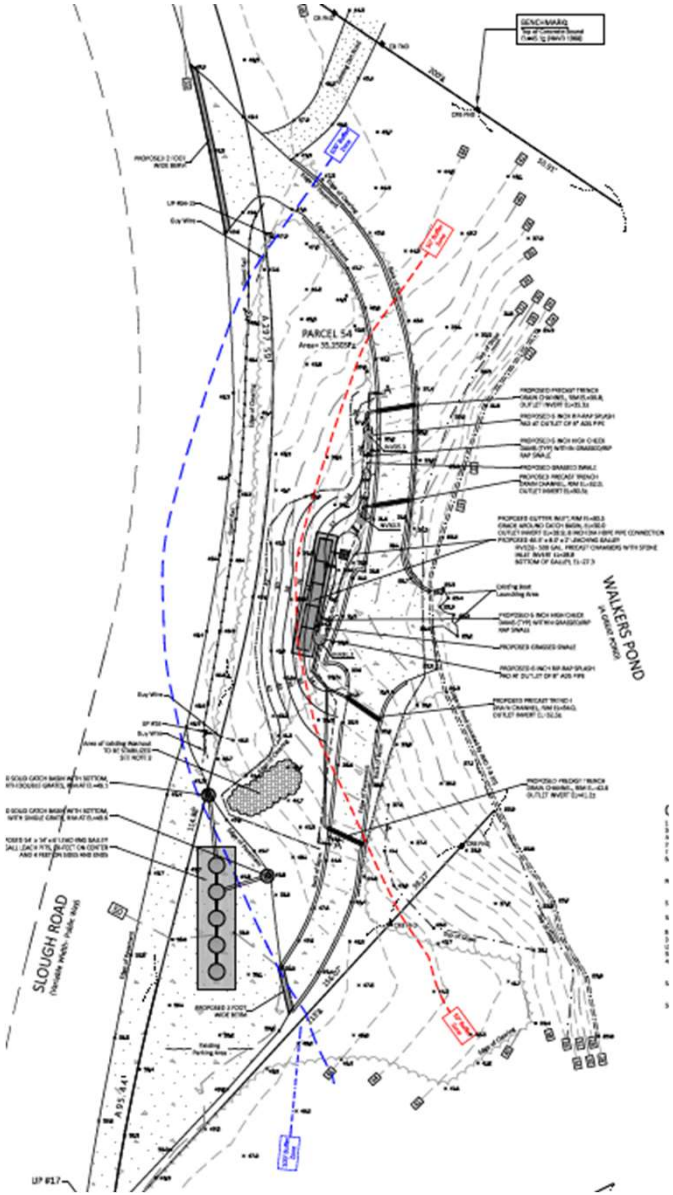
June 2023

Breakwater Road Paving & Drainage Improvements

June 2023

Municipal Separate Storm Sewer System (MS4) Permit

Retro-Fit Design Walkers Pond



JUNE 2023

Brewster Ponds Coalition and DPW Coordination

- BPC has helped to identify locations in Town where retro-fits could occur
- Work with engineers to develop desktop analysis with conceptual design options
- Review the options to determine best fit
- Finalize Design
- Permitting & Construction
- New BMPs/SCMs are incorporated into the list
- On-going O&M

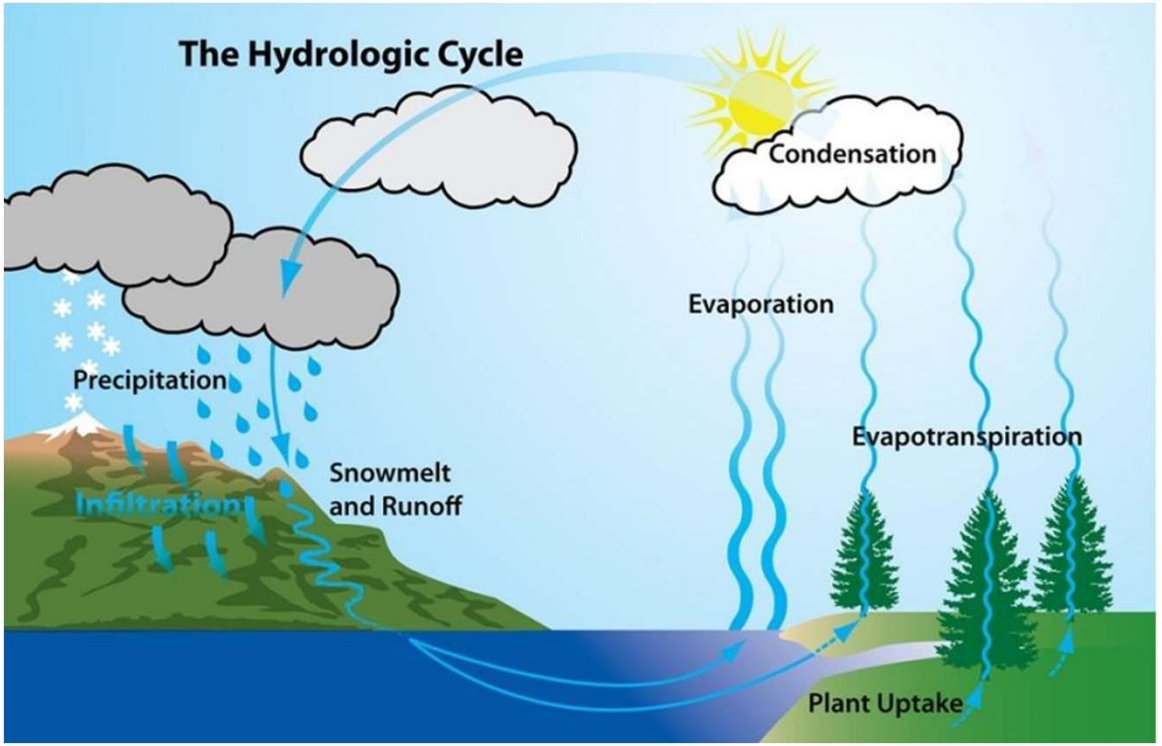
JUNE 2023

Chapter 119- Brewster Fertilizer Bylaw

- Adopted per CCC Cape-wide DCPC (2014)
- Regulates turf fertilizer applications town-wide
- Time/place/ manner restrictions & standards
  - Includes 100' wetlands buffer prohibition
- Enforceable
- Also emphasizes education about practices

JUNE 2023

Thank You.



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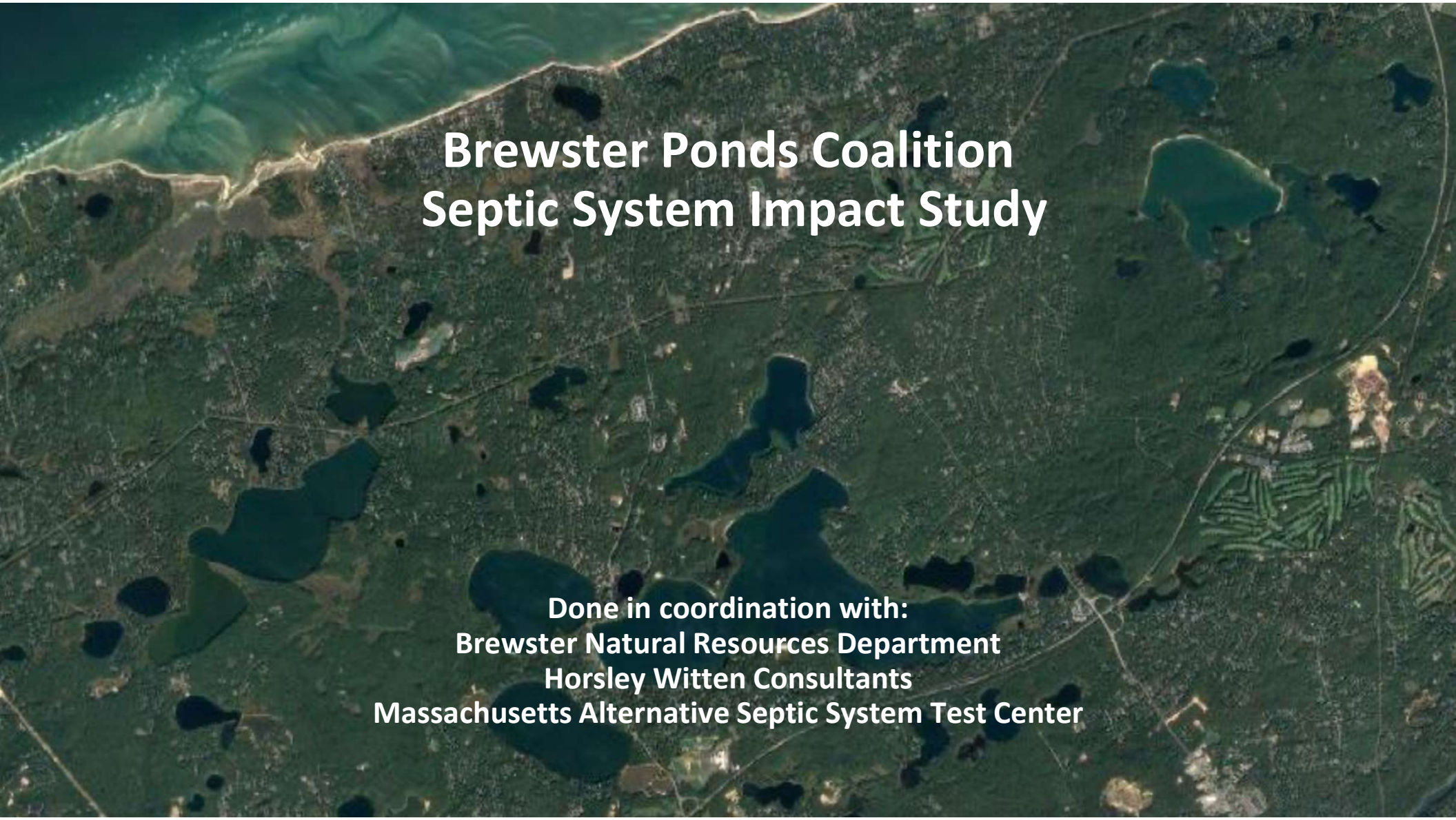

Brewster Ponds Coalition
Septic System Impact Study

Done in coordination with:
Brewster Natural Resources Department
Horsley Witten Consultants
Massachusetts Alternative Septic System Test Center

Pollution Sources for Cape Cod Ponds

- **Septic tanks often the major source for nutrients – P & N**
  - Also for toxic chemicals like PFAs and pharmaceuticals
- Other important human-related sources:
  - Road and driveway runoff during rain – silt, salts, oil
  - Lawns and gardens near ponds - fertilizers runoff
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- Sources that add nutrients with little ability to control:
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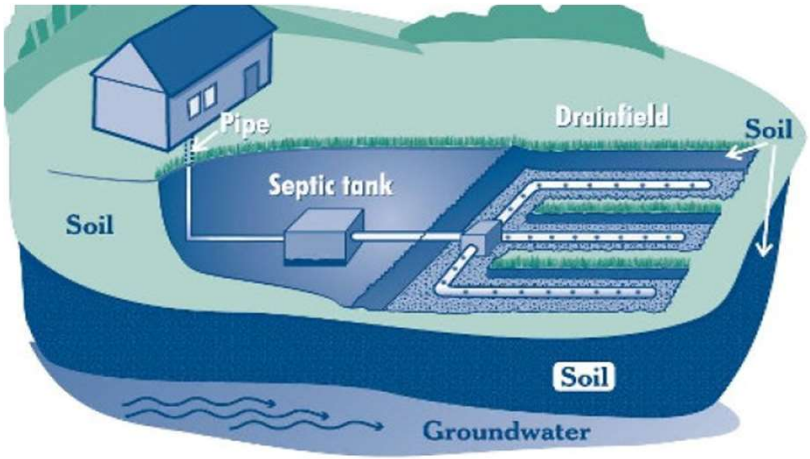
- Sediments often a critical factor in pond impairment
  - Low DO (<2 ppm) at pond bottom releases P from sediments

Septic System Impact on Ponds

- It is known that the greatest impact is from:
  - Systems close to and upgradient of ponds and wells
  - Systems close to groundwater level (i.e. pond levels)
  - Old systems – leach pits and especially cesspools
  - Poorly managed systems – overloaded, not pumped regularly
- But there is a lot not known – specifically which septic systems impact ponds? How far away from ponds?



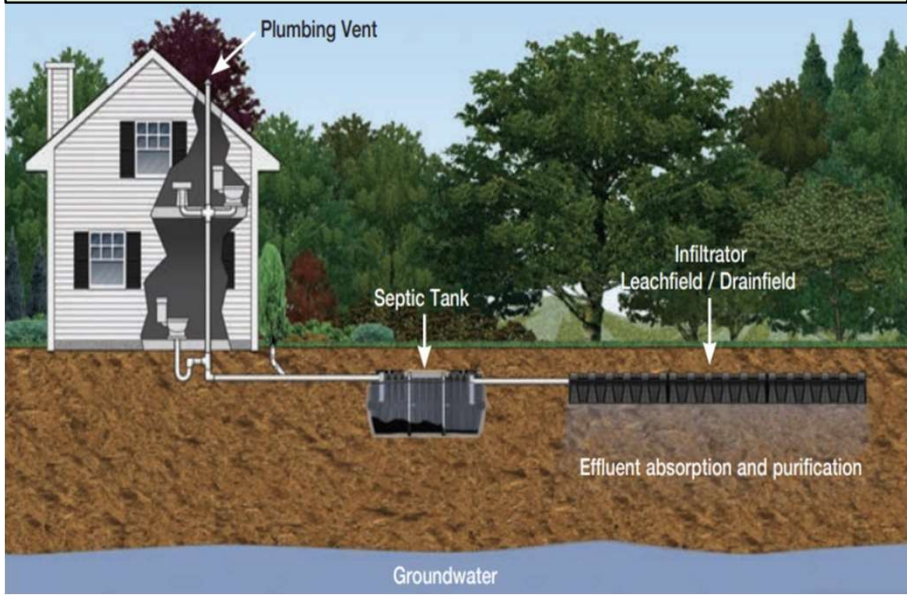
Typical Title V Septic System Layout

Septic Tank being pumped out

How far away from ponds do septic systems need to be to not impact ponds?

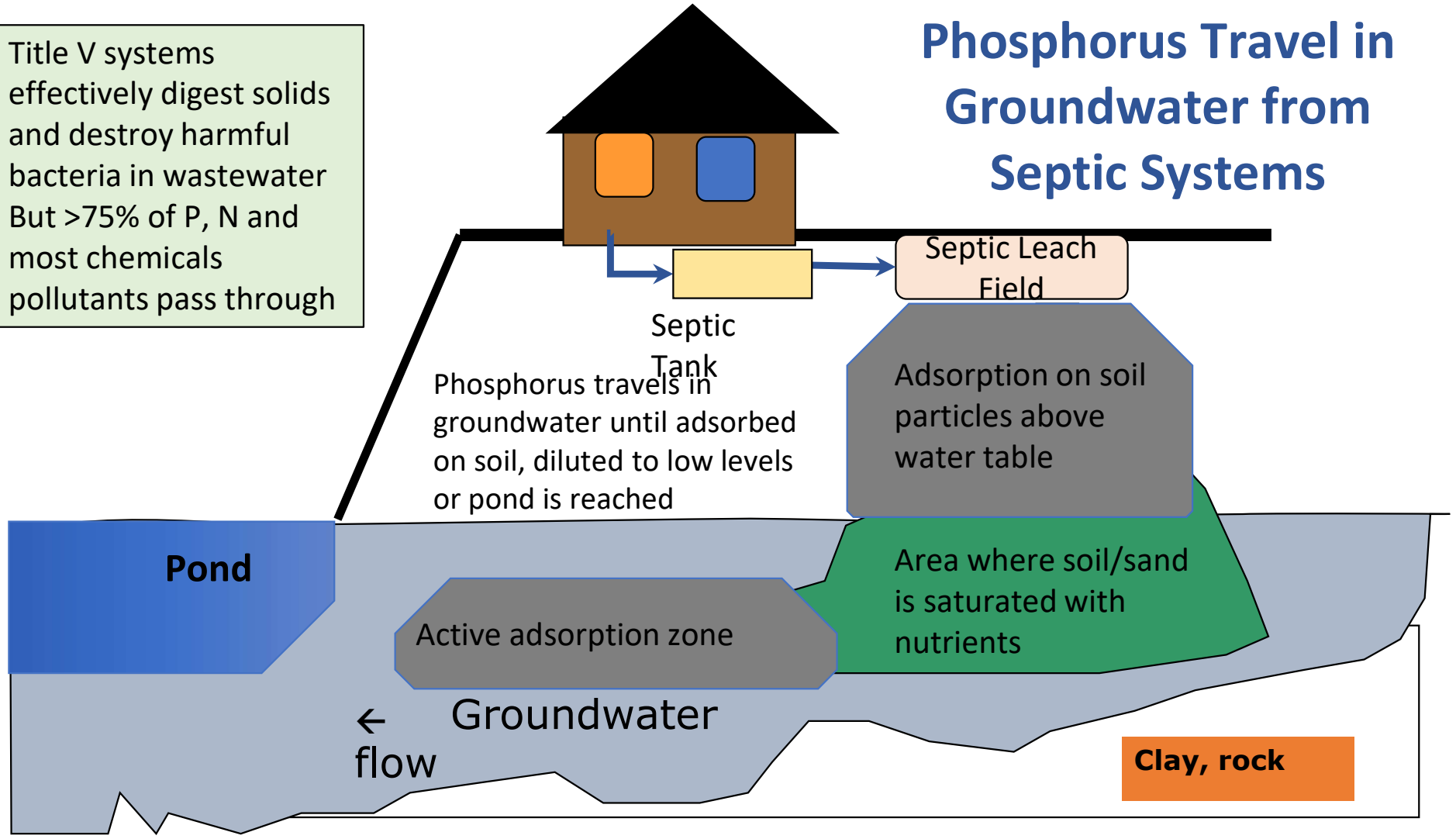
- Rule of thumb from past studies: Systems upgradient and <300 ft from ponds might impact ponds within the life of a typical house (50 years)
  - But studies not done on Cape Cod
  - Do not consider all important factors
- Many variables influence this:
  - Age of house
  - Distance to pond
  - Elevation of leach field above pond
  - Number of people in house
  - Year round use or summer only
  - Iron and manganese levels in soil (they absorb P)
  - How many septic systems nearby
  - Are there fertilized lawns using phosphorus?
- Actual distance for Cape ponds likely varies - not well known

Groundwater moves 0.5 to 2 ft/day through sand, but P maybe only 0.005 to 0.02 ft/day. At 0.01 ft/day, would take 27 years to move 100 ft. But reality depends on many things.



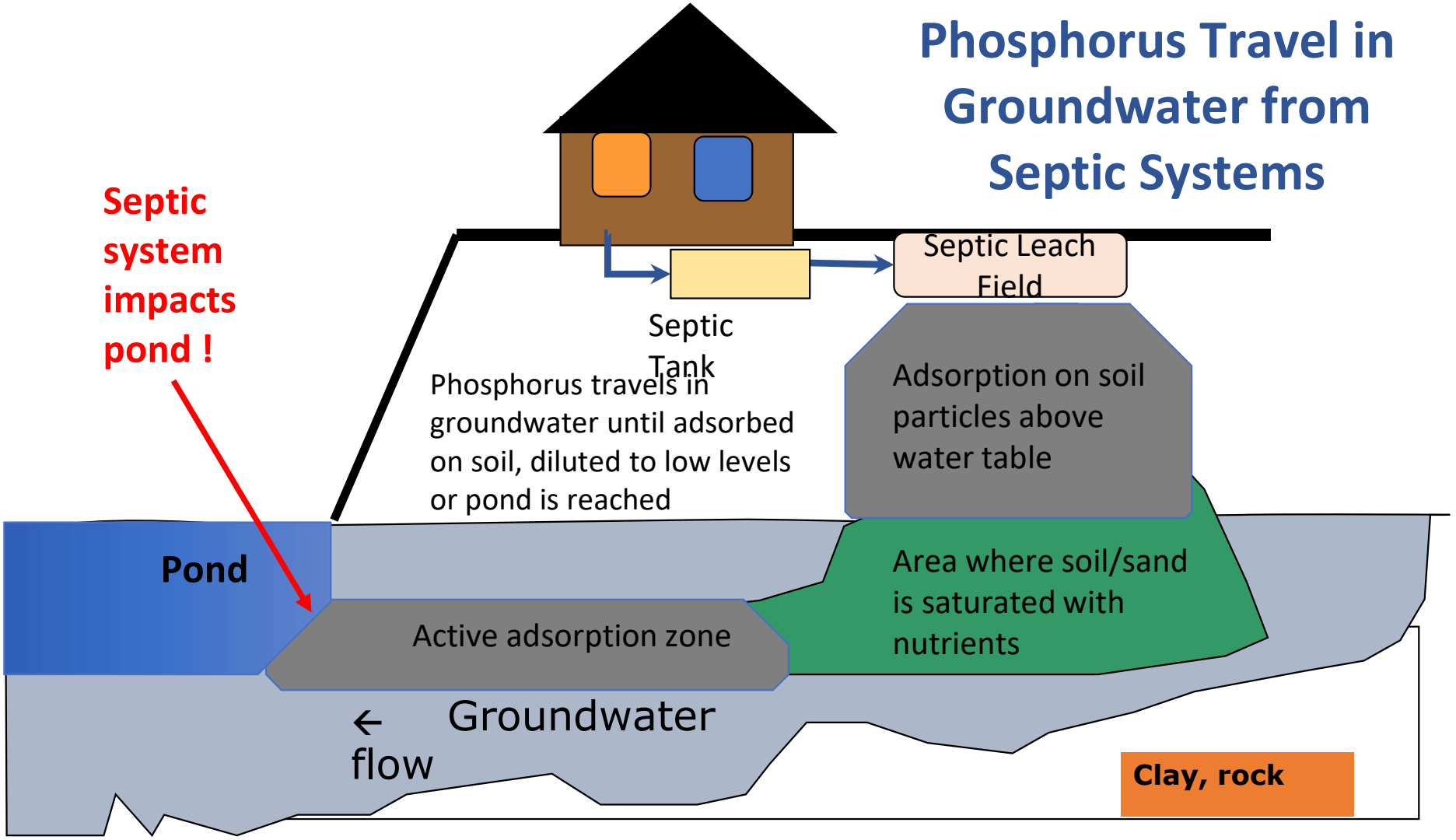
Phosphorus Travel in Groundwater from Septic Systems

- Title V systems effectively digest solids and destroy harmful bacteria in wastewater
- But >75% of P, N and most chemicals pollutants pass through

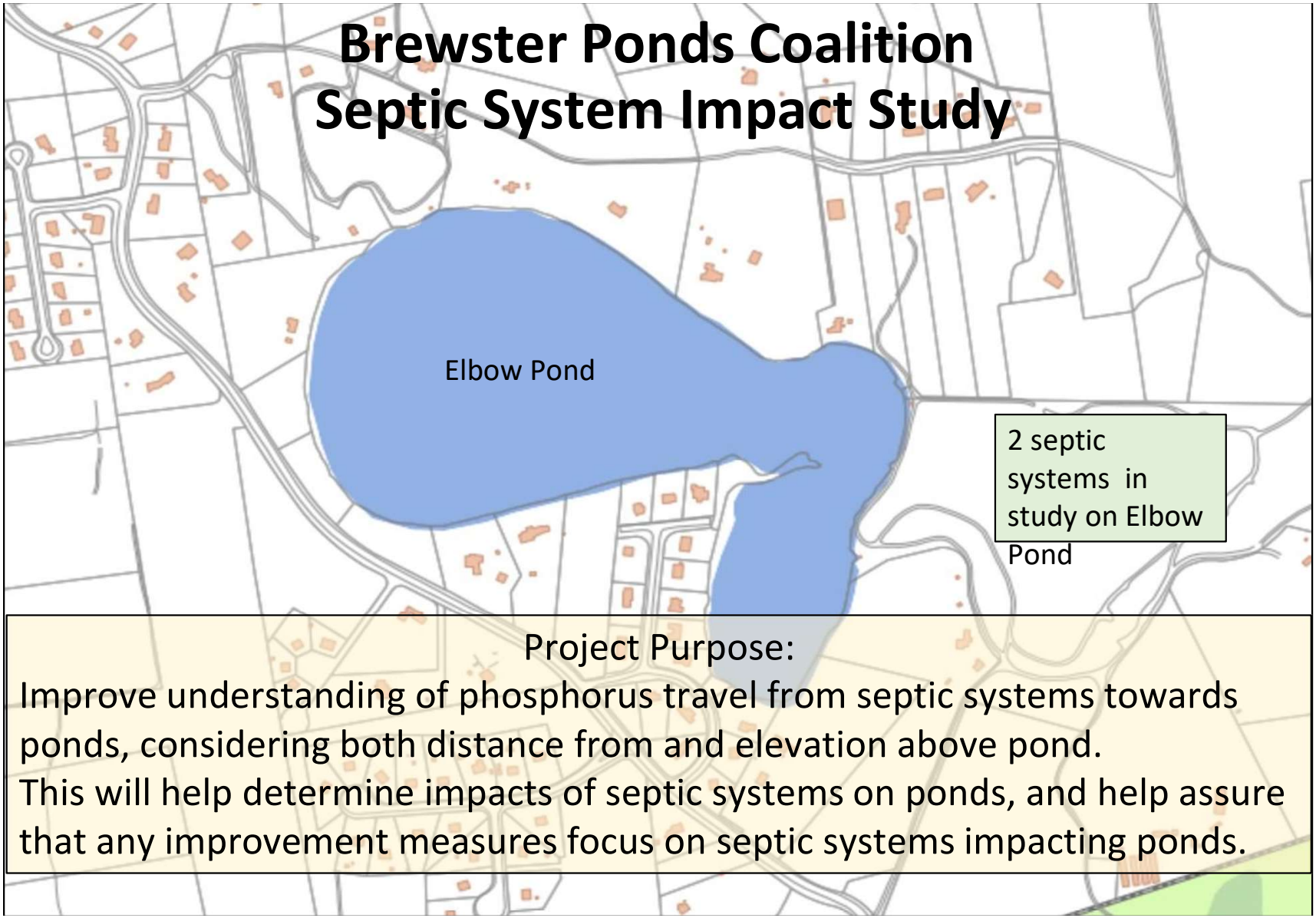


Septic system has not impacted pond yet

Phosphorus Travel in Groundwater from Septic Systems



Brewster Ponds Coalition
Septic System Impact Study



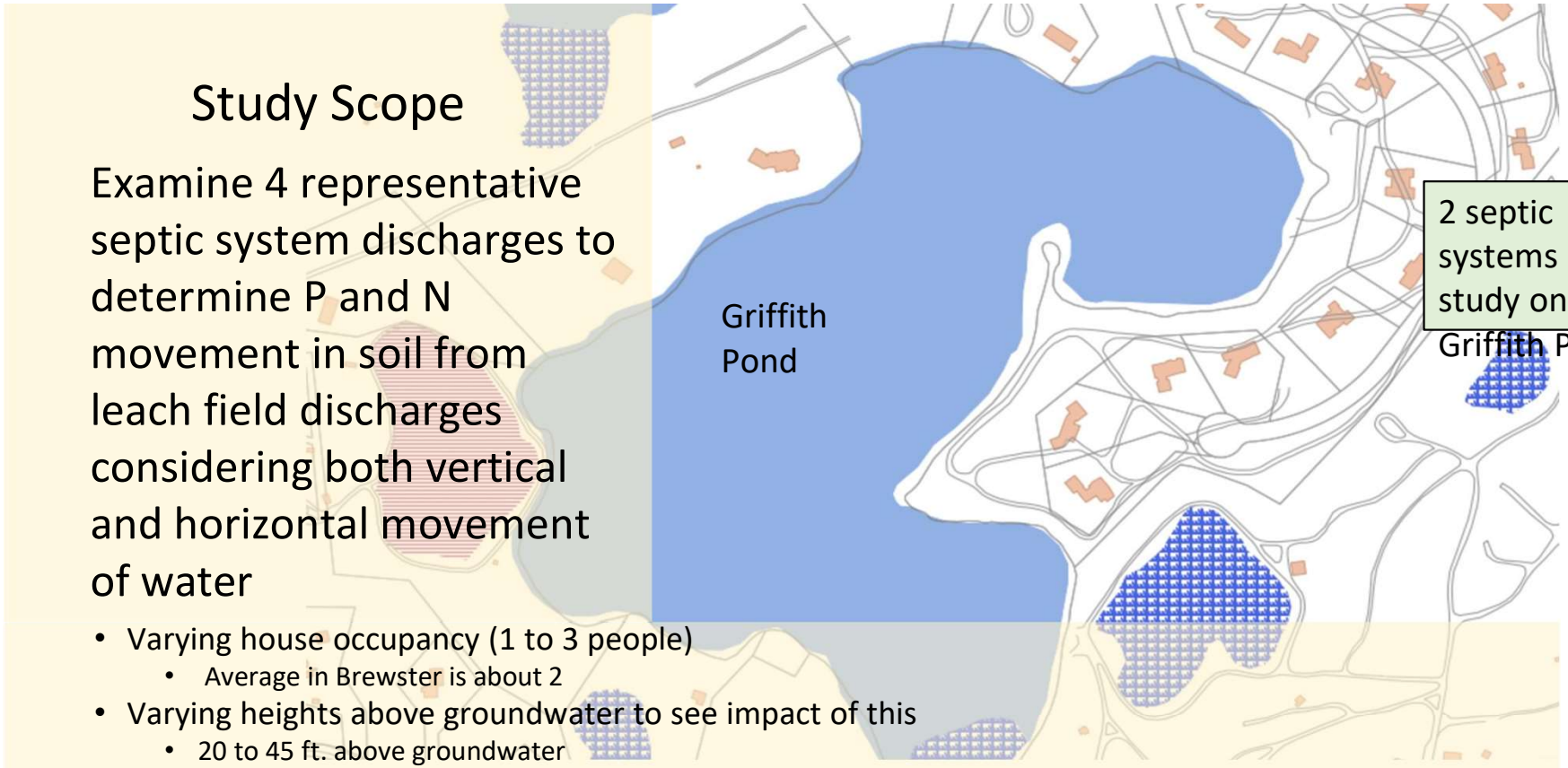
Project Purpose:

Improve understanding of phosphorus travel from septic systems towards ponds, considering both distance from and elevation above pond.

This will help determine impacts of septic systems on ponds, and help assure that any improvement measures focus on septic systems impacting ponds.

Study Scope

Examine 4 representative septic system discharges to determine P and N movement in soil from leach field discharges considering both vertical and horizontal movement of water



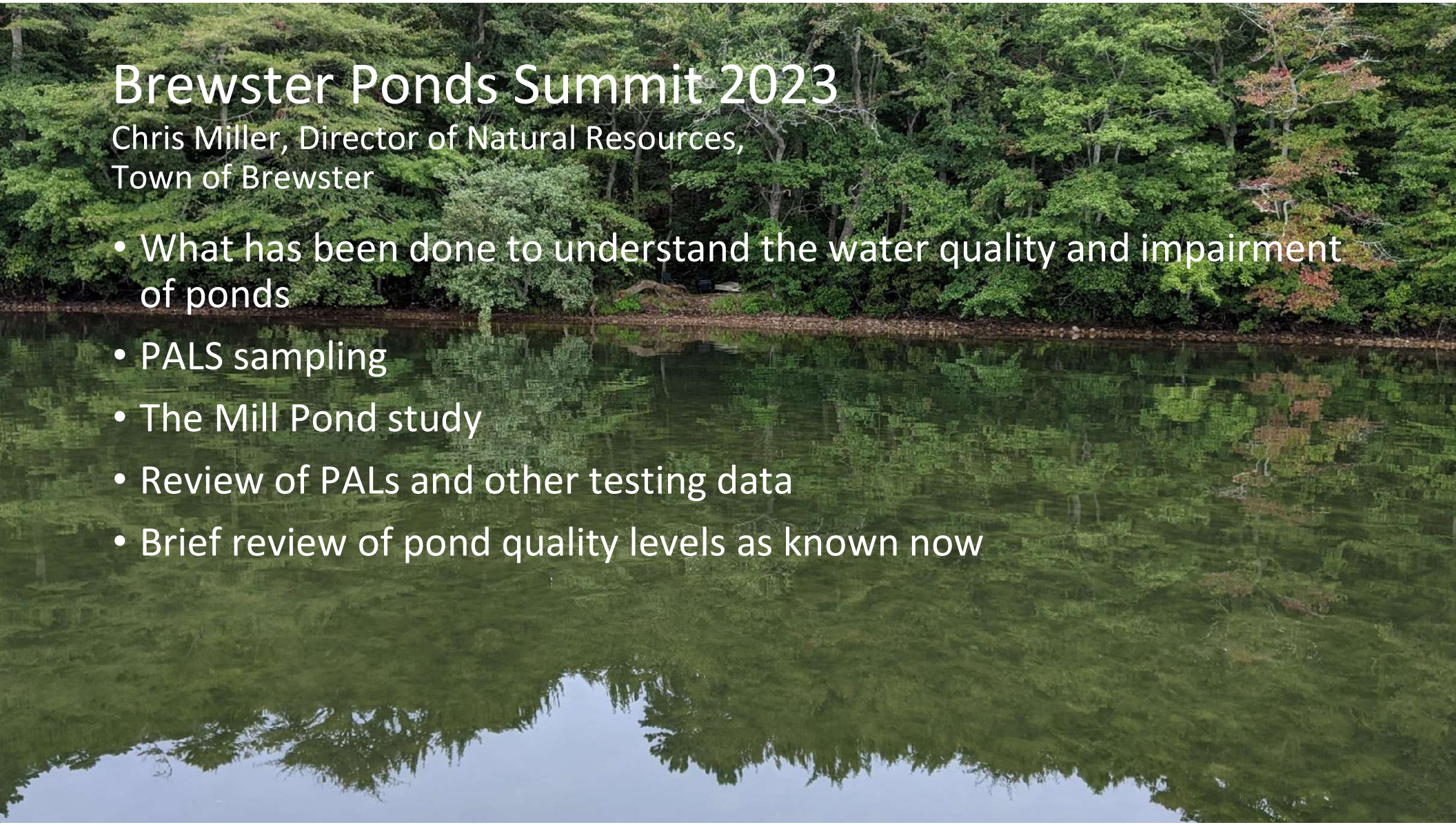
- Varying house occupancy (1 to 3 people)
  - Average in Brewster is about 2
- Varying heights above groundwater to see impact of this
  - 20 to 45 ft. above groundwater
  - Typical of houses around kettle hole ponds
- Monitor vertical and horizontal movement in groundwater by constructing monitoring wells at and down-gradient from systems
  - With extensive effort to assure wells are exactly downstream
- Sample wells over 1 year period for P, N and other parameters
- Also do enhanced sampling of ponds at the same time for P and N

Possible Future Study

What about impact when there are many septic systems up-gradient of a pond?

- Example: Cobb's has large groundwater catchment area, including old settled areas
- Phosphorus from septic systems, cesspools & outhouses has had hundreds of years to accumulate and migrate. Likely large amount of P in groundwater moving toward pond


Thank You



Brewster Ponds Summit 2023

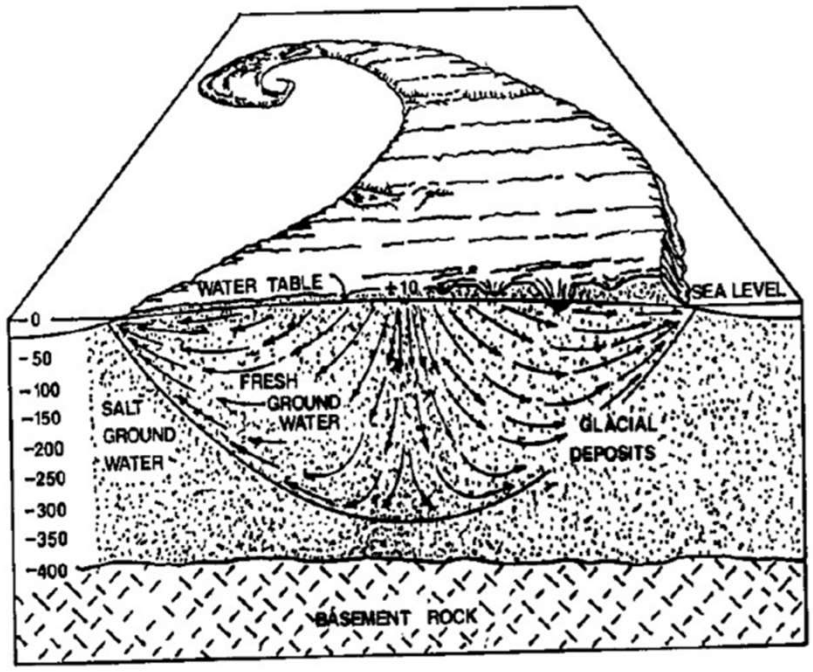
Chris Miller, Director of Natural Resources,
Town of Brewster

- What has been done to understand the water quality and impairment of ponds
- PALS sampling
- The Mill Pond study
- Review of PALs and other testing data
- Brief review of pond quality levels as known now

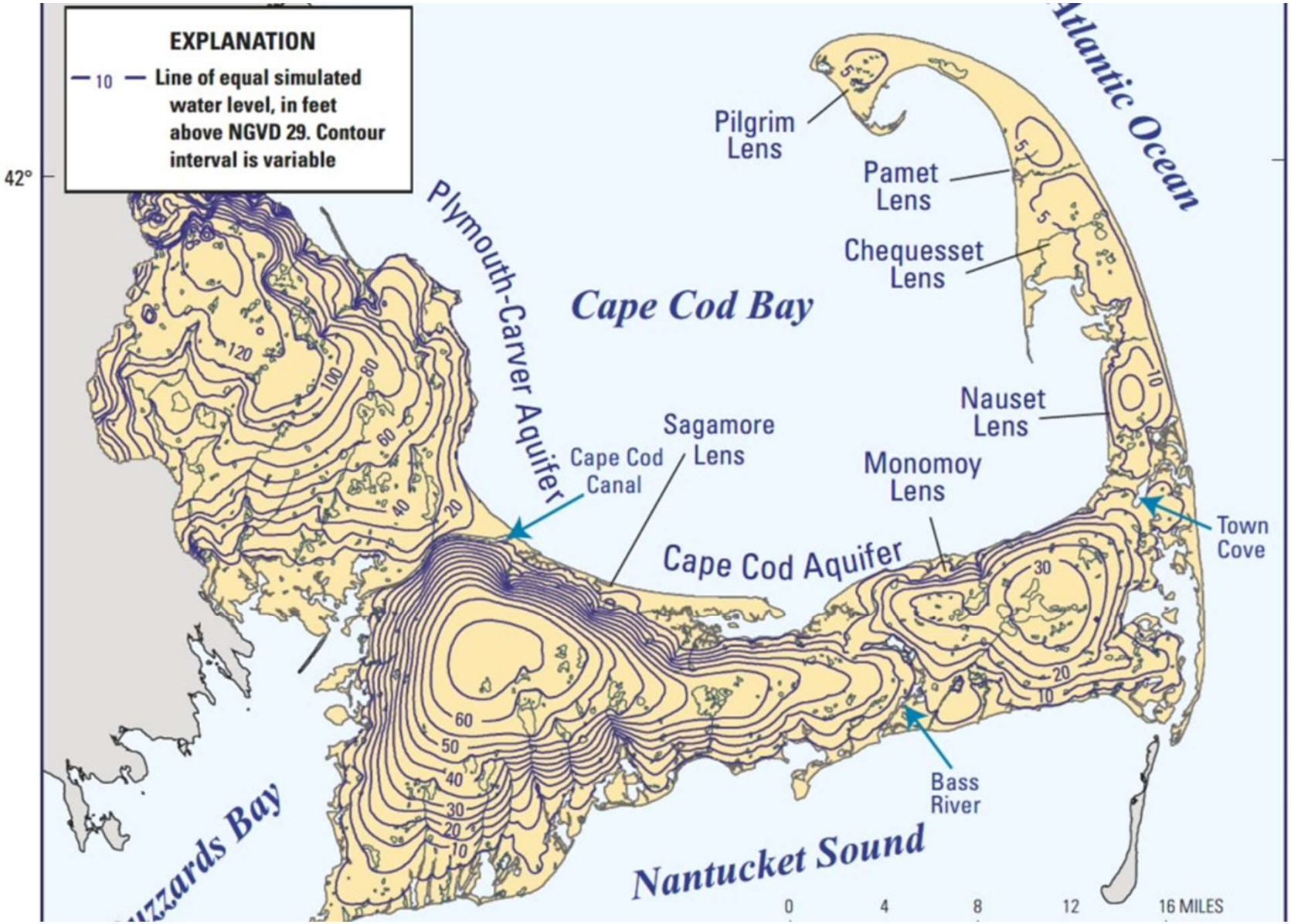
Pond formation

About 12,000 years ago, the glaciers retreated from Cape Cod leaving large chunks of ice behind. As these chunks of ice melted, the landscape above them collapsed forming large depressions called "kettle holes". When these depressions dip below the groundwater table, they are filled with water and create the hundreds of ponds we see on Cape Cod today. Typically, the ponds lack a surface water inlet or outlet. Instead, the sandy sides of these ponds allow a steady inflow and outflow of water to and from the adjacent aquifer. The pond surfaces generally fluctuate up and down in response to the seasonal rise and fall of the water table, giving us a "window" into the aquifer.

verticle scale greatly exaggerated



Cape Cod is a mound of sediments pushed into place by glacial action over a period of several thousand years during the last ice age and distributed as **outwash plain** by the melting of the glaciers. Beneath our feet, in the sand, lies our groundwater/drinking water. The water-saturated soil, known as the **aquifer**, extends in some places to a depth of approximately 400 feet (130 meters), then grows more shallow toward the edges of the land as seen in the cross-section to the left. When drawn true to scale the aquifer appears as a thin film of water, which because of its convex shape resembles a lens. On Cape Cod, water moves about one foot (30 cm) per day through the soil. It is pushed by gravity toward the shore or tidal river where it is gradually discharged and lost from the aquifer.


EXPLANATION
10 Line of equal simulated water level, in feet above NGVD 29. Contour interval is variable
42°
Atlantic Ocean
Pilgrim Lens
Pamet Lens
Chequesset Lens
Cape Cod Bay
Plymouth-Carver Aquifer
Nauset Lens
Sagamore Lens
Cape Cod Canal
Monomoy Lens
Town Cove
Cape Cod Aquifer
Bass River
Nantucket Sound
0 4 8 12 16 MILES

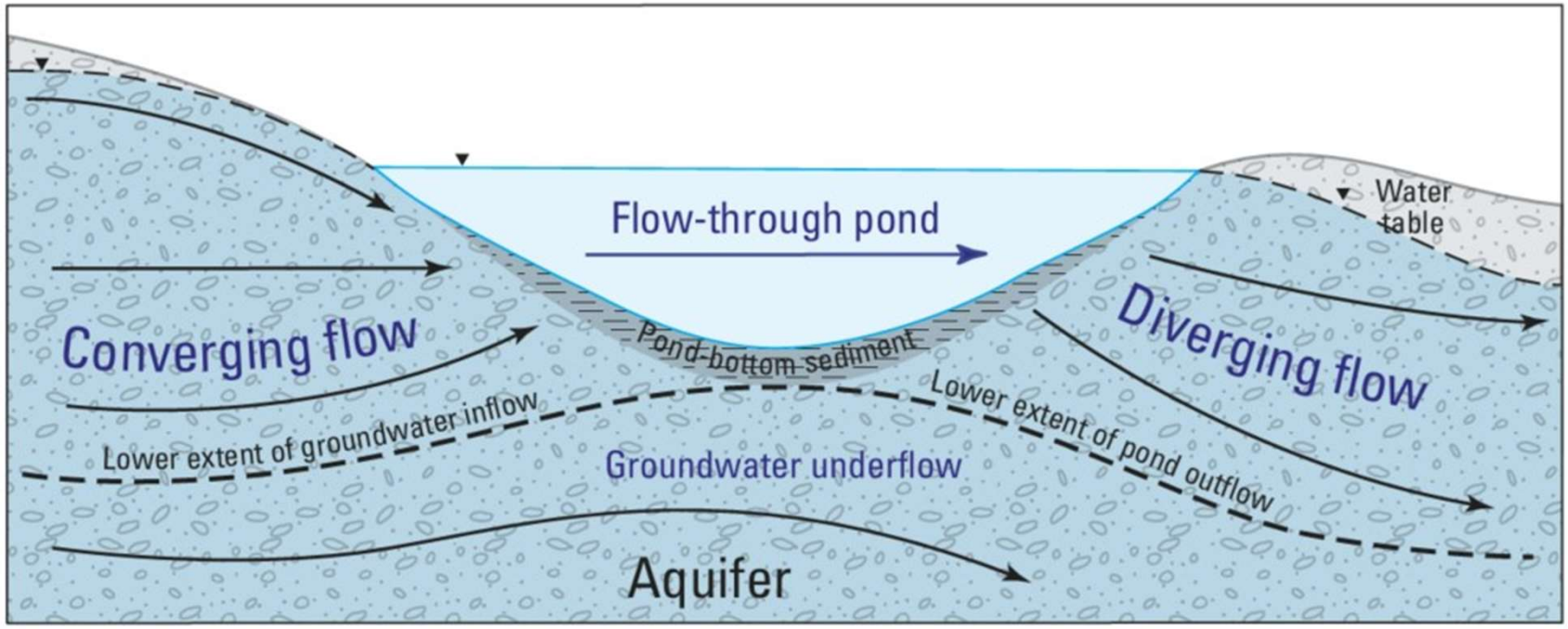


Figure 3. Vertical groundwater-flow paths upgradient and downgradient from kettle-hole ponds typical of those found in coastal aquifers of southeastern Massachusetts.

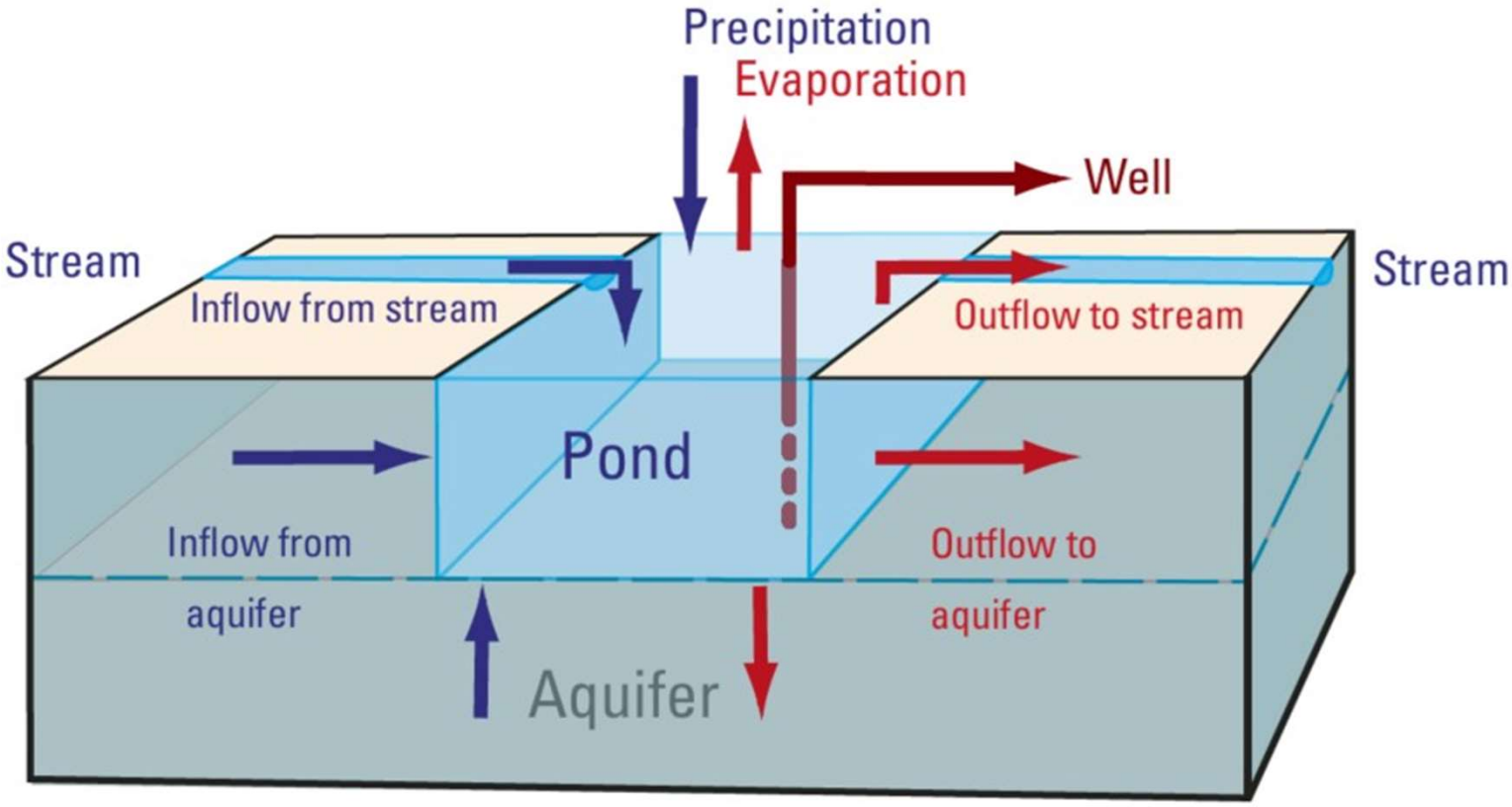
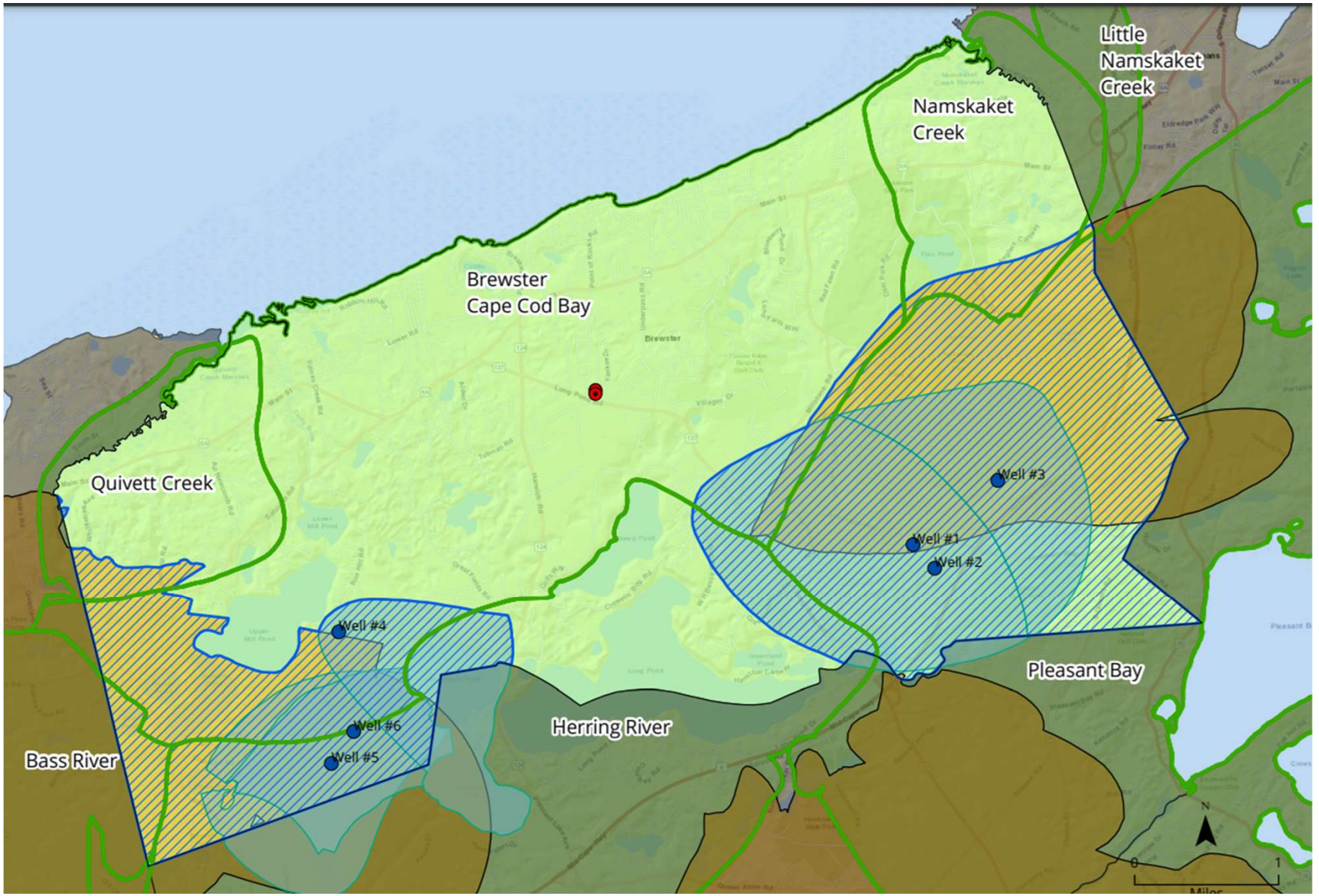
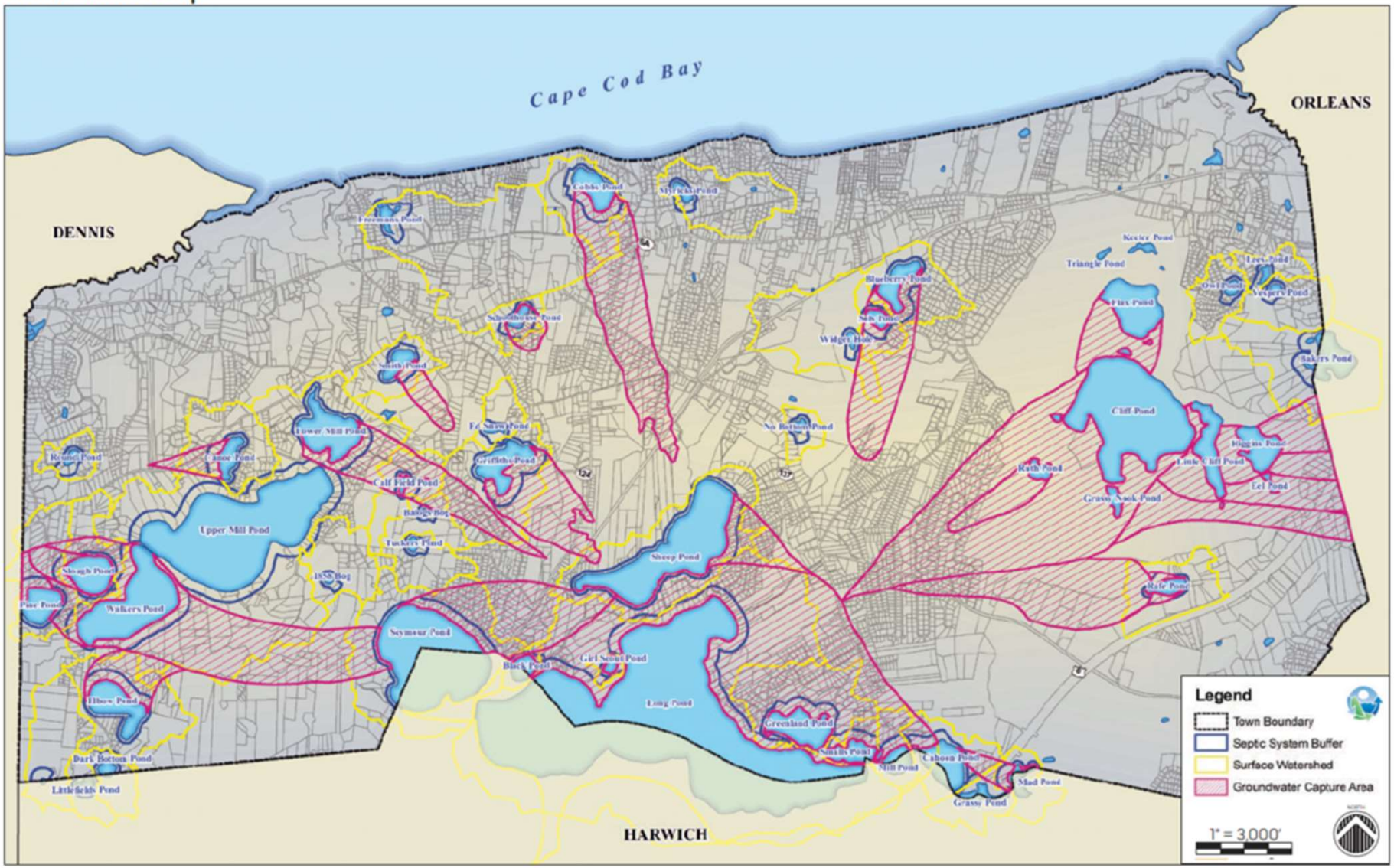


Figure 6. Schematic diagram of hydrologic-budget components (inflows and outflows) to and from kettle-hole ponds in coastal aquifers of southeastern Massachusetts.

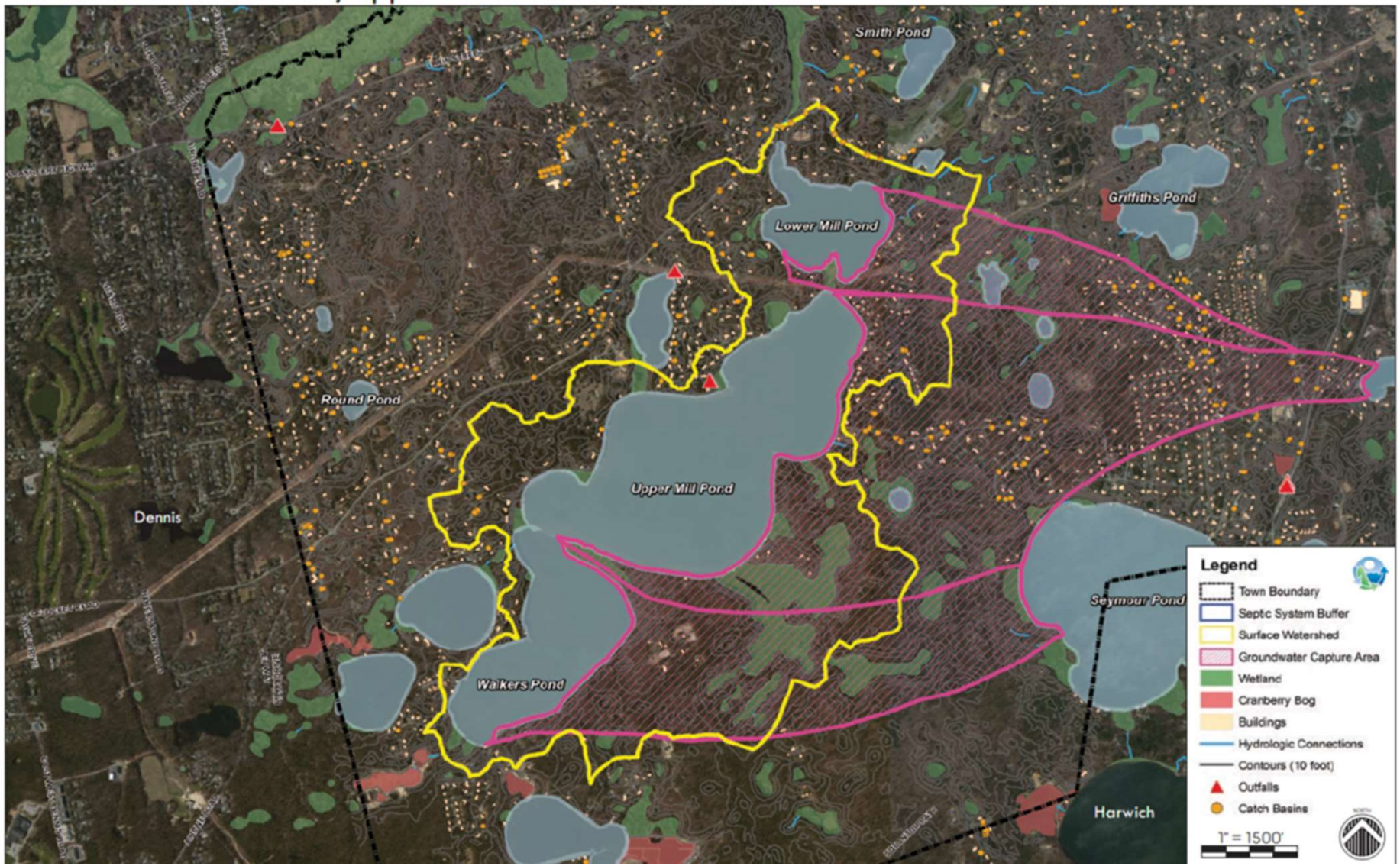

Little
Namskaket
Creek
Namskaket
Creek
Brewster
Cape Cod Bay
Brewster
Quivett Creek
Well #3
Well #1
Well #2
Well #4
Well #6
Well #5
Herring River
Pleasant Bay
Bass River
N
0
1
Miles

Water Resource Atlas
Fresh Water Ponds
Brewster, Massachusetts

Town-wide Map



Mill Ponds - Walkers Pond, Upper Mill Pond and Lower Mill Pond



Sheep Pond

Management History:

The first complete survey of Sheep Pond was made on July 25, 1911. This survey and a 1903 report indicated black bass, chain pickerel, yellow perch, sunfish, shiners and smelt were present. An August 1948 pond survey reported smallmouth bass, yellow perch, white suckers and banded killifish. Sheep Pond was reclaimed in September of 1957. The 3060 pounds of fish picked up (estimated 45-50% pickup) were composed by weight of 60% white sucker, 30% brown bullhead, 7% yellow perch, 3% banded killifish and small amounts of rainbow trout, brown trout, smallmouth bass and johnny darters. It was reclaimed again in 1966 and 1972. Sheep Pond was limed with agricultural limestone in 1971 and 1982 to counteract increasing acidity. Adult smallmouth bass were stocked in 1979 and 1982. The pond has been illegally stocked in the past with alewives by angler seeking to increase trout growth.

Fish Populations:

The most recent fisheries survey, conducted in 1988, recorded five species: smallmouth bass, pumpkinseed, yellow perch, brown bullhead and banded killifish. Sheep Pond is annually stocked in the spring and fall with brook, brown and rainbow trout. Atlantic salmon broodstock are annually stocked.

GREAT PONDS ON CAPE COD

LENS	TOWNS	# OF GREAT PONDS	AREA (acres)
SAGAMORE	Bourne, Sandwich Falmouth, Mashpee Barnstable, Yarmouth	111	6318
MONOMOY	Dennis, Brewster, Harwich, Chatham, Orleans	74	3881
NAUSET	Eastham, South Wellfleet	7	239
CHEQUESSET	Wellfleet, South Truro	12	354
PAMET	Truro	1	351
PILGRIM	Provincetown	3	65

Source: An Inventory of the Ponds, Lakes, and Reservoirs of Massachusetts, 1969

Executive Summary

Long Pond is the largest great pond on Cape Cod covering over 740 acres and split between the Towns of Brewster and Harwich. Long Pond has begun to experience water quality problems that threaten the environmental health and the enjoyment of the pond by town residents. A large algal bloom occurred on the lake during 1996 and a significant fish kill (> 100 fish) occurred in June 1997. To help address concerns about these events, the Towns, the Cape Cod Commission, and the Long Pond Watershed Association contributed matching funds and staff and volunteer time to help obtain a $10,000 state Department of Environmental Management grant to complete an analysis of factors influencing the water quality in Long Pond. This analysis includes collection and analysis of water quality data and a phosphorus loading assessment. Phosphorus was a primary focus of the analysis because it is the key nutrient in pond ecosystems.

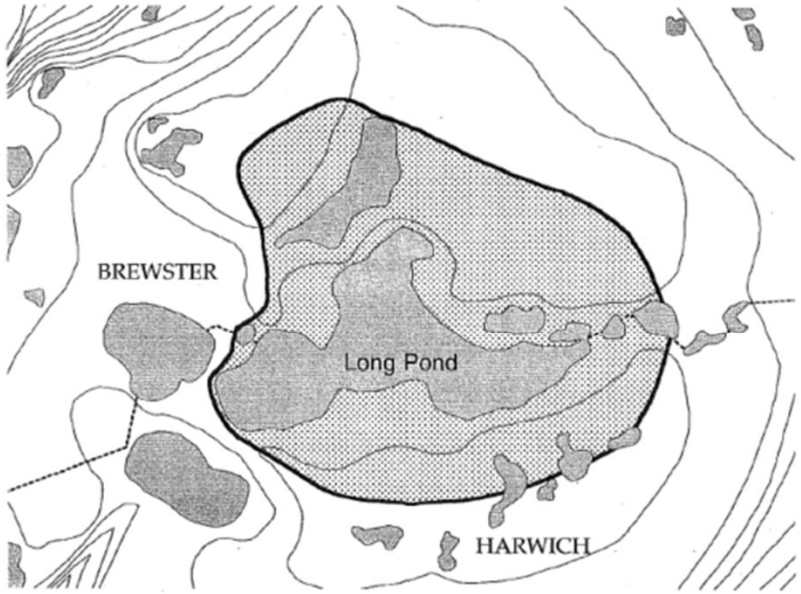
Based on analyses of the collected data, the Commission staff concluded that Long Pond is experiencing low oxygen conditions in its bottom waters during summer stratification due to bacterial respiration during the decomposition of organic sediment materials. Limited oxygen is a habitat impairment for bullheads, trout, and other creatures who live in the colder bottom waters during summer months and is the likely cause of the 1997 fish kill.

Low oxygen conditions also cause the release of phosphorus from the sediments. Phosphorus loads from land uses surrounding Long Pond are approximately half of the load regenerated from the sediments. In-lake phosphorus reductions will improve water quality in the short run, but phosphorus reductions within a 250 ft deep buffer strip around Long Pond are necessary to sustain good water quality in the long term.

Long Pond
Water Quality Assessment

Final Report

March, 1999



Completed by:

Water Resources Office
Cape Cod Commission

Completed for:

Town of Brewster
Conservation Commission

2001 Ponds in Peril Workshop

North American Lake Management Society: https://www.nalms.org/secchidipin/about/history/

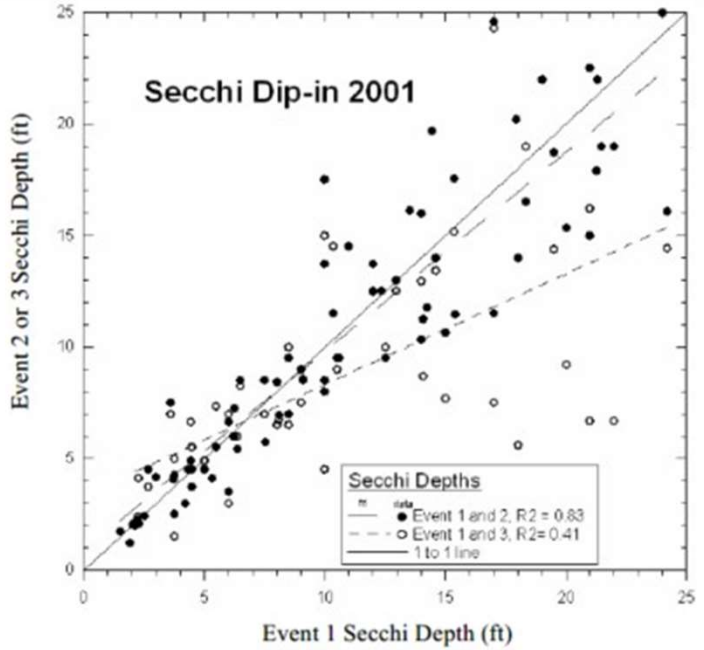
3. PALS Secchi Disk Monitoring

As mentioned previously, at the first "Ponds in Peril" workshop in May 2001, prospective Pond and Lake Stewards (PALS) were encouraged to begin collecting Secchi disk readings. Over 100 Secchi disks were distributed free of charge to volunteers along with postage-paid, preaddressed postcards for reporting of results. Cape Cod Commission staff coordinated these activities and ensured that each pond had only one sampler. Samples were collected in early July, late July, and early August.

A total of 66 volunteers participated in the first measurement of 107 ponds. Repeat measurements scheduled for late July and early August were made for 83 and 65 ponds, respectively, with 55 and 45 volunteers participating for each measurement event. Results collected between June 29 and July 14 were submitted to the Great North American Secchi Dip-In, which is coordinated through Kent State University (http://dipin.kent.edu/) and the North American Lake Management Society. Results for all three measurement events were presented at the second "Ponds in Peril" workshop.

Water clarity generally declined by a larger magnitude between the first and third measurement events as compared to the decline observed between the first and second events (Figure 23). Overall, more than half of the ponds experienced reduced water clarity.

Figure 23. 2001 Secchi Dip-In: Comparison of Results



Cape Cod Pond and Lake Atlas

Project 2000-02

Prepared by:

Cape Cod Commission
Eduard M. Eichner, Water Scientist/Project Manager
Thomas C. Cambareri, Water Resources Program Manager
Gabrielle Belfit, Hydrologist
Donna McCaffery, Water Resources Project Assistant
Scott Michaud, Hydrologist
Ben Smith, GIS Analyst

Margo Fenn, Executive Director

Prepared for:

MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

COMMUNITY FOUNDATION OF CAPE COD

AND

SCHOOL OF MARINE SCIENCE AND TECHNOLOGY
AT UNIVERSITY OF MASSACHUSETTS - DARTMOUTH

May, 2003

This project has been partially funded by and carried out in partnership with the Massachusetts Executive Office of Environmental Affairs. The contents do not necessarily reflect the views and policies of EOEA or of the Department, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

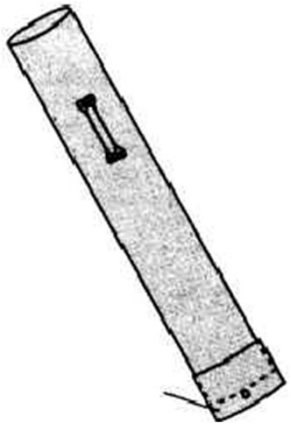
This Pond and Lake Atlas is a status report on the PALS program. It documents the outreach and education activities leading to the creation of the PALS program, reviews water quality data collected by volunteers during the 2001 PALS Snapshot from over 190 ponds, uses this data to develop Cape Cod-specific indicators of pond impacts, reviews data collected in previous studies, and details further efforts necessary to move pond protection and remediation forward on the Cape.

Cape Cod has nearly 994 ponds covering nearly 11,000 acres. These ponds range in size from less than an acre to 735 acres; with the 21 biggest ponds having nearly half of the total Cape-wide pond acreage. Approximately 40% of the ponds are less than an acre. Prior to the creation of this Pond Atlas, a complete count of all the ponds on Cape Cod had not been accomplished. Of the 994 ponds, only 176 have maximum depth measurements and only 89 have bathymetric information, which is important for understanding water quality information.

As part of the overall PALS program, SMAST provided laboratory services at no cost to towns or volunteers for the 2001 PALS Snapshot of pond water quality. Volunteers collected dissolved oxygen and temperature profiles, clarity readings, and 421 water quality samples from 195 ponds between August 15 and September 30. Samples were analyzed for chlorophyll *a*, alkalinity, pH, total nitrogen, and total phosphorus. This information is the most comprehensive dataset on Cape Cod ponds.

This dataset was used to provide a general assessment of pond water quality on Cape Cod. The authors reviewed existing tools for evaluating pond ecosystem nutrient levels, including Carlson's Trophic Status Index and USEPA's ecoregion nutrient thresholds, and applied USEPA's nutrient threshold calculation methodology to develop Cape Cod-specific nutrient thresholds. These tools were used to look at the general status of ponds on town by town basis and select number of individual ponds.

Secchi Depth



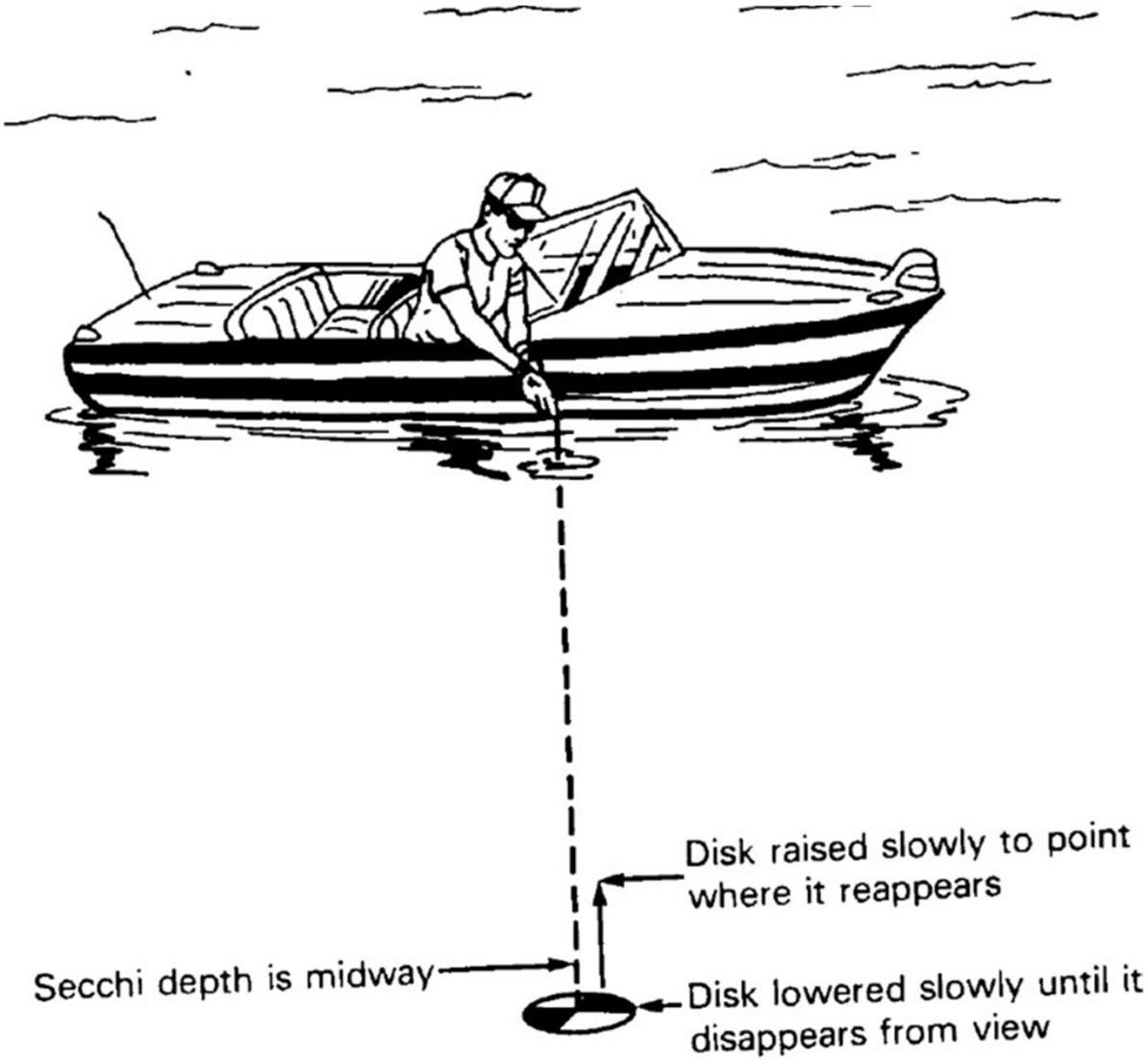
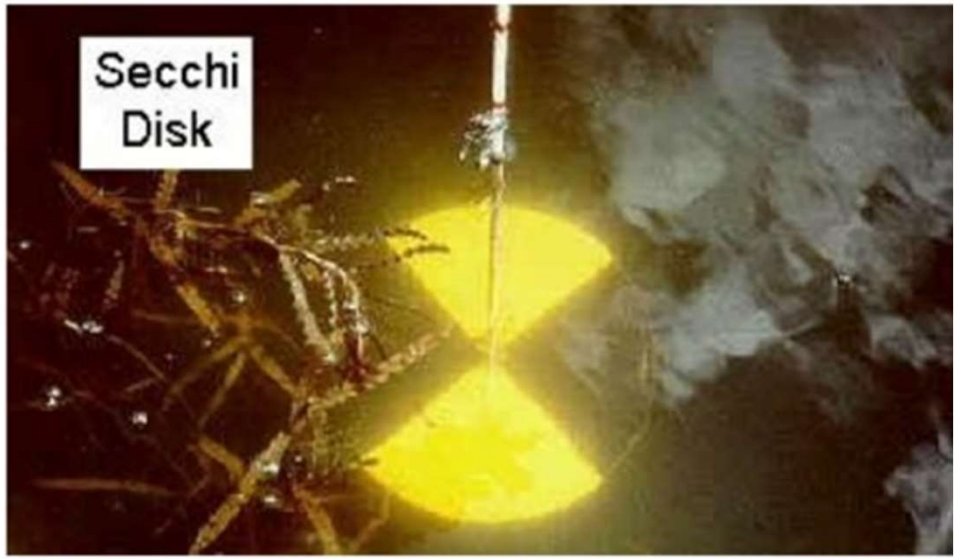


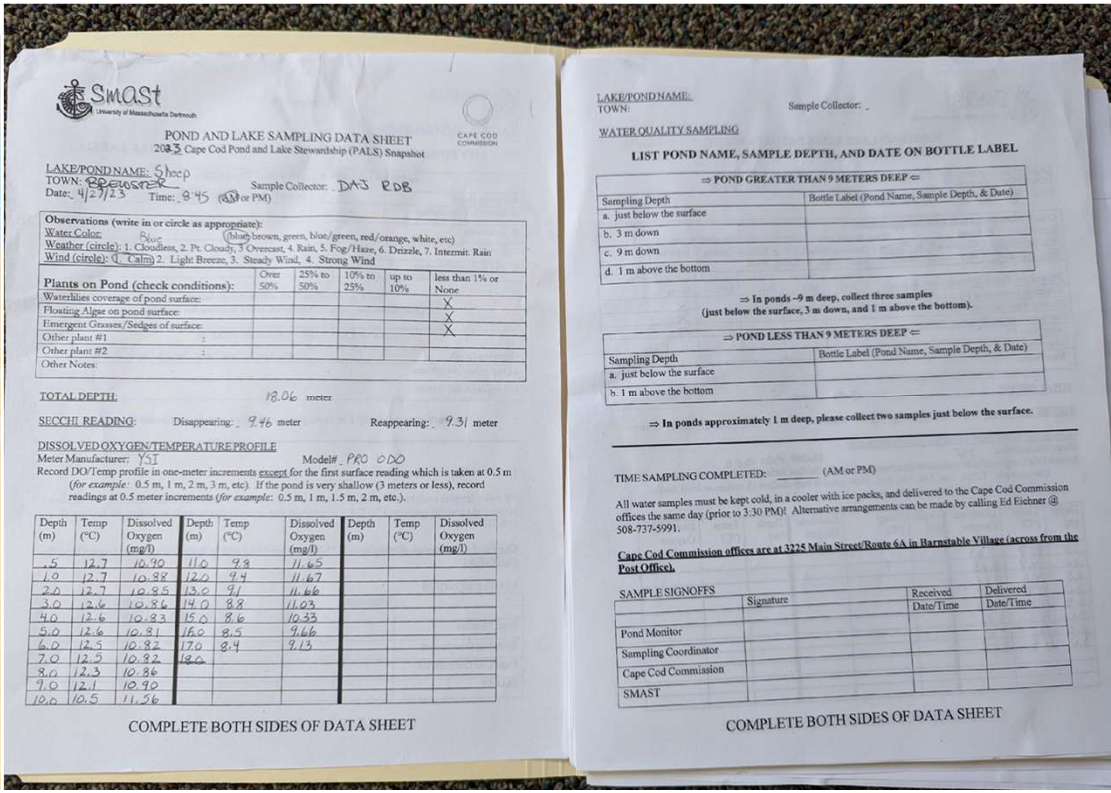
Figure 15. – Secchi Disk



From: www.epa.state.il.us/water/conservation-2000/volunteer-lake-monitoring/secchi-disk.jpg

Figure 16 presents the comparison of the 2001 Snapshot results to the Cape Cod reference criteria. During the 2001 Snapshot sampling, 192 Secchi depth readings were collected. The average of depth of these readings is 2.66 m (or 8.7 ft), while the median is 2.26 m. Town results show how many pond's Secchi depth readings are above the reference depth (6.8 m) based only on data from unimpacted ponds, below the reference depth (3.8 m) based on data from all the ponds, and how many are between these two depths. For example, Brewster volunteers collected Secchi depth readings from 25 ponds, 20 of which had Secchi depths of less than 3.8 m (12.5 ft) (see Figure 16). As would be expected by the method used to develop the reference criterion, the analysis shows that about a three-quarters (75%) of the ponds on Cape Cod have been "impacted" by human activities. Individual pond results are included in the town-specific sections of this Atlas.

Pond and Lake Stewards (PALS) Sampling



SMAST
University of Massachusetts Dartmouth

POND AND LAKE SAMPLING DATA SHEET
2023 Cape Cod Pond and Lake Stewardship (PALS) Snapshot

CAPE COD COMMISSION

LAKE/POND NAME: Sheep
TOWN: Brewster
Date: 4/27/23 Sample Collector: DAJ RDB
Time: 8:45 (AM or PM)

Observations (write in or circle as appropriate):
Water Color: Blue (blue, brown, green, blue/green, red/orange, white, etc)
Weather (circle): 1. Cloudless, 2. Pt. Cloudy, 3. Overcast, 4. Rain, 5. Fog/Haze, 6. Drizzle, 7. Intermit. Rain
Wind (circle): 1. Calm 2. Light Breeze, 3. Steady Wind, 4. Strong Wind

Plants on Pond (check conditions):	Over 50%	25% to 50%	10% to 25%	up to 10%	less than 1% or None
Waterlilies coverage of pond surface:					
Floating Algae on pond surface:					X
Emergent Grasses/Sedges of surface:					X
Other plant #1 :					X
Other plant #2 :					
Other Notes:					

TOTAL DEPTH: 18.06 meter

SECCHI READING: Disappearing: 9.46 meter Reappearing: 9.31 meter

DISSOLVED OXYGEN/TEMPERATURE PROFILE
Meter Manufacturer: YSI Model# PRO ODO
Record DO/Temp profile in one-meter increments except for the first surface reading which is taken at 0.5 m (*for example:* 0.5 m, 1 m, 2 m, 3 m, etc). If the pond is very shallow (3 meters or less), record readings at 0.5 meter increments (*for example:* 0.5 m, 1 m, 1.5 m, 2 m, etc.).

Depth (m)	Temp (°C)	Dissolved Oxygen (mg/l)	Depth (m)	Temp (°C)	Dissolved Oxygen (mg/l)	Depth (m)	Temp (°C)	Dissolved Oxygen (mg/l)
.5	12.7	10.90	11.0	9.8	11.65			
1.0	12.7	10.88	12.0	9.4	11.67			
2.0	12.7	10.85	13.0	9.1	11.66			
3.0	12.6	10.86	14.0	8.8	11.03			
4.0	12.6	10.83	15.0	8.6	10.33			
5.0	12.6	10.81	16.0	8.5	9.66			
6.0	12.5	10.82	17.0	8.4	9.13			
7.0	12.5	10.82	18.0					
8.0	12.3	10.86						
9.0	12.1	10.90						
10.0	10.5	11.56						

COMPLETE BOTH SIDES OF DATA SHEET

LAKE/POND NAME:
TOWN: Sample Collector:

WATER QUALITY SAMPLING

LIST POND NAME, SAMPLE DEPTH, AND DATE ON BOTTLE LABEL

⇒ POND GREATER THAN 9 METERS DEEP ⇐	
Sampling Depth	Bottle Label (Pond Name, Sample Depth, & Date)
a. just below the surface	
b. 3 m down	
c. 9 m down	
d. 1 m above the bottom	

⇒ In ponds ~9 m deep, collect three samples (just below the surface, 3 m down, and 1 m above the bottom).

⇒ POND LESS THAN 9 METERS DEEP ⇐	
Sampling Depth	Bottle Label (Pond Name, Sample Depth, & Date)
a. just below the surface	
b. 1 m above the bottom	

⇒ In ponds approximately 1 m deep, please collect two samples just below the surface.

TIME SAMPLING COMPLETED: _____ (AM or PM)

All water samples must be kept cold, in a cooler with ice packs, and delivered to the Cape Cod Commission offices the same day (prior to 3:30 PM)! Alternative arrangements can be made by calling Ed Eichner @ 508-737-5991.

Cape Cod Commission offices are at 3225 Main Street/Route 6A in Barnstable Village (across from the Post Office).

SAMPLE SIGNOFFS	Signature	Received Date/Time	Delivered Date/Time
Pond Monitor			
Sampling Coordinator			
Cape Cod Commission			
SMAST			

COMPLETE BOTH SIDES OF DATA SHEET

PALS Testing

Recommended citation for use of any PALS Snapshot laboratory data:

August/September Laboratory Data provided without cost and in support of the Cape Cod Pond and Lake Stewardship (PALS) Program by:

Coastal Systems Group
School for Marine Science and Technology
University of Massachusetts Dartmouth
706 Rodney French Blvd.
New Bedford, MA 02744

Key		Weather Conditions:		Wind:	
NES = Not Enough Sample		1	Clear	1	Calm
NS = No Sample		2	Partly Cloudy	2	Light Breeze
NC = No Chain Of Custody		3	Overcast	3	Steady Wind
ND = No Data, samples being		4	Fog/Haze	4	Strong Wind
BDL = Below Detection Limit		5	Drizzle		
NA = Not Applicable		6	Intermit. Rain		
		7	Rain		

Please contact Ed Eichner (508.737.5991) at TMDL Solutions or Sara Horvet (508.910.6325) at SMAST for data interpretation, development of pond databases, pond sampling and/or other pond and lake information

Town	Pond	Sample Depth (M)	Date	QC	Number of Samples	Total Depth (M)	Secchi Depth (M)	% Secchi	DO (mg/L)	Temp C	pH	Alk (mg CaCO3/L)	Chla (ug/L)	Phaeo (ug/L)	TP (uM)	TN (uM)	T-pig ug/L	Water Color	Weather	Wind	Plants
BREWSTER	SHEEP	0.5	4/21/2022		4	18.1	7.535	41.6%	11.03	10.6	6.19	5.8	0.80	0.12	0.63	17.68	0.92	ND	ND	ND	ND
BREWSTER	SHEEP	1	4/21/2022						11.02	10.6	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	2	4/21/2022						11.01	10.6	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	3	4/21/2022						10.98	10.6	6.20	5.3	1.11	0.03	0.25	16.18	1.14				
BREWSTER	SHEEP	4	4/21/2022						10.98	10.6	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	5	4/21/2022						10.97	10.5	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	6	4/21/2022						10.94	10.5	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	7	4/21/2022						10.92	10.4	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	8	4/21/2022						10.88	10.4	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	9	4/21/2022						10.89	10.3	6.18	6	1.32	0.03	1.81	18.69	1.34				
BREWSTER	SHEEP	10	4/21/2022						10.88	10.3	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	11	4/21/2022						10.84	10.3	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	12	4/21/2022						10.82	10.3	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	13	4/21/2022						10.81	10.3	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	14	4/21/2022						10.81	10.2	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	15	4/21/2022						10.78	10.2	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	16	4/21/2022						10.74	10.2	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	17	4/21/2022						10.64	10.2	6.15	5.8	1.46	0.03	0.38	18.54	1.48				
BREWSTER	SHEEP	0.5	9/8/2022						ND	ND	6.37	32.4	0.40	0.08	0.23	14.52	0.49				
BREWSTER	SHEEP	3	9/8/2022						ND	ND	6.30	6.1	0.55	0.03	0.15	13.01	0.58				
BREWSTER	SHEEP	9	9/8/2022						ND	ND	6.24	5.9	0.52	0.03	0.26	15.23	0.55				
BREWSTER	SHEEP	16	9/8/2022						ND	ND	6.26	5.9	1.44	0.03	0.57	15.27	1.47				
BREWSTER	SLOUGH	0.5	4/25/2022		2	5.5	2.425	44.1%	10.59	14.7	5.90	3.1	3.89	0.03	0.98	31.87	3.92	BROWN	OVERCAST	LIGHT BREEZE	NA
BREWSTER	SLOUGH	1	4/25/2022						10.55	14.6	NS	NS	NS	NS	NS	NS	NS				

PAL CLIENT FINAL 2022

CAPE COD WATERSHED

Assessment and 5-Year Action Plan

compiled by the

Former EOEA Cape Cod Watershed Team

edited by

Courtney Armentrout

Former Assistant Watershed Team Leader

2004

The Commonwealth of Massachusetts

Executive Office of Environmental Affairs

Eutrophication and Aquatic Plant Management in Massachusetts

Final Generic Environmental Impact Report

Executive Office of Environmental Affairs
Commonwealth of Massachusetts
2004

The Practical Guide to Lake Management in Massachusetts

A Companion to the Final Generic Environmental Impact Report on Eutrophication and Aquatic Plant Management in Massachusetts

Commonwealth of Massachusetts
Executive Office of Environmental Affairs

2004

The Massachusetts Lake and Pond Guide

Protection Through Education

dcr
Massachusetts Department of
Conservation and Recreation
Lakes and Ponds Program

State Publications

Brochures

Lawns & Landscapes in Your Watershed (DEP)
TMDL's: Another Step to Cleaner Waters (DEP)
Don't Trash the Grass (DEP)
Invasive Plants (DCR)
Shoreline Surveys: Action Tool (DEP)
Clean Rivers Begin at Home: A Guide to Understanding Nonpoint Pollution (DEP)
Protect Your Pet and Preserve the Environment: Don't Release Exotic Species! (CZM)

Manuals and Guides

- Guide to Selected Invasive Non-native Aquatic Species in Massachusetts (DCR)
- Guide to Aquatic Plants in Massachusetts (DCR)
- Final Generic Environmental Impact Report (GEIR) on Eutrophication and Aquatic Plant Management in Massachusetts (DCR)
- The Practical Guide to Lake Management in Massachusetts (A Companion to the Final Generic Environmental Impact Report on Eutrophication and Aquatic Plant Management in Massachusetts)(DCR)
- Nonpoint Source Management Manual: A Guidance Document for Municipal Officials (DEP)
- Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas: A Guide for Planers, Designers, and Municipal Officials (DEP)
- Volume I: Stormwater Policy Handbook (DEP)
- Volume II: Stormwater Technical Handbook (DEP)
- A Guide to Lakes and Ponds in Massachusetts Forests and Parks
- Surveying a Lake Watershed and Preparing an Action Plan (DEP)
- Give Your Lake the Blues! (DEP)
- Shoreline Buffer Guide (BCRP + DEP)
- More than Just a Yard (EOEA)
- A Field Guide to the Animals of Vernal Pools (DFW)
- Critters of Massachusetts (DFW)
- Guide to the Dragonflies and Damselflies of Massachusetts (DFW)

Other

- Boat Ramp Sign "Stop the Spread of Nuisance Species" (DCR)
- Invasive Species Poster (DCR)
- Waterline (a quarterly guide to watersheds, wetlands waterways, drinking water) (DEP)
- Online Lake and Pond Maps (DFW) www.state.ma.us/dfwele/dfw/dfw_pond.htm
- Abstracts of the Fish and Wildlife Laws (DFW)
- Boat Massachusetts Your Guide to Boating Laws and Responsibilities (Environmental Police)

Additional copies of DEP Materials can be obtained by calling a Regional DEP Service Center:
Northeast (978) 661- 7677
Southeast (508) 946-2714
Central (508) 792-7683
Western (413) 755-2124
www.state.ma.us/dep

Additional copies of DCR publications/materials can be obtained from:
Department of Conservation and Recreation
www.mass.gov/lakesandponds

Additional copies of DFW publications can be obtained from:
Division of Fisheries and Wildlife
1-508-792-7270

Additional copies of Environmental Police publications, or for information on fishing and boating regulations call 1-800-632-8075 or visit www.mass.gov/dfwele/dle

Long Pond Alum 2007

Anoxia has been a feature of deep water in Long Pond for at least half a century, but excessive internal recycling of nutrients accumulated over many years seems to be a more recent phenomenon. It may have taken many decades for the internal load to reach the threshold where it could supply sufficient phosphorus to cause the observed blooms. The release of previously bound and sedimented P inputs back into the water column is cause for concern on several grounds:

1. Some algae may be able to access this increased nutrient level by moving between lower and upper water layers
2. Some of the P accumulated in the bottom waters does pass into surface waters during summer, fueling algal growth
3. Upon eventual mixing, more of that accumulated P becomes available to algae
4. The long detention time of Long Pond means that seasonal events such as P release from sediment may have longer term impacts
5. The release of P without a commensurate release of nitrogen will lower N:P ratios and favor cyanobacteria, the most troublesome of algae

Remedial action aimed at that internal load was chosen to restore desirable conditions in Long Pond, and protective measures in the watershed are to be implemented to slow down the accumulation of phosphorus and internal loading in the future. Aluminum treatment was favored over aeration methods. The primary reason for the choice of alum over aeration was economics, as an appropriate aeration system would cost at least as much as an alum treatment, but also requires annual maintenance and operational costs not incurred with the alum treatment.

Prepared for:

The Towns of Brewster and Harwich, Massachusetts

Prepared by:

AECOM

TREATMENT SUMMARY

for

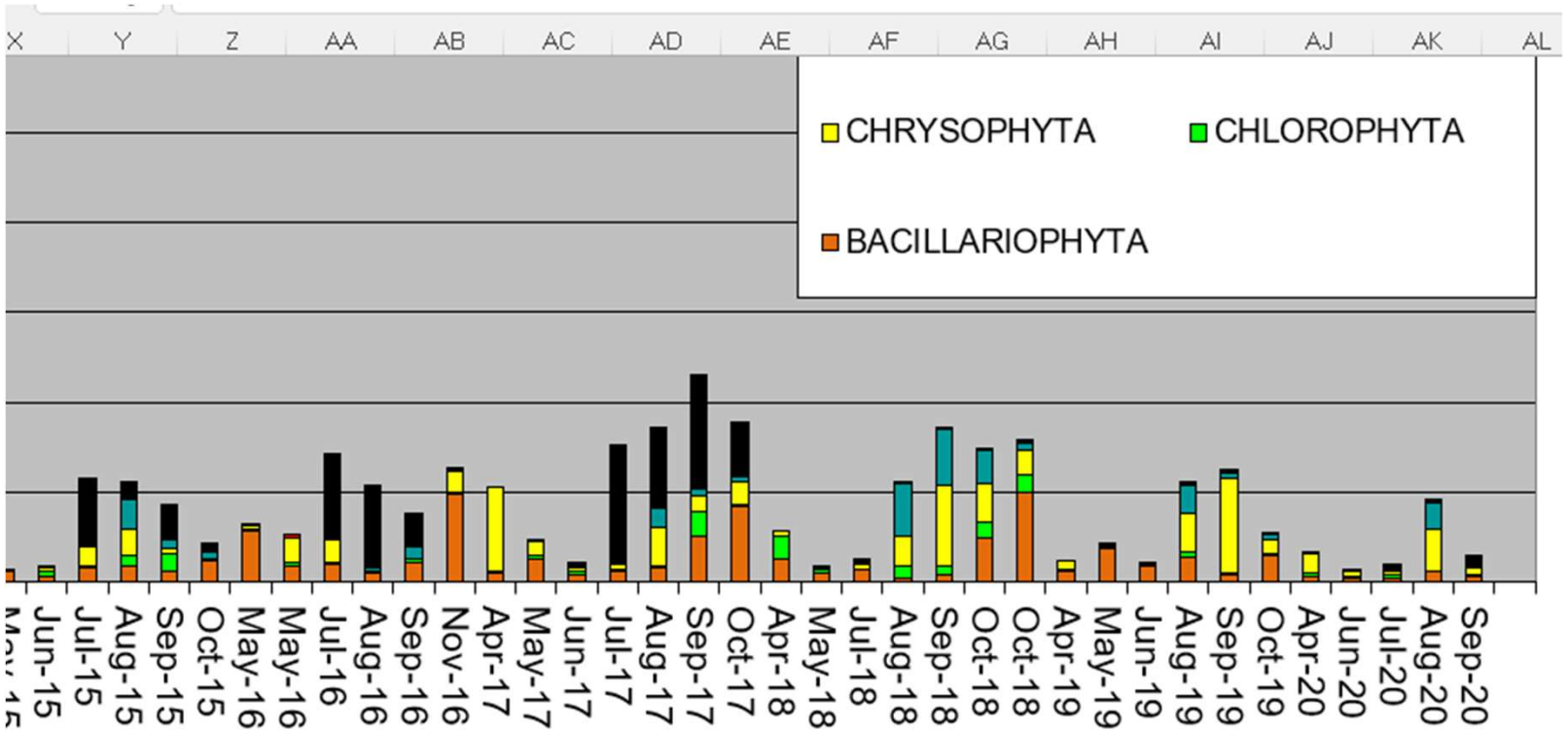
Phosphorus Inactivation in Long Pond

Brewster and Harwich, Massachusetts

February 2009

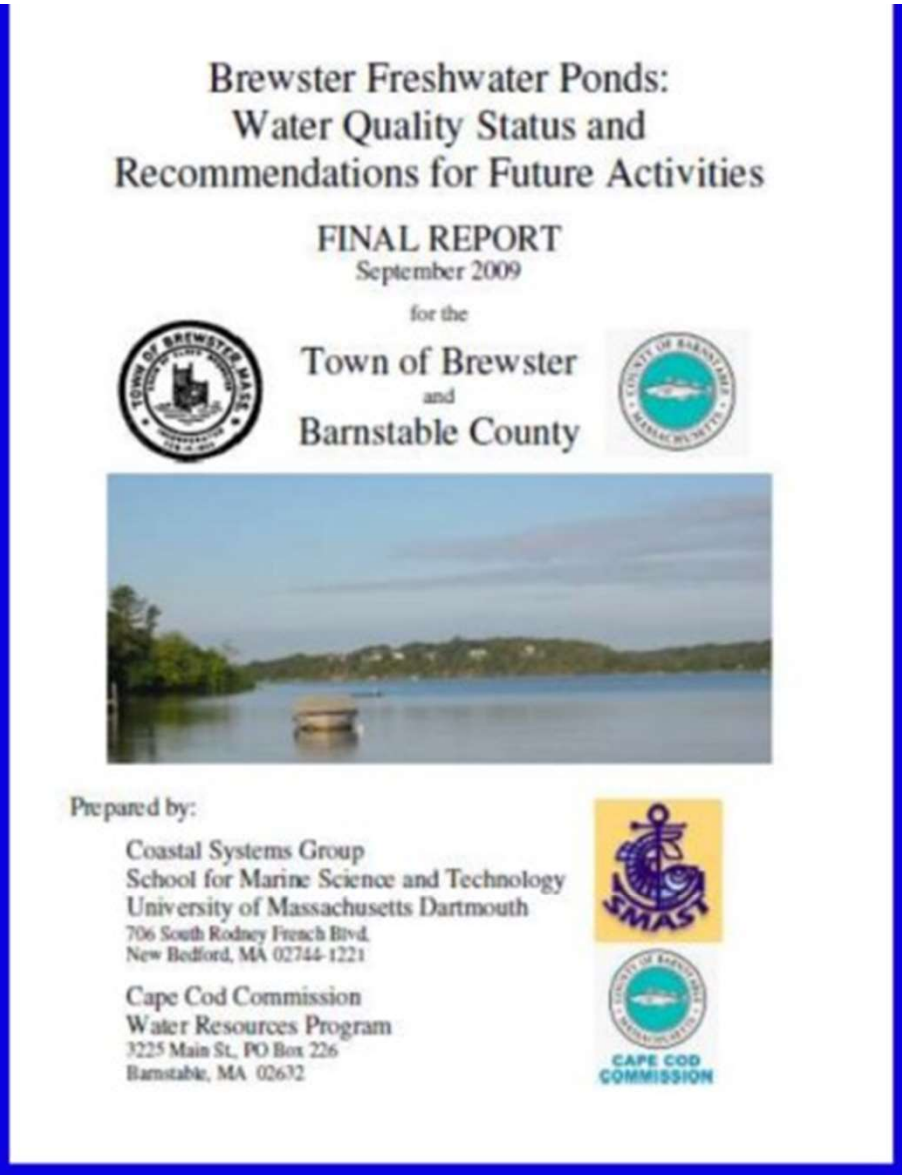
Document No. 12283-001C

Long Pond continued monitoring



2009 Brewster Ponds Report

1. Reviewed citizens/PALS data for all 29 monitored ponds
2. Completed more detailed reviews of 6 selected ponds (including Walkers, Upper Mill and Lower Mill)
   - watershed delineations
   - comparison of water quality to regulatory standards
   - identify additional data needs



Brewster Freshwater Ponds:
Water Quality Status and
Recommendations for Future Activities

FINAL REPORT
September 2009

for the

Town of Brewster
and
Barnstable County

Prepared by:

Coastal Systems Group
School for Marine Science and Technology
University of Massachusetts Dartmouth
706 South Rodney French Blvd.
New Bedford, MA 02744-1221

Cape Cod Commission
Water Resources Program
3225 Main St., PO Box 226
Barnstable, MA 02632

Executive Summary

Brewster Freshwater Ponds: Water Quality Status and Recommendations for Future Activities

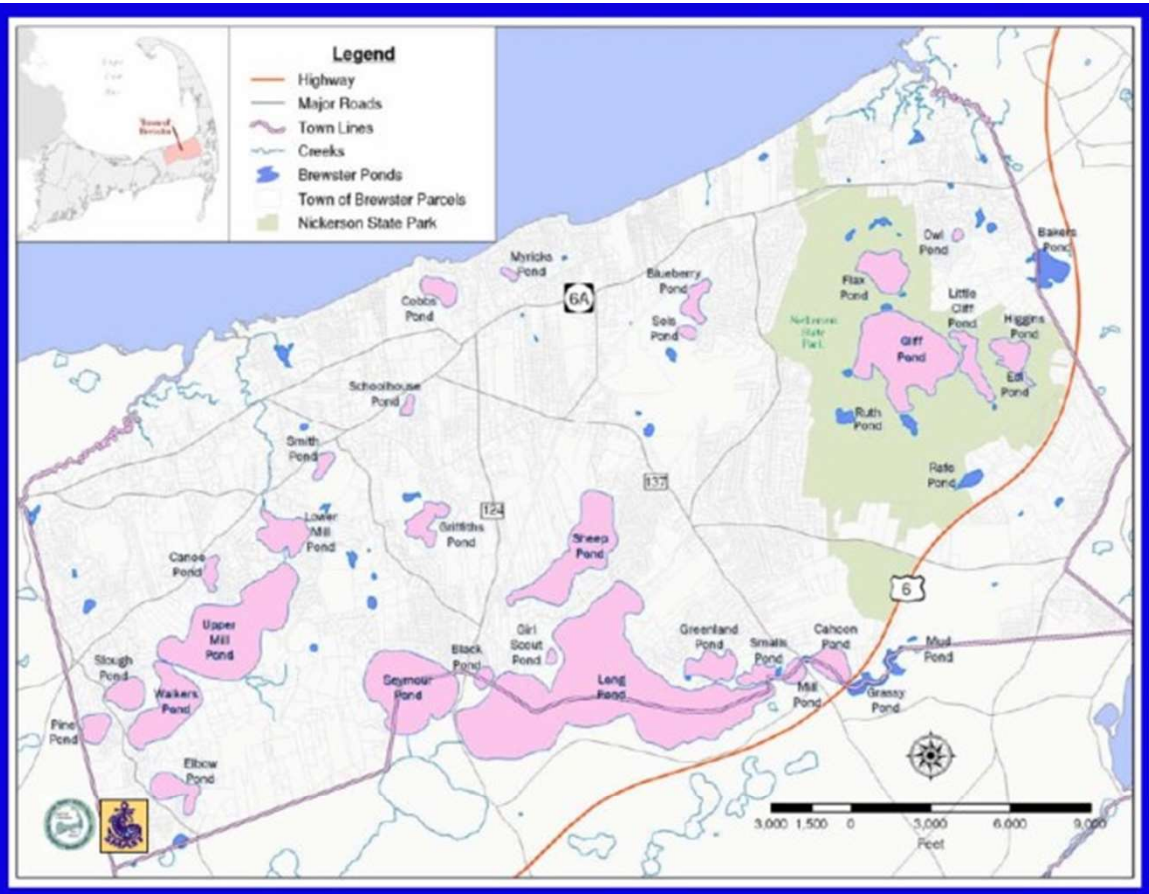
Final Report

September 2009

Cape Cod ponds are part of the regional aquifer system and, as such, are linked to drinking water and coastal estuaries, as well as any pollutants added to the aquifer. In Brewster, water quality in the ponds are generally a reflection of the amount of development around the ponds, including impacts from wastewater, fertilizers, and stormwater runoff, as well as the individual characteristics of each pond. Until the Cape Cod Pond and Lake Stewardship (PALS) program was created, water quality in most ponds was generally limited to anecdotal information from long time residents.

Ponds reviewed

- Data collected: DO, Temp, Secchi, TN and DIN, TP and ortho-P, chlorophyll, alkalinity, and pH
- Data analysis focused on June through September



Black	Cobbs	Greenland	Lower Mill	Schoolhouse	Smith
Blueberry	Eel	Griffiths	Mill	Seymour	Sol's
Cahoon	Elbow	Higgins	Myricks	Sheep	Upper Mill
Canoe	Flax	Little Cliff	Owl	Slough	Walker
Cliff	Girl Scout	Long	Pine	Smalls	

Brewster Ponds Assessment

Starting Point

- Over 11,000 data entries
- Data from 29 ponds (2001-2007)
- Laboratory analyses provided by National Park Service and School for Marine Science and Technology (SMAST), Coastal Systems Program
- Field data collected by Brewster PALS volunteers

Brewster Ponds Assessment
Summary of Water Quality Findings

- Town-wide: 24 of 29 have average dissolved oxygen concentrations that are less than state minimum regulatory standards and may require TMDLs;
- Town-wide: 23 to 28 of the 29 have average total phosphorus and chlorophyll a concentrations higher than Cape Cod-specific guidelines
- Detailed pond-specific analysis for 6 ponds:
  - Seymour, Canoe, and Blueberry do not meet state dissolved oxygen minimums, meet regulatory definition of impaired, and will require TMDLs under state regulations,
  - Walkers, Upper Mill, and Lower Mill generally have acceptable DO, but exceptionally high nutrient concentrations

Brewster Ponds Assessment: Project Partners

All Brewster PALS

especially

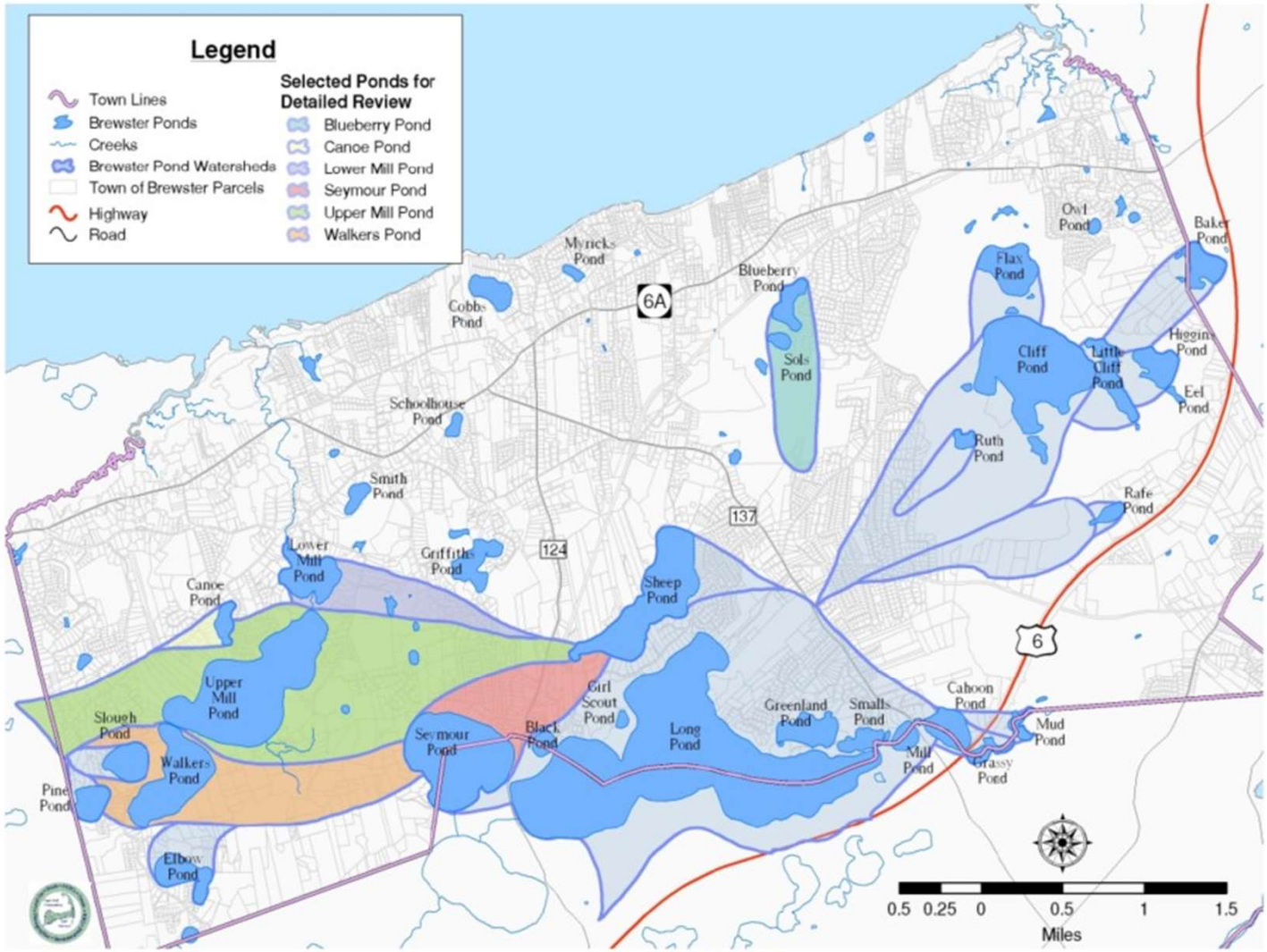
Jane Johnson
Carroll Johnson
Paul Alt
Ed Kassman
Chris Miller
Charlie Sumner
Bob Mant

Tom Cambareri
Donna McCaffery
Xiaotong Wu
Scott Michaud
Gabrielle Belfit
Jay Detjens

Krista Lee

Coastal Systems Program

Brian Howes
David White
Dale Goehringer
Dave Schlezinger
Roland Samimy
Sara Sampieri
Jen Antosca
Mike Bartlett
Elizabeth White



Mtg with Town of Brewster Comprehensive Water Planning Committee
December 13, 2010

Horsley Witten Group
Sustainable Environmental Solutions
90 Route 6A • Sandwich, MA • 02563
Tel: 508-833-6600 • Fax: 508-833-3150 • www.horsleywitten.com

MEMORANDUM

DATE: October 11, 2013

TO: Town of Brewster

FROM: Horsley Witten Group, Inc

RE: Rapid Watershed Assessment of Schoolhouse Pond in the Town of Brewster, MA

The purpose of this memorandum is to provide results on the rapid watershed assessment for Schoolhouse Pond located in the Town of Brewster, Massachusetts. The watershed assessment involved a desktop analysis using GIS data, a field assessment, and the development of a nutrient loading model to determine the potential nutrient loading to the pond. Results were used to identify actions and best management practices that may be used to reduce nutrient loads and improve pond water quality. The project findings will be used to help develop rapid watershed assessment approaches for other fresh water ponds in the Town of Brewster.

Mills Ponds Complex
Water Quality Assessment

Town of Brewster
Comprehensive Water Planning Committee
February 7, 2013

Ed Eichner
Senior Water Scientist
Coastal Systems Program
School for Marine Science And Technology
University of Massachusetts Dartmouth

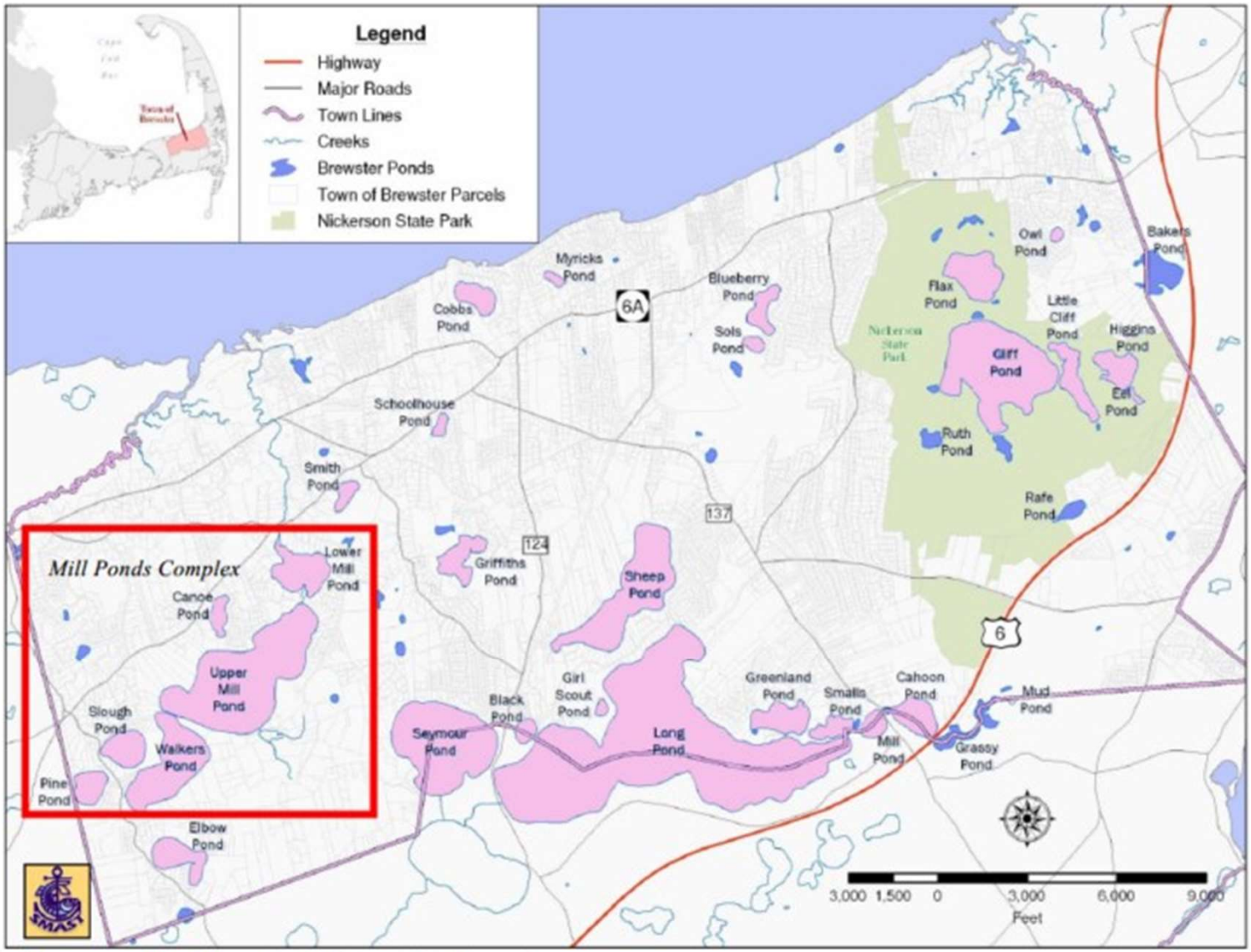


Figure I-1. Brewster Ponds and Mill Ponds Complex.

Table EX-1. Summary of Recommended Management Plan Actions

Action	Description	Pond	Estimated Cost	Issues to Resolve
1	Macrophyte Harvesting	Walkers	$15,000 to $52,000	All costs and implementation details including optimal plant disposal, permitting, timing of harvesting, monitoring, and regular adaptation based on monitoring results; renting vs. buying harvester
2	Alum application	Upper Mill Pond	$158,300	All costs and implementation details including mussel accommodations, permitting, monitoring (for at least two years), and regular adaptation based on monitoring results
3	Await results of management activities in other ponds	Lower Mill Pond	To be determined	Monitoring and adaptation based on transferred results from other two ponds; monitoring for at least two years
4	Shoreline Landowner Education Program	All ponds	To be determined	Best form of accessibility (website, pamphlets, etc.) for clear homeowner understanding of issues to reduce or eliminate phosphorus contributions to ponds including setbacks, buffer designs, alternative groundcover options, and stormwater design
5	Implement Stormwater Infiltration Program	All ponds	To be determined	Redesign six (6) identified areas that have direct stormwater discharges to pond surfaces. Initial step: complete elevation surveys in the areas and review design options to encourage infiltration. Program should also include regular (1-2 year) visual inspection of steeper slopes along the pond shorelines for stormwater scour channels and development of strategies to mitigate any identified channels.
6	Pond Monitoring Program	All ponds	To be determined	Program to monitor and regularly review benefits of management activities and adjust as indicated. Issues to resolve include components to be monitored (*e.g.*, water, plant height, etc.), monitoring schedule, schedule for data review, and action thresholds for changes/adjustments.

Mill Ponds Management Plan

Walkers Pond, Upper Mill Pond, and Lower Mill Pond

FINAL REPORT

November 2014

for the

Town of Brewster

Prepared by:

Coastal Systems Group
School for Marine Science and Technology
University of Massachusetts Dartmouth
706 South Rodney French Blvd.
New Bedford, MA 02744-1221

Walkers Pond recommendations

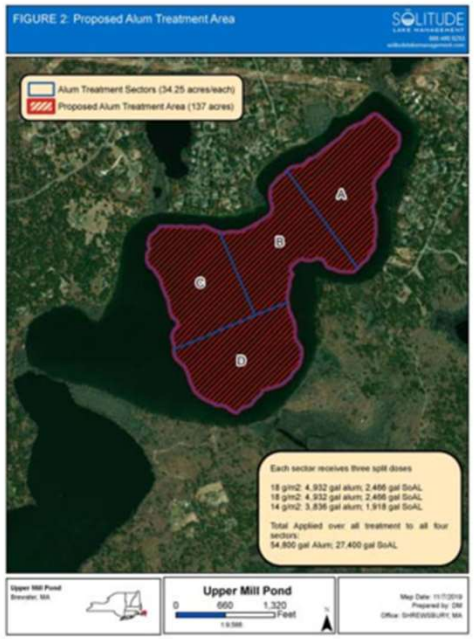
1. Macrophyte harvesting in Walkers Pond
   A. Plan and implement macrophyte harvesting in Walkers Pond. Complete the initial harvesting in September/October to minimize conflict with recreational use of the pond and spawning of herring. The initial targeting will be 16.5 acres (~50% of the >80% density area). It is recommended that the harvesting target areas along the western shoreline where no mussels were detected during the CSP/SMAST survey. Harvested sections should be monitored for regrowth with additional harvesting if plants regain more than half of their pre-harvest height or density.
   B. Water quality monitoring should occur before and after the harvesting using standard PALS protocols, including collection of water quality samples. Similar monitoring should also occur in April and August/September of the year following the harvesting with Secchi readings and dissolved oxygen/temperature profiles on a monthly basis between the sample collection runs. Flow measurements and water quality samples should also be collected in the hydroconnection between Walkers Pond and Upper Mill Pond on a monthly basis between April and the August/September samplings. Monitoring results should be compared to past measurements and management procedures should be adjusted if indicated.

Weed Harvester

Upper Mill Pond Recommendations

2. Aluminum salt application in Upper Mill Pond
   A. Plan and implement an aluminum salt application in Upper Mill Pond. Complete the application in September/October to avoid conflict with recreational use of the pond and spawning of herring. The application should target areas of the pond greater than 6 m in depth.
   B. Water quality monitoring should occur before, during, and after the application using standard PALS protocols, including collection of water quality samples. Similar monitoring should also occur in April and August/September of the two years following the application in order to encompass the pond's 15 month pond residence time. In addition, Secchi readings and dissolved oxygen/temperature profiles should be collected on a monthly basis between the sample collection runs. Flow measurements and water quality samples should also be collected in the hydroconnection between Upper Mill Pond and Lower Mill Pond on a monthly basis between April and the August/September samplings. Monitoring results should be compared to past measurements and management procedures should be adjusted if indicated.
   C. Water quality monitoring should also occur in Lower Mill Pond. This monitoring should include April and August/September for at least two years following the Upper Mill Pond aluminum salt application and use standard PALS protocols, including collection of water quality samples. Between these twice-yearly monitoring runs, Secchi readings and dissolved oxygen/temperature profiles should be collected on a monthly basis. Flow measurements and water quality samples should also be collected at the discharge from Lower Mill Pond to Stony Brook on a monthly basis between April and the August/September samplings.

Upper Mill Pond
Alum treatment 2019



Solitude Lake Management was contracted by the Town of Brewster to conduct an alum treatment at Upper Mill Pond in Brewster, Massachusetts. Based on extensive assessments, the project specifications called for the application of liquid aluminum sulfate and sodium aluminate to achieve a dose of 50 g/m^2 of aluminum over approximately 137-acre of Upper Mill Pond, corresponding with areas greater than 6 feet in depth (see map – left). The selected dose was determined to lower available phosphorus in the water column and sediment and reduce the likelihood of nuisance algal blooms. The project was conducted between November 18th and December 2nd, where the entire treatment area was traversed three times, each time with approximately one-third of the required dose. Splitting the dose over multiple passes was a safeguard to limit the concentration of aluminum applied to the lake at any one time.

SOLITUDE
LAKE MANAGEMENT

Alum Treatment Final Completion Report
Upper Mill Pond

Brewster, MA

Submitted: January 30, 2020

SOLitude Lake Management

590 Lake Street
Shrewsbury, MA 01524
Phone: (888) 480-5253

FAX: (508) 865-1220

info@solitudelake.com
www.solitudelakemanagement.com

Walkers Pond
Water Quality Change and Adaptive Management

Town of Brewster
Natural Resources Department
December 8, 2022

Ed Eichner
Principal/Water Scientist, TMDL Solutions
Coastal Systems Program
School for Marine Science And Technology
University of Massachusetts Dartmouth

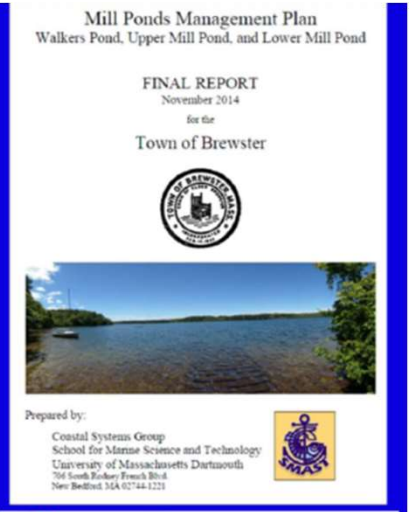
Walkers Pond
Water Quality Management

2014 Mill Ponds Management Plan

Walkers Pond Diagnostic Assessment (2011-2013 data)

- High nutrient and chlorophyll (pigment) concentrations
- Low clarity (~1.5 m)
- Generally acceptable dissolved oxygen, but some indication of excessive levels
- Regular mixing of entire water column (max depth 3.5 m)
- Extremely dense submerged aquatic vegetation (SAV) from shoreline to ~1.5 m all around pond transferring P to the water column (~90% of overall budget)

Recommended: Regular aquatic plant harvesting to slowly remove phosphorus and create active SAV growth


Mill Ponds Management Plan
Walkers Pond, Upper Mill Pond, and Lower Mill Pond

FINAL REPORT
November 2014
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Prepared by:
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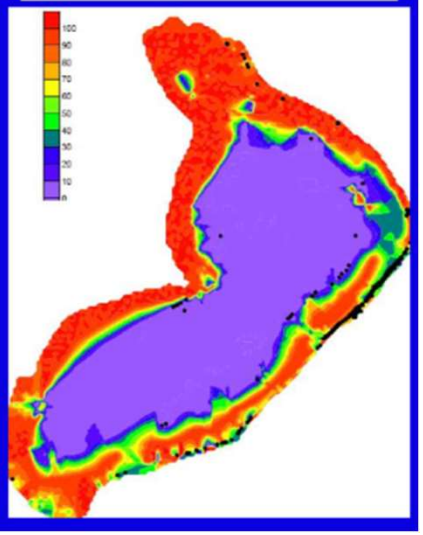


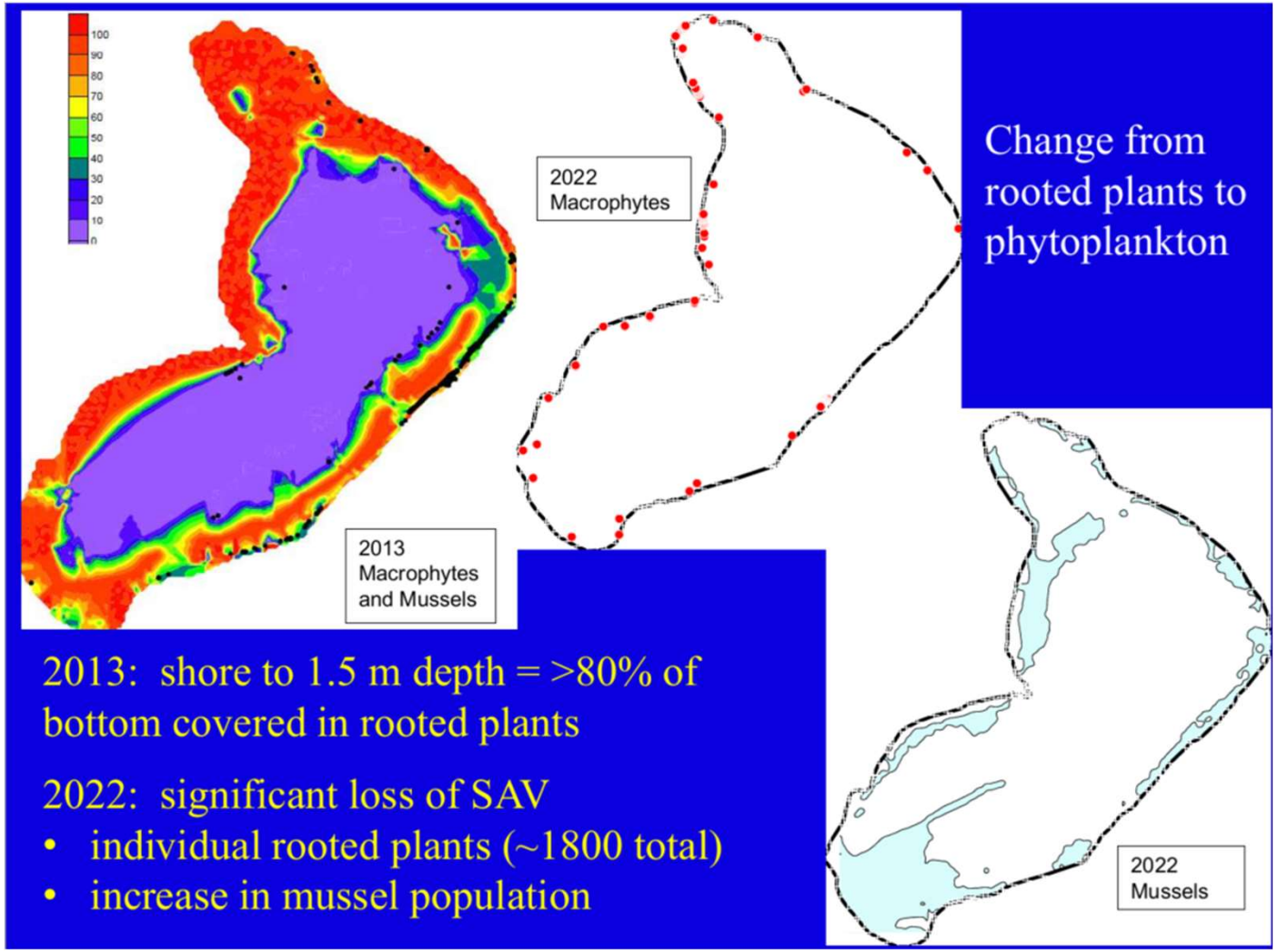
Walkers Pond
Water Quality Management

2017
Town purchases Pond Weed Harvester and harvests submerged aquatic plants (harvests again in 2018)

2019-2020
Town notes plants not growing back as expected

2020
TMDL Solutions and CSP/SMAST review PALS Snapshot and APCC water column data since Management Plan

- No significant differences from 2011 data collection



2013: shore to 1.5 m depth = >80% of bottom covered in rooted plants

2022: significant loss of SAV

- individual rooted plants (~1800 total)
- increase in mussel population

Walkers Pond
2022 Diagnostic Summary

1. Conditions have changed substantially since 2011-2013
2. Phytoplankton population has become the primary plant community in Walkers Pond largely through shading submerged aquatic vegetation (SAV).
3. Increased phytoplankton was driven by sediment P release due to increased bottom anoxia.
4. Increased phytoplankton has allowed freshwater mussel population to increase.
5. In order to restore acceptable water quality in Walkers Pond, one of the components of the phosphorus/phytoplankton feedback loops need to be disrupted.

2023 Pond Water Quality Data Review

TMDL Solutions
141 Pine Tree Drive, Centerville, MA 02632
Tel: 508-737-5991
eichner@tmdlsolutions.net

Scope of Work

Technical Support for the Town of Brewster
Freshwater Pond Water Quality Database and Trend Analysis Project

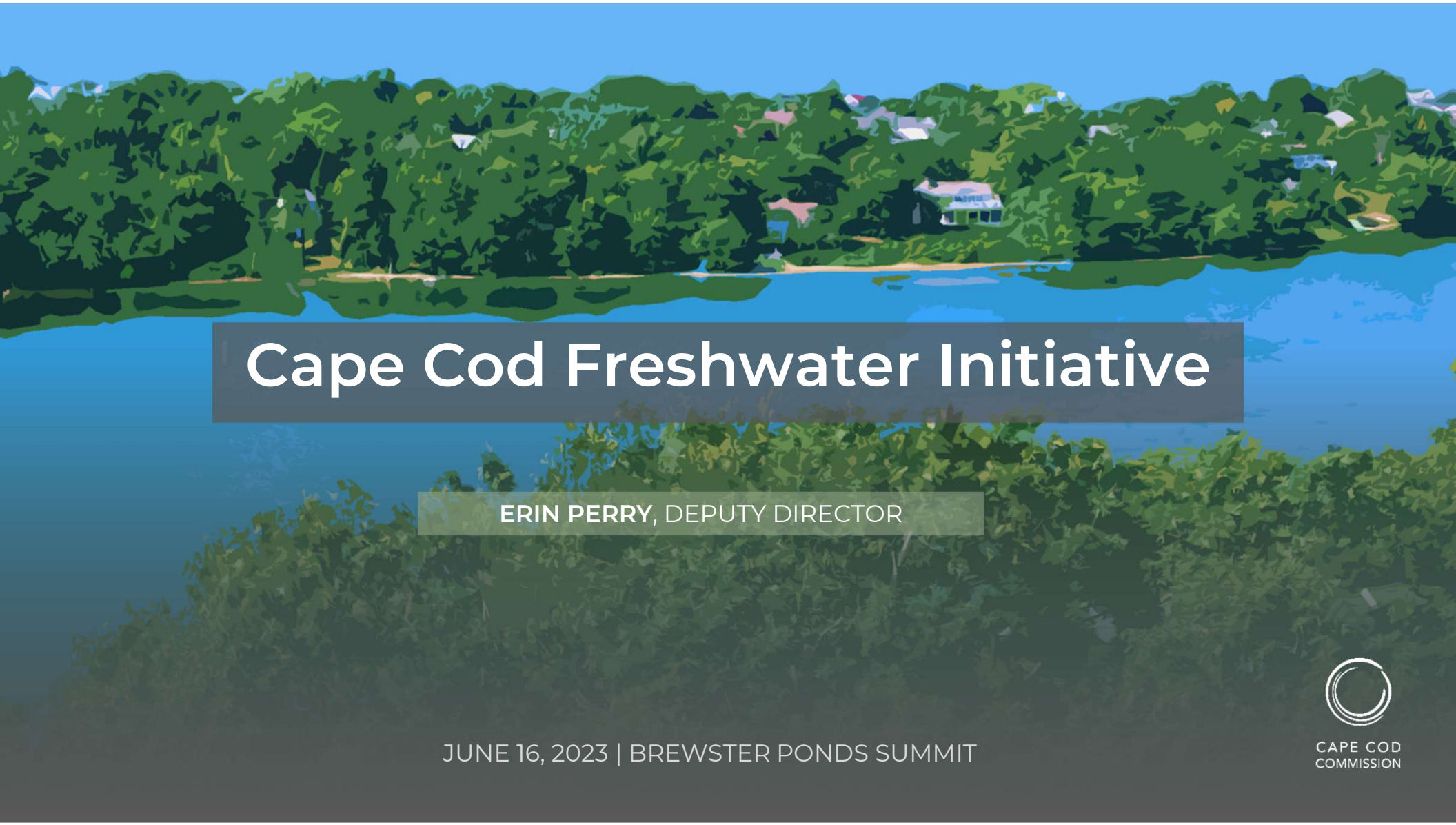
April 20, 2023

Overview

The Town of Brewster has been significantly invested in freshwater pond water quality management planning for several decades. Citizens have played an active role in these planning discussions, as well as collecting crucial water quality data.

In 2009, the Town, through the Coastal Systems Program from the School for Marine Science and Technology at UMass-Dartmouth (CSP/SMAST) and the Cape Cod Commission, organized, reviewed, and synthesized pond water column data collected by Brewster volunteers from 29 ponds between 2001 and 2007.[1] This effort also included detailed review of six ponds selected by the Town: Blueberry, Seymour, Canoe, Walkers, Upper Mill, and Lower Mill. These detailed reviews included watershed delineations, land use analysis, development of preliminary water and nutrient budgets, and identification of data gaps to be addressed prior to developing water quality management options.

In 2011, the Town worked with CSP/SMAST to address the identified data gaps for the primary ponds in the Mill Ponds complex (Upper Mill Pond, Lower Mill Pond, and Walkers Pond). This effort was completed for a diagnostic assessment of these pond and included a) collection and incubation of sediment cores to measure phosphorus regeneration and b) measurement of surface water flow and phosphorus transfer between the connected ponds and out of the system to Stony Brook. Using the refined data gap information and historical water column data collected by volunteers, CSP/SMAST subsequently developed a water quality management plan in 2014 that identified potential and recommended remedial options and their likely costs.[2] Based on management plan review of management options, the Town implemented a 2019 alum treatment of Upper Mill Pond, began harvesting rooted plants in Walkers Pond in 2017, and began review of Walkers Pond water quality to decide on adaptive management strategies in 2022.[3]



Cape Cod Freshwater Initiative

ERIN PERRY, DEPUTY DIRECTOR

JUNE 16, 2023 | BREWSTER PONDS SUMMIT

CAPE COD COMMISSION

Properly Functioning Ponds and Lakes Play an Important Role in Preserving and Restoring Coastal Water Quality

Ponds are credited with reducing up to 50% of the nitrogen that passes through them on its way to coastal embayments.

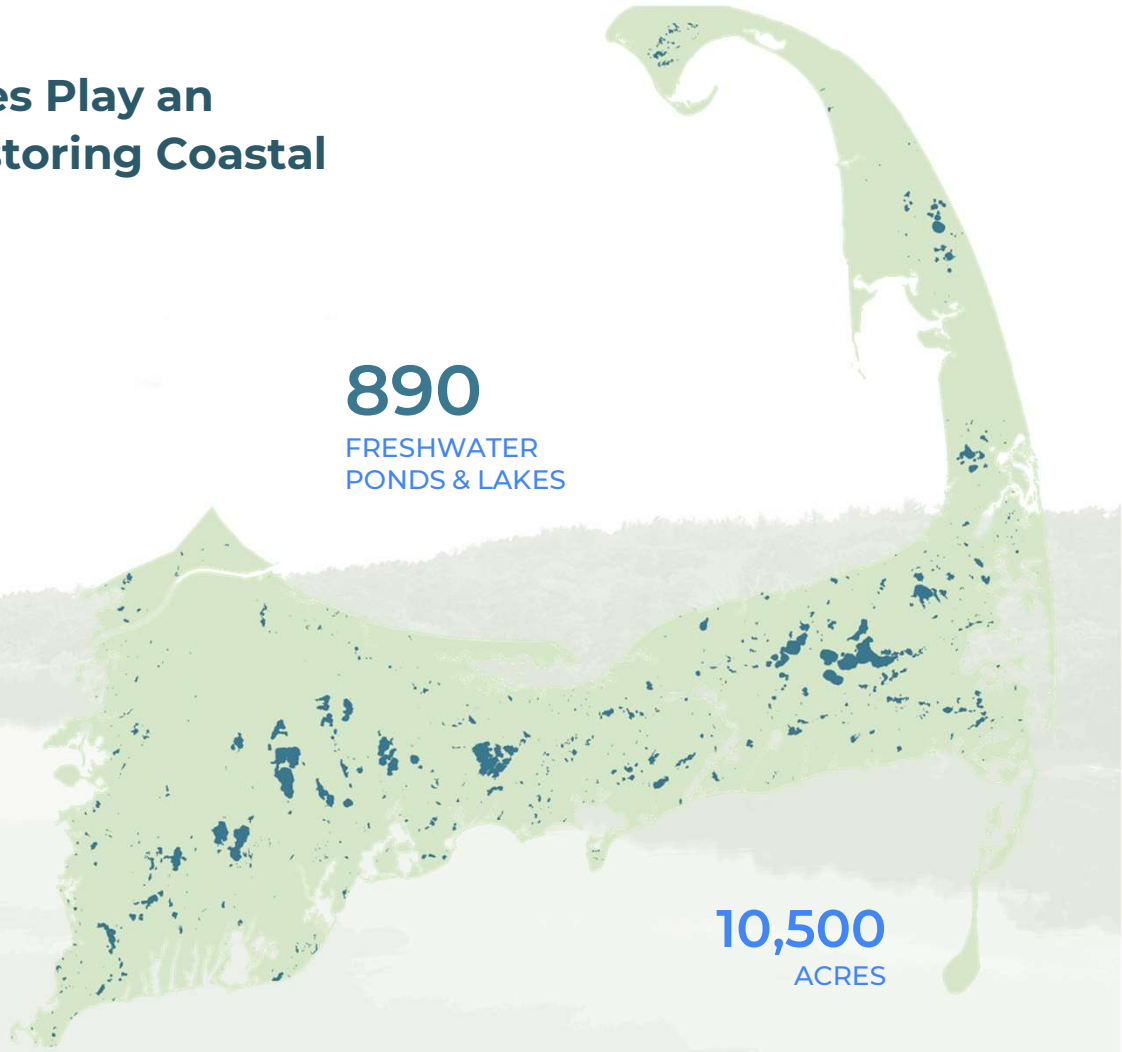
Lack of Consistent and Consecutive Data Collection

less than **10%**

Of Cape Cod's ponds and lakes are monitored

just **4%**

Had sufficient recent water quality data to grade pond health in 2021



890
FRESHWATER PONDS & LAKES

10,500
ACRES

THE FRESHWATER INITIATIVE PURPOSE

To understand, characterize, and analyze the contributing factors to water quality degradation, develop data-driven policies and strategies, and enable action at both the local and regional scale for sustained and dedicated efforts to preserve, protect, and restore Cape Cod’s freshwater ponds, fundamental for the region’s environment and economy.

Cape Cod Freshwater Initiative

A science-based, information-driven planning process that will engage stakeholders and enable action to protect and restore Cape Cod's freshwater ponds

ESTABLISHING THE BASELINE

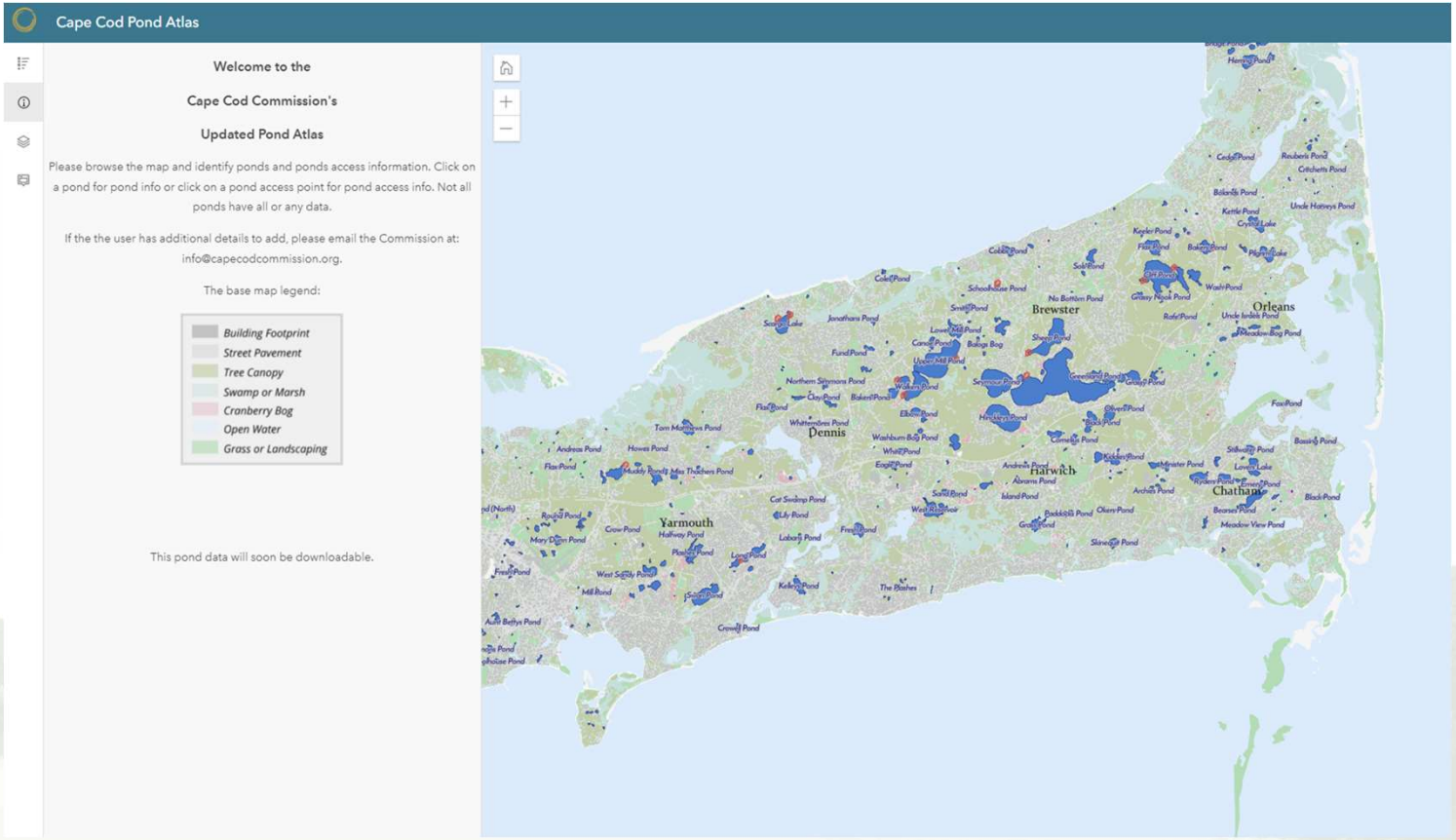
- Ponds And Lakes Atlas Update
- Physical Characteristics
- Data Management And Analysis
- Remote Sensing

STRATEGY DEVELOPMENT

- Engagement and Outreach
- Strategies Database
- Economic Analysis
- Legal Analysis

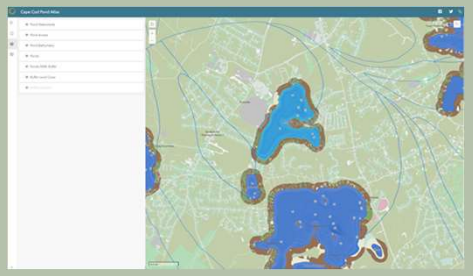
ONGOING MONITORING AND ANALYSIS

- Monitoring Program
- Ongoing Data Management and Analysis



Cape Cod Pond Viewer

The Pond Viewer serves as a companion to the Atlas and can be used to explore Cape Cod's ponds, ecology, and the challenges they face.



MAP LAYERS

Available map layers include access points, pond watershed delineations, bathymetry data, 300 ft. pond buffer area, and other pond and surrounding land use characteristics.

POND CHARACTERISTICS

Select a pond and open the Info Panel to view related characteristics including acreage, depth, and more. Users can also explore surrounding land cover and land use summaries within a 300 ft. pond buffer area.

EXPLORE: cccom.link/pond-atlas

Brewster Pond Watersheds

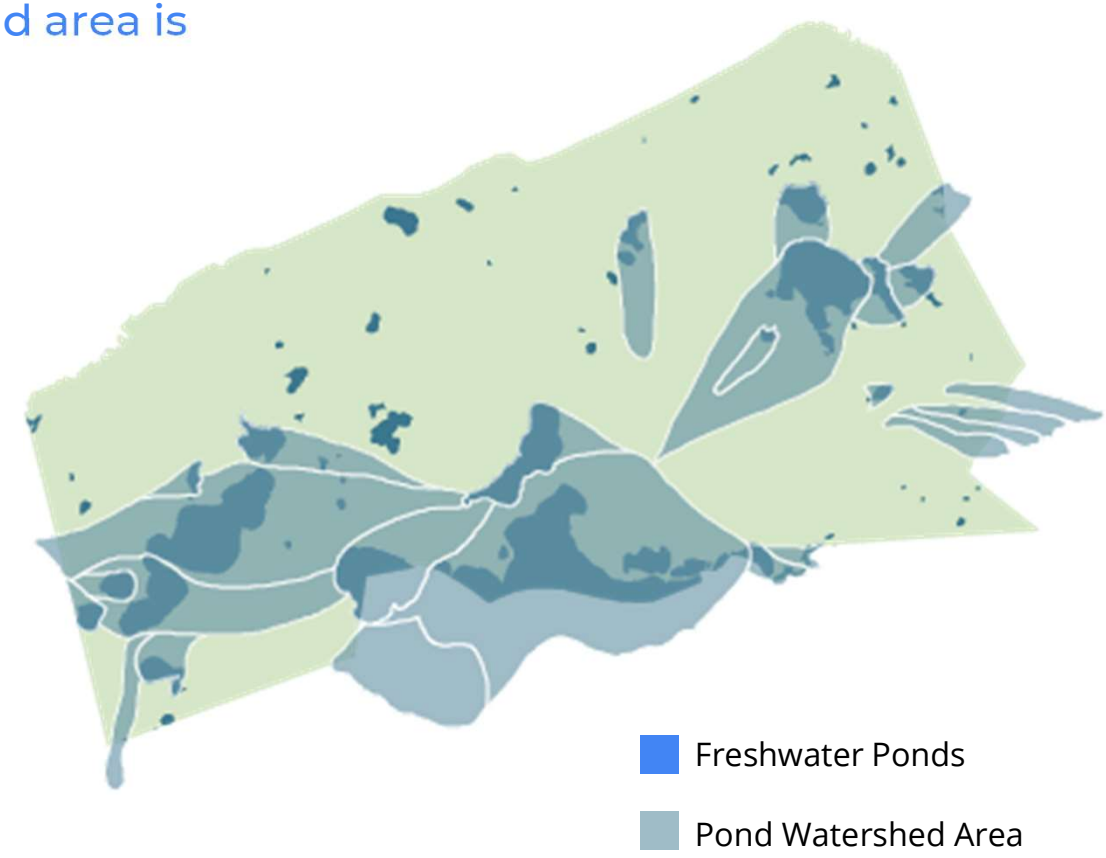
In Brewster, 34% of the town's total land area is within a delineated pond watershed.

26
Pond Watersheds Delineated

5,480
Acres of Pond Watershed Area

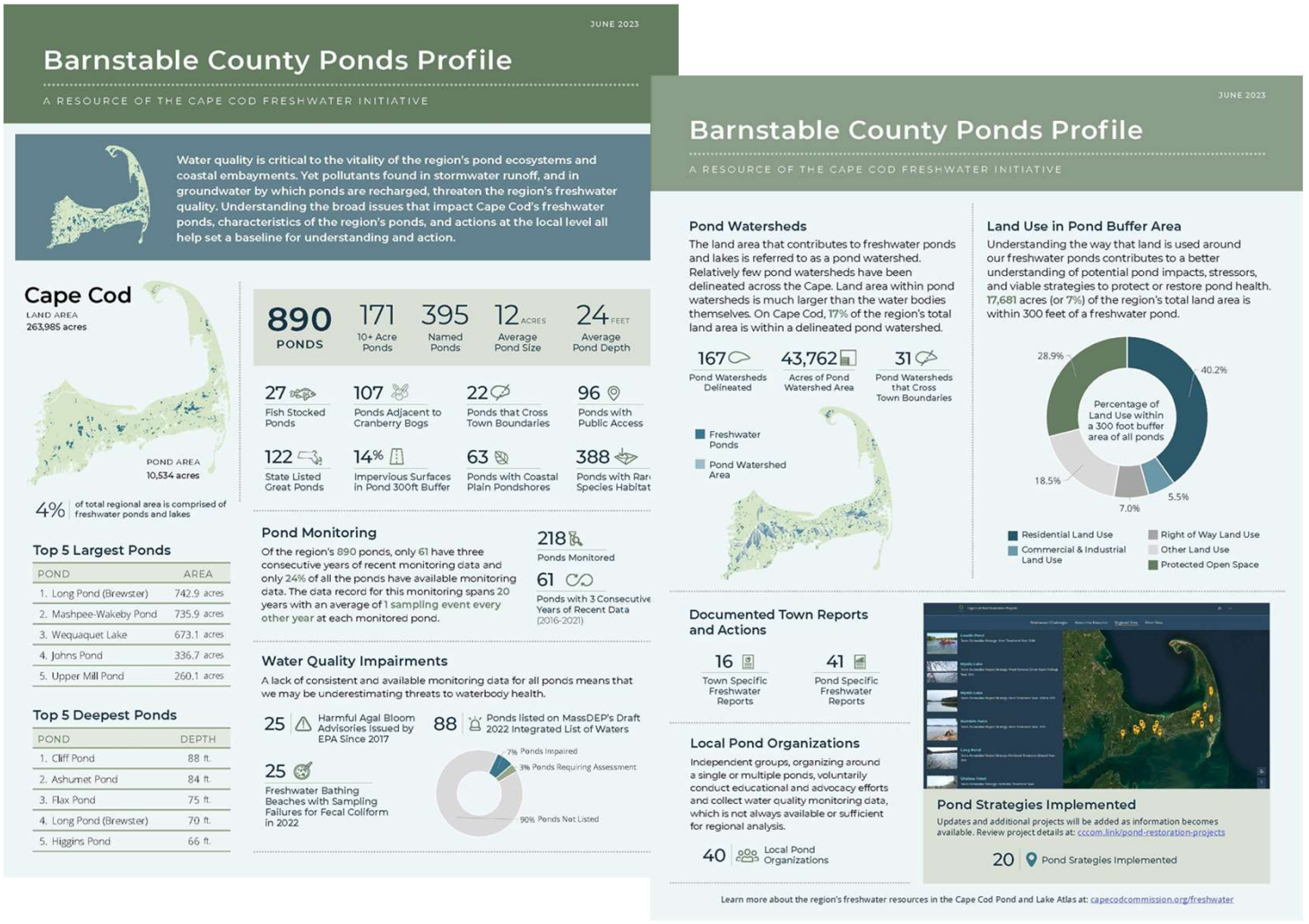
13
Pond Watersheds that Cross Town Boundaries

The land area that contributes to freshwater ponds and lakes is referred to as a pond watershed. Relatively few pond watersheds have been delineated across the Cape. Land area within pond watersheds is much larger than the water bodies themselves.



Pond Profiles

Expanded Pond Profiles provide a snapshot of regional and town-by-town pond information, including physical characteristics, existing monitoring efforts, watersheds, strategies, and more.



JUNE 2023

Barnstable County Ponds Profile

A RESOURCE OF THE CAPE COD FRESHWATER INITIATIVE

Water quality is critical to the vitality of the region's pond ecosystems and coastal embayments. Yet pollutants found in stormwater runoff, and in groundwater by which ponds are recharged, threaten the region's freshwater quality. Understanding the broad issues that impact Cape Cod's freshwater ponds, characteristics of the region's ponds, and actions at the local level all help set a baseline for understanding and action.

Cape Cod

LAND AREA
263,985 acres

POND AREA
10,534 acres

4% of total regional area is comprised of freshwater ponds and lakes

890 PONDS | 171 10+ Acre Ponds | 395 Named Ponds | 12 ACRES Average Pond Size | 24 FEET Average Pond Depth

27 Fish Stocked Ponds | 107 Ponds Adjacent to Cranberry Bogs | 22 Ponds that Cross Town Boundaries | 96 Ponds with Public Access

122 State Listed Great Ponds | 14% Impervious Surfaces in Pond 300ft Buffer | 63 Ponds with Coastal Plain Pondshores | 388 Ponds with Rare Species Habitat

Top 5 Largest Ponds

POND	AREA
1. Long Pond (Brewster)	742.9 acres
2. Mashpee-Wakeby Pond	735.9 acres
3. Wequaquet Lake	673.1 acres
4. Johns Pond	336.7 acres
5. Upper Mill Pond	260.1 acres

Top 5 Deepest Ponds

POND	DEPTH
1. Cliff Pond	88 ft.
2. Ashumet Pond	84 ft.
3. Flax Pond	75 ft.
4. Long Pond (Brewster)	70 ft.
5. Higgins Pond	66 ft.

Pond Monitoring

Of the region's 890 ponds, only 61 have three consecutive years of recent monitoring data and only 24% of all the ponds have available monitoring data. The data record for this monitoring spans 20 years with an average of 1 sampling event every other year at each monitored pond.

218 Ponds Monitored

61 Ponds with 3 Consecutive Years of Recent Data (2016-2021)

Water Quality Impairments

A lack of consistent and available monitoring data for all ponds means that we may be underestimating threats to waterbody health.

25 Harmful Agal Bloom Advisories Issued by EPA Since 2017

88 Ponds listed on MassDEP's Draft 2022 Integrated List of Waters

25 Freshwater Bathing Beaches with Sampling Failures for Fecal Coliform in 2022

7% Ponds Impaired
3% Ponds Requiring Assessment
90% Ponds Not Listed

JUNE 2023

Barnstable County Ponds Profile

A RESOURCE OF THE CAPE COD FRESHWATER INITIATIVE

Pond Watersheds

The land area that contributes to freshwater ponds and lakes is referred to as a pond watershed. Relatively few pond watersheds have been delineated across the Cape. Land area within pond watersheds is much larger than the water bodies themselves. On Cape Cod, 17% of the region's total land area is within a delineated pond watershed.

167 Pond Watersheds Delineated | 43,762 Acres of Pond Watershed Area | 31 Pond Watersheds that Cross Town Boundaries

Freshwater Ponds
Pond Watershed Area

Land Use in Pond Buffer Area

Understanding the way that land is used around our freshwater ponds contributes to a better understanding of potential pond impacts, stressors, and viable strategies to protect or restore pond health. 17,681 acres (or 7%) of the region's total land area is within 300 feet of a freshwater pond.

Percentage of Land Use within a 300 foot buffer area of all ponds

28.9% | 40.2% | 18.5% | 7.0% | 5.5%

Residential Land Use
Commercial & Industrial Land Use
Right of Way Land Use
Other Land Use
Protected Open Space

Documented Town Reports and Actions

16 Town Specific Freshwater Reports | 41 Pond Specific Freshwater Reports

Local Pond Organizations

Independent groups, organizing around a single or multiple ponds, voluntarily conduct educational and advocacy efforts and collect water quality monitoring data, which is not always available or sufficient for regional analysis.

40 Local Pond Organizations

Pond Strategies Implemented

Updates and additional projects will be added as information becomes available. Review project details at: cccom.link/pond-restoration-projects

20 Pond Strategies Implemented

Learn more about the region's freshwater resources in the Cape Cod Pond and Lake Atlas at: capecodcommission.org/freshwater

CAPE COD FRESHWATER INITIATIVE

ENGAGEMENT AND OUTREACH

Pond Network

Coalition of pond groups and associations or pond water quality monitors to invite connection, collaboration, and shared resources

Municipal Meetings

Meetings with representatives from the 15 towns to better understand local priorities, challenges, and opportunities

Technical Advisory Group

Technical experts will advise components of the Initiative such as the freshwater quality strategies database

Stakeholder Engagement

Engagement that incorporates broad stakeholder representation to understand priorities, the range of potential solutions, and build consensus on a framework for action

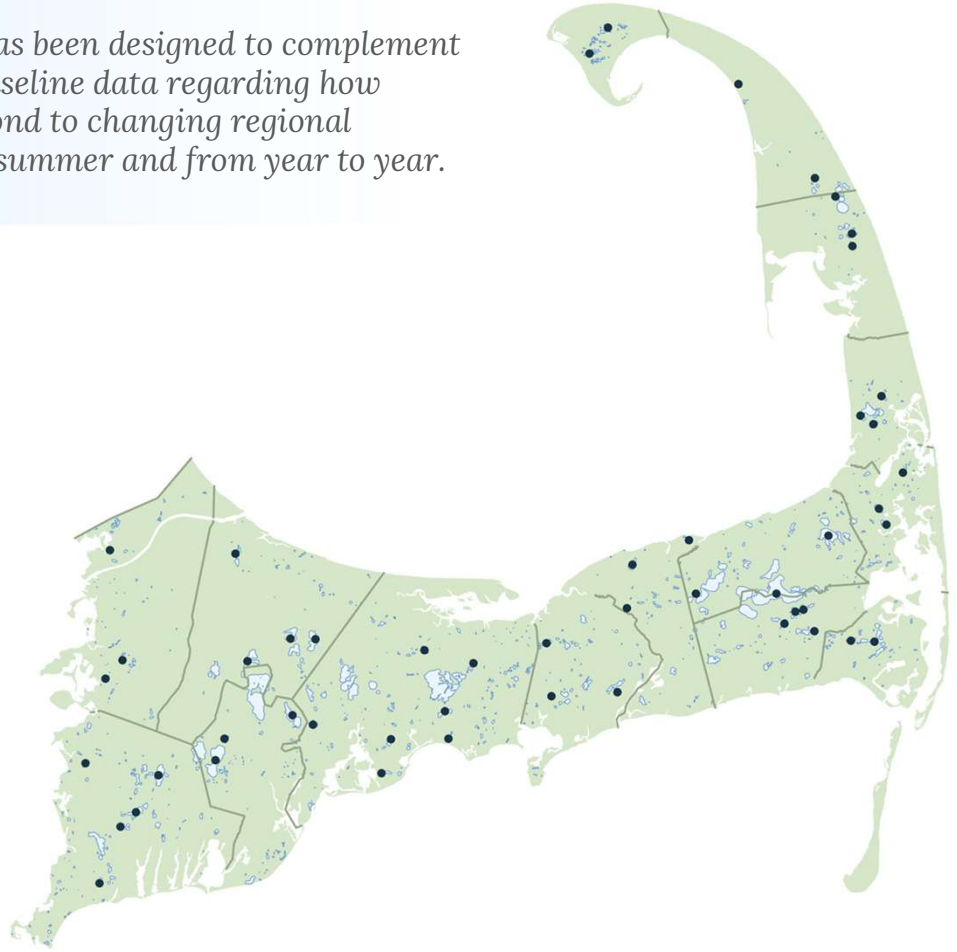
CAPE COD FRESHWATER INITIATIVE

REGIONAL POND MONITORING PROGRAM

The Regional Pond Monitoring Program has been designed to complement existing monitoring efforts and provide baseline data regarding how different types of ponds on Cape Cod respond to changing regional environmental conditions throughout the summer and from year to year.

Pond selection criteria:

- Spatial coverage across all towns and aquifer lenses
- Range of physical characteristics e.g., pond size, depth, level of watershed development
- Stream/herring run connections, implementation projects, and Coastal Plain Pondshore community
- Water quality status
- Public uses of ponds
- Located in or adjacent to environmental justice area

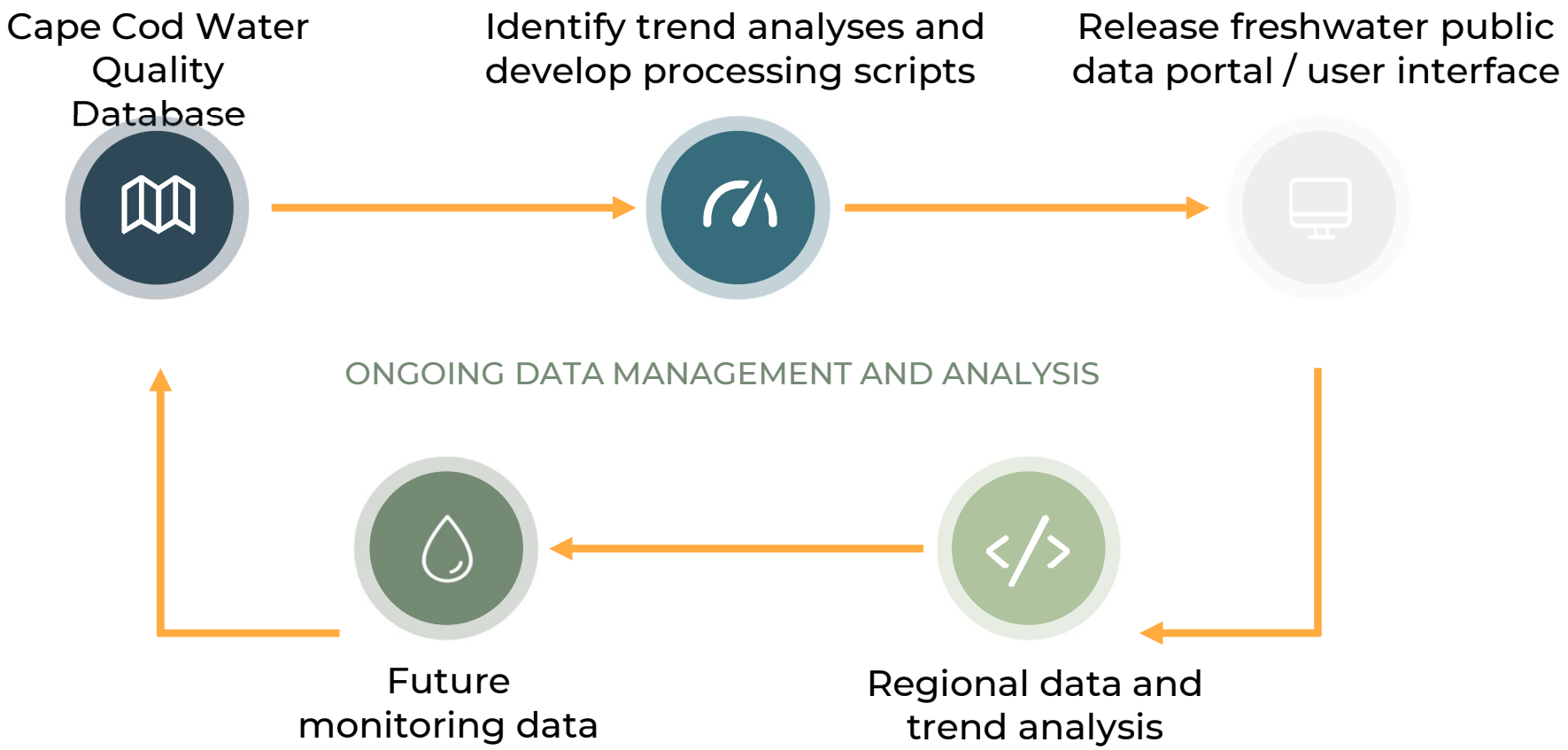


Ponds by Town

Barnstable	7
Bourne	3
Brewster	3
Chatham	2
Dennis	3
Eastham	3
Falmouth	5
Harwich	4
Mashpee	3
Orleans	3
Provincetown	2
Sandwich	4
Truro	2
Wellfleet	3
Yarmouth	3

CAPE COD FRESHWATER INITIATIVE

DATA MANAGEMENT AND ANALYSIS

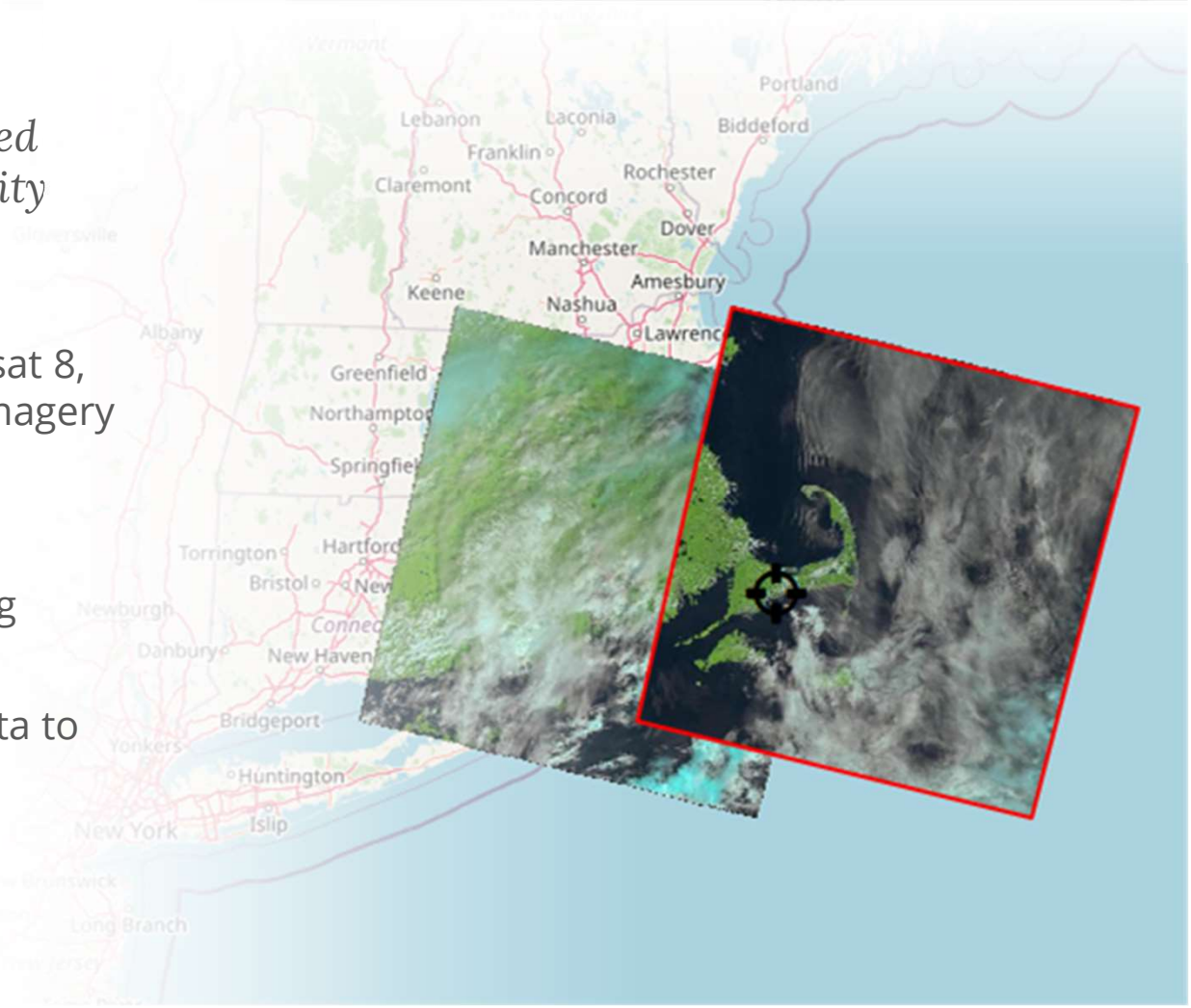


CAPE COD FRESHWATER INITIATIVE

REMOTE SENSING

Investigating the use of satellite-derived imagery and existing pond water quality data to quantify changes in pond characteristics

- Partnership with NOAA, using Landsat 8, Landsat 9, and Sentinel 2 satellite imagery (images every 5-16 days)
- Connecting imagery to water clarity
- Field validation data collected during satellite overpass to calibrate
- Sufficient satellite and validation data to analyze 217 ponds



CAPE COD FRESHWATER INITIATIVE

POND STRATEGIES DATABASE

SCALE OF APPROACHES:

WATERSHED

Comprehensive watershed planning, land use regulations, land protection, advanced wastewater treatment

POND SHORES

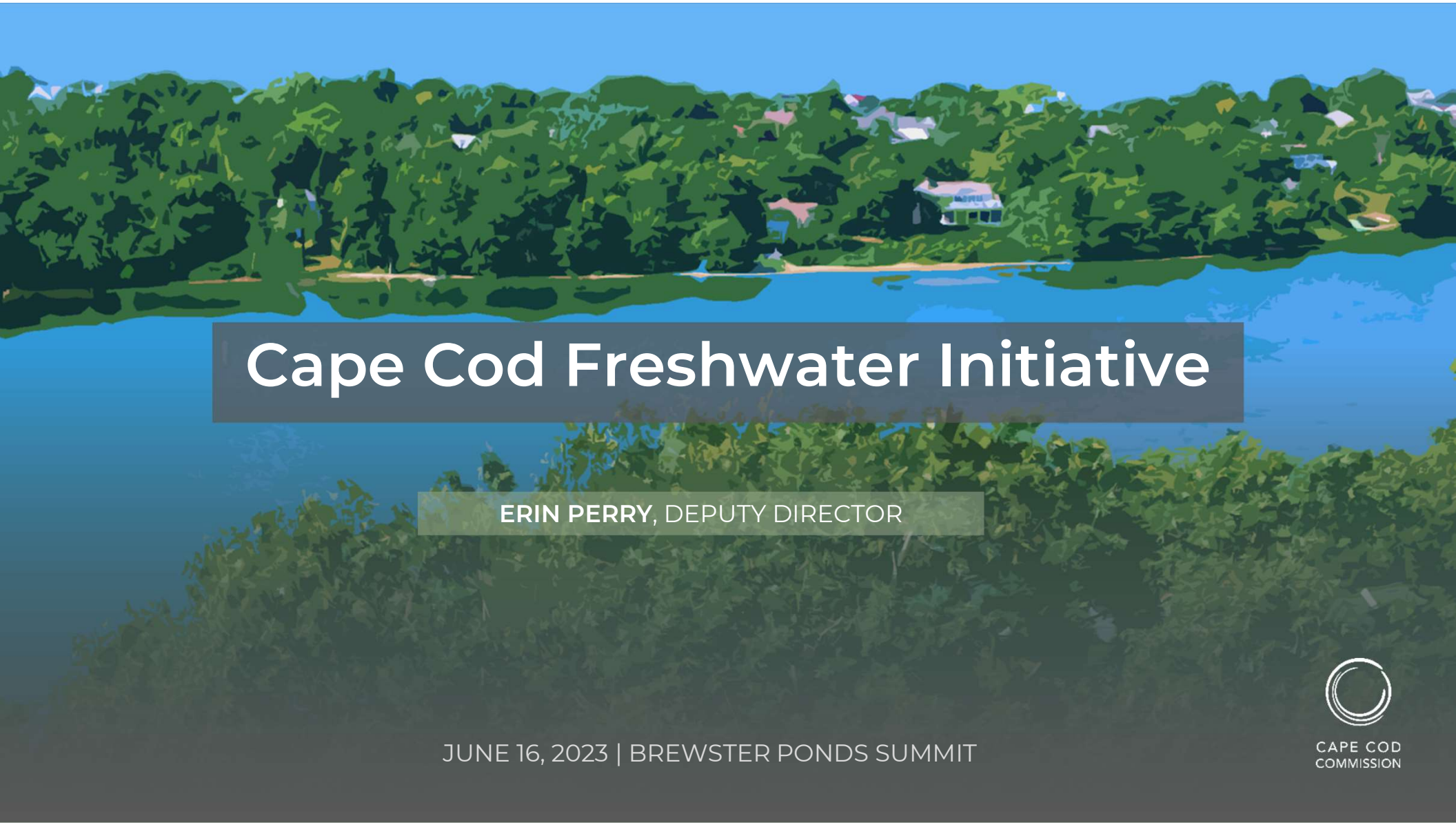
Vegetated buffers, fertilizer management, septic setbacks, I/A septic systems

IN POND

Sediment, nutrient, algae, and vegetation management approaches

DATABASE INCLUDES:

Policy Approaches | Physical Approaches | Chemical Approaches | Biological Approaches



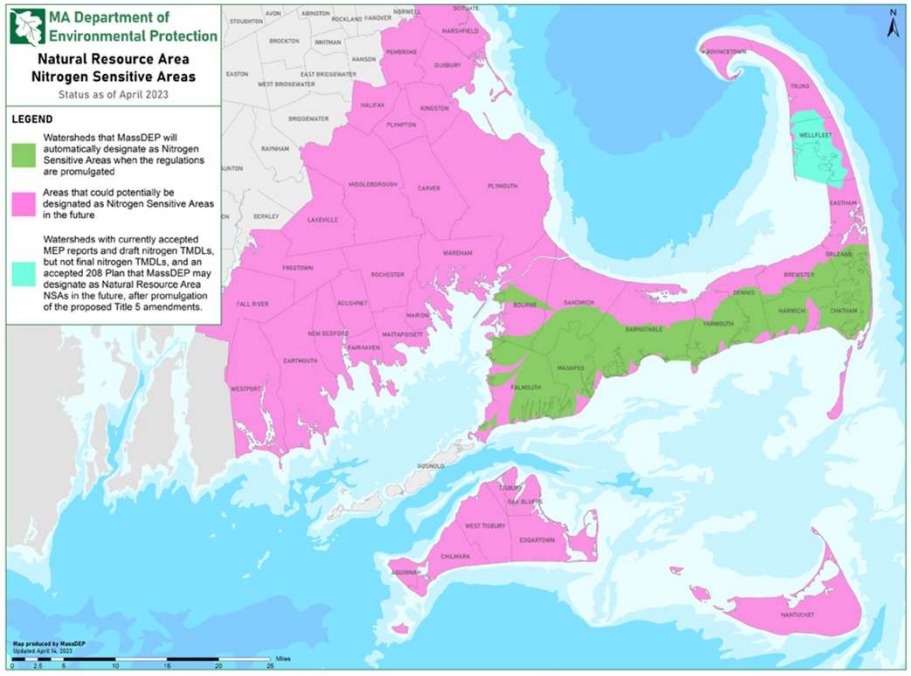
Cape Cod Freshwater Initiative

ERIN PERRY, DEPUTY DIRECTOR

JUNE 16, 2023 | BREWSTER PONDS SUMMIT

CAPE COD COMMISSION

Restoring our Coastal Estuaries – Proposed Changes to Title 5



Horsley Witten Group, Inc.

Mass DEP's Goal - Accelerate the Restoration of Coastal Estuaries

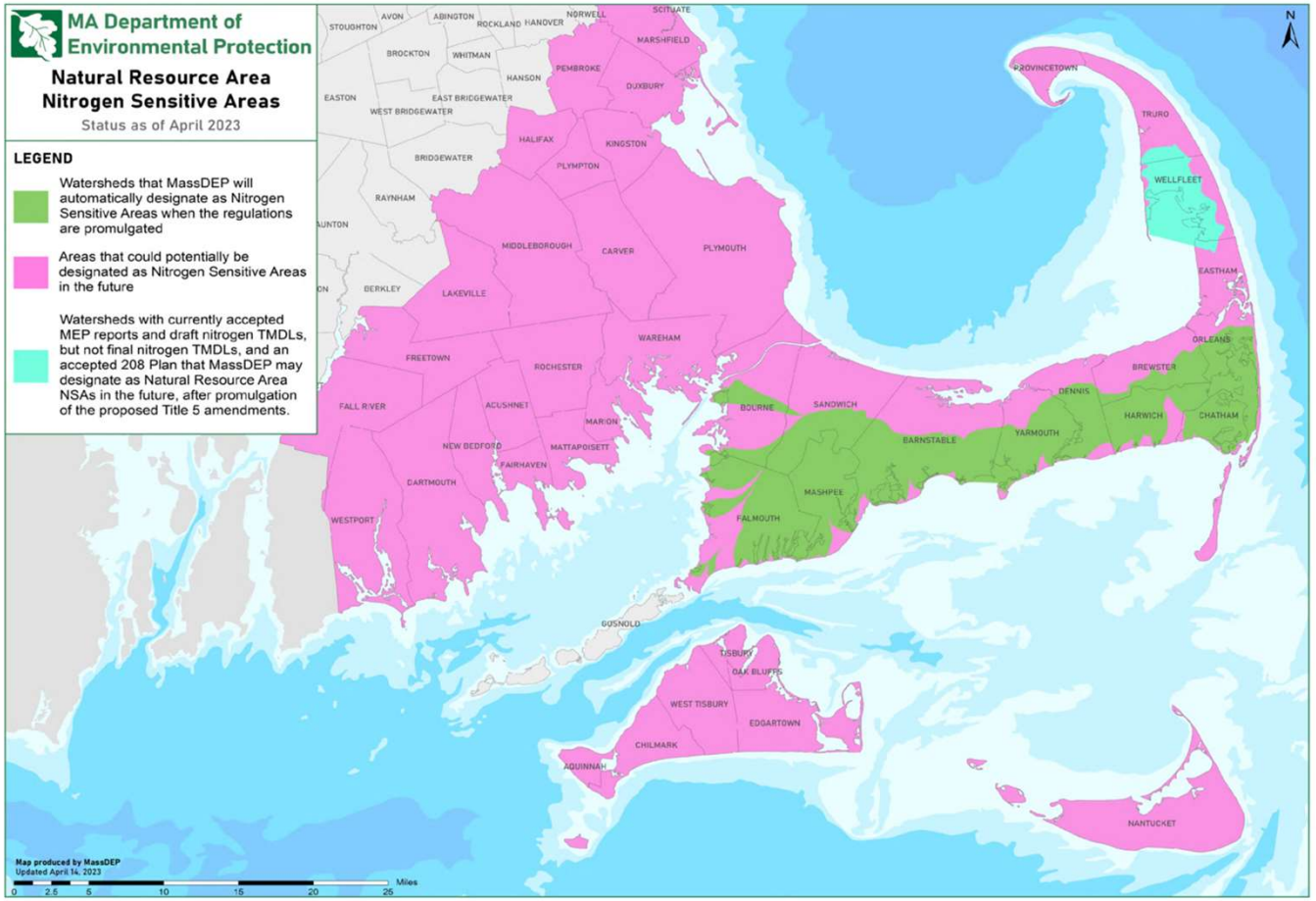
- Two Proposed Options:

  - Require Septic System Upgrades

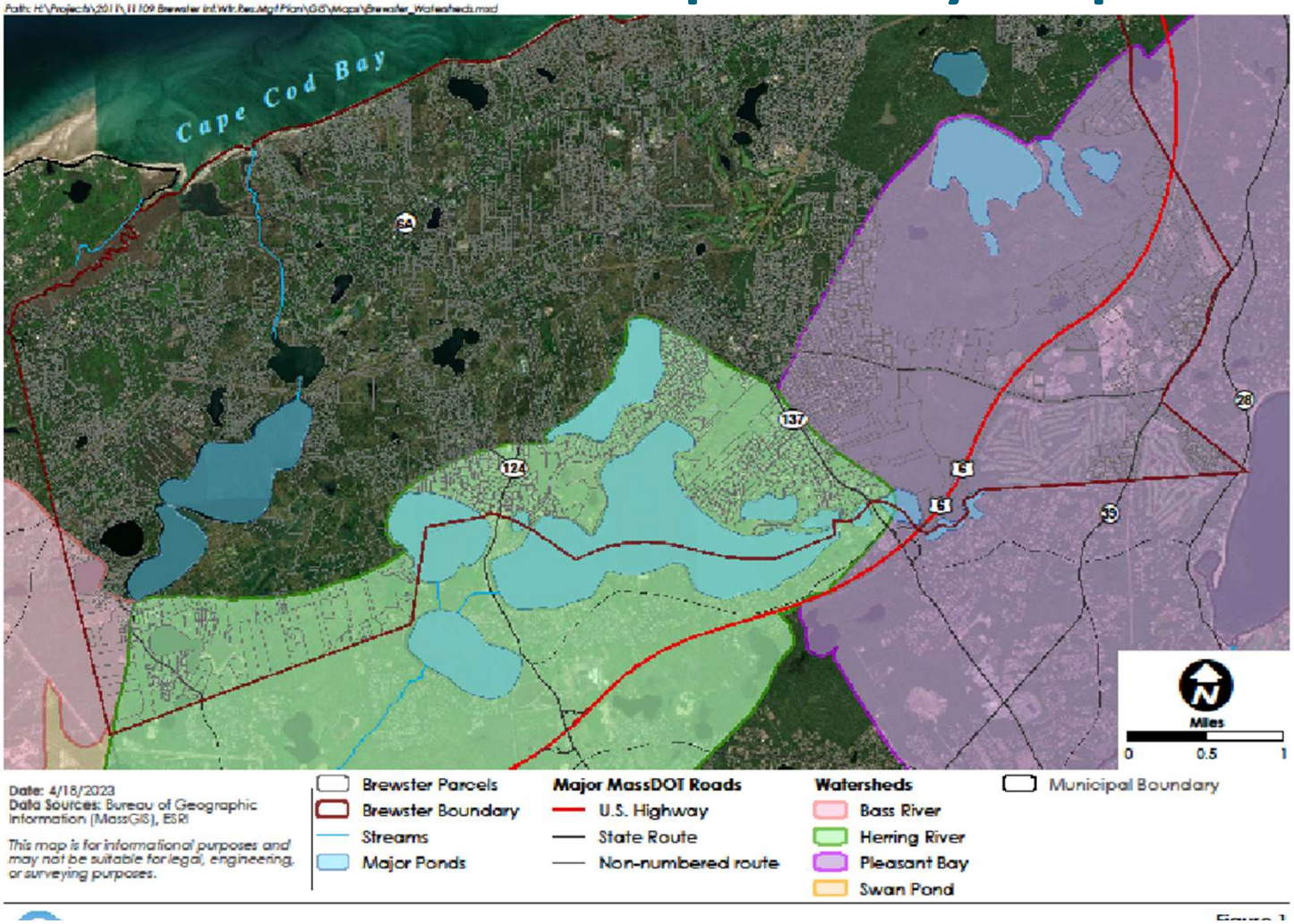
    - OR –

  - Initiate Watershed Permits for Specific Estuaries

Jurisdiction of Proposed Regs

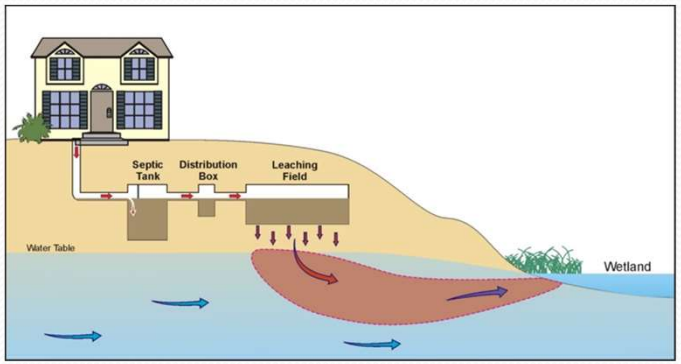


Brewster Watersheds Impacted by Proposed Regs



Proposed Title 5 Changes

- Septic Systems In Impaired Watersheds Must Be Upgraded to Treat for Nitrogen within 5 Years of the Regulations
  - Unless:
- A Town or Towns File a Notice of Intent to Obtain a Watershed Permit



Watershed Permits

- Similar to the Process Used to Obtain the Pleasant Bay Watershed Permit by Brewster, Chatham, Harwich and Orleans

Watershed Permits

- If Towns can file a notice of intent to obtain a permit within 18 months the Title 5 upgrade regs are paused.

- Proposed permit must document the removal of 75% of the nitrogen needed to meet the watershed TMDL in 20 years.

- Permit can be for 1 town or combination of towns sharing a watershed.

Watershed Permits

- Permit requires annual reporting on progress to restore the estuary.

- Provides flexibility in the options to remove nitrogen as new information is available.

Proposed Title 5 Requirements

- If no permit is requested, homeowners have five years to upgrade their septic system.
- Must use "Best Available Nitrogen Reducing Technology".
- Designed to encourage towns to request watershed permits.

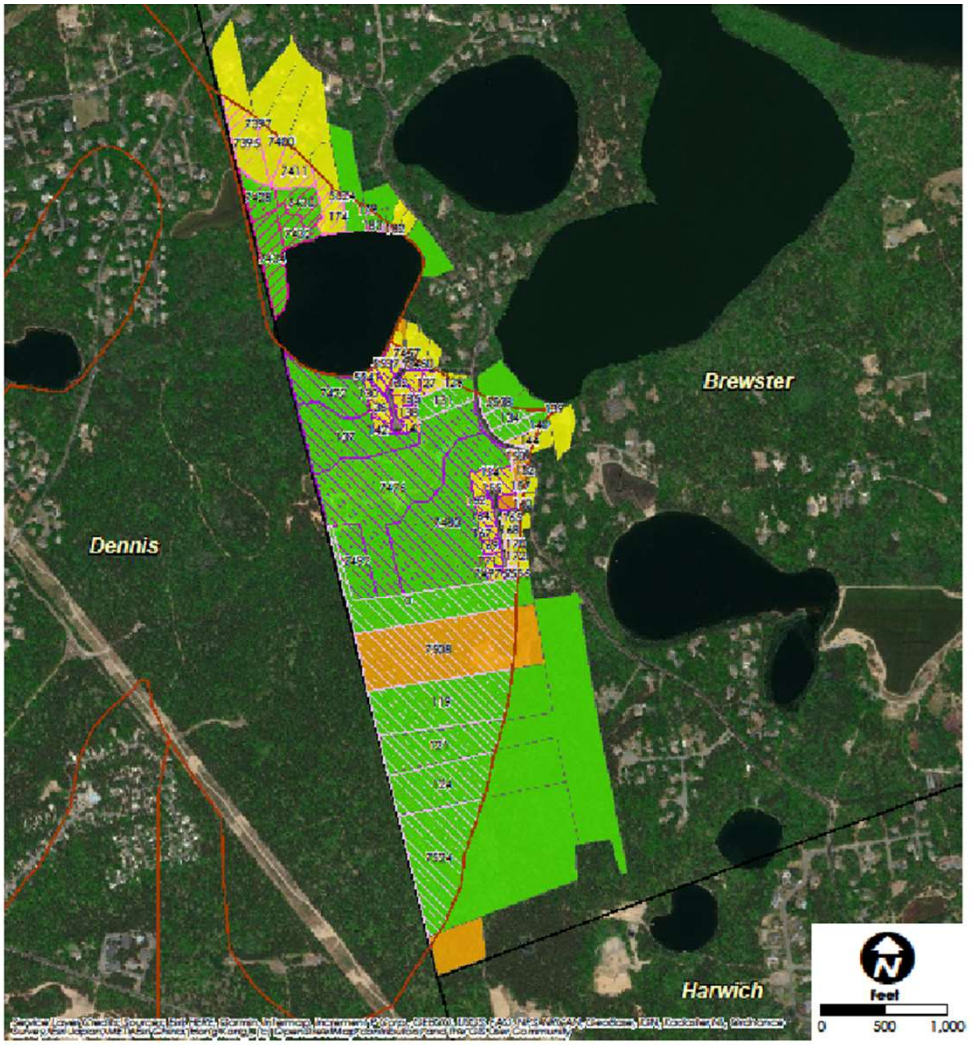
Current Status

- Public hearings held last November – January
- Comments received through January 30, 2023
- Recent Advisory Committee Meeting provided updates on status – potential changes

Town and Ponds Coalition Comments

- 5-year timeframe to upgrade septic systems not feasible
- Concerns with "Best Available Nitrogen Reducing Technology."
- Need a simplified permit process for small watershed areas that little nitrogen removal is needed.

Bass River Watershed



Town and Ponds Coalition Comments

- Proposed Regulations Need to Consider Ponds
  - Currently not part of the proposed regs
  - Could phosphorus treatment could be included in a septic system upgrade?

Thanks

Mark Nelson, Principal
Horsley Witten Group, Inc.
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Managing Decentralized Wastewater Treatment Infrastructure

How to Make Septic Systems a Thing of the Past

BRIAN BAUMGAERTEL

SENIOR ENVIRONMENTAL SPECIALIST

MASSTC DIRECTOR

What is Decentralized Wastewater Treatment Infrastructure?

Hypothetical Watershed

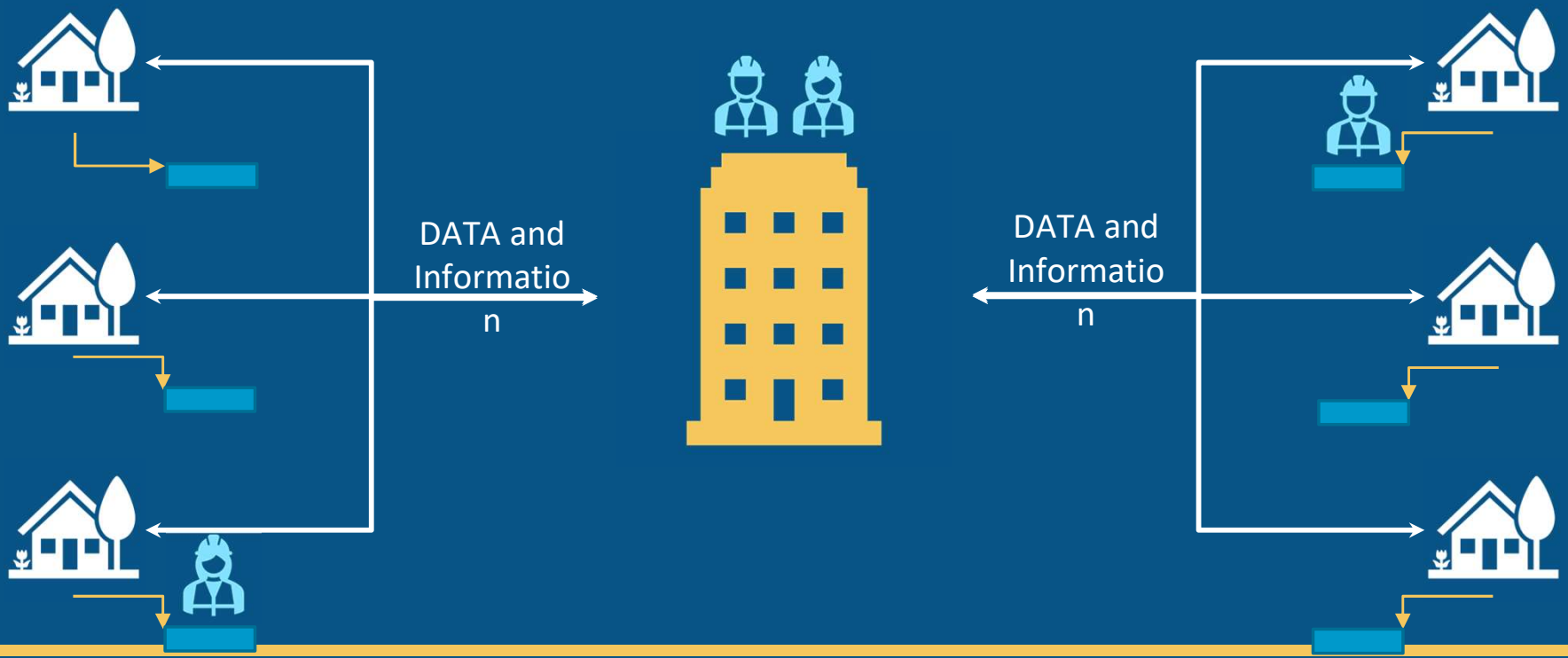
Problem: Too Much Nitrogen (or Phosphorus)

Infrastructure *(noun)*

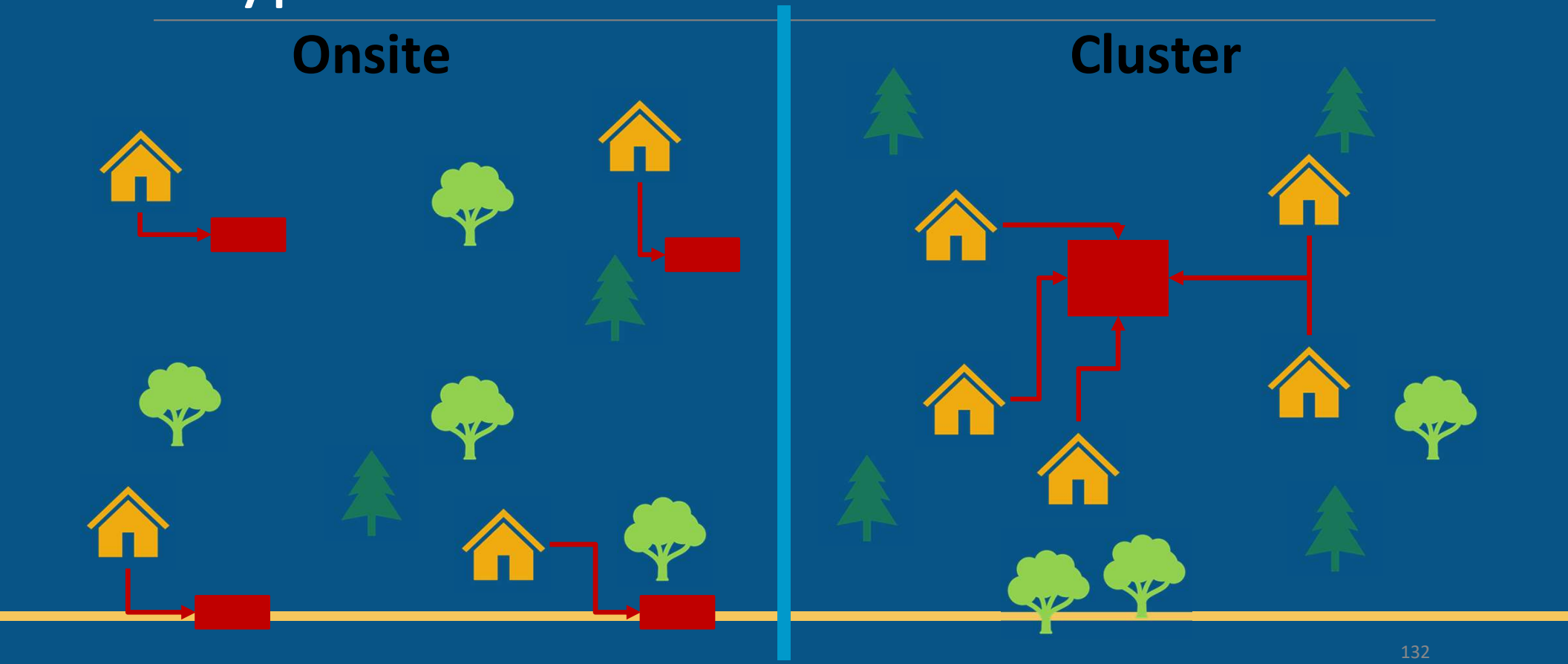
the basic physical and organizational structures and facilities (e.g. buildings, roads, power supplies) needed for the operation of a society or enterprise.

Centralized Treatment Infrastructure

Decentralized Treatment Infrastructure



Types of Decentralized Infrastructure



Three Questions

1. Do we have the technology?
2. How do we pay for it?
3. How do we install and manage it?

Currently Best-Performing Technologies

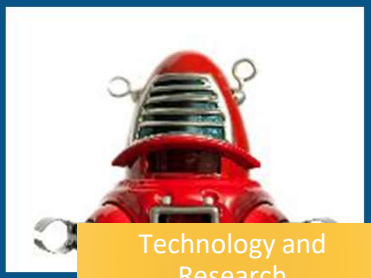
Less than 10 mg/L TN	Nitroe by Kleantu
	Nitrex by Lombardo Associates
	Layer Cake “Nonproprietary Woodchip Systems”
Between 10 and 15 mg/L TN	FujiClean
	HydroAction
	BioMicrobics MBBR
Others in the mix	Advantex

How do we Manage the Lifecycle of DWTI?

Lifecycle Management of DWTI:
A Spectrum Services


Planning


Communication


Technology and Research


Finance


Design and Construction


Operation and Maintenance


Monitoring and Compliance


Records and Reporting

Responsible Management Entities

An organization or collection of organizations tasked with overseeing the cradle-to-grave lifecycle of decentralized wastewater treatment infrastructure

5-year project to develop and implement a

Regional RME Program

Regional Responsible Management Entity Primary Goals

- Help towns meet TMDL's
- Reduce risk to homeowners
- Cost Effective
- Financially Self-Sustainable
- Maintain Flexibility

How do we Pay for DWTI?

Cape Cod AquiFund (formerly CSMLP)

Helping to make the costs of clean water solutions more equitable

0%, 2%, and 4% per annum betterment loans.

Lowest interest rate goes to those who need more help.

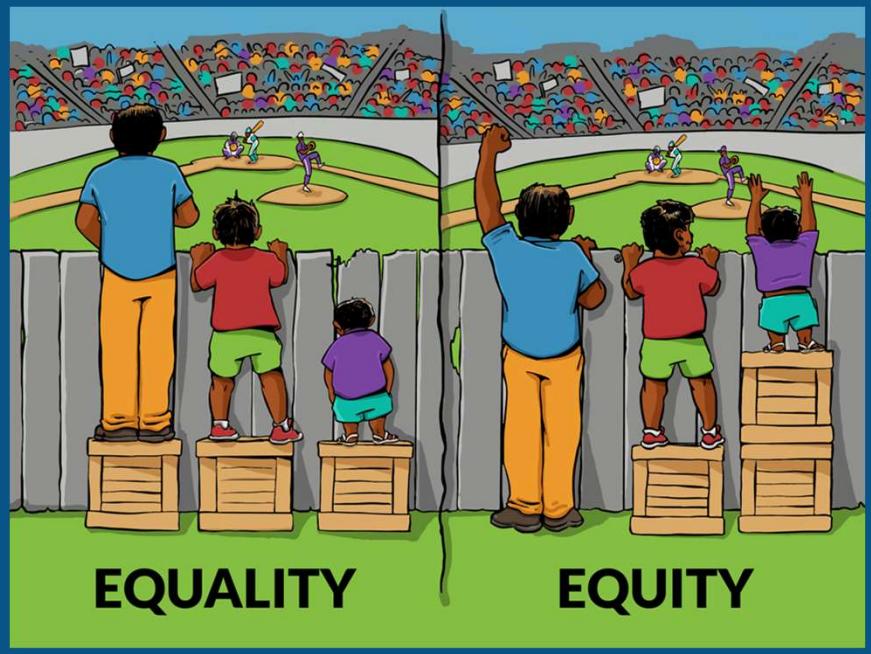


Image Credit:

Interaction Institute for Social Change | Artist: Angus Maguire.

What kinds of projects are eligible?

Installation of a nutrient-reducing I/A technology*

Installation of a sewer connection

*In a town-mandated nutrient removal project

Learn More

www.capecod.gov/aquifund

www.masstc.org/rme

FINANCING BREWSTER'S WATER RESOURCE INITIATIVES

BREWSTER POND SUMMIT 2023

PETER LOMBARDI
TOWN MANAGER

CAPE COD & ISLANDS WATER PROTECTION FUND (CCIWPF)

- Established by MA legislature in 2018 (Chapter 337 of the Acts of 2018) to help 15 Cape & Island towns pay for wastewater infrastructure and water quality remediation projects to meet obligations of the 208 Plan
- Affiliated with existing state programs – State Revolving Fund (SRF) and Clean Water Trust (CWT)
- Funded through new 2.75% additional surcharge added to all lodging transactions (both traditional and short-term rentals) on Cape effective July 1, 2019

CCIWPF GOVERNANCE

- Board is comprised of member representatives from each town – must be Town staff or Select Board
- Cape Cod Commission (CCC) provides administrative support and technical assistance
- Board is responsible for determining allocating funds, including equitable distribution among participating towns for eligible projects and debt relief
- Regulations and bylaws originally developed and adopted in Fall 2020

CCIWPF FINANCIAL ASSUMPTIONS

- Assumed $66M in prior eligible debt plus $60M/year in new loans by FY22 with 2% annual escalator
- Assumed $19M/year in revenues by FY23 with 2.5% annual escalator
- 25% subsidy for new projects in equal installments over 4 years for Clean Water Trust loans (SRF eligible) – 50% for projects less than $1M
- 25% subsidy for pre-existing projects in equal installments over 10 years for already issued debt

CCIWPF FINANCIAL ACTUALS

- $167M in Cape-wide SRF eligible projects in FY23 – almost 275% higher than projected (more projects and at a higher cost)
- Eligible project costs are currently expected to drop down to $125M in FY24 with 2% annual escalator – still 200% higher than originally anticipated
- $21M in annual revenues with 2-3% annual escalator – slightly higher than expected

CCIWPF FINANCIAL FUTURE

- At current rate, fund will be insolvent by FY24
- Does not account for increased funding requests related to proposed changes to Title 5 regulations and adoption of new DEP watershed regulations (focused solely on nitrogen mitigation)
- CCIWPF Board examining combination of potential reductions to subsidy levels and advocating for ~$70M in supplemental state funding over next several years

CCIWPF PROJECT ELIGIBILITY

- As drafted, statute explicitly allowed CCIWPF funds to cover costs of innovative/alternative (I/A) septic systems
- Eligibility of non-traditional wastewater solutions for SRF funding has been uncertain – must be on DEP's annual Intended Use Plan (IUP)
- Brewster contributes ~$1M/year to CCIWPF
- Brewster's long-term non-traditional water quality initiatives projected to cost $20-30+M as of Spring 2022

CCIWPF PROJECT ELIGIBILITY CONTINUED

- In March 2022, CCIWPF Board authorized CCC to provide technical assistance to help answer this question
- CCC completed their work this month – their analysis points to similar non-traditional initiatives that have received SRF funding (e.g. Wellfleet)
- DEP has also recently changed their SRF evaluation criteria to favor Cape projects – documenting environmental impacts and related goals in Town planning documents are key

SHORT-TERM RENTAL TAX

- New 6% surcharge was placed on short-term rentals (STRs) statewide effective July 1, 2019
- Revenues are collected by state and disbursed to towns on quarterly basis
- Towns could not include STR revenues in operating budget projections until FY21
- State data on traditional lodging tax vs. STR revenues in first few years was lacking

SHORT-TERM RENTAL TAX CONTINUED

- Actual revenues have consistently outpaced projections
- $1M in projected STR revenues in FY24 Town operating budget – comparable to traditional lodging revenues
- Select Board adopted policy in Spring 2020 that allocated 50% of projected STR revenues to the Affordable Housing Trust, 40% to Capital Stabilization Fund, and no more than 10% to General Fund

WATER QUALITY CAPITAL STABILIZATION FUND

- Brewster has historically funded water quality projects, including their Integrated Water Resource Management Plan, from Free Cash
- Town Meeting voted to create this new capital stabilization fund in May 2022
- Funds must be spent on water quality initiatives and require 2/3 vote of Town Meeting to be appropriated

WATER QUALITY CAPITAL STABILIZATION FUND CONTINUED

- Select Board updated their STR revenue allocation policy in Spring 2022 to direct 15% of projected revenues to new fund, effective in FY23 Town operating budget ($112,500)
- $150k in FY24 Town operating budget transferred to this fund
- Examples of funded projects include Town-wide pond water quality analysis updated ($50k) and Walkers Pond water quality improvements ($82k)

Contaminants of Emerging Concern (CEC's) in Wastewater

Kimberley Crocker Pearson MS MD MPH

What are CEC’s?

- Contaminants of Emerging Concern (CECs) are chemicals that have been found in water bodies
- CEC’s may cause ecological or human health impacts and are not currently regulated
- There are two general categories:
    - Those that are commonly used in households
    - Those primarily used in industry

Household:

- Pharmaceutical and Personal Care Products (PPCP's)
  - Prescription and over-the counter drugs
  - Fragrances and Cosmetics
  - Sunscreen products
  - Detergents
  - Antimicrobials
- Other common products:
  - Microplastics
    - Microbeads banned in rinse-off products since 2015
    - Still may be used in deodorants, lotion and makeup

Commercial:

- Industrial chemicals
  - Pesticides
  - Per- and polyfluorinated alkyl substances (PFAS)
    i. Manufacturers use PFAS to make products resistant to oil, heat, stain, or water
    ii. Flame retardants
- Agricultural pharmaceuticals
  - Antibiotics
- Endocrine Disruptors
  - Bisphenol A (BPA)
  - Phthalates

CECs enter septic systems in three ways:

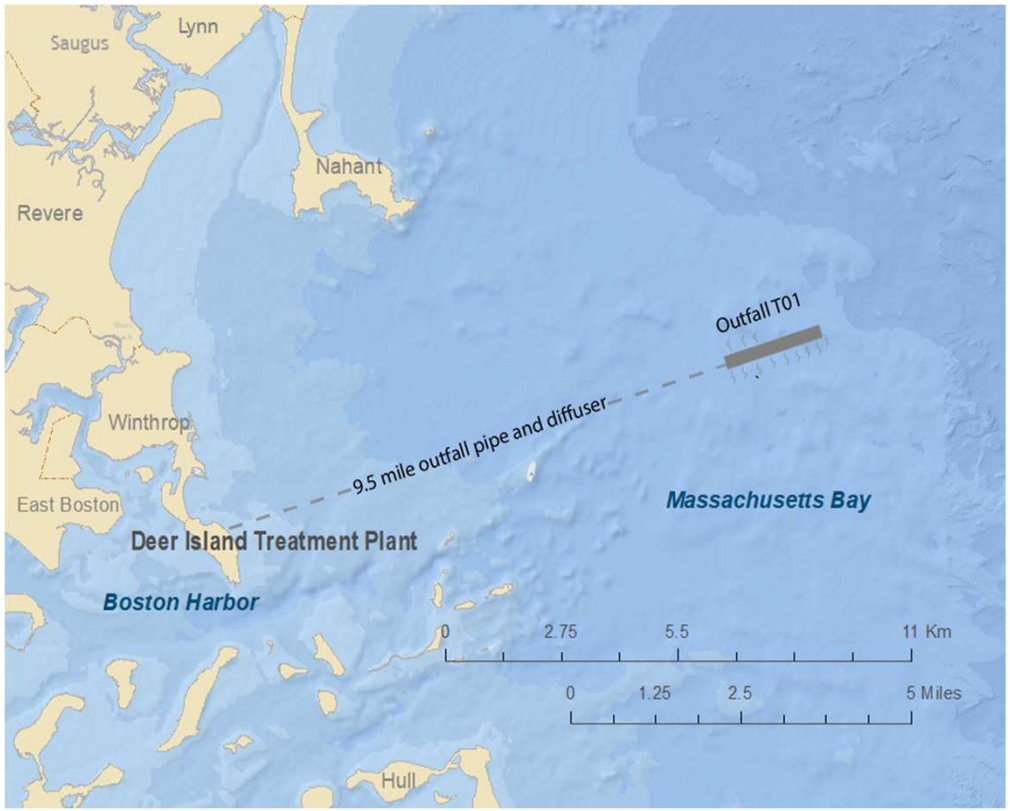
- Direct disposal – People may dispose of products down a household drain
  - Example: flushing unused pharmaceuticals in the toilet may lead to a high concentration of PPCPs in wastewater
- Indirect disposal – CECs enter the wastewater stream due to indirect contact with the substance
  - Example: microplastics enter wastewater from laundering synthetic material like fleece jackets, microfiber towels, and polyester materials
- Excretion – People and livestock consume – then excrete – drugs and their breakdown products. The chemicals then get into our wastewater treatment plants, septic systems, and stormwater runoff

Wouldn’t sewers and treatment plants solve this problem?

Standard Wastewater Treatment is not designed to remove CEC's

- Wastewater treatment plants are designed to remove excess nutrients like nitrogen and phosphorus, kill pathogens, and filter out items like gravel and sneakers that find their way into the waste stream
- Traditional treatment may remove some types of CECs from waste; however, there are multiple common CECs that are not removed by biological treatment
- In fact, the heat generated by microbial digestion of waste can change PFAS precursor molecules in to PFAS toxins
- There are some newer, more advanced treatment technology options that can remove some of these contaminants but they tend to be expensive to implement and very energy intensive to operate

The Deer Island Treatment Plant Outfall: Stellwagen Bank National Marine Sanctuary



Unintended Consequences

- Scientists took water samples at various depths near the outfall and measured for 17 pharmaceuticals, caffeine, sucralose, and 25 per- and polyfluoroalkyl substances (PFAS) surrounding the wastewater discharge tunnel from Deer Island
- Ten of 17 pharmaceuticals, sucralose, caffeine, and 9 PFAS were detected in surface and bottom water at different points during the seasons
- Concentrations were proportional to proximity to the outfall
- In a companion study, PFAS was found in the livers of juvenile seabirds from Massachusetts Bay

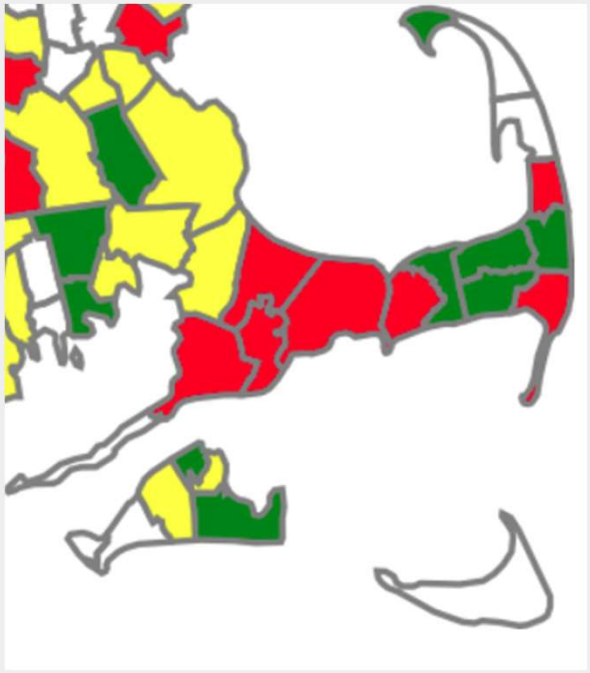
- We cannot treat our way out of our current CEC predicament; we must change our consumption habits
- Minimizing use and responsible disposal of CEC’s does not need to disrupt day to day life
- With good information, consumers have the power to make choices that drive markets in more sustainable directions
- We don't need a handful of people avoiding CEC’s perfectly. We need millions of people doing it imperfectly

UN Sustainable Development Goal 12:

Responsible Consumption and Production

“Unsustainable patterns of consumption and production are the root causes of the triple planetary crises of climate change, biodiversity loss and pollution. These crises, and related environmental degradation, threaten human well-being and achievement of the Sustainable Development Goals.”

Brewster drinking water has been tested for PFAS and none have been detected



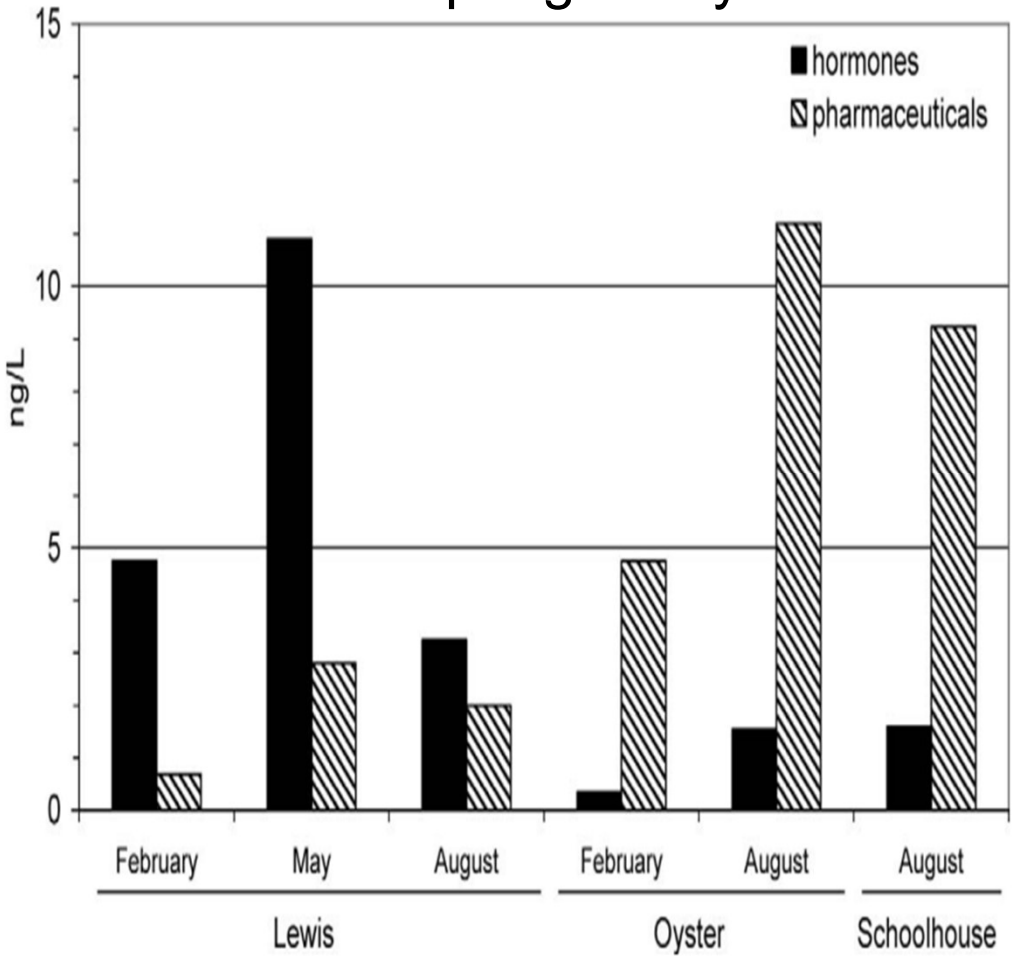
Key:

Green = 0 ppt of PFAS6 reported

Yellow = PFAS6 detected under state MCL

Red = exceeds state MCL for PFAS6

Contaminants of Emerging Concern in Brewster Ponds: 2008 Silent Spring Study



- Silent Spring Institute studied six Cape Cod ponds, three in high-density residential areas and three in low-density residential areas.
- All of the homes near the six ponds have septic systems.
- Researchers found higher concentrations of pharmaceuticals in the ponds in higher-density areas than in lower-density areas

CEC Detox: 6 small steps to reduce your use and protect our water

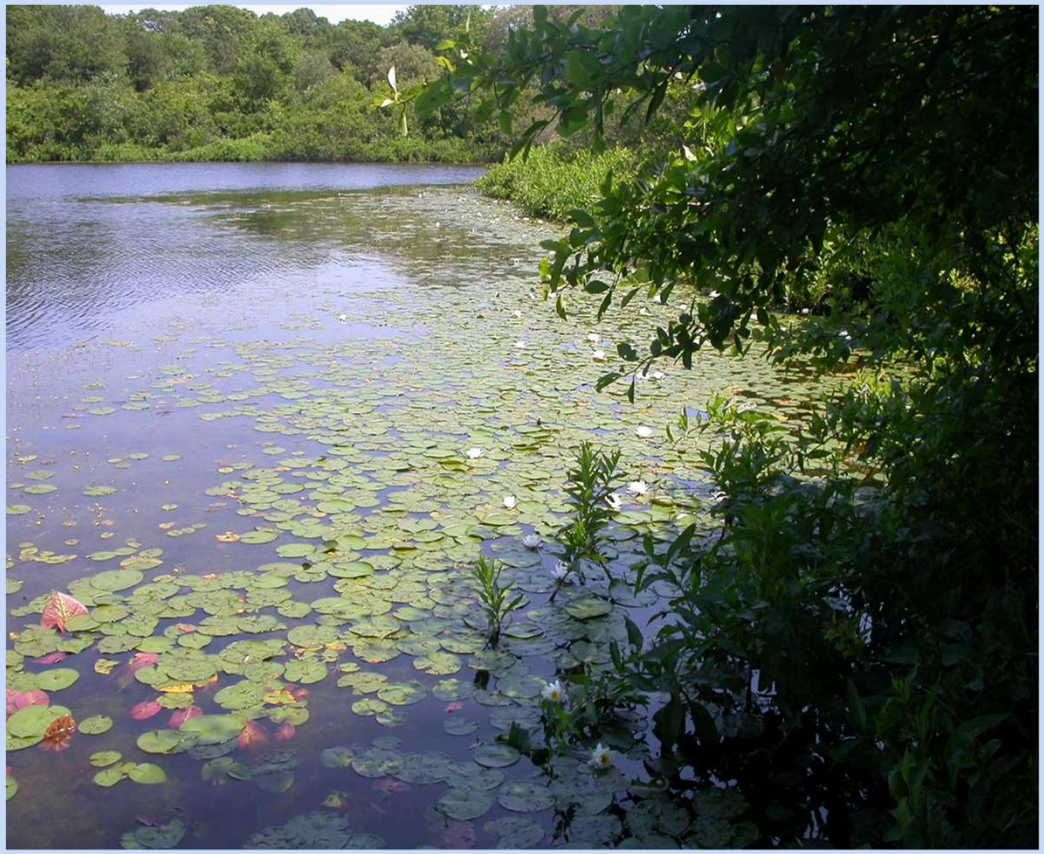
1. Take advantage of prescription and over-the-counter pharmaceutical take back events
2. Do a personal care product inventory. Avoid using water-resistant products and products with PTFE or “fluoro-” in the ingredients
3. Avoid taking thermal paper receipts which contain BPA. Many stores will provide receipts by email
4. Do not dispose of chemicals in household drains or toilets. Take advantage of local hazardous materials collections.
5. Maintain your septic system as recommended
6. Subscribe to the Green Science Policy Institute to receive consumer information on how to limit your use of CEC’s in future purchases

The Brewster Ponds Coalition and the Town of Brewster thank the Leighton Team, a BPC Business Partner, for sponsoring this event.

LEIGHTON TEAM

POWERED BY PLACE | kw CAPE COD & THE ISLANDS KELLERWILLIAMS. REALTY

Thank you for coming!



Brewster Ponds Coalition

Our Mission:
Protecting and improving the health of Brewster's ponds through science, education and advocacy.