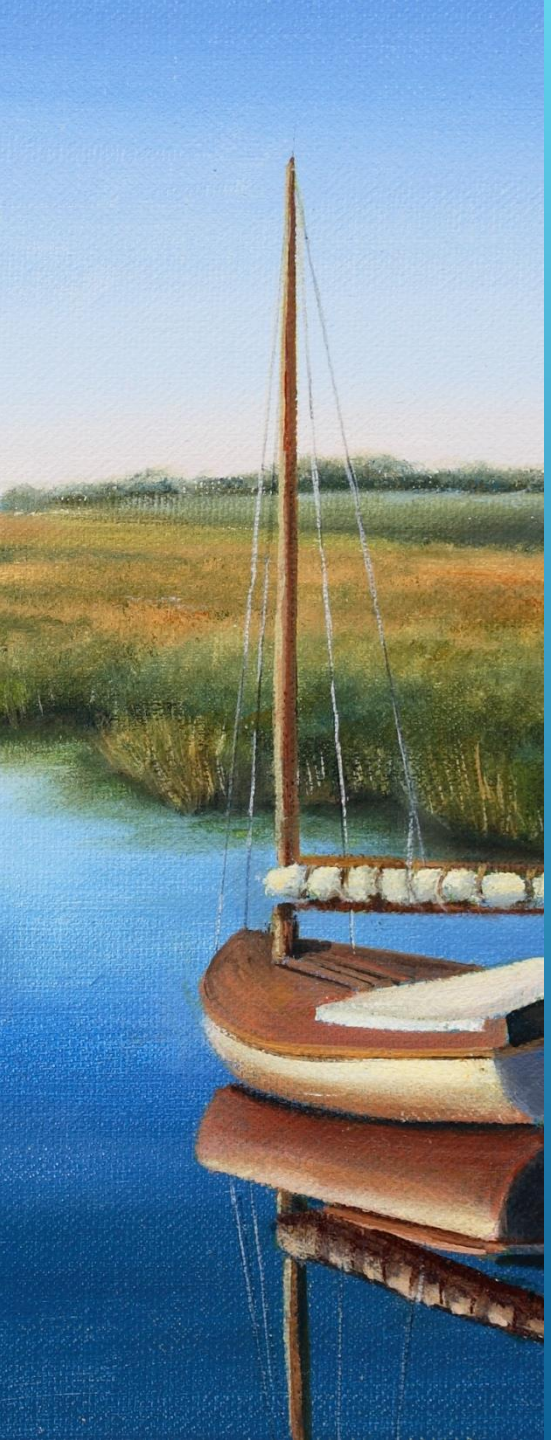


Pleasant bay Community Boating Fall Speaker Series

Pleasant Bay: A Focus on Environmental Stewardship

September 6, 2024

Robert A. Duncanson, Ph.D.
Retired Director of Health & Natural Resources
Town of Chatham

OVERVIEW OF THE PLEASANT BAY SYSTEM

- 21,000 acre watershed
  - a land area that channels water to rivers, lakes, and oceans.
- 9,000 acre estuarine system (ACEC)
- 6,800 acre saltwater surface area
- 458 acre freshwater surface area /11 ponds
- 71 miles of shoreline
  - 51 miles of inner shoreline
  - 7 miles of barrier beach
  - 13 miles around islands

- Groundwater on Cape moves on average 1 ft/day.
- Water discharged on a property ¼ mile from the estuary would take 3.6 years to reach the estuary.

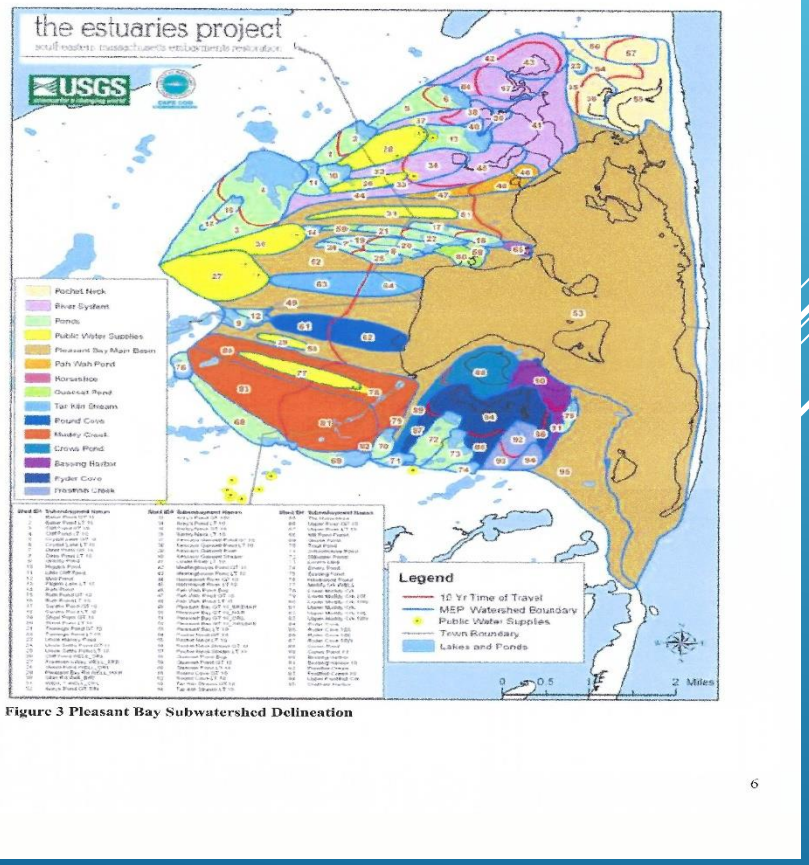
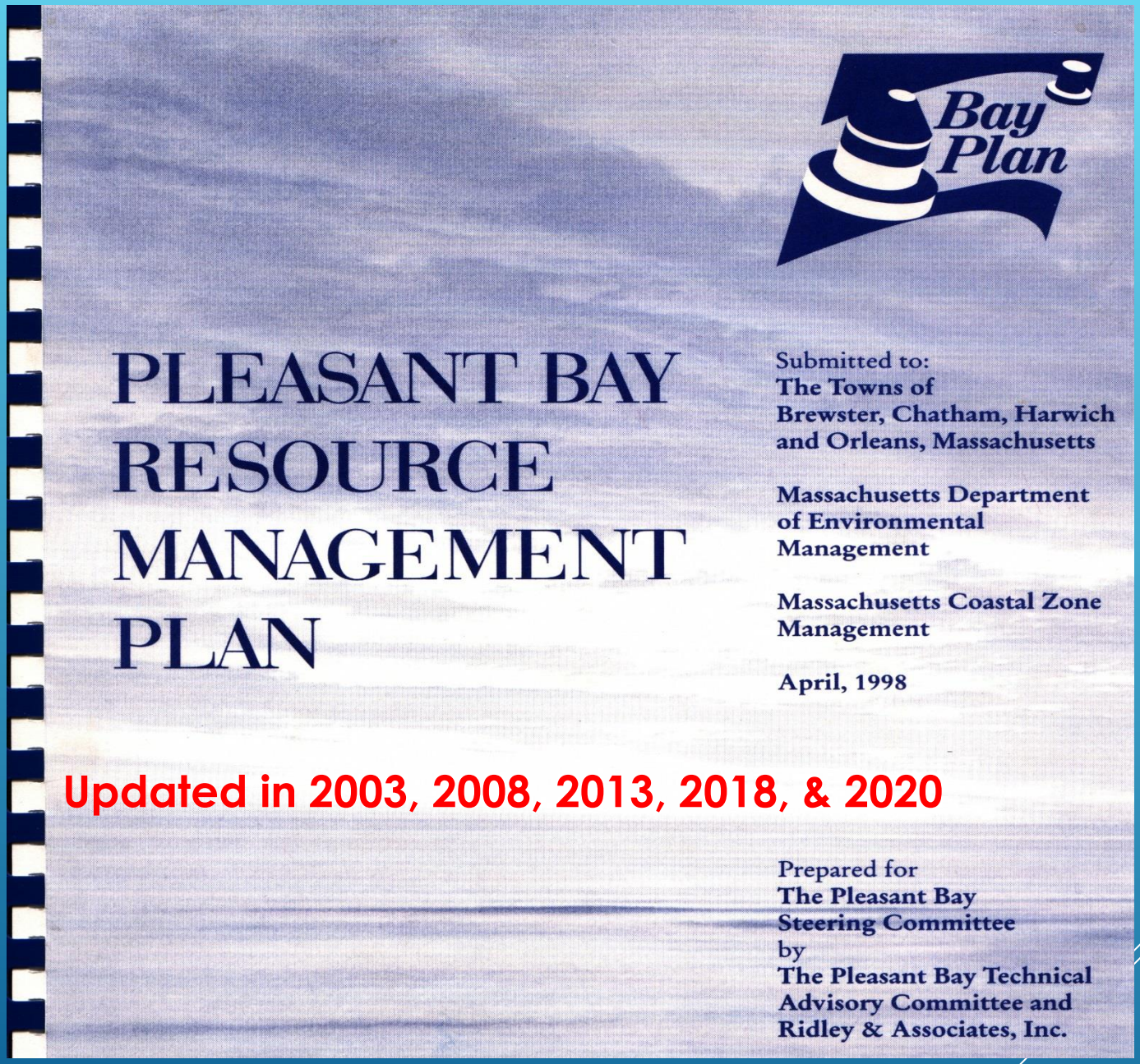


Figure 3 Pleasant Bay Subwatershed Delineation

Community Stewardship

- Local officials and Friends of Pleasant Bay, Inc. nominated ACEC - designated 1987
- Towns adopted Resource Management Plan, 1998
  - Pleasant Bay Alliance established – intergovernmental organization of Brewster, Chatham, Harwich & Orleans
    - Steering Committee – appointed representatives from each Community
    - Technical Advisory Committee & multiple subject workgroups – town staff & interested citizens

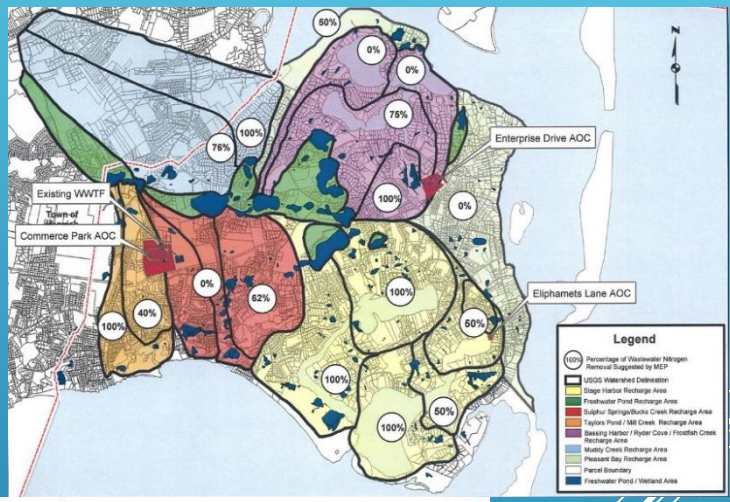

Bay Plan
PLEASANT BAY RESOURCE MANAGEMENT PLAN
Submitted to:
The Towns of
Brewster, Chatham, Harwich and Orleans, Massachusetts
Massachusetts Department of Environmental Management
Massachusetts Coastal Zone Management
April, 1998
Updated in 2003, 2008, 2013, 2018, & 2020
Prepared for
The Pleasant Bay Steering Committee
by
The Pleasant Bay Technical Advisory Committee and
Ridley & Associates, Inc.

Program Areas

- Watershed Management
- Water Quality Monitoring
- Ecological Inventory
- Waterways Management
- Shoreline Structures
- Public Access

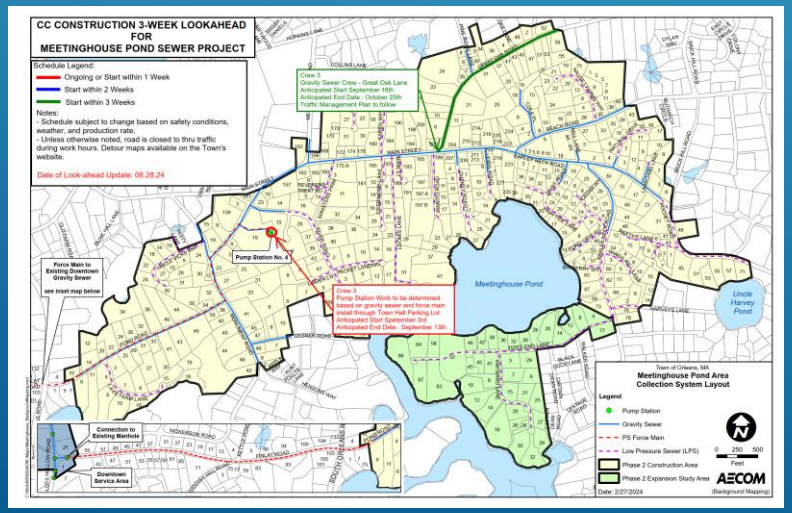
Watershed Management

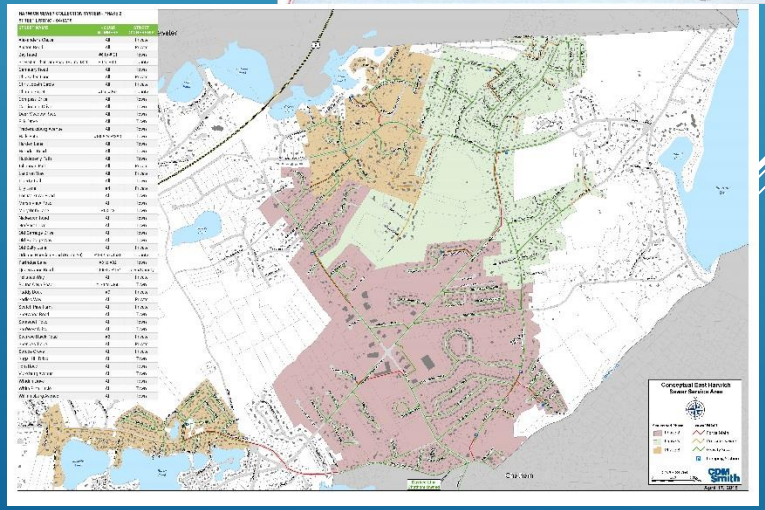
- *Build out analysis – nitrogen management*
- *Citizen's Guide to Estuarine Protection Pleasant Bay Composite Nitrogen Management Analysis: An Assessment of Nitrogen Management Plans of Brewster, Chatham, Harwich, & Orleans*
- *Chatham-Harwich Intermunicipal Agreement for Wastewater Collection & Treatment*
- *Pleasant Bay Targeted Watershed Management Plan*
- *Pleasant Bay Watershed Permit – 2018; 1st in MA*



Water Quality Monitoring

- *QAPP approved by DEP/USEPA*
- *150± volunteers/year*





Ecological Monitoring

- *Aerial photography*
- *Intertidal Habitat & Sediment Assessment*
- *Freshwater Resource assessment*
- *Massachusetts Estuaries Project (MEP)*

Waterways Management

- *Coordinated harbor patrols*
- *PWC management*
- *Increased/coordinated navigational aids*

Shoreline Structures

- *Guidelines for private docks and piers*
- *Guidelines for walkways and stairways*

Public Access

- *Shoreline Access Inventory Program*

WATER QUALITY ACTIVITIES

- 1965-1967 DMF – Marine Resources Inventory; 3 stations
- 1965 DPH – Bacterial Survey; 45 stations
- 1976 DEQE – WQ Classification
- 1987 FOPB/Boston College – 18 stations
- DMF (shellfish) – Bacteria; ongoing
- 2000 PBA – Nutrients; ongoing

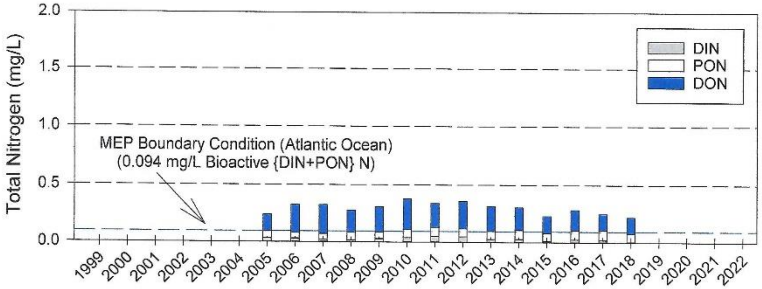
PBA WATER QUALITY MONITORING PROGRAM OBJECTIVES

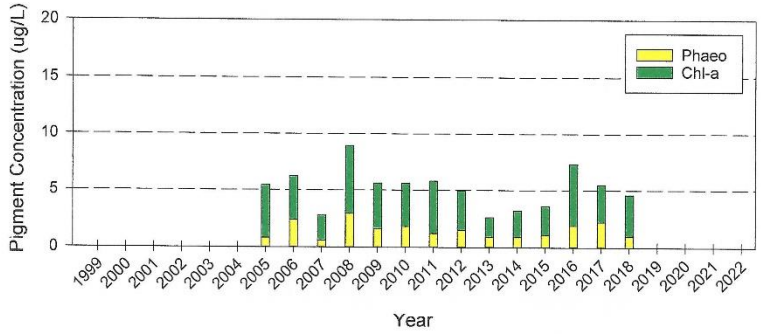
- Provide comprehensive background data on Bay water quality;
- Monitor nitrogen-loading trends;
- Provide data for use in policy, regulatory and educational applications;
- Provide data for WQ modeling (MEP);
- Document efficacy of mitigation measures;
- Document impacts of morphological changes.

WATER QUALITY MONITORING PROGRAM

- 25+ monitoring stations throughout the main basin and sub-embayments
- Samples collected from 2000 through 2024
- Minimum sampling frequency is twice in July and August and once in September
- In addition to in-situ measurements, samples are transported to UMass Dartmouth for analyses.

Chatham Harbor *Flood Tide* **(PBA-17A)**





Hundreds of water samples are taken over each summer sampling yielding thousands of measurements.

Five key measurements are combined into the "Eutrophication Index", a more easily understood indication of water quality:

0 - 35

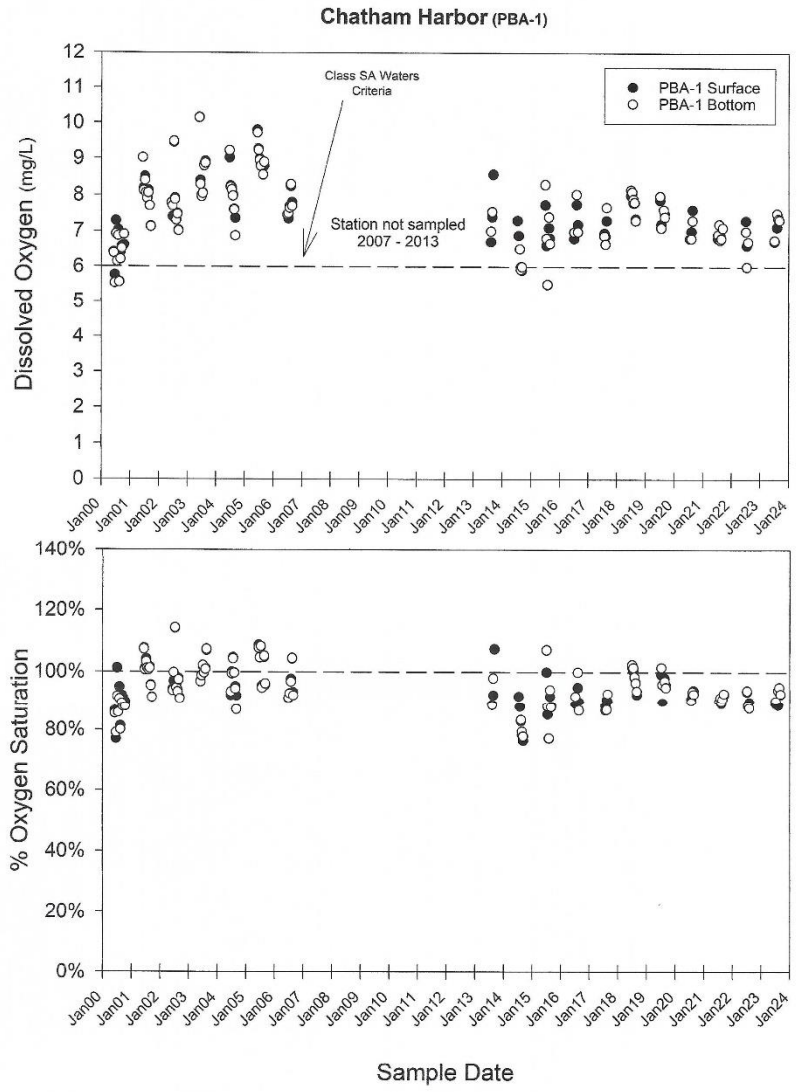
Poor
There is too much nitrogen pollution in the water. Underwater habitats are unhealthy for fish and shellfish. The waterway is not functioning as a viable ecosystem.

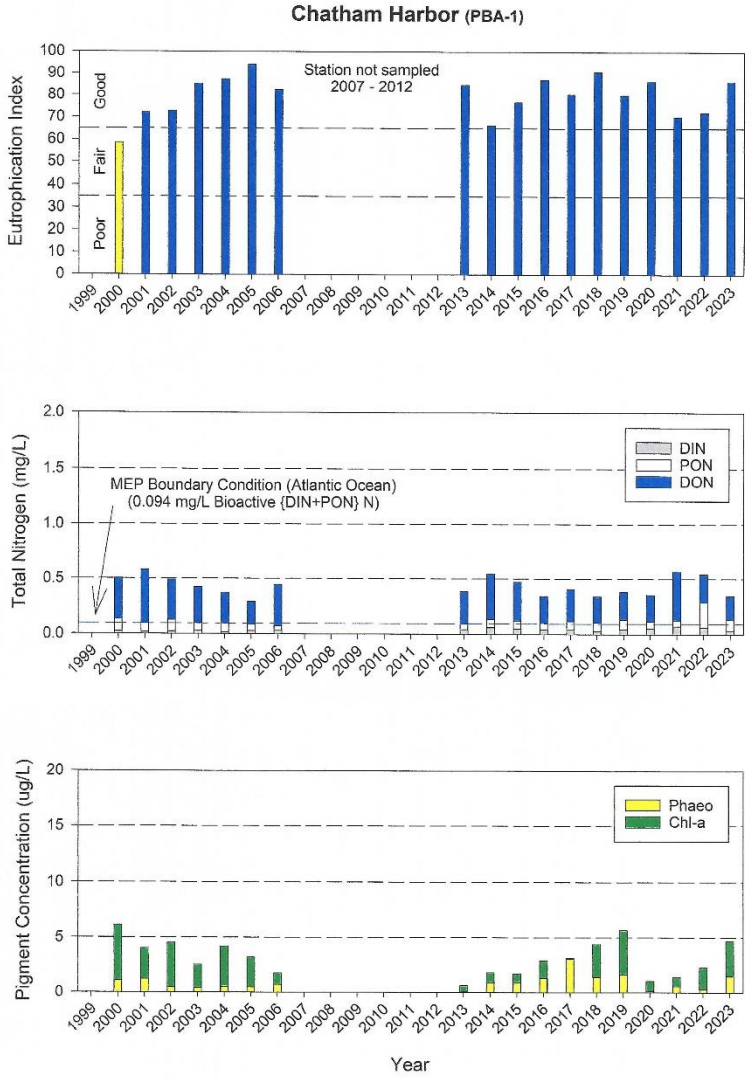
>35 - 65

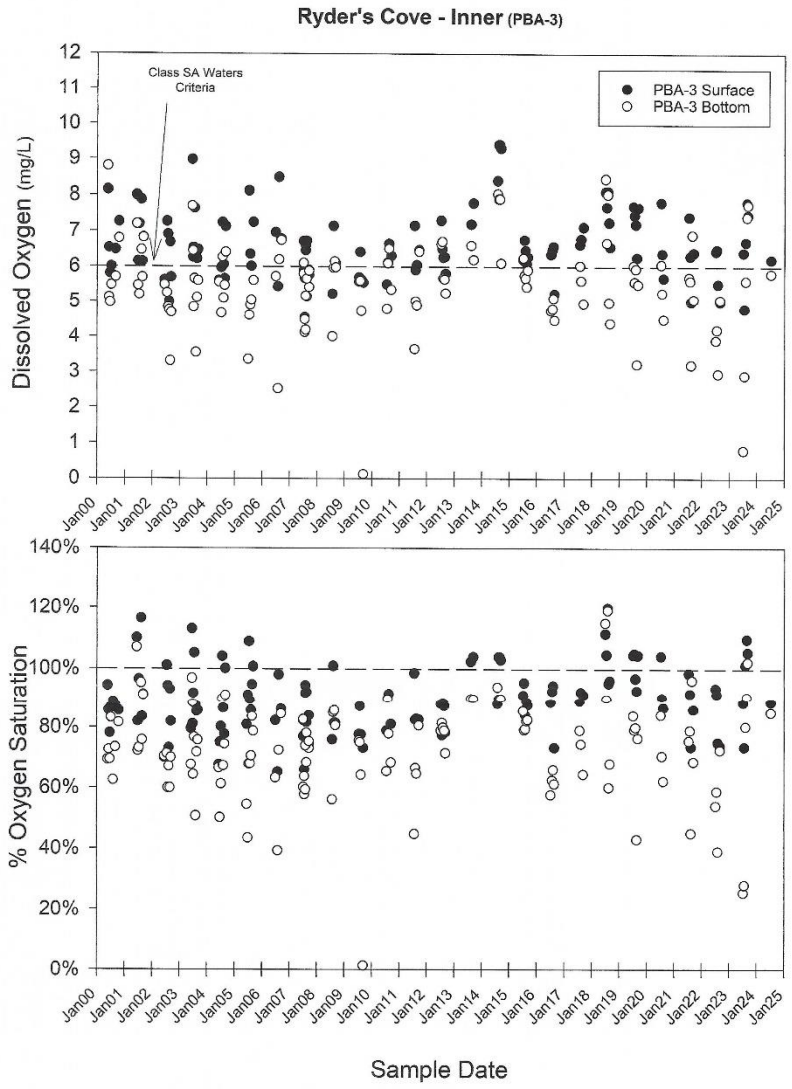
Fair
These are transitional areas that are either improving or, more likely, becoming more polluted with nitrogen. The habitat health is damaged.

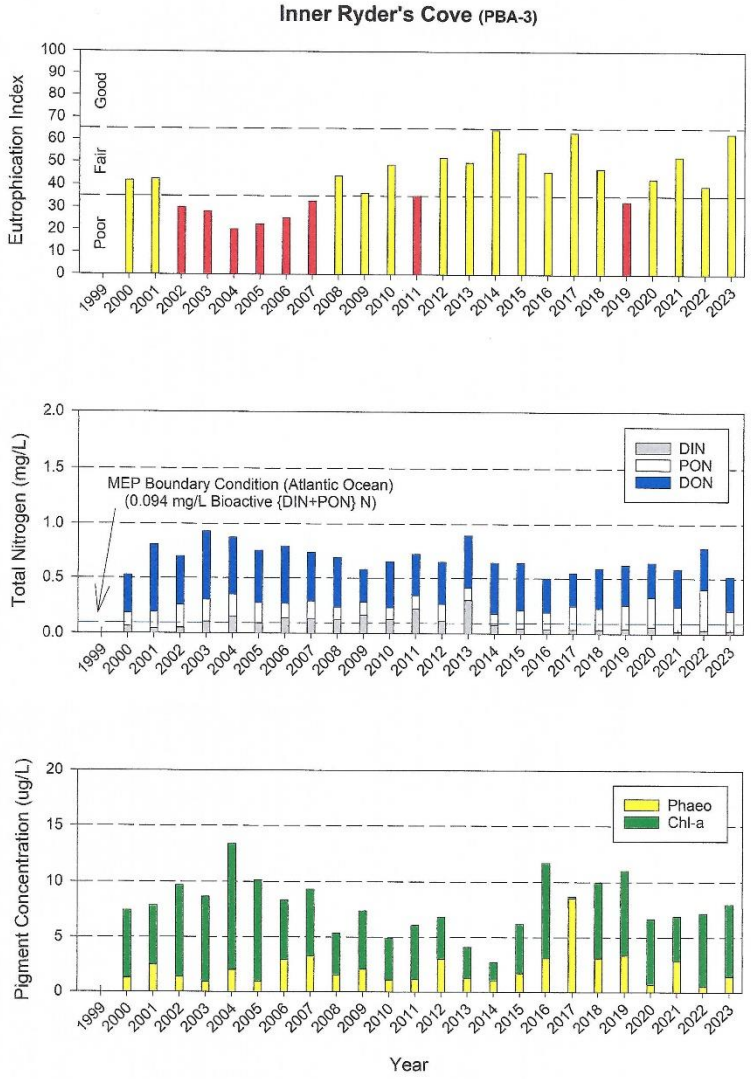
>65 – 100

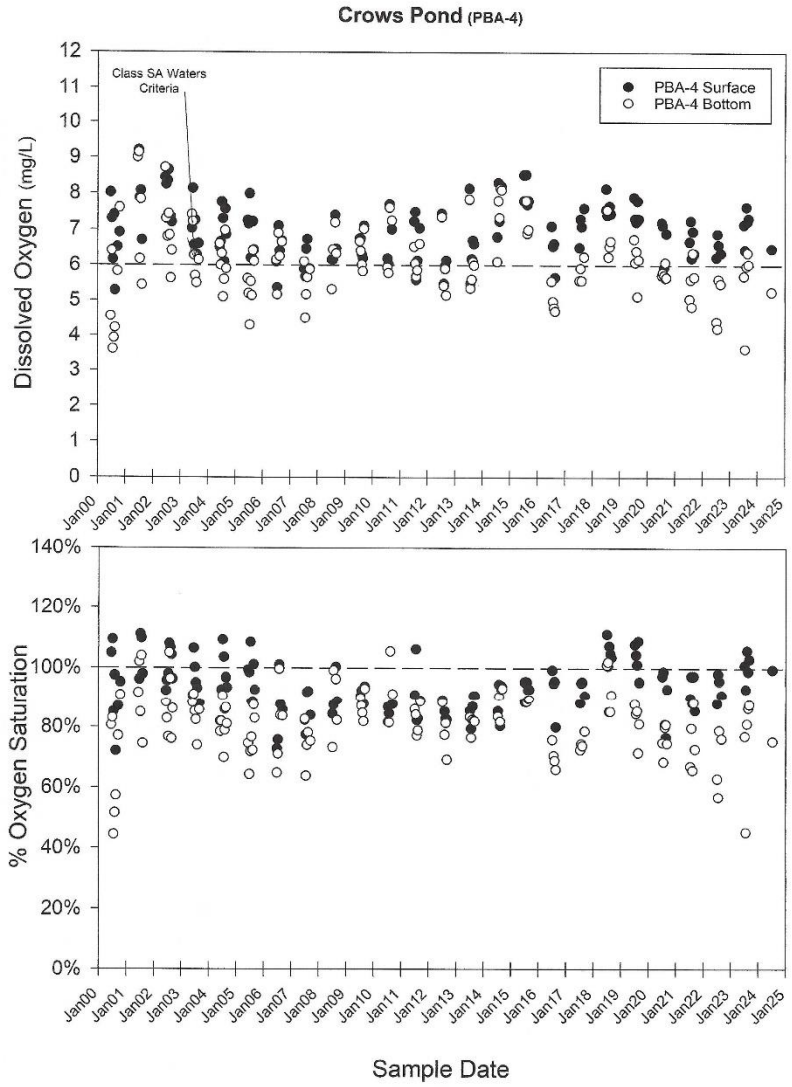
Good
There is little nitrogen pollution in the water. The waterway offers healthy underwater habitats for fish and shellfish. Overall, the ecosystem is in balance.

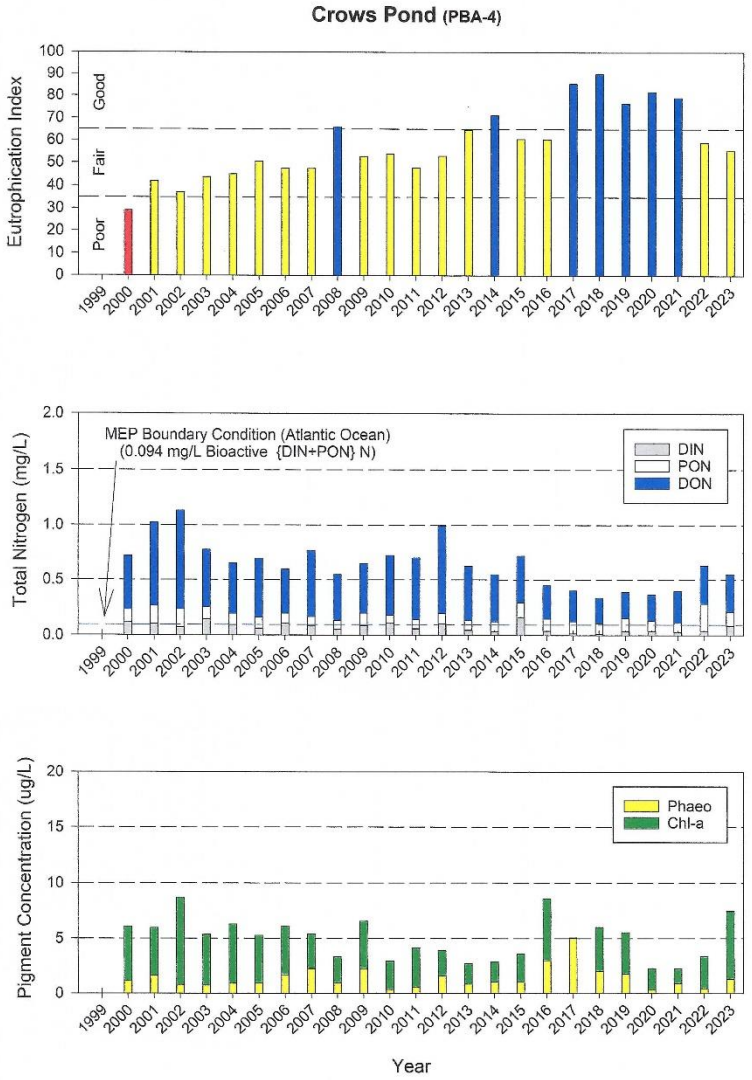

Chatham Harbor (PBA-1)
Dissolved Oxygen (mg/L)
Class SA Waters Criteria
PBA-1 Surface
PBA-1 Bottom
Station not sampled 2007 - 2013
% Oxygen Saturation
Sample Date

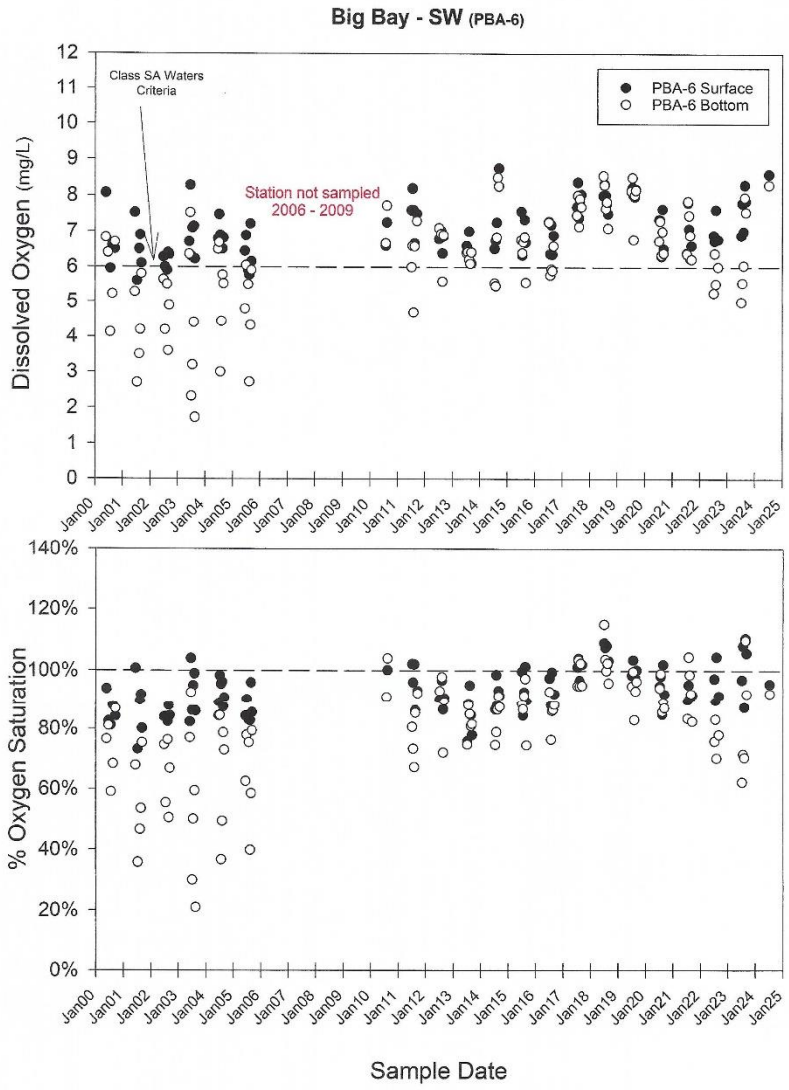

Chatham Harbor (PBA-1)
Eutrophication Index
Good
Fair
Poor
Station not sampled 2007 - 2012
Total Nitrogen (mg/L)
DIN
PON
DON
MEP Boundary Condition (Atlantic Ocean)
(0.094 mg/L Bioactive {DIN+PON} N)
Pigment Concentration (ug/L)
Phaeo
Chl-a
Year

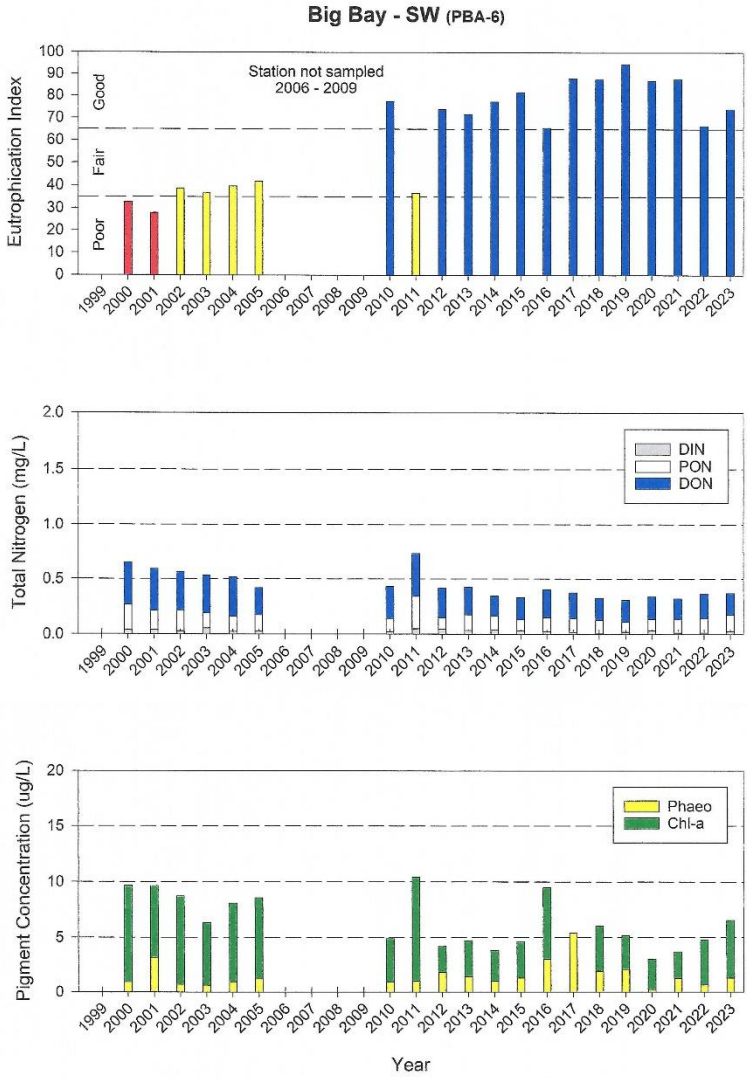

Ryder's Cove - Inner (PBA-3)
Class SA Waters Criteria
PBA-3 Surface
PBA-3 Bottom
Dissolved Oxygen (mg/L)
% Oxygen Saturation
Sample Date

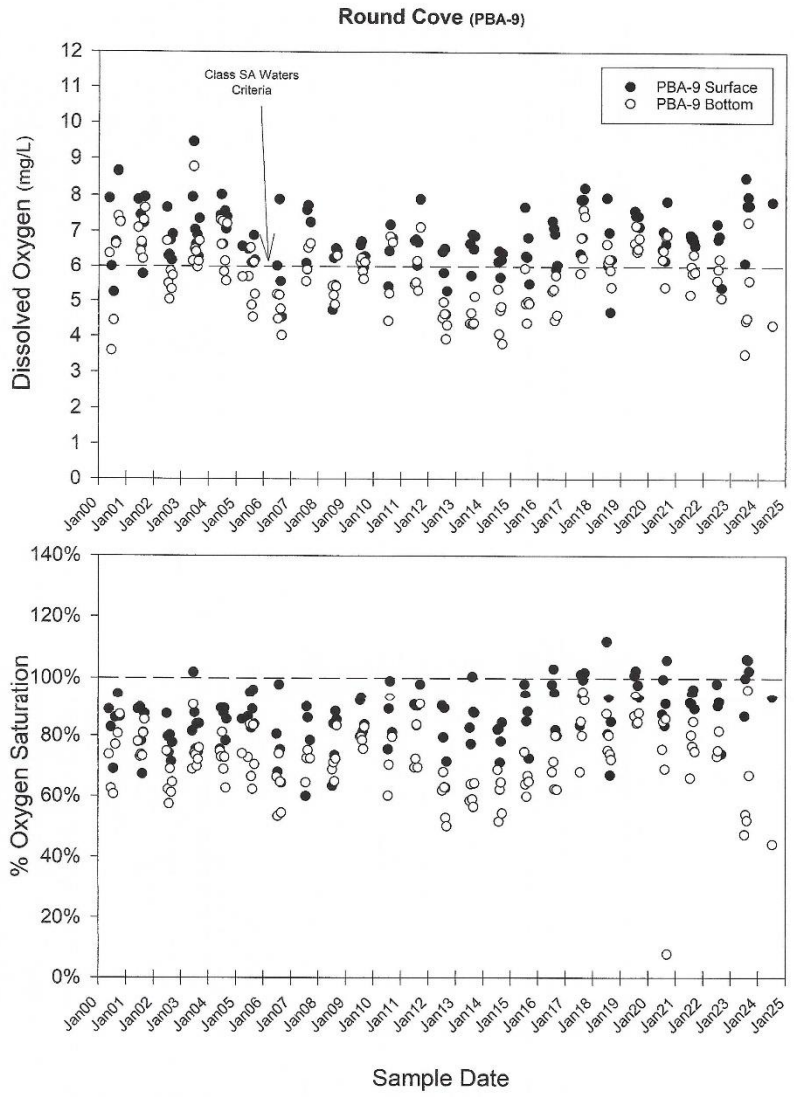

Inner Ryder's Cove (PBA-3)
Eutrophication Index
Good
Fair
Poor
Total Nitrogen (mg/L)
MEP Boundary Condition (Atlantic Ocean)
(0.094 mg/L Bioactive {DIN+PON} N)
DIN
PON
DON
Pigment Concentration (ug/L)
Phaeo
Chl-a
Year

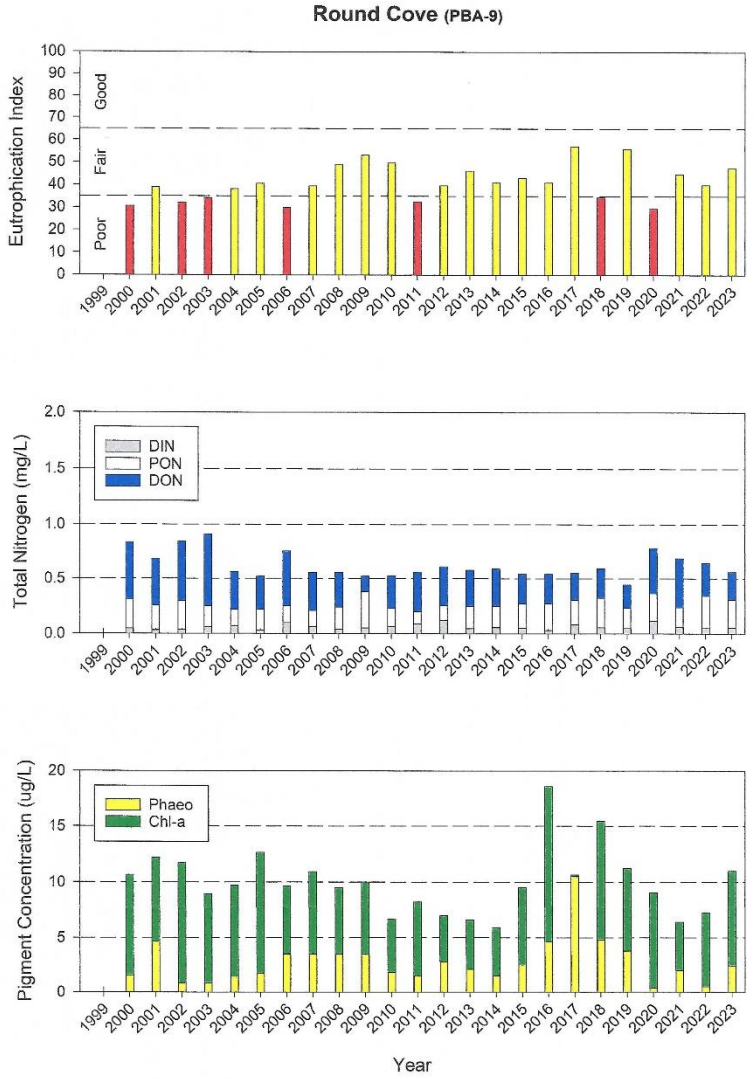

Crows Pond (PBA-4)
Class SA Waters Criteria
PBA-4 Surface
PBA-4 Bottom
Dissolved Oxygen (mg/L)
% Oxygen Saturation
Sample Date

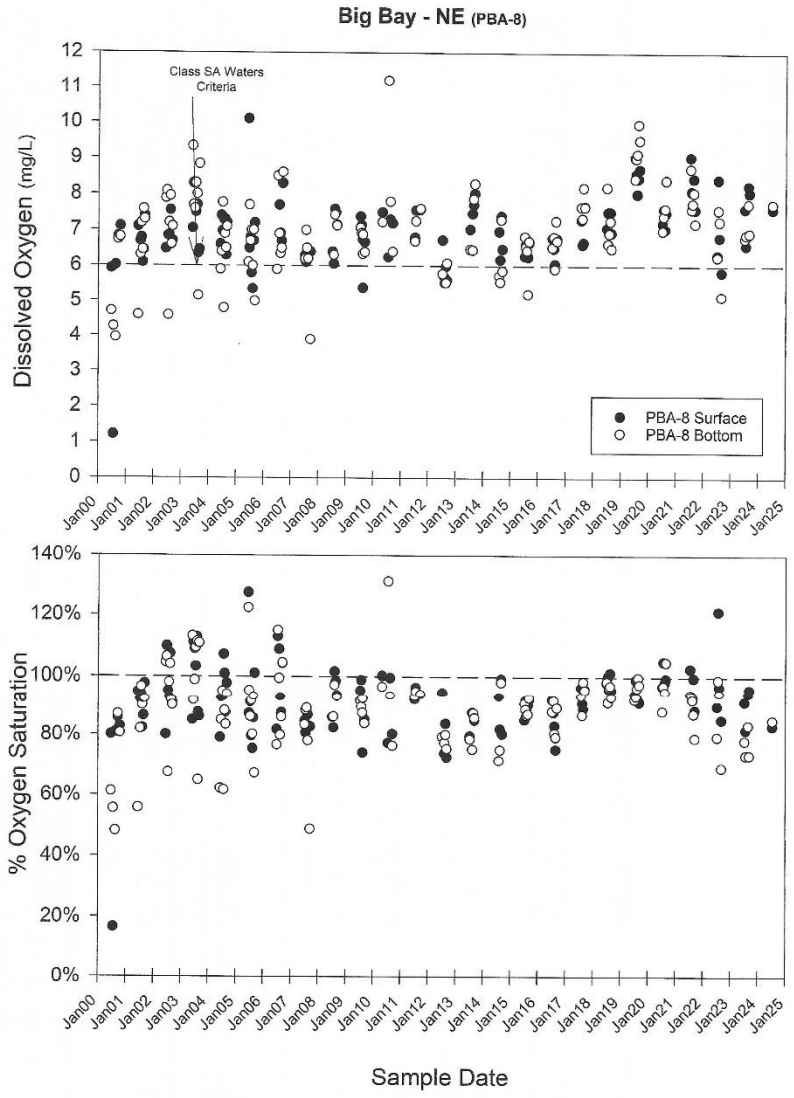

Crows Pond (PBA-4)
Eutrophication Index
Good
Fair
Poor
MEP Boundary Condition (Atlantic Ocean)
(0.094 mg/L Bioactive {DIN+PON} N)
DIN
PON
DON
Total Nitrogen (mg/L)
Phaeo
Chl-a
Pigment Concentration (ug/L)
Year

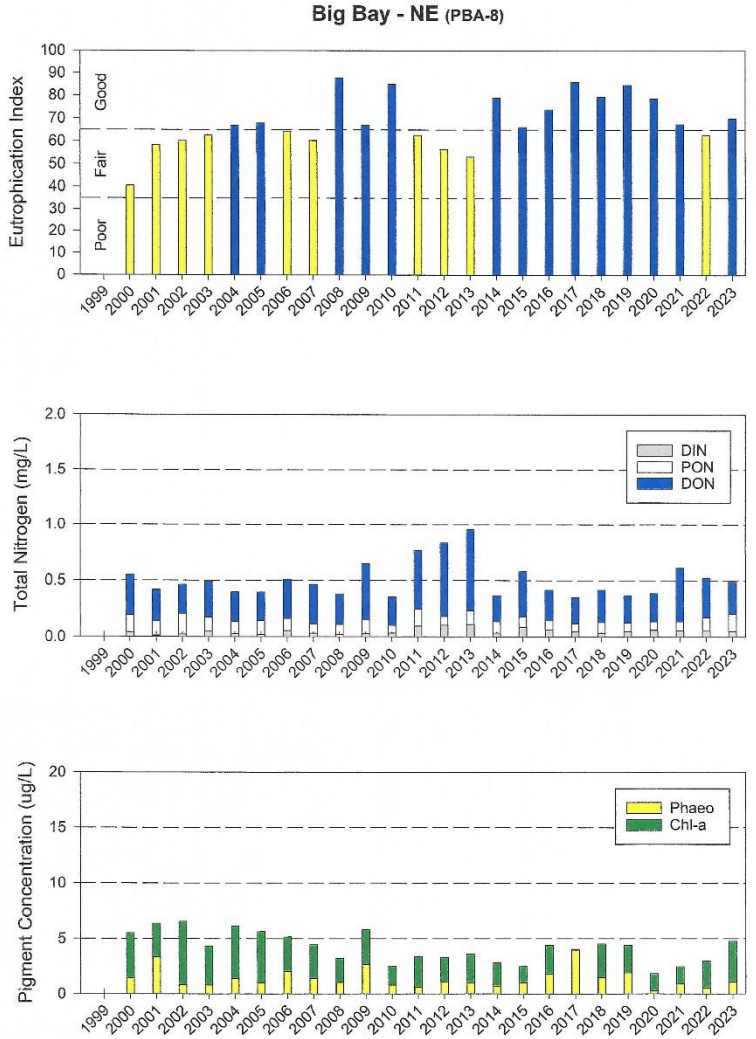

Big Bay - SW (PBA-6)
Class SA Waters Criteria
PBA-6 Surface
PBA-6 Bottom
Station not sampled 2006 - 2009
Dissolved Oxygen (mg/L)
% Oxygen Saturation
Sample Date

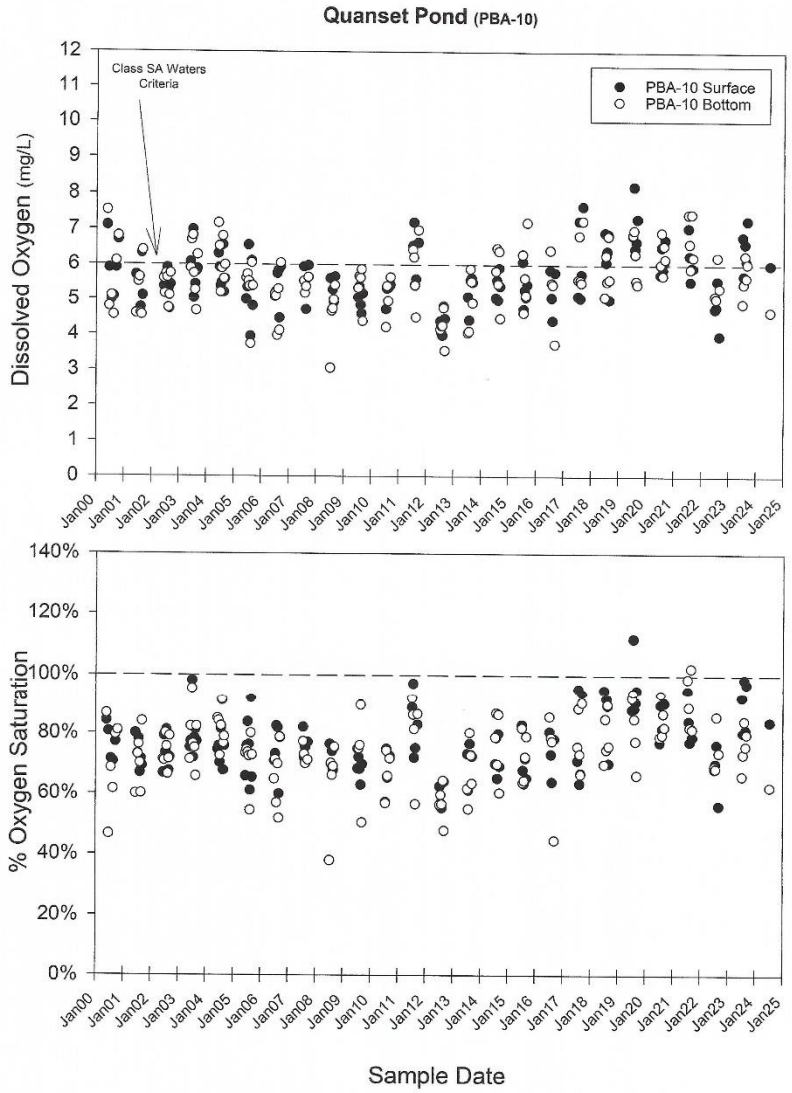

Big Bay - SW (PBA-6)
Station not sampled 2006 - 2009
Good
Fair
Poor
Eutrophication Index
DIN
PON
DON
Total Nitrogen (mg/L)
Phaeo
Chl-a
Pigment Concentration (ug/L)
Year

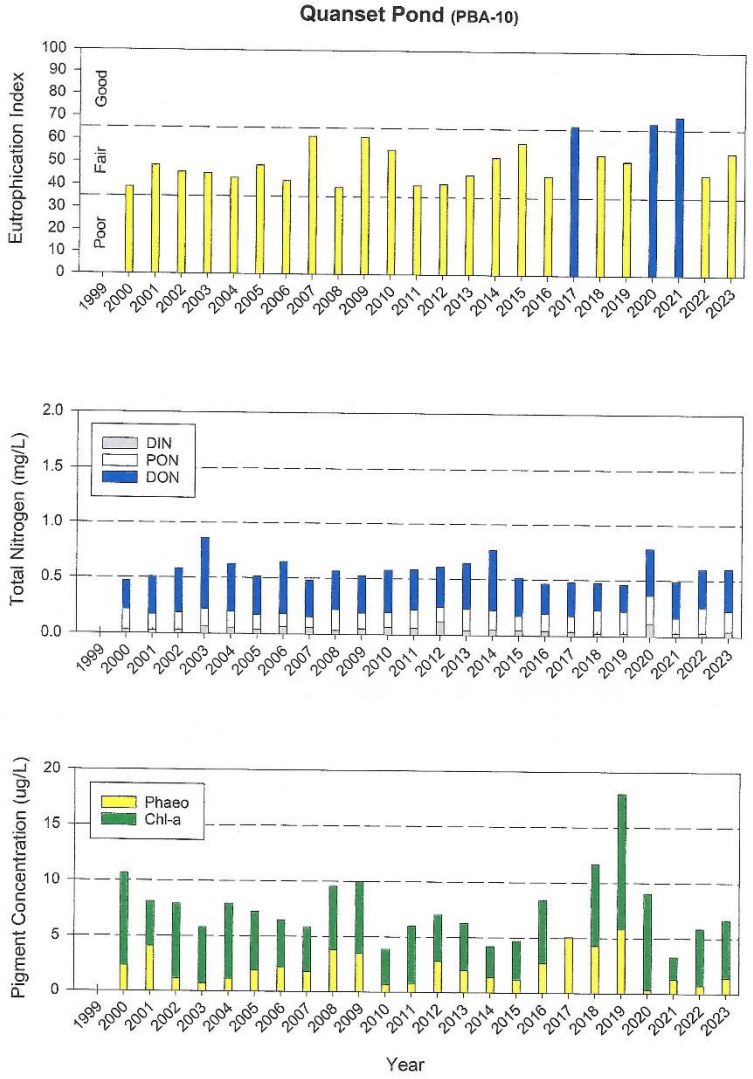

Round Cove (PBA-9)
Class SA Waters Criteria
PBA-9 Surface
PBA-9 Bottom
Dissolved Oxygen (mg/L)
% Oxygen Saturation
Sample Date

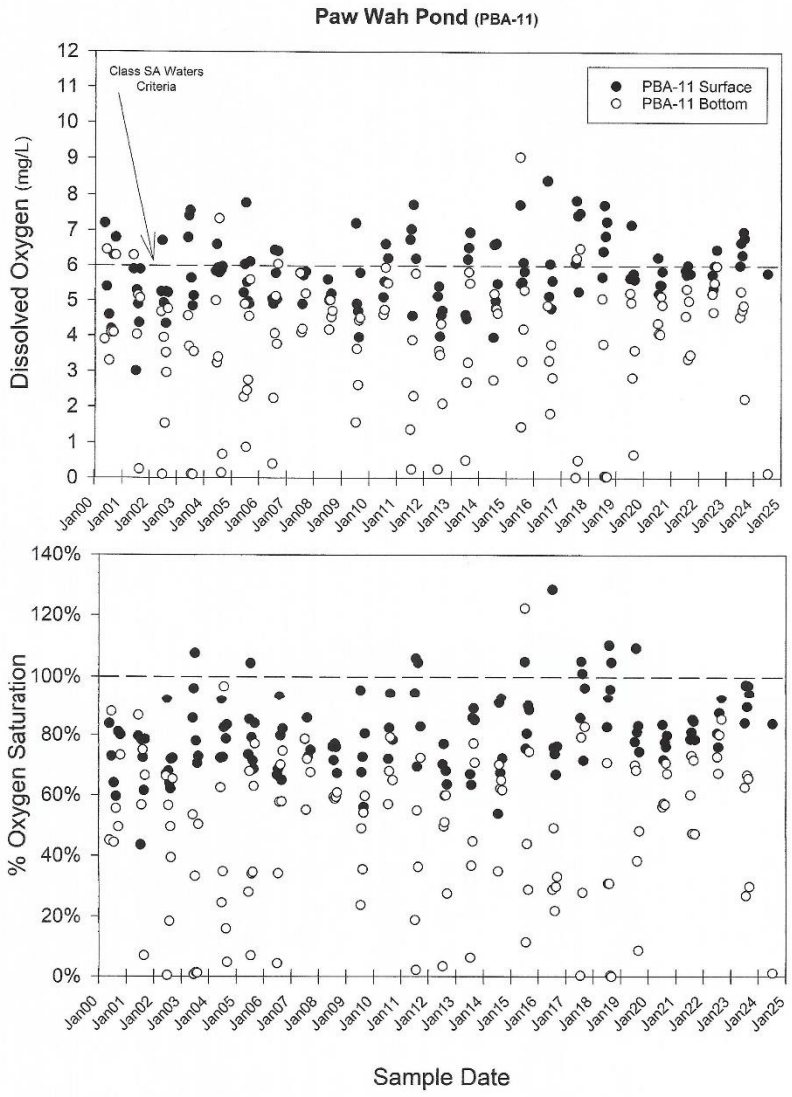

Round Cove (PBA-9)
Eutrophication Index
Good
Fair
Poor
Total Nitrogen (mg/L)
DIN
PON
DON
Pigment Concentration (ug/L)
Phaeo
Chl-a
Year

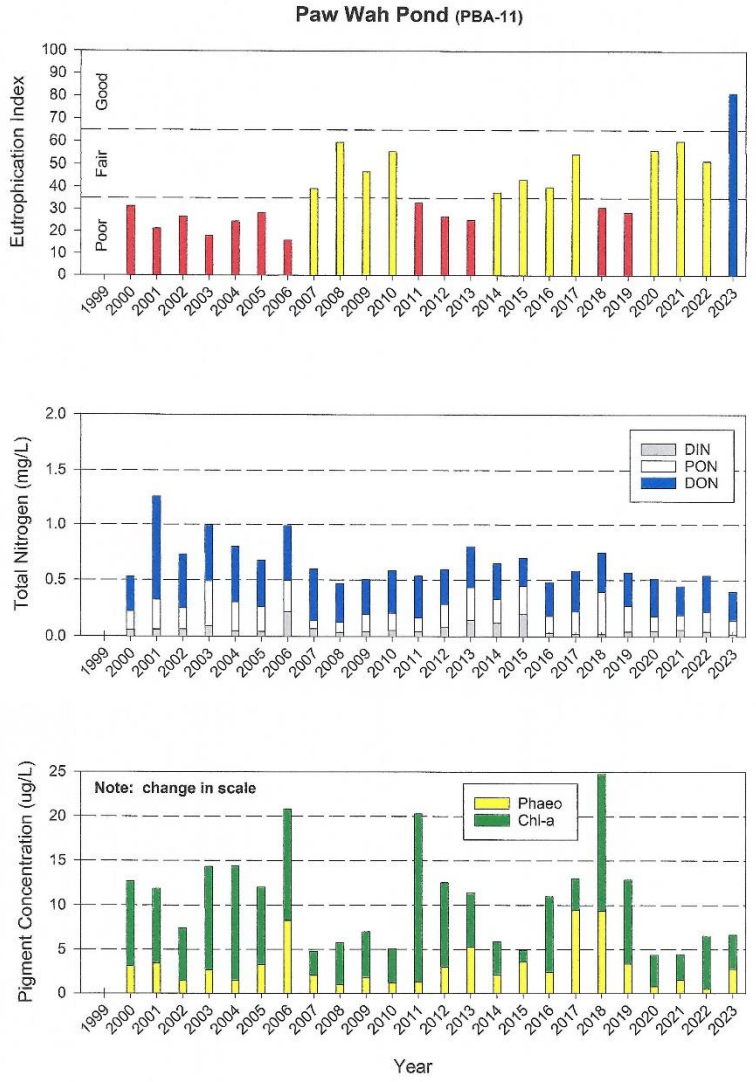

Big Bay - NE (PBA-8)
Class SA Waters Criteria
Dissolved Oxygen (mg/L)
PBA-8 Surface
PBA-8 Bottom
% Oxygen Saturation
Sample Date

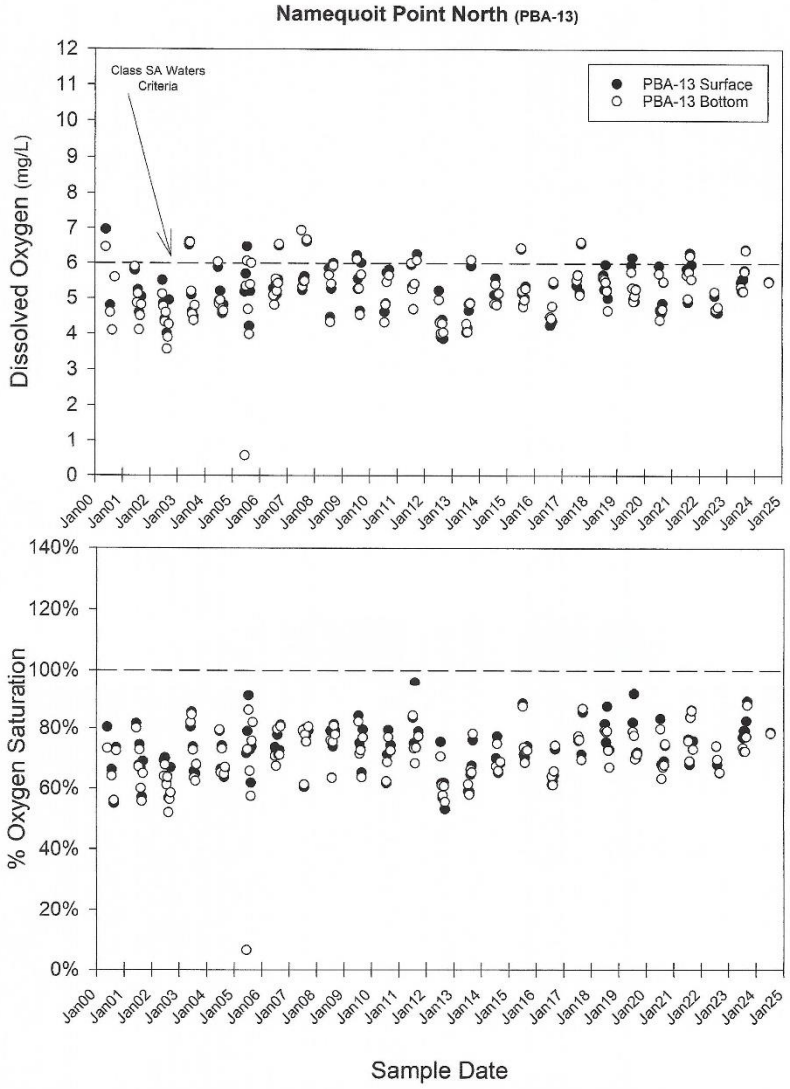

Big Bay - NE (PBA-8)
Eutrophication Index
Good
Fair
Poor
Total Nitrogen (mg/L)
DIN
PON
DON
Pigment Concentration (ug/L)
Phaeo
Chl-a

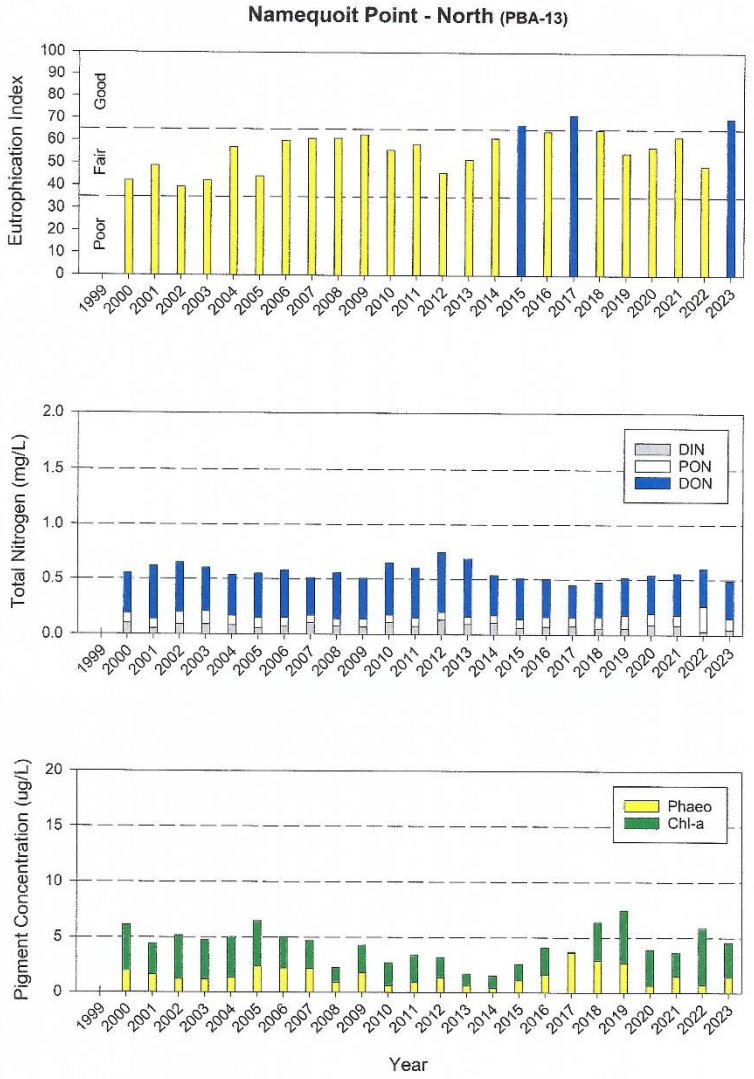

Quanset Pond (PBA-10)
Class SA Waters Criteria
PBA-10 Surface
PBA-10 Bottom
Dissolved Oxygen (mg/L)
% Oxygen Saturation
Sample Date

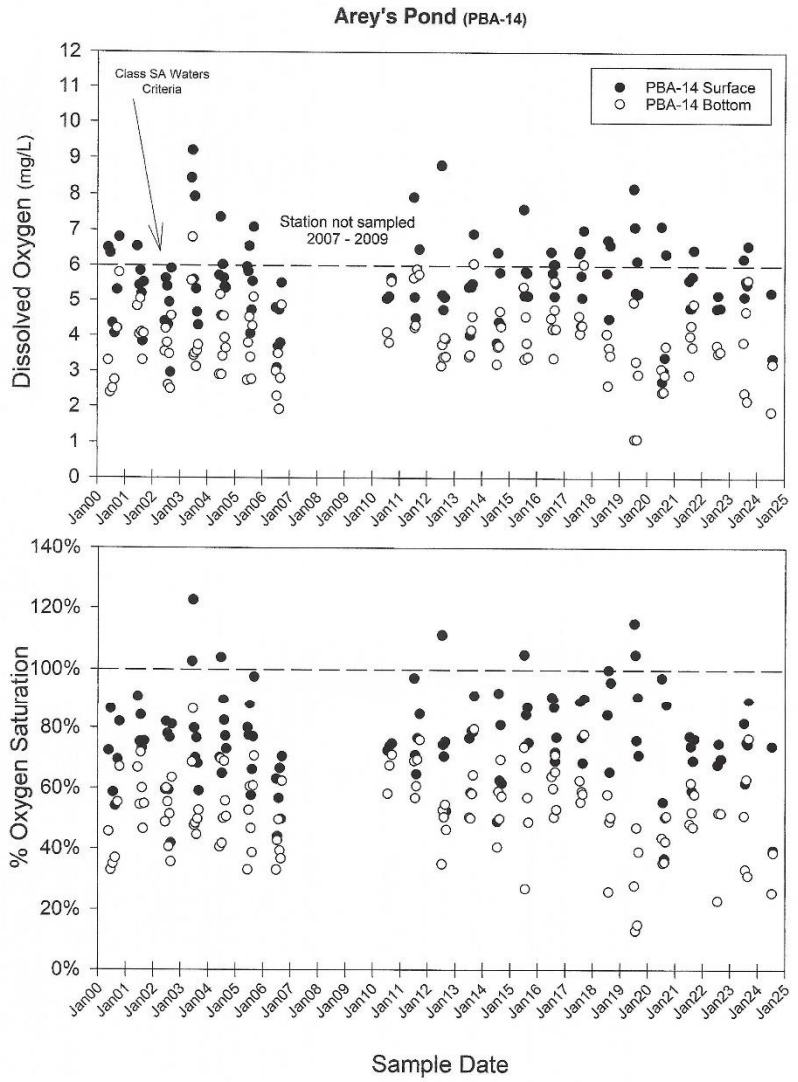

Quanset Pond (PBA-10)
Eutrophication Index
Good
Fair
Poor
Total Nitrogen (mg/L)
DIN
PON
DON
Pigment Concentration (ug/L)
Phaeo
Chl-a
Year

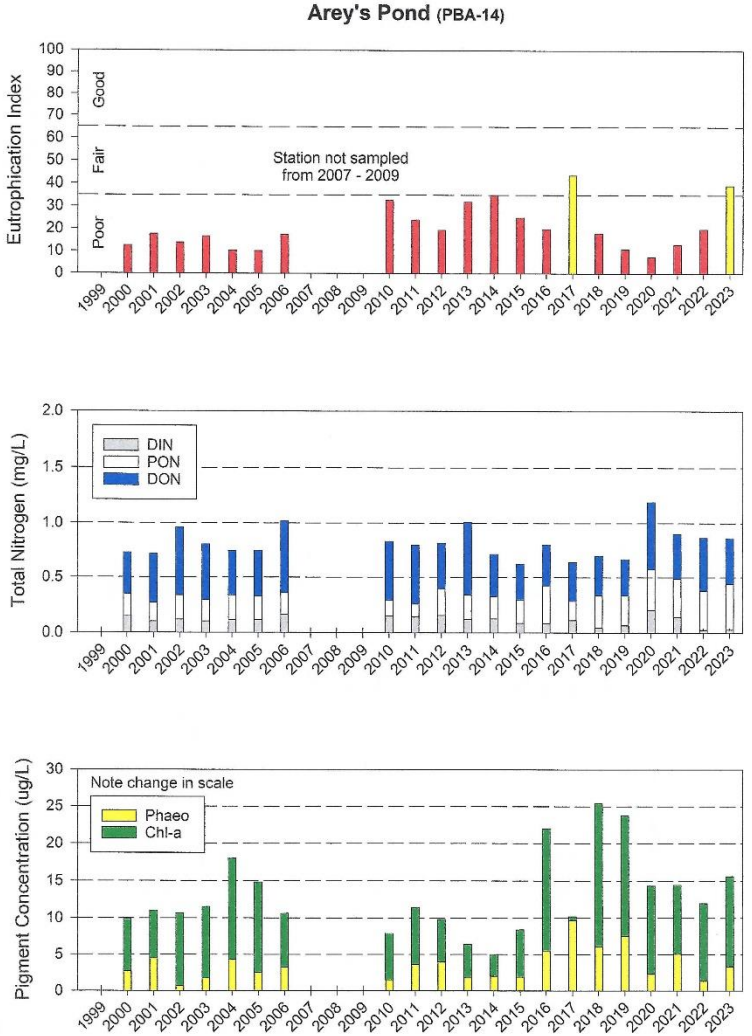

Paw Wah Pond (PBA-11)
Class SA Waters Criteria
PBA-11 Surface
PBA-11 Bottom
Dissolved Oxygen (mg/L)
% Oxygen Saturation
Sample Date

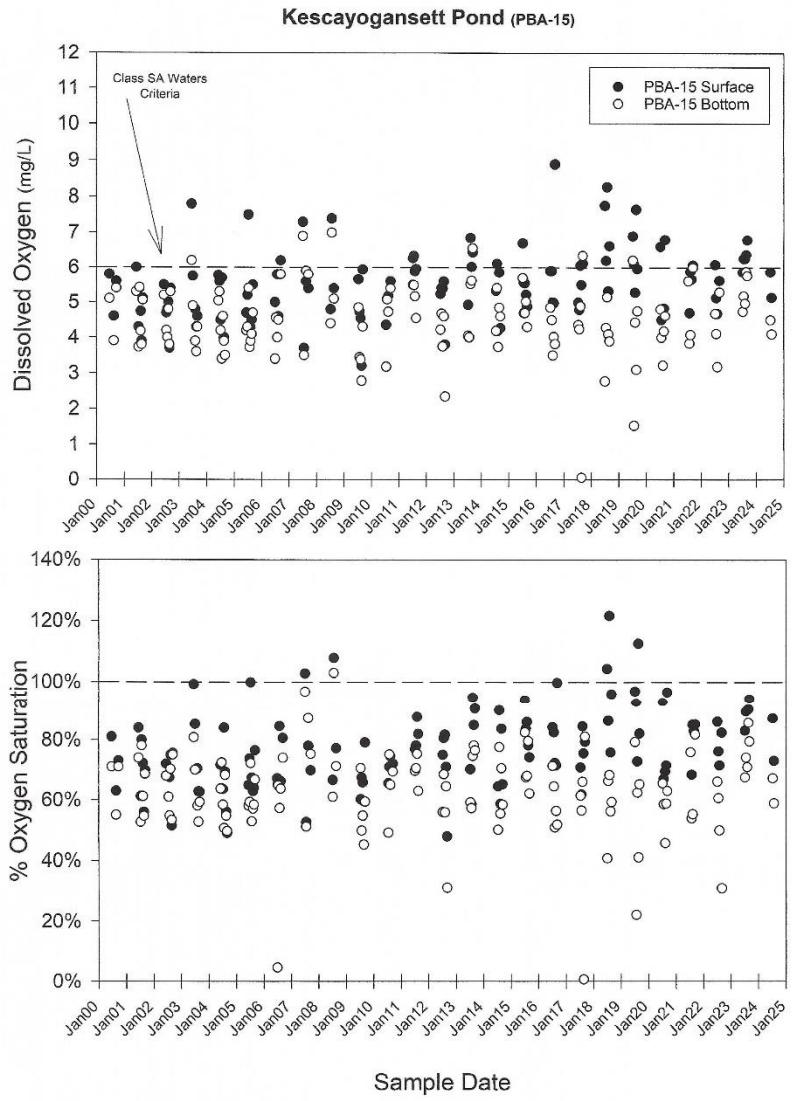

Paw Wah Pond (PBA-11)
Eutrophication Index
Good
Fair
Poor
Total Nitrogen (mg/L)
DIN
PON
DON
Note: change in scale
Phaeo
Chl-a
Pigment Concentration (ug/L)
Year

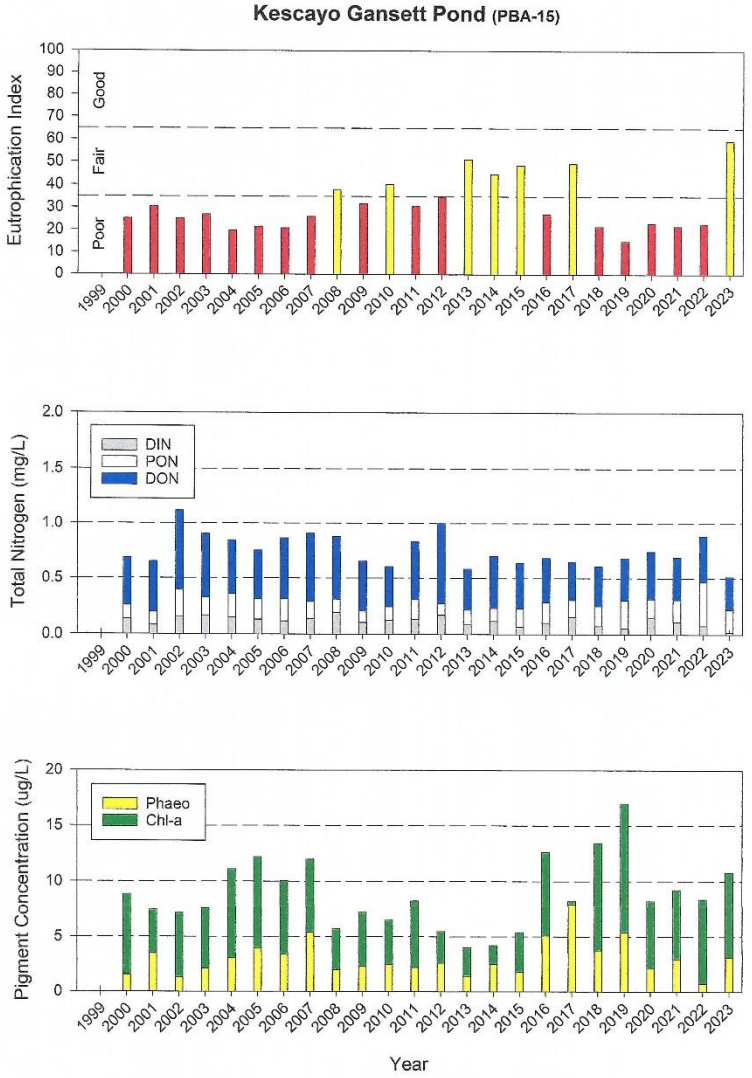

Namequoit Point North (PBA-13)
Class SA Waters Criteria
PBA-13 Surface
PBA-13 Bottom
Dissolved Oxygen (mg/L)
% Oxygen Saturation
Sample Date

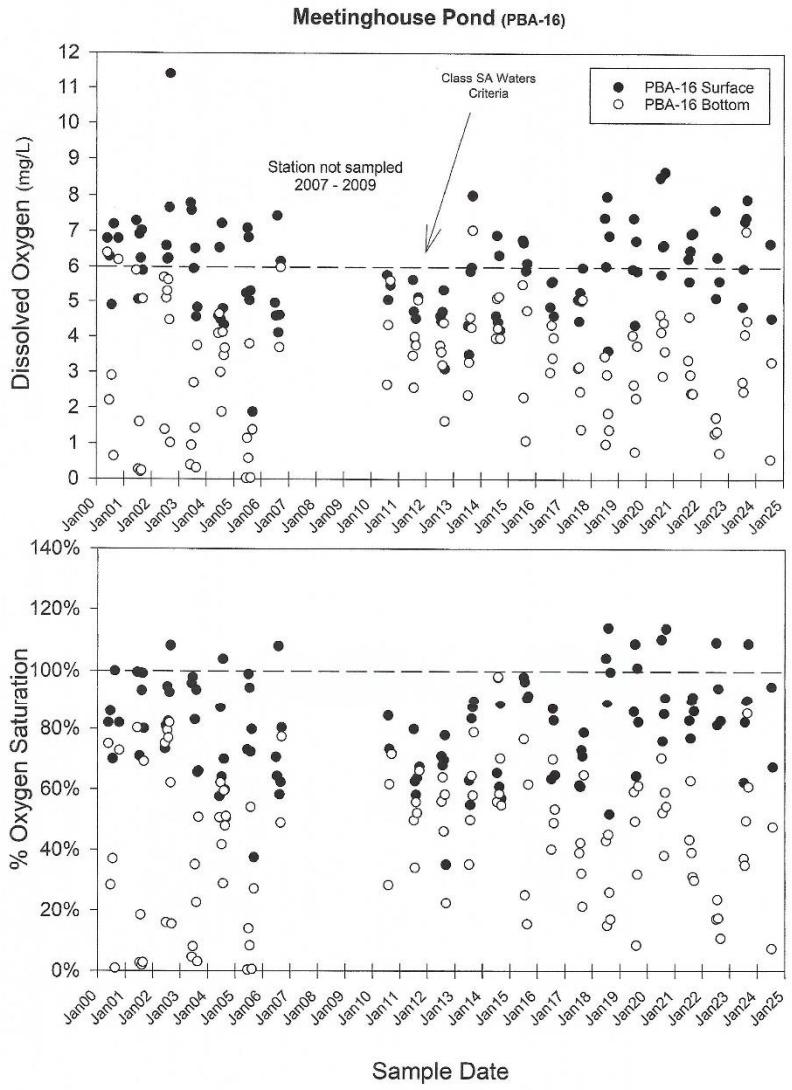

Namequoit Point - North (PBA-13)
Eutrophication Index
Good
Fair
Poor
Total Nitrogen (mg/L)
DIN
PON
DON
Pigment Concentration (ug/L)
Phaeo
Chl-a
Year

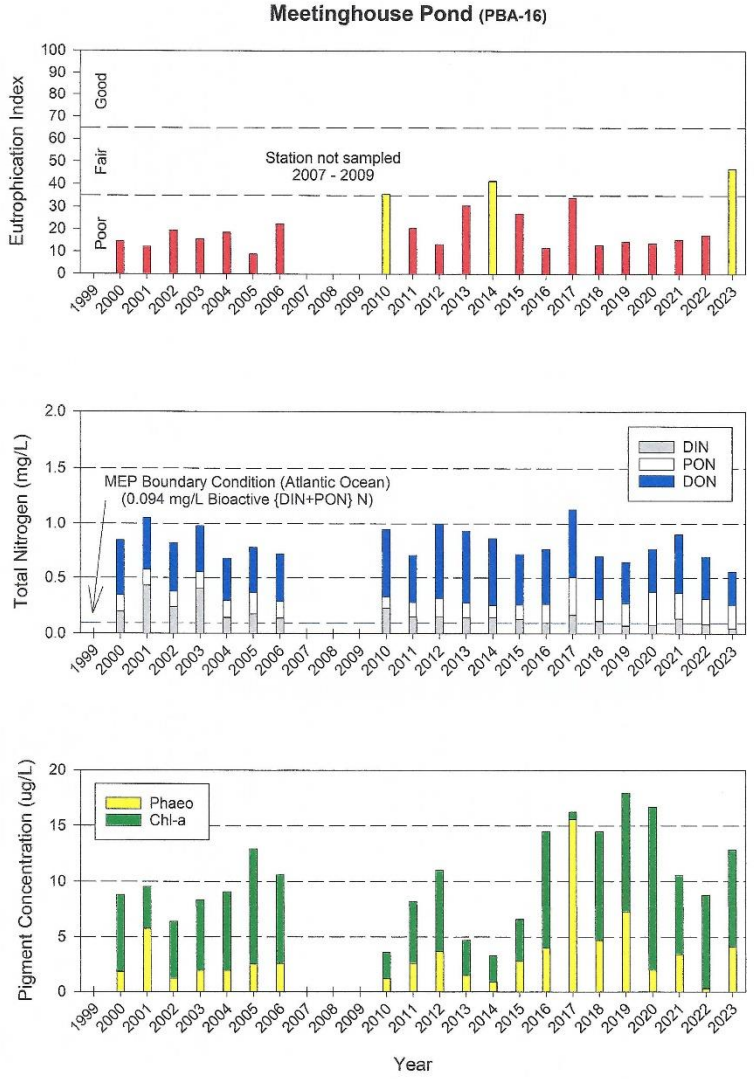

Arey's Pond (PBA-14)
Class SA Waters Criteria
PBA-14 Surface
PBA-14 Bottom
Station not sampled 2007 - 2009
Dissolved Oxygen (mg/L)
% Oxygen Saturation
Sample Date

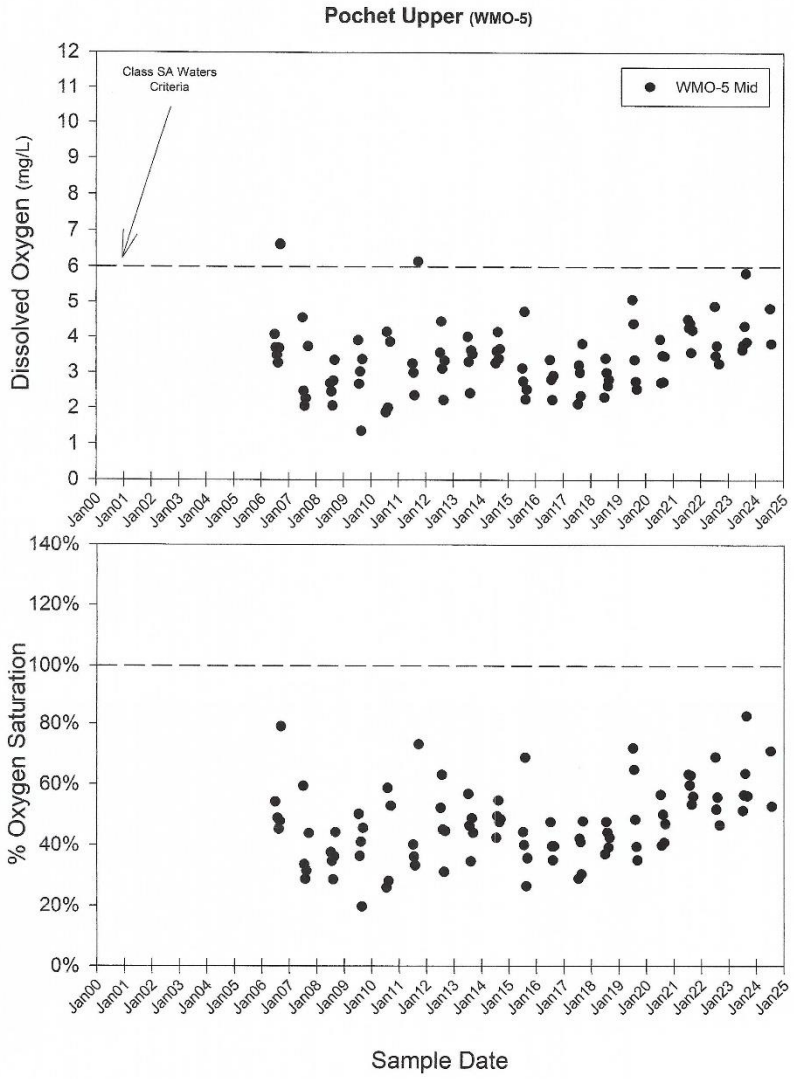

Arey's Pond (PBA-14)
Eutrophication Index
Good
Fair
Poor
Station not sampled from 2007 - 2009
Total Nitrogen (mg/L)
DIN
PON
DON
Pigment Concentration (ug/L)
Note change in scale
Phaeo
Chl-a

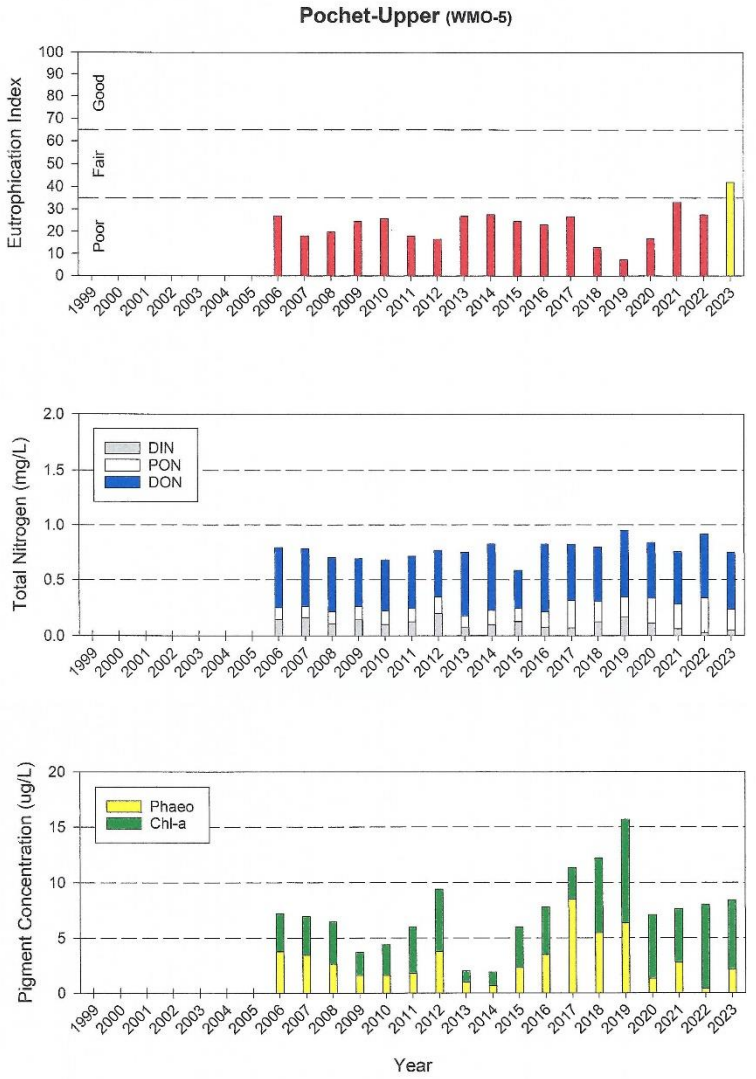

Kescayogansett Pond (PBA-15)
Class SA Waters Criteria
PBA-15 Surface
PBA-15 Bottom
Dissolved Oxygen (mg/L)
% Oxygen Saturation
Sample Date


Kescayo Gansett Pond (PBA-15)
Eutrophication Index
Good
Fair
Poor
Total Nitrogen (mg/L)
DIN
PON
DON
Pigment Concentration (ug/L)
Phaeo
Chl-a
Year


Meetinghouse Pond (PBA-16)
Dissolved Oxygen (mg/L)
Class SA Waters Criteria
PBA-16 Surface
PBA-16 Bottom
Station not sampled 2007 - 2009
% Oxygen Saturation
Sample Date


Meetinghouse Pond (PBA-16)
Eutrophication Index
Good
Fair
Poor
Station not sampled 2007 - 2009
Total Nitrogen (mg/L)
MEP Boundary Condition (Atlantic Ocean)
(0.094 mg/L Bioactive {DIN+PON} N)
DIN
PON
DON
Pigment Concentration (ug/L)
Phaeo
Chl-a
Year

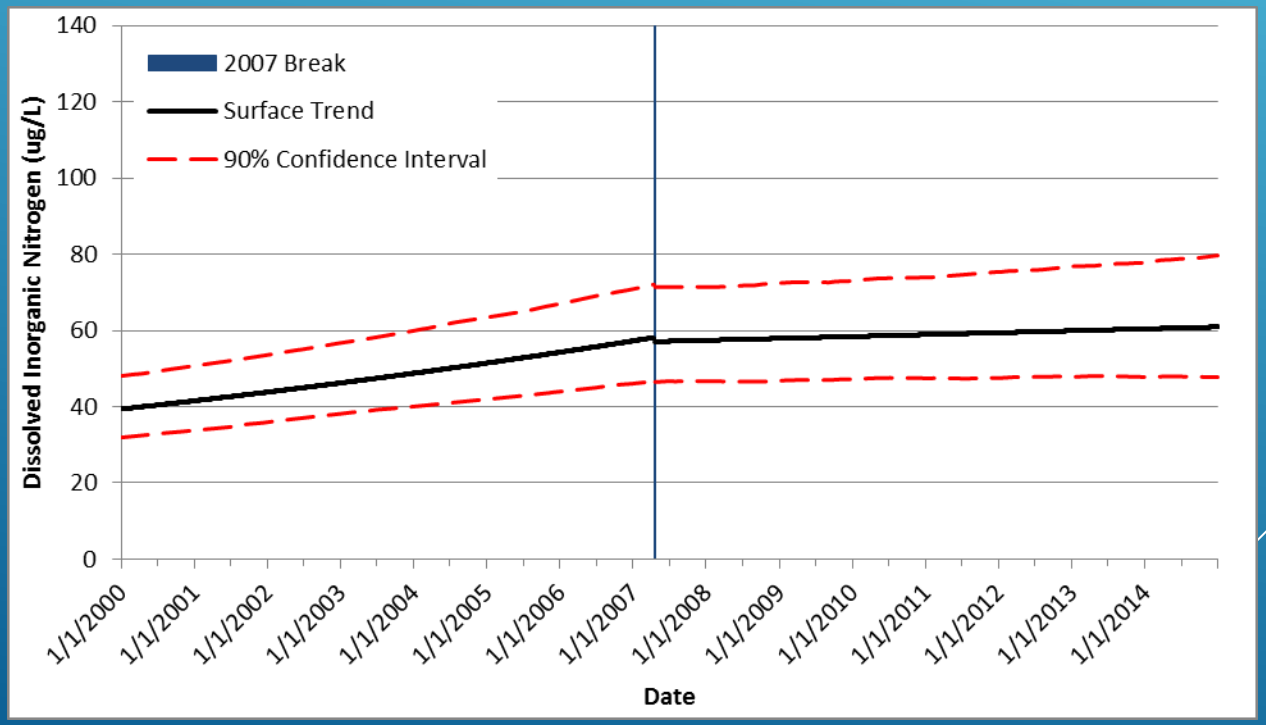

Pochet Upper (WMO-5)
Class SA Waters Criteria
WMO-5 Mid
Dissolved Oxygen (mg/L)
% Oxygen Saturation
Sample Date


Pochet-Upper (WMO-5)
Eutrophication Index
Good
Fair
Poor
Total Nitrogen (mg/L)
DIN
PON
DON
Pigment Concentration (ug/L)
Phaeo
Chl-a
Year

BAY-WIDE RESULTS

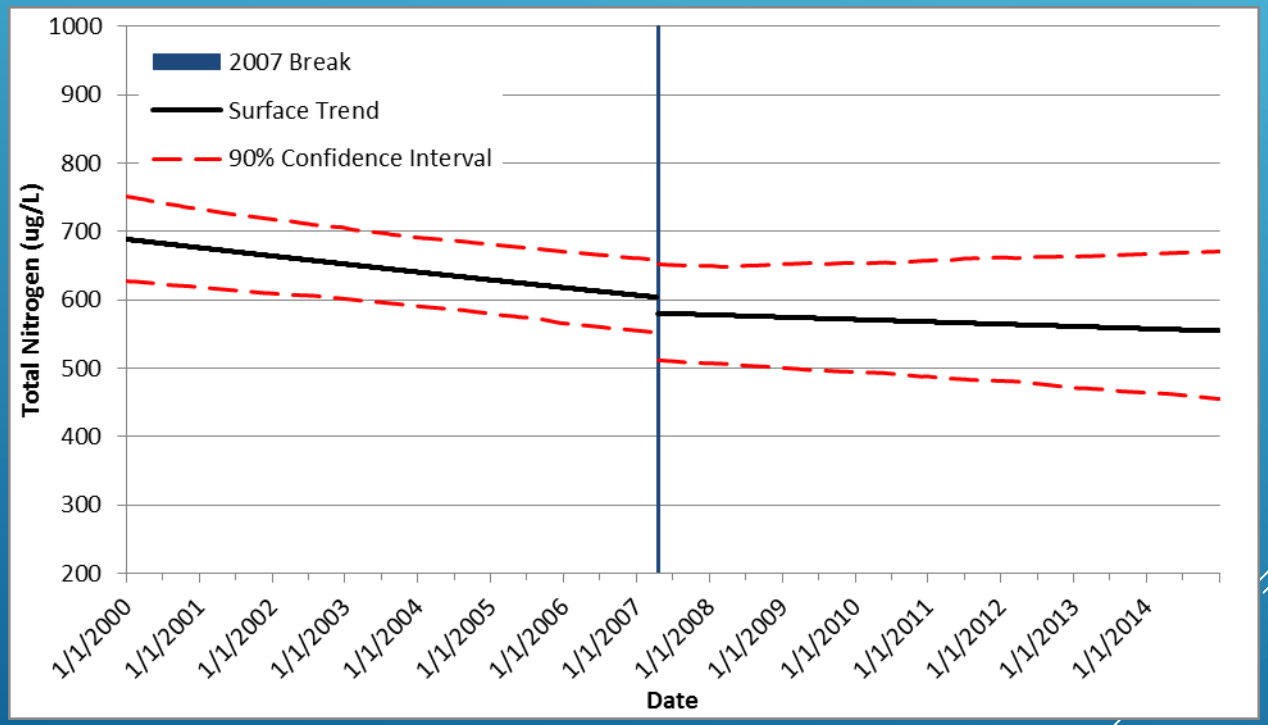
Dissolved Inorganic Nitrogen

- Increasing trend before 2007 break
- After break concentrations still increasing but at lower rate



Total Nitrogen

- Decreasing trend before 2007 break
- No significant trend after break



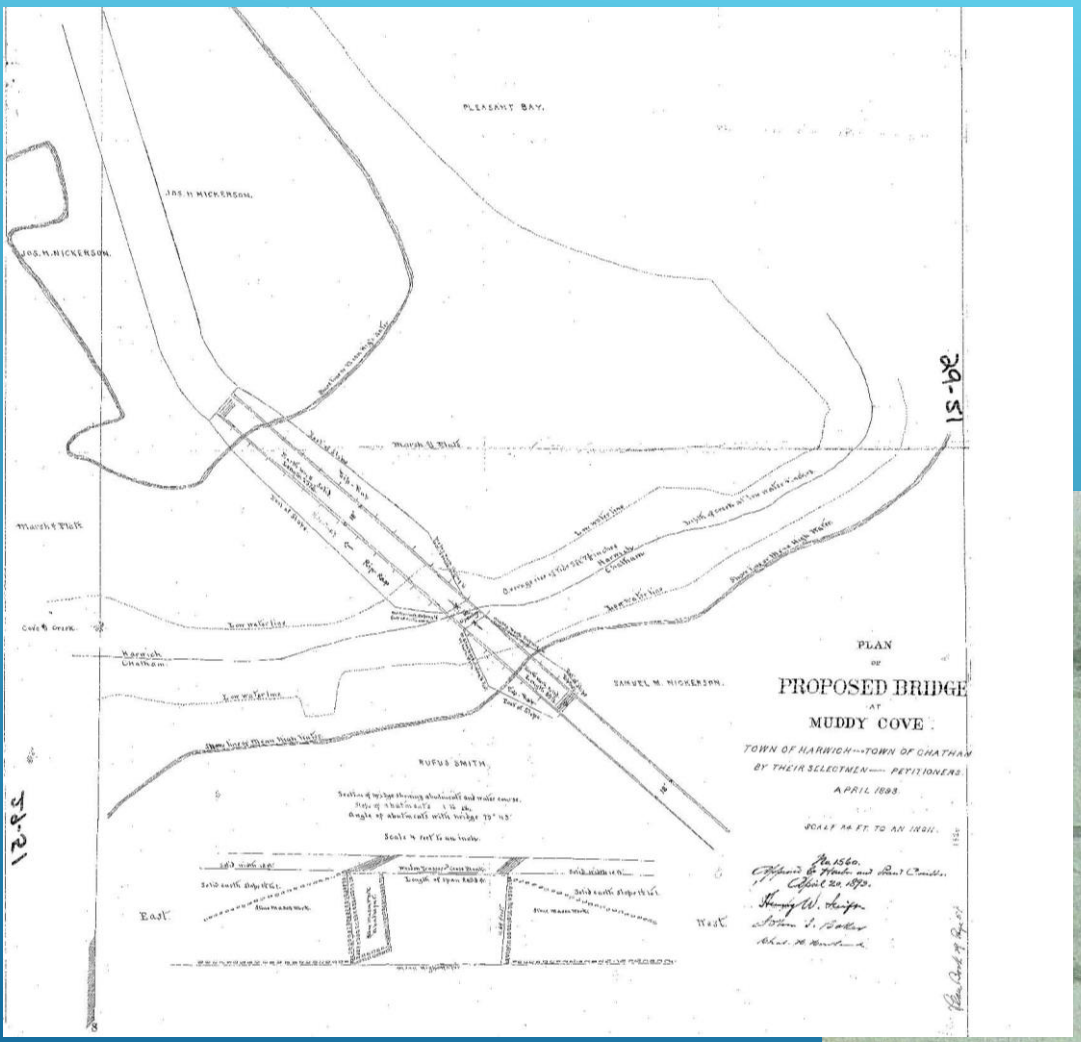
MUDDY CREEK RESTORATION BRIDGE PROJECT

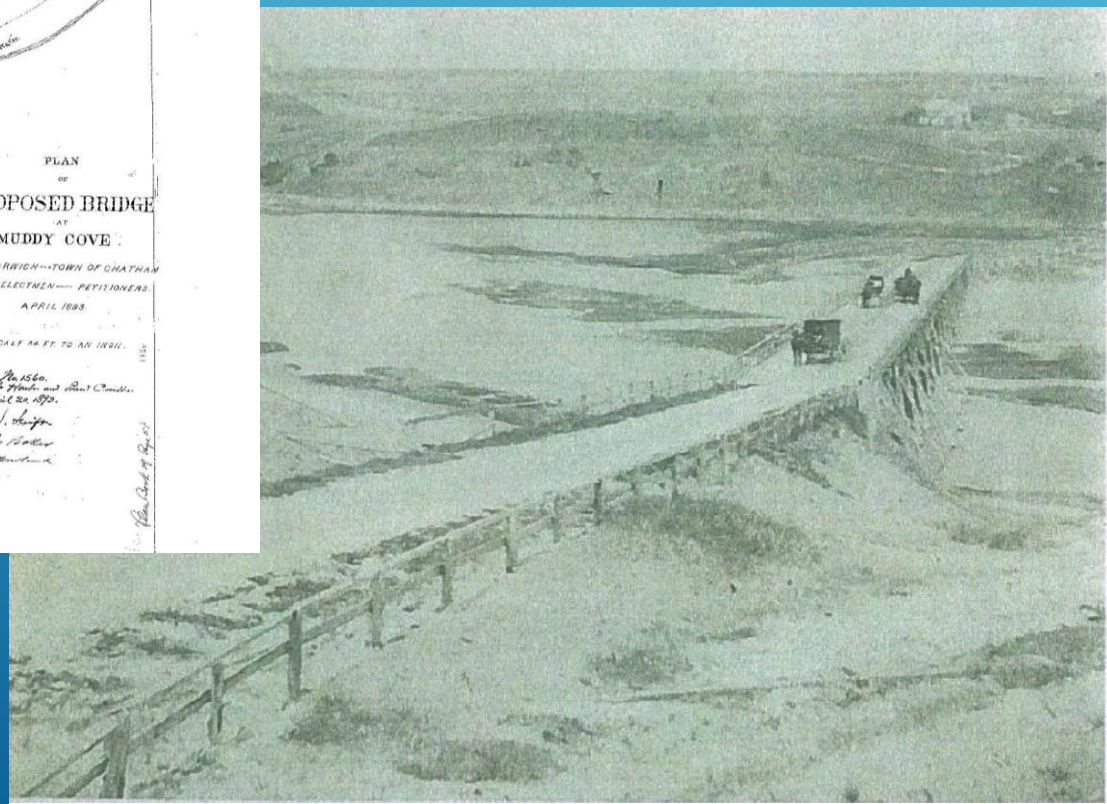
A Joint Project of:

With Support From:

MASSACHUSETTS DEPARTMENT OF FISH AND GAME
Division of Ecological Restoration

HISTORIC CONDITION





Historic photo of earthen fill placement at Orleans Road (Route 28) over Muddy Creek, facing south toward Chatham circa 1900


25 10:09AM


Harwich
Christopher Way
Church St
39
Washburn Way
Blue Heron Landing
Osprey Ln
Route 28
Bay Rd
Williamsburg Ave
Fredericksburg Ave
Orleans Rd
Arbutus Trail
Bee Ln
Monomoyic Way
Riverview Dr
Potonumecot Rd
Continental Dr
Church St
Noreast Dr
Locust Grove Rd
Nickerson Rd
Sugar Hill Dr
Monomessar Way
Deer Meadow Ln
Round Cove Rd
Knob Rd
Cemetery Rd
Church St
Harden Ln
Chipping Stone Rd
Joshua Jethro Rd
Sachemas Way
Riverview Dr
Lakeview Ave
North Rd
Valley Rd
Trout Pond Ln
Park Ave
Training Field Rd
Chickadee Ln
Duck Marsh Ln
Riverview Dr
Countryside Dr
Wequasset Way
Captain Kendrick Dr
Old Comers Rd
Deer Meadow Ln
Wading Place Path
Old Queen Anne Rd
500 feet
Pictometry Bird's Eye © 2010 MDA Geospatial Se
Pictometry Bird's Eye © 2010 Pictometry International Corp © AND © 2010
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PRE-BRIDGE CONDITIONS

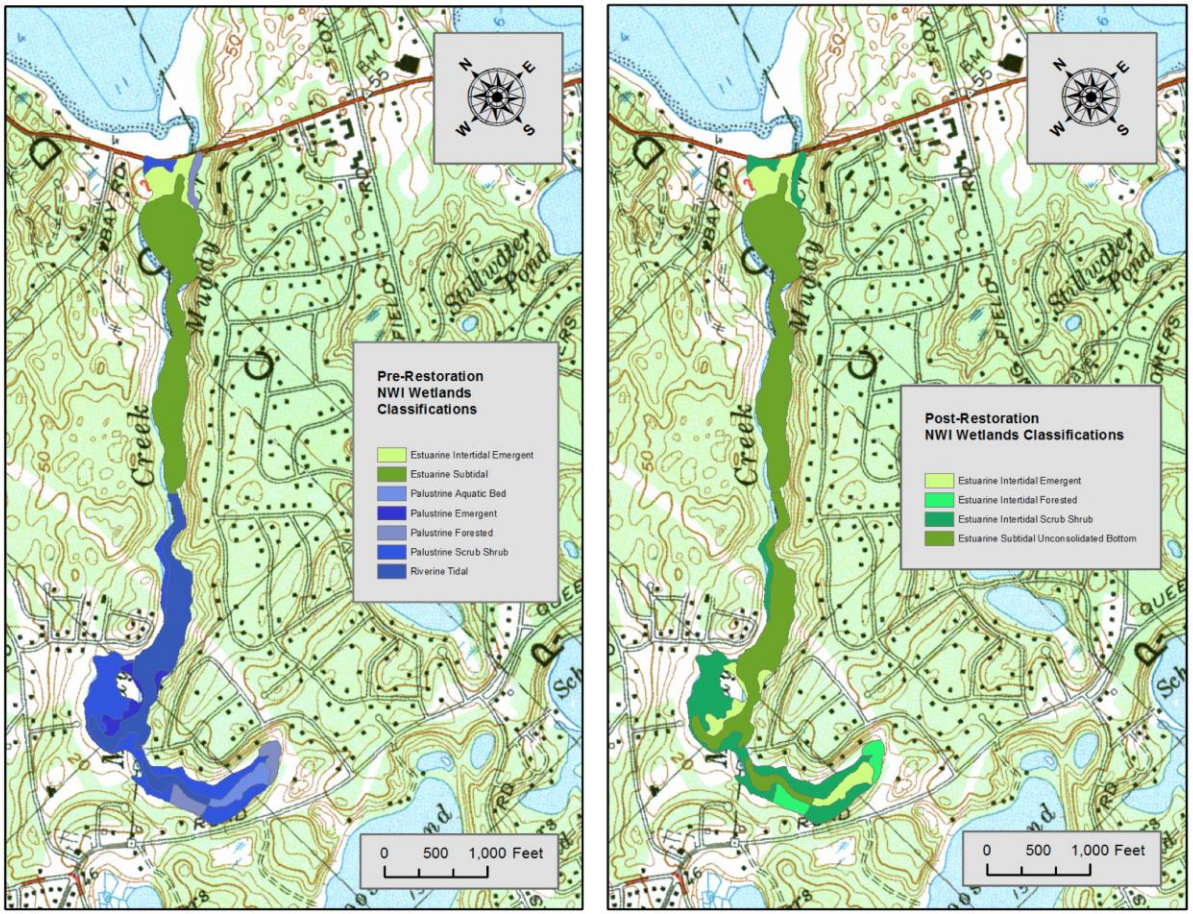
- Restricted tidal flushing
- Poor water quality
  - Total Nitrogen TMDL
  - Bacterial TMDL
- Wetlands impacts
  - Loss of marine wetlands
  - Introduction of invasive species
- Shellfish Closures
- Limitations on fish passage
- Limited public water access

RESTORATION ASSESSMENT

- Alternatives - Chatham MEP (2003)
- Priority Project – MassDER Wetland Restoration Program (2008)
- Hydrodynamic Model ➔ optimal opening (2009)
- Water Quality & Resource Assessments - Confirmed Benefits (2010-2012)
- Design alternatives ➔ single span bridge (2012)
- Design and permitting (2013-2015)
- Construction 2016 (January – May)

RESTORATION BENEFITS – WETLANDS

- 56 acres of wetlands restored
- Long-Term Restoration Benefits
  - Increased Salinity and Tidal Range
  - Reduction of Invasive Stands - Improved Biodiversity
  - Expansion of Tidal Mud Flats and Low Marsh Communities
  - New and Expanded Brackish & High Marsh Communities
  - Improved Habitat for several High Priority Species/Populations of migratory waterfowl & other migratory species.



PRE- AND POST WETLANDS

RESTORATION BENEFITS - FISH/SHELLFISH

- Long-Term Restoration Benefits
  - Larger Channel Opening Will Improve Fish Passage Opportunities for American eel, Alewife, White Perch, Frost Fish and Blue Crab.
  - Increased Tidal Exchange Will Improve Water and Habitat Quality
  - Improved Shellfish habitat (formerly a robust habitat for quahog (*Mercenaria mercenaria);*

September 11, 2014

June 11, 2017

Photos Courtesy of
Spencer Kennard


Harwich
Christopher Way
Church St
39
Washburn Way
Blue Heron Landing
Osprey Ln
Route 28
Bay Rd
Williamsburg Ave
Fredericksburg Ave
Orleans Rd
PBA-5
Arbutus Trail
Bee Ln
Monomoyic Way
Riverview Dr
Potonumecot Rd
Continental Dr
Church St
Noreast Dr
Locust Grove Rd
Nickerson Rd
Sugar Hill Dr
Monomessar Way
Deer Meadow Ln
Round Cove Rd
Knob Rd
Cemetery Rd
Church St
Harden Ln
PBA-5A
Chipping Stone Rd
Joshua Jethro Rd
Sachemas Way
Riverview Dr
Lakeview Ave
North Rd
Valley Rd
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Chickadee Ln
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Wading Place Path
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Old Comers Rd
Old Queen Anne Rd
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Pictometry Bird's Eye © 2010 MDA Geospatial Se
Pictometry Bird's Eye © 2010 Pictometry International Corp © AND © 2010
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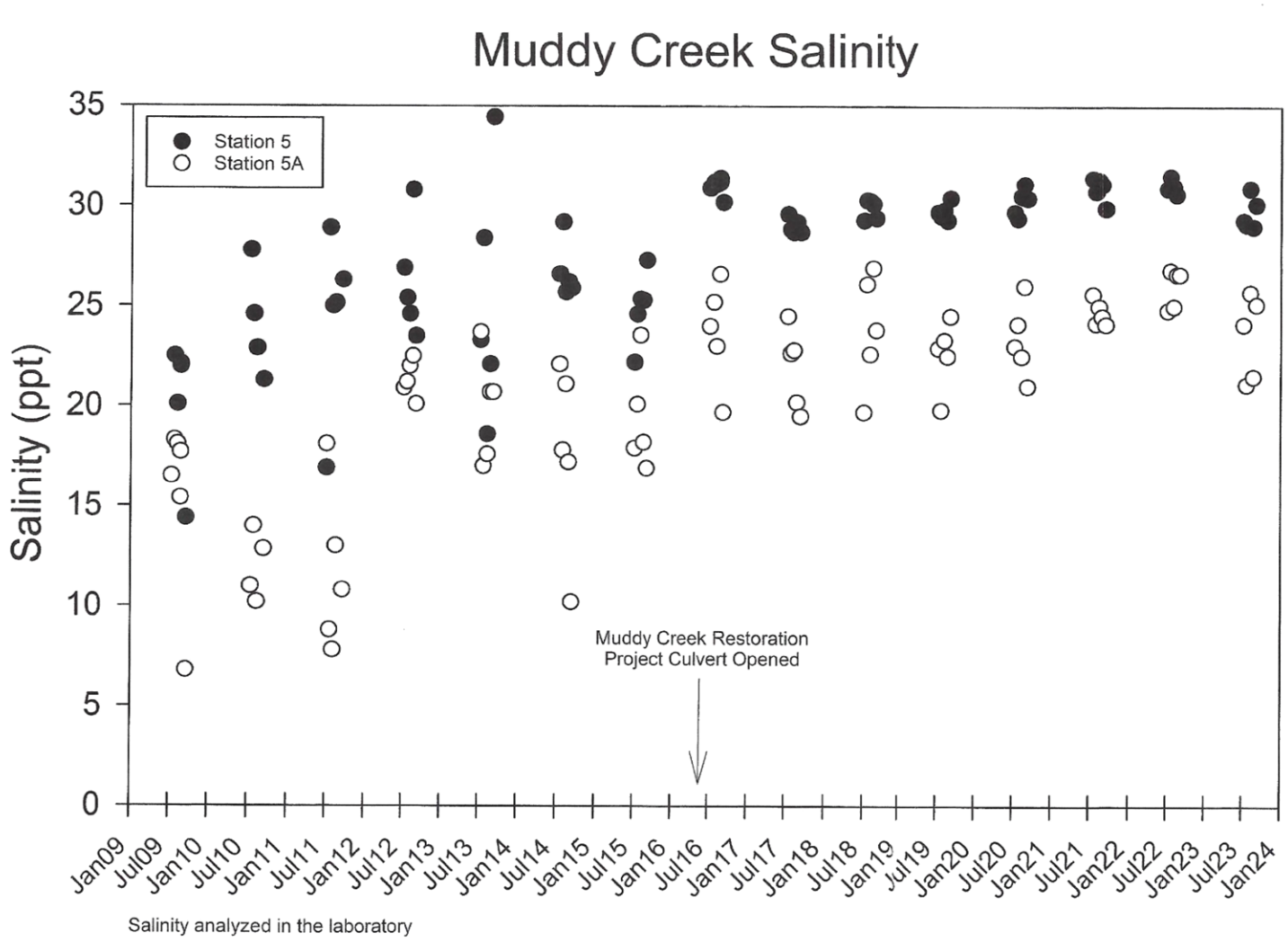
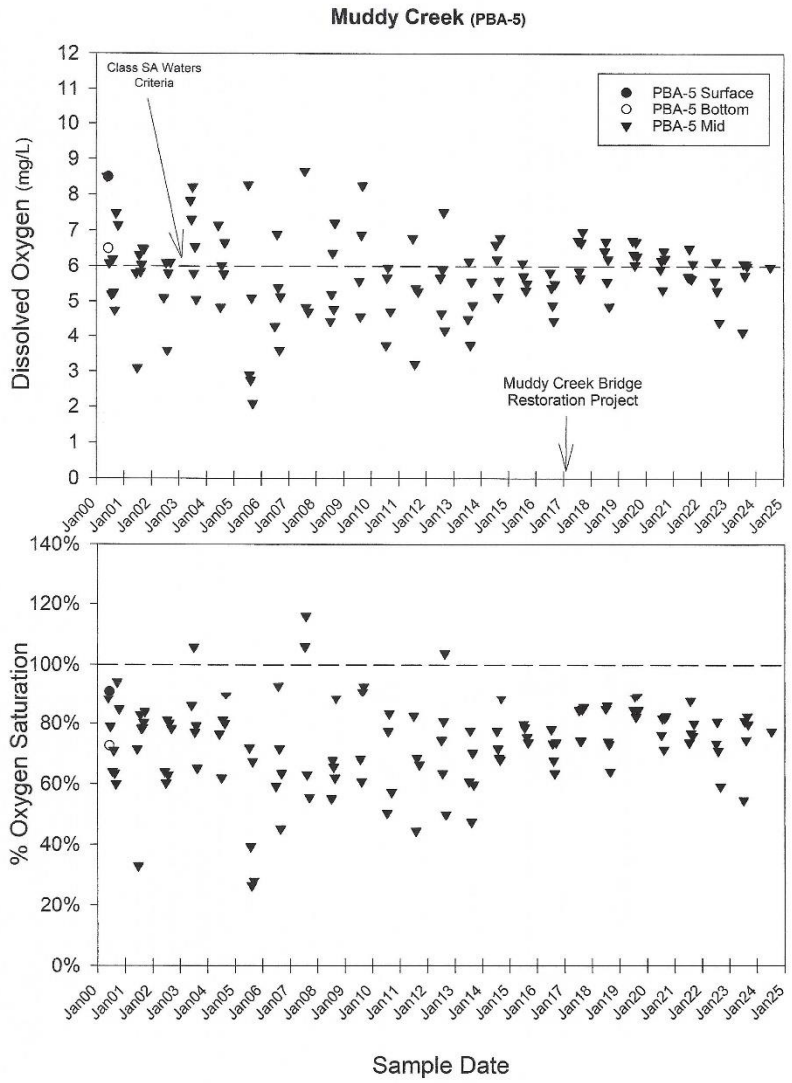
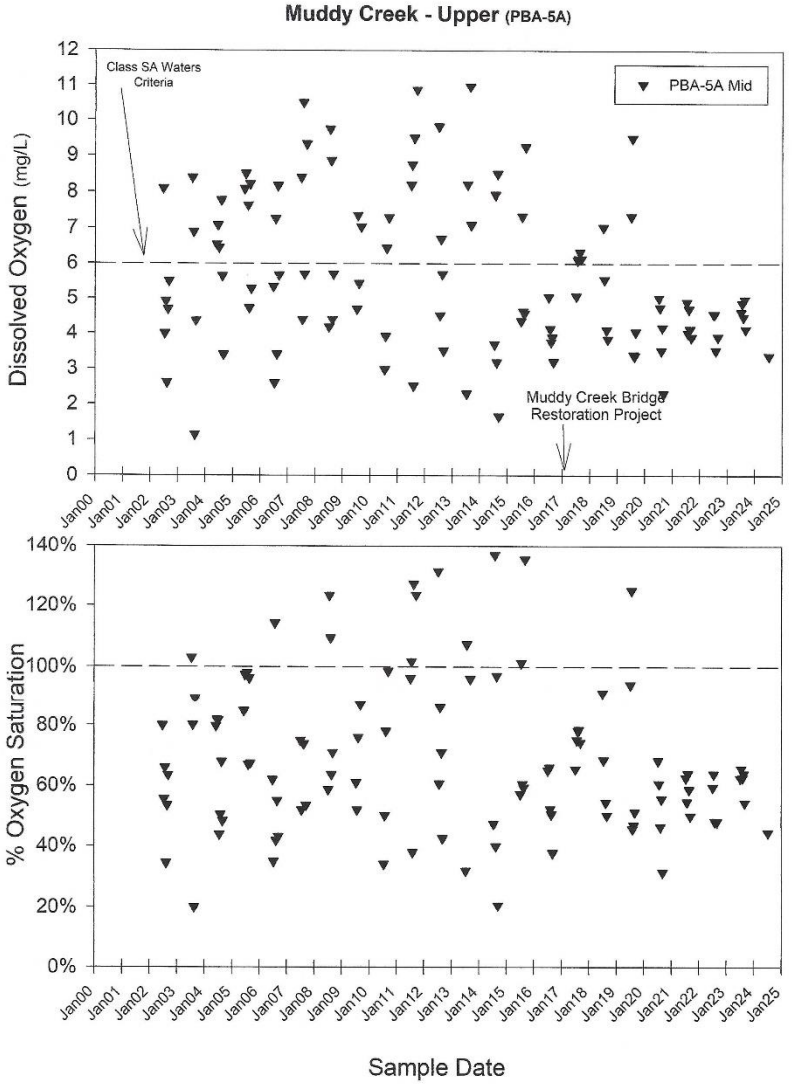
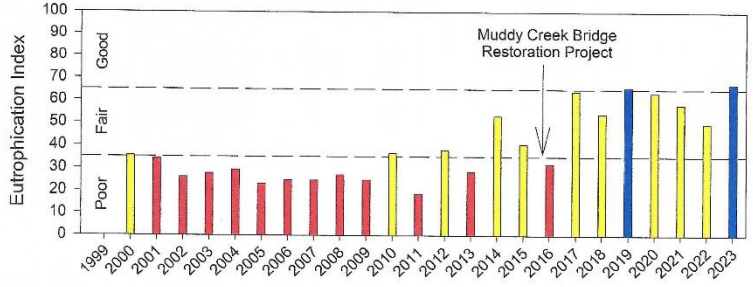
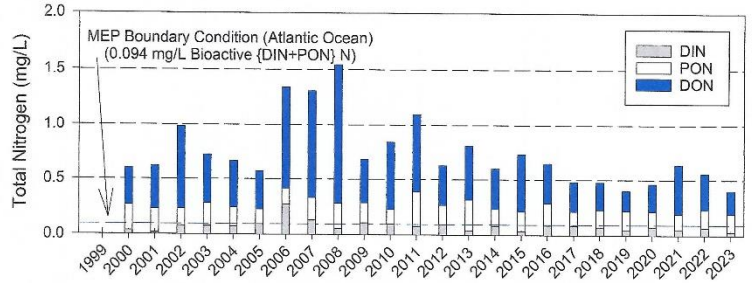

Muddy Creek Salinity
Station 5
Station 5A
Salinity (ppt)
35
30
25
20
15
10
5
0
Muddy Creek Restoration
Project Culvert Opened
Jan09
Jul09
Jan10
Jul10
Jan11
Jul11
Jan12
Jul12
Jan13
Jul13
Jan14
Jul14
Jan15
Jul15
Jan16
Jul16
Jan17
Jul17
Jan18
Jul18
Jan19
Jul19
Jan20
Jul20
Jan21
Jul21
Jan22
Jul22
Jan23
Jul23
Jan24
Salinity analyzed in the laboratory

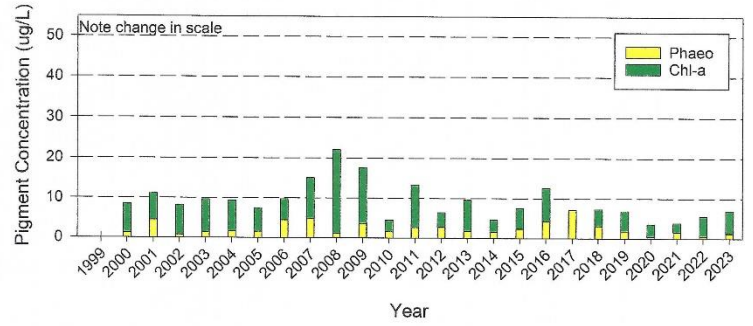

Muddy Creek (PBA-5)
Class SA Waters Criteria
PBA-5 Surface
PBA-5 Bottom
PBA-5 Mid
Muddy Creek Bridge Restoration Project
Dissolved Oxygen (mg/L)
% Oxygen Saturation
Sample Date


Muddy Creek - Upper (PBA-5A)
Class SA Waters Criteria
PBA-5A Mid
Muddy Creek Bridge Restoration Project
Dissolved Oxygen (mg/L)
% Oxygen Saturation
Sample Date

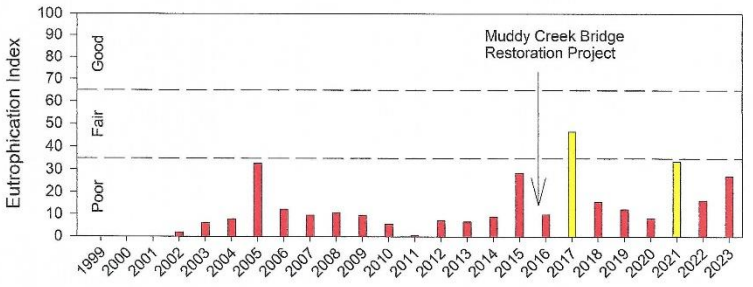
Muddy Creek (PBA-5)

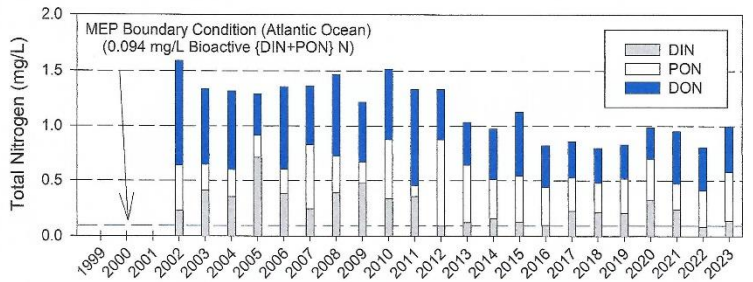


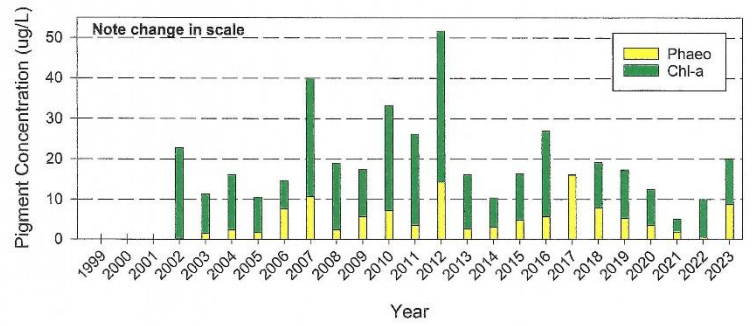




Muddy Creek - Upper (PBA-5A)







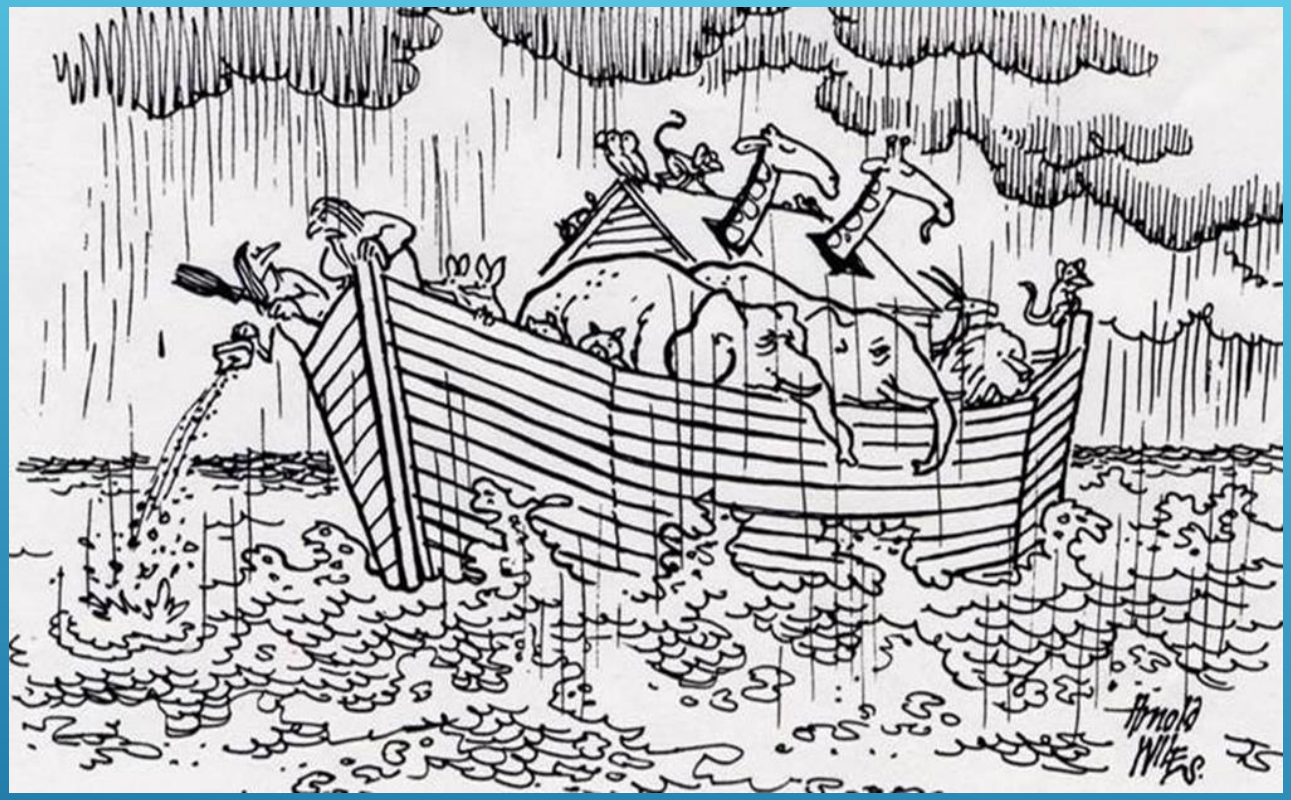
Continuing Work…

- Study shoreline dynamics and measure change
- System-wide approach to dredge material disposal
- Guidelines for freshwater docks, erosion control structures
- Continue water quality monitoring

Continuing Work…

- Update land-use and water quality models
- Evaluate changes to strengthen wetlands protection
- Monitor freshwater & intertidal habitats
- Study changes in finfish, shellfish populations and eelgrass
- Continue implementation of Watershed Permit

Questions?



“How many times must I tell you, the sea is not one vast, inexhaustible refuse dump.”

More info at: http://pleasantbay.org/