

# **Upper Cape West & South Group**



**Baseline Conditions & Needs Assessment**

# **What is the 208 Plan?**

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# Clean Water Act Section 208



The Commission was directed to update the 1978 Plan

The Commonwealth provided \$3 million to fund the project

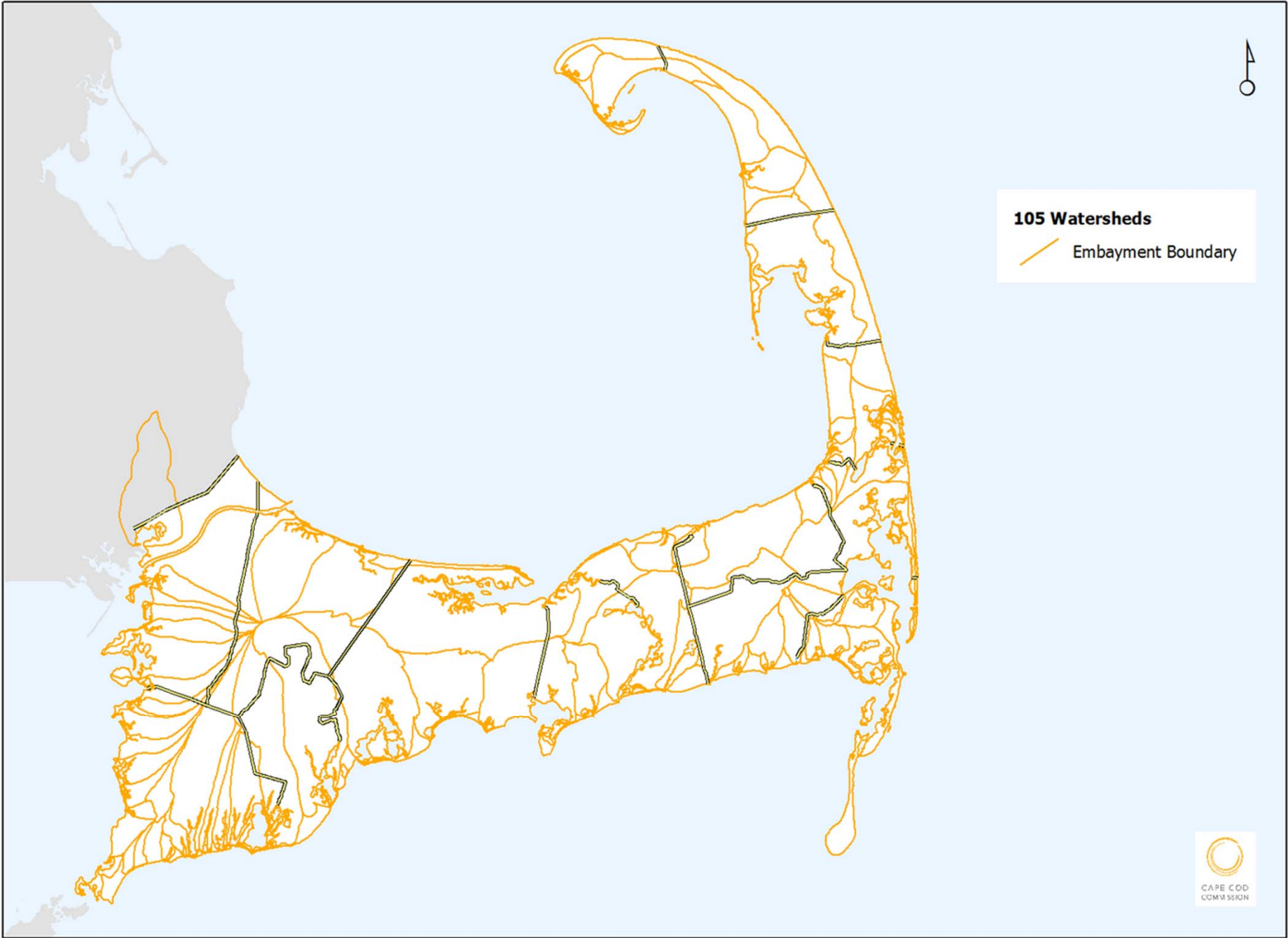
# Focus on 21<sup>st</sup> Century Problems



Nitrogen:  
Saline Waters

Phosphorus:  
Fresh Waters

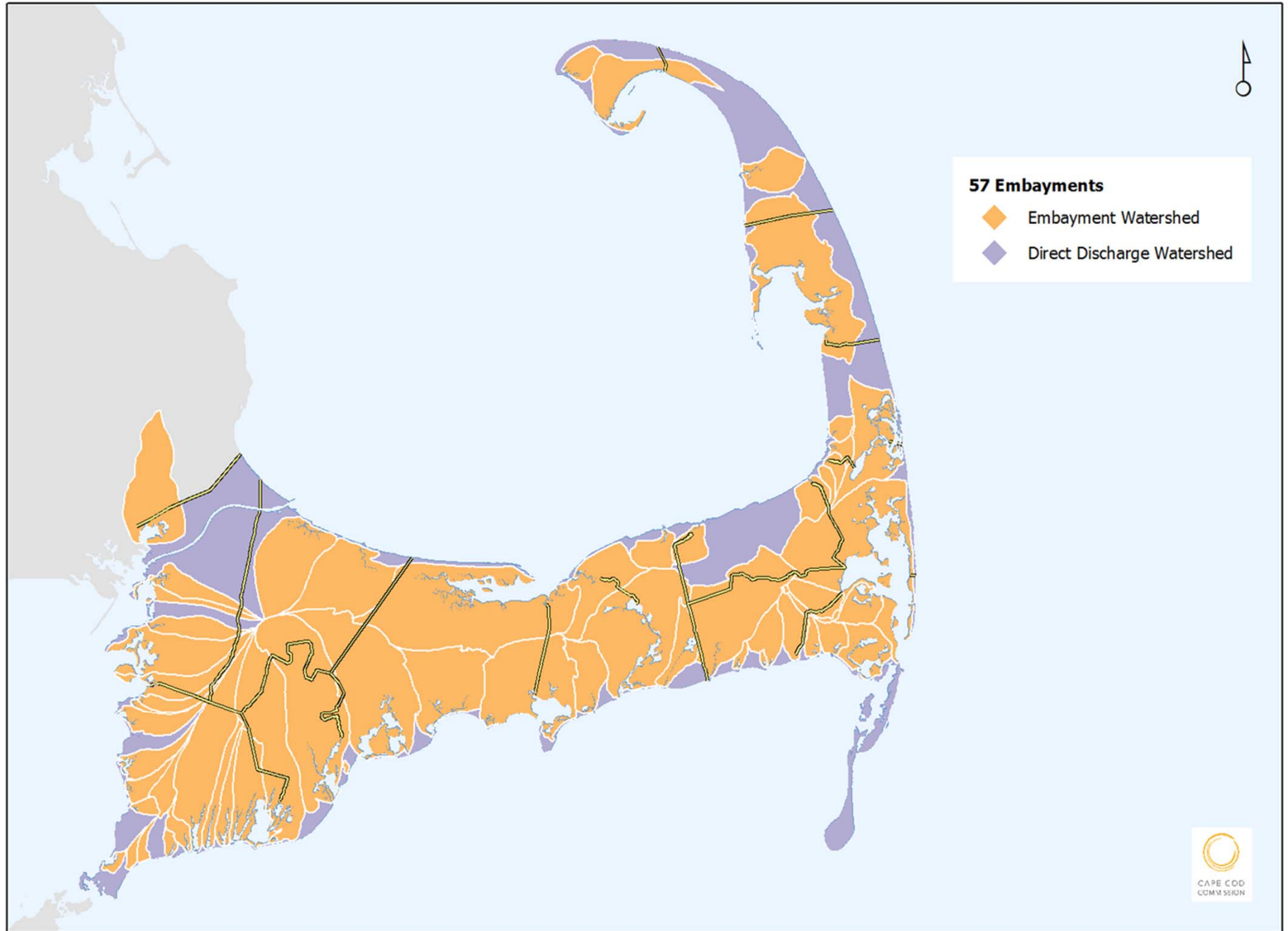
Growth &  
Title 5  
Limitations



**105 Watersheds**

— Embayment Boundary

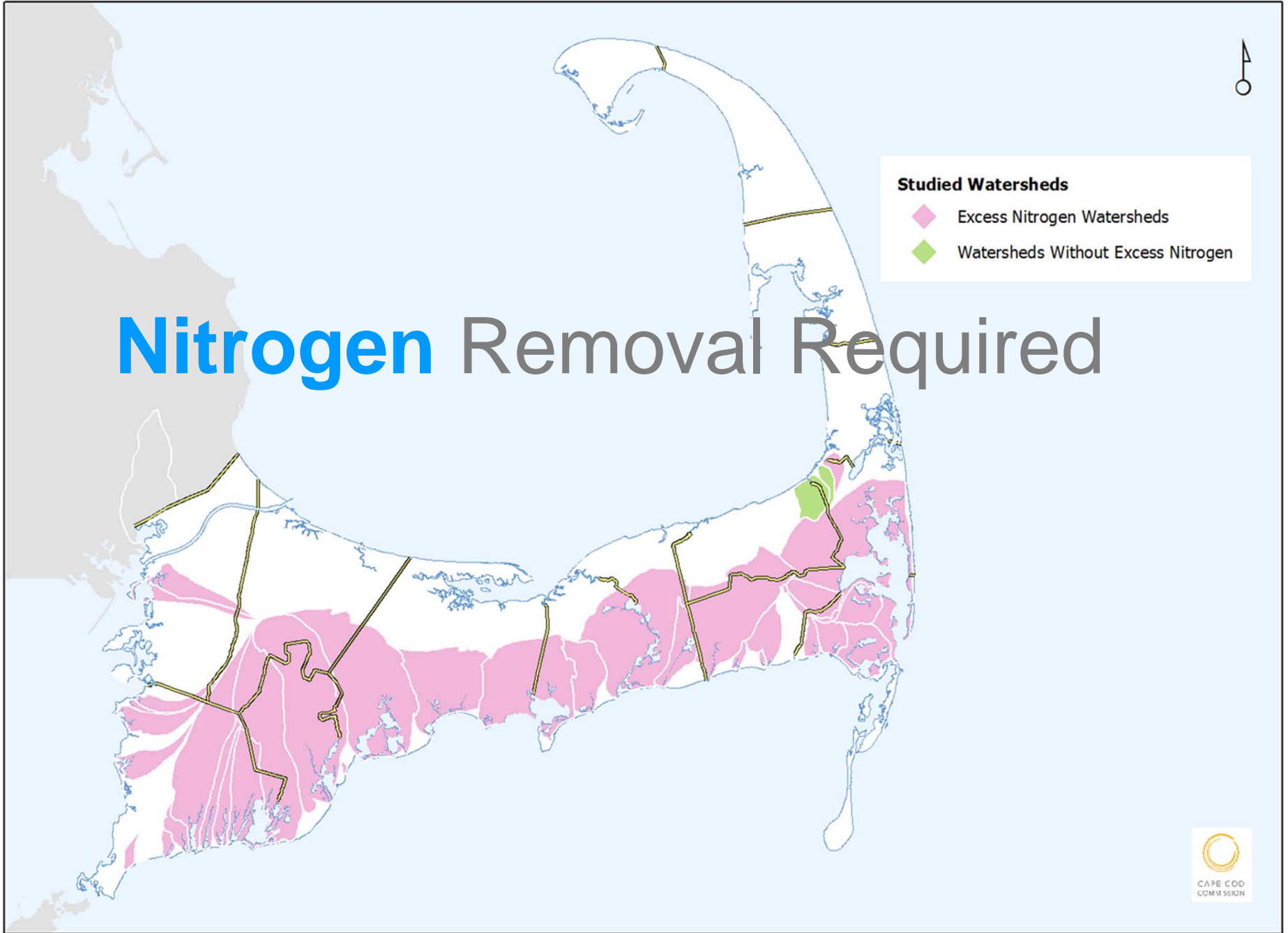


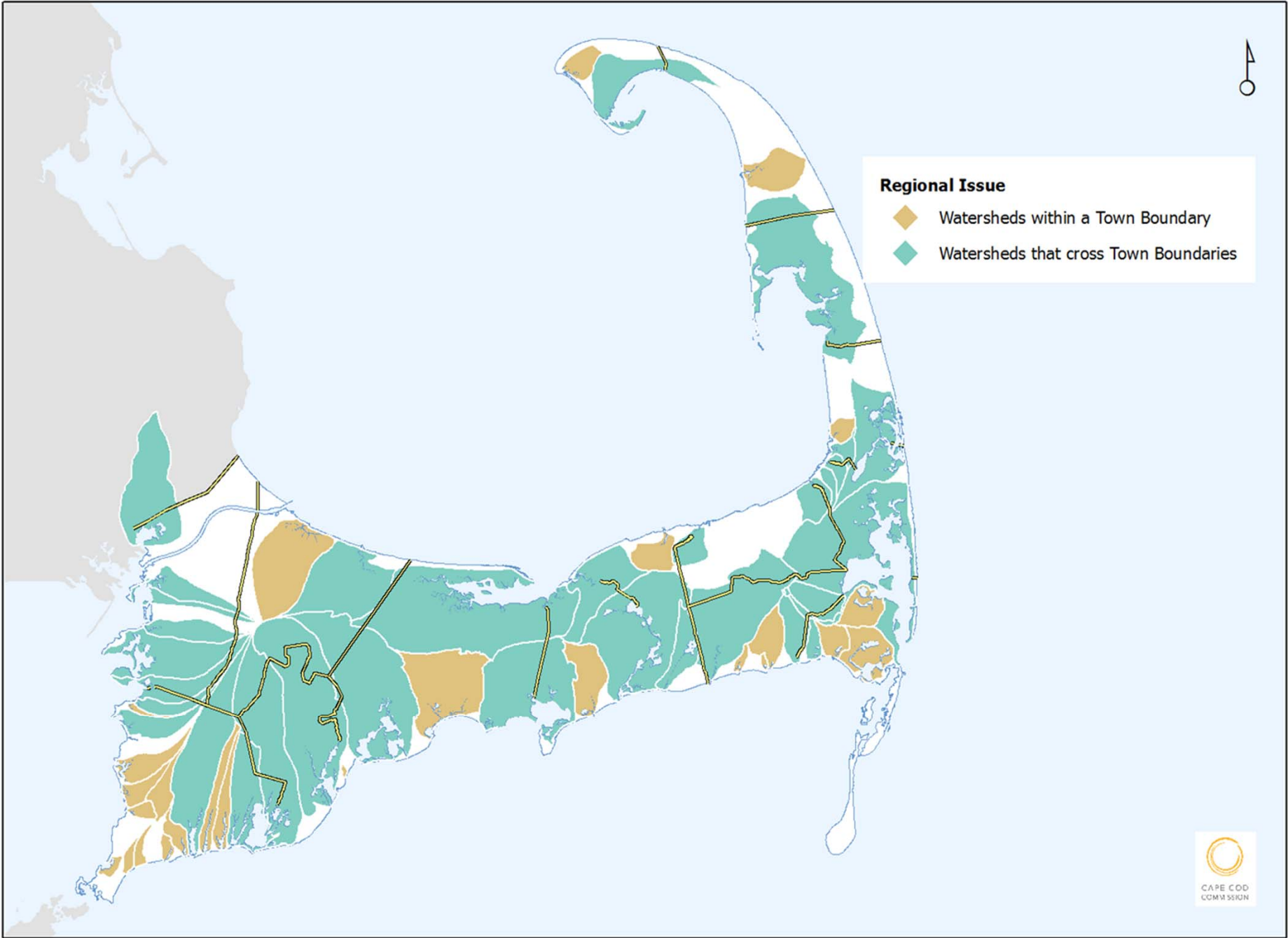


# Nitrogen Removal Required

## Studied Watersheds

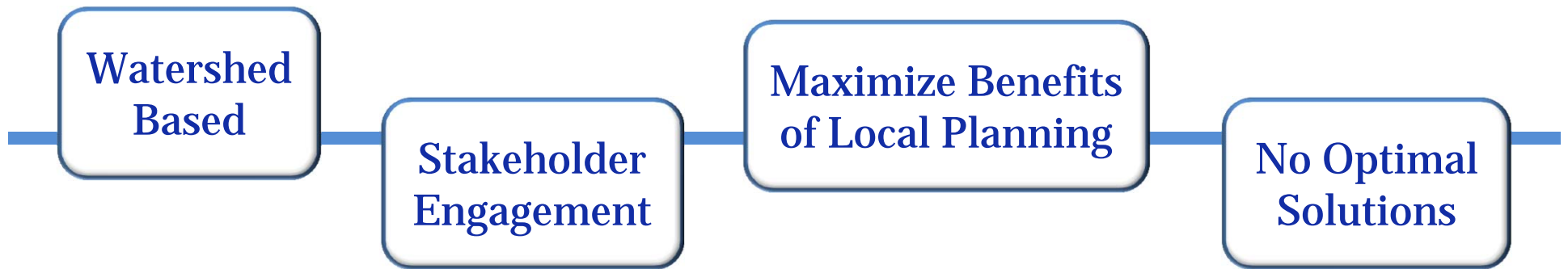
- ◆ Excess Nitrogen Watersheds
- ◆ Watersheds Without Excess Nitrogen







# Approach to the 208 Plan Update

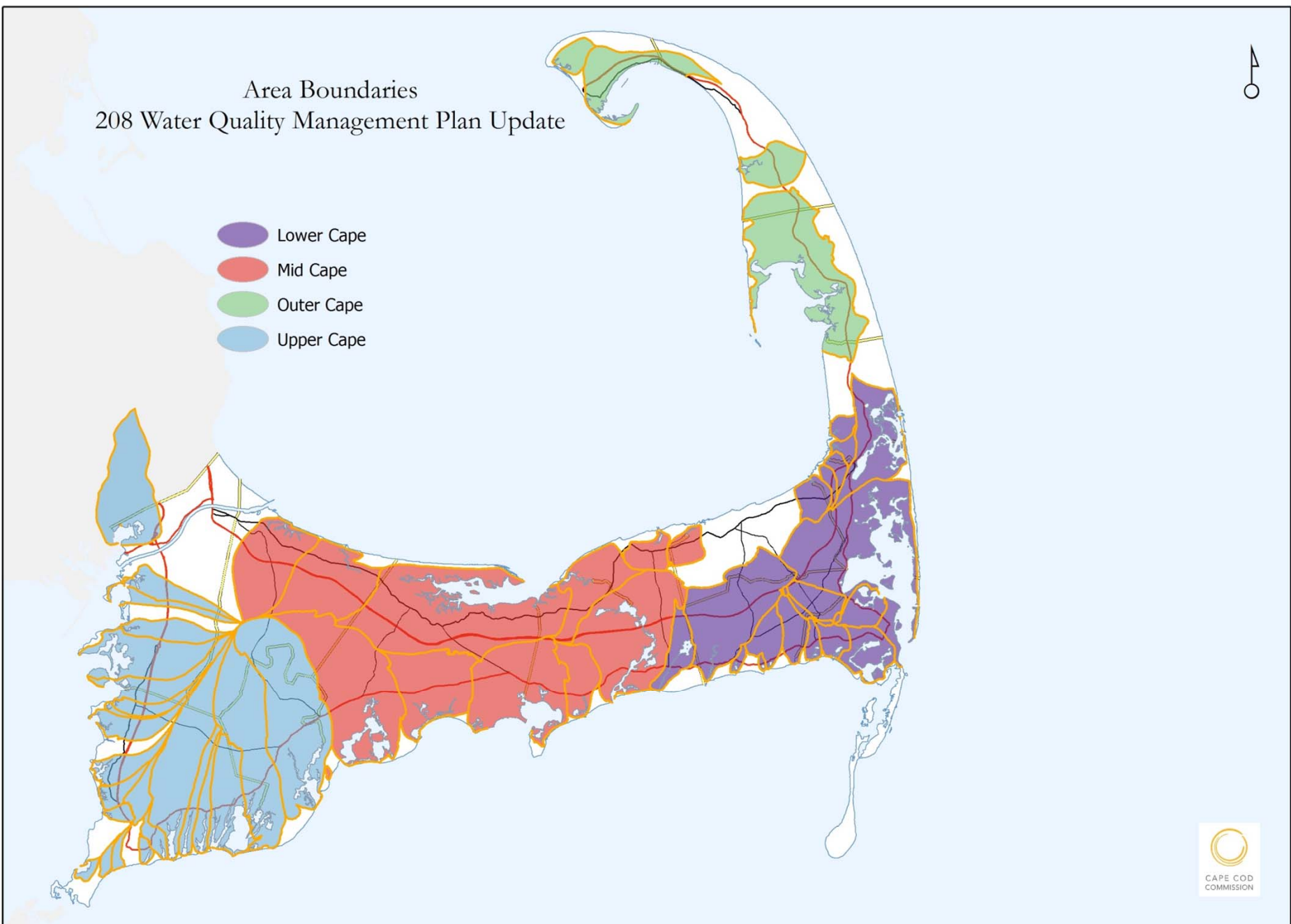


## **Goal:**

To generate a series of approaches in each watershed that will meet water quality standards

Area Boundaries  
208 Water Quality Management Plan Update

- Lower Cape
- Mid Cape
- Outer Cape
- Upper Cape



# Subgroup Boundaries 208 Water Quality Management Plan Update



## Lower Cape

- Herring River
- Pleasant Bay
- Stage Harbor Group
- Nauset and Cape Cod Bay Marsh Group

## Mid Cape

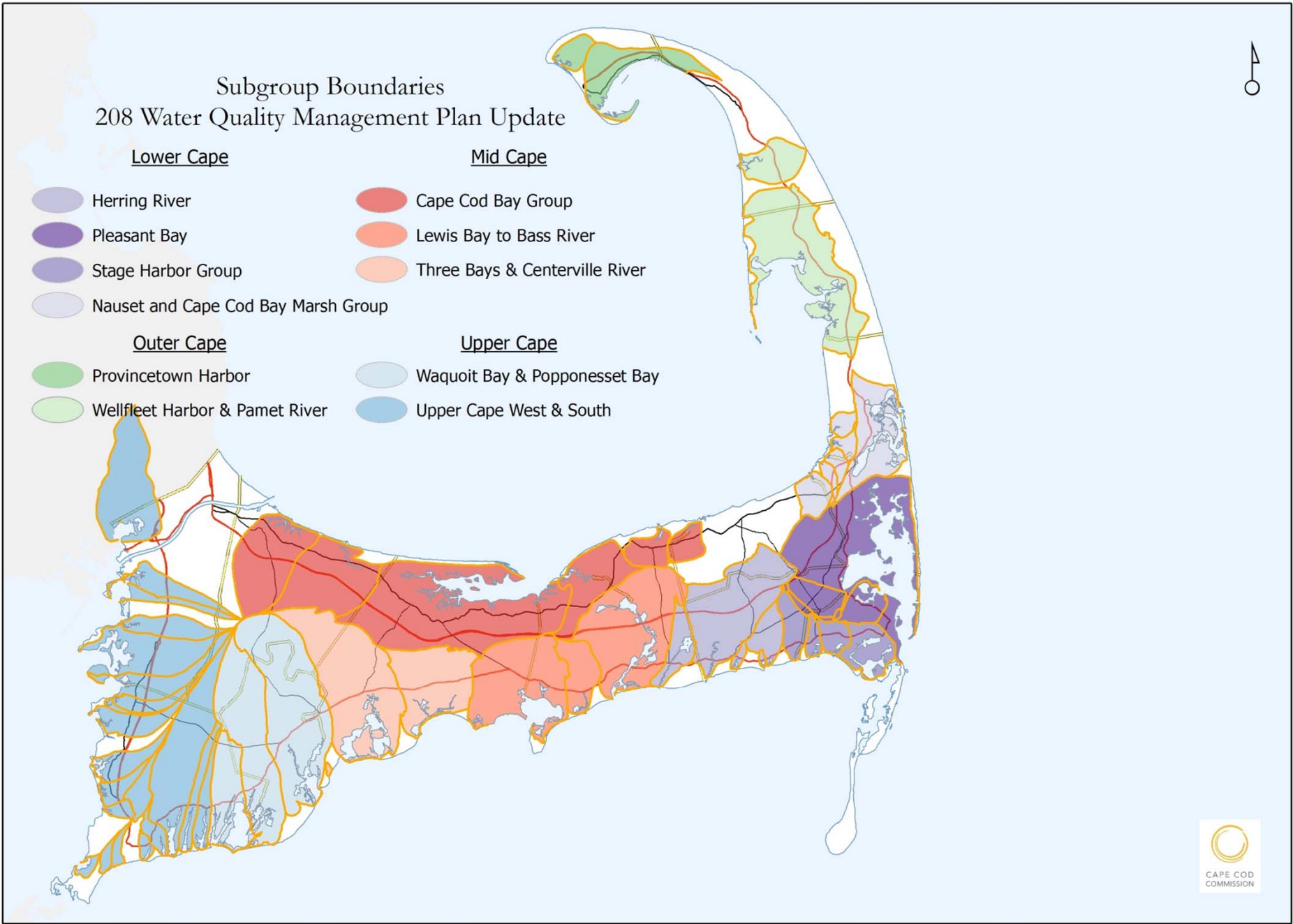
- Cape Cod Bay Group
- Lewis Bay to Bass River
- Three Bays & Centerville River

## Outer Cape

- Provincetown Harbor
- Wellfleet Harbor & Pamet River

## Upper Cape

- Waquoit Bay & Popponesset Bay
- Upper Cape West & South



**What is the stakeholder process?**

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## Public Meetings

## Watershed Working Groups



July

August

September

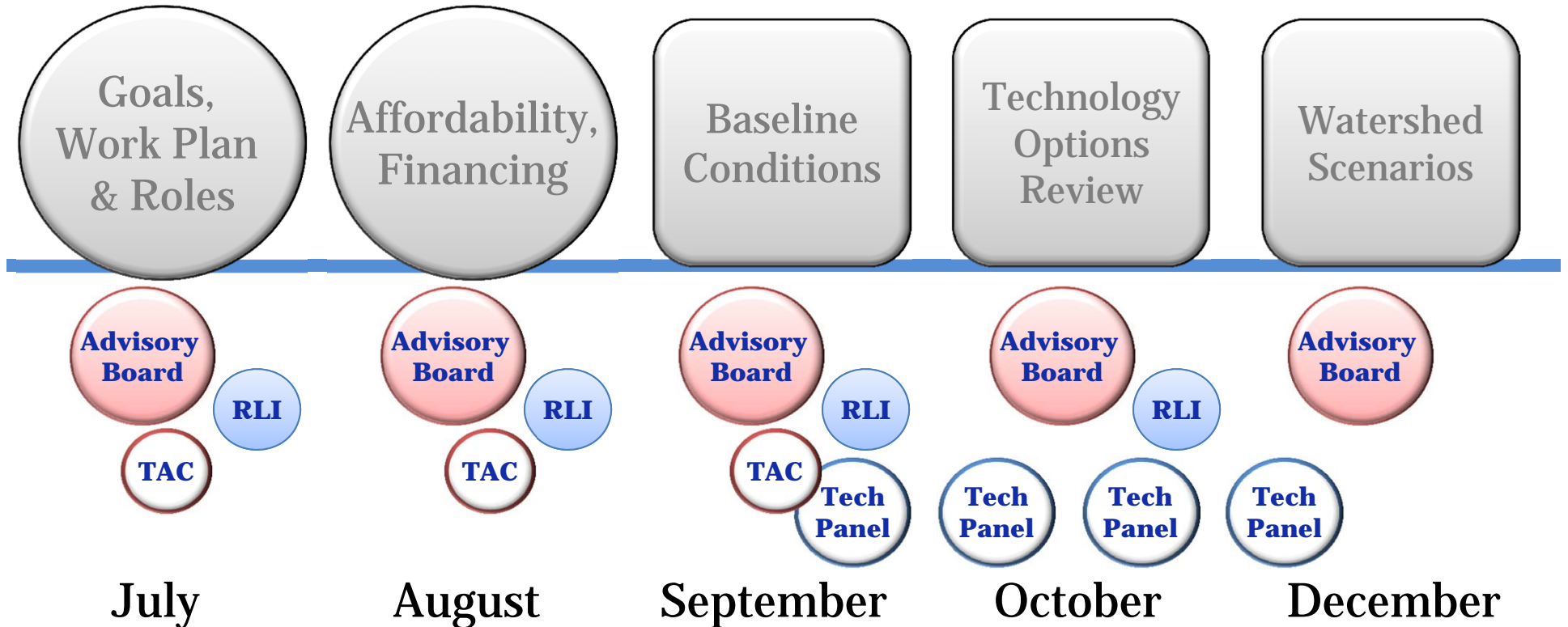
October

December

**208 Planning Process**

## Public Meetings

## Watershed Working Groups



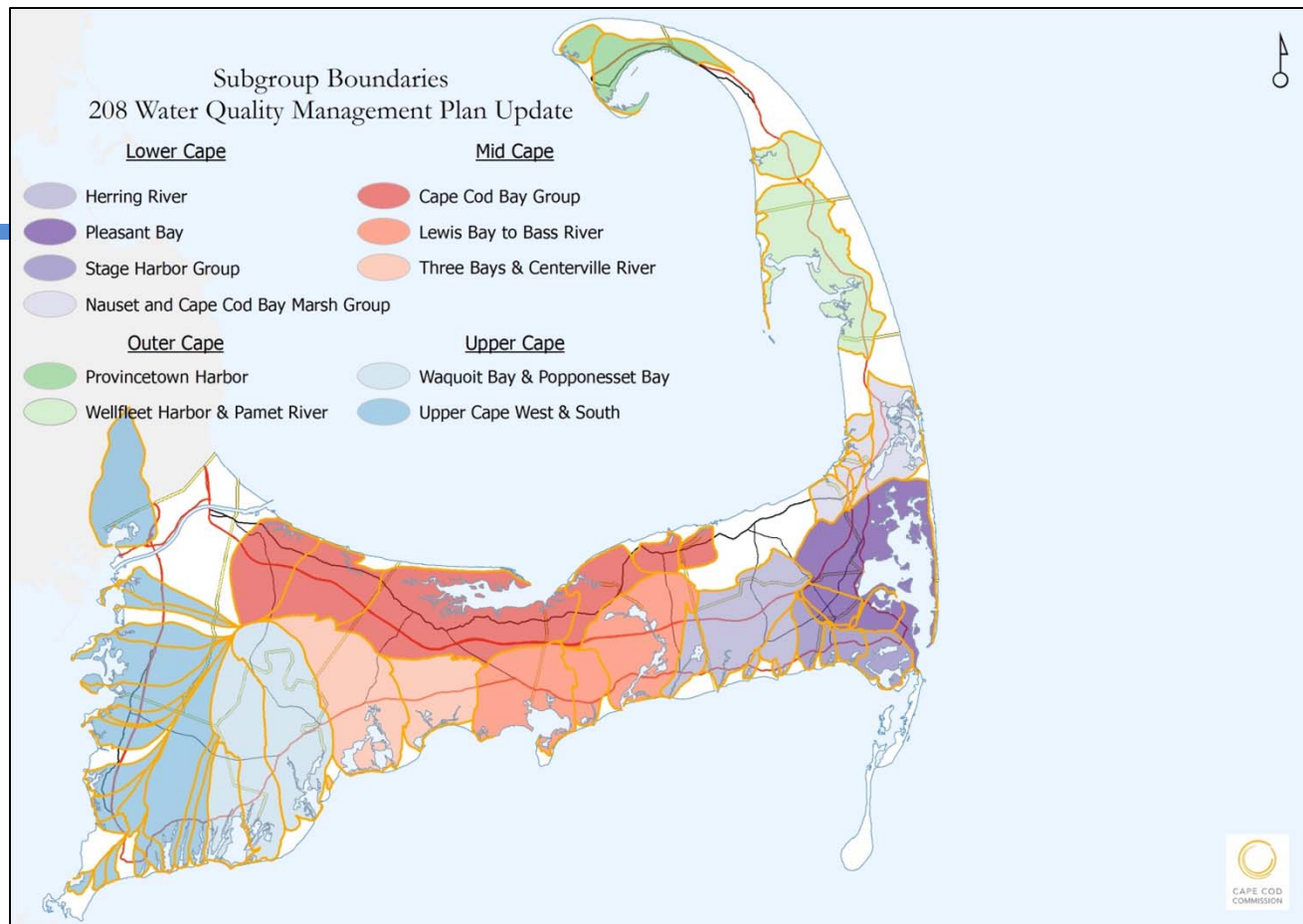
**RLI** Regulatory, Legal & Institutional Work Group

**TAC** Technical Advisory Committee of Cape Cod Water Protection Collaborative

# 208 Planning Process

# Baseline Conditions

11 Working Group Meetings:  
Sept 18-27



## 208 Planning Process

**Baseline Conditions**

11 Working Group Meetings:  
Sept 18-27

**Technology Options Review**

11 Working Group Meetings:  
Oct 21-Nov 5



- Wastewater
- Stormwater
- Existing Water Bodies
- Regulatory

# 208 Planning Process



Baseline  
Conditions

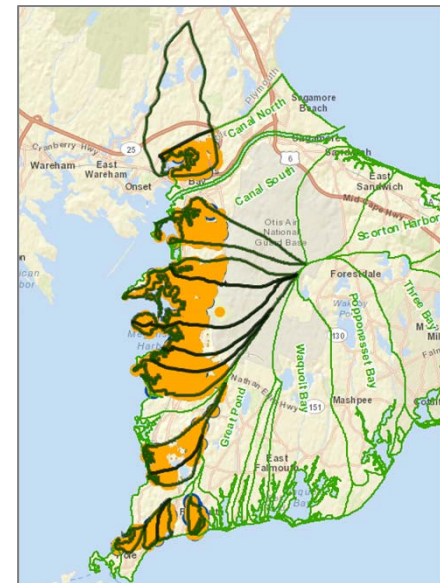
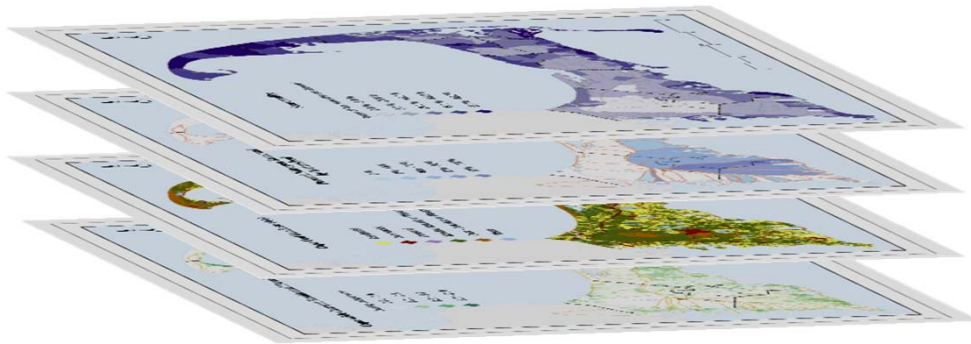
11 Working  
Group Meetings:  
Sept 18-27

Technology  
Options  
Review

11 Working  
Group Meetings:  
Oct 21-Nov 5

Watershed  
Scenarios

11 Working  
Group Meetings:  
Dec 2-11



**208 Planning Process**

Baseline  
Conditions

11 Working  
Group Meetings:  
Sept 18-27

## Goal of Today's Meeting:

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To review and develop shared understanding of the characteristics of these watersheds, the work done to date, existing data and information available, and how to apply all of this to planning for water quality improvements for these watersheds moving forward.

**208 Planning Process**

# Local Progress to Date



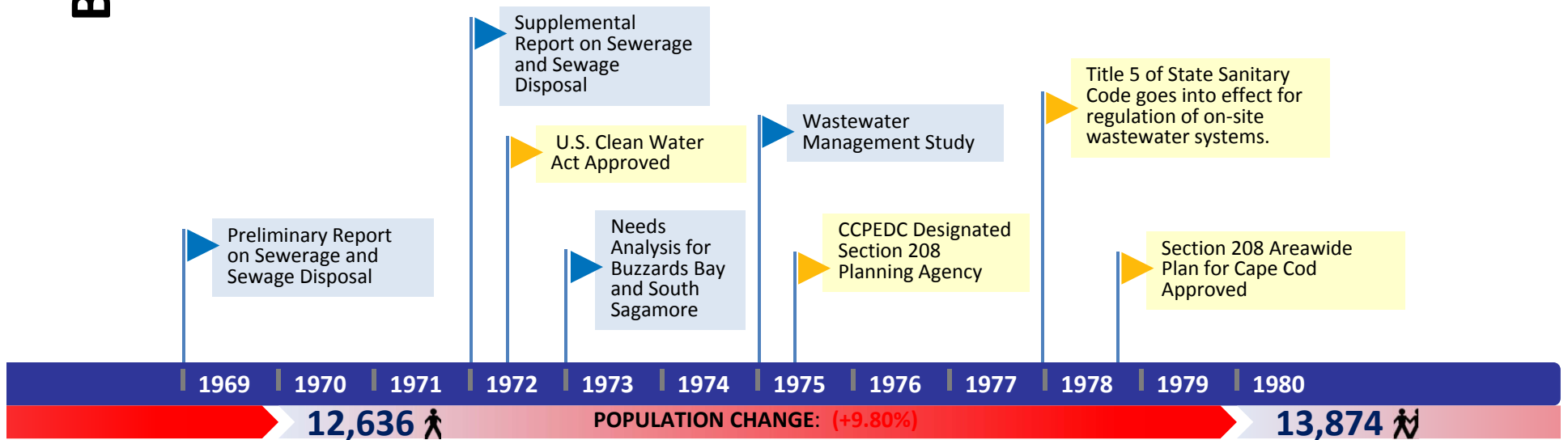
Buttermilk Bay  
Phinney's Harbor  
Back River/Eel Pond  
Pocasset River  
Pocasset Harbor  
Megansett Harbor  
Fiddler Cove  
Rands Canal

Wild Harbor  
Great Sippewisset Creek  
Little Sippewisset Marsh  
Falmouth Inner Harbor  
Quissett Harbor  
Oyster Pond  
Salt Pond

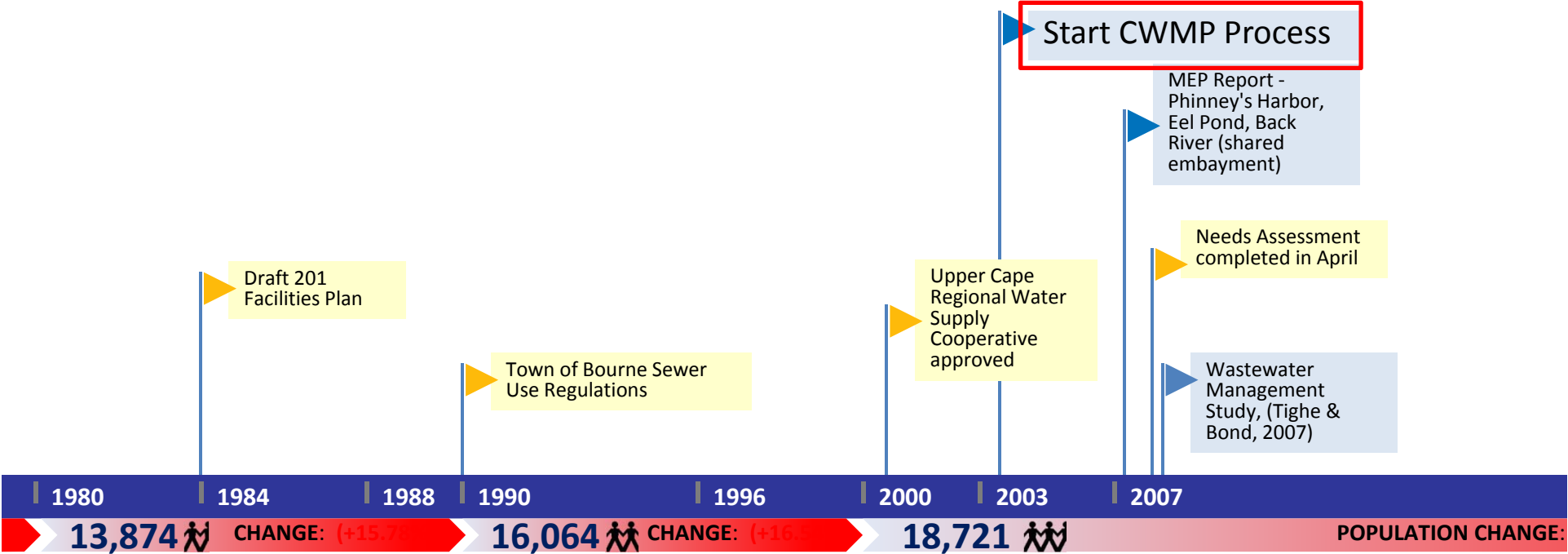
# Bourne: 1969-2013

## From 1978 Section 208 Plan

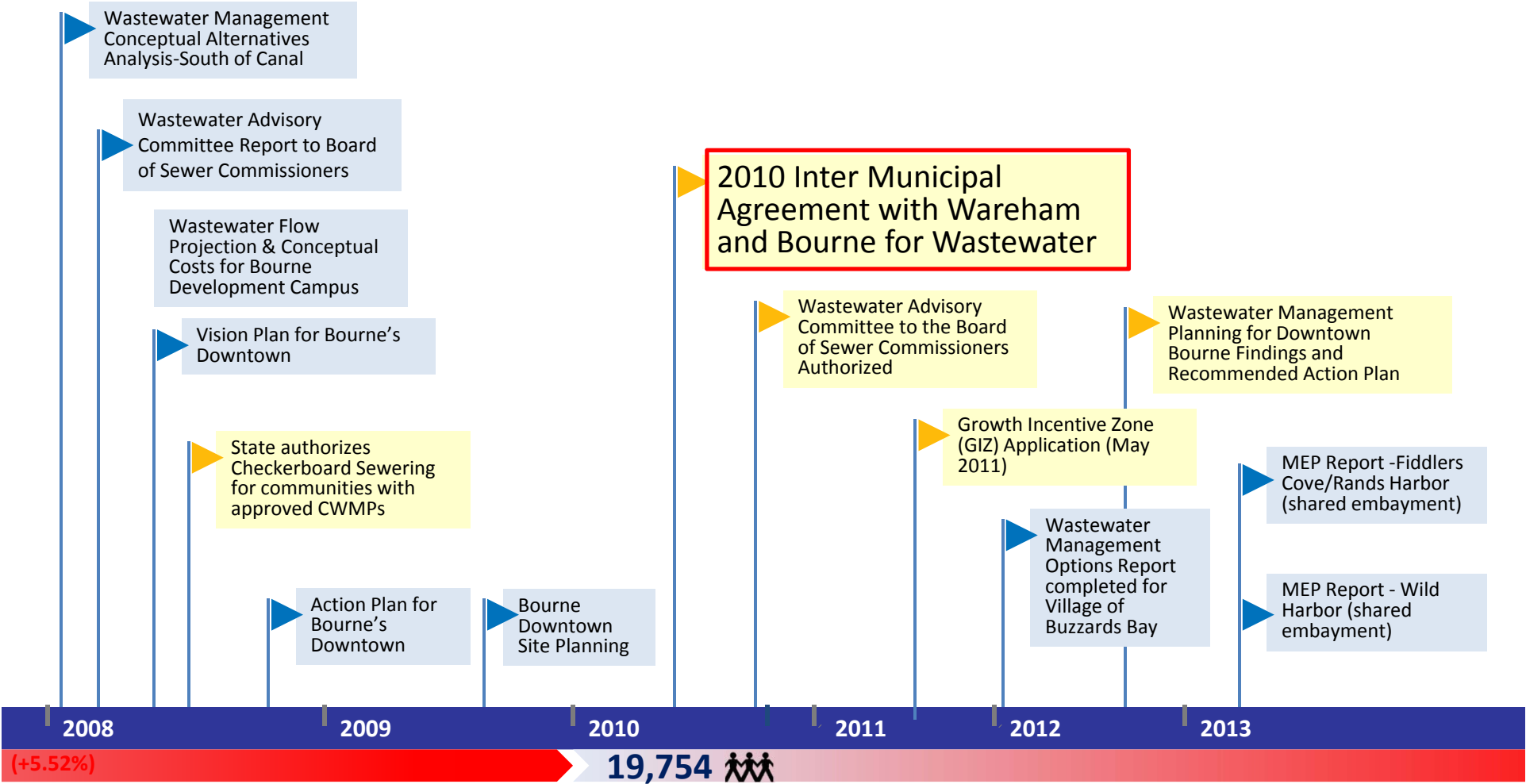
- ▶ The Town of Bourne presents unique geographic difficulties to be overcome in water quality management due to its physical division by the Cape Cod Canal.
- ▶ The Town of Bourne has a major Category 1 problem area in Buzzards Bay, a densely developed commercial area. On-site system failures in this area have been tied to documented groundwater degradation.
- ▶ The Wareham treatment plant is planned to serve the area adjacent to Buzzards Bay and has the capacity to accept sewage from Buzzards Bay.
- ▶ It is likely that watershed protection measures are as important in this area as wastewater management facilities.
- ▶ It is the general recommendation of this plan that the town should apply for 201 facility planning funds to abate existing problems and construct a septage facility.
- ▶ The town prefers the district approach and itself must then assume full responsibility for investigating and correcting problems in remaining problem areas.
- ▶ Should the town be unsuccessful in implementing this approach it should reconsider the possibility of conducting a 201 study.
- ▶ On-site system management should be implemented throughout the unsewered sections of Bourne, including a maintenance pumping program when adequate septage facilities are available.



# Bourne: 1969-2013



# Bourne: 1969-2013



# Falmouth: 1947-2013

## From 1978 Section 208 Plan

Falmouth's difficulties with sewer system planning and

- ▶ construction have a 30 year history. It is strongly recommended that the town appoint a water quality advisory committee.
- ▶ A survey of residents and potential sewer users was conducted in the summer of 1978 to determine whether they would be willing to pay for sewers.
- ▶ The DWPC ordered the town to take immediate action to complete a facility plan for Woods Hole or to begin construction of sewers in downtown

Falmouth. Town meeting voted on September 27, 1978 to appropriate additional funds to complete a facility plan for both Woods Hole and Falmouth Village. The plan recommended that DWPC not prosecute the town as long as it is moving in a positive direction towards completion of a comprehensive plan.

- ▶ The plan also recommended that if town meeting action is not taken expeditiously on the final plan recommendations, the DWPC and DEQE should pursue regulatory actions.
- ▶ The health agent for the town has stated that there are critical problems with on- site system failures and Title 5 enforcement, both within and outside of, proposed sewer service areas.
- ▶ A maintenance pumping program should be implemented as part of the facility plan.
- ▶ The town of Falmouth adopted the first Watershed Protection District bylaw on Cape Cod.

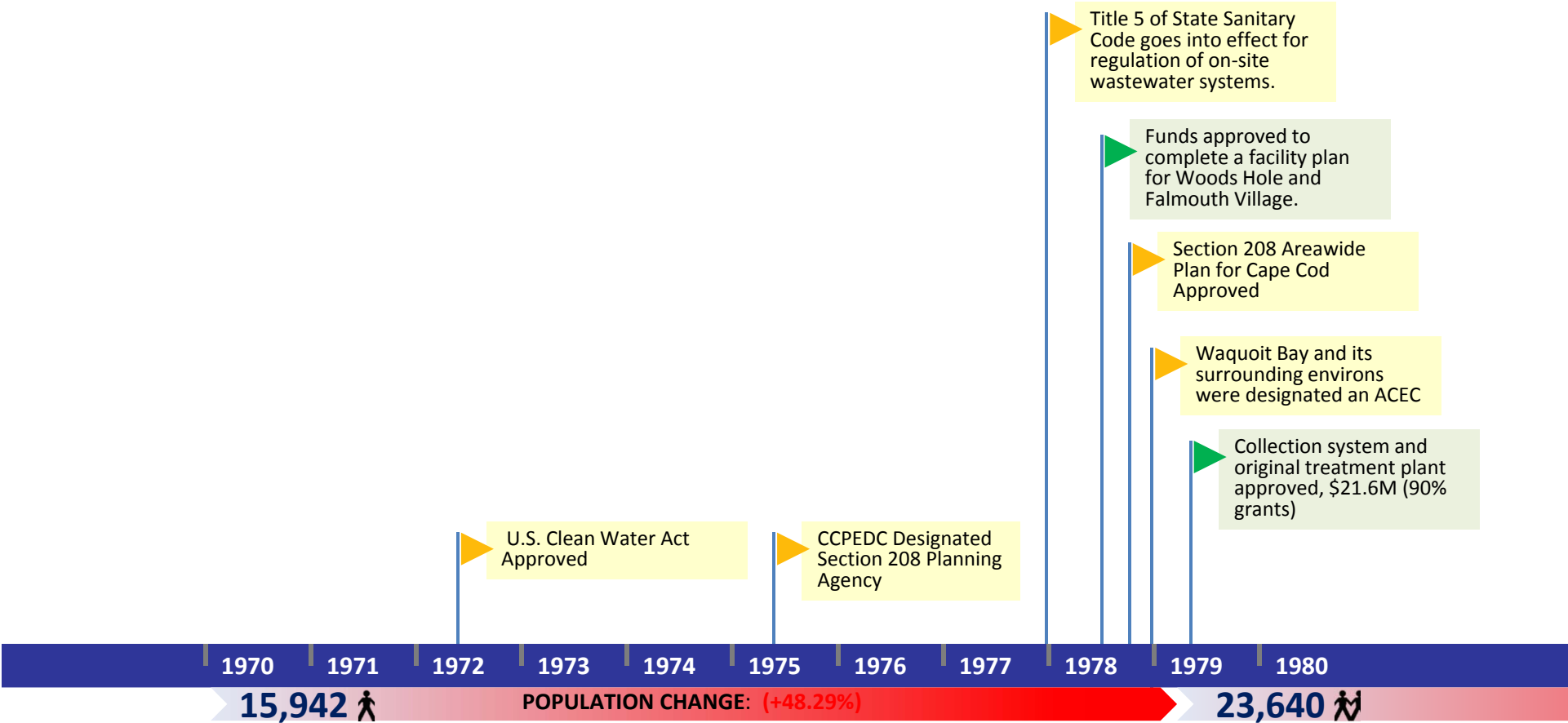


▶ Cost: \$168,625 town built Woods Hole sewer

▶ Parts of Woods Hole sewered, Great Harbor ocean outfall pipe installed

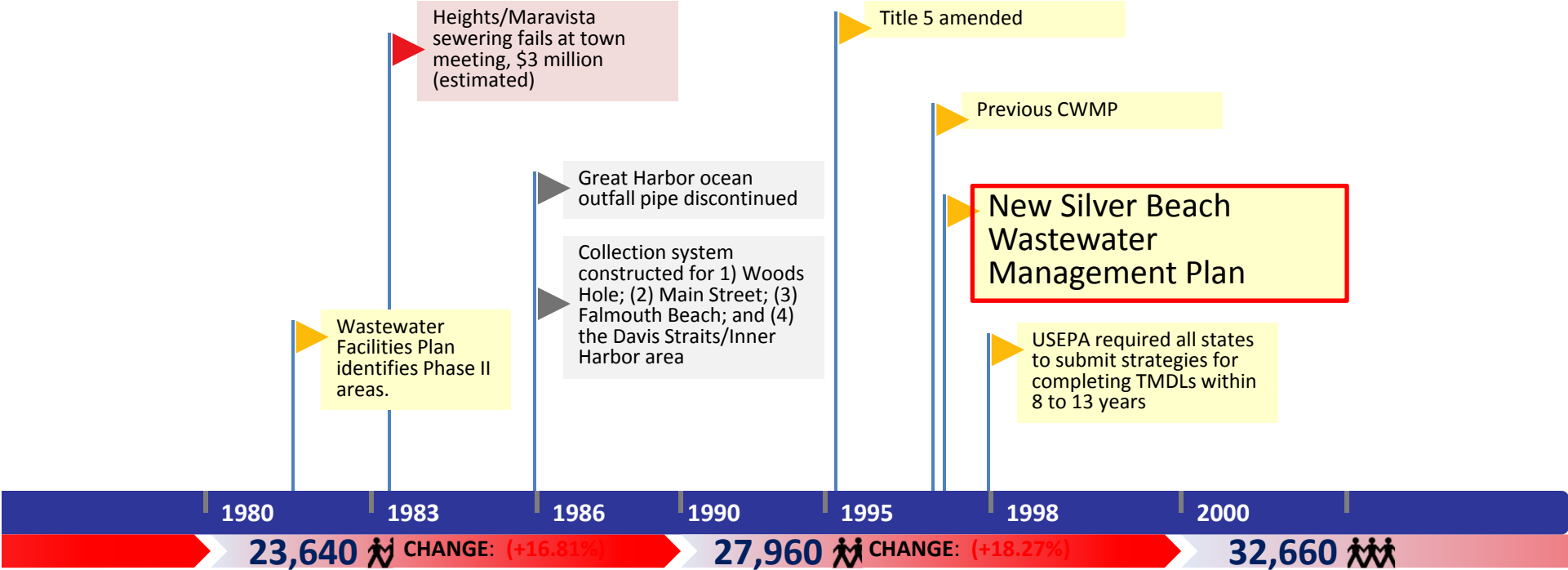
▶ Sewer plan fails at town meeting, \$500,000, (30% to be covered by grants).

# Falmouth: 1947-2013

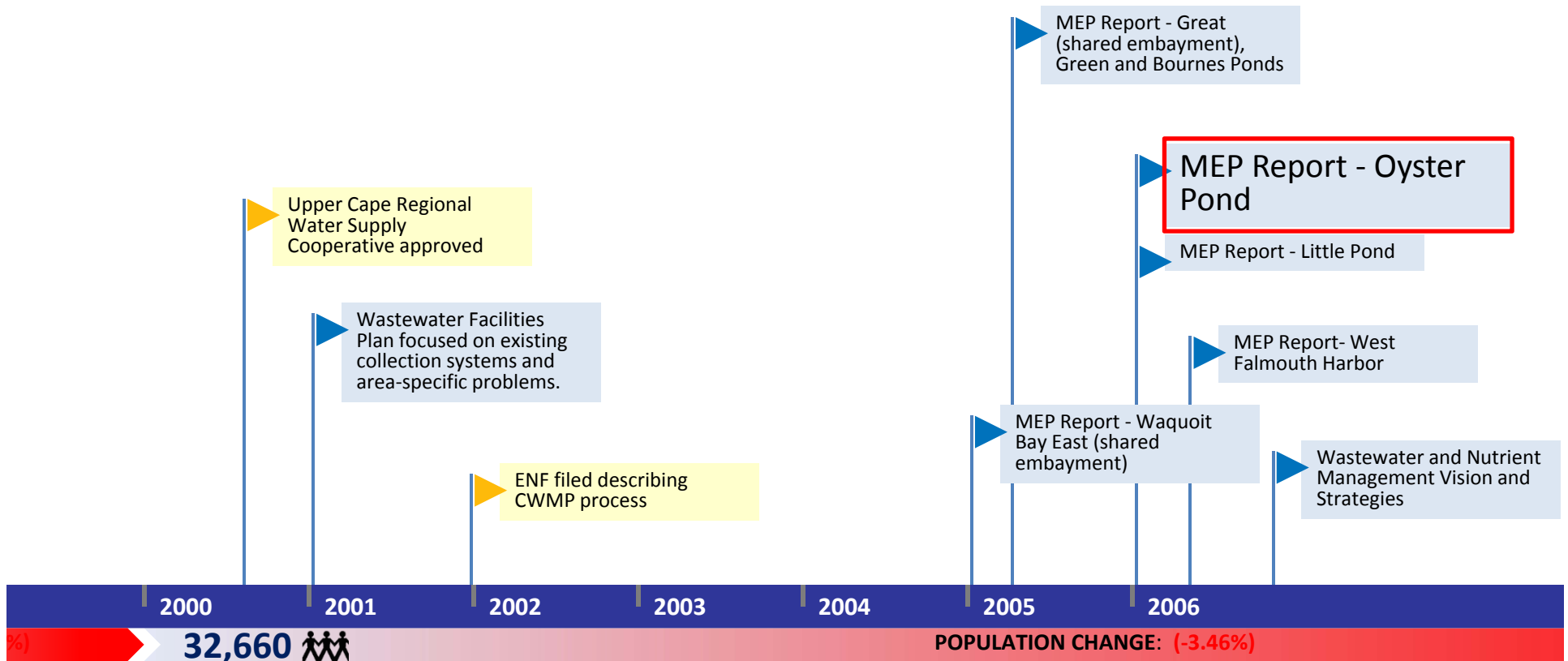




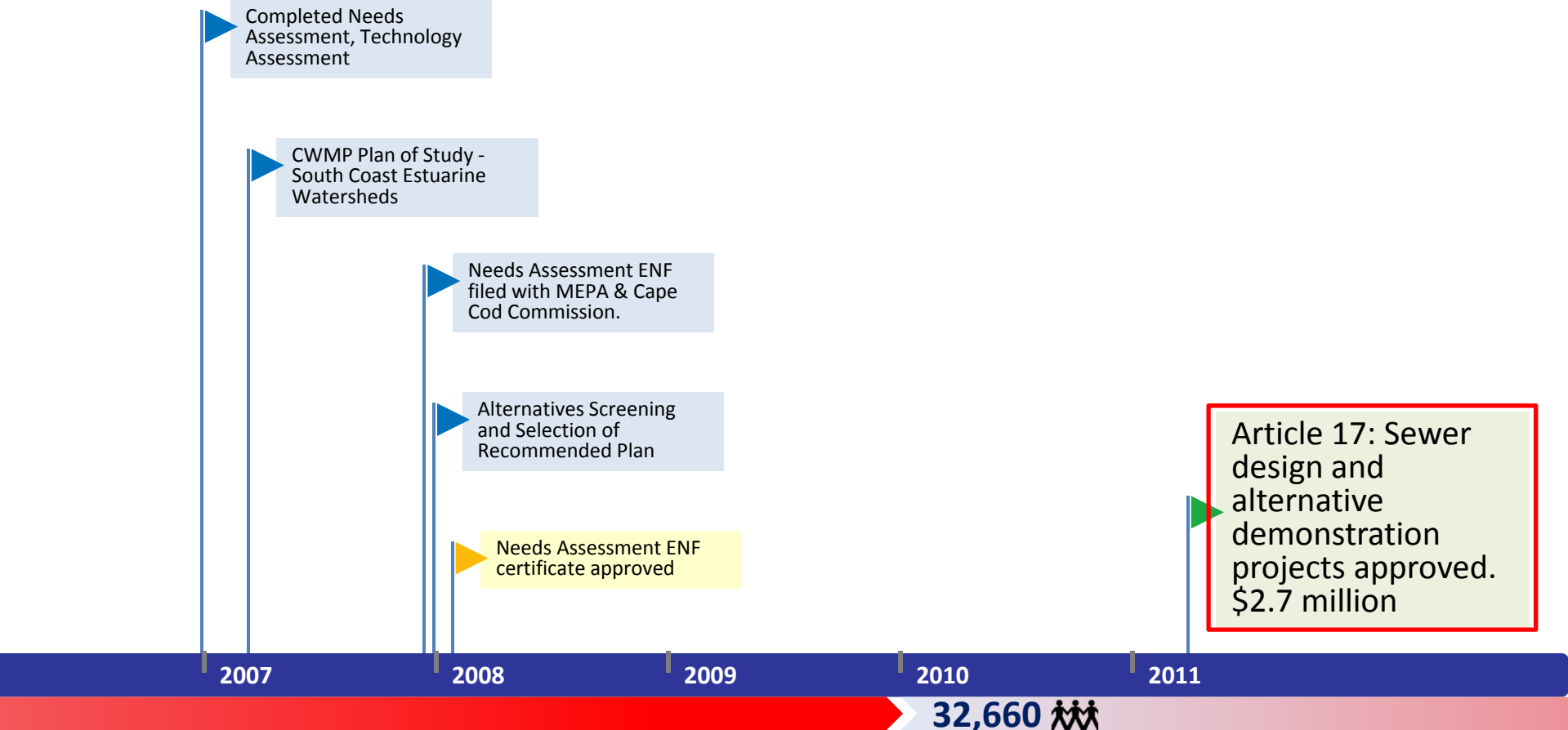
# Falmouth: 1947-2013



# Falmouth: 1947-2013



# Falmouth: 1947-2013



# Falmouth: 1947-2013

- MEP Report - Wild Harbor (shared embayment)
- MEP Report - Fiddlers Cove/Rands Harbor (shared embayment)
- MEP Report - Waquoit Bay West (shared embayment)
- MEP Report - Quissett Harbor
- MEP Report - Falmouth Inner Harbor

Local Order of Conditions approved for Shellfish Demonstration Project

Spring TM approved the funding for final design of the following:

**Fertilizer Bylaw passed with legislative approval**

Little Pond System Design approved, \$5.6 million

AG disapproves fertilizer bylaw as preempted

Town installs oysters in Little Pond for first year of Demonstration Project

Town Meeting votes to evaluate environmental impacts of discharge at Site 7, including Crocker Pond

Town Meeting Adopts Nitrogen Control Bylaw for fertilizer

State deems Draft CWMP adequate

Oyster Pond CWMP commenced

MEPA Certificate issued with comments for FEIR/DRI.

DEIR/DRI filed through MEPA

Falmouth, MassDEP, Buzzards Bay Coalition Settlement Agreement over Groundwater Discharge Permit.



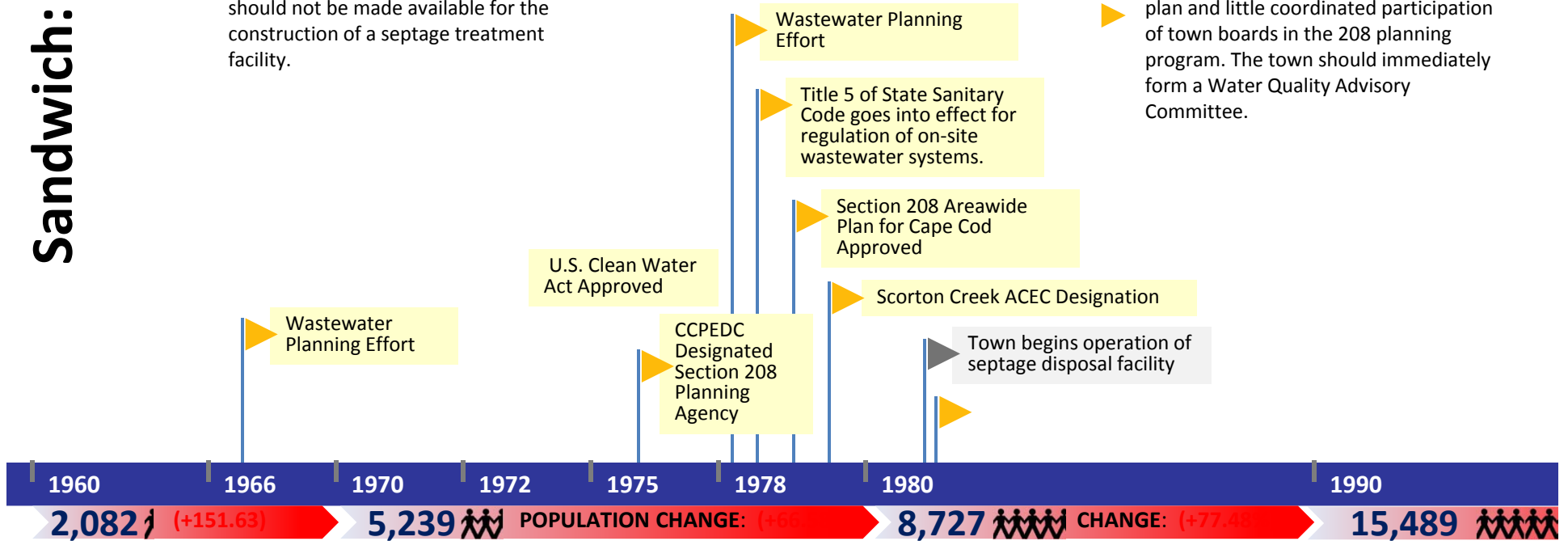
# Sandwich: 1960-2013

## From 1978 Section 208 Plan

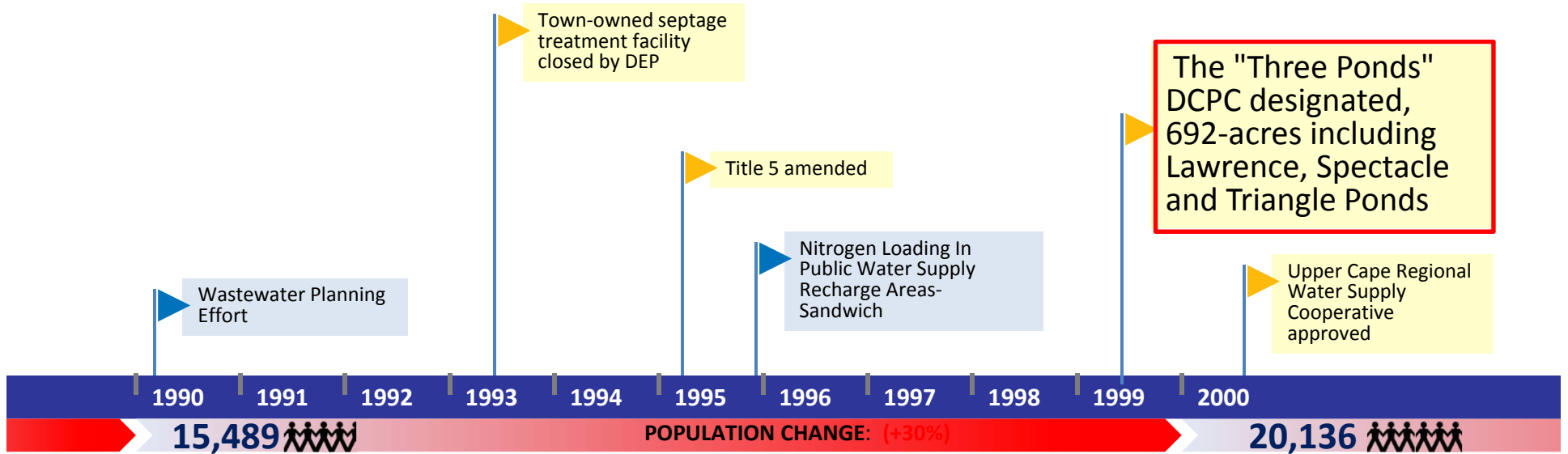
- ▶ A sewer facilities plan was completed for Sandwich in 1978. The plan calls for a small outfall into the Cape Cod Canal, which now could only be allowed through a special act of the legislature.
- ▶ Should the town fail to act by 1980, a DEQE investigation of Title 5 violations should be initiated.
- ▶ A septage treatment facility would not provide a comprehensive solution and could not be considered to be consistent with the 208 plan. Funds should not be made available for the construction of a septage treatment facility.

- ▶ The town health agent should strictly enforce Title 5 and should seek additional qualified personnel to implement the 208 recommended on-site systems management program.
- ▶ The town has taken progressive steps to increase lot sizes to at least one acre in most areas of town. The town has indicated willingness to cooperate with the 208 staff in delineating watershed areas and in adopting Watershed Protection Districts.

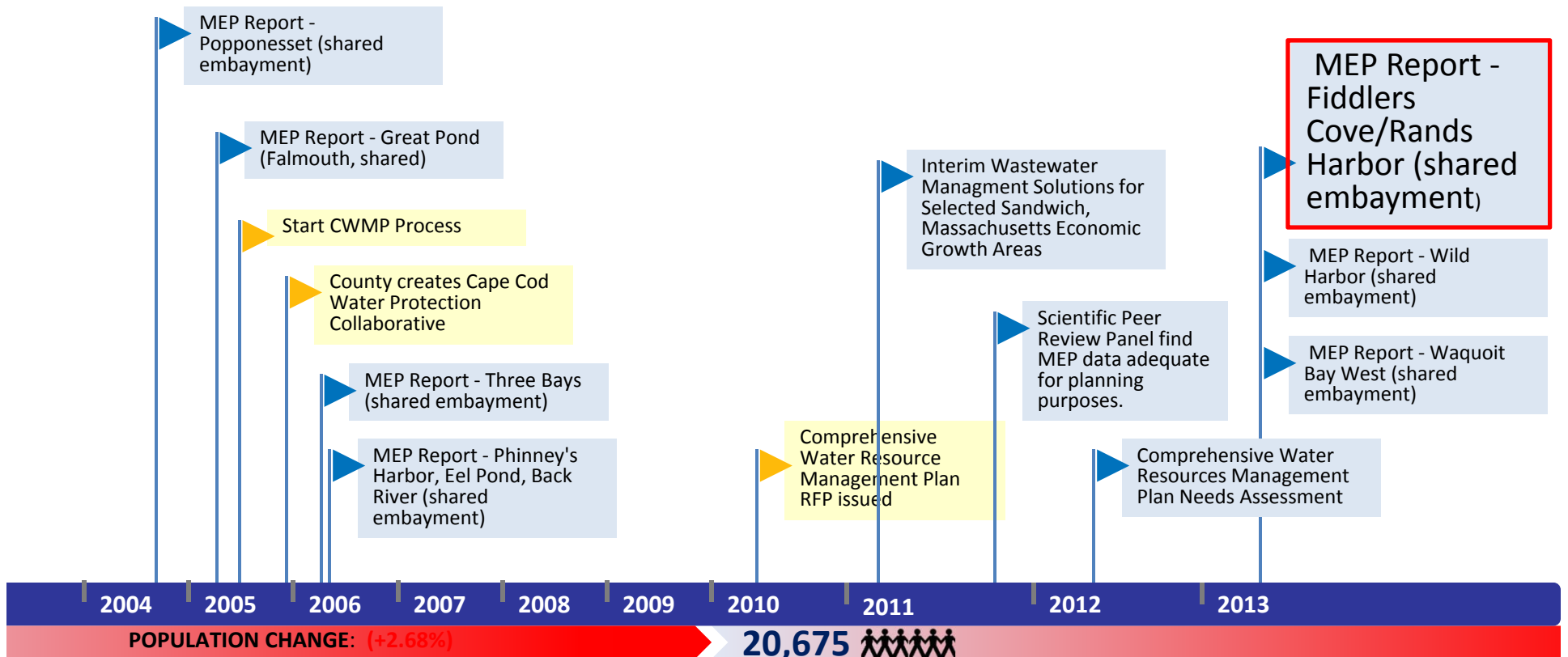
- ▶ The problem of the State Fish Hatchery discharging over half a million gallons of fresh water must be addressed by the Department of Fisheries and Wildlife as recommended in the "Water Conservation" section of the final plan.
- ▶ The town should actively participate in regional solid waste planning to develop a long-range solution to its solid waste management problems.
- ▶ There has been a serious delay in action on the town's proposed sewer facility plan and little coordinated participation of town boards in the 208 planning program. The town should immediately form a Water Quality Advisory Committee.



# Sandwich: 1970-2013



# Sandwich: 1970-2013



**Did we miss anything?**

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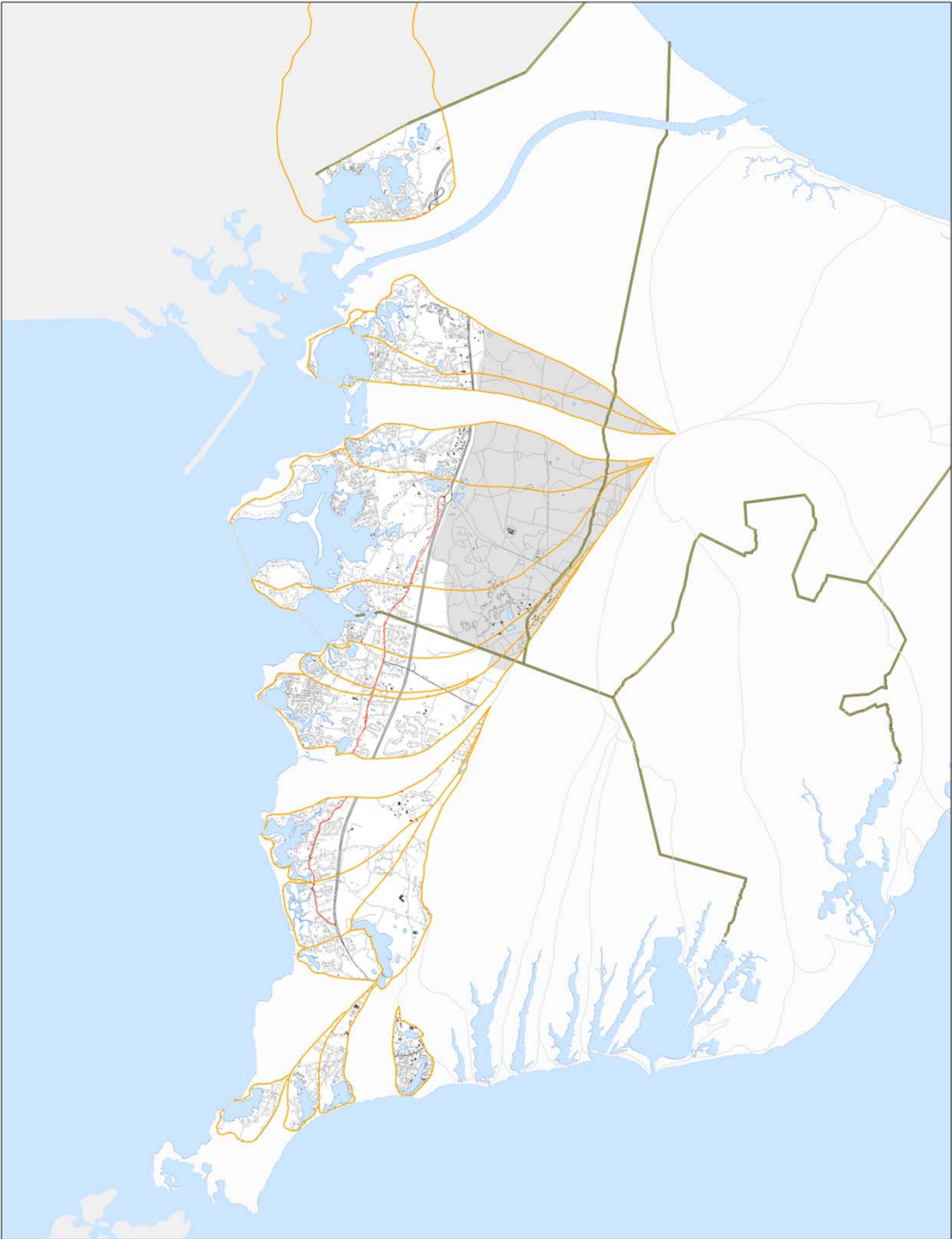


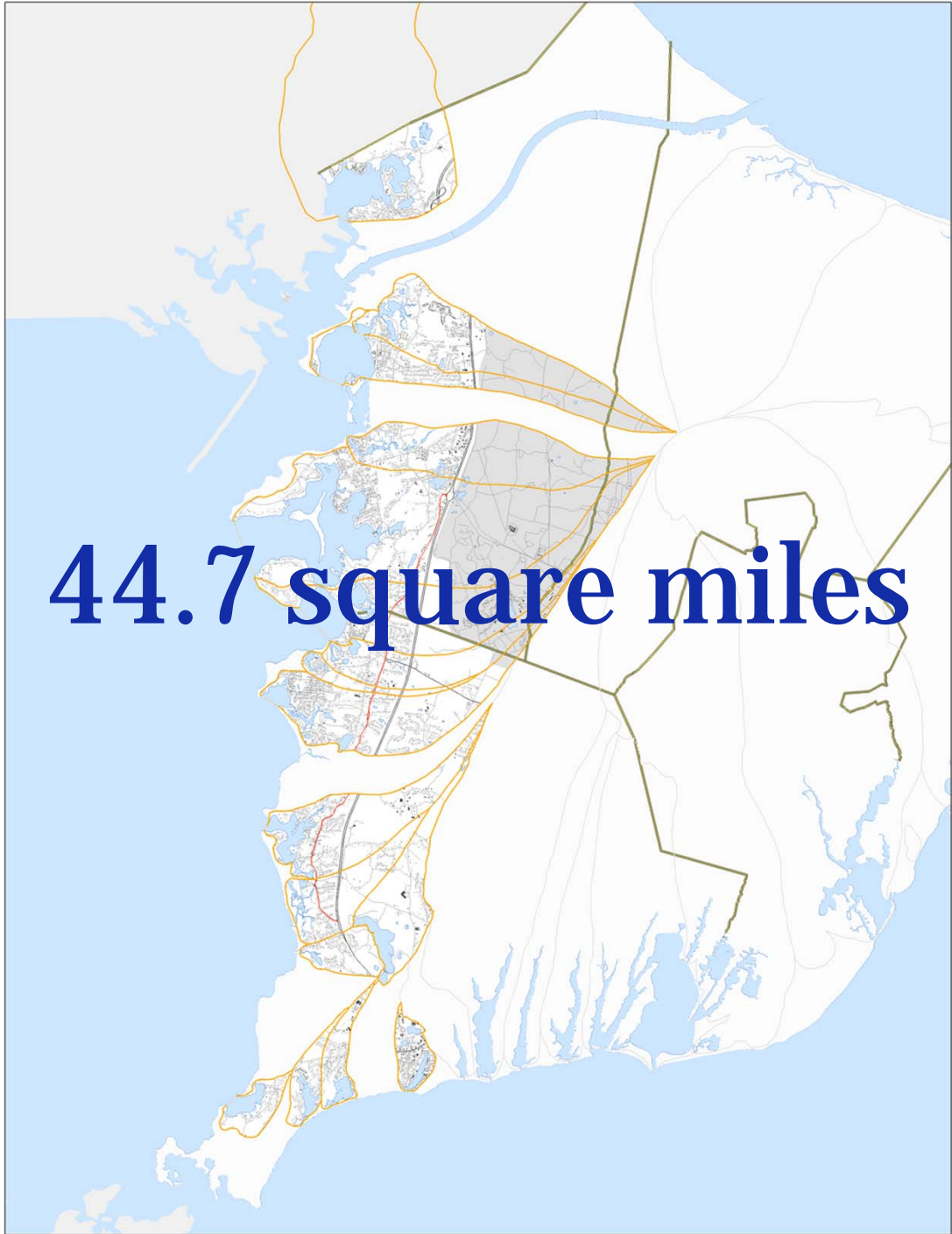
# Your Watersheds



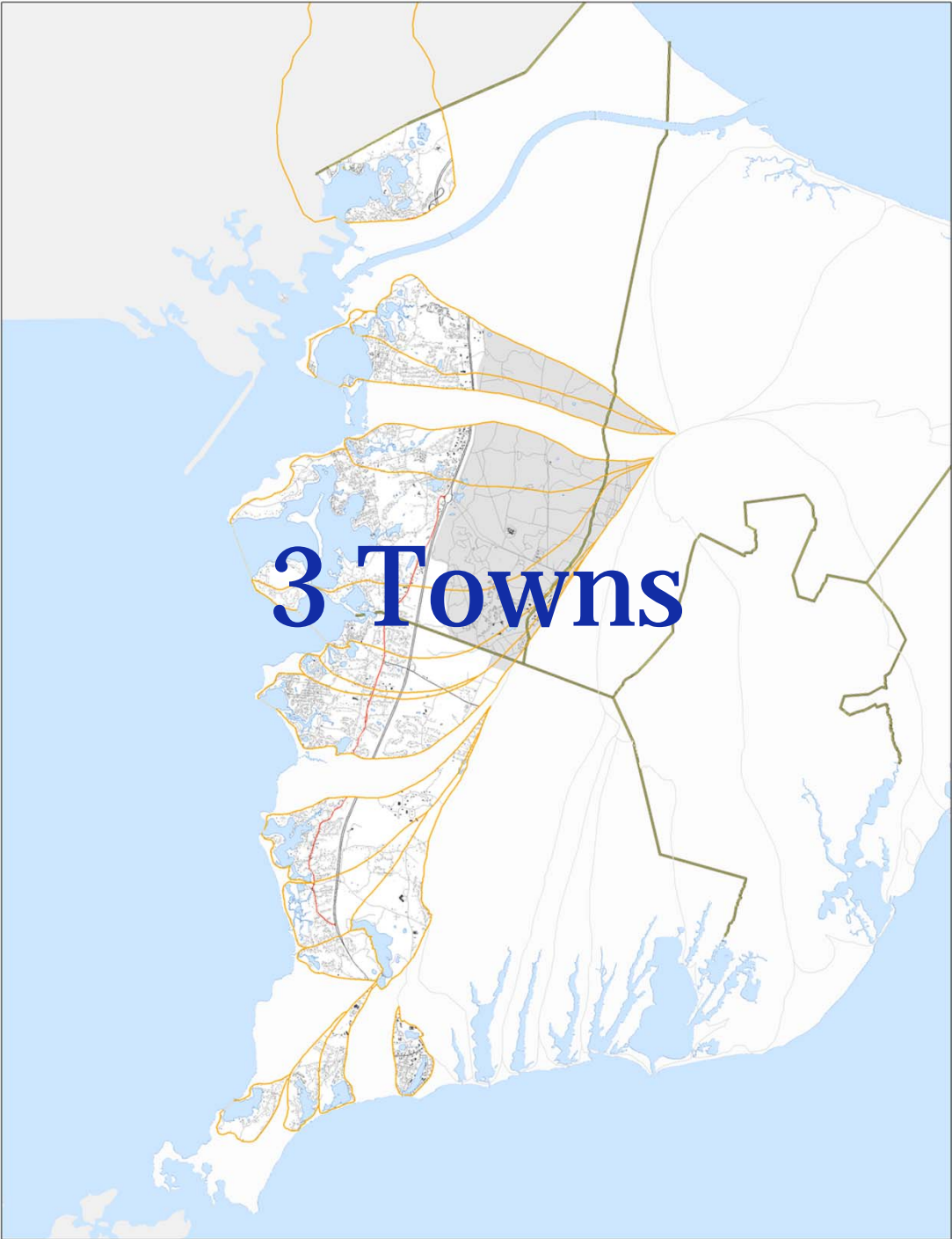
Buttermilk Bay  
Eel Pond & Back River  
Falmouth Inner Harbor  
Fiddlers Cove  
Great Sippewisset Creek  
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Megansett Harbor  
Oyster Pond

Phinney's Harbor  
Pocasset Harbor  
Pocasset River  
Quissett Harbor  
Rands Canal  
Salt Pond  
Wild Harbor





**44.7 square miles**



**3 Towns**


# Natural Features


## Base Map

 Town Lines


 Rivers


## Embayment Boundary

 On Land


 On Sea

## Major Roads

 US Highway

 State Highway


 Roads


 Structures

 Ponds

## Natural Areas


 Natural Heritage & Endangered Species Program (NHESP) Certified Vernal Pools

 Water Table Contours

 Cranberry Bogs

 Wetlands

 Sea, Lake, & Overland Surges from Hurricanes (SLOSH) Update 2013

 Preliminary FEMA Flood Insurance Rate Map (FIRM) Zones 2013


# Managed Surfaces


## Base Map

 Town Lines

 Rivers


## Embayment Boundary

 On Land


 On Sea

## Major Roads

 US Highway


 State Highway


 Roads

 Structures


 Ponds

## Managed Surfaces

 Approximate Managed Ground Surfaces


 Approximate Residential Managed Lawns

 Approximate Managed Golf Courses

 Approximate Municipal Managed Natural Surfaces

# Regulatory


## Base Map

 Town Lines

 Rivers


## Embayment Boundary

 On Land


 On Sea

## Major Roads

 US Highway


 State Highway


 Roads


 Structures

 Ponds


## Regulatory

 Areas of Critical Environmental Concern

 DEP Approved Wellhead Protection Areas (Zone IIs)

 Growth Incentive Zone


## OpenSpace: Level of Protection


 In Perpetuity

 Limited

 None

## Landuse Vision Map


 Economic Center

 Industrial and Service Trade Area

 Village


 Resource Protection Area

 Other

 Undesignated

# Land Use Change


## Base Map

 Town Lines

 Rivers

## Embayment Boundary

 On Land


 On Sea

## Major Roads

 US Highway


 State Highway


 Roads


 Structures


 Ponds


## LandUse Change

 Residential

 Commercial

 Industrial

 Wooded, Natural, or Wetlands

 Open - Disturbed or Managed

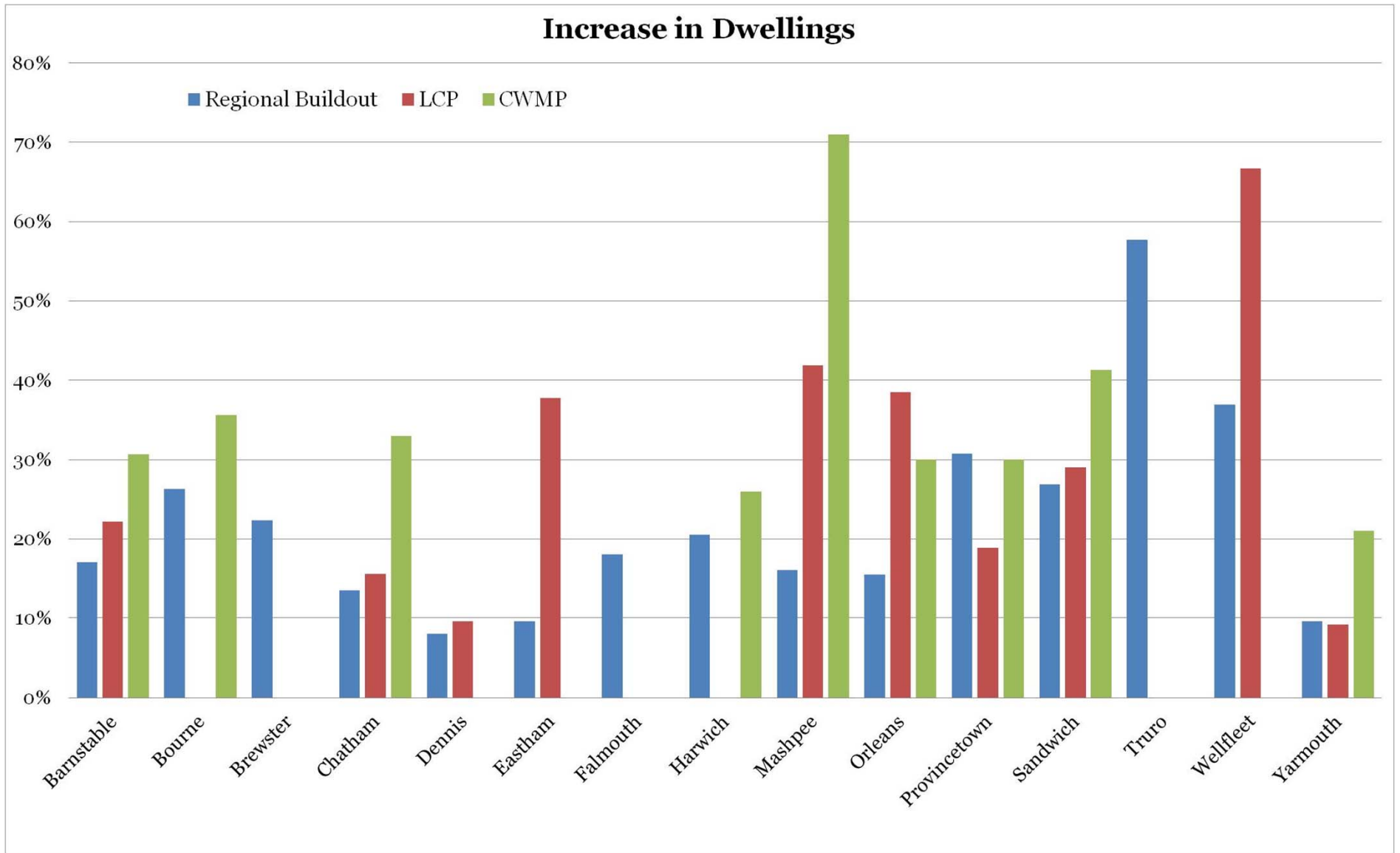
 Water



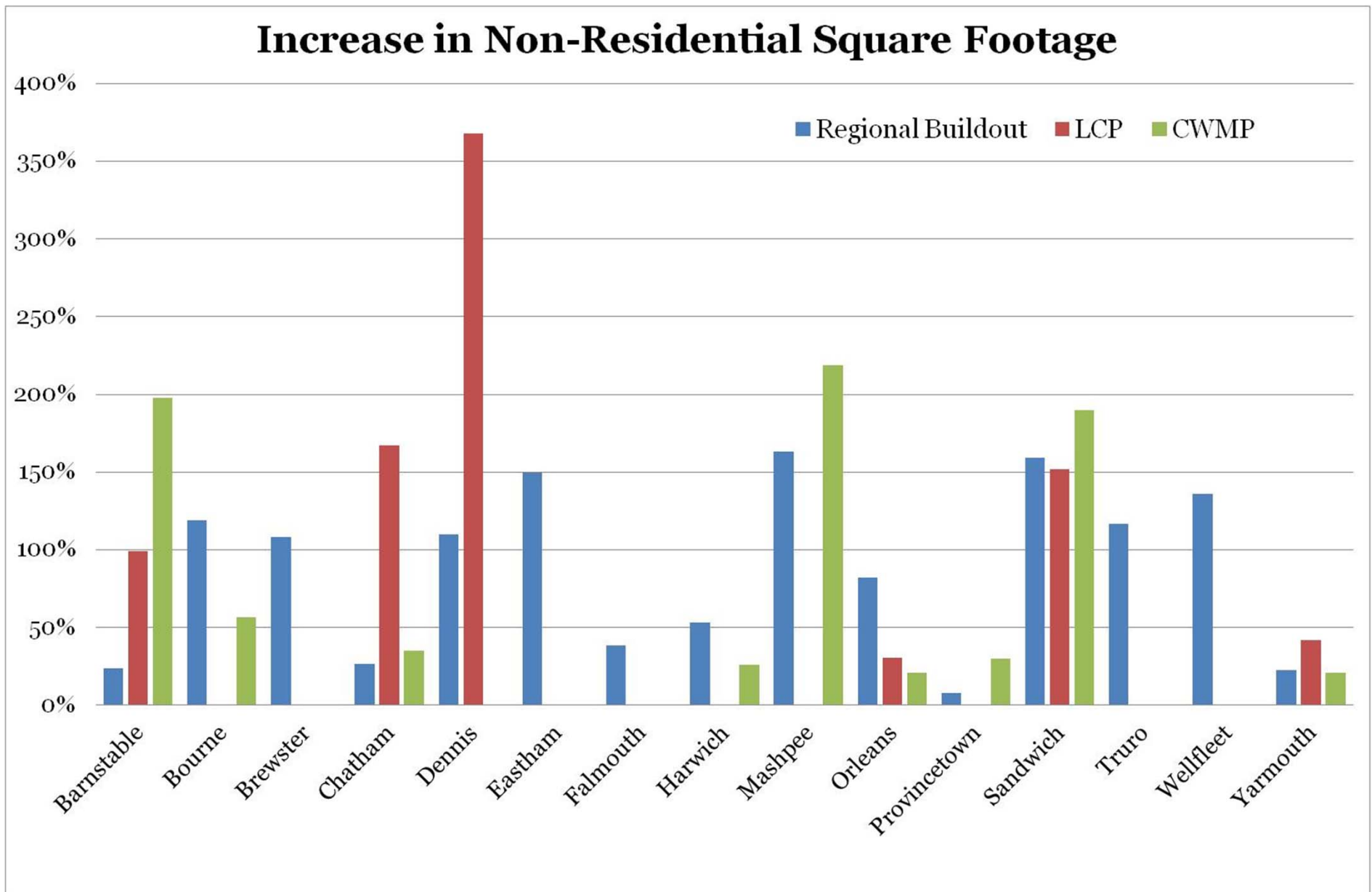
# Density

**Cape Wide Cost Estimate:  
30% growth will increase  
capital costs by 40%**

# Buildout



# Buildout



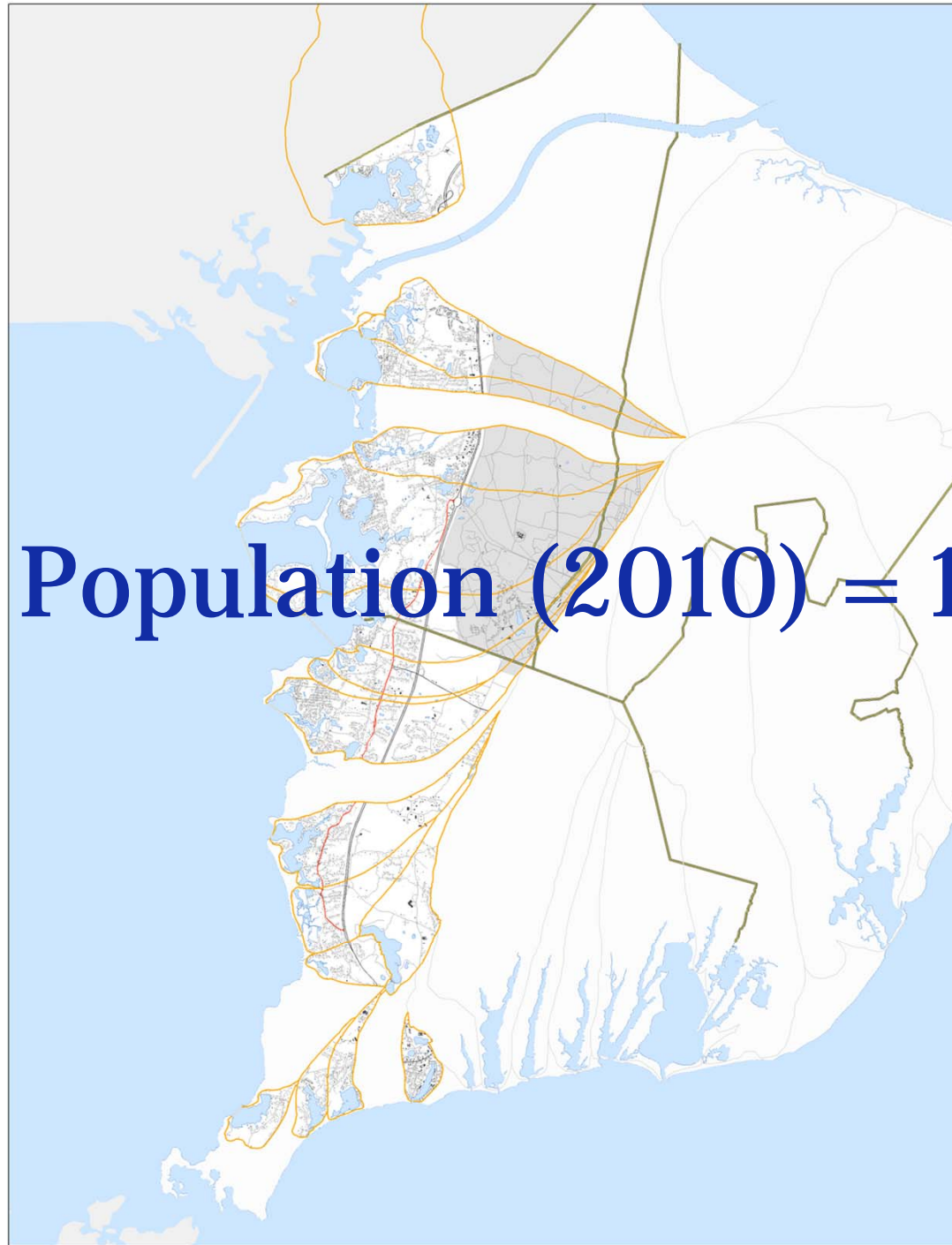
# The People



Buttermilk Bay  
Eel Pond & Back River  
Falmouth Inner Harbor  
Fiddlers Cove  
Great Sippewisset Creek  
Little Sippewisset Marsh  
Megansett Harbor  
Oyster Pond

Phinney's Harbor  
Pocasset Harbor  
Pocasset River  
Quissett Harbor  
Rands Canal  
Salt Pond  
Wild Harbor

**Total Population (2010) = 16,516**



## Population (2010)

3,000

2,500

2,000

1,500

1,000

500

7.3% of the Total Cape Cod  
Population

Butternut

Eel Pond & Back

Falmouth Inner

Fiddlers Neck

Great Sippewissett

Little Sippewissett

Megansett

Oysteroche

Phinneys

Pocasset

Pocasset

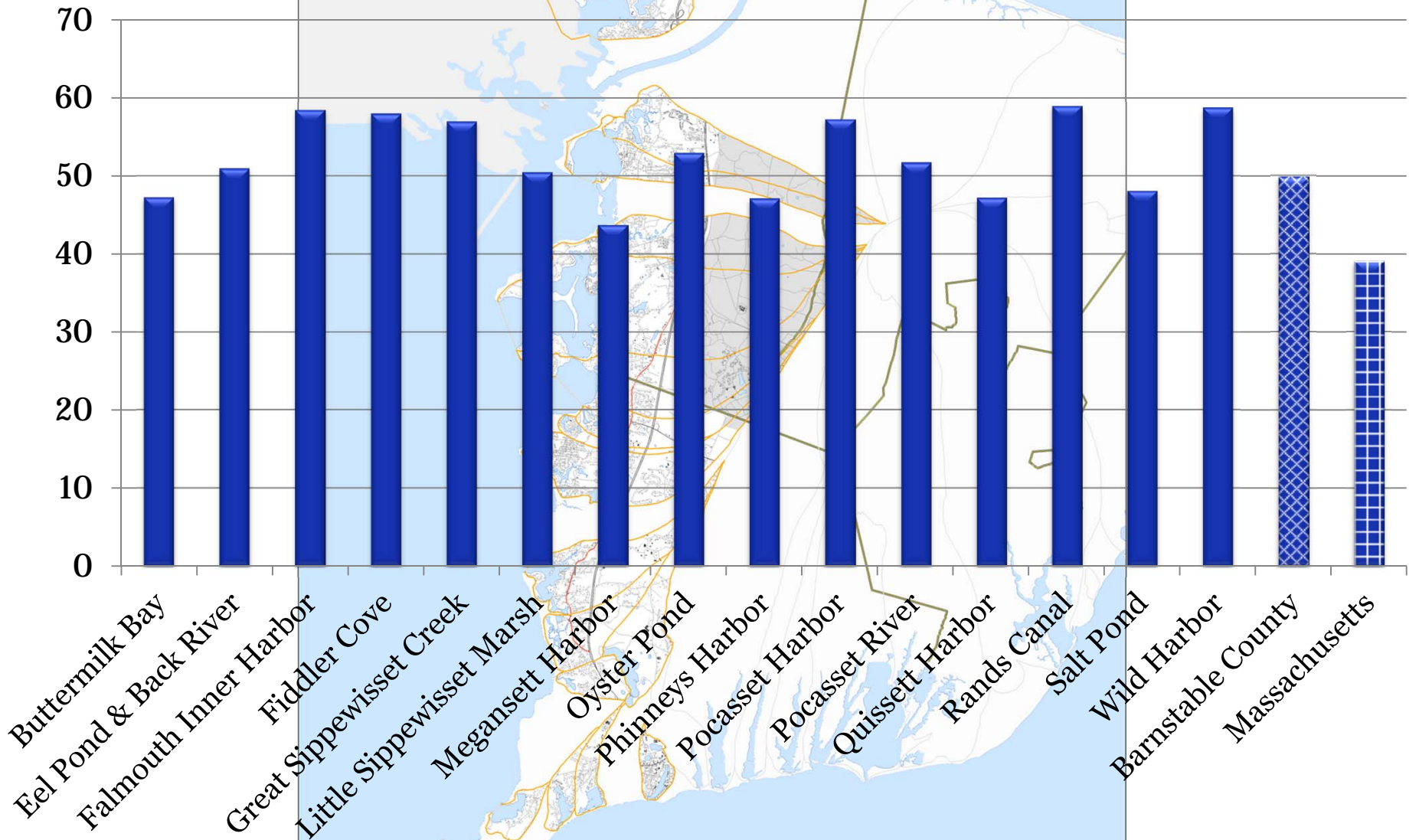
Quissett

Randall

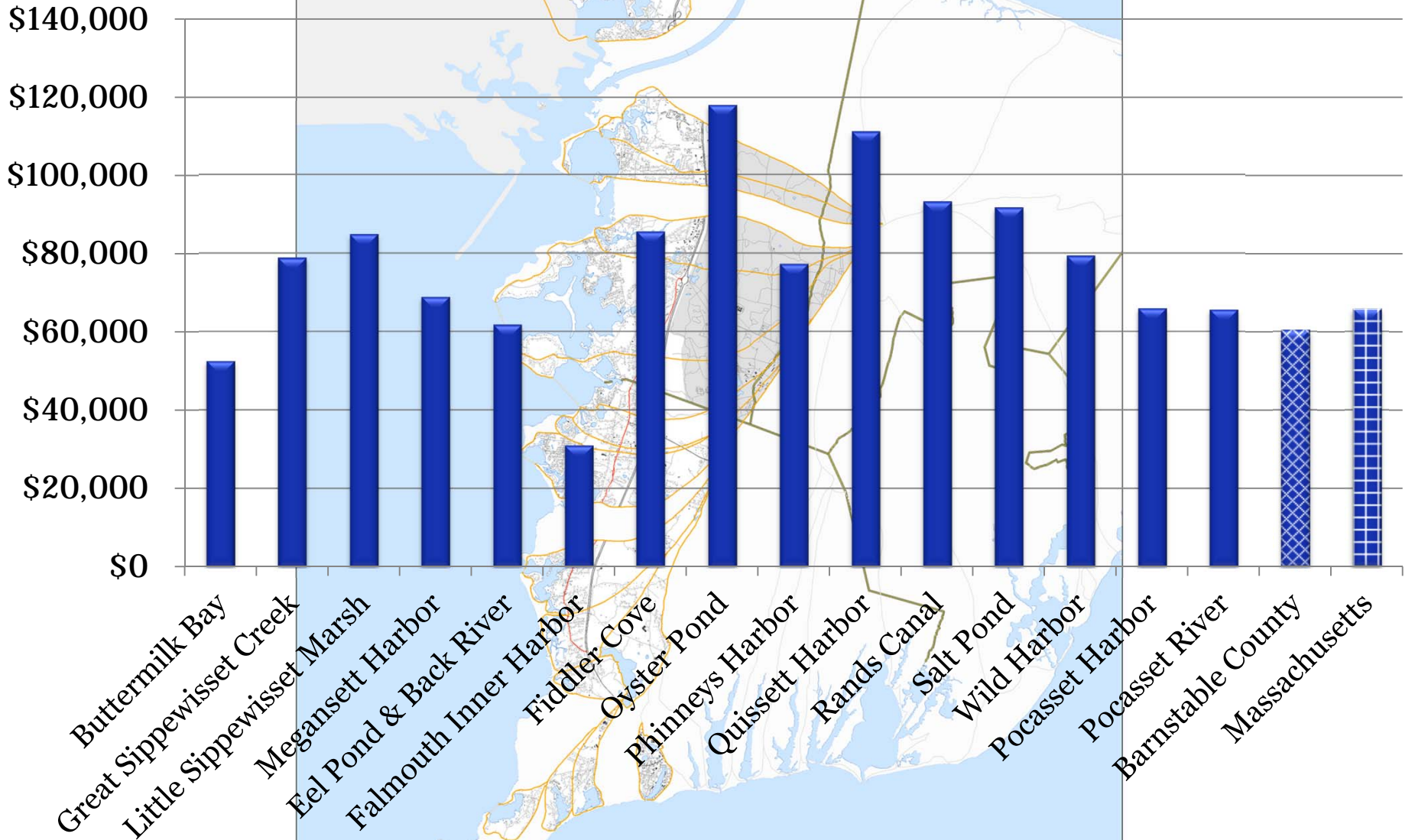
Saunders

Wildcat

# Median Age (2010)

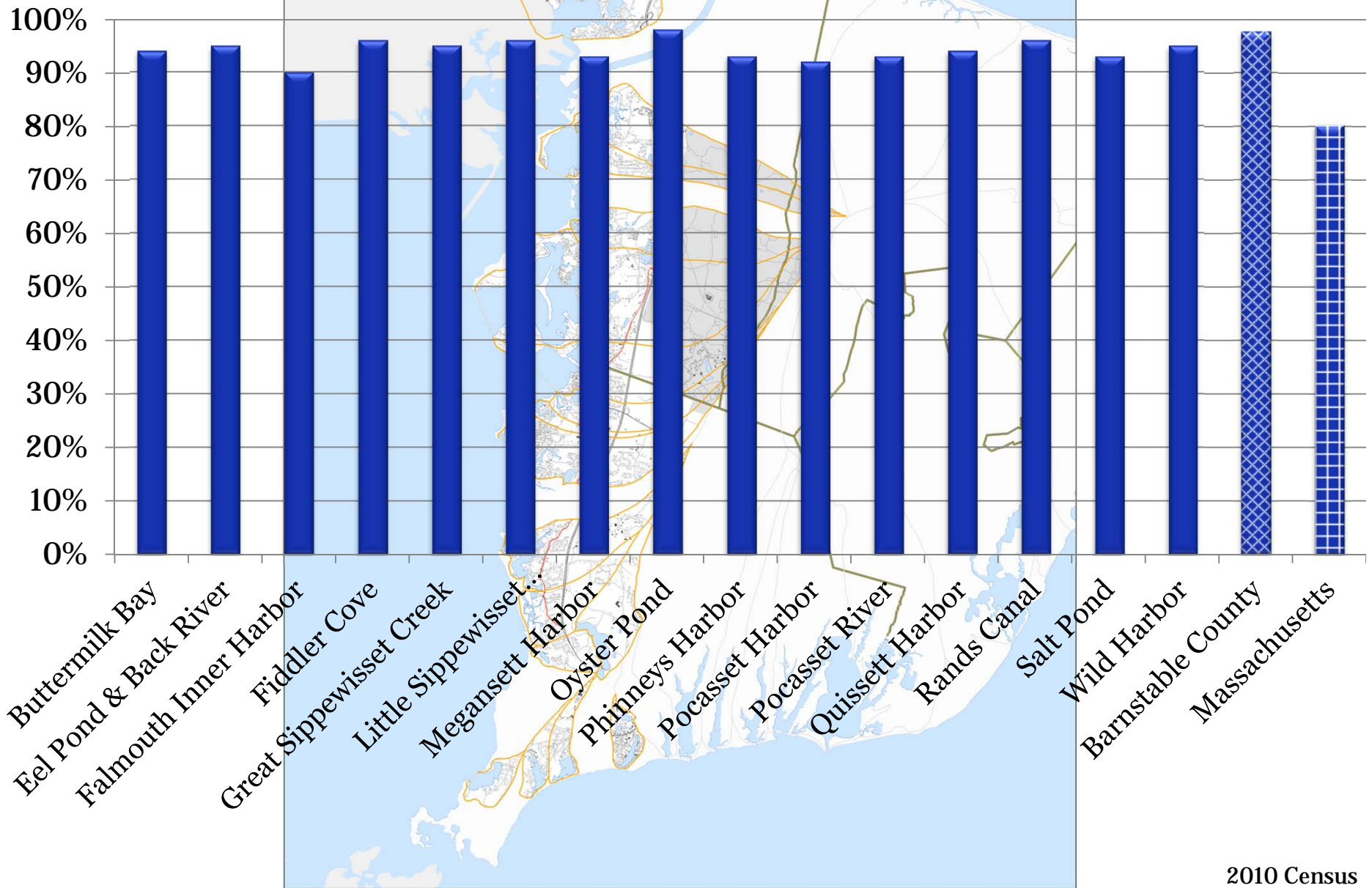


# Median Income (2010)

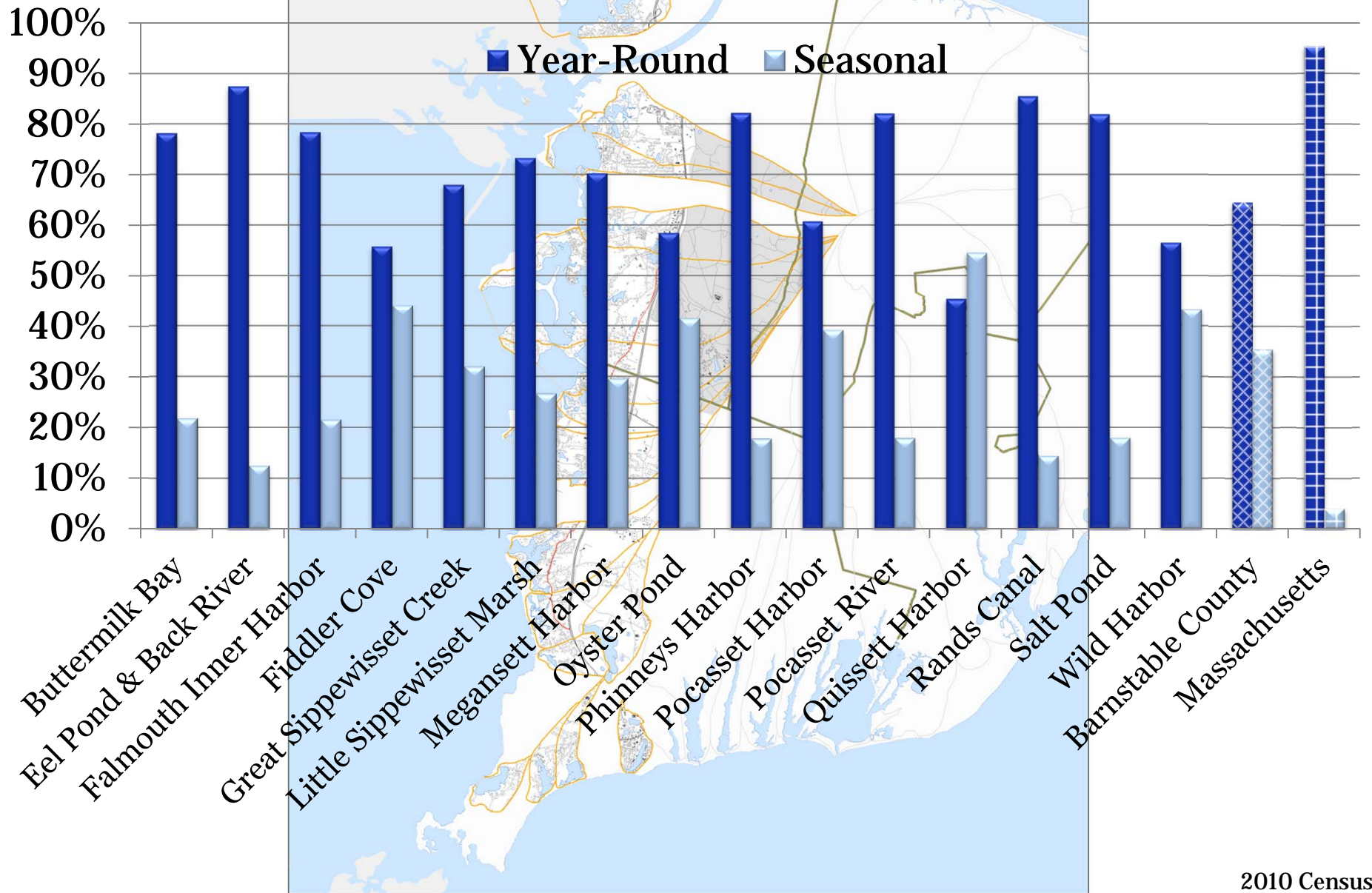




# Race - % White (2010)



# Seasonal vs. Year Round Housing (2010)



## Average Assessed Home Value (2010)

\$1,400,000

\$1,

\$1,

\$

\$

\$

\$

Total Assessed Value of  
Residential Homes=  
**\$4,275,621,950**

Butte

Eel Pond &

Falmouth Inl.

Great Sippewi

Little Sippewi

Megans

Phinne

Pocas

Poc

Quiss

Re

Barnsta

Mas

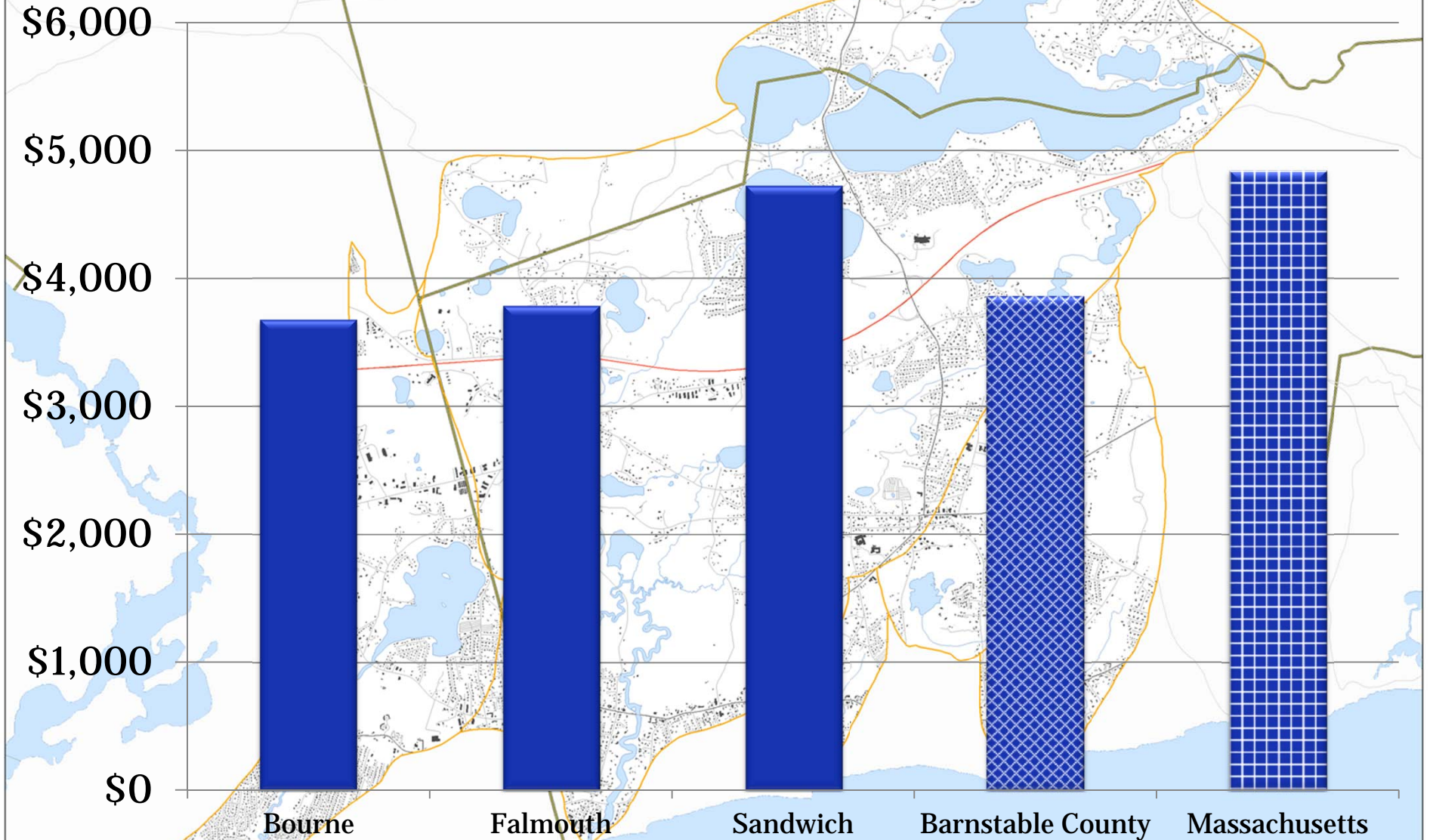
# **Your Government & Taxes**



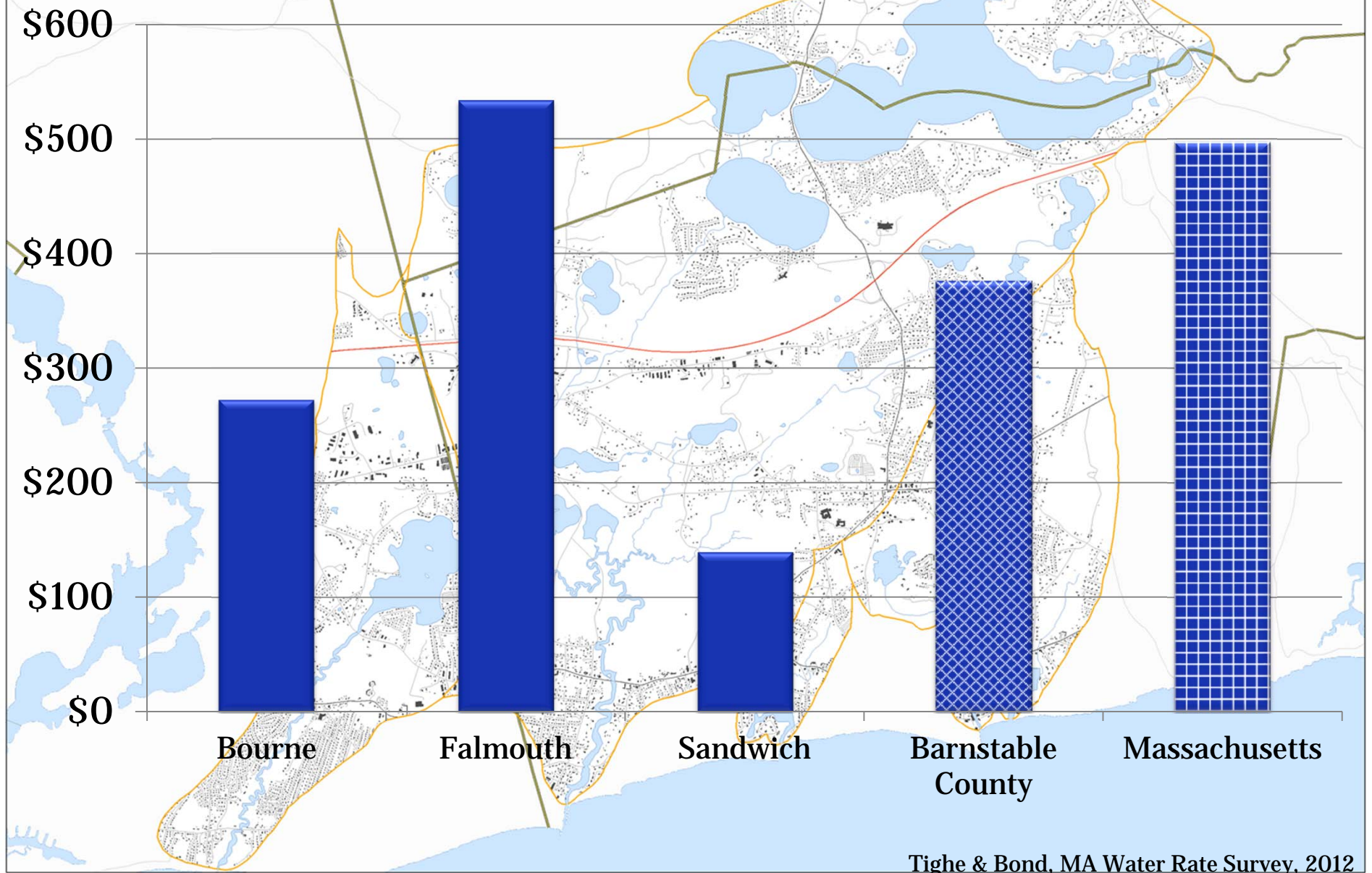
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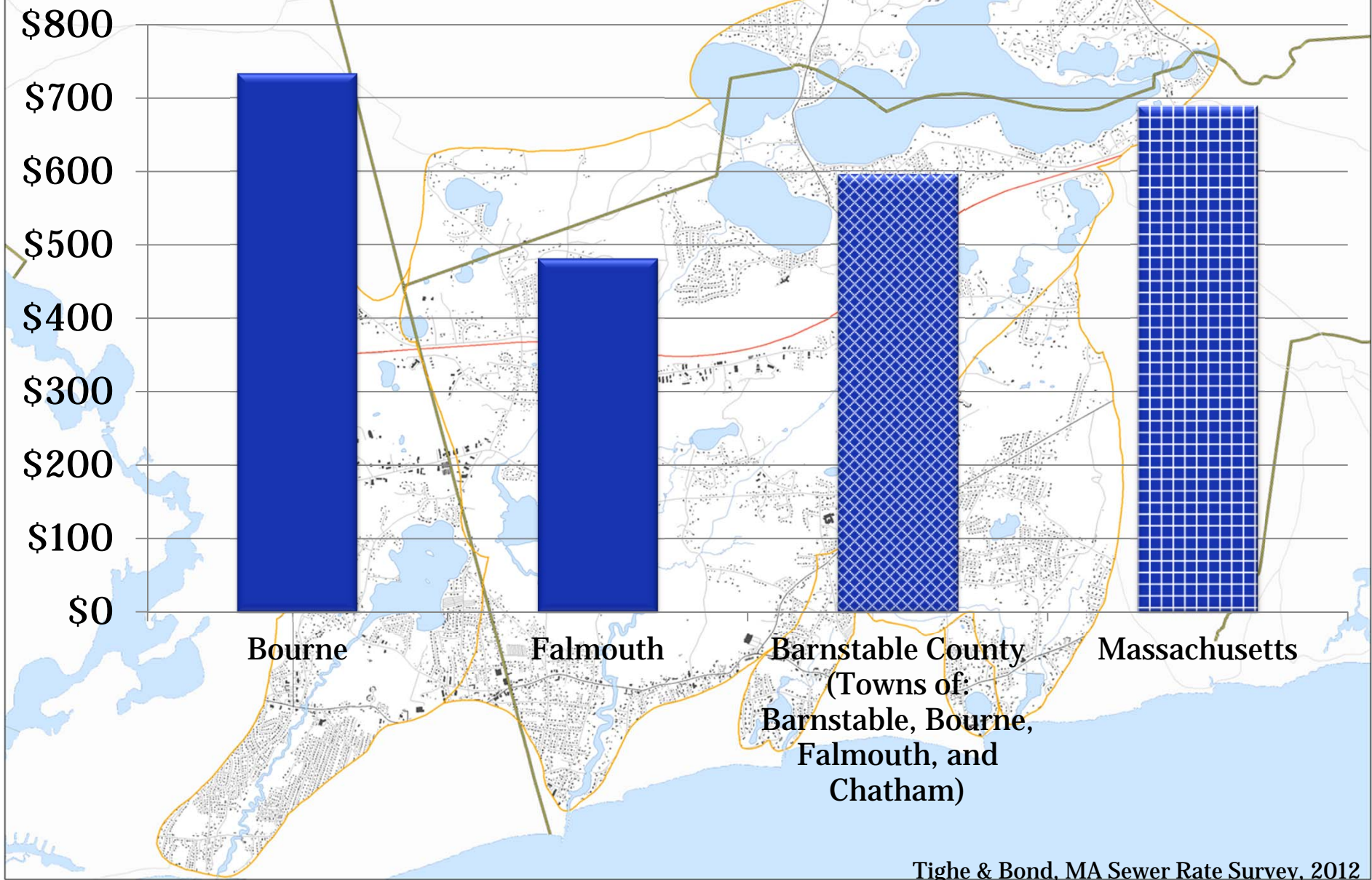
# Average Single Family Property Tax Bill (2013)



# Average Annual Water Bill (2012)



# Average Annual Sewer Bill (2012)



# The Problem



Buttermilk Bay  
Eel Pond & Back River  
Falmouth Inner Harbor  
Fiddlers Cove  
Great Sippewisset Creek  
Little Sippewisset Marsh  
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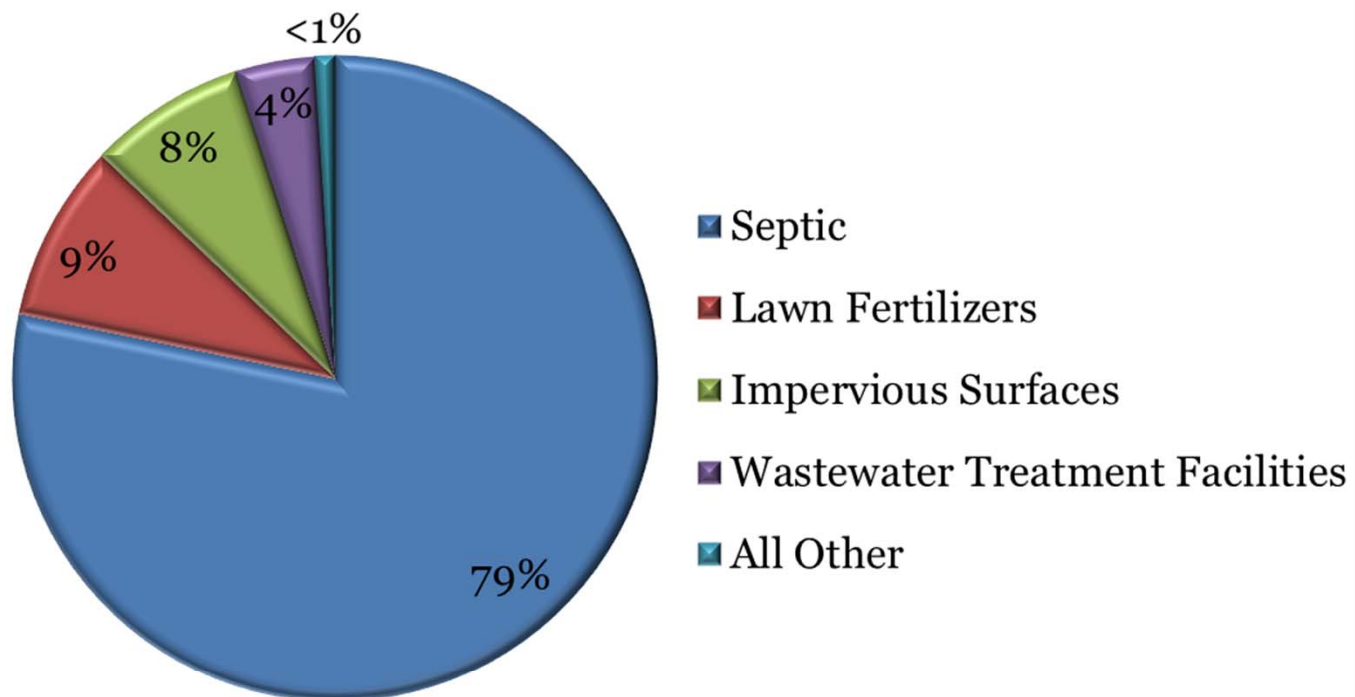




## Massachusetts Estuaries Project

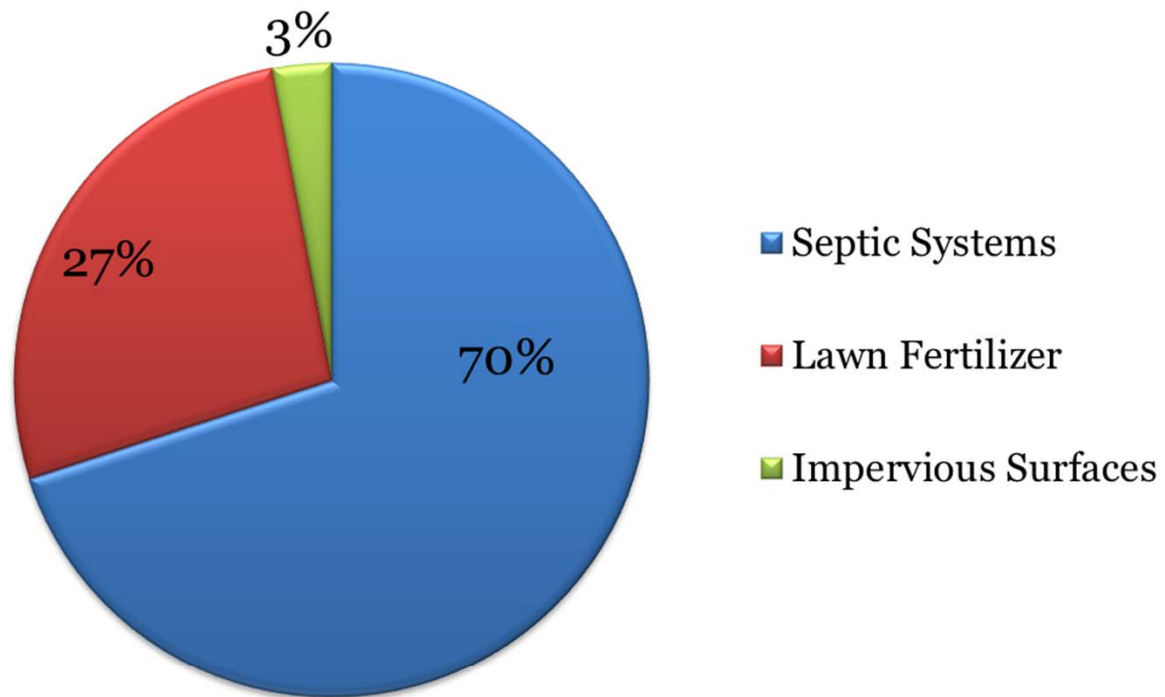
- Opportunity for towns to obtain independent analysis of nitrogen loading and its impact on water quality
- Provides water quality, nutrient loading, and hydrodynamic information
- Water quality monitoring – minimum of 3 years of data for each embayment
- Watershed model links water quality data to nitrogen loads

## Cape-Wide Controllable Nitrogen Loads



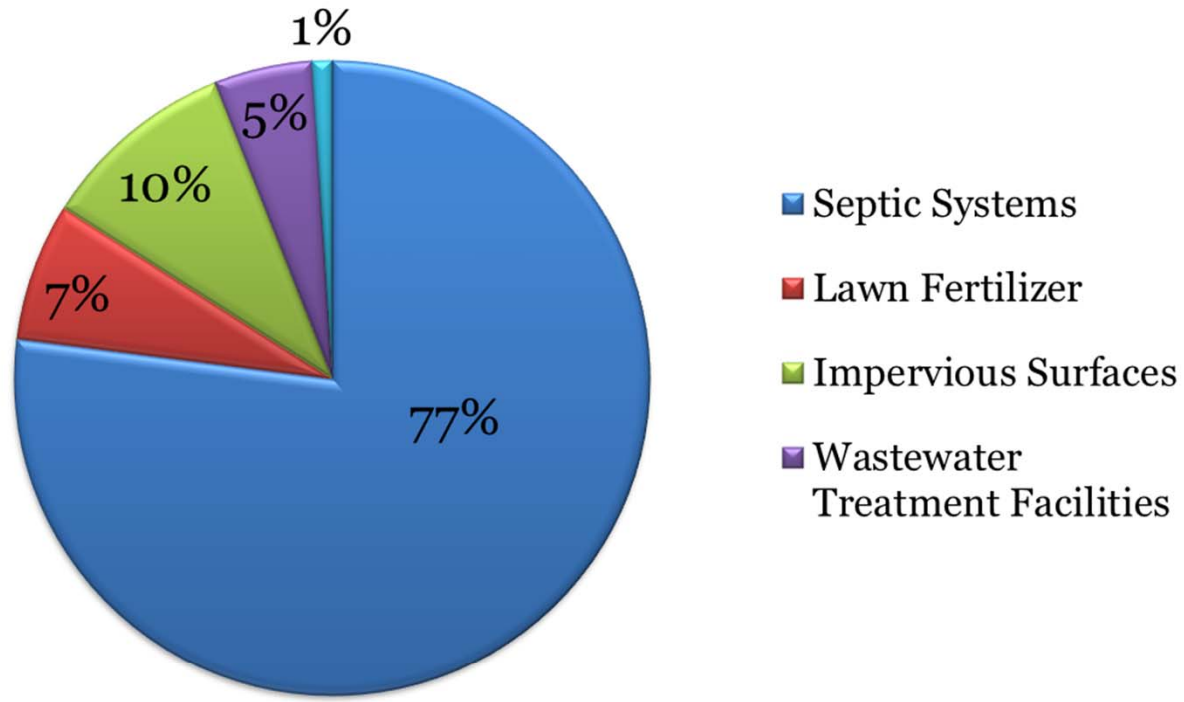
Note: Data averaged from existing Massachusetts Estuaries Project Reports

## Back River/Eel Pond Controllable Nitrogen Loads



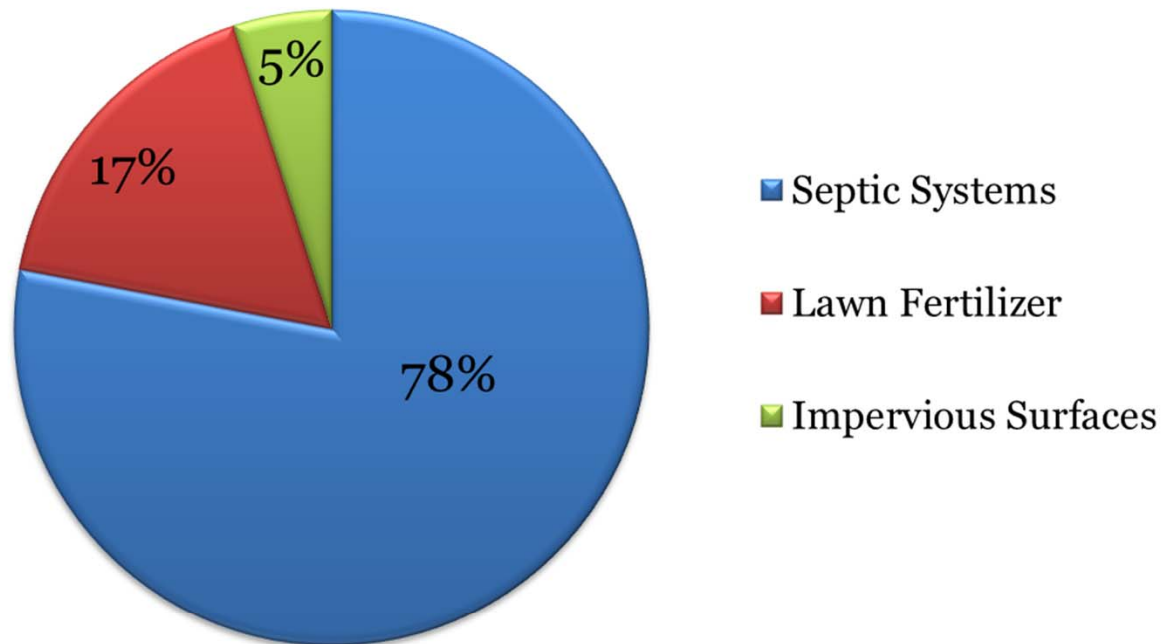
MEP 2006

## Falmouth Inner Harbor Controllable Nitrogen Loads



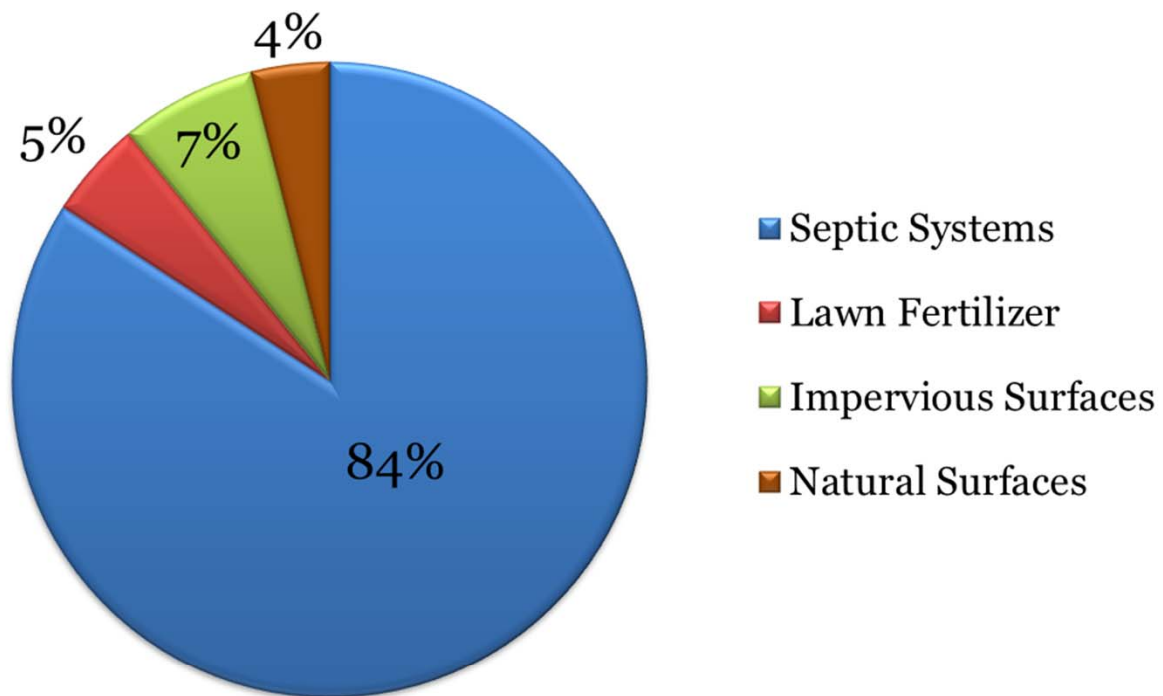
MEP 2013

## Fiddlers Cove Controllable Nitrogen Loads



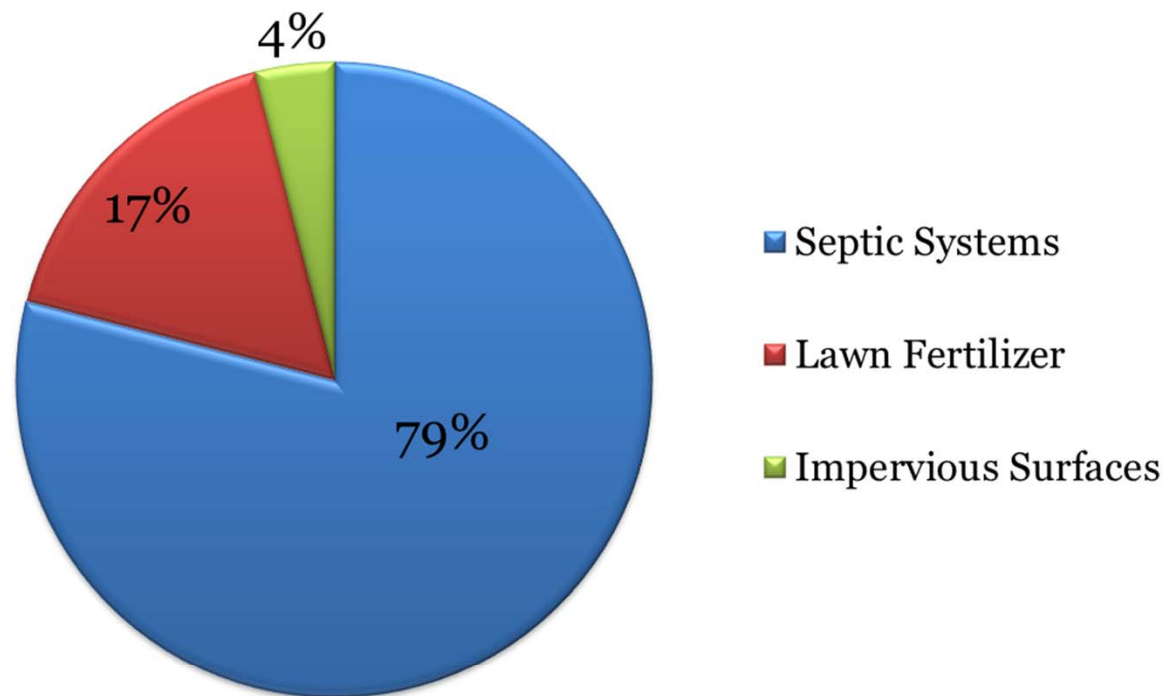
MEP 2013

## Oyster Pond Controllable Nitrogen Loads



MEP 2006

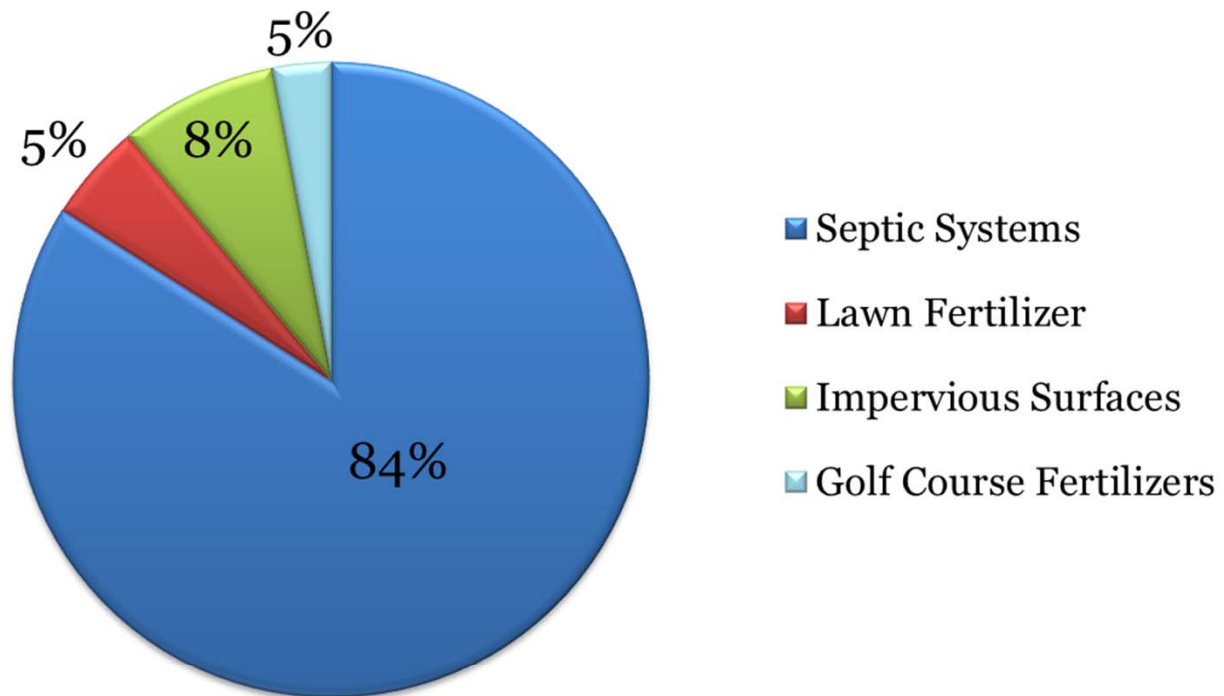
## Phinney's Harbor Controllable Nitrogen Loads



MEP 2006

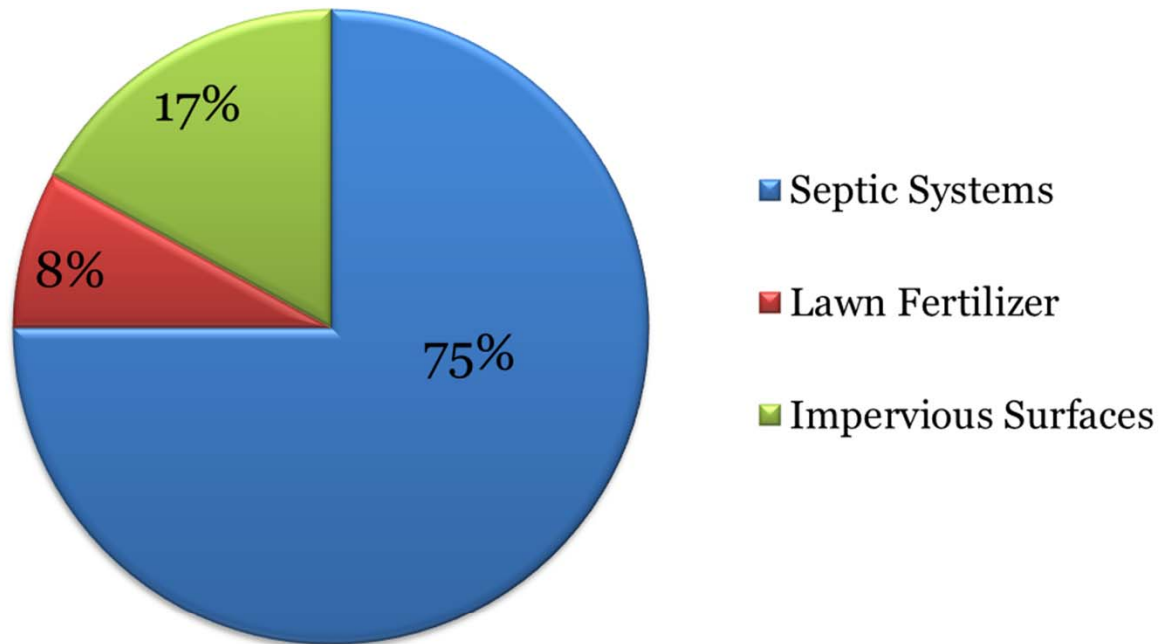


## Quissett Harbor Controllable Nitrogen Loads



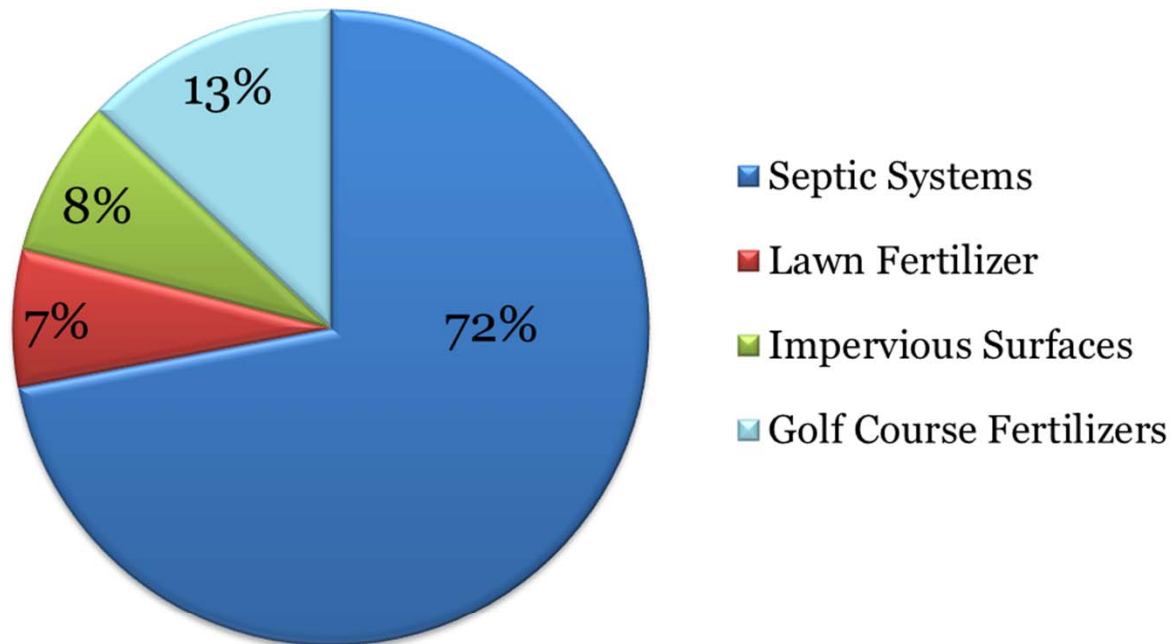
MEP 2013

## Rands Canal Controllable Nitrogen Loads



MEP 2013

## Wild Harbor Controllable Nitrogen Loads



MEP 2013


# Nitrogen Problem


## Base Map

 Town Lines

 Rivers


## Embayment Boundary

 On Land


 On Sea

## Major Roads

 US Highway

 State Highway


 Roads

 Structures





 Ponds

## Nitrogen

### Water Quality Stations






-  Healthy
-  Healthy/Moderately Impacted
-  Healthy/Significantly Impacted
-  Moderately Impacted
-  Moderately Impacted/Significantly Impacted
-  Significantly Impacted
-  Significantly Impacted/Significantly Degraded
-  Significantly Degraded

### Yearly Nitrate Concentration Averages

-  0 - 0.5 mg/l **in Public Water Supply Wells**
-  0.5 - 1 mg/l
-  1 - 2.5 mg/l
-  2.5 - 5 mg/l






### Embayments with Removal Target

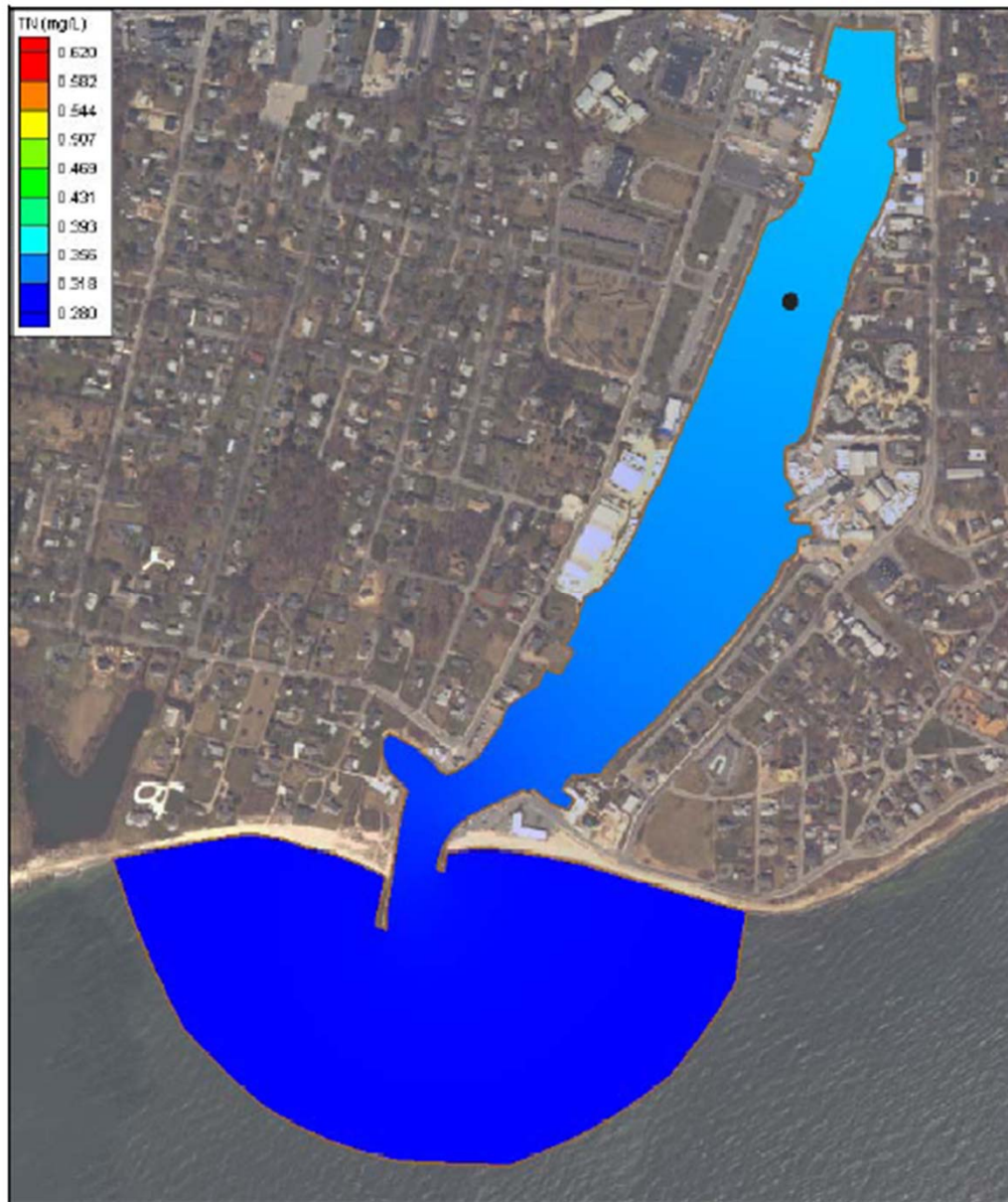
Total NLoad Percent Removal

-  0 %
-  1 - 52 %
-  53 - 72 %
-  73 - 86 %
-  87 - 100 %

### Subwatersheds with Removal Target

Total NLoad Percent Removal

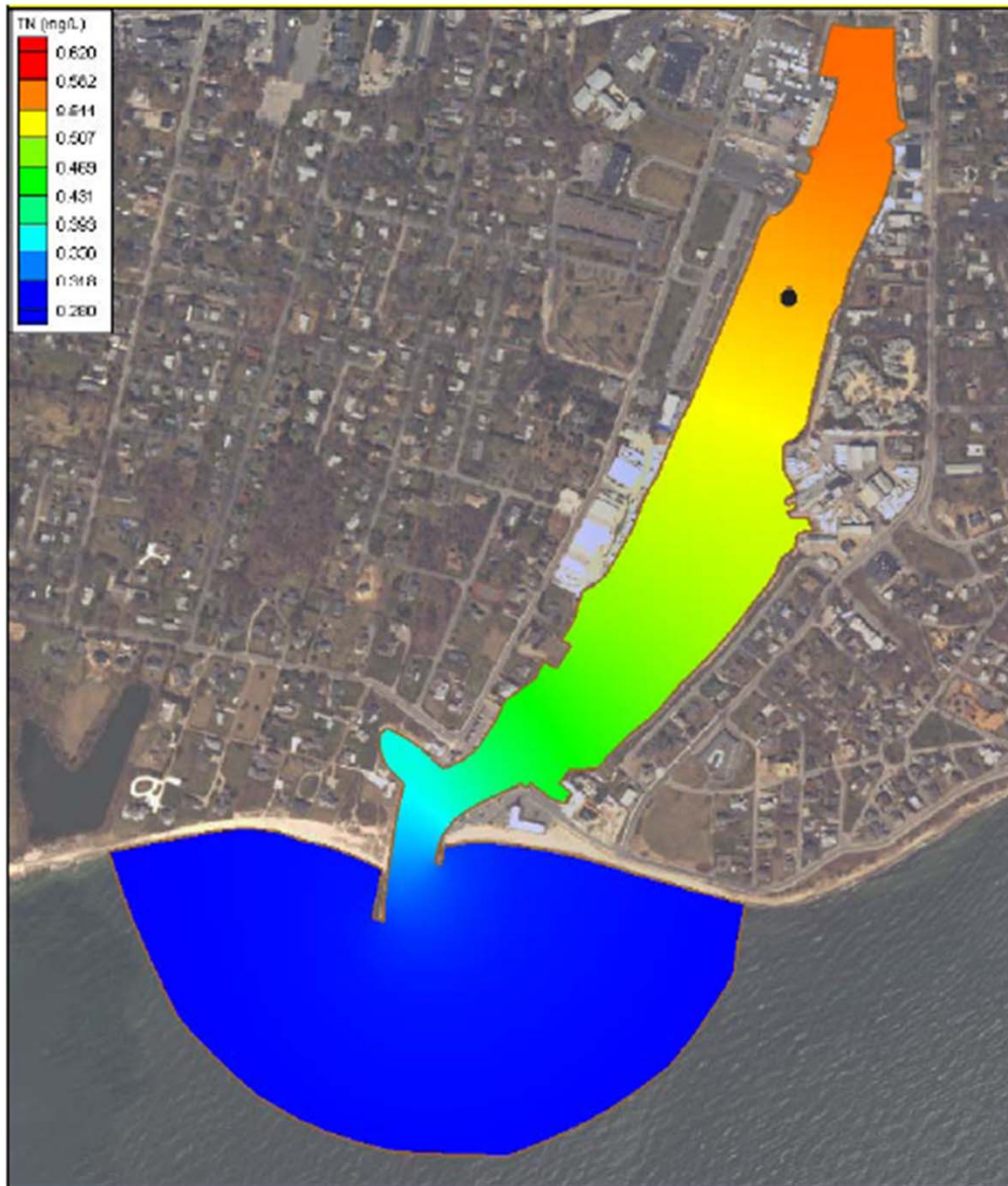
-  0.1 % - 9%
-  9.1 % - 38 %
-  38.1 % - 62 %
-  62.1 % - 86 %
-  86.1 % - 100%



Contour plots of **modeled total nitrogen concentrations (mg/L)** in Falmouth Harbor estuary system, for no anthropogenic loading conditions, and bathymetry. The approximate location of the sentinel threshold stations for Falmouth Harbor estuary system is shown by the black symbol.

(Source: MEP 2013)

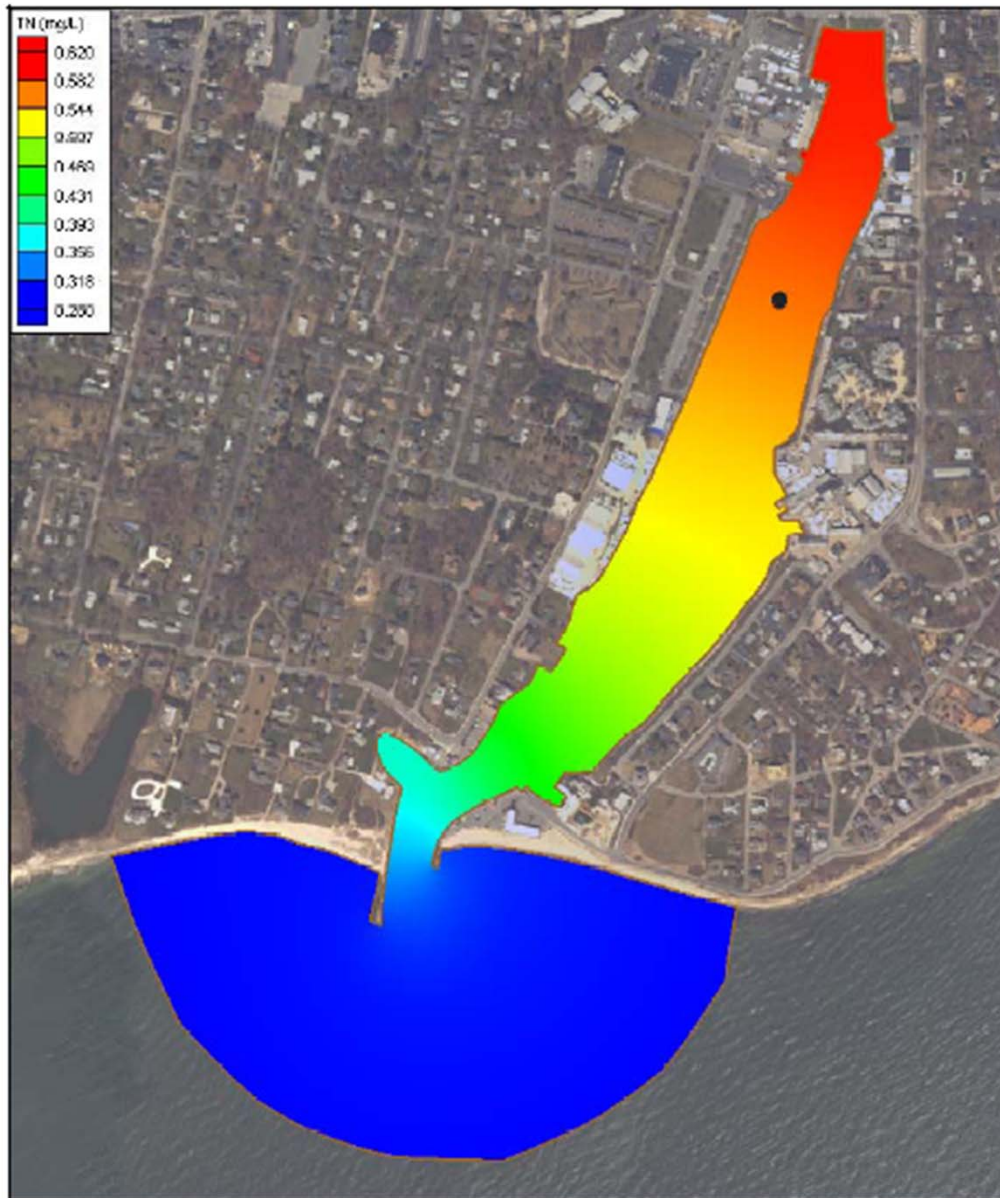
**Pre-Colonial Conditions: Falmouth Inner Harbor**



Contour plots of **average total nitrogen concentrations** from results of the present conditions loading scenario, for Falmouth Harbor estuary system. The approximate location of the sentinel threshold station for Falmouth Harbor estuary system is shown by the black symbol.

(Source: MEP 2013)

**Present Conditions: Falmouth Inner Harbor**



Contour plots of **modeled total nitrogen concentrations (mg/L)** in Falmouth Harbor estuary system, for projected build-out loading conditions, and bathymetry. The approximate location of the sentinel threshold station for Falmouth Harbor estuary system is shown by the black symbol.

(Source: MEP 2013)

**Buildout Conditions: Falmouth Inner Harbor**

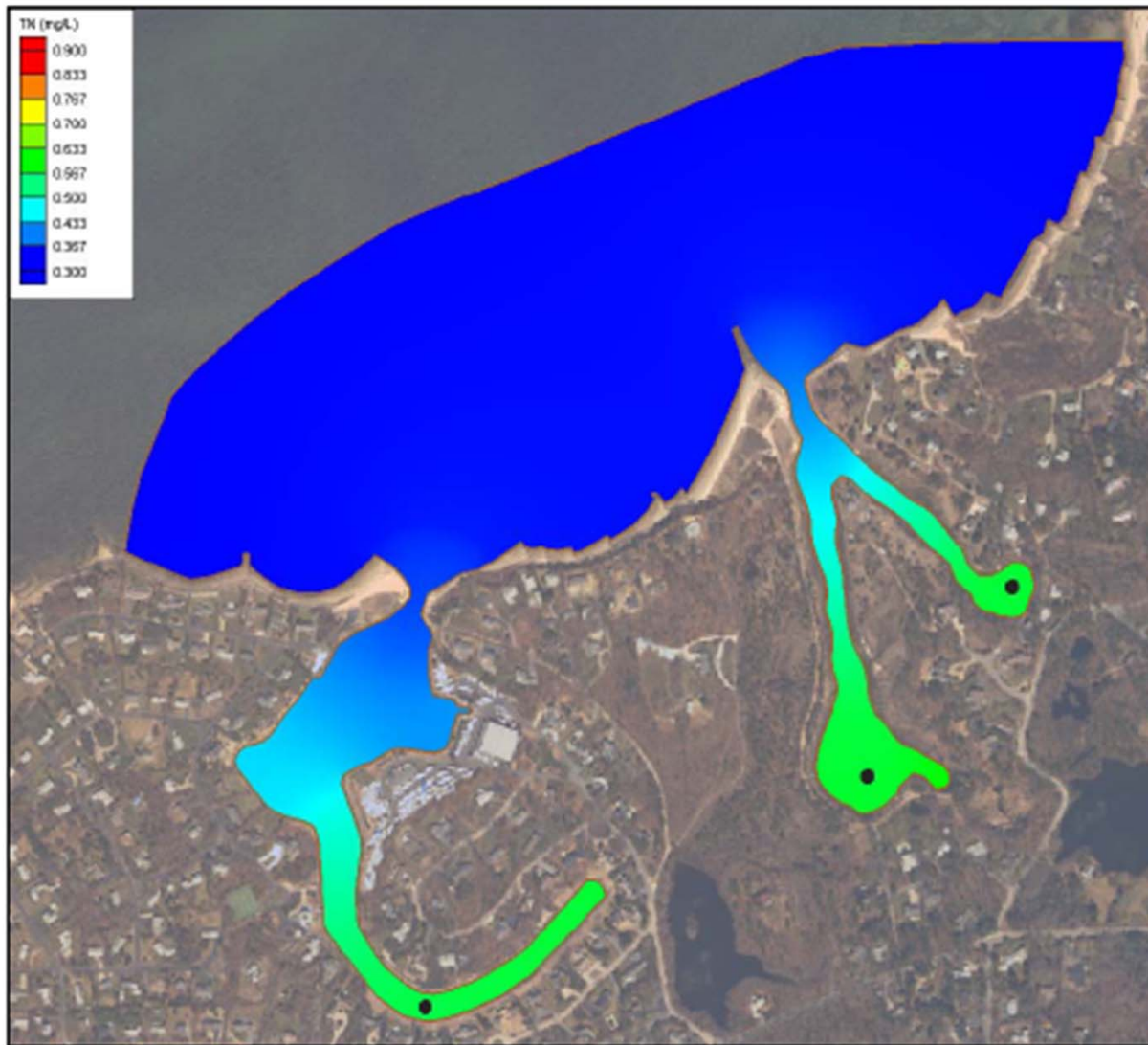


Contour plots of **modeled total nitrogen concentrations (mg/L)** in Fiddlers Cove and Rands Harbor estuary systems, for no anthropogenic loading conditions, and bathymetry. The approximate location of the sentinel threshold stations for Fiddlers Cove and Rands Harbor estuary systems are shown by the black symbols.

(Source: MEP 2013)

**Pre-Colonial Conditions: Fiddler Cove and Rands Harbor**

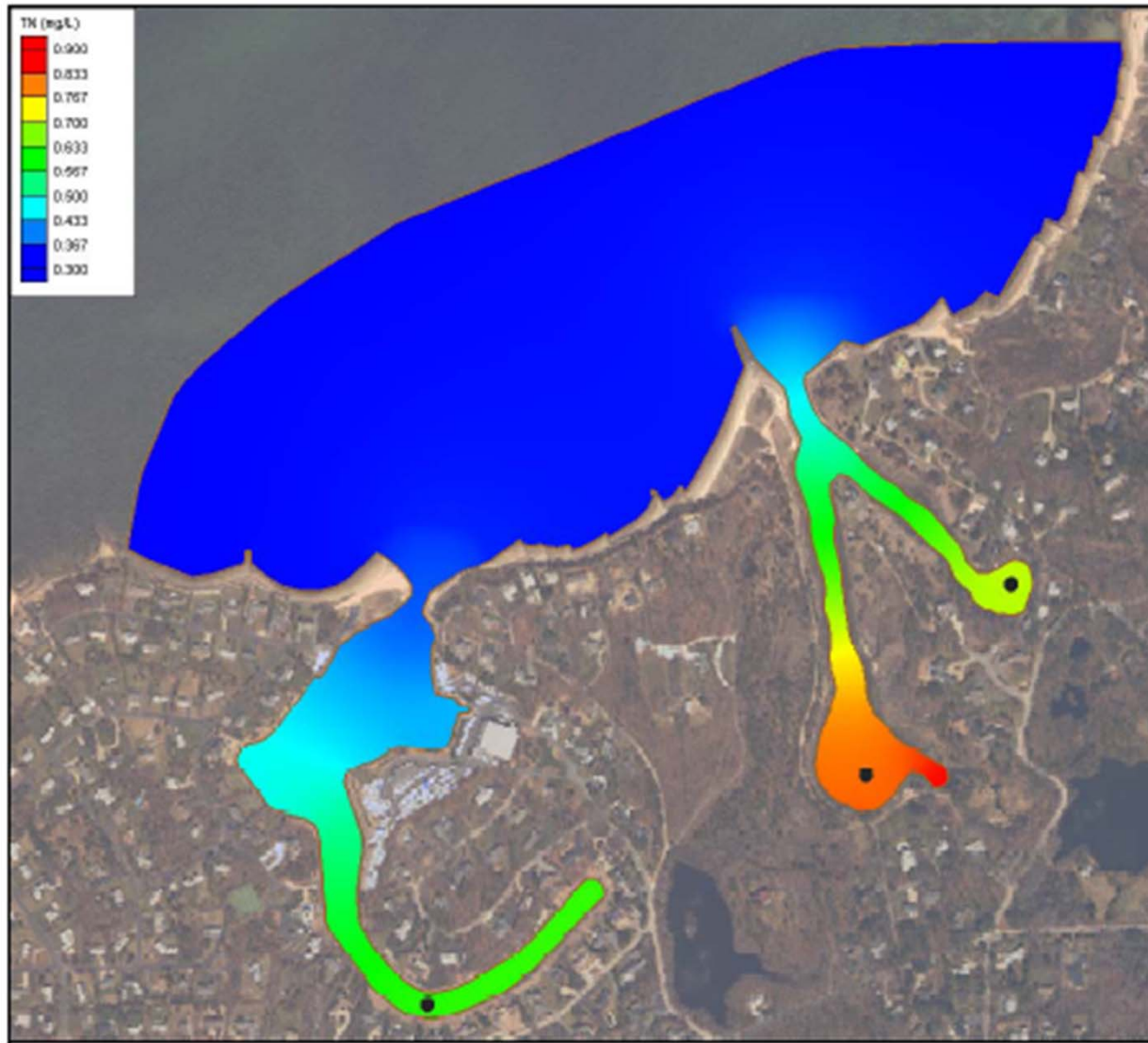




Contour plots of **average total nitrogen concentrations** from results of the present conditions loading scenario, for Fiddlers Cove and Rands Harbor estuary systems. The approximate location of the sentinel threshold stations for Fiddlers Cove and Rands Harbor estuary systems are shown by the black symbols.

(Source: MEP 2013)

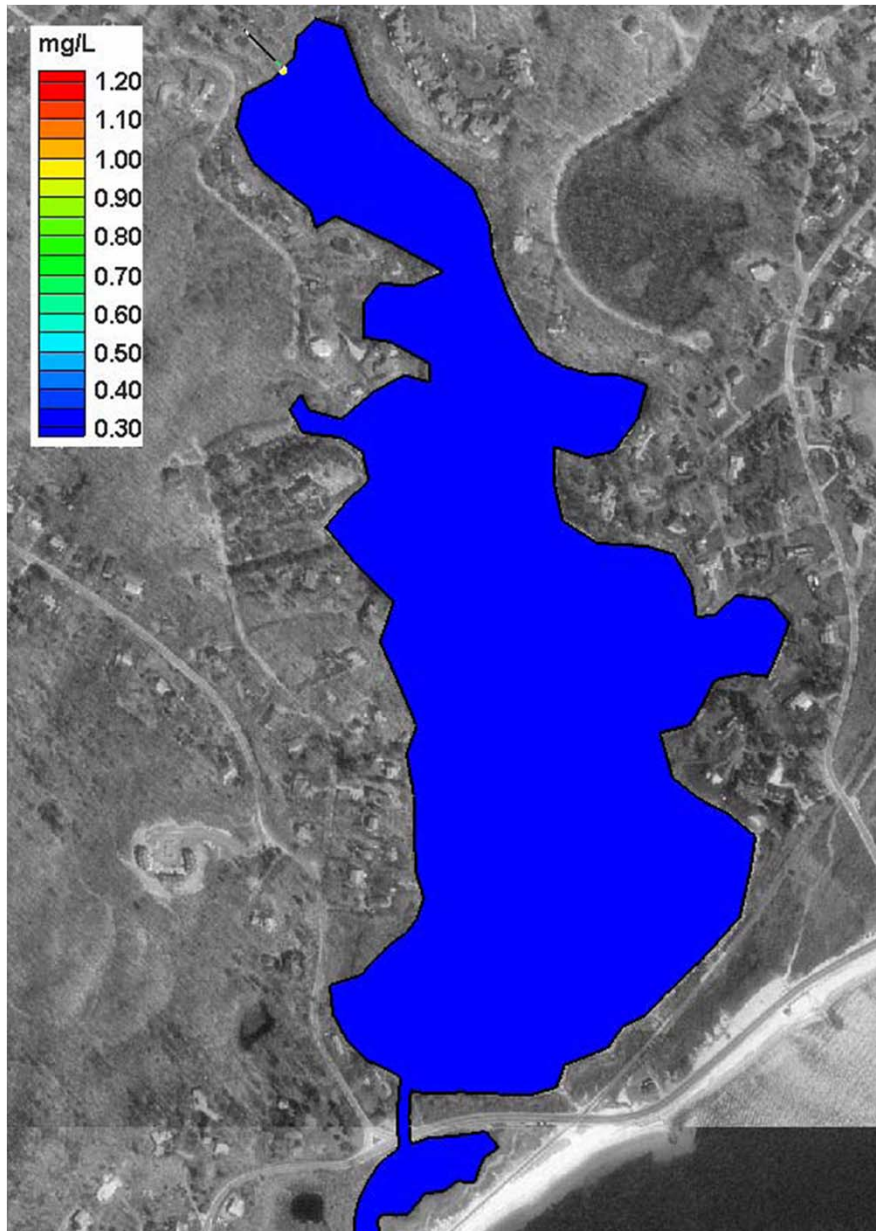
**Present Conditions: Fiddler Cove and Rands Harbor**



Contour plots of **modeled total nitrogen concentrations (mg/L)** in Fiddlers Cove and Rands Harbor estuary systems, for projected build-out loading conditions, and bathymetry. The approximate location of the sentinel threshold stations for Fiddlers Cove and Rands Harbor estuary systems are shown by the black symbols.

(Source: MEP 2013)

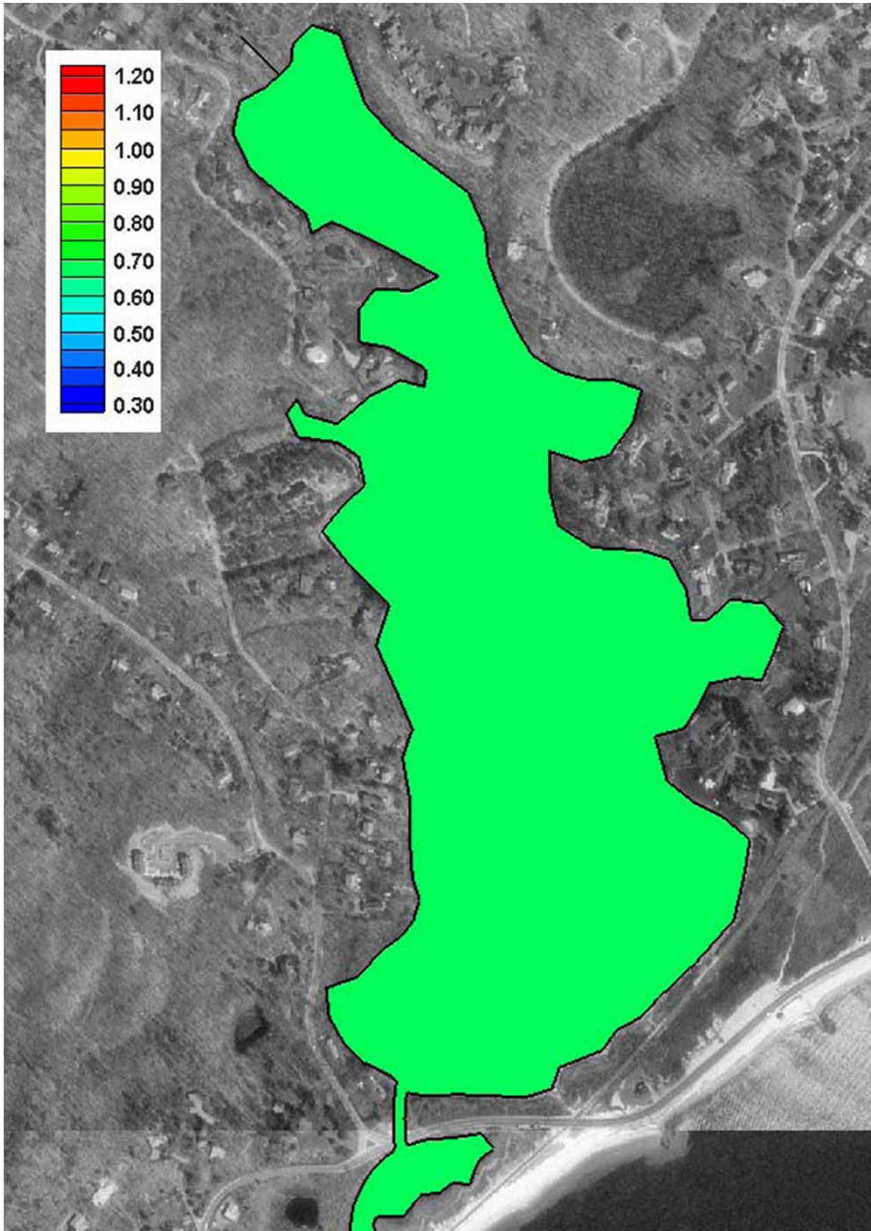
**Buildout Conditions: Fiddler Cove and Rands Harbor**



Contour plot of **modeled total nitrogen concentrations (mg/L)** in Oyster Pond, for no anthropogenic loading conditions.

(Source: MEP 2006)

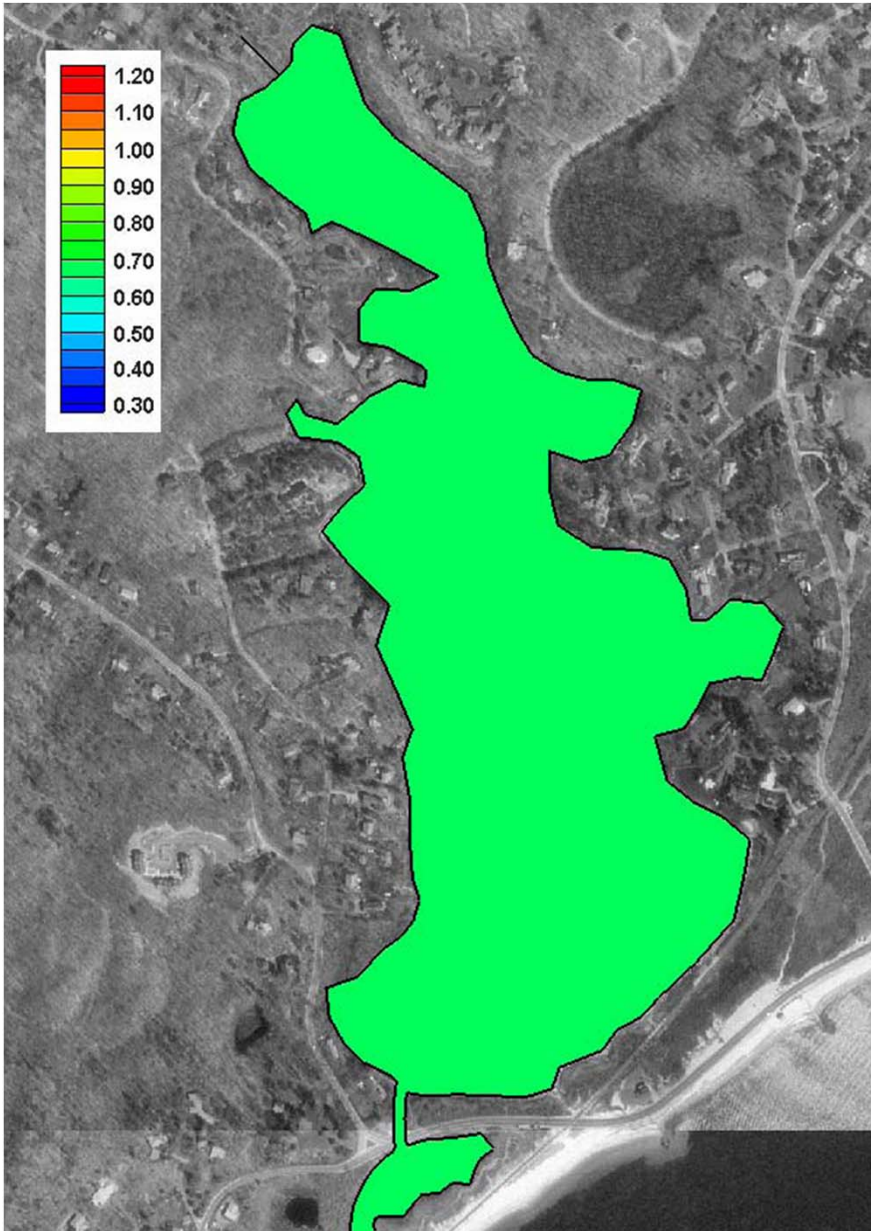
**Pre-Colonial Conditions: Oyster Pond**



Contour plot of **average total nitrogen concentrations** from results of the present conditions loading scenario, for Oyster Pond.

(Source: MEP 2006)

**Present Conditions: Oyster Pond**



Contour plot of **modeled total nitrogen concentrations (mg/L)** in Oyster Pond, for projected build-out loading conditions.

(Source: MEP 2006)

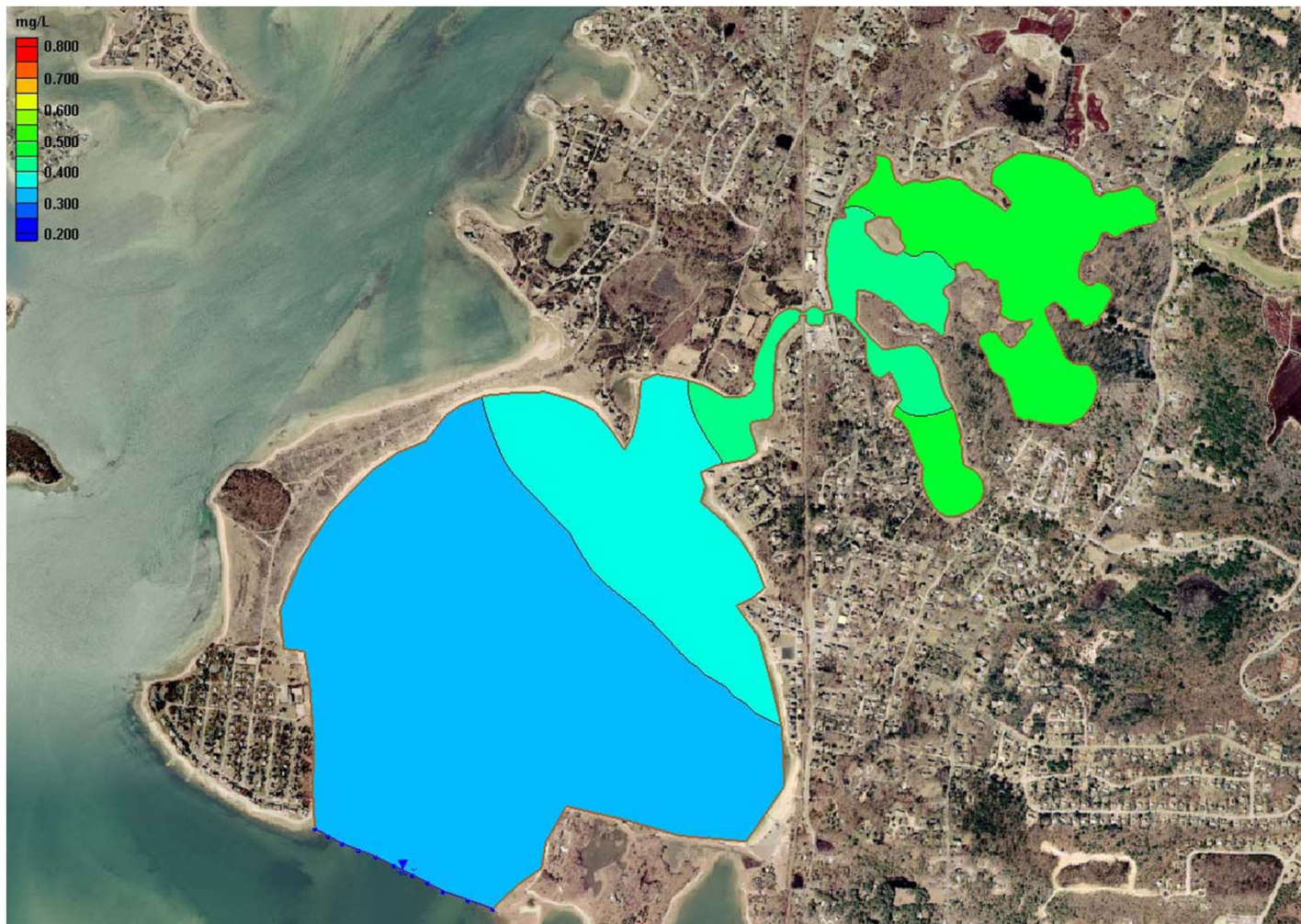
**Build-out Conditions: Oyster Pond**



Contour plots of **modeled total nitrogen concentrations (mg/L)** in Phinney's Harbor estuary system, for no anthropogenic loading conditions, and bathymetry. The approximate location of the sentinel threshold station for Phinney's Harbor estuary system (PH4) is shown.

(Source: MEP 2006)

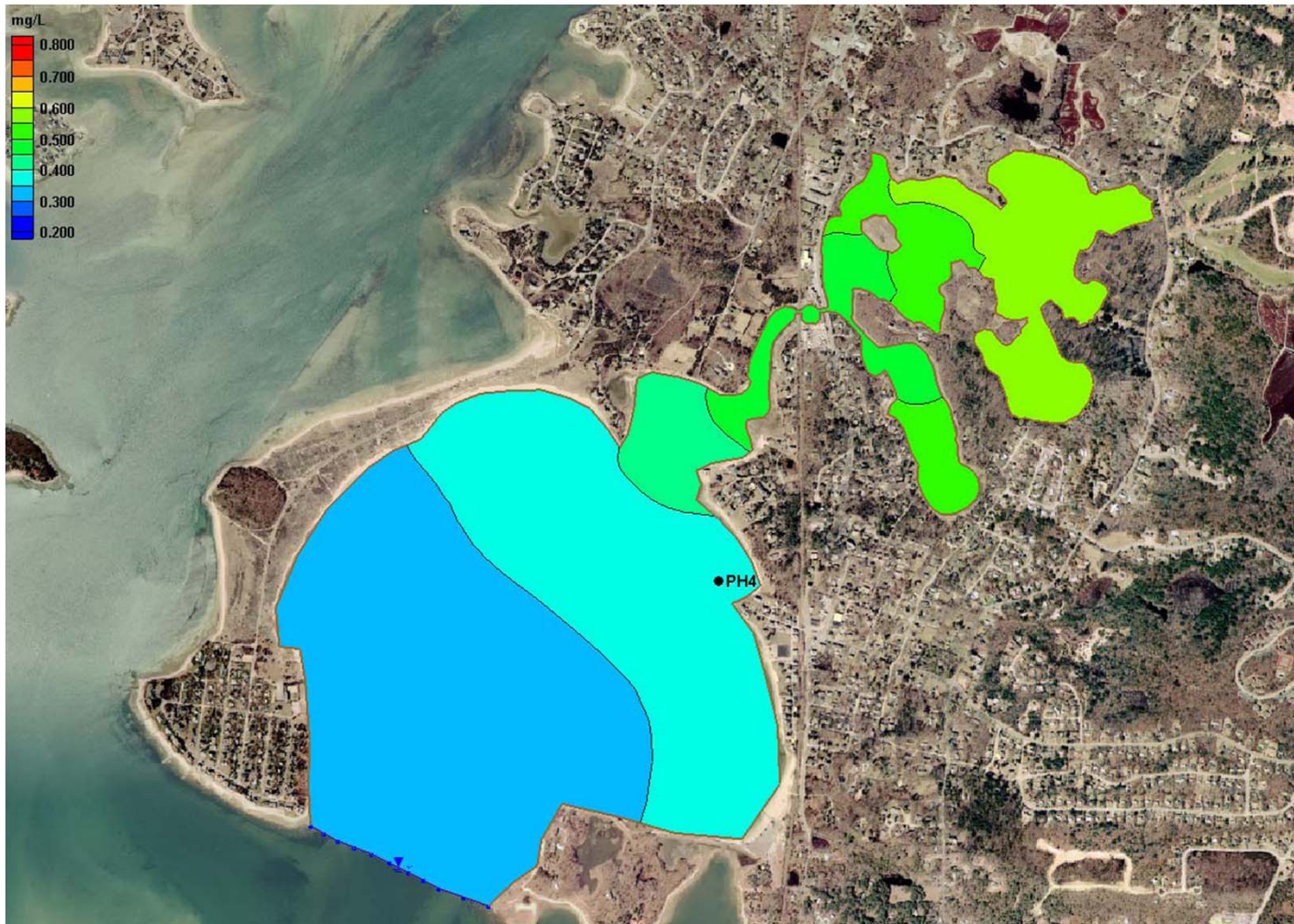
## Pre-Colonial Conditions: Phinney's Harbor, Back River & Eel Pond



Contour plots of **average total nitrogen concentrations** from results of the present conditions loading scenario and the bathymetry, for Phinney's Harbor system. The approximate location of the sentinel threshold station for Phinney's Harbor estuary system (PH4) is shown.

(Source: MEP 2006)

**Present Conditions: Phinney's Harbor, Back River & Eel Pond**

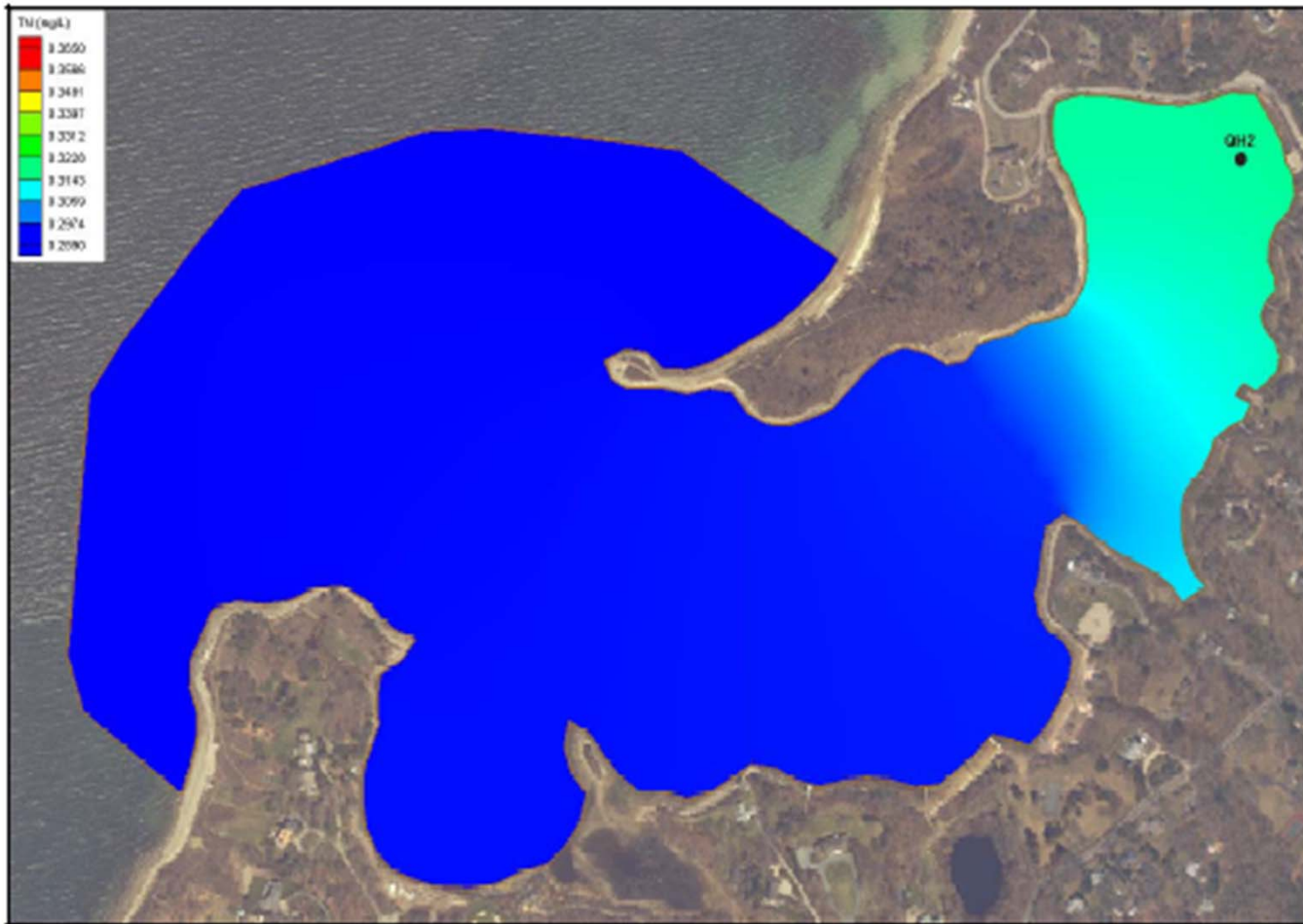


Contour plots of **modeled total nitrogen concentrations (mg/L)** in Phinney's Harbor estuary system, for projected build-out loading conditions, and bathymetry. The approximate location of the sentinel threshold station for Phinney's Harbor estuary system (PH4) is shown.

(Source: MEP 2006)

## Build-out Conditions: Phinney's Harbor, Back River & Eel Pond

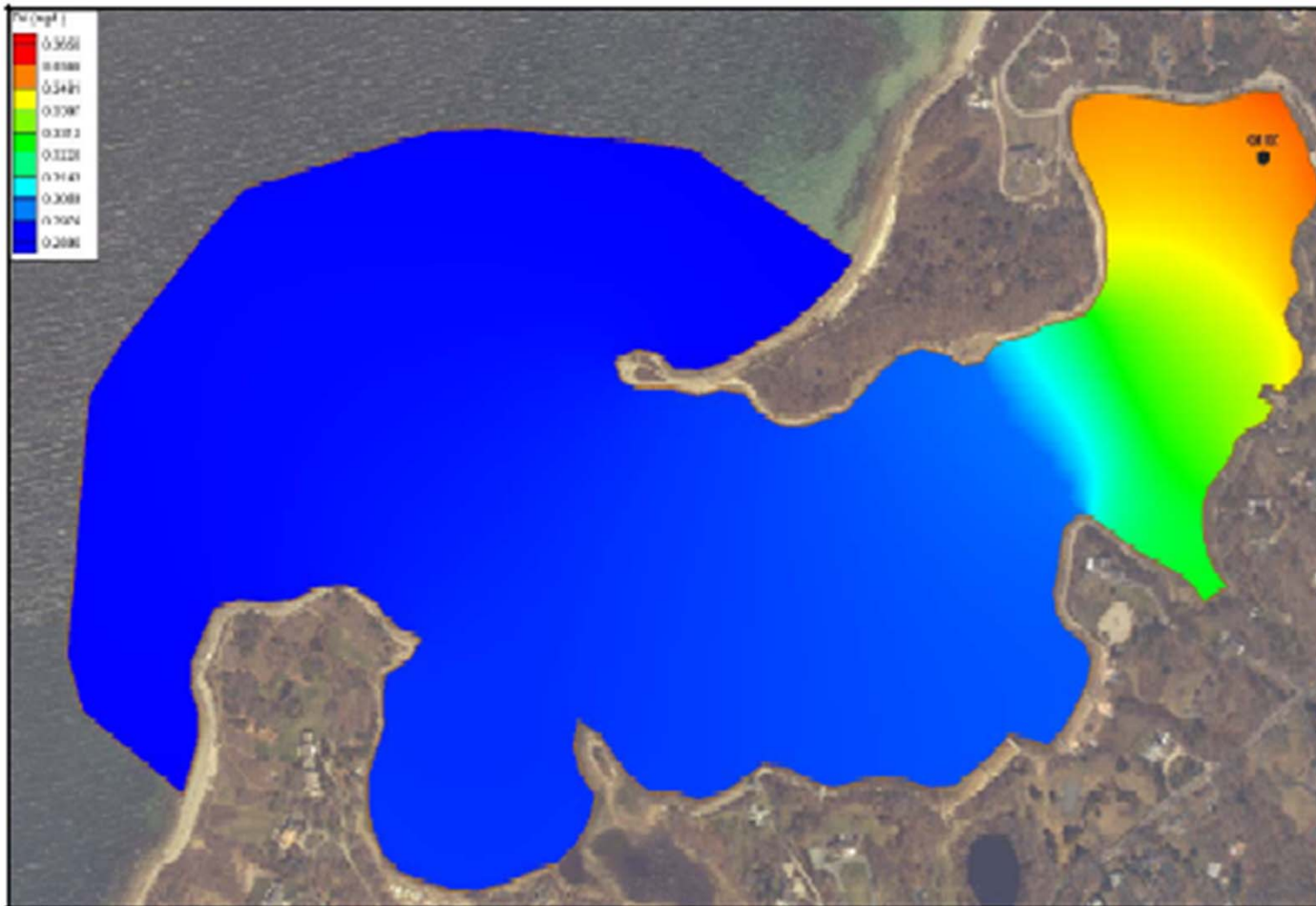




Contour plots of **modeled total nitrogen concentrations (mg/L)** in Quissett Harbor System, for no anthropogenic loading conditions and bathymetry. The approximate location the sentinel threshold station for Quissett Harbor System (QH2) is shown.

(Source: MEP 2013)

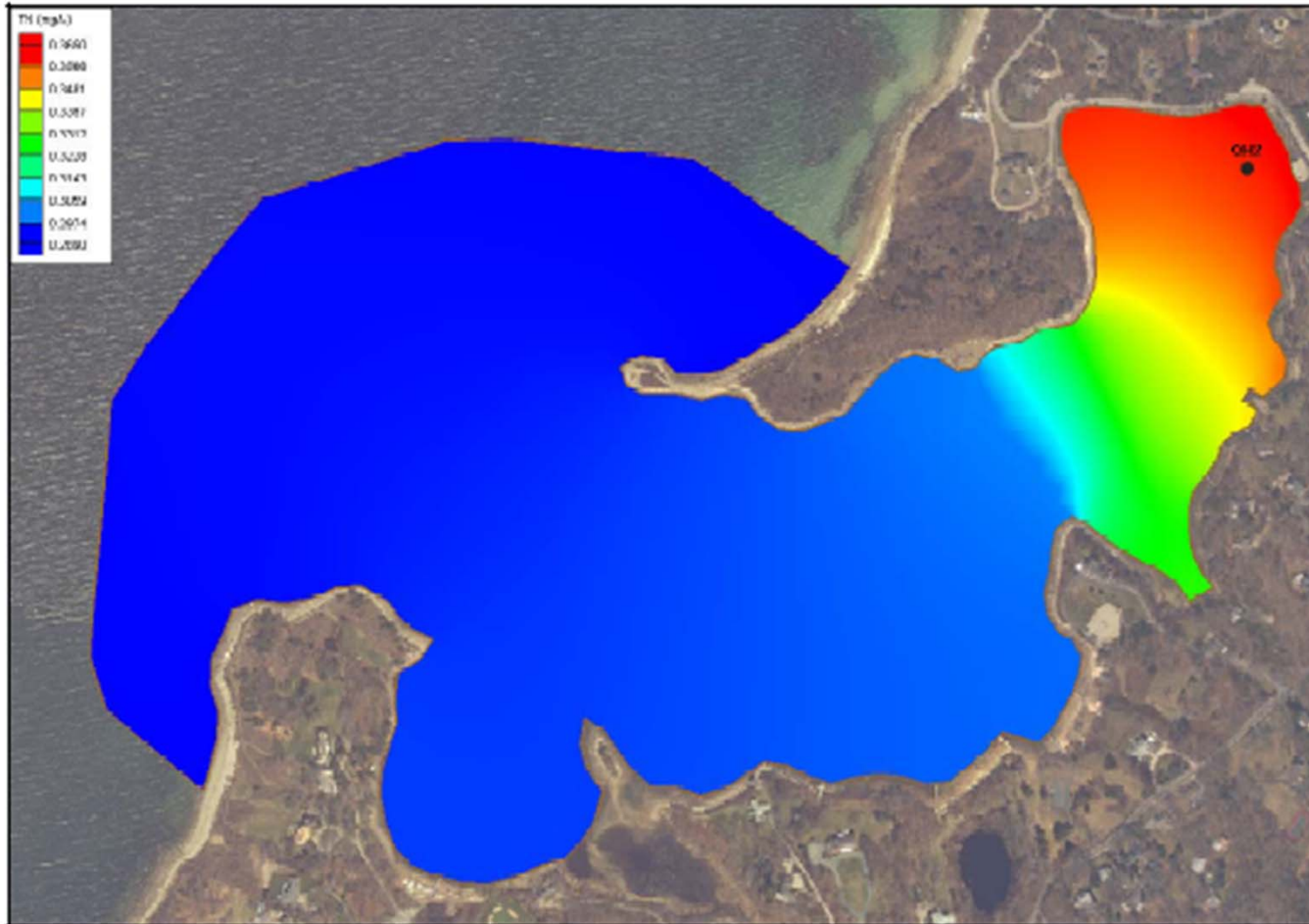
**Pre-Colonial Conditions: Quissett Harbor**



Contour plots of **average total nitrogen concentrations** from results of the present conditions loading scenario, for Quissett Harbor System. The approximate location the sentinel threshold station for Quissett Harbor System (QH2) is shown.

(Source: MEP 2013)

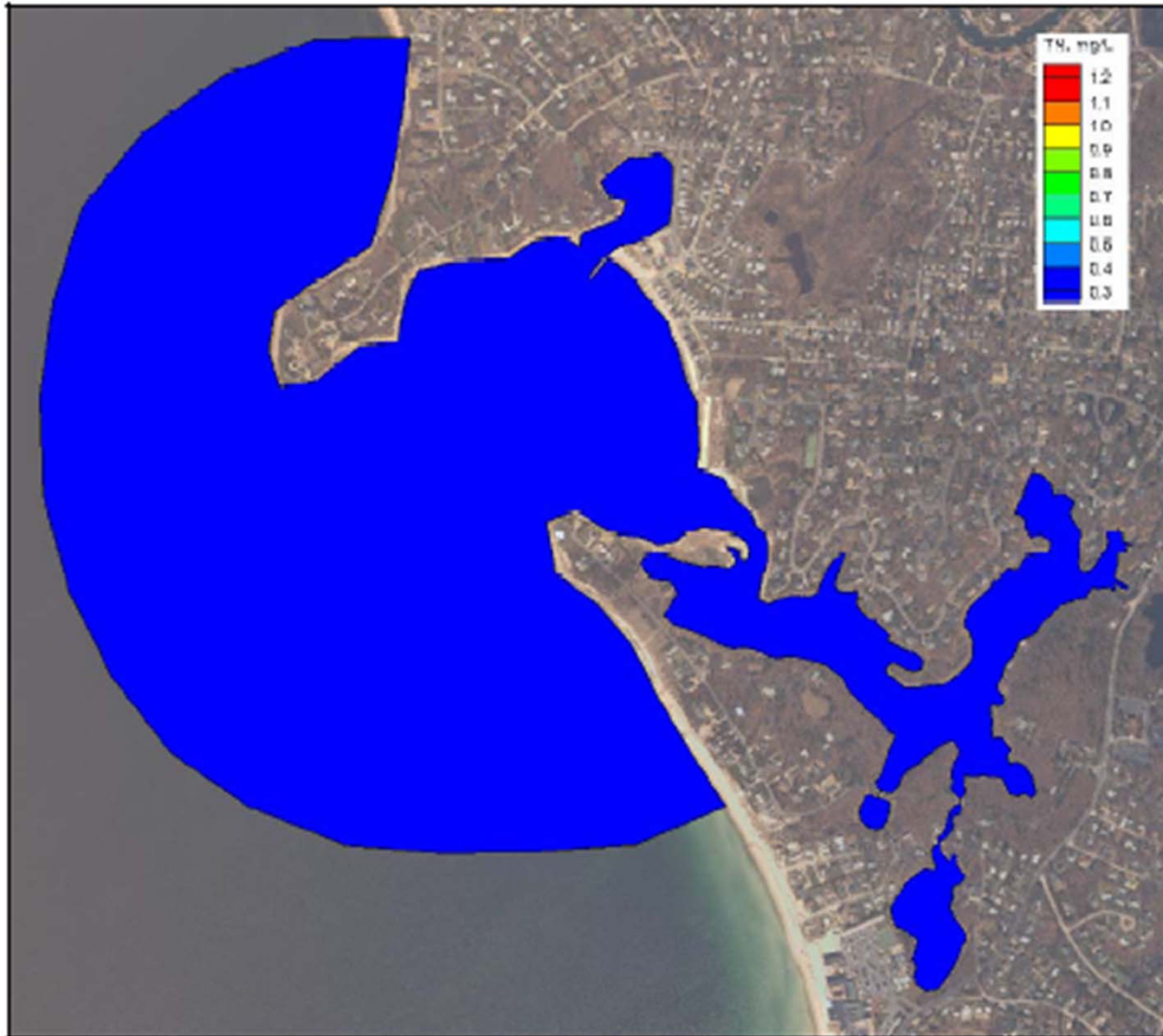
Present Conditions: Quissett Harbor



Contour plots of **modeled total nitrogen concentrations (mg/L)** in Quissett Harbor System for projected build-out loading conditions, and bathymetry. The approximate location the sentinel threshold station for Quissett Harbor System (QH2) is shown.

(Source: MEP 2013)

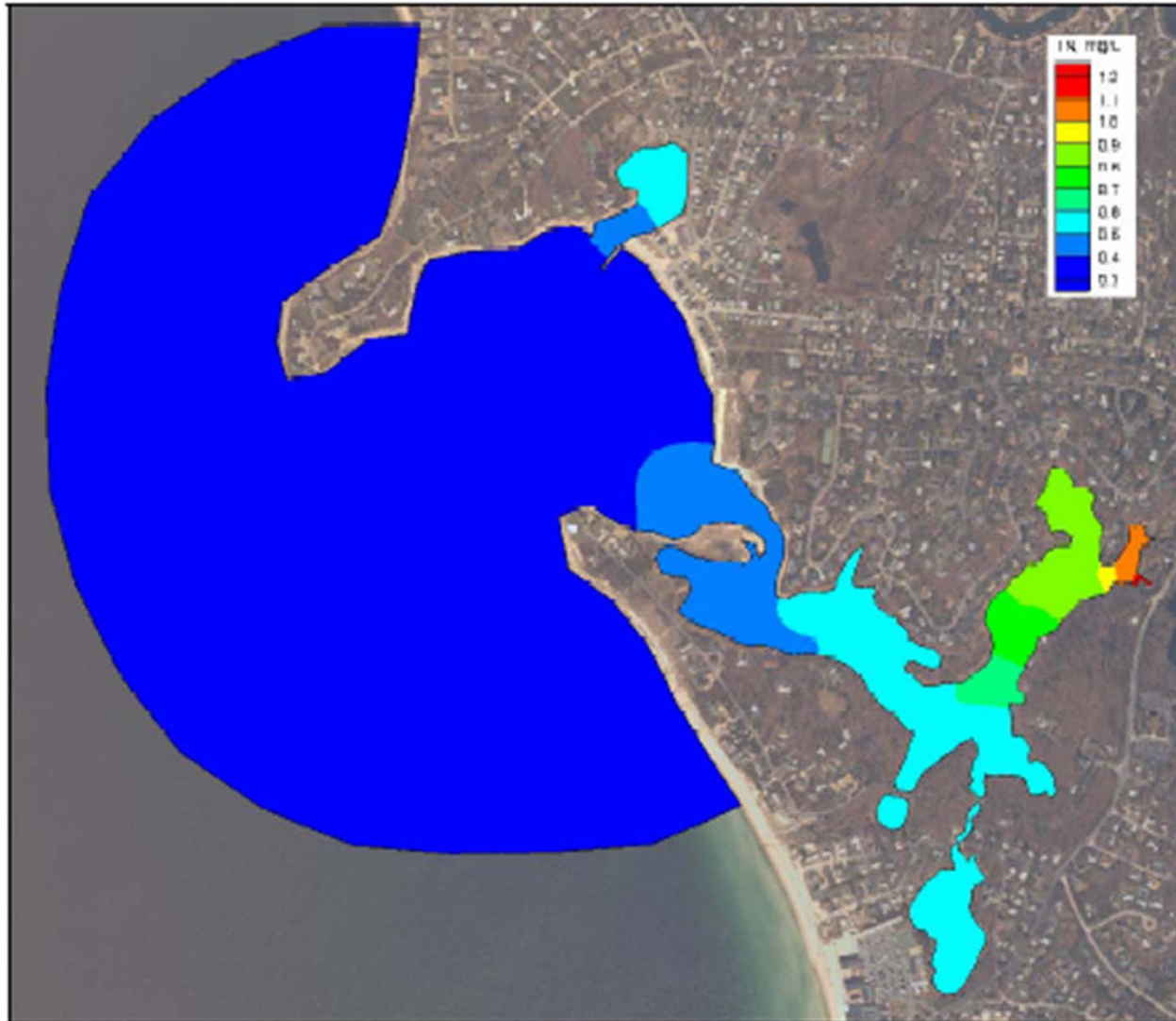
**Build-out Conditions: Quissett Harbor**



Contour plot of **modeled total nitrogen concentrations (mg/L)** in Wild Harbor, for no anthropogenic loading conditions.

(Source: MEP 2013)

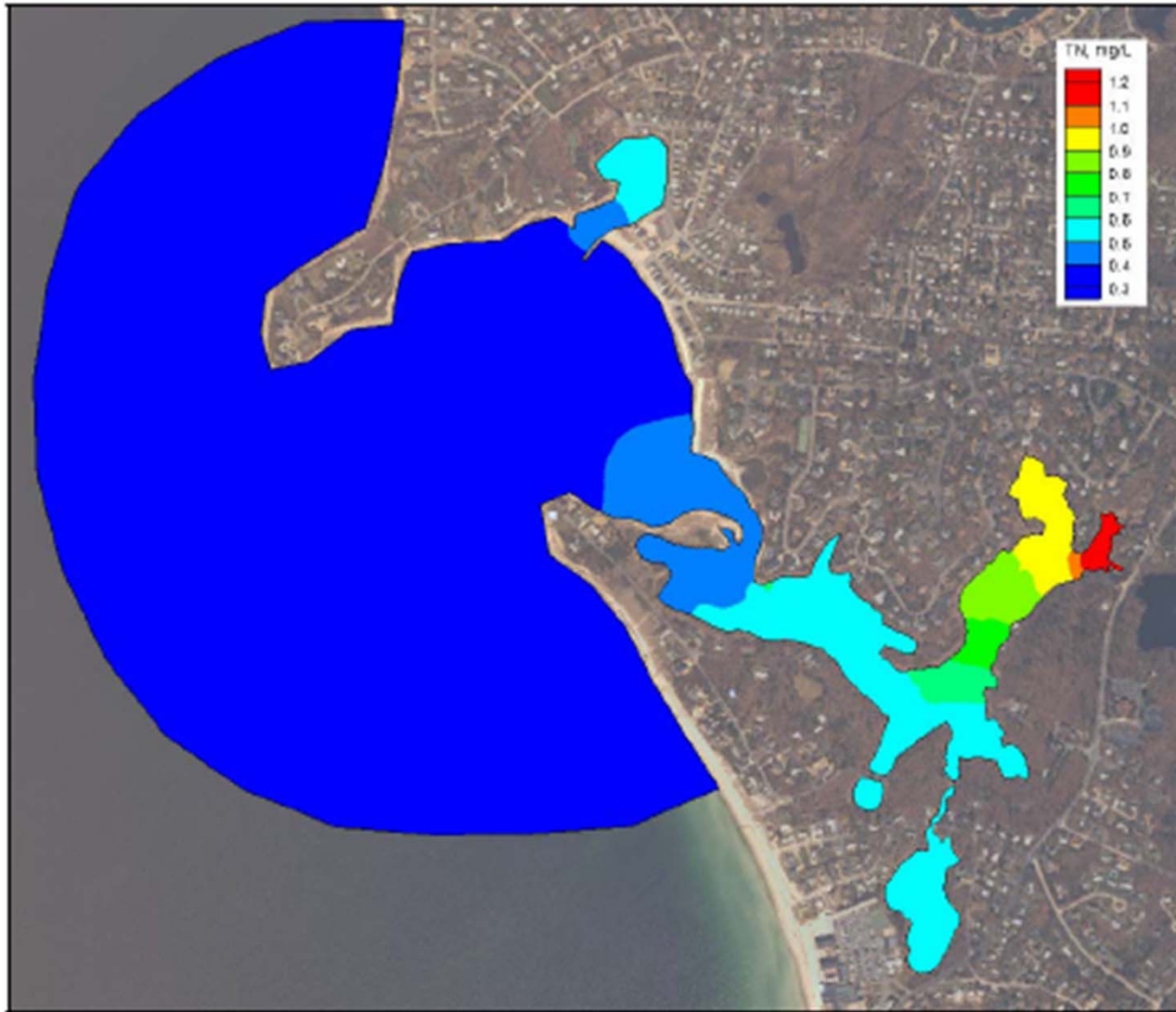
Pre-Colonial Conditions: Wild Harbor



Contour plot of **average total nitrogen concentrations** from results of the present conditions loading scenario, for the Wild Harbor System.

(Source: MEP 2013)

Present Conditions: Wild Harbor



Contour plot of **modeled total nitrogen concentrations (mg/L)** for results of the projected buildout loading scenario, for the Wild Harbor System.

(Source: MEP 2013)

Present Conditions: Wild Harbor


# Nitrogen Problem


## Base Map

 Town Lines


 Rivers


## Embayment Boundary

 On Land


 On Sea

## Major Roads

 US Highway

 State Highway



 Roads

 Structures





 Ponds

## Nitrogen

### Water Quality Stations






-  Healthy
-  Healthy/Moderately Impacted
-  Healthy/Significantly Impacted
-  Moderately Impacted
-  Moderately Impacted/Significantly Impacted
-  Significantly Impacted
-  Significantly Impacted/Significantly Degraded
-  Significantly Degraded

### Yearly Nitrate Concentration Averages

-  0 - 0.5 mg/l **in Public Water Supply Wells**
-  0.5 - 1 mg/l
-  1 - 2.5 mg/l
-  2.5 - 5 mg/l






### Embayments with Removal Target

Total NLoad Percent Removal

-  0 %
-  1 - 52 %
-  53 - 72 %
-  73 - 86 %
-  87 - 100 %


### Subwatersheds with Removal Target

Total NLoad Percent Removal

-  0.1 % - 9%
-  9.1 % - 38 %
-  38.1 % - 62 %
-  62.1 % - 86 %
-  86.1 % - 100%

# Eelgrass Extent


## Base Map

 Town Lines


 Rivers

## Embayment Boundary

 On Land


 On Sea

## Major Roads

 US Highway


 State Highway

 Roads

 Structures

 Ponds

## Eelgrass

 Eelgrass Extent




# Phosphorus Problem


## Base Map

 Town Lines


 Rivers


## Embayment Boundary

 On Land


 On Sea

## Major Roads

 US Highway

 State Highway

 Roads

 Structures


 Ponds


## Phosphorus


### Priority Ponds

Trophic Status

 Eutrophic *Most Impacted*


 Mesotrophic

 Oligotrophic *Least Impacted*

 Not Interpreted


# Title 5 Compliance Issues


## Base Map

 Town Lines

 Rivers


## Embayment Boundary

 On Land


 On Sea

## Major Roads

 US Highway


 State Highway


 Roads

 Structures


 Ponds


## Existing Conditions

 Approx. Locations of Loans Issued for Title 5 Repair

 Potential Title 5 Compliance Issues

 Wastewater Treatment Facility

 Groundwater Discharge Points

 Sewered Parcels

# Existing & Proposed Solutions

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Buttermilk Bay  
Eel Pond & Back River  
Falmouth Inner Harbor  
Fiddlers Cove  
Great Sippewisset Creek  
Little Sippewisset Marsh  
Megansett Harbor  
Oyster Pond

Phinney's Harbor  
Pocasset Harbor  
Pocasset River  
Quissett Harbor  
Rands Canal  
Salt Pond  
Wild Harbor


# Existing Infrastructure


## Base Map

 Town Lines


 Rivers


## Embayment Boundary

 On Land


 On Sea

## Major Roads

 US Highway


 State Highway

 Roads


 Structures


 Ponds


## Existing Conditions

 Approx. Locations of Loans Issued for Title 5 Repair

 Potential Title 5 Compliance Issues

 Wastewater Treatment Facility

 Groundwater Discharge Points


 Sewered Parcels

## Enhanced Attenuation Sites

 Pipe


 Stormwater


## Public Supply Wells

 Public Water Supply Well

 Small Volume Wells, Non-Transient

 Proposed Public Water Supply Well

 Surface Water Supply

 Small Volume Wells, Transient


# Proposed Infrastructure


## Base Map

 Town Lines

 Rivers


## Embayment Boundary

 On Land


 On Sea

## Major Roads

 US Highway

 State Highway

 Roads

 Structures

 Ponds

## Proposed Conditions

### Natural Attenuation Sites


 Bridge

 Culvert


 Inlet

 Pipe


 Sewer Alternatives


 Stormwater


### CWMP Sewershed Phasing


 No Date Set


Phase Date

 2001 - 2010

 2011 - 2020

 2021 - 2030

 2031 - 2040

 2041 - 2050

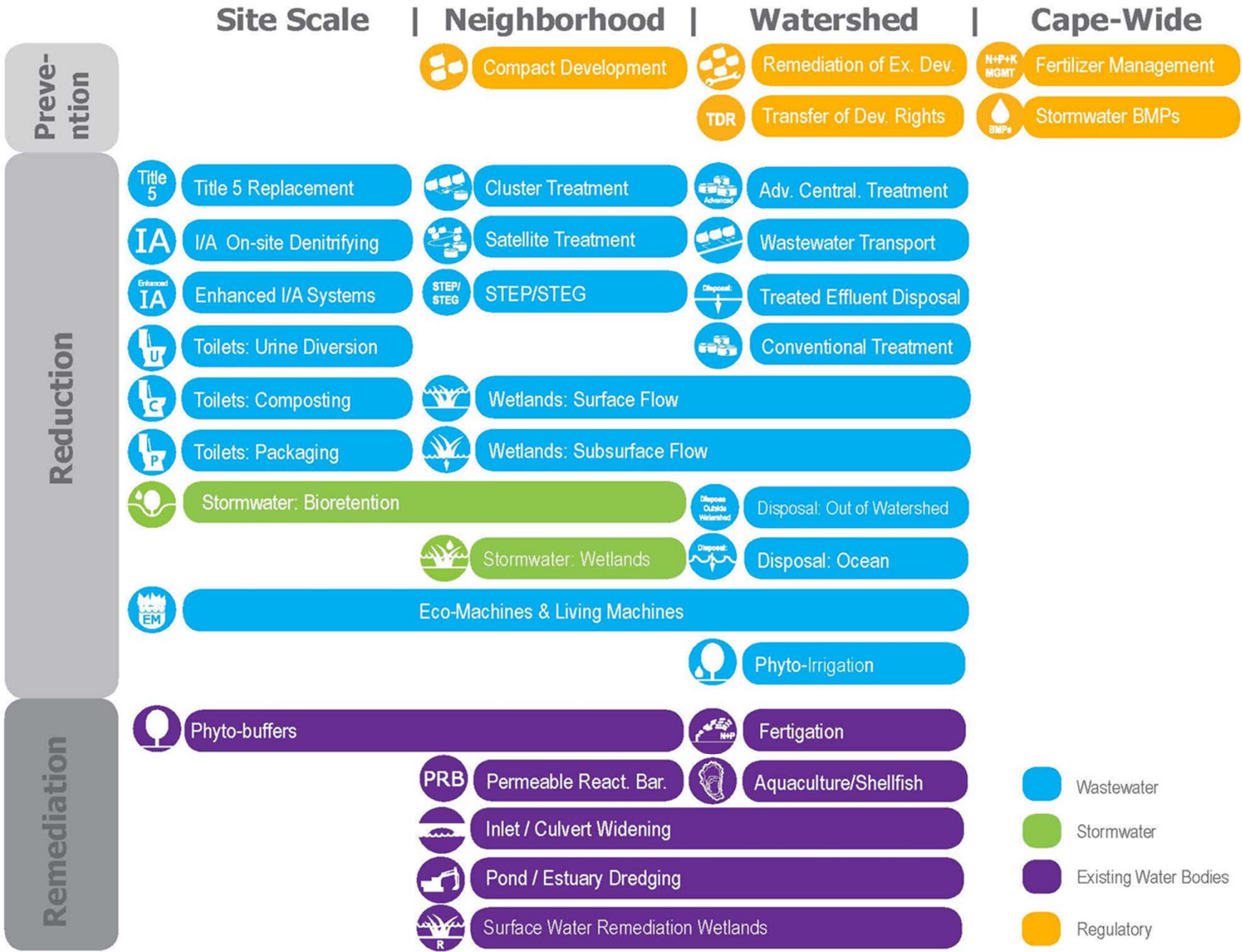


# Framework for Addressing Solutions Moving Forward

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Buttermilk Bay  
Eel Pond & Back River  
Falmouth Inner Harbor  
Fiddlers Cove  
Great Sippewisset Creek  
Little Sippewisset Marsh  
Megansett Harbor  
Oyster Pond

Phinney's Harbor  
Pocasset Harbor  
Pocasset River  
Quissett Harbor  
Rands Canal  
Salt Pond  
Wild Harbor



- Wastewater
- Stormwater
- Existing Water Bodies
- Regulatory

# Alternatives: Screening Method

1  
2  
3  
4  
5  
6  
7



Wastewater



Existing Water Bodies



Regulatory

## Targets/ Goals

**Present Load:** X kg/day **−** **Target:** Y kg/day **=** **Reduction Required:** N kg/day

## Composite Target Areas

- A. High Nitrogen Reduction Areas
- B. Pond Recharge Areas
- C. Title 5 Problem Areas

## Low Barrier to Implementation

- A. Fertilizer Management
- B. Stormwater Mitigation



## Watershed/Embayment Options

- A. Permeable Reactive Barriers
- B. Inlet/Culvert Openings
- C. Constructed Wetlands
- D. Dredging



## Alternative On-Site Options

- A. Eco-toilets (UD & Compost)
- B. I/A Technologies
- C. Enhanced I/A Technologies
- D. Shared Systems



## Priority Collection/High-Density Areas

- A. Greater Than 1 Dwelling Unit/acre
- B. Village Centers
- C. Economic Centers
- D. Growth Incentive Zones



## Supplemental Sewering





**All materials and resources for the Herring River Group  
will be available on the Cape Cod Commission website:**

<http://watersheds.capecodcommission.org/index.php/watersheds/upper-cape/upper-cape-west-south>

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