Combining Sewering with Non-traditional Technologies to Meet Nitrogen TMDLs in Dennis, MA

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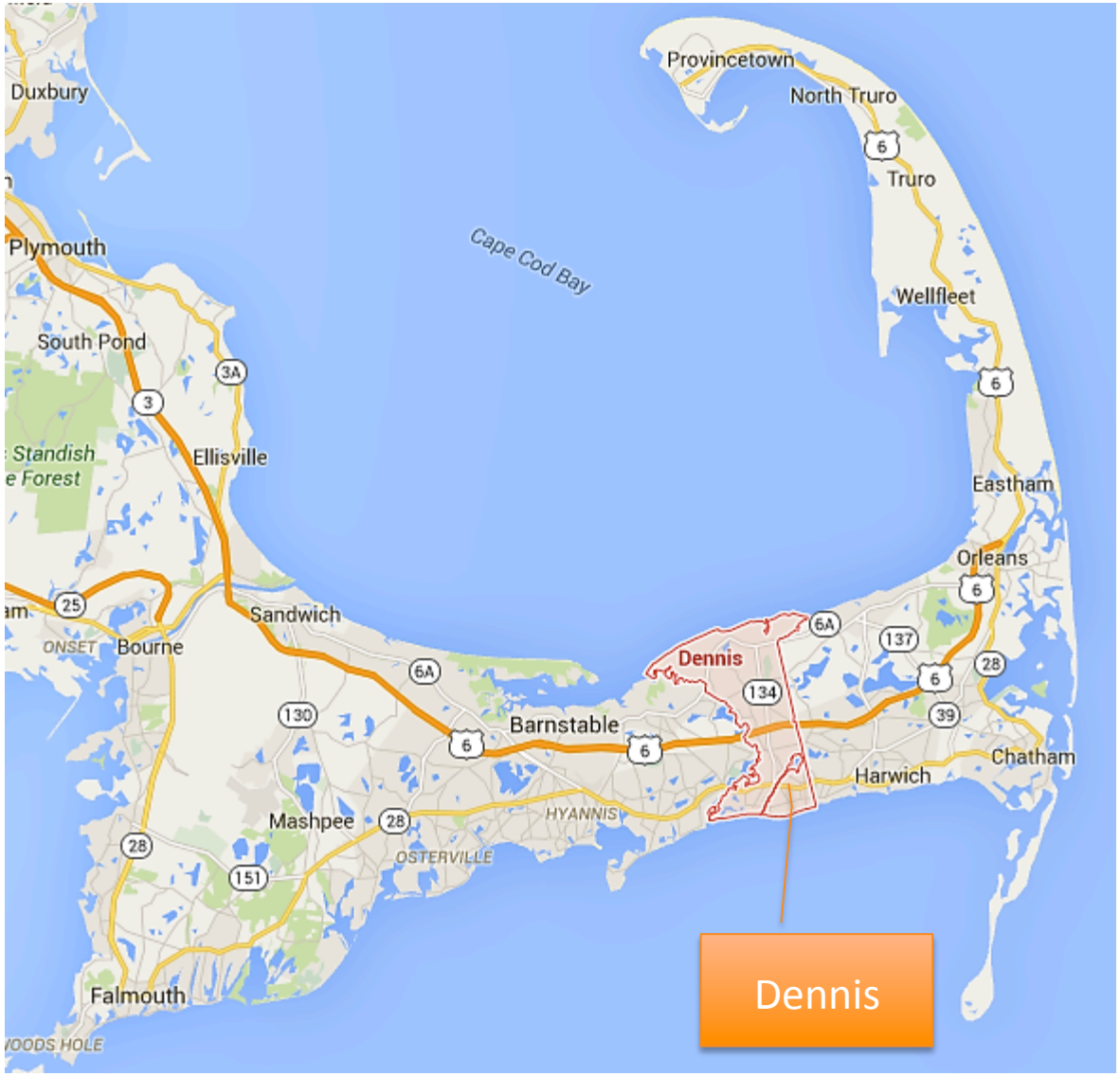
Dennis
preserving our water resources

CDM Smith

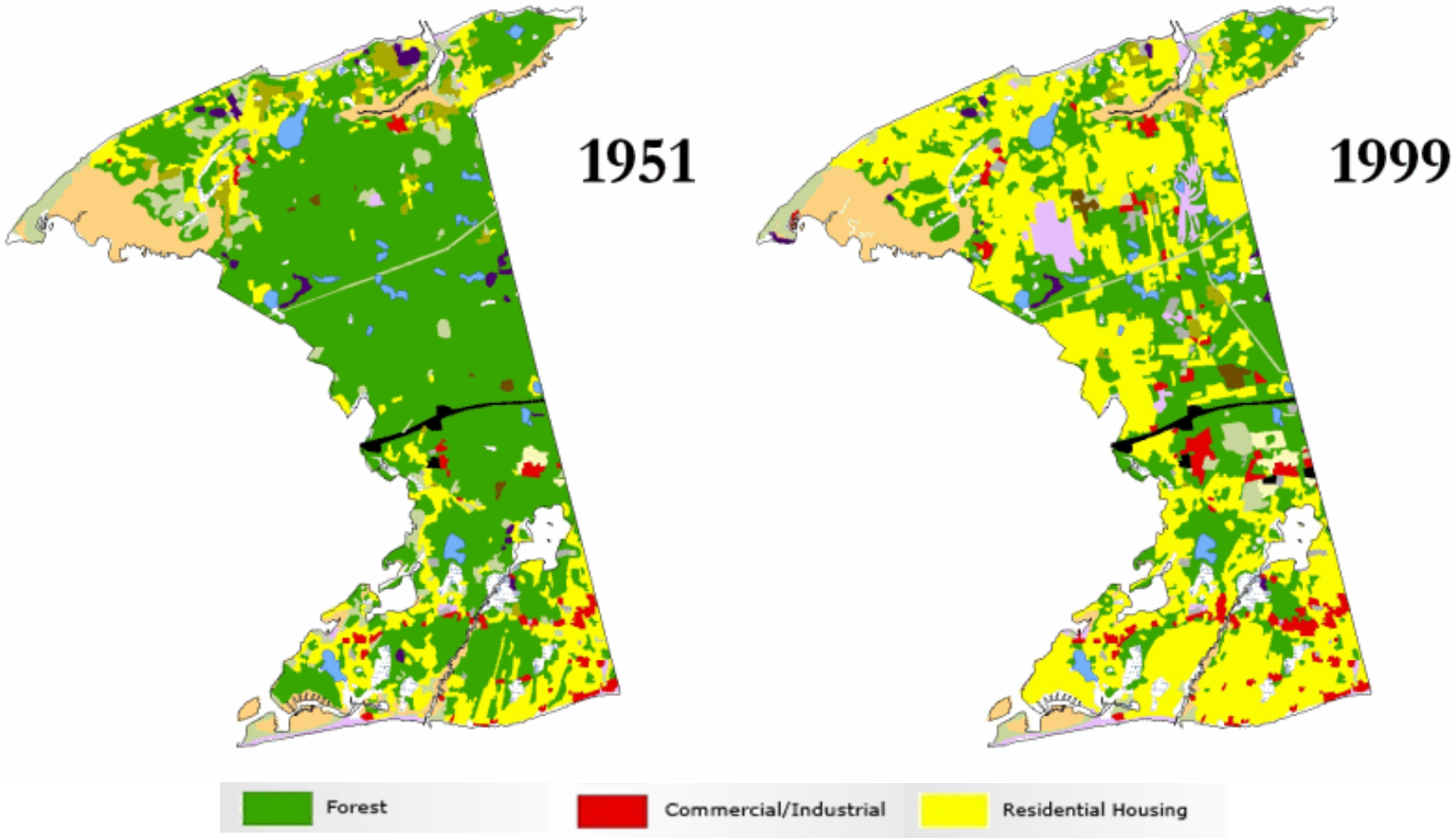


Dennis
preserving our water resources

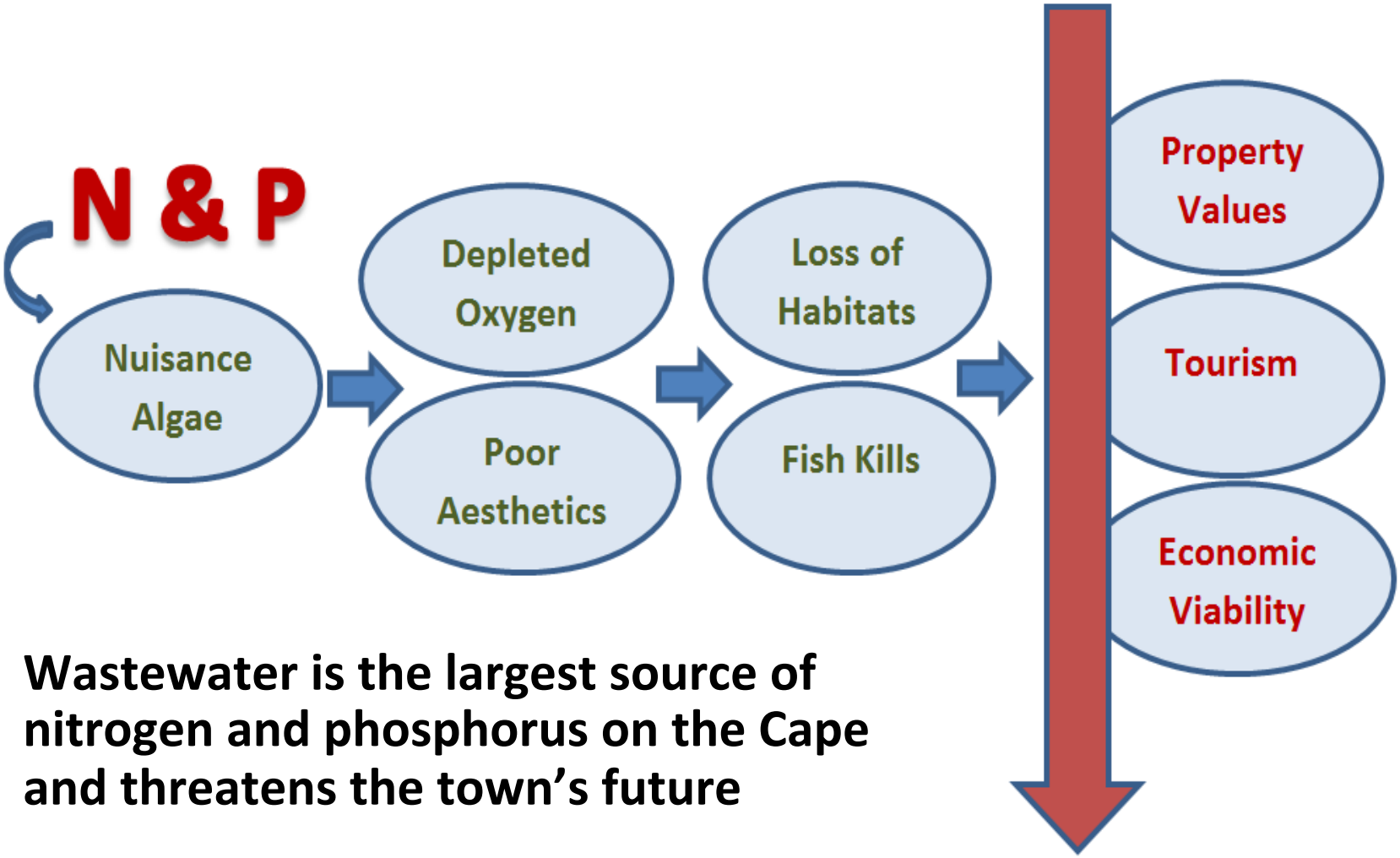
- Cape Cod represents 4% of the state's population, but 20% of the state's septic systems.

Population Growth in Dennis:

2,500 15,900



The Issue…

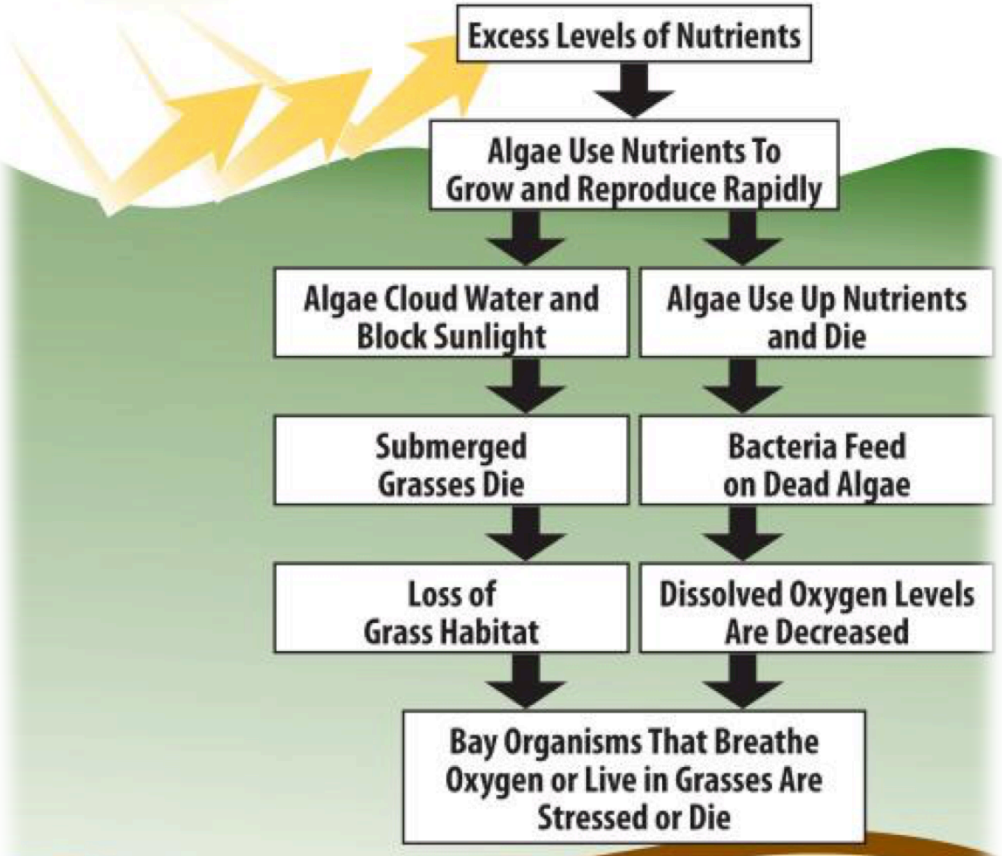


Wastewater is the largest source of nitrogen and phosphorus on the Cape and threatens the town's future

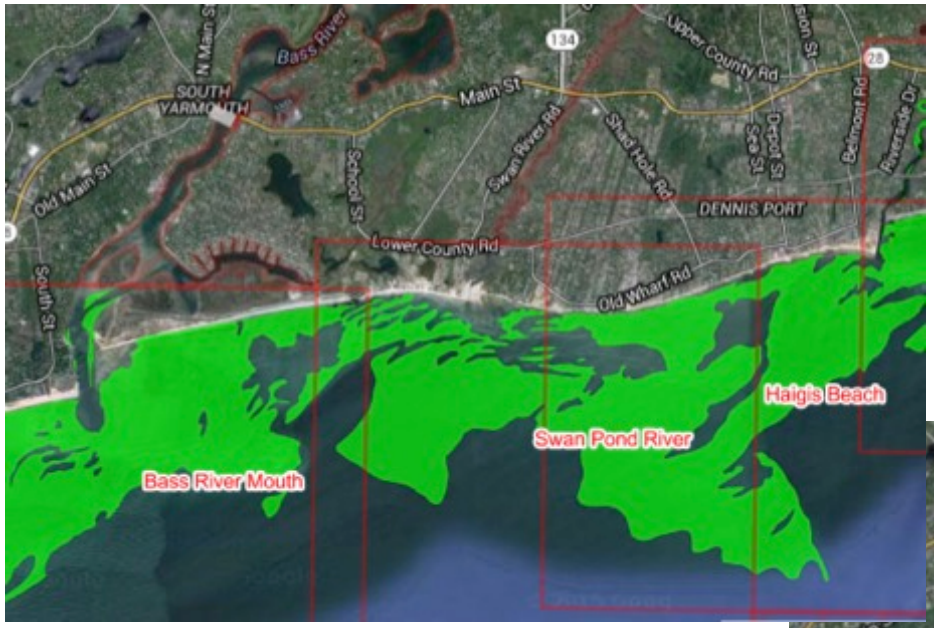
Beaches, Rivers, Harbors, and Ponds Are Severely Impacted By Nutrients

Unhealthy Nitrogen and Phosphorus Levels

Algae Bloom in Swan Pond

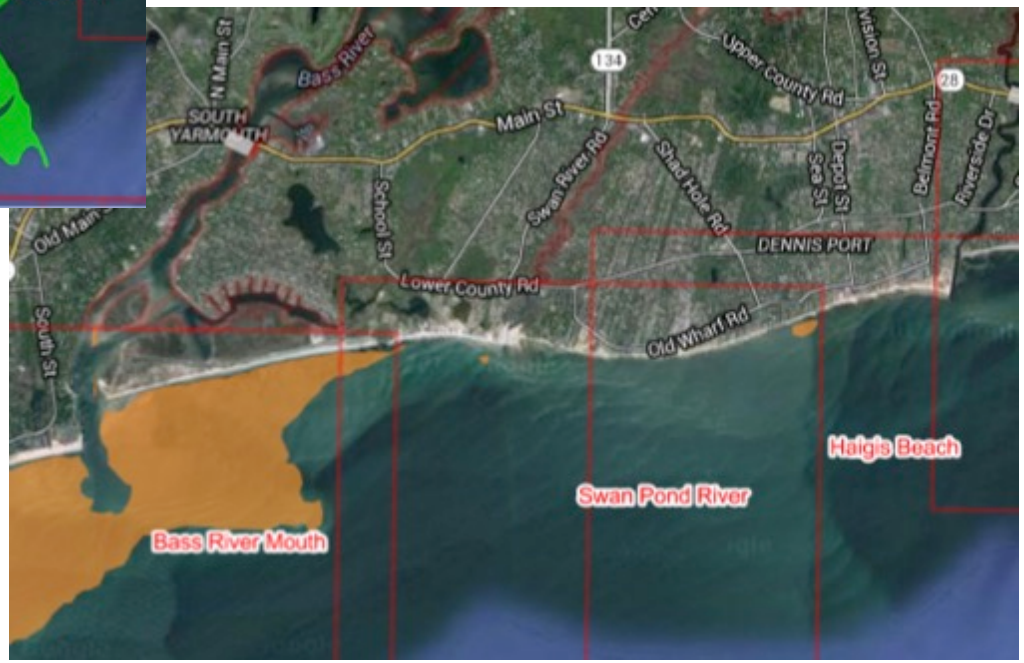


Eelgrass Loss in Dennis



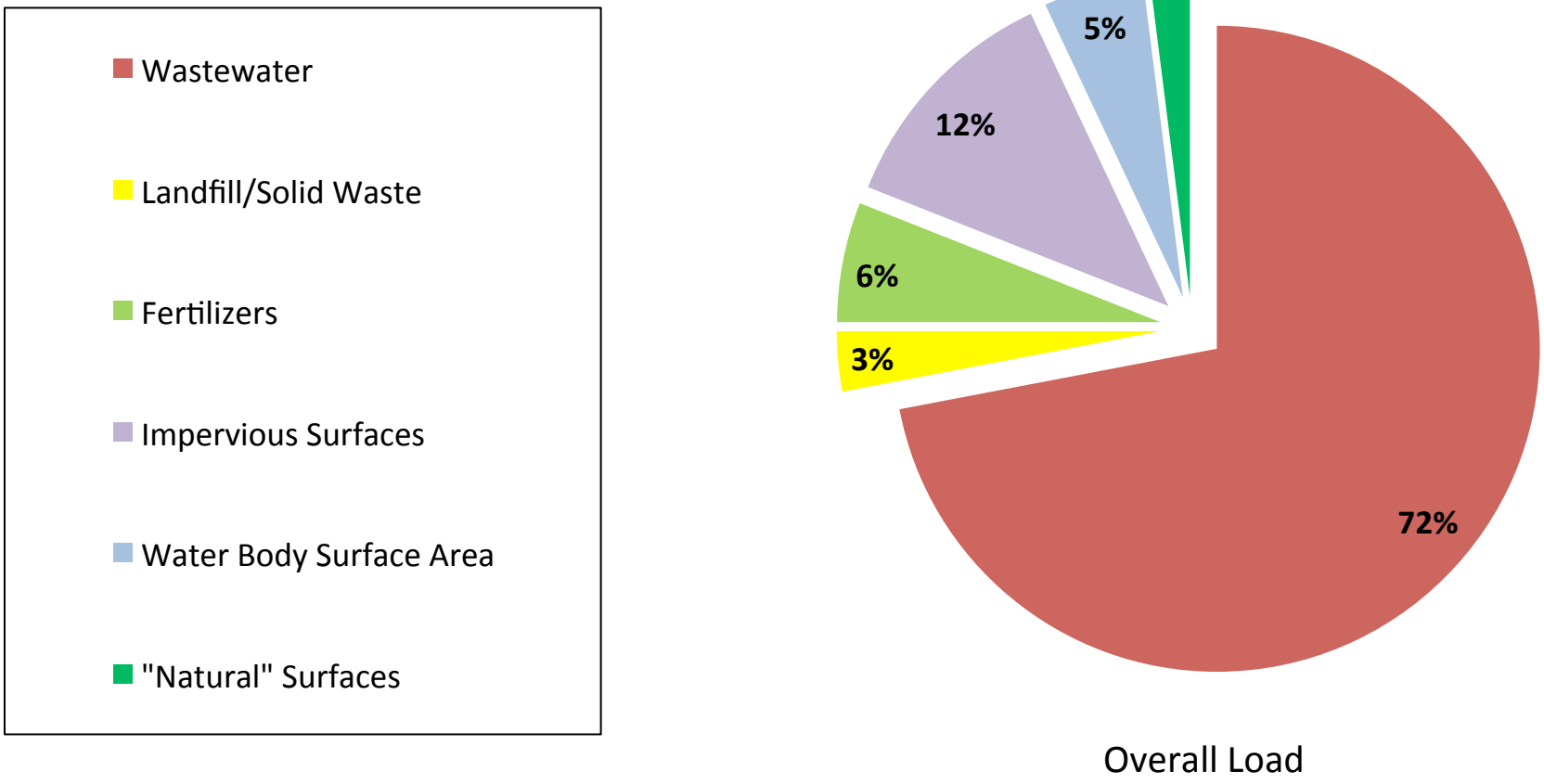
1995

2010-13



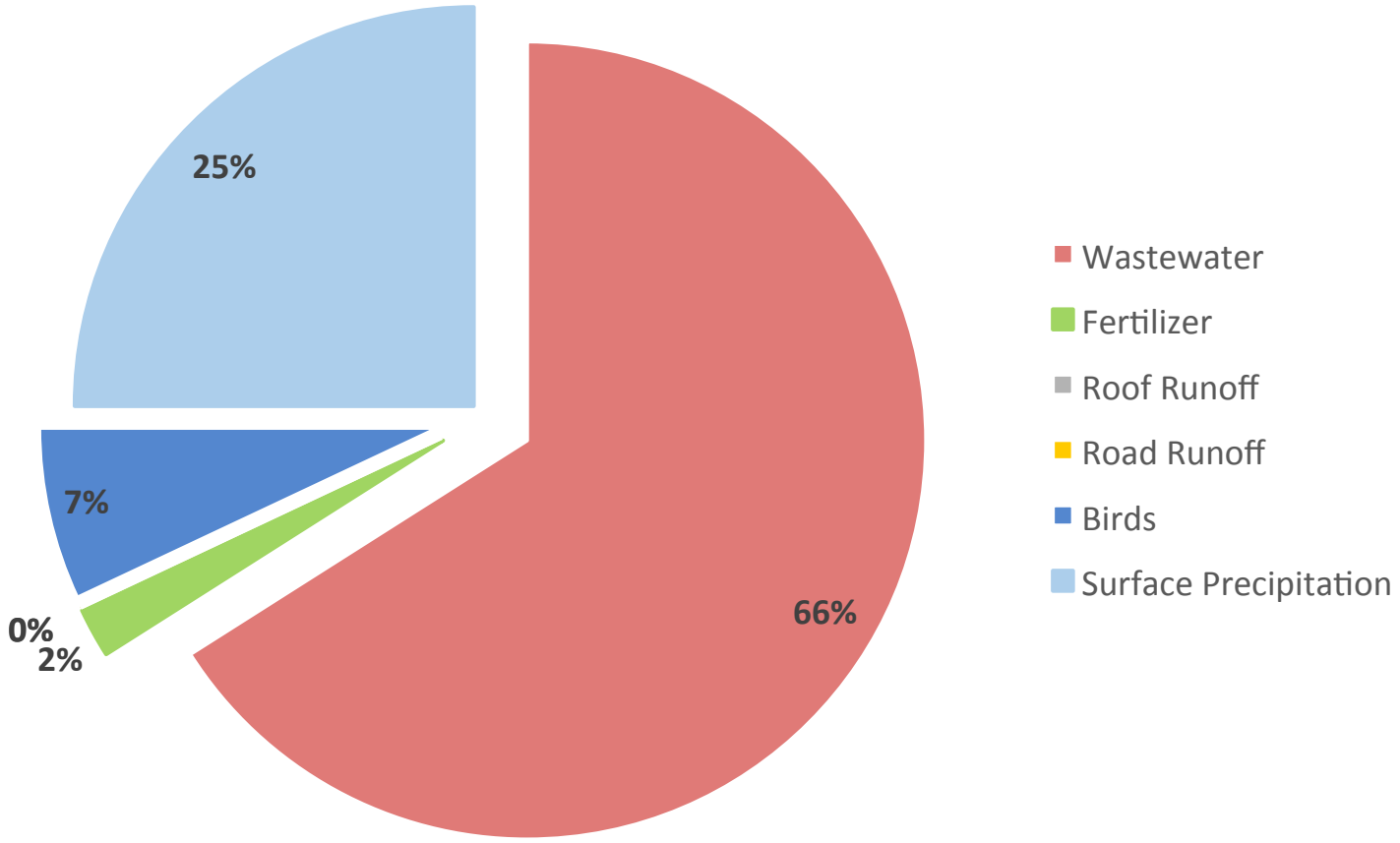
MassDEP Eelgrass Mapping Project Viewer

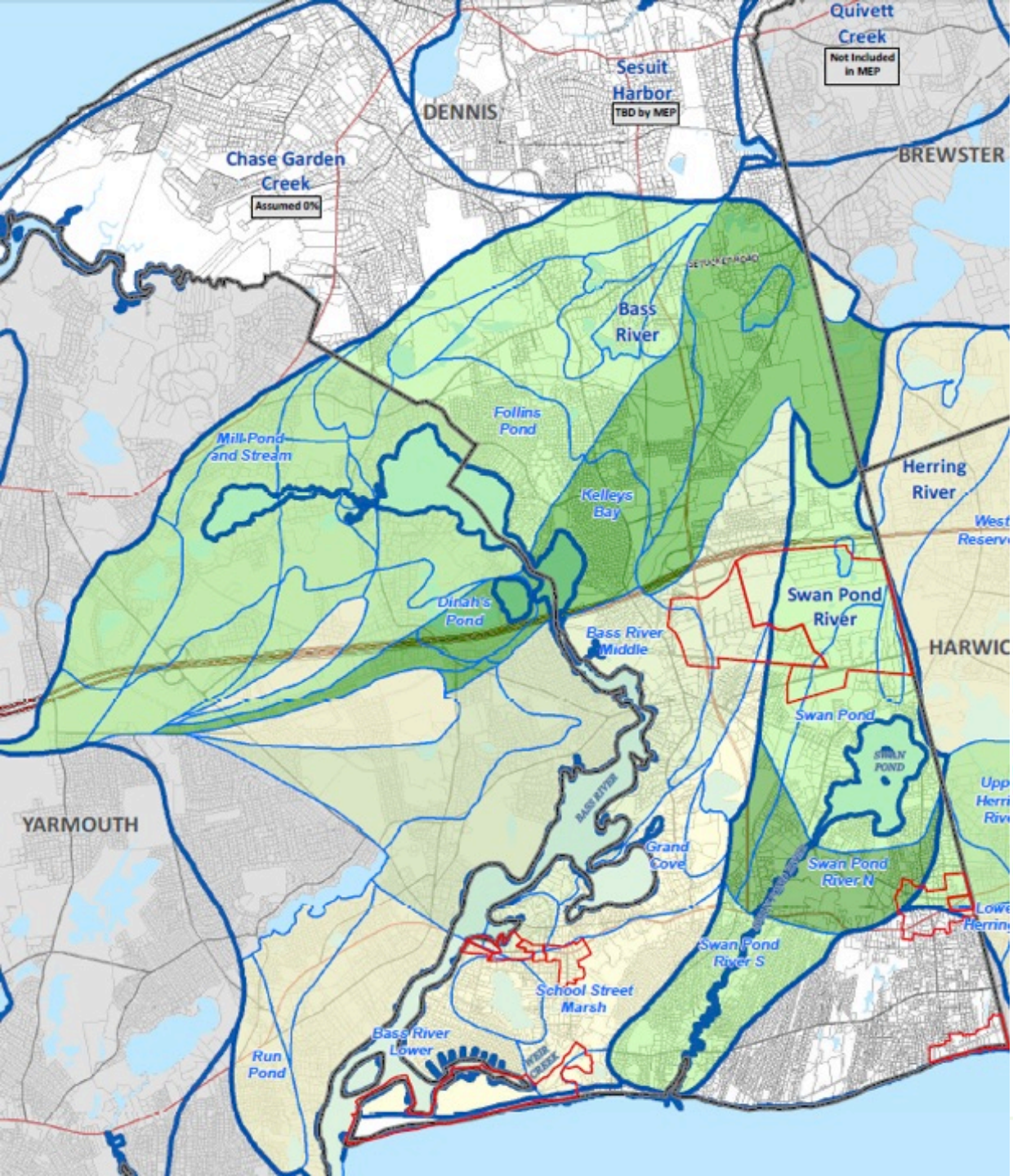
Controllable Nitrogen Sources – Swan Pond River Watershed



Scargo Lake Phosphorus Loading

High = 8.3 kg/year





<u>MEP Summary</u>:
Required Nitrogen Removal by Sub-watershed

Includes:

- **Bass River**
- **Swan Pond River**
- **Herring River**

Legend

- MEP Watershed Delineations
- MEP Subwatersheds
- Planning Districts

Proposed Controllable Nitrogen Removal from MEP to Meet TMDL

- 80-90%
- 70-80%
- 50-60%
- 0%

Goals for Nitrogen Management

Dennis Portion of MEP Watersheds	***Septic Nitrogen ("N") Removal Rates from Wastewater to Meet TMDL Under Existing Conditions***
Swan Pond River	**-75.5%**
Bass River	**-47.4%**
Herring River	**-100%**

How do we achieve this?

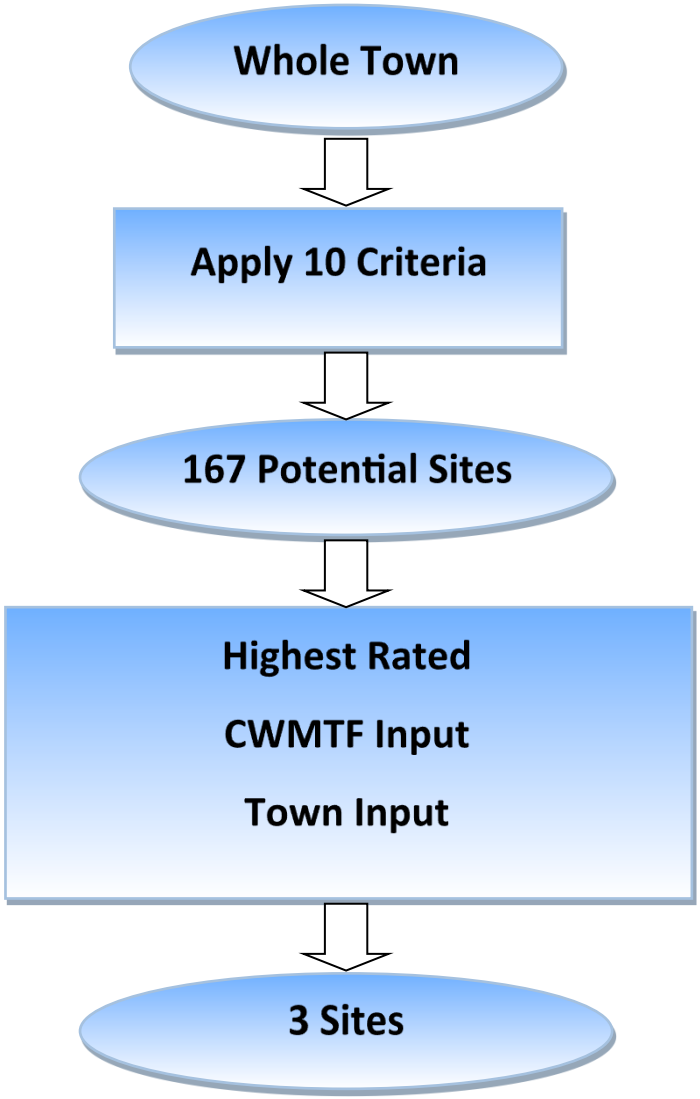
CCC 208 Plan- Technology Matrix

Hybrid Approach

- Fertilizer Education Program (25% N-Reduction credit)
- Stormwater BMPs (25% N-Reduction credit)
- Inlet Widening (Route 6 Bridge & Cape Cod Rail Trail)

Technology	*Nitrogen Removal*
Discharge Outside Watershed	6.2 kg/yr/parcel
Enhanced I/A Onsite Septic Systems	3.1 kg/yr/parcel
Sewer with Decentralized Treatment	5.0 kg/yr/parcel
Sewer with Centralized Treatment	5.5 kg/yr/parcel
Sewer with Treatment and PRB	6.0 kg/yr/parcel
Aquaculture (polishing step)	0.88 kg/day/acre of aquaculture

Treatment and Effluent Recharge Site Screening



Treatment Site Screening Criteria

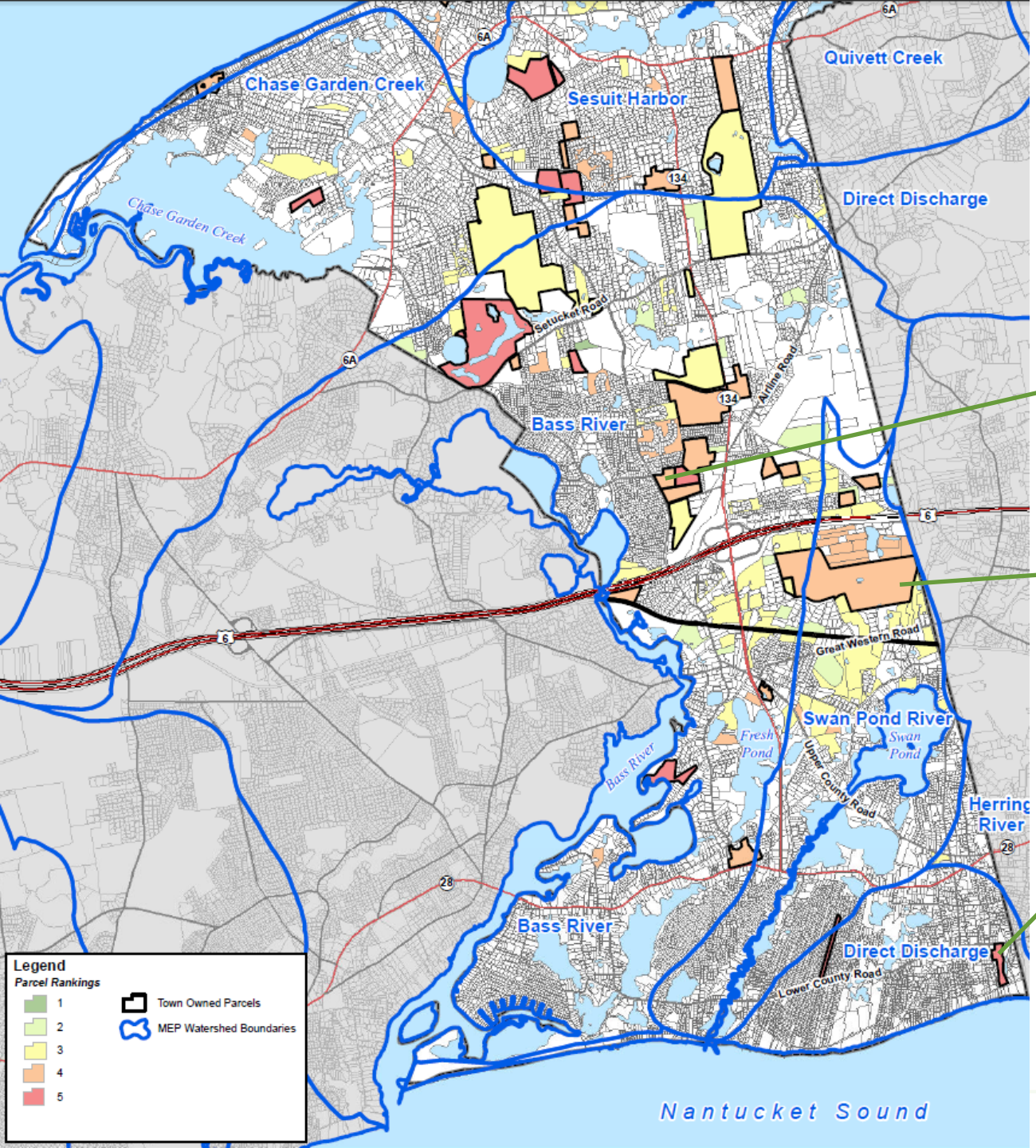
Exclusion Criteria

1. Parcel Size Greater than Three Acres
2. Outside Zone of Contribution
3. Outside Special Flood Hazard Areas
4. Outside of Wetlands
5. Favorable Depth to Groundwater

Secondary Criteria

1. Permeable Soils
2. Favorable Development Status
3. Outside Priority Habitat Areas
4. Outside Municipal Wellhead Protection Zone II
5. Town-owned Property

Map of Final Sites



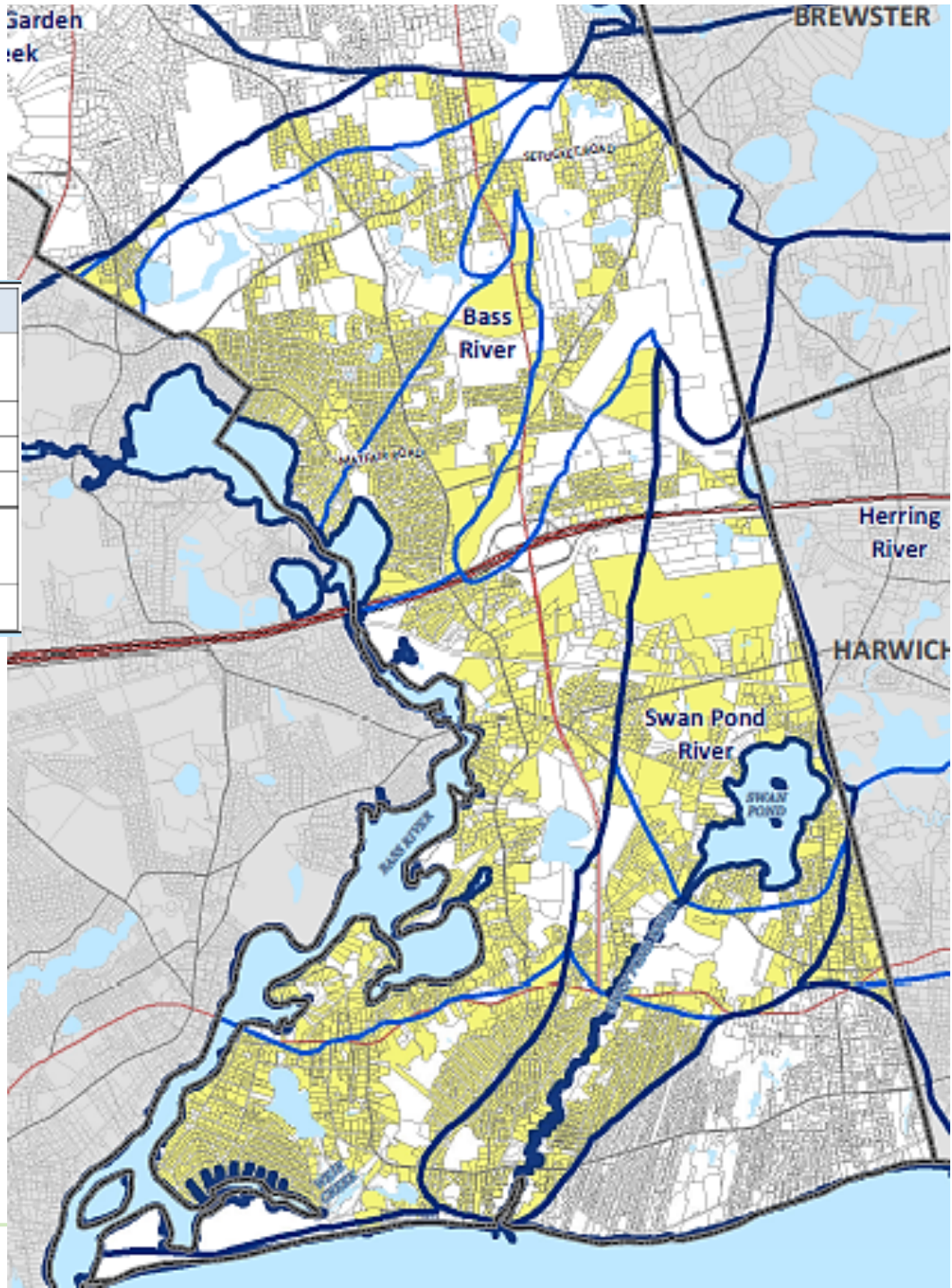
SITE 2

SITE 1

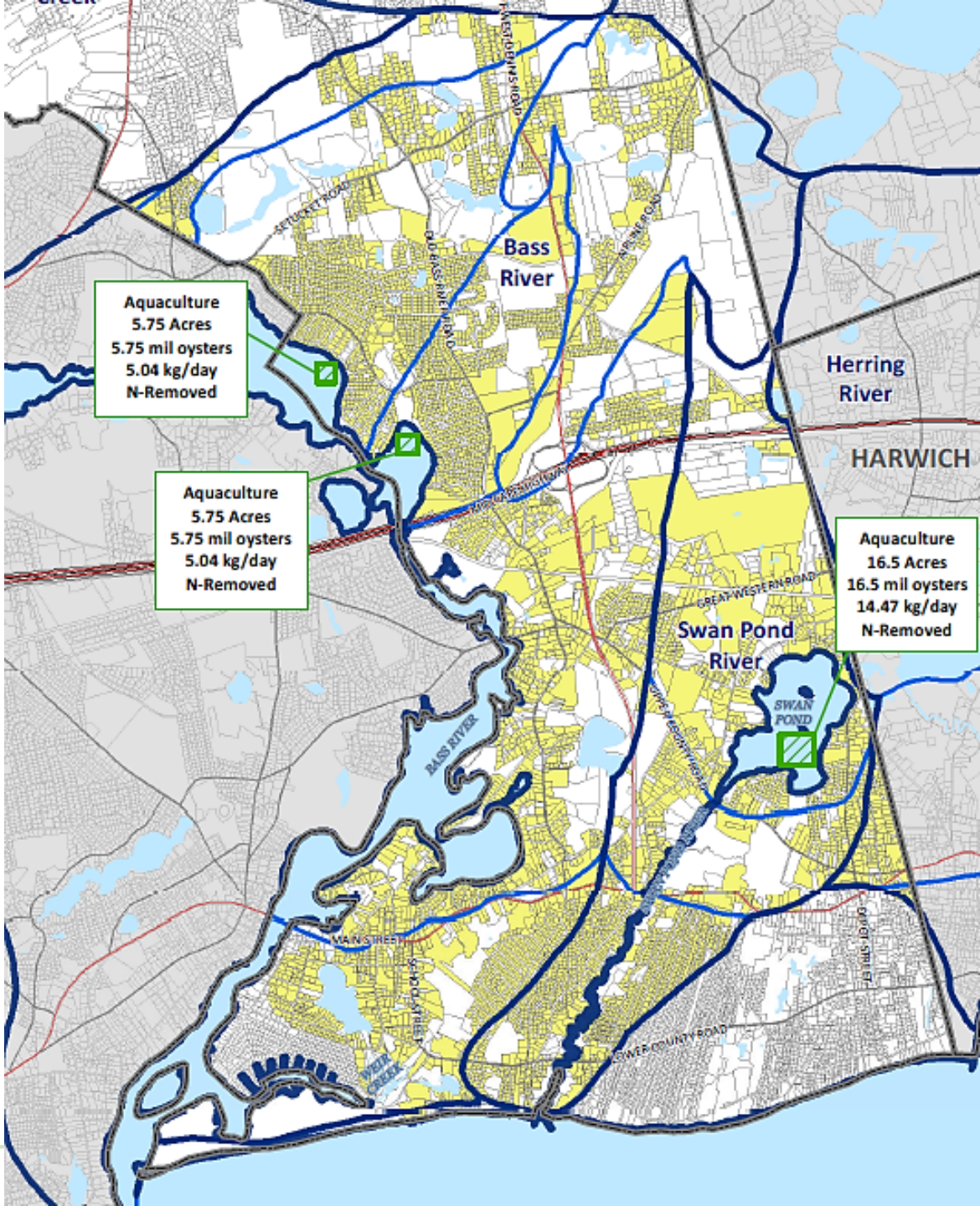
SITE 3

Scenario 1

	Bass River	Swan Pond River
N Removal Required -Dennis (kg/day)	*46.50*	*33.00*
Fertilizer	*-2.04*	*-0.73*
Stormwater	*-2.14*	*-1.36*
I/A Systems	*-37.68*	*-16.49*
Remaining N Removal Required	***4.64***	***14.42***
Threshold Not Met		



Scenario 2

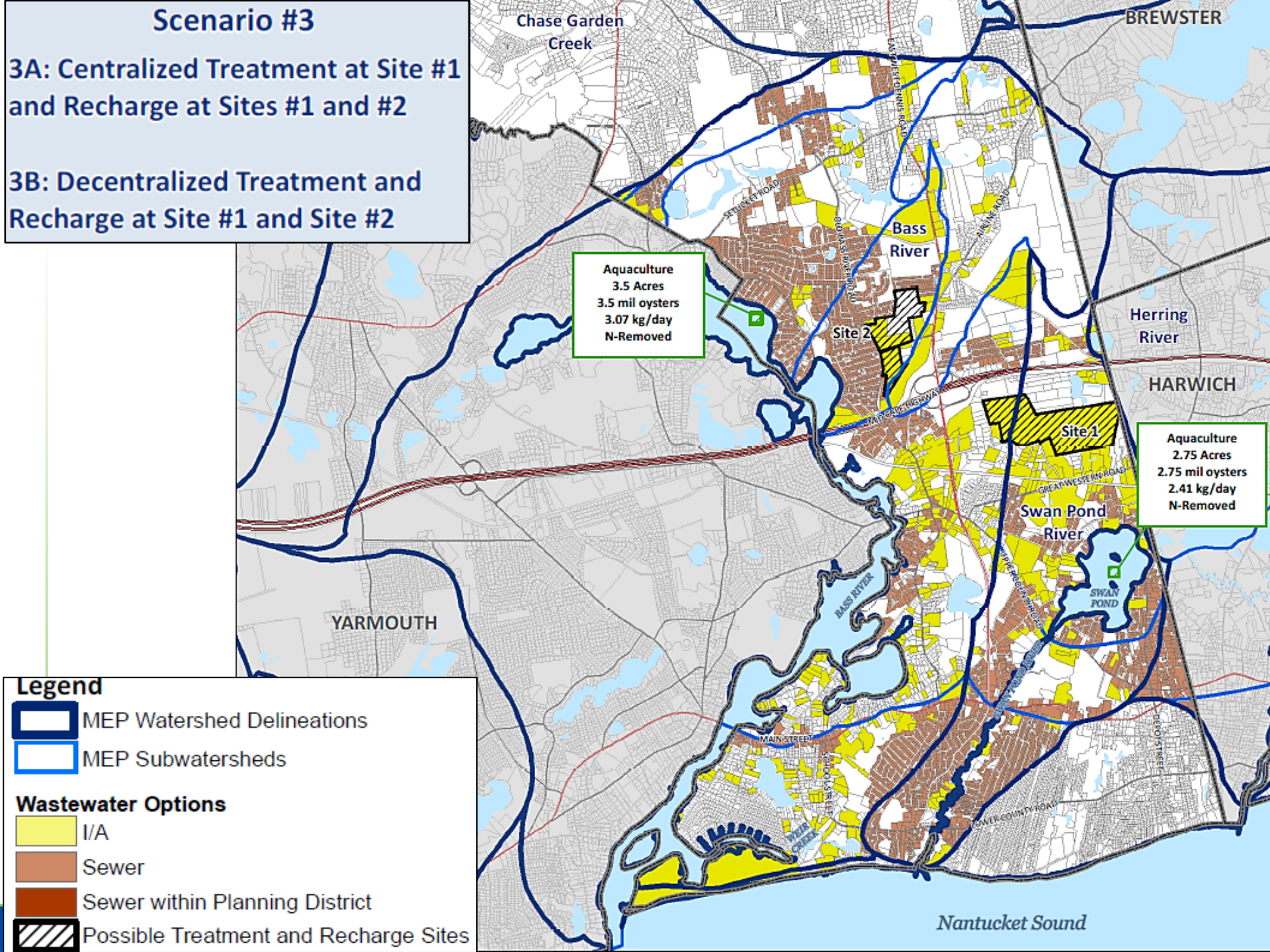


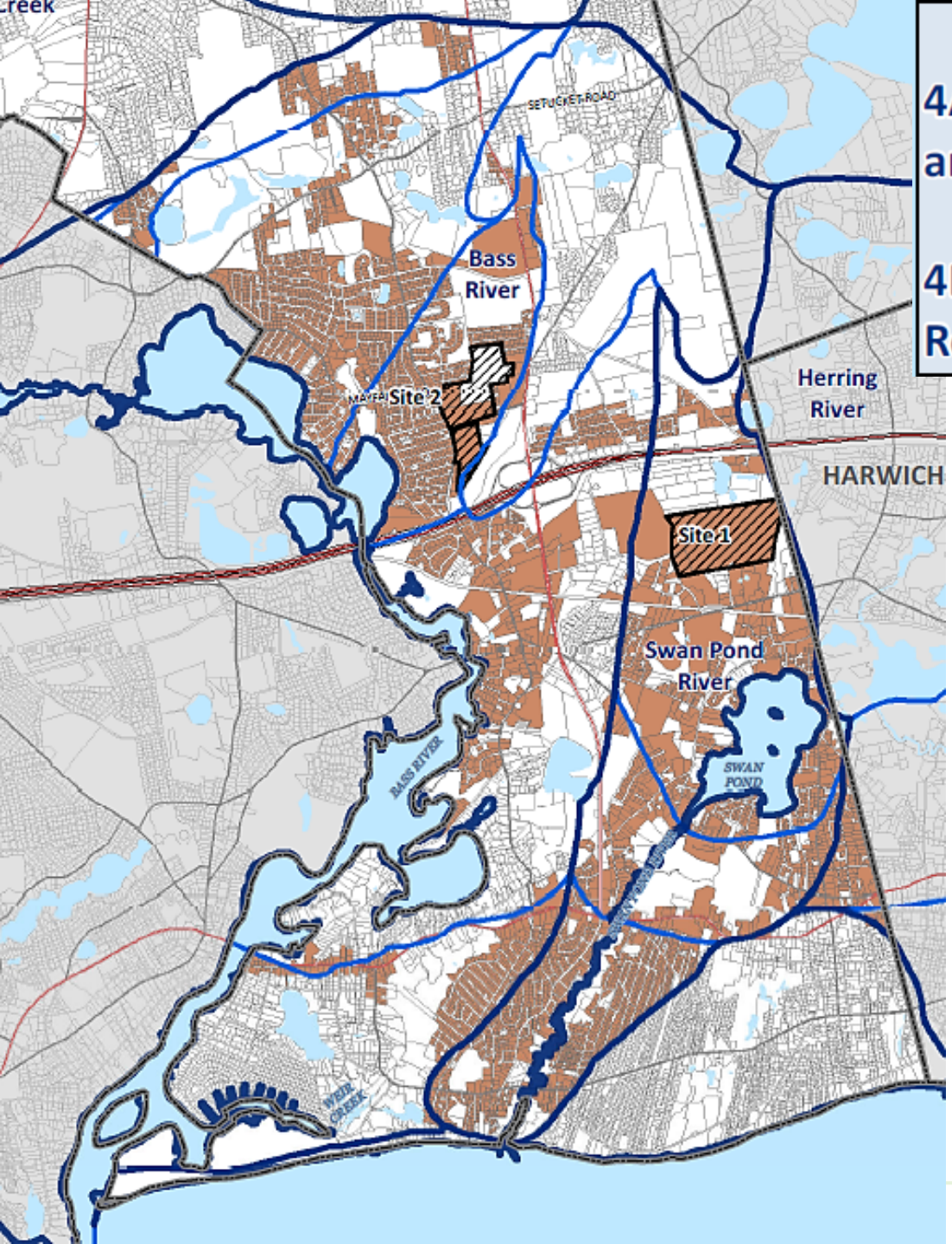
Legend

- MEP Watershed Delineations
- MEP Subwatersheds

Wastewater Options

- I/A
- Sewer
- Sewer within Planning District
- Possible Treatment and Recharge Sites


Scenario #3
3A: Centralized Treatment at Site #1 and Recharge at Sites #1 and #2
3B: Decentralized Treatment and Recharge at Site #1 and Site #2
Chase Garden Creek
BREWSTER
Bass River
Herring River
HARWICH
YARMOUTH
Aquaculture
3.5 Acres
3.5 mil oysters
3.07 kg/day
N-Removed
Site 2
Site 1
Aquaculture
2.75 Acres
2.75 mil oysters
2.41 kg/day
N-Removed
Swan Pond River
SWAN POND
BASS RIVER
MAIN STREET
SCHOOL STREET
WEIR CREEK
OLD COUNTY ROAD
Nantucket Sound
Legend
MEP Watershed Delineations
MEP Subwatersheds
Wastewater Options
I/A
Sewer
Sewer within Planning District
Possible Treatment and Recharge Sites



Scenario #4

4A: Centralized Treatment at Site #1 and Recharge at Sites #1 and #2

4B: Decentralized Treatment and Recharge at Site #1 and Site #2

Legend

- MEP Watershed Delineations
- MEP Subwatersheds

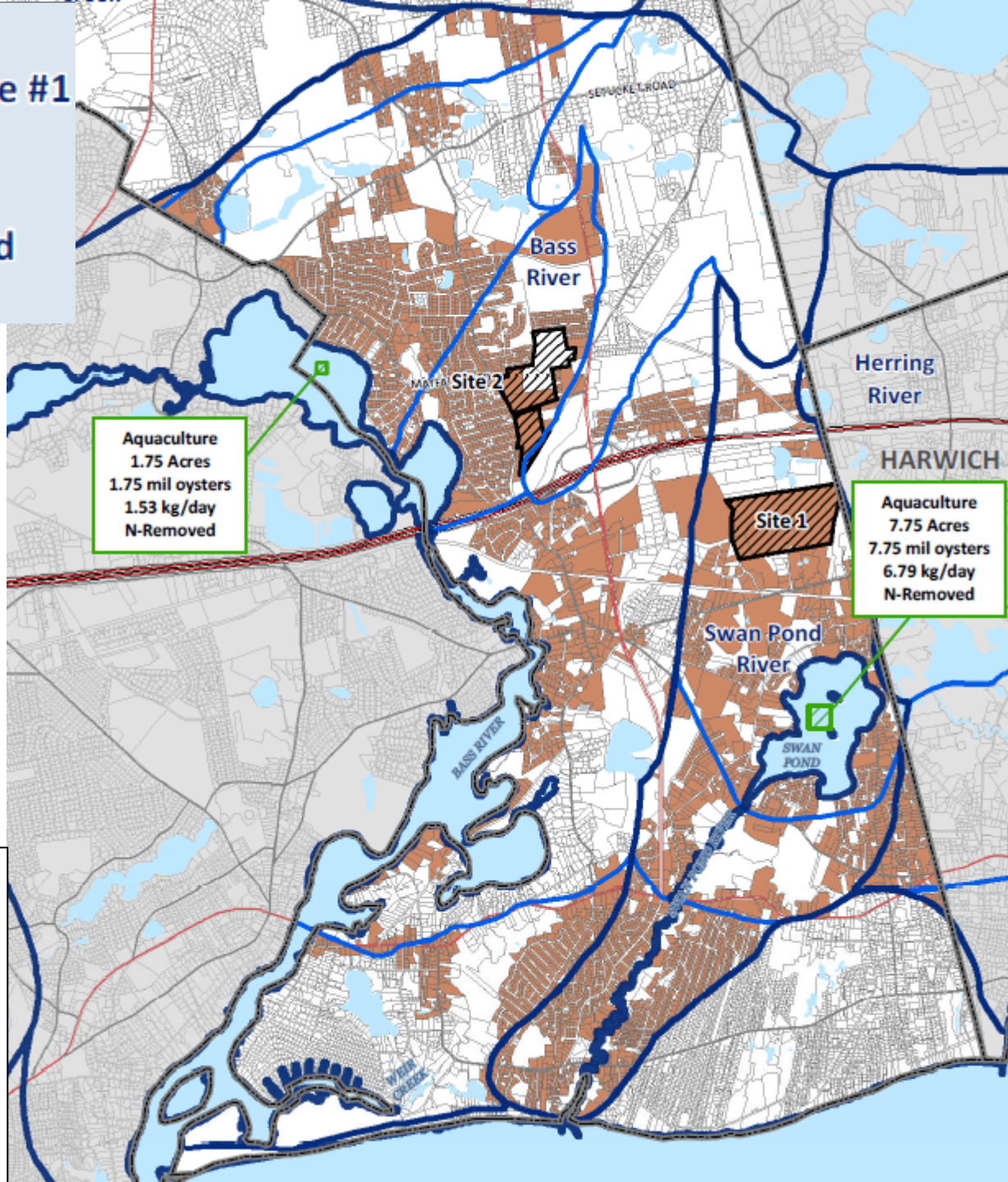
Wastewater Options

- I/A
- Sewer
- Sewer within Planning District
- Possible Treatment and Recharge Sites

Scenario #5

5A: Centralized Treatment at Site #1 and Recharge at Sites #1 and #2

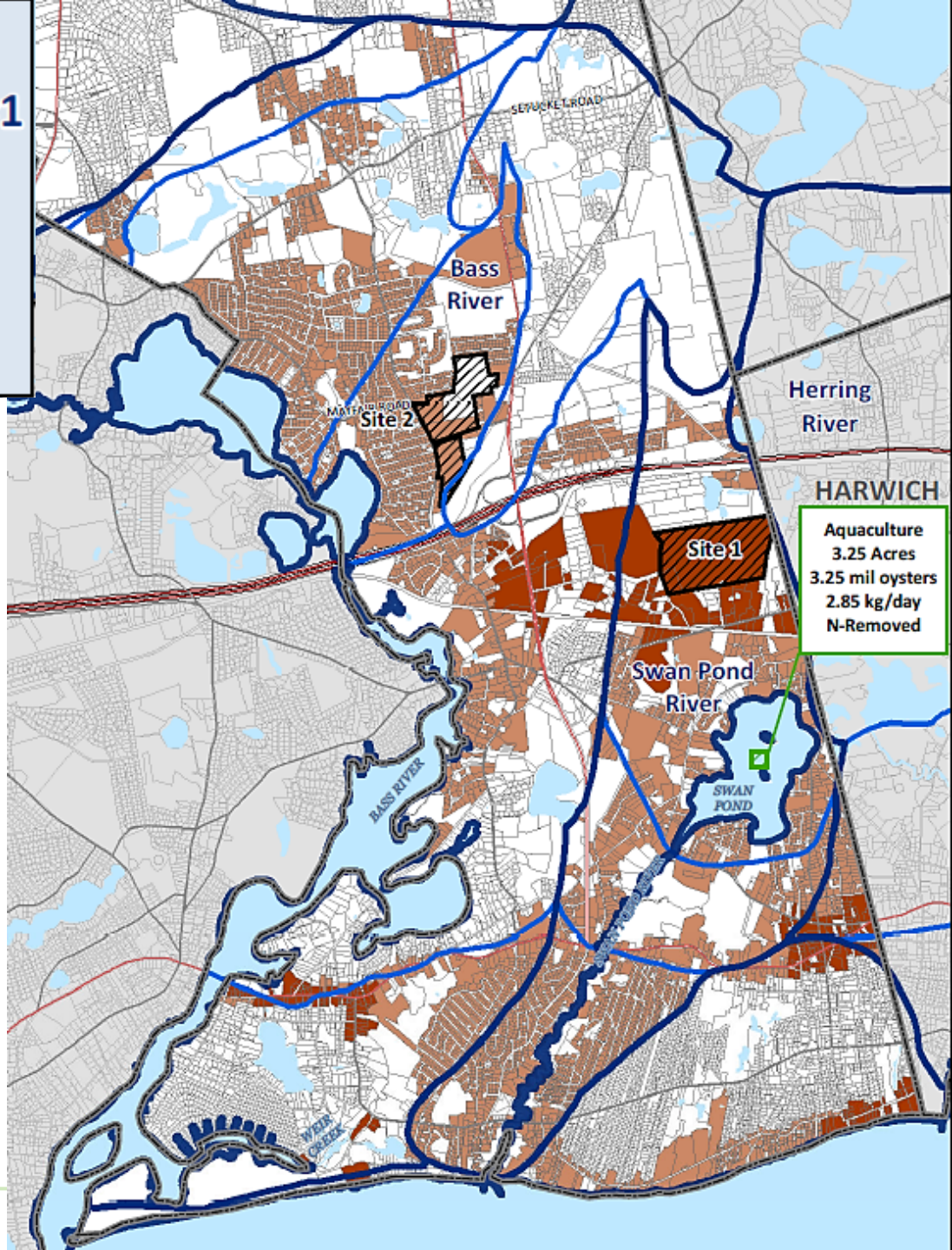
5B: Decentralized Treatment and Recharge at Site #1 and Site #2



Scenario #6

6A: Centralized Treatment at Site #1 and Recharge at Sites #1 and #2

6B: Decentralized Treatment and Recharge at Site #1 and Site #2

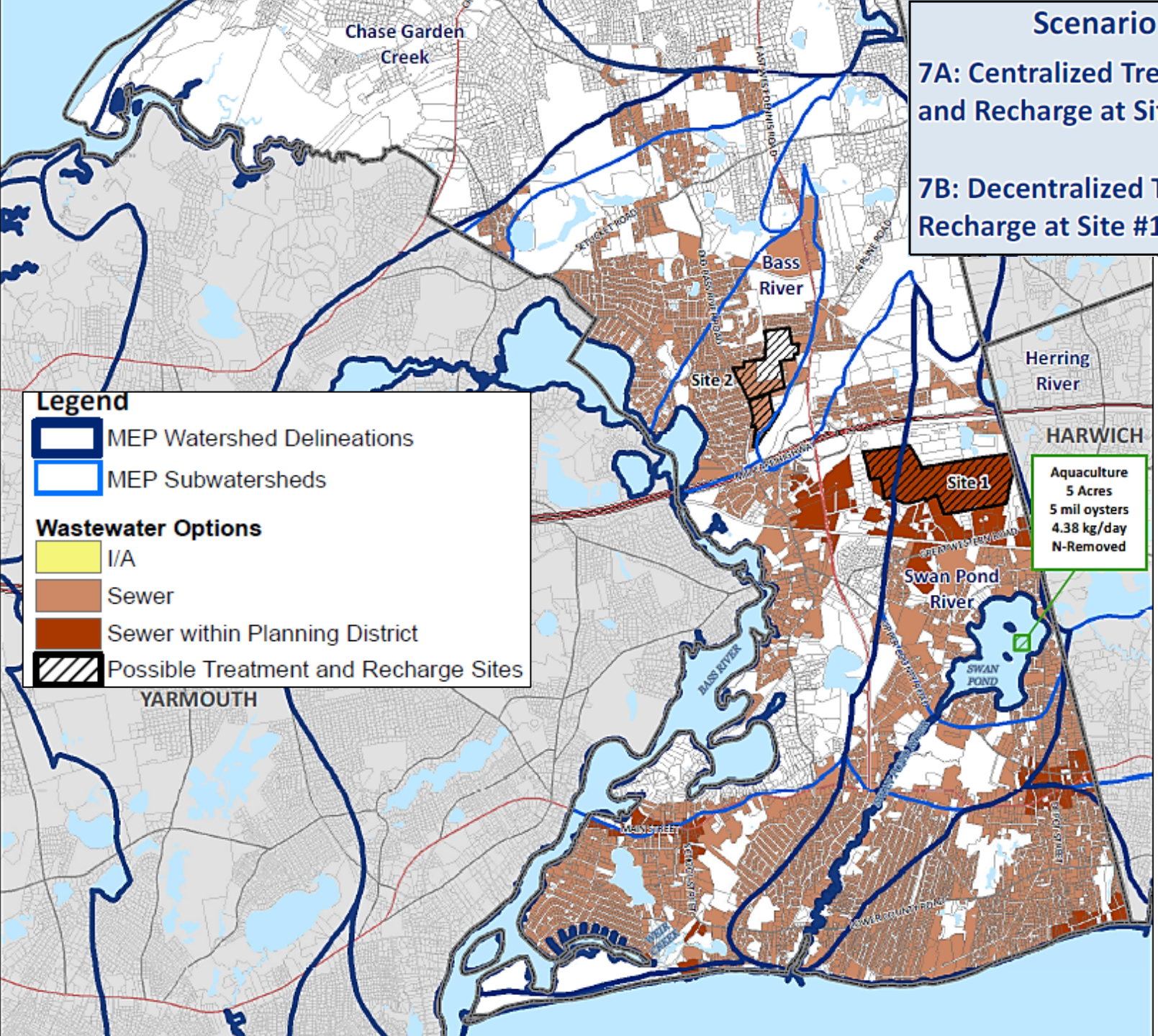


Legend

- MEP Watershed Delineations
- MEP Subwatersheds

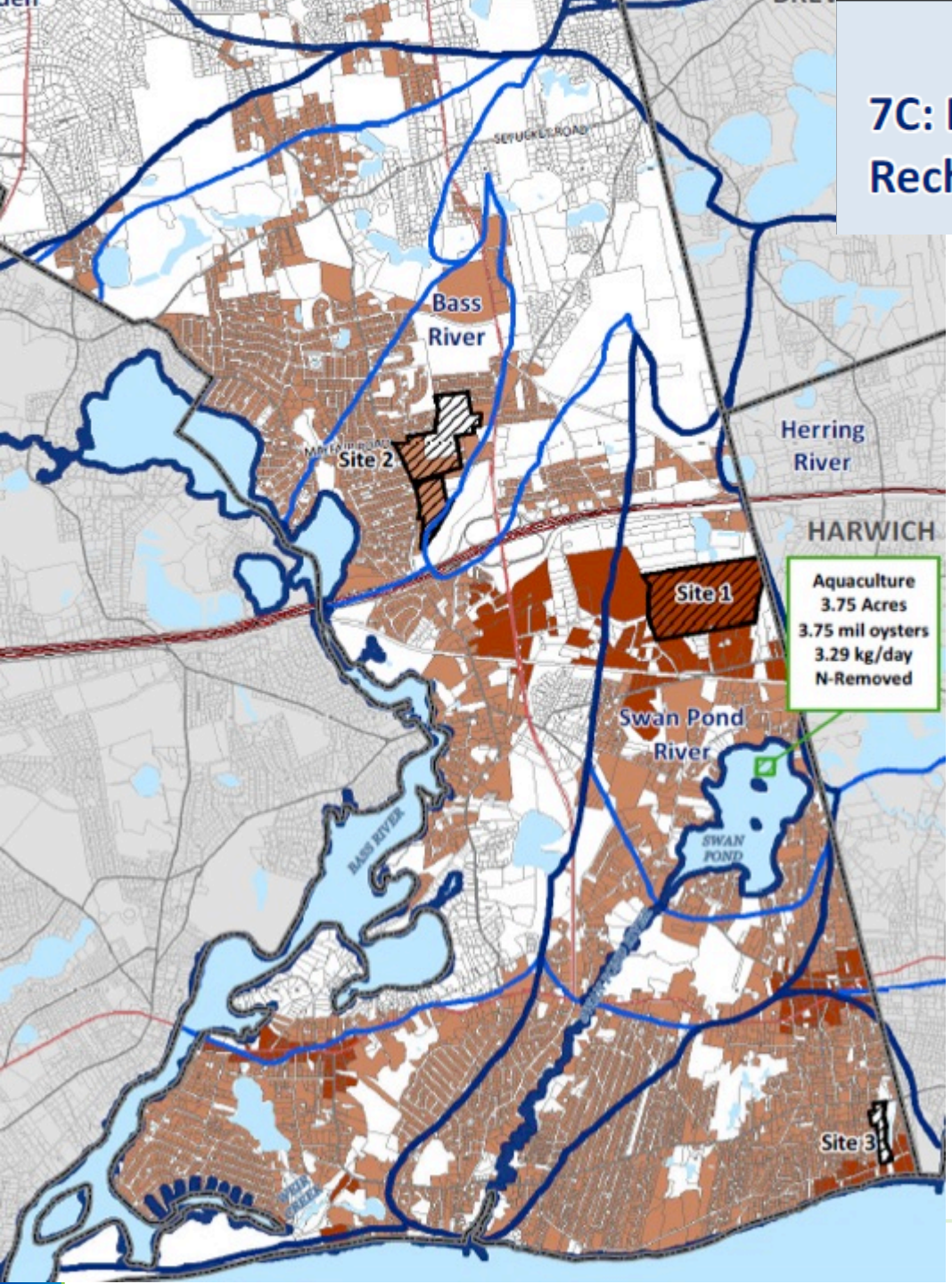
Wastewater Options

- I/A
- Sewer
- Sewer within Planning District
- Possible Treatment and Recharge Sites

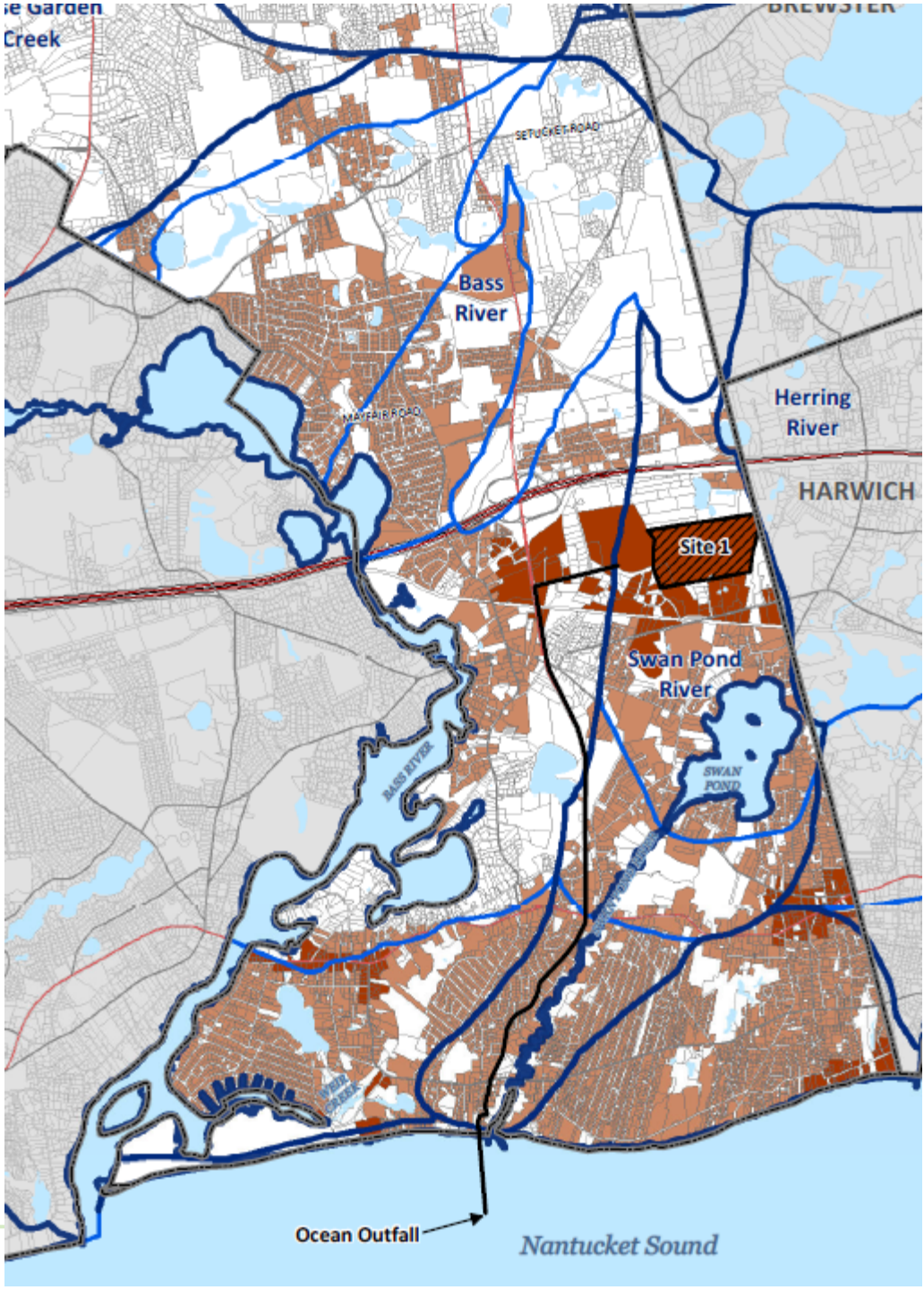

Scenario #7A/7B
7A: Centralized Treatment at Site #1 and Recharge at Sites #1 and #2
7B: Decentralized Treatment and Recharge at Site #1 and Site #2
Chase Garden Creek
Bass River
Site 2
Herring River
HARWICH
Site 1
Aquaculture
5 Acres
5 mil oysters
4.38 kg/day
N-Removed
Swan Pond River
SWAN POND
BASS RIVER
YARMOUTH
Legend
MEP Watershed Delineations
MEP Subwatersheds
Wastewater Options
I/A
Sewer
Sewer within Planning District
Possible Treatment and Recharge Sites

Scenario #7C

7C: Decentralized Treatment and Recharge at Site #1, Site #2, and Site #3



Scenario #7D



Legend

- MEP Watershed Delineations
- MEP Subwatersheds

Wastewater Options

- I/A
- Sewer
- Sewer within Planning District
- Possible Treatment and Recharge Sites

Comparative Planning Level Cost Summary

Scenario	Total Capital Cost	EAC (20 yr, 2%)
1- All I/A (Does not meet MEP goals)	$202 M	$39 M
2- I/A with Aquaculture	$191 M	$37 M
3A- I/A + Minimal Centralized Sewer + PRB + Aq.	$184 M	$17 M
3B- I/A + Minimal Decentralized Sewer + PRB + Aq.	$191 M	$19 M
4A- Centralized Sewer + PRB	$189 M	$17 M
4B- Decentralized Sewer + PRB	$197 M	$18 M
5A- Centralized Sewer + Aq.	$186 M	$17 M
5B- Decentralized Sewer + Aq.	$189 M	$18 M
6A- Centralized Sewer (Planning Dist.) + PRB + Aq.	$207 M	$18 M
6B- Decentralized Sewer (Planning Dist.) + PRB + Aq.	$217 M	$20 M
7A- Centralized Sewer (Planning + AOCs) + PRB + Aq.	$293 M	$26 M
7B- Decentralized Sewer (Planning + AOCs) + PRB + Aq.	$302 M	$27 M
7C- Decentralized Sewer (3rd Treatment Site) + PRB + Aq	$307 M	$28 M
7D- Centralized Sewer + Ocean Outfall	$366 M	$30 M

Scenario Screening Matrix Criteria

Evaluation Criteria	Criteria Weight
RELATIVE COSTS	50%
Capital Costs	5%
O&M Costs	5%
Equivalent Annual Cost (EAC)	25%
Cost per lb of N Removed	15%
TECHNICAL CRITERIA	18%
Complexity of Transport	3%
Reliability	3%
Effluent Recharge Issues	3%
Future Recharge Capacity	3%
Phosphorus Removal	3%
Ability to Handle CECs	3%
INSTITUTIONAL CRITERIA	16%
Phasing	4%
Addresses Other Community Needs	4%
Regulatory Considerations	4%
Municipal vs. Property Owner	4%
ENVIRONMENTAL CRITERIA	16%
Effluent Recharge Impacts	4%
Water Balance Considerations	4%
Sensitive Receptors	4%
Construction Impacts	4%
TOTAL WITH WEIGHTING	100%

Scenario Screening Results

Evaluation of Alternatives															
Evaluation Criteria	Criteria Weight	1	2	3A	3B	4A	4B	5A	5B	6A	6B	7A	7B	7C	7D
TOTAL WITH WEIGHTING	500	204	206	367	355	394	395	419	402	394	370	307	316	296	262

- Scenarios 5A and 5B were selected because they rated the highest
- Scenario 3B was selected to evaluate an option with minimal sewers, decentralized treatment systems, and I/A systems on large lots
- Scenario 6B was selected to include an option with a decentralized approach and aquaculture that provides infrastructure to economic growth areas

New Scenario 8: Community Partnership

Percent Savings from Baseline EAC			
Scenario	**Yarmouth**	**Dennis**	**Harwich**
Yarmouth Only- 1 WWTP	$27.5 M		
Dennis Only- 1 WWTP		$15.0 M	
Dennis Only- 2 WWTPs		9%	
Harwich (with Chatham)			$14.5 M
Dennis, Yarmouth- 2 WWTPs	10%	-15%	
Dennis, Yarmouth- 1 WWTP- Recharge in Yarmouth	-11%	-23%	
Dennis, Yarmouth- 1 WWTP- Recharge in Y & D	-10%	-18%	
Dennis, Harwich (with Chatham)- 1 WWTP		-10%	-3%
Yarmouth + Yarmouth/Dennis/Harwich - 2 WWTPs	9%	-19%	-1%

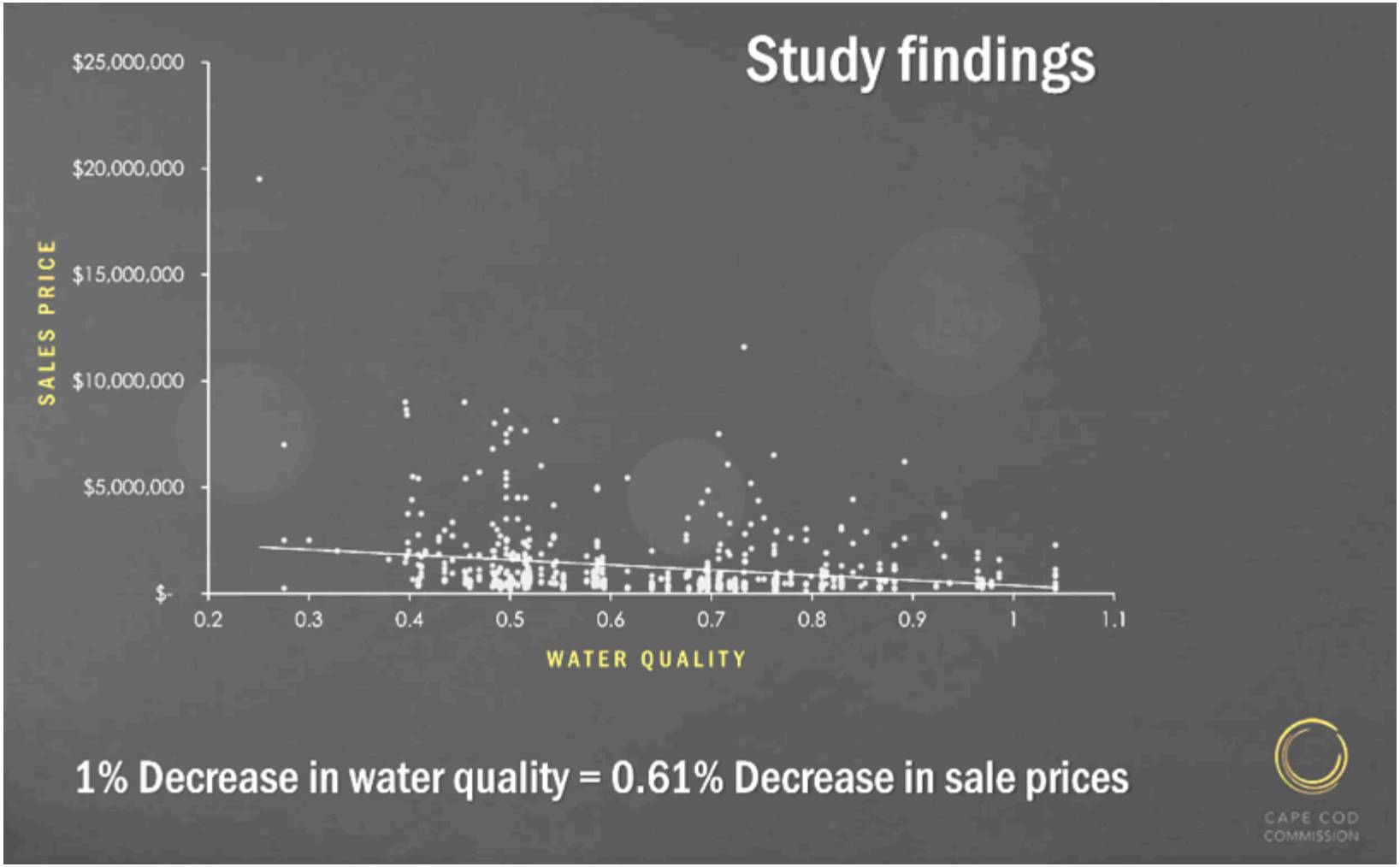
Cost Recovery Options

- Property Taxes
- Betterments
- Sewer User Fees
- Municipal Water Infrastructure Investment Fund (similar to Community Preservation Act- up to 3% allowed)
- Real Estate Transfer Tax (1%)
- Meals and Room Taxes
- Local Infrastructure Development Program (Public/Private Partnerships)
- Consumption (fee based on water consumption)
- Other

- Beach Parking, Beach Stickers, Waterway Slip Charges

DOING NOTHING IS NOT AN OPTION

2015 Three Bays Economic Study



Why the Hybrid Approach is Best

- Striking a balance: sewering where necessary to cost effectively meet MEP goals, supplemented with non-traditional technologies in logical locations to make up the difference in required nitrogen reduction.
- Considers Town's preferences
- Adaptive management approach
- Finds cost effective ways of removing nitrogen
- Optimize TMDL compliance by watershed

Questions?