Cleaning Up Our Waters

How Can Martha's Vineyard Towns Incorporate Non-Traditional Approaches into Their Nitrogen Management Plans?

Martha's Vineyard Innovative-Alternative Conference:

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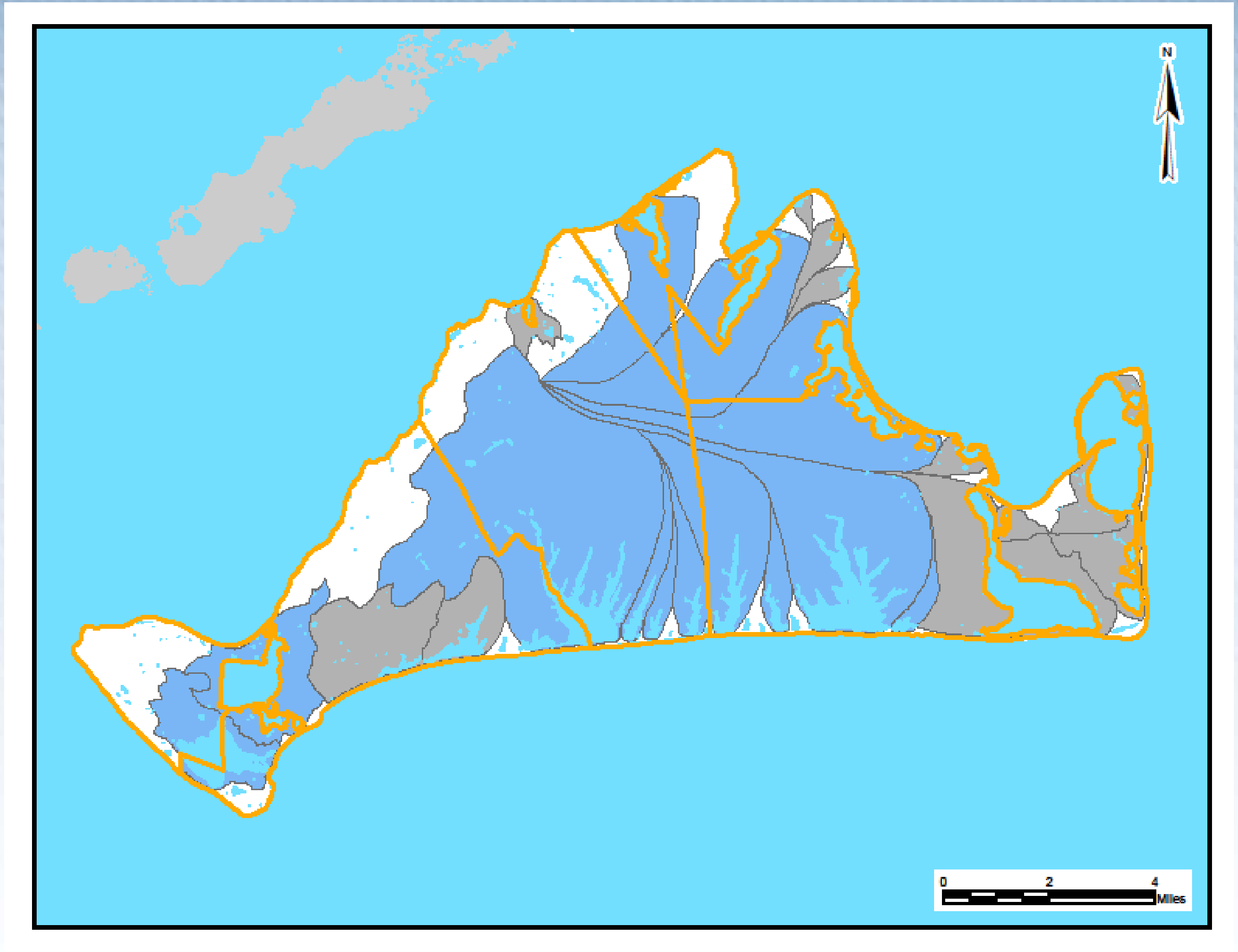
WRIGHT-PIERCE
Engineering a Better Environment

Island Watersheds

Martha's Vineyard Shared Watersheds



The Setting—Martha's Vineyard

- 6 towns make up Dukes County
- 14,000 developed parcels (88% on septic)
- 3 "centralized" wastewater treatment facilities
  - 0.1 mgd to 0.75 mgd
- 2 satellite treatment plants
  - 20,000 gpd to 40,000 gpd
- Many enhanced on-site systems
- Off-island septage treatment disposal
- Surface water discharges are prohibited

The Setting—Martha's Vineyard

Land area, acres

N-sensitive watersheds	40,300	*(71%)*
P-sensitive watersheds	4,300	*(7%)*
Open ocean discharge	12,400	*(22%)*

75% of N-sensitive watersheds are shared by 2 to 4 towns

Zone II area 8,900 acres

16% of total land area

Sources of Nitrogen

- The nitrogen “driver” = surface water impacts from nutrient overloading
- Nitrogen loads
  - Septic systems
  - Fertilization of lawns and golf courses
  - Stormwater disposal
  - Atmospheric deposition
  - Sediment release

Today's Key Question

What is the best way to protect a coastal embayment from nitrogen overloading? Is it to:

1. Rely on traditional approaches?, or
2. Use non-traditional systems that may allow faster, cheaper nitrogen control?

Presentation Overview

- Describe the “wastewater/nitrogen setting” on Martha’s Vineyard
- Identify the issues that must be addressed to implement new technologies
- Discuss pros/cons of remediation
- Present a framework for evaluation

Important Terms

Traditional vs. non-traditional

Proven vs emerging?

Structural versus non-structural

Construction vs. regulation?

Centralized vs. decentralized

One large solution or multiple dispersed solutions?

Traditional Approaches

Eliminate/reduce septic nitrogen by:

- *Adding denite to existing septics*
- *Installing sewers leading to centralized treatment plant*
- *Installing sewers leading to decentralized facilities*

Adopt nitrogen control regulations

Provide for stormwater treatment

Examples of Non-Traditional Approaches

Install “eco toilets” (new, retrofit)

Widen inlets of coastal ponds

Propagate shellfish

Use hydroponics

Build permeable reactive barriers

Examples of Non-Traditional Approaches

Irrigate turf with effluent or groundwater

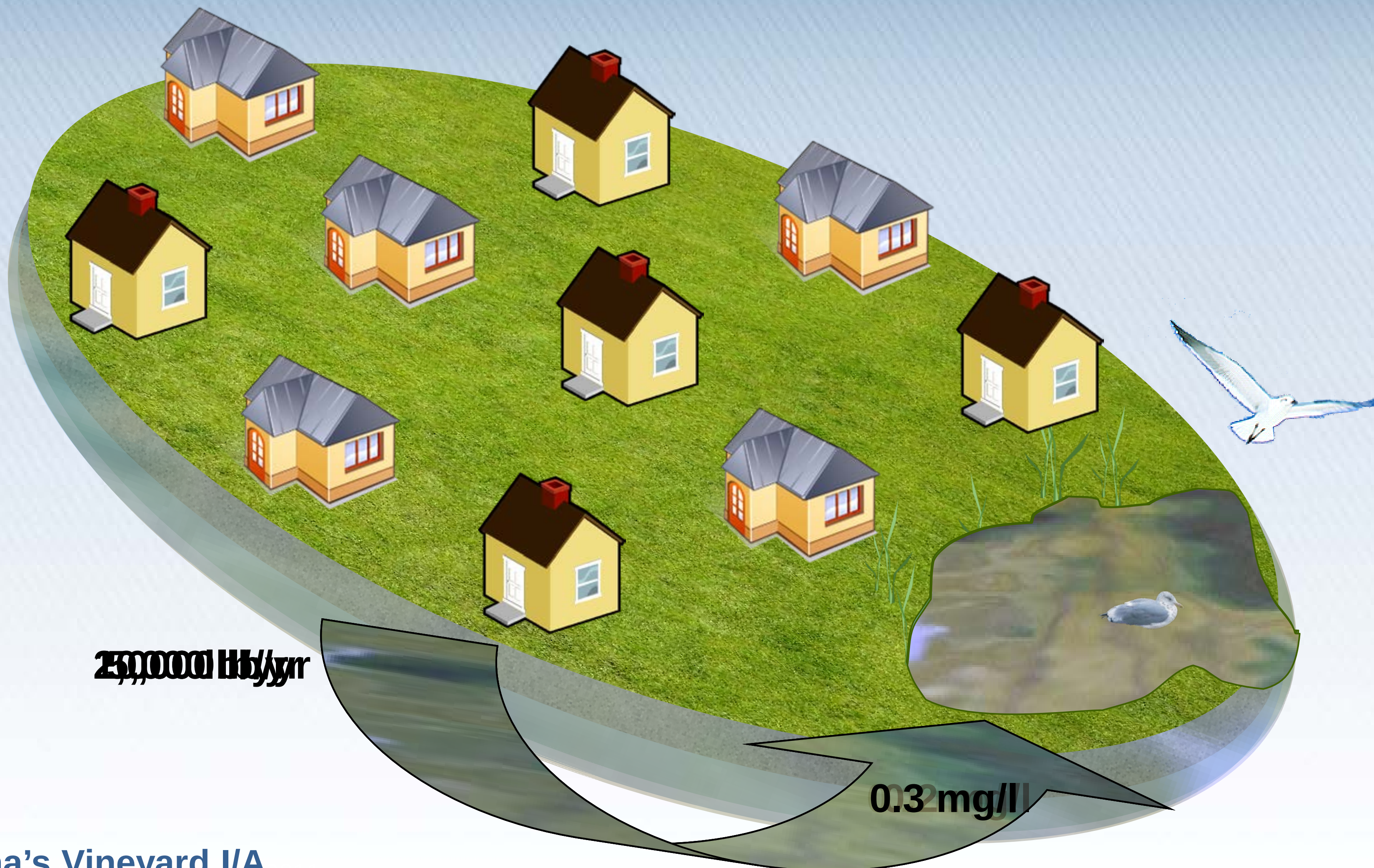
Install constructed wetlands

Build urine diversion facilities

Use pond mixing to eliminate stratification

Restore estuarine habitat

Relative Nitrogen Thresholds



Types of Nitrogen Control

1. Prevention

   Prevent N-using activity

2. Source Control

   N removed prior to reaching groundwater

3. Remediation

   N removed from groundwater or coastal pond

Where does the N Removal Occur?

1. At the source (before reaching groundwater)
2. In the groundwater
   - before it reaches the property line
   - after the property line but before it reaches the coastal pond
3. In the coastal pond

Key Aspects of Traditional Approaches

1. Very predictable results
2. Straightforward permitting
3. Generally costly
4. May allow economies of scale
5. Typically involve
   - Prevention
   - Source control

Key Aspects of Traditional Approaches

6. Often address only septic N
7. Must be designed for summer peak
8. Amendable to public-private partnerships
9. Can be easy to measure N removal

Key Aspects of Non-Traditional Approaches, especially Remediation

1. Faster impacts on coastal ponds
2. Can address all N in groundwater, not just septic N
3. Generally less proven
4. “Permittability” often an unknown
5. N removal may be hard to measure
6. May be influenced by uncontrollable natural factors

Key Aspects of Non-Traditional Approaches, especially Remediation

7. Will need back-up plan
   - More of non-traditional technology?
   - Traditional back-up
8. Risk of under-performance
9. Less susceptible to seasonal peaks
10. Likely to need demonstration testing

How Proven is the Approach?

1. Ready for immediate implementation
2. Requires large local demonstration
   - Enough benefits to defer traditional technologies
   - Concurrent with phase traditional approach
3. More experience needed even before large demonstration

Non-Structural Approaches

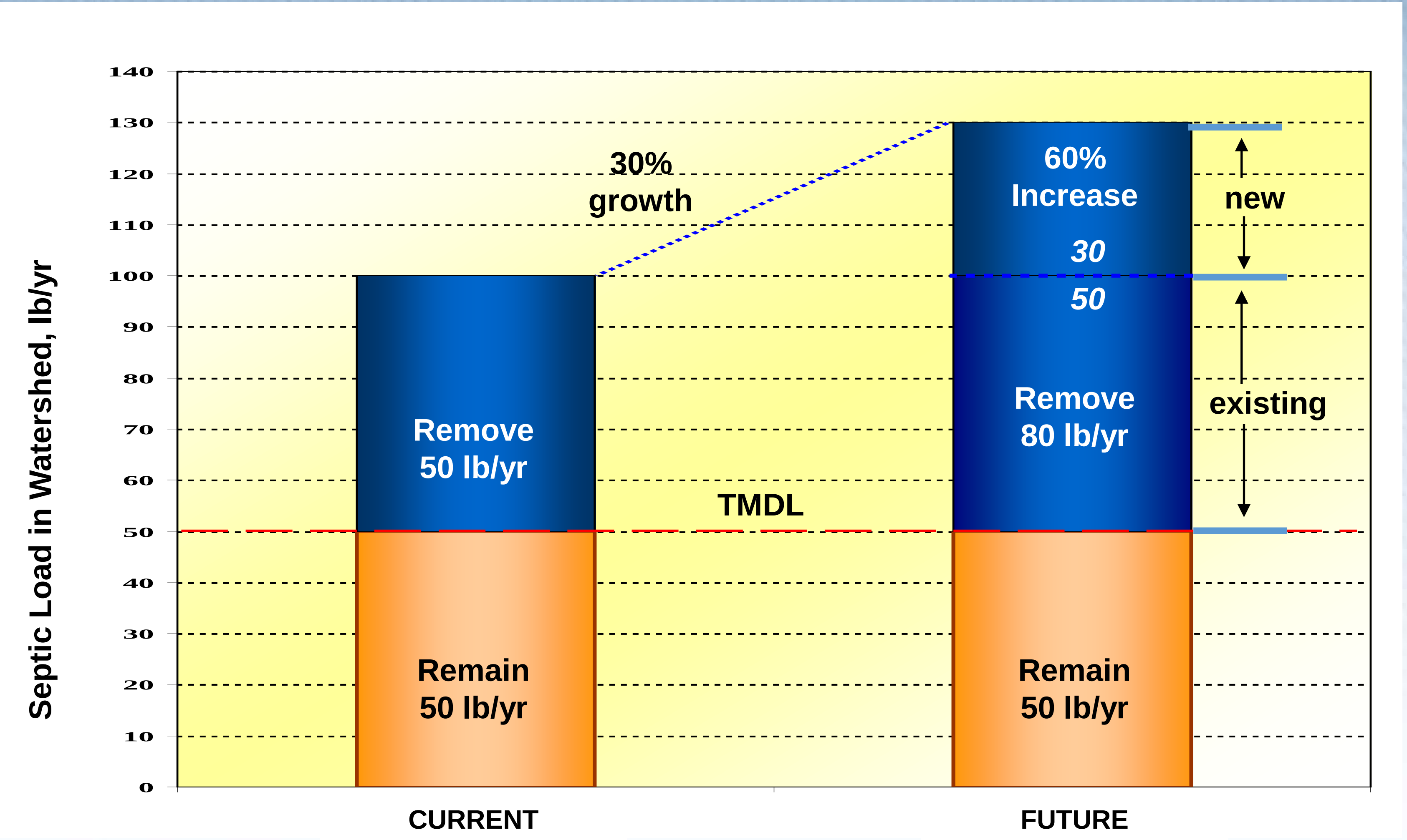
- N Load regulations that limit
  - aggregate annual load – lbN/ac/yr
  - Bedroom count --- 1 BR/10,000sf
- Fertilizer control bylaws
- Set-aside of vacant land
  - Purchase
  - Acquire development rights
- No-Net-Nitrogen regulations

Future N Loads

- Remember 2 parts of N control equation:
  1. *Remove X% of current load*
  2. *Remove 100% of "new" load*

- *Controlling future load may be as much of a cost burden as current load, if high growth rates are expected*

Impact of Growth on N Removal



Recent Cost Comparisons

Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod

Barnstable County Wastewater Cost Task Force

April 2010

Cost Calculation Example

Capital Cost	$31 M
Amortized Capital Cost (5%, 20-yr)	$2.5 M/yr
O&M Cost	$0.5 M/yr
Equivalent Annual Cost	$3.0 M/yr
Nitrogen Load Removed	8,700 lb/yr
Unit Cost	$350 / lb N

"Life Cycle" Costs

Must consider 20-year life cycle costs

Contrast options that are:

- *High Capital and low O&M*
- *Low Capital and high O&M*

Use $/lbN metric

Remember Monitoring Costs

Wastewater Costs Report

Electronic copy of report is available on the website of the Water Protection Collaborative

www.ccwpc.org

Technology Assessment Matrix

Formalize the evaluation of new technology considering two important issues:

1. Where does the N removal occur?
    1. *source control*
    2. *remediation*
2. How mature is technology in terms of:
    1. *permittability*
    2. *need for demonstration*
    3. *need for traditional back-up*

Technology Assessment Matrix

Location of N Removal	Applicability to Near-Term TMDL Compliance			
	Not Applicable to Cape/Islands Situation	Applicable as an Addition to an Ongoing Phased Plan after Further Study	Sufficiently Applicable to Allow Deferral of Traditional Approaches	Ready for Immediate Application as Primary Remedy
Prevent Future N Loads				
Remove N Before Reaching Groundwater				
Remove N from Groundwater Before Reaching Embayment				
Increase Embayment's Assimilative Capacity for N				
Remove N from Embayment Water Column				

Comments and Questions

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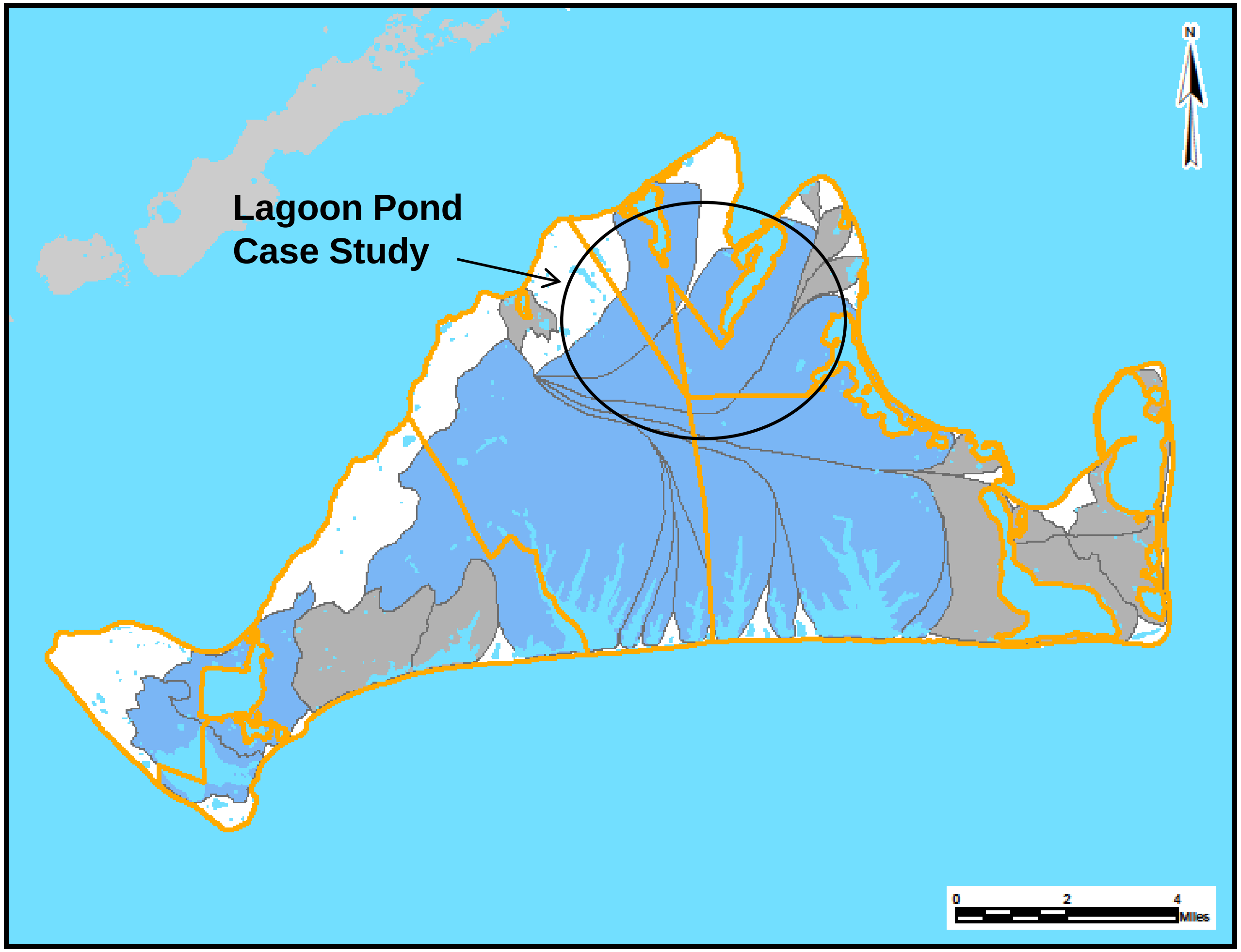
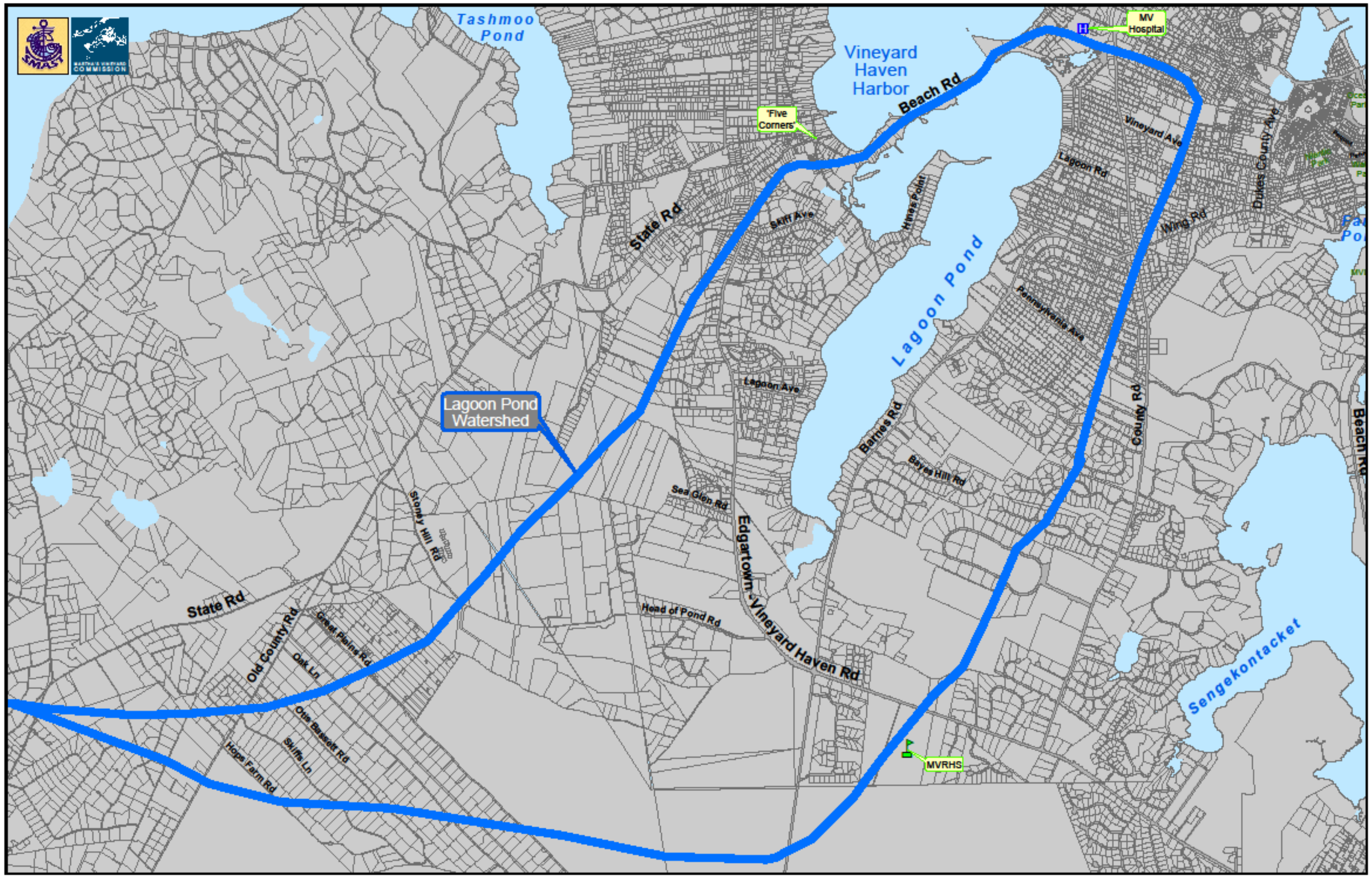
Lagoon Pond Case Study



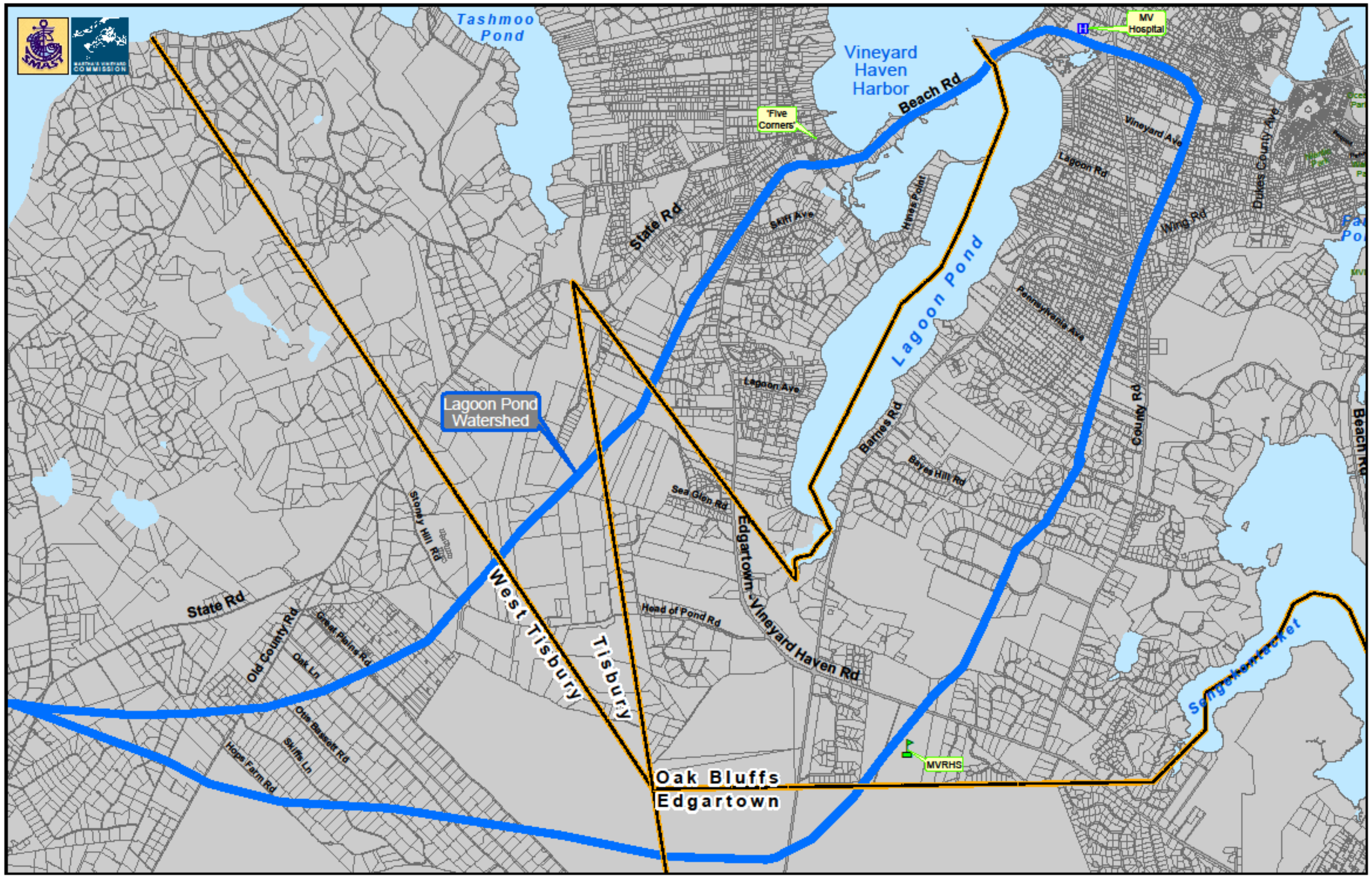
Lagoon Pond Watershed



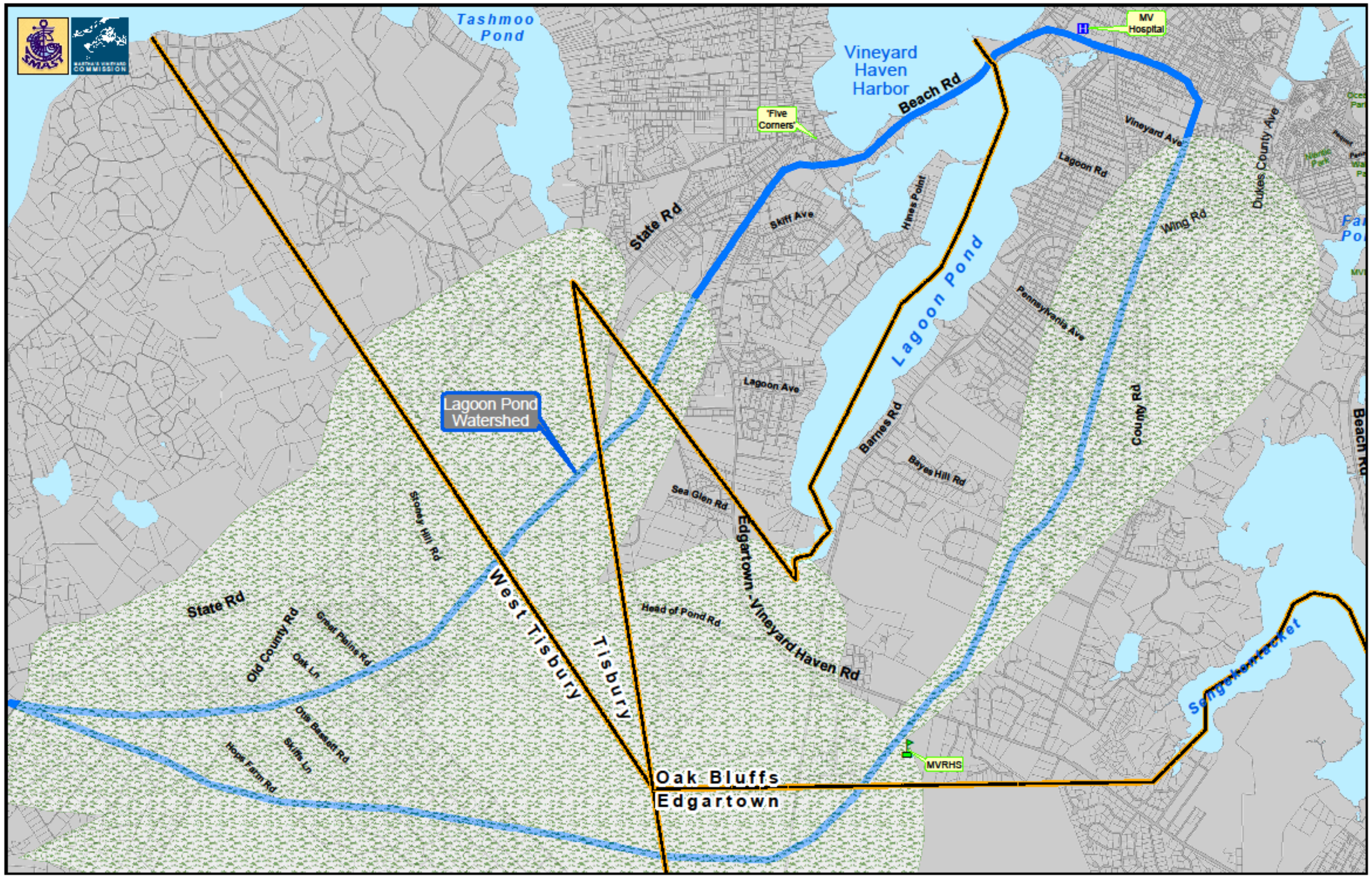
Lagoon Pond Water Quality

Current watershed N load	37,700 lb/yr
Current septic N load	27,700 lb/yr
Threshold watershed N load	24,600 lb/yr
N load to be removed	13,100 lb/yr
Septic removal need	47%
Current wastewater flow	354,000 gpd
Septic flow to be eliminated	165,000 gpd

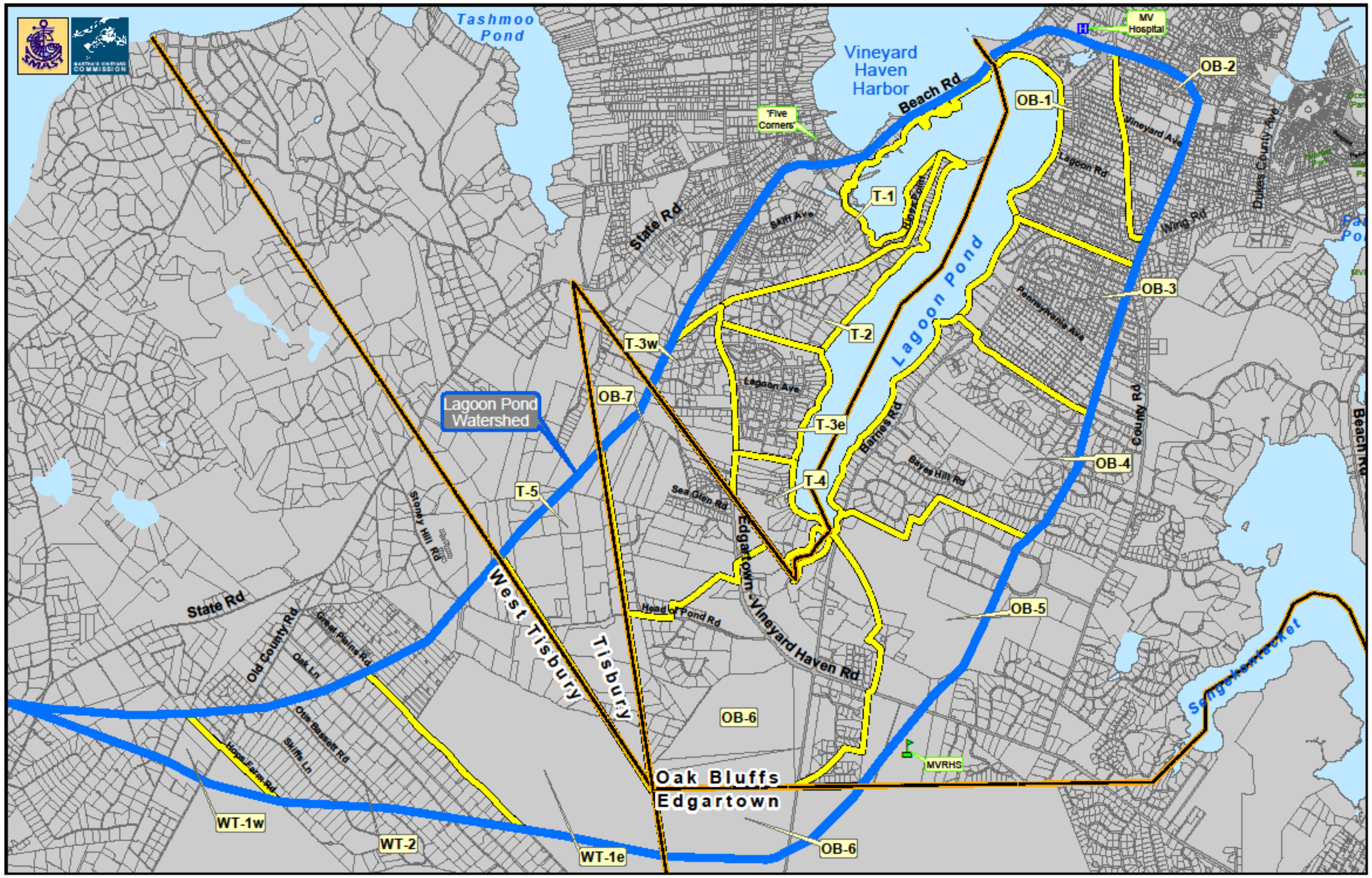
Town Boundaries



Water Supply Recharge Areas



Neighborhoods



Neighborhood Statistics

Development density, road ft per lot

OB2:	78	T1:	91
WT1:	340	T5:	310

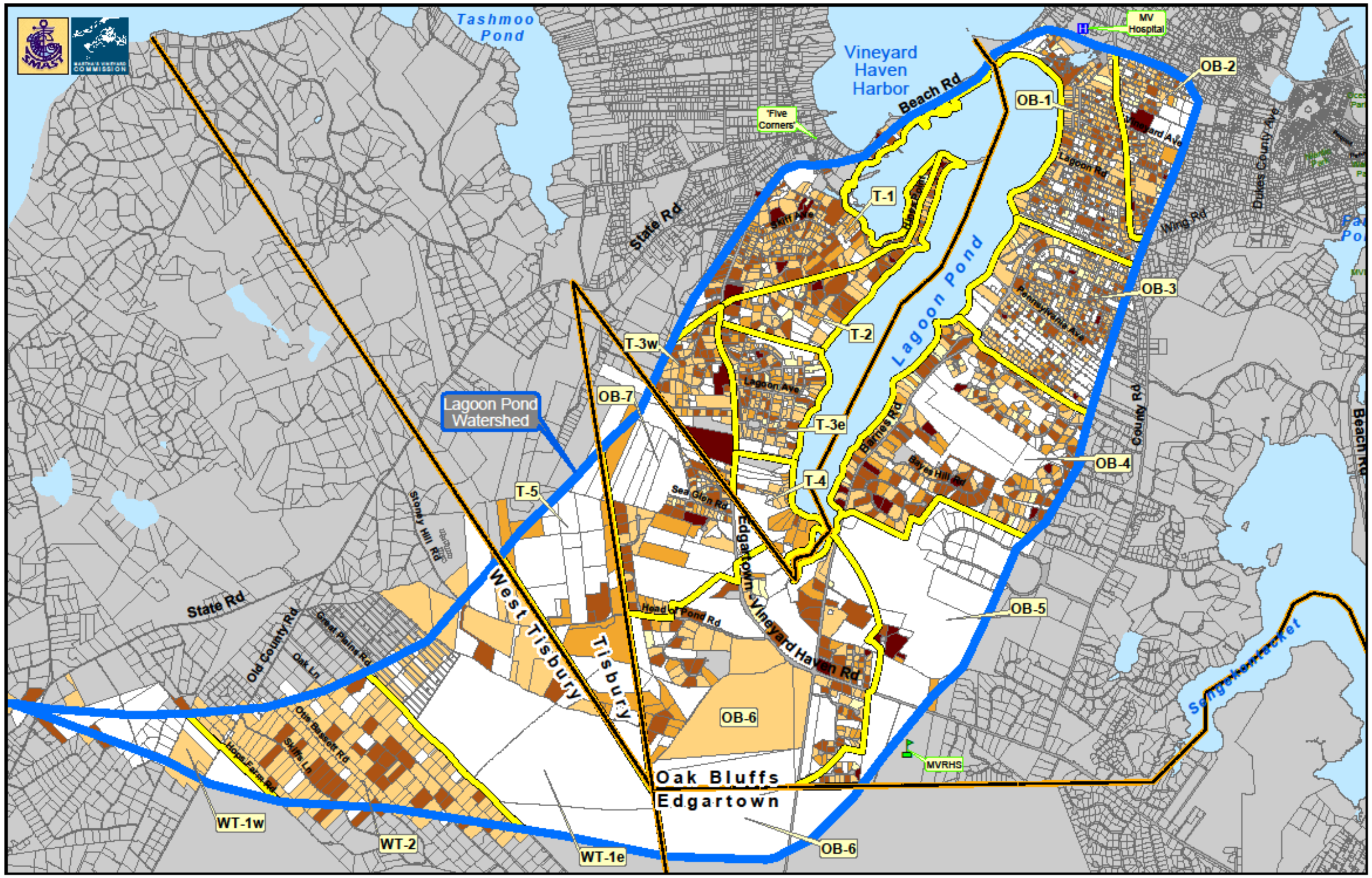
Distance to shore, miles

T4:	0.08	OB1:	0.11
T5:	0.98	WT2:	2.19

Percentage of homes that are year-round

OB6:	73%	T5:	75%
T4:	50%	OB4:	47%

Distribution of Nitrogen Loads



Neighborhood Statistics

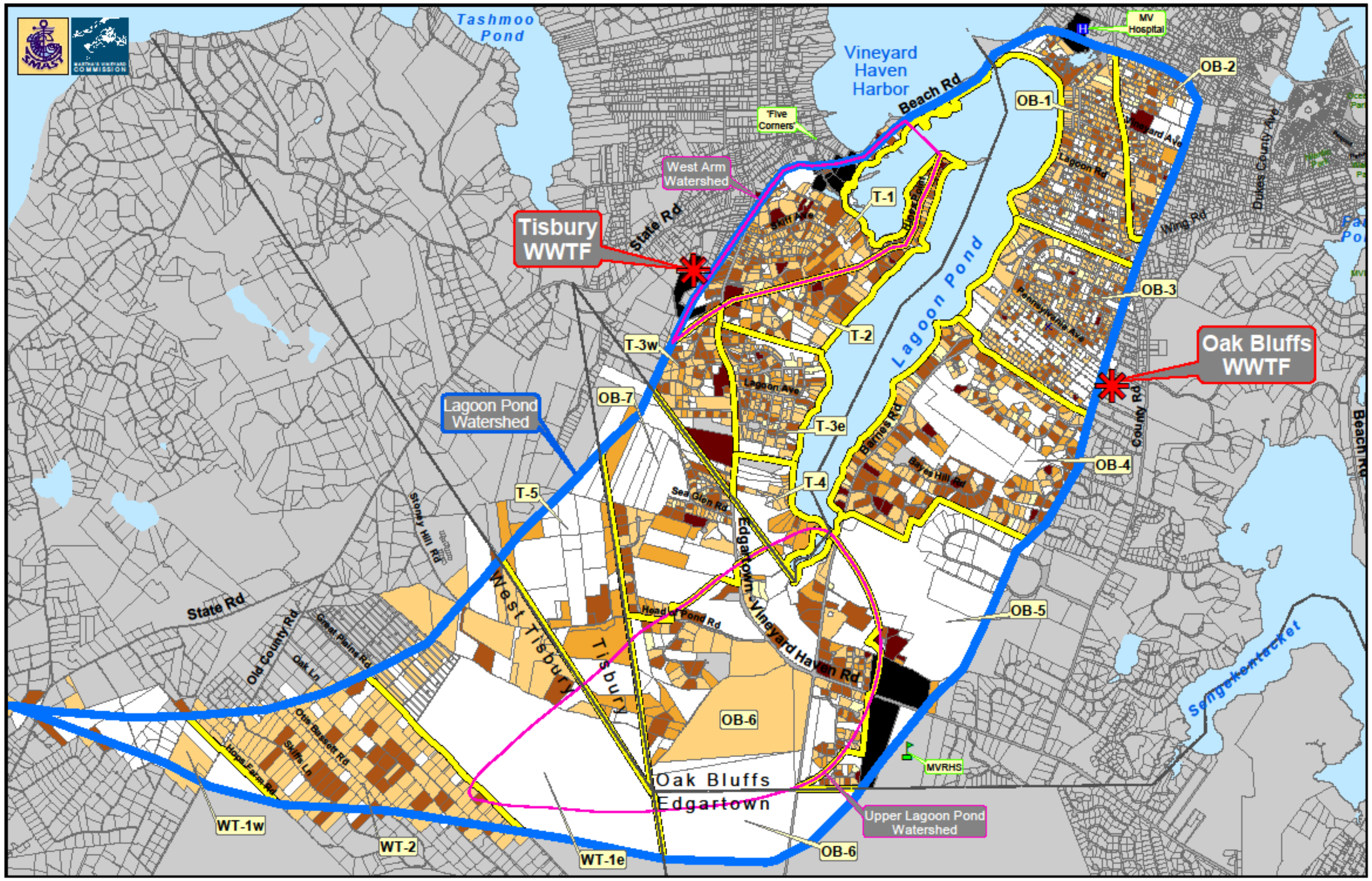
Wastewater density, gpd per lot

- OB5: 510
- T5: 410
- WT2: 160
- T4: 140

Nitrogen density, lb/yr per lot

- T5: 32
- OB5: 41
- T4: 12
- WT2: 13

Treatment Plant Locations



Existing Wastewater Infrastructure

Oak Bluffs WWTF	
Design capacity	370,000 gpd
Current summer flows	240,000 gpd
Tisbury WWTF	
Design capacity	104,000 gpd
Current summer flows	70,000 gpd

Lagoon Pond Options

1. Sewers and treatment only in Oak Bluffs
2. Sewer all of Tisbury watershed (113,000 gpd) and some of Oak Bluffs (52,000 gpd) with treatment at both plants
3. Sewers and treatment in all 3 towns proportional to current N load

Oak Bluffs	100,000 gpd
Tisbury	49,000 gpd
West Tisbury	17,000 gpd

Lagoon Pond – Preliminary Costs

1. Sewer and treatment only in Oak Bluffs

   $250/lb N

2. Sewer all of Tisbury watershed (110,000 gpd) and some of Oak Bluffs (50,000 gpd) with treatment at both plants

   $275/lb N

3. Sewers and treatment in all 3 towns proportional to current N load

   $300/lb N

Lagoon Pond – Other Factors

1. Some of Tisbury's discharge may reach Lagoon Pond
2. West Tisbury has no wastewater infrastructure
3. Oak Bluffs is already preparing to expand
3. New Oak Bluffs disposal area is in a water supply Zone II
4. Each Town has other N control needs

Collection Needs by Watershed

Nitrogen control needs, gal/day

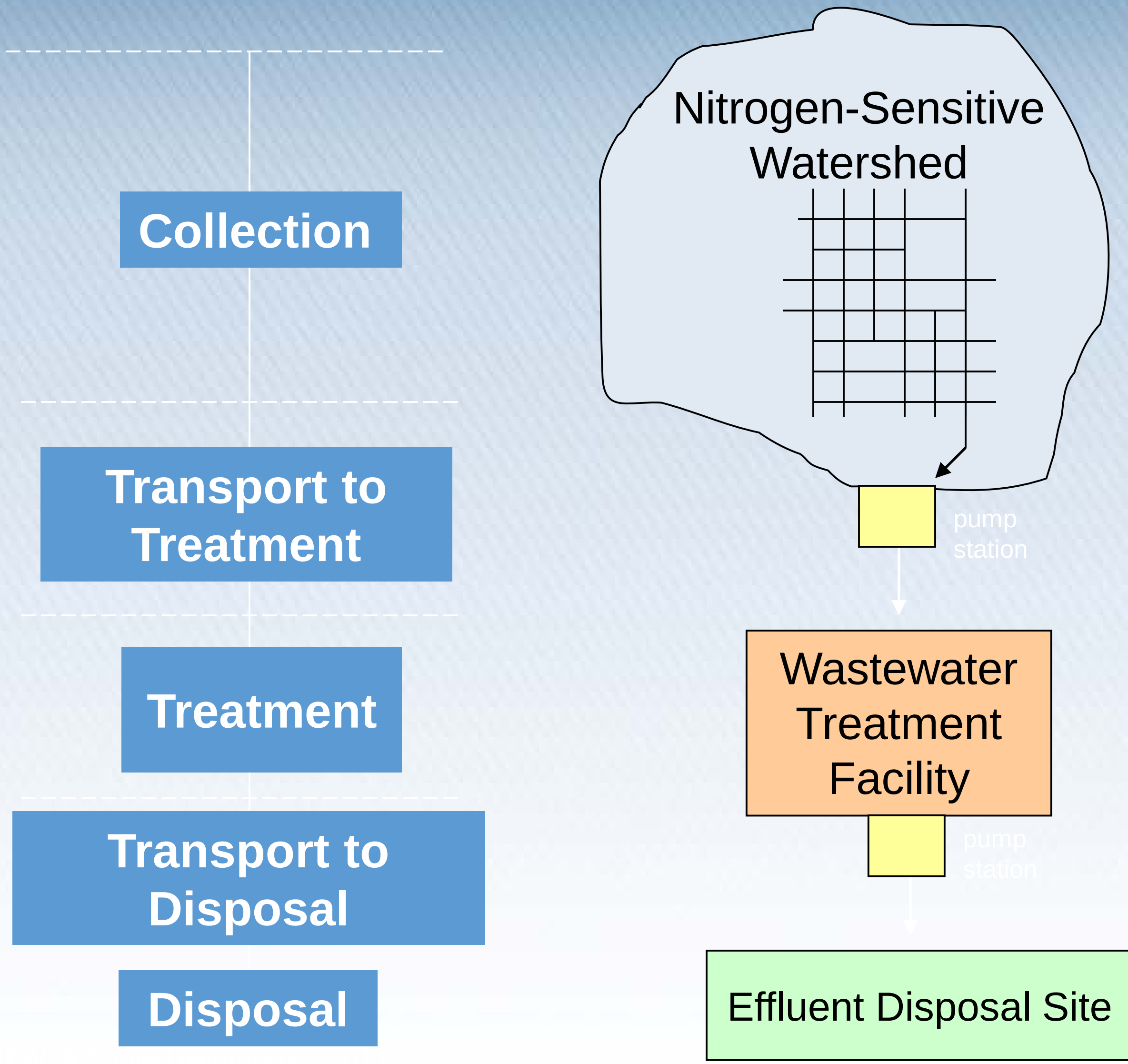
Lagoon Pond	165,000
Oak Bluffs Harbor	111,000
Edgartown Great Pond	68,000
Chilmark Pond	67,000
Tisbury Great Pond	65,000
Sengekontacket Pond	51,000
All others	111,000
Total	638,000

Collection Needs by Town

Nitrogen control needs, gal/day

Oak Bluffs	263,000
Edgartown	140,000
Chilmark	87,000
West Tisbury	81,000
Tisbury	54,000
Aquinnah	13,000
Total	638,000

Elements of a Wastewater System



Cost per Pound of N

$200

$65

Growth in Wastewater Flows

Growth percentages by town:

Oak Bluffs	32%
Tisbury	52%
West Tisbury	60%
Edgartown	65%
Chilmark	81%
Aquinnah	104%

Wastewater Management Structures

Candidate structures:

- Individual towns acting alone
- Host town and customer town
- Single regional public entity
- Wastewater/nutrient manag. district
- Single regional private entity
- Combined water and wwr. entity
- Regional health district

Wastewater Management Structures

Evaluative criteria:

- Ease in implementation
- Political acceptability
- Set-up costs and long-term savings
- Ability to assess fees
- Impact on community growth
- Ability to garner grants and loans
- Public accountability