

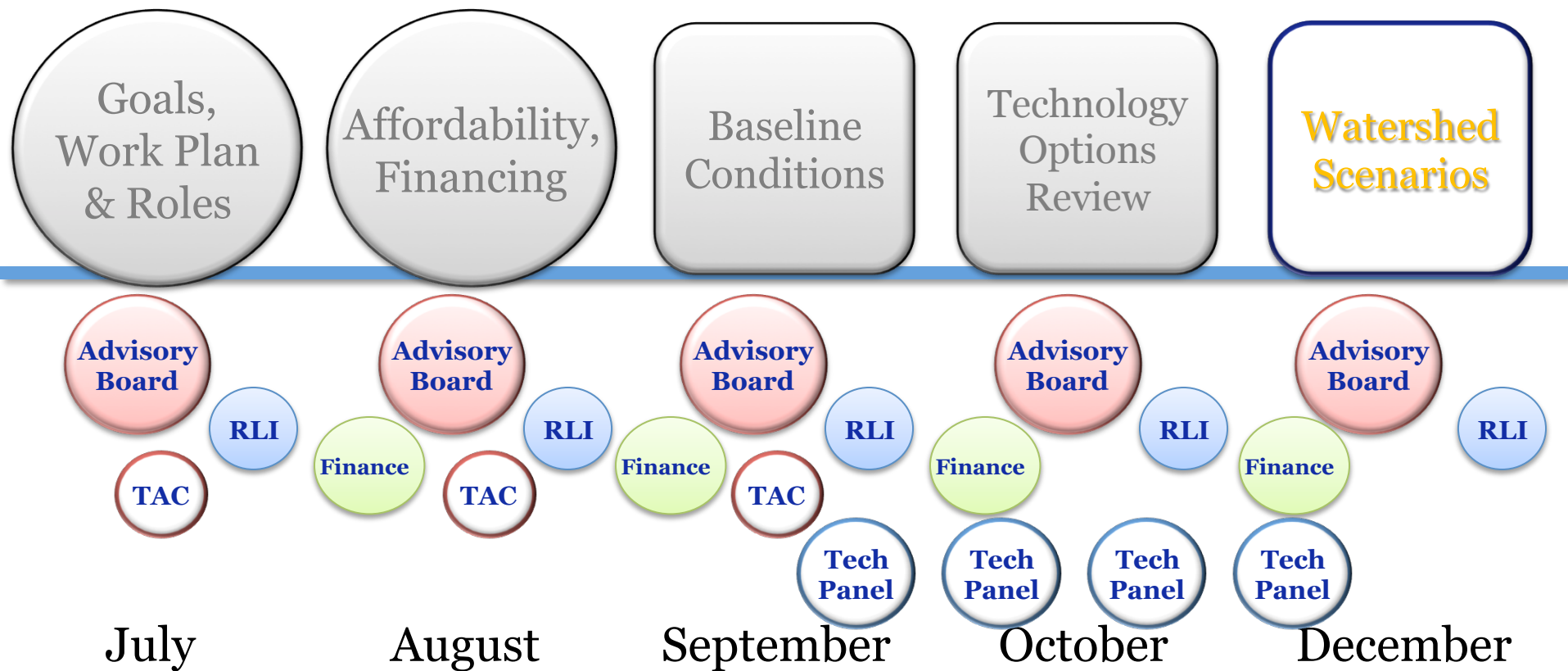
# Cape Cod Bay Group



## Watershed Scenarios

## Public Meetings

## Watershed Working Groups



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

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

**208 Planning Process**

# Site Scale

# Neighborhood

# Watershed

# Cape-Wide

## Prevention



Compact Development



Remediation of Existing Development



Fertilizer Management



Transfer of Development Rights



Stormwater BMPs

## Reduction



Standard Title 5 Systems



Cluster & Satellite Treatment Systems



Conventional Treatment



I/A Title 5 Systems



STEP/STEG Collection



Advanced Treatment



I/A Enhanced Systems



Wastewater Collection Systems



Toilets: Urine Diverting



Effluent Disposal Systems



Toilets: Composting



Constructed Wetlands: Surface Flow



Toilets: Packaging



Constructed Wetlands: Subsurface Flow



Stormwater: Bioretention / Soil Media Filters



Effluent Disposal: Out of Watershed/Ocean Outfall



Stormwater: Wetlands



Phytoremediation



Eco-Machines & Living Machines



Phytobuffers



Fertigation Wells



Permeable Reactive Barrier



Shellfish and Salt Marsh Habitat Restoration



Aquaculture/Shellfish Farming



Inlet / Culvert Widening



Pond and Estuary Dredging



Surface Water Remediation Wetlands

## Remediation

Wastewater

Stormwater

Existing Water Bodies

Regulatory

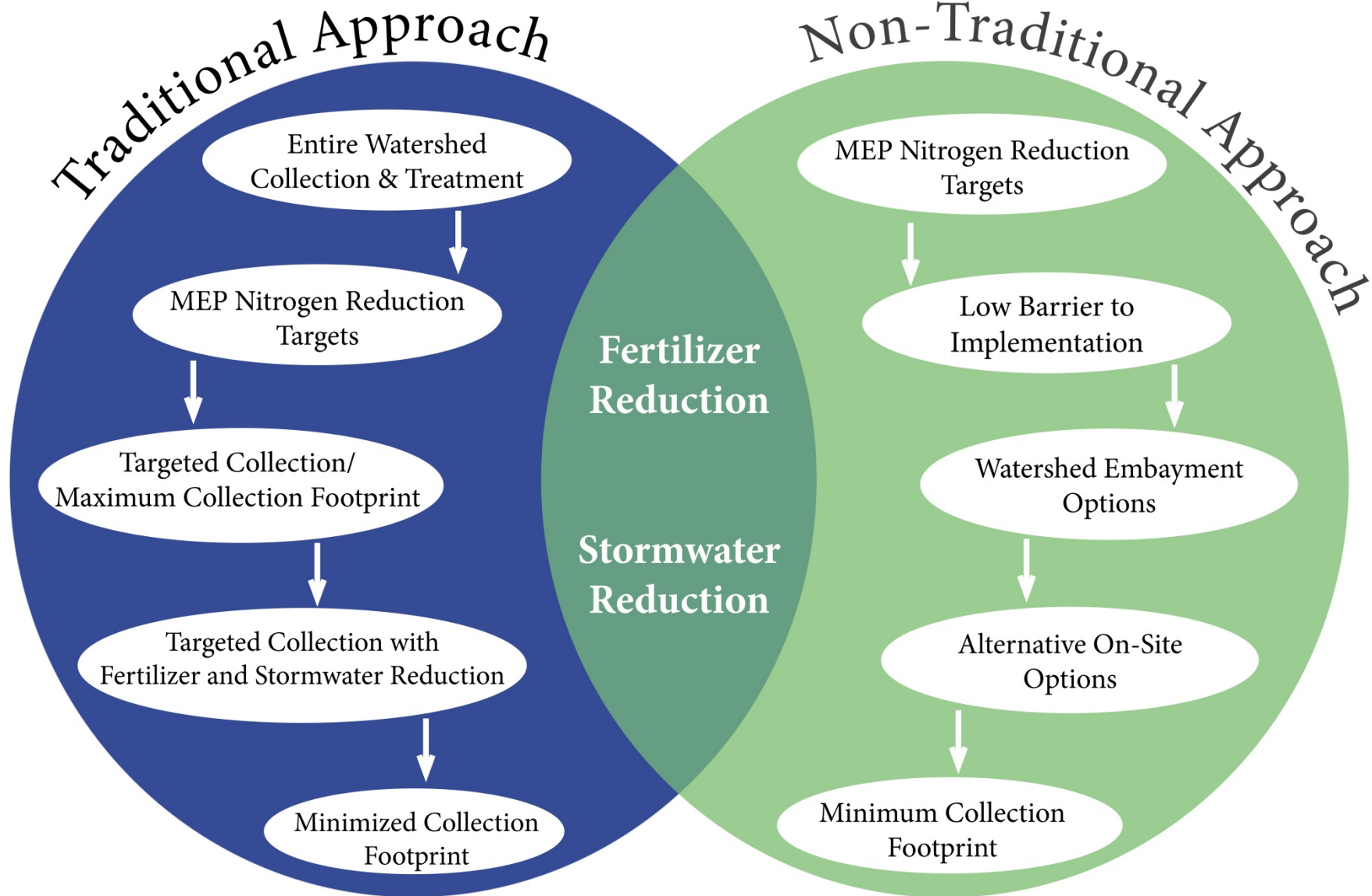
Watershed  
Scenarios

11 Working  
Group Meetings:  
Dec 2-11

## Goal of Today's Meeting:

- To discuss the approach for developing watershed scenarios that will remediate water quality impairments in your watersheds.
- To identify preferences, advantages and disadvantages of a set of scenarios of different technologies and approaches, and
- To develop a set of adaptive management principles to guide sub-regional groups in refining scenarios for the 208 Plan.

**208 Planning Process**



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# Neighborhood

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# Cape-Wide

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Surface Water Remediation Wetlands

## Remediation

Wastewater

Stormwater

Existing Water Bodies

Regulatory

# Site Scale

# Neighborhood




















# Watershed

# Cape-Wide

Prevention


		Remediation of Existing Development		Fertilizer Management
		TDR		Stormwater BMPs

Reduction

	Standard Title 5 Systems		Cluster & Satellite Treatment Systems		Conventional Treatment
	I/A Title 5 Systems		STEP/STEG Collection		Advanced Treatment
	I/A Enhanced Systems				Wastewater Collection Systems
					Effluent Disposal Systems
	Toilets: Composting		Constructed Wetlands: Surface Flow		
	Toilets: Packaging		Constructed Wetlands: Subsurface Flow		
	Stormwater: Bioretention / Soil Media Filters			Effluent Disposal: Out of Watershed/Ocean Outfall	
			Stormwater: Wetlands		Phytoirrigation
	Eco-Machines & Living Machines				

## Traditional Approach

Remediation

	Phytobuffers			Fertigation Wells
	Permeable Reactive Barrier			Shellfish and Salt Marsh Habitat Restoration
				Aquaculture/Shellfish Farming
		Inlet / Culvert Widening		
		Pond and Estuary Dredging		
		Surface Water Remediation Wetlands		

-  Wastewater
-  Stormwater
-  Existing Water Bodies
-  Regulatory

# Site Scale

# Neighborhood

# Watershed

# Cape-Wide

Prevention



Compact Development



Remediation of Existing Development



Fertilizer Management



TDR  
Transfer of Development Rights



Stormwater BMPs

Reduction



Standard Title 5 Systems



Cluster & Satellite Treatment Systems



Conventional Treatment



I/A Title 5 Systems



STEP/STEG Collection



Advanced Treatment



I/A Enhanced Systems



Wastewater Collection Systems



Toilets: Urine Diverting



Effluent Disposal Systems



Toilets: Composting



Constructed Wetlands: Surface Flow



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Constructed Wetlands: Subsurface Flow



Stormwater: Bioretention / Soil Media Filters



Effluent Disposal: Out of Watershed/Ocean Outfall



Stormwater: Wetlands



Phytoremediation



Eco-Machines & Living Machines



Phytobuffers



Fertigation Wells



Permeable Reactive Barrier



Shellfish and Salt Marsh Habitat Restoration



Aquaculture/Shellfish Farming



Inlet / Culvert Widening



Pond and Estuary Dredging



Surface Water Remediation Wetlands

# Traditional Approach Plus Fertilizer & Stormwater Reduction

Remediation

Wastewater

Stormwater

Existing Water Bodies

Regulatory



# Site Scale

# Neighborhood

# Watershed

# Cape-Wide

## Prevention

	Compact Development		Remediation of Existing Development		Fertilizer Management
			TDR Transfer of Development Rights		Stormwater BMPs

## Reduction

	Standard Title 5 Systems		Cluster & Satellite Treatment Systems		Conventional Treatment
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	Toilets: Composting		Constructed Wetlands: Surface Flow		
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	Stormwater: Bioretention / Soil Media Filters			Effluent Disposal: Out of Watershed/Ocean Outfall	
			Stormwater: Wetlands		Phytoirrigation
	Eco-Machines & Living Machines				

## Remediation

	Phytobuffers			Fertigation Wells	
	Permeable Reactive Barrier			Shellfish and Salt Marsh Habitat Restoration	
				Aquaculture/Shellfish Farming	
		Inlet / Culvert Widening			
		Pond and Estuary Dredging			
		Surface Water Remediation Wetlands			

# Non-Traditional Approaches

- Wastewater
- Stormwater
- Existing Water Bodies
- Regulatory

Site Scale

Neighborhood

Watershed

Cape-Wide




Prevention








 Remediation of Existing Development
  NHPK MGMT Fertilizer Management



 TDR Transfer of Development Rights
  Stormwater Stormwater BMPs



Reduction



 Title 5 Standard Title 5 Systems
  Cluster & Satellite Treatment Systems
  Conventional Treatment



 IA I/A Title 5 Systems
  STEP/STEG STEP/STEG Collection
  Advanced Treatment



 Enhanced IA I/A Enhanced Systems
  Wastewater Collection Systems


 Toilet
  Disposal Effluent Disposal Systems

 Toilets: Composting
  Constructed Wetlands: Surface Flow

 Toilets: Packaging
  Constructed Wetlands: Subsurface Flow

 Stormwater: Bioretention / Soil Media Filters
  Effluent Disposal: Out of Watershed/Ocean Outfall

 Stormwater: Wetlands
  Phytotirrigation

 Eco-EM Eco-Machines & Living Machines

Traditional Approach

Remediation

 Phytobuffers
  Fertigation Wells

 PRB Permeable Reactive Barrier
  Shellfish and Salt Marsh Habitat Restoration

 Aquaculture/Shellfish Farming

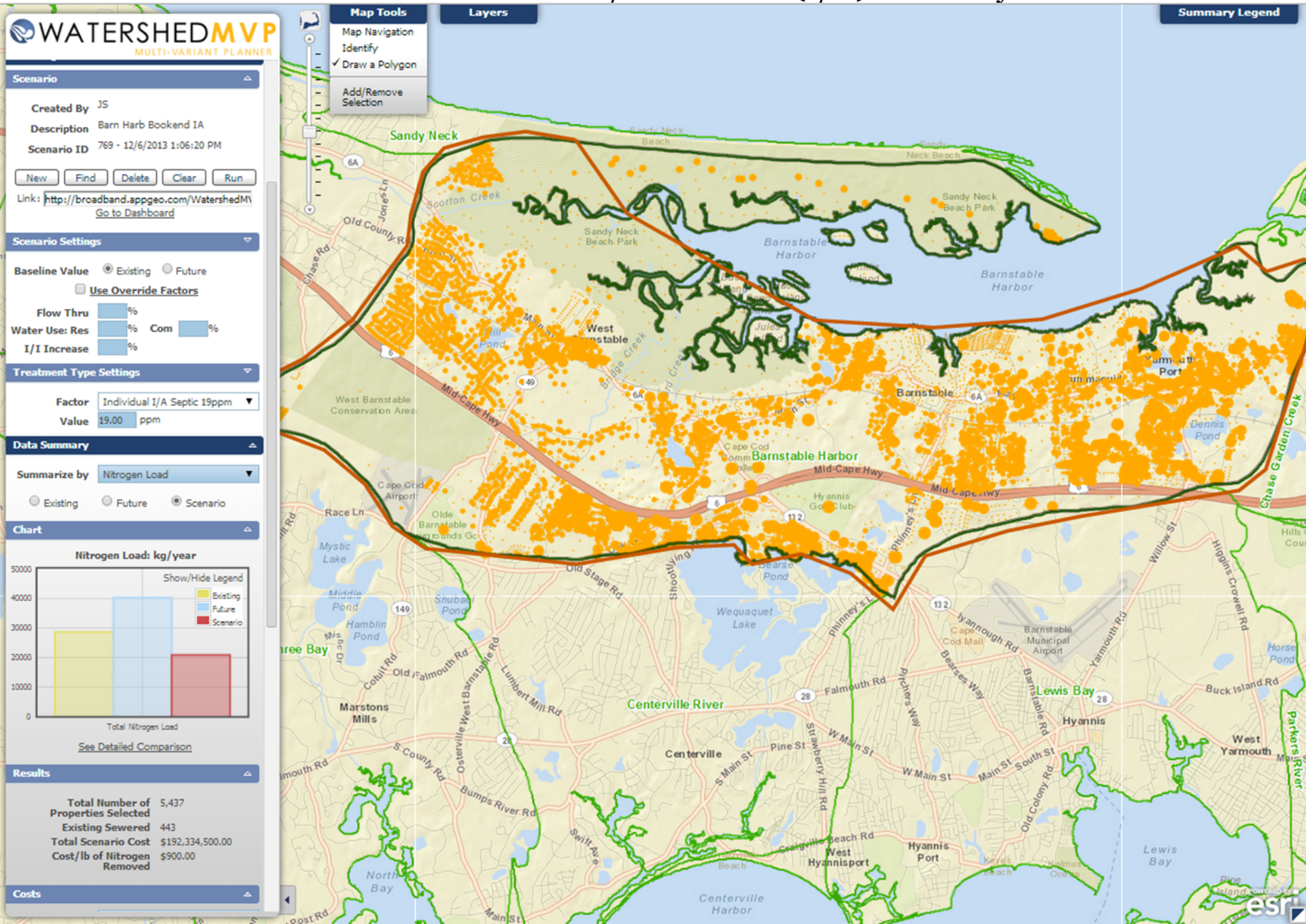
 Inlet / Culvert Widening

 Pond and Estuary Dredging

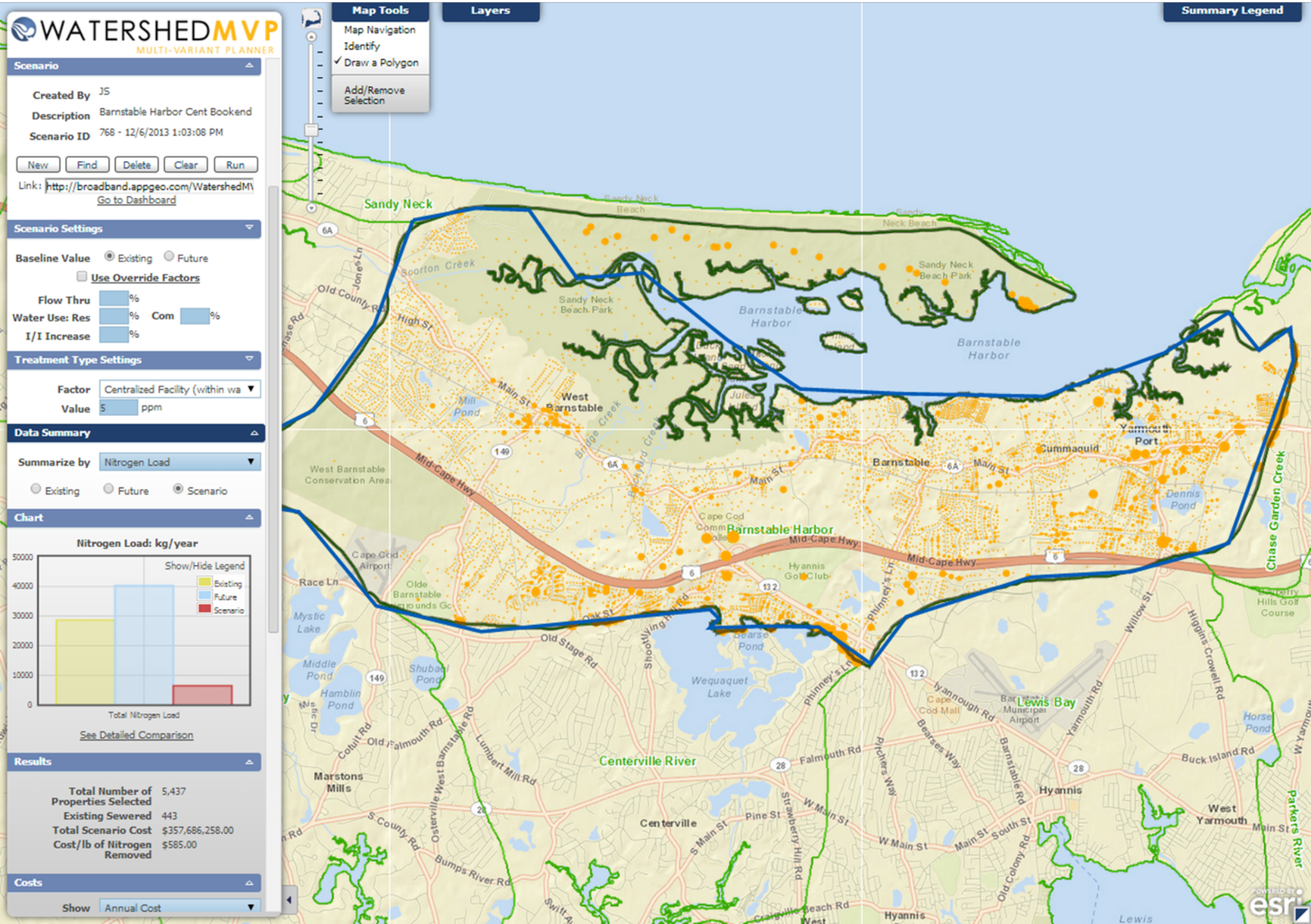
 Surface Water Remediation Wetlands

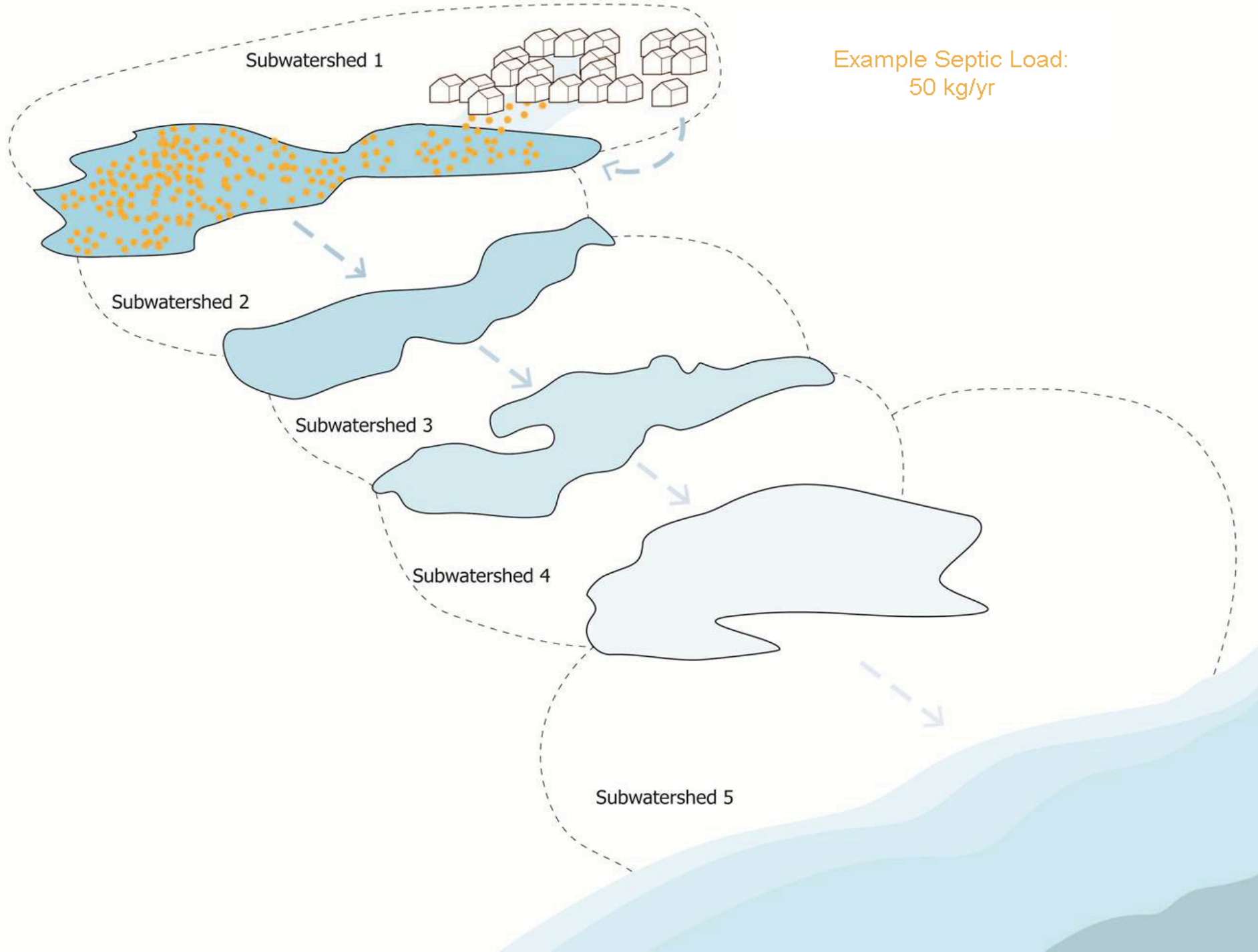
 Wastewater
  Stormwater
  Existing Water Bodies
  Regulatory

# Watershed-Wide Innovative/Alternative (I/A) Onsite Systems



# Watershed-Wide Centralized Treatment with Disposal Inside the Watershed





Subwatershed 1

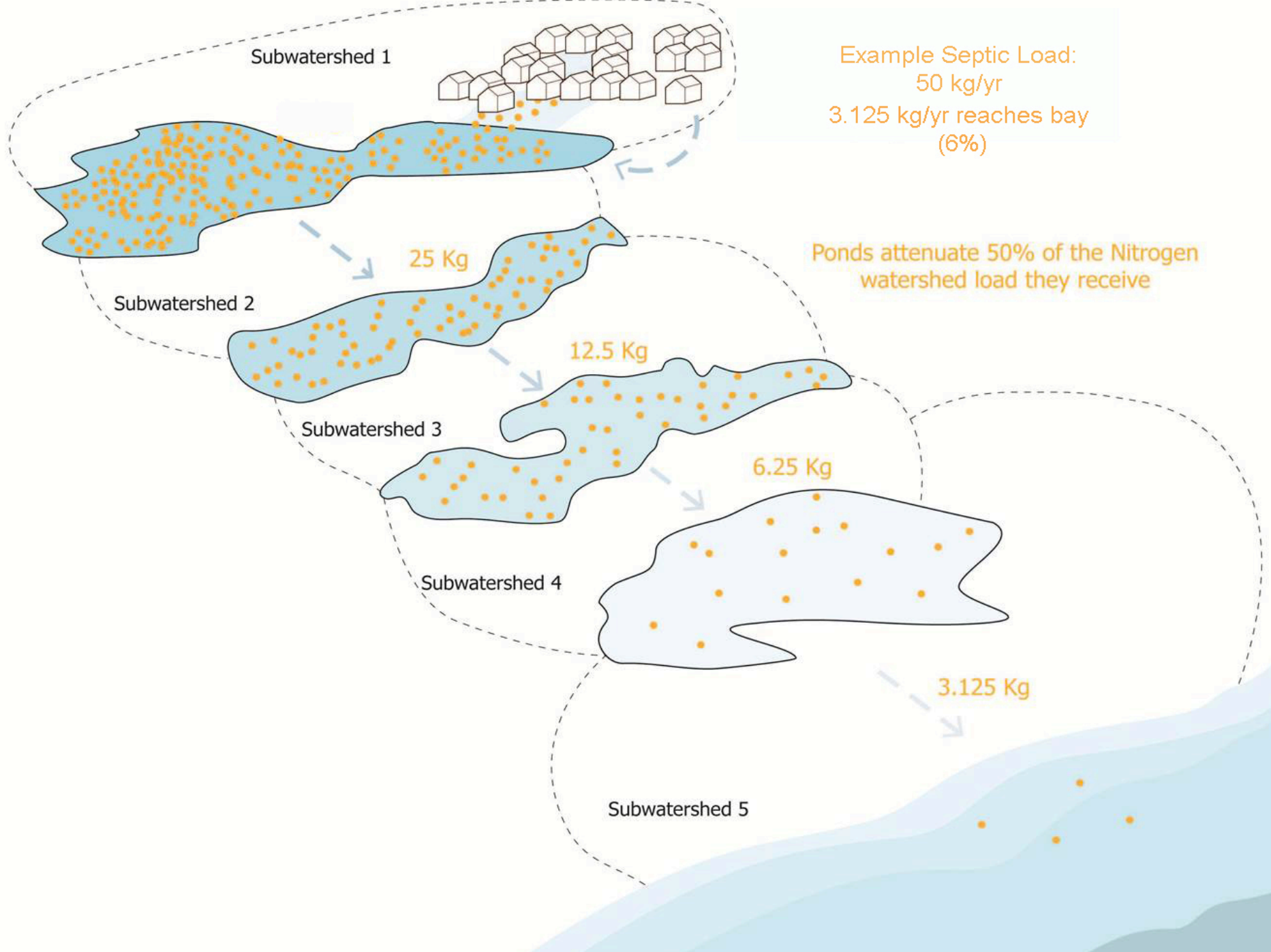
Example Septic Load:  
50 kg/yr

Subwatershed 2

Subwatershed 3

Subwatershed 4

Subwatershed 5



Subwatershed 1



Example Septic Load:  
50 kg/yr  
3.125 kg/yr reaches bay  
(6%)

25 Kg

Ponds attenuate 50% of the Nitrogen watershed load they receive

Subwatershed 2

12.5 Kg

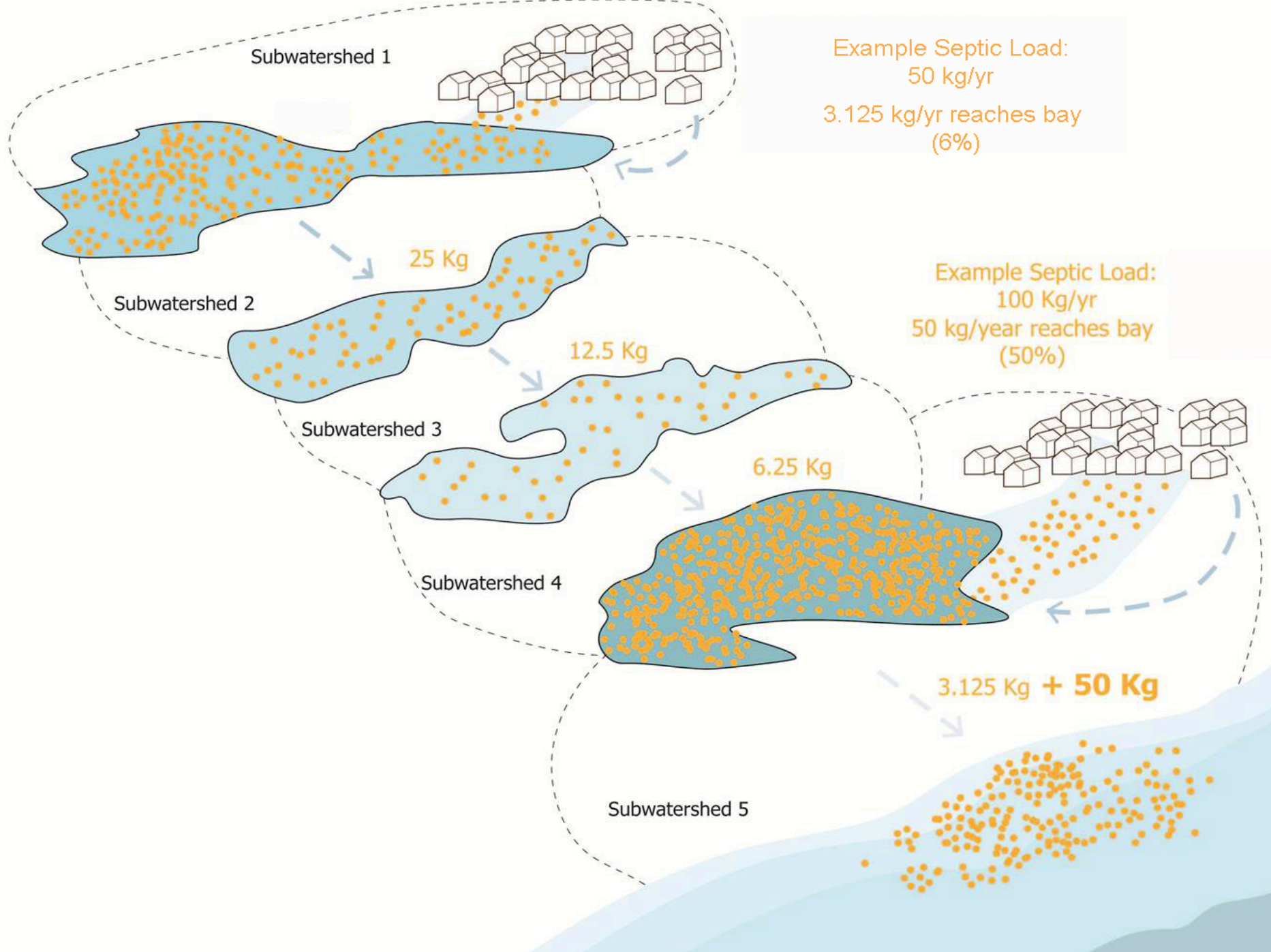
Subwatershed 3

6.25 Kg

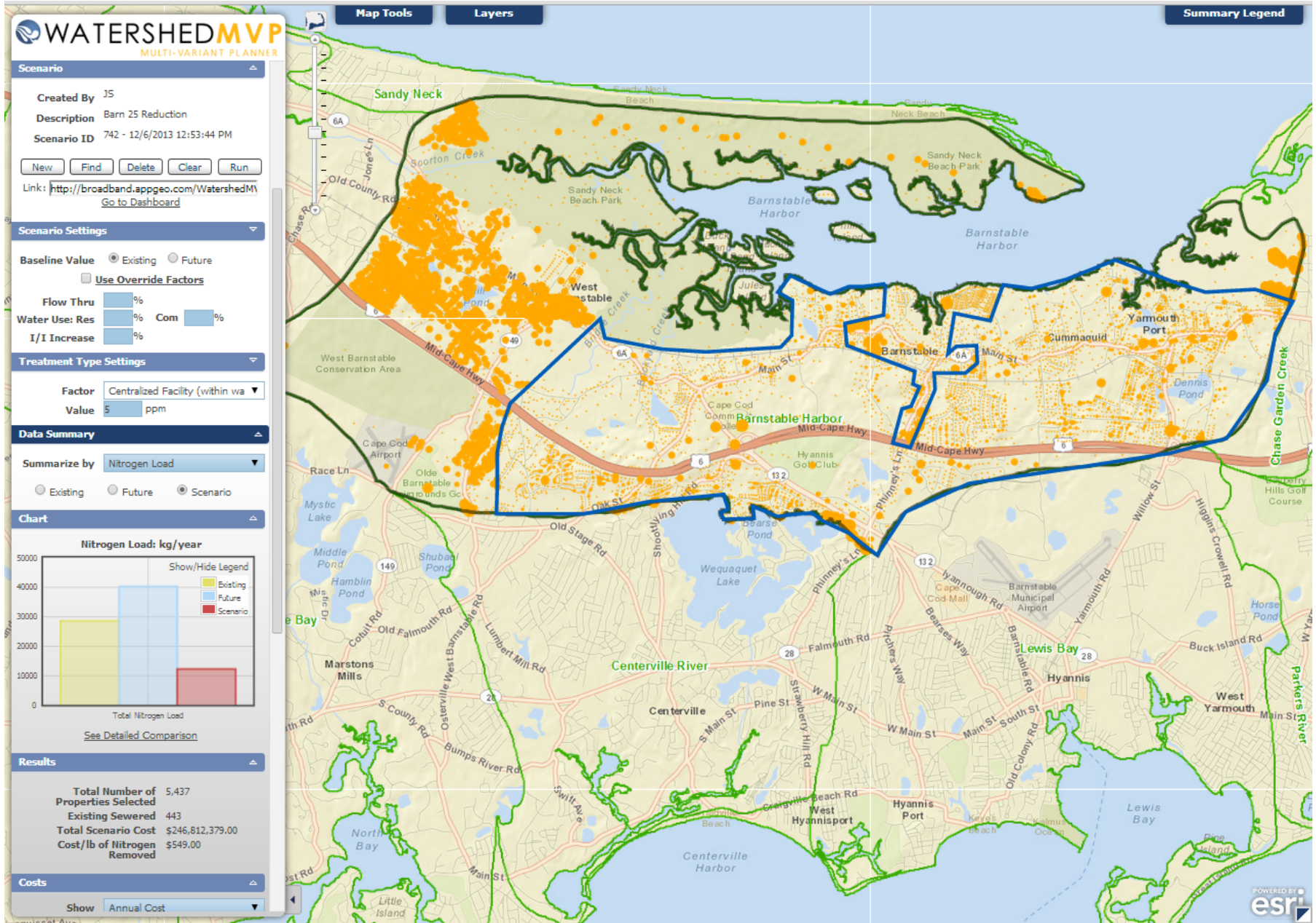
Subwatershed 4

3.125 Kg

Subwatershed 5



# Targeted Centralized Treatment to Achieve a 25% Reduction in Total Nitrogen Load<sup>1</sup>



<sup>1</sup> Cape Cod Surface Water Nutrient Management Study Final Report June, 2002



Site Scale

Neighborhood

Watershed

Cape-Wide

Prevention

	Compact Development		Remediation of Existing Development		Fertilizer Management
			TDR Transfer of Development Rights		Stormwater BMPs

Reduction

	Standard Title 5 Systems		Cluster & Satellite Treatment Systems		Conventional Treatment
	I/A Title 5 Systems		STEP/STEG Collection		Advanced Treatment
	I/A Enhanced Systems				Wastewater Collection Systems
	Toilets: Urine Diverting				Effluent Disposal Systems
	Toilets: Composting		Constructed Wetlands: Surface Flow		
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	Stormwater: Bioretention / Soil Media Filters			Effluent Disposal: Out of Watershed/Ocean Outfall	
			Stormwater: Wetlands		Phytoirrigation
	Eco-Machines & Living Machines				

Remediation

	Phytobuffers			Fertigation Wells	
	Permeable Reactive Barrier			Shellfish and Salt Marsh Habitat Restoration	
				Aquaculture/Shellfish Farming	
		Inlet / Culvert Widening			
		Pond and Estuary Dredging			
		Surface Water Remediation Wetlands			

# Non-Traditional Approaches

- Wastewater
- Stormwater
- Existing Water Bodies
- Regulatory

# Problem Solving Approach

1  
2  
3  
4  
5  
6  
7



Wastewater



Existing Water Bodies



Regulatory

## Targets/Reduction Goals

**Present Load:**

X kg/day

—

**Target:**

Y kg/day

=

**Reduction Required:**

N kg/day

## Other Wastewater Management Needs

- A. Title 5 Problem Areas
- B. Pond Recharge Areas

- C. Growth Management

## 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. Aquaculture



## 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



**Watershed Calculator**

THREE BAYS

**MEP Targets and Goals:**

		<b>kg/day</b>	<b>Nitrogen (kg/yr)</b>
Present Total Nitrogen Load:		130.7	64,492
wastewater		0	23,923
fertilizer			9,243
stormwater			6,449
Target Nitrogen Load:		0	48,369
Nitrogen Removal Required:		<b>0</b>	<b>16,123</b>
Total Number of Properties:	5437		

**Watershed Calculator**

THREE BAYS

**MEP Targets and Goals:**

Present Total Nitrogen

Load:

wastewater

fertilizer

stormwater

Target Nitrogen Load:

Nitrogen Removal Required:

Total Number of Properties:

5437

**kg/day****Nitrogen (kg/yr)**

130.7

0

0

**0**

64,492

23,923

9,243

6,449

48,369

**16,123****Other Wastewater Management Needs**

Ponds

Title 5 Problem Areas

Growth Management

**Watershed Calculator**

THREE BAYS

**MEP Targets and Goals:**

Present Total Nitrogen Load:

- wastewater
- fertilizer
- stormwater

Target Nitrogen Load:

Nitrogen Removal Required:

Total Number of Properties: 5437

**kg/day**

**Nitrogen (kg/yr)**

130.7

64,492

0

23,923

9,243

6,449

0

48,369

**0**

**16,123**

**Other Wastewater Management Needs**

Ponds

Title 5 Problem Areas

Growth Management

**Low Barrier to Implementation:**

Fertilizer Management

Stormwater Mitigation

**Reduction by Technology (Kg/yr)**

**Remaining to Meet Target (Kg/yr)**

**Unit Cost (\$/lb N)**

4,621

11,502

3,225

8,277

# Watershed Calculator

THREE BAYS

## MEP Targets and Goals:

Present Total Nitrogen Load:

kg/day

Nitrogen (kg/yr)

wastewater  
fertilizer  
stormwater

130.7

64,492

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6,449

Target Nitrogen Load:

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48,369

Nitrogen Removal Required:

**0**

**16,123**

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## Other Wastewater Management Needs

Ponds

Title 5 Problem Areas

Growth Management

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**Remaining to Meet Target (Kg/yr)**

**Unit Cost (\$/lb N)**

### Low Barrier to Implementation:

Fertilizer Management

4,621

11,502

Stormwater Mitigation

3,225

8,277

### Watershed/Embayment Options:

Permeable Reactive Barrier (PRB)

120 homes

369.6

7,907

\$452

# Watershed Calculator

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\$452

Constructed Wetlands

2 acres

1,132

6,775

\$521

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6,775

\$521

Fertigation Wells

1 golf course

136

6,639

\$438



# Watershed Calculator

THREE BAYS

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fertilizer  
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Target Nitrogen Load:

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Ponds

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6,639

\$438

Dredging

cu. yard

4,012

2,627

\$0

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\$521

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136

6,639

\$438

Dredging

cu. yard

4,012

2,627

\$0

Oyster Beds/Aquaculture

10 acres

2,500

127

\$0

# Watershed Calculator

THREE BAYS

## MEP Targets and Goals:

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stormwater

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6,639

\$438

Dredging

cu. yard

4,012

2,627

\$0

Oyster Beds/Aquaculture

10 acres

2,500

127

\$0

### Alternative On-Site Options:

Ecotoilets (UD & Compost)

272 homes

1,076.5

-949

\$1,265

**Watershed Calculator**

THREE BAYS

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Oyster Beds/Aquaculture

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2,500

127

\$0

**Alternative On-Site Options:**

Ecotoilets (UD & Compost)

272 homes

1,076.5

-949

\$1,265

**Sewering**

-216 homes

-949

0

\$1,000

## *Adaptive Management:*

A structured approach for addressing uncertainties by linking science and monitoring to decision-making and adjusting implementation, as necessary, to increase the probability of meeting water quality goals in a cost effective and efficient way.



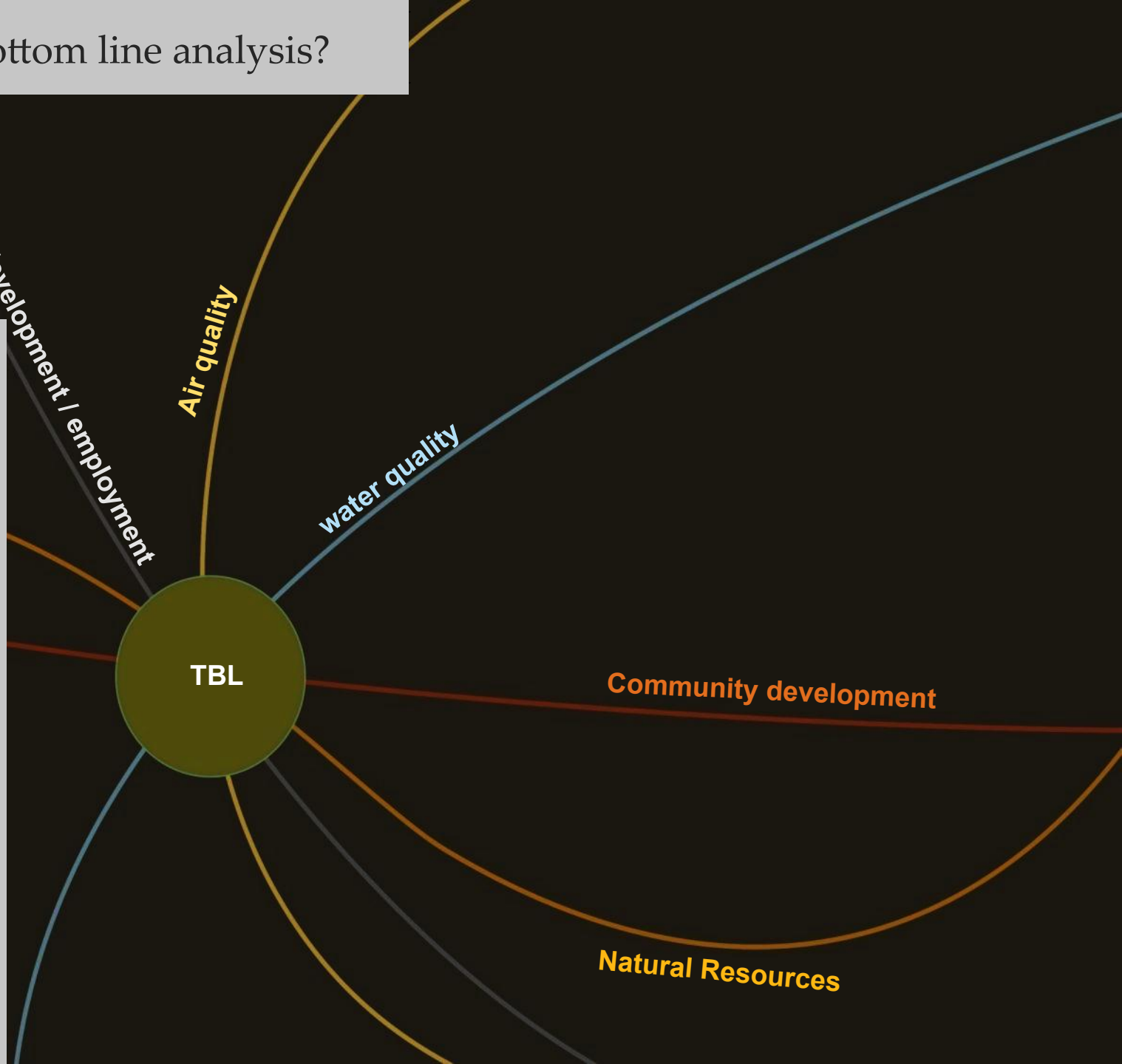
# Triple Bottom Line (TBL) Introduction

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# What is triple bottom line analysis?

Triple Bottom Line Analysis  
Provides a full accounting of the financial, social, and environmental consequences of investments or policies

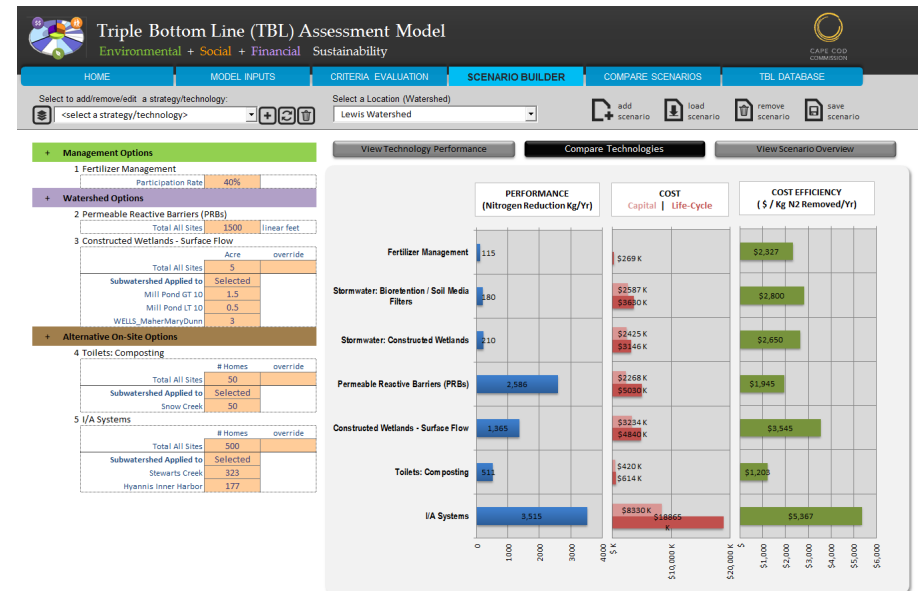
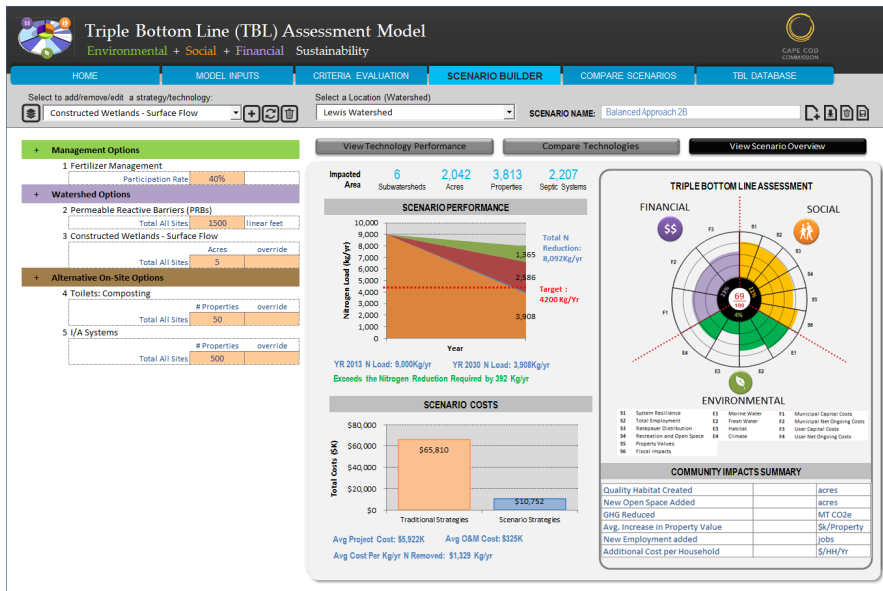
Often "TBL" analysis is used to identify the best alternative and to report to stakeholders on the public outcomes of a given investment.





# Why develop a TBL model?

- To consider the financial, environmental, and social consequences of water quality investments and policies in Cape Cod.
- TBL Model evaluates the “ancillary” or downstream consequences of water quality investments not the direct Phosphorous or Nitrogen levels.







# Triple Bottom Line (TBL) Assessment Model

Environmental + Social + Financial Sustainability



HOME

MODEL INPUTS

CRITERIA EVALUATION

SCENARIO BUILDER

COMPARE SCENARIOS

TBL DATABASE

Alternative Definition

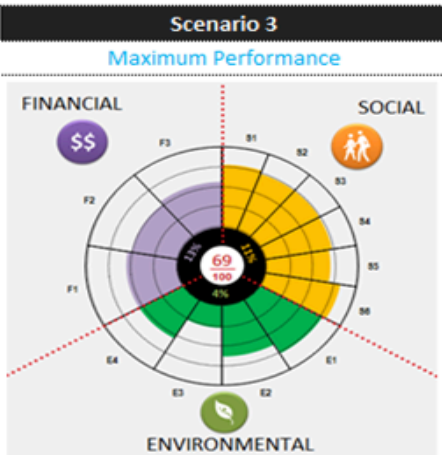
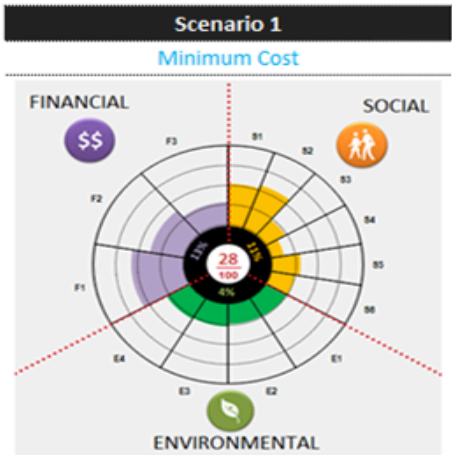
Alternative Results

Alternative Scoring Rules

## Criterion Scores

SOCIAL	
System Resilience	S1
Employment	S2
Ratepayer Distribution	S3
Recreation and Open Space	S4
Property Values	S5
Fiscal Impacts	S6
ENVIRONMENTAL	
Marine Water	E1
Fresh Water	E2
Habitat	E3
Climate	E4
FINANCIAL	
Municipal Capital Costs	F1
Municipal Other Costs	F2
Property Owner Capital Costs	F3
Property Owner Other Costs	F4

## Strategy/Technology Distribution



## COST & PERFORMANCE

Nitrogen Reduction %	30%	52%	61%
Remaining Nitrogen Load (Kg N)	8,400	5,760	4,680
Life Cycle Costs (\$K)	\$5,922	\$7,350	\$9,800
Municipal O&M Cost (\$K)	\$325	\$425	\$610
Municipal Project Cost (\$K)	\$1,329	\$1,600	\$1,800
Property Owner O&M Cost (\$K)	\$98	\$128	\$183
Property Owner Project Cost (\$K)	\$397	\$480	\$540

## COMMUNITY BENEFITS

Quality Habitat (acres)	0.5	1.8	2.4
New Open Space Added (acres)	1.5	4.6	5.0
GHG Reduced (MT CO2e/yr)	2.1	3.1	3.3
Avg. Increase in Property Value (\$/pty)	\$200	\$1,200	\$2,000
New Employment Added (jobs)	152	188	252
Additional Cost per Household (\$/HH/yr)	\$20	\$26	\$37

# 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

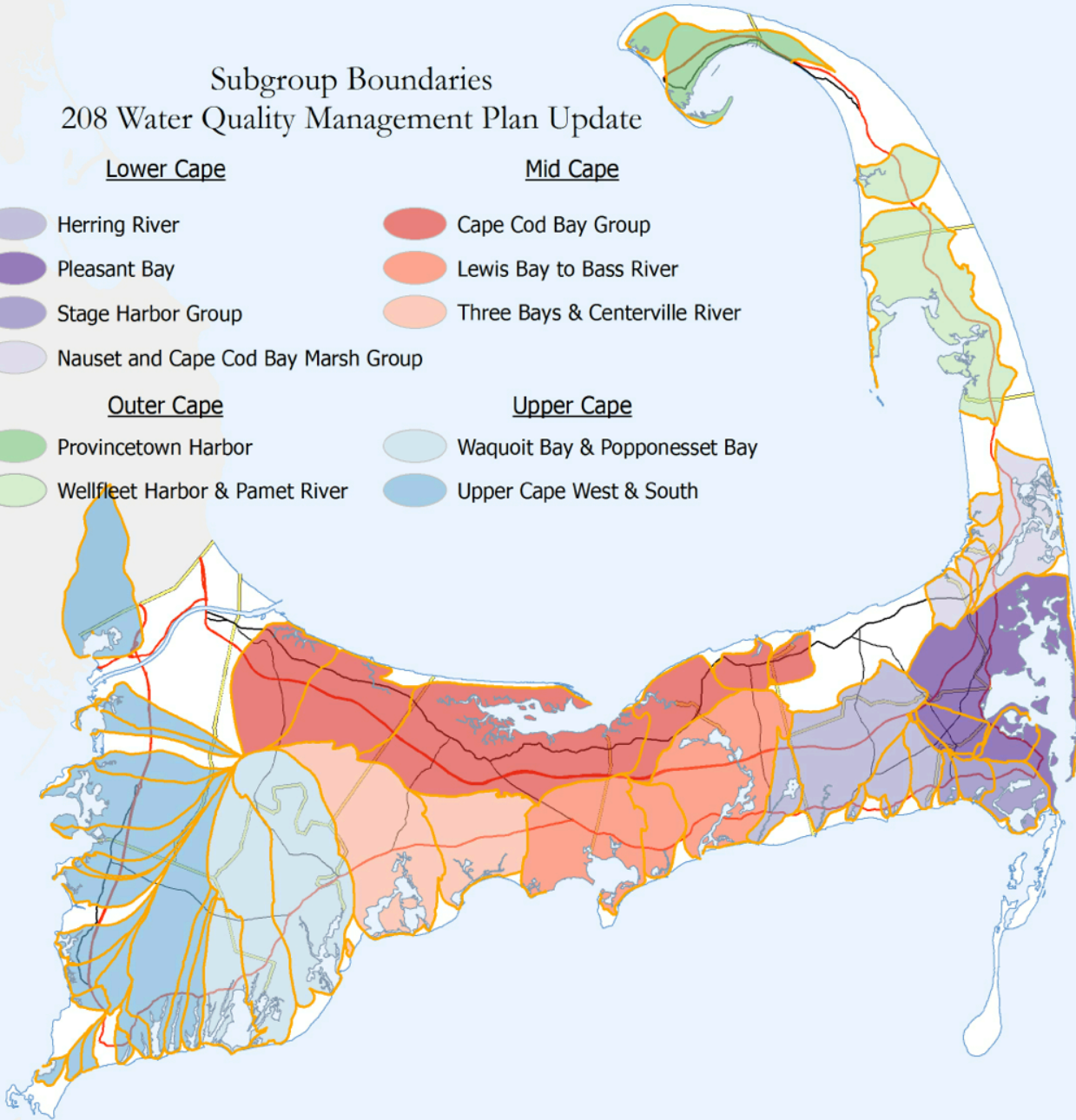
- Cape Cod Bay Group
- Lewis Bay to Bass River
- Three Bays & Centerville River

### Outer Cape

- Provincetown Harbor
- Wellfleet Harbor & Pamet River

### Upper Cape

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



# Area Boundaries 208 Water Quality Management Plan Update

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

