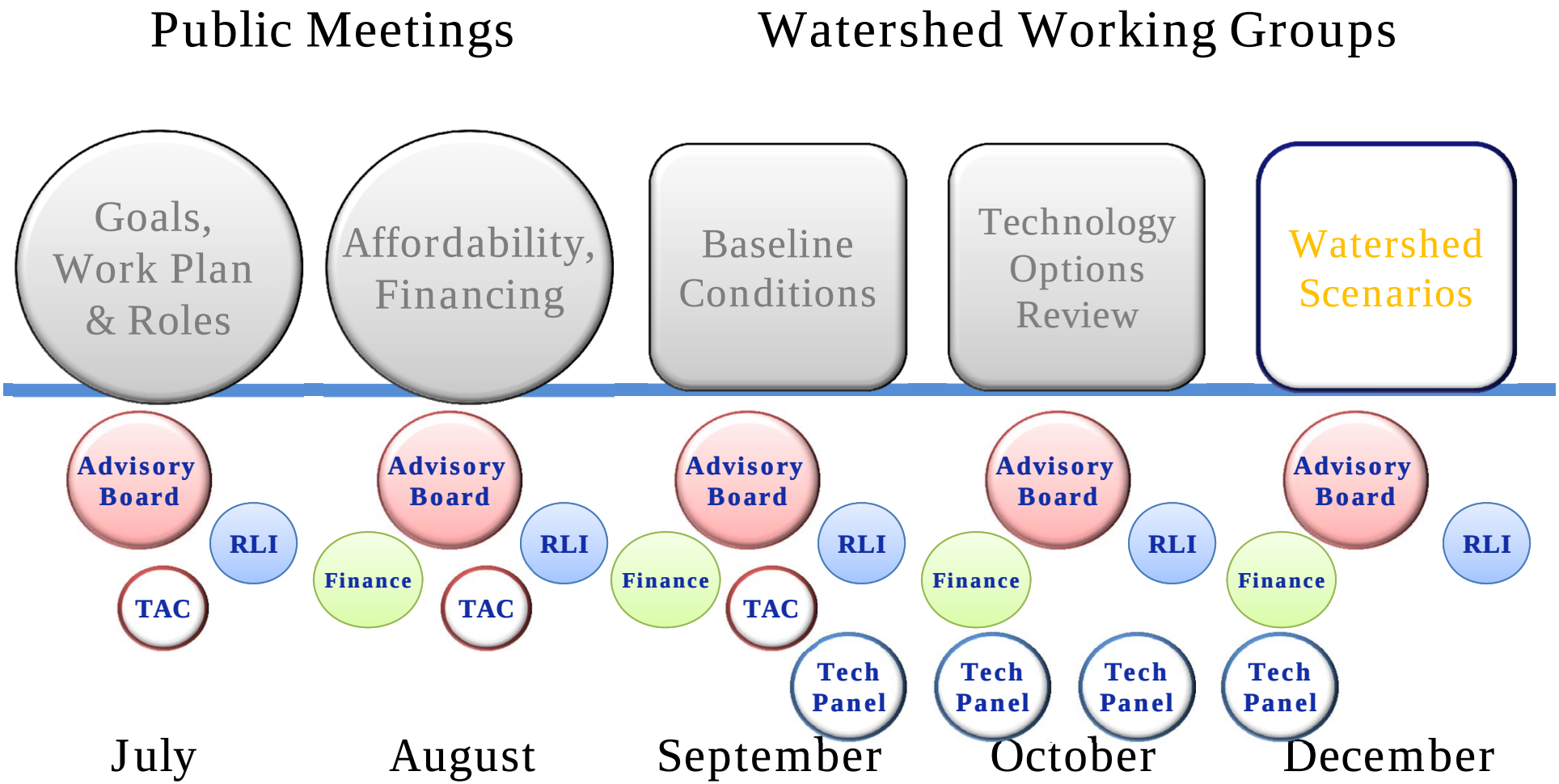
Wellfleet Harbor & Pamet River Group

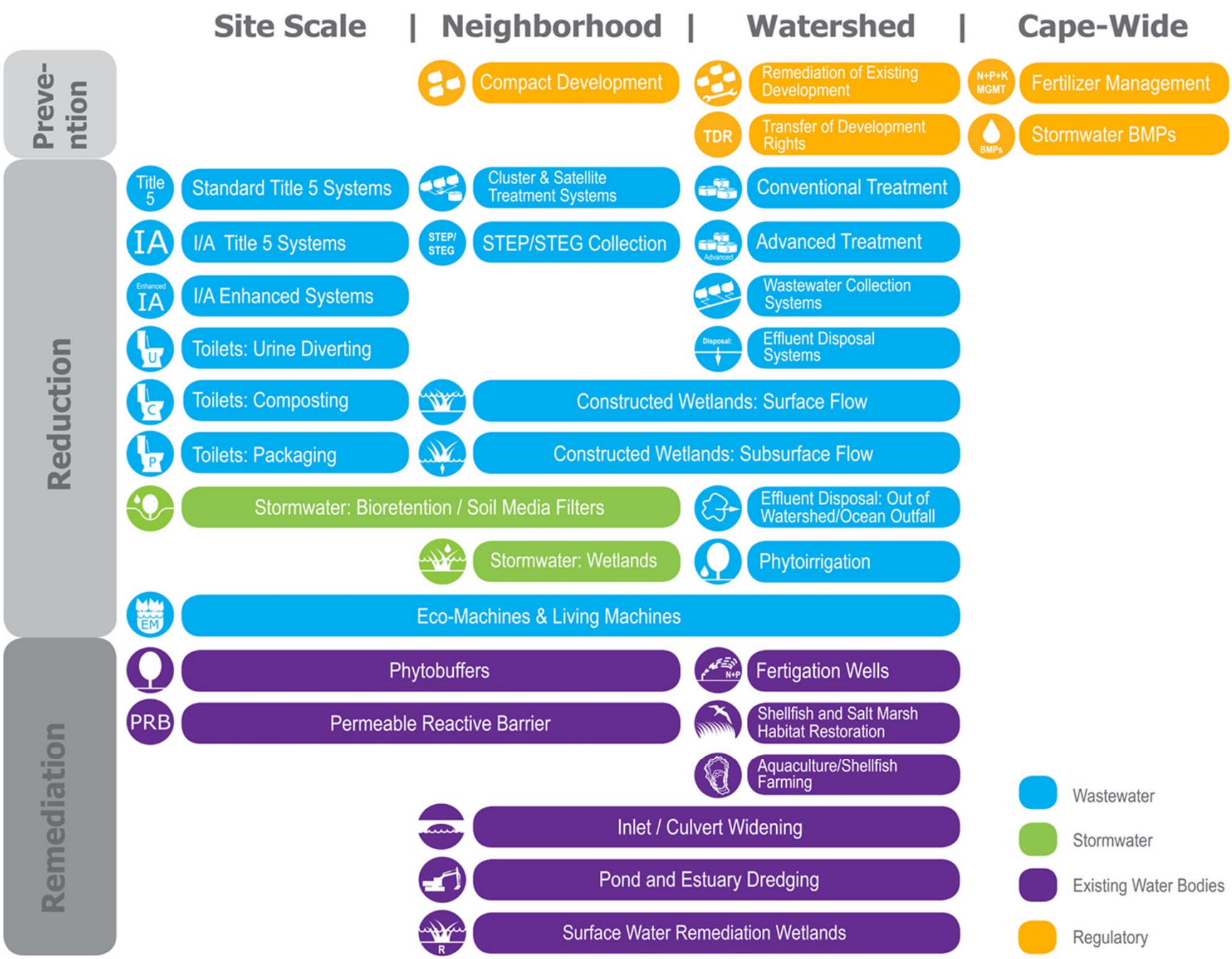
Watershed Scenarios



RLI — Regulatory, Legal & Institutional Work Group

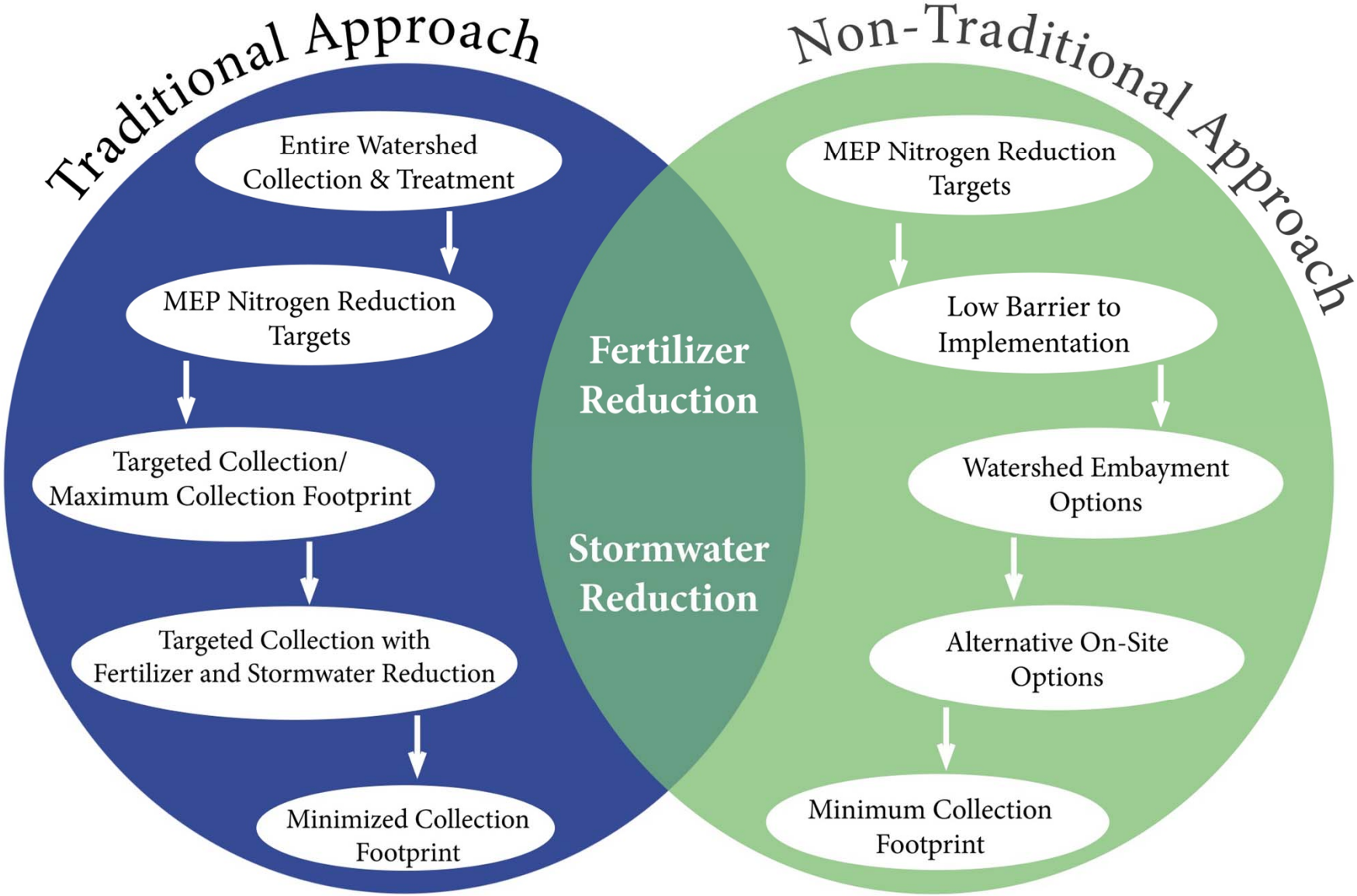
TAC — Technical Advisory Committee of Cape Cod Water Protection Collaborative

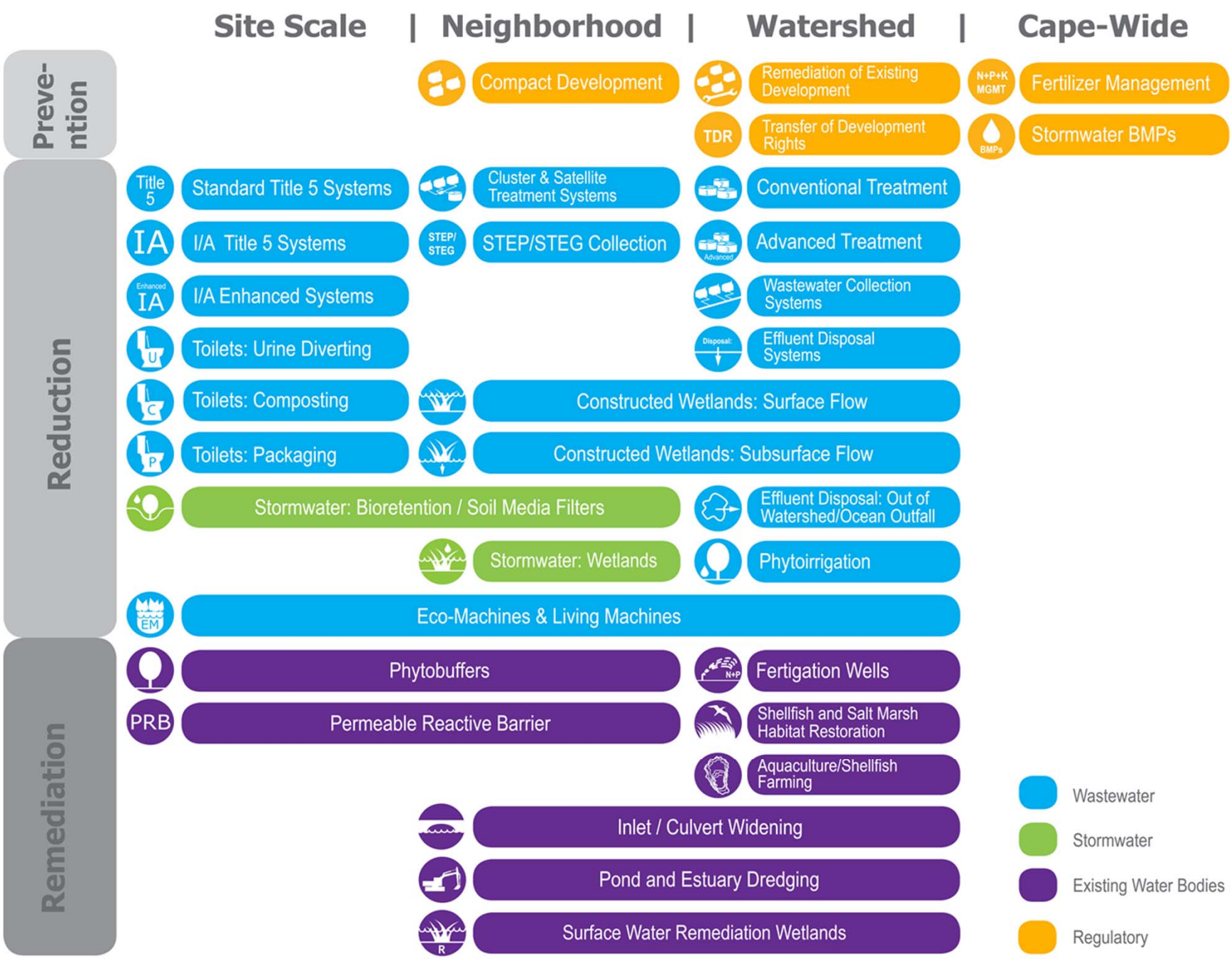
208 Planning Process


Site Scale | Neighborhood | Watershed | Cape-Wide
Preve-ntion
Reduction
Remediation
Compact Development
Remediation of Existing Development
Fertilizer Management
Transfer of Development Rights
Stormwater BMPs
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
Phytoirrigation
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
Wastewater
Stormwater
Existing Water Bodies
Regulatory

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.


Traditional Approach
Entire Watershed Collection & Treatment
MEP Nitrogen Reduction Targets
Targeted Collection/ Maximum Collection Footprint
Targeted Collection with Fertilizer and Stormwater Reduction
Minimized Collection Footprint
Fertilizer Reduction
Stormwater Reduction
Non-Traditional Approach
MEP Nitrogen Reduction Targets
Low Barrier to Implementation
Watershed Embayment Options
Alternative On-Site Options
Minimum Collection Footprint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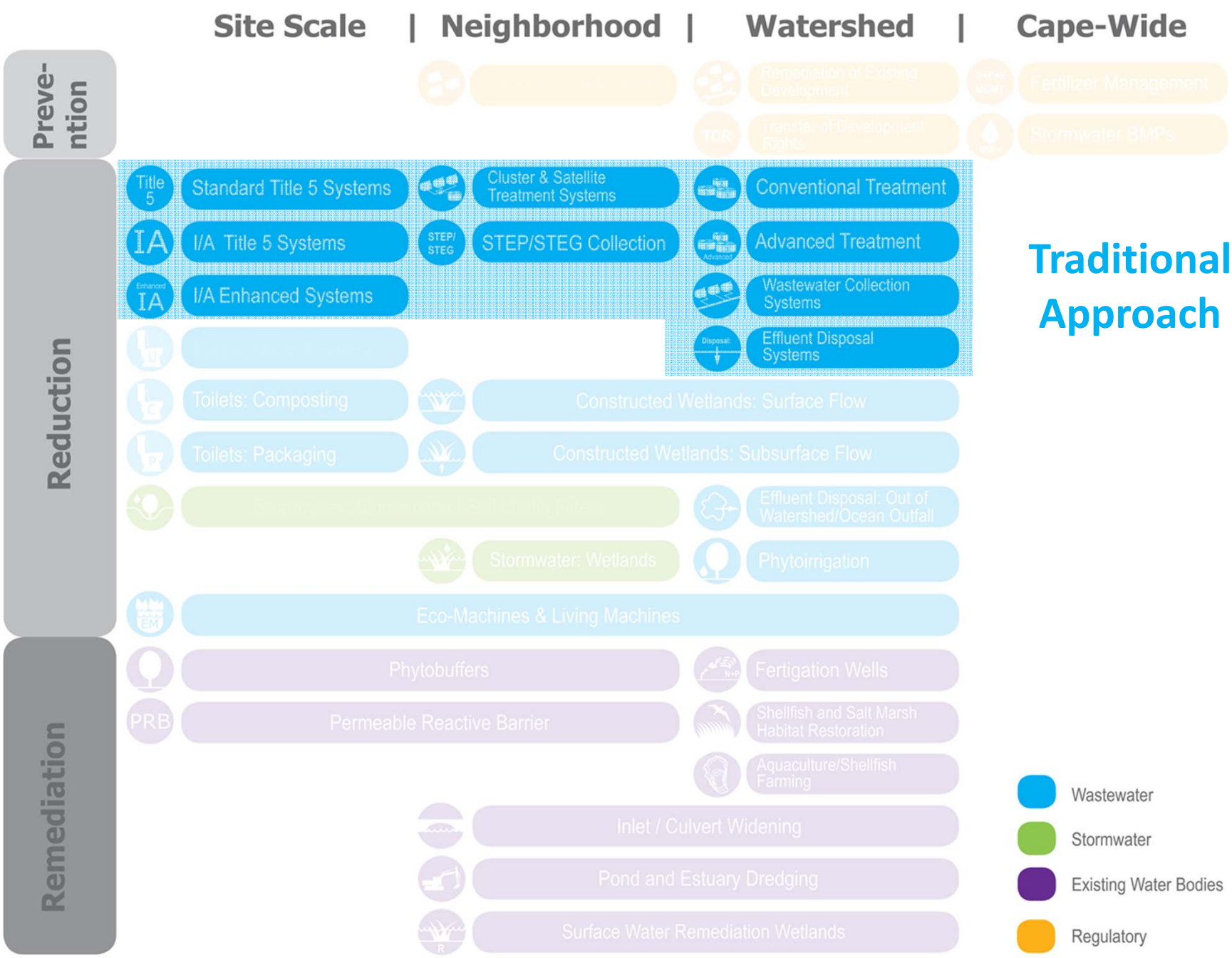
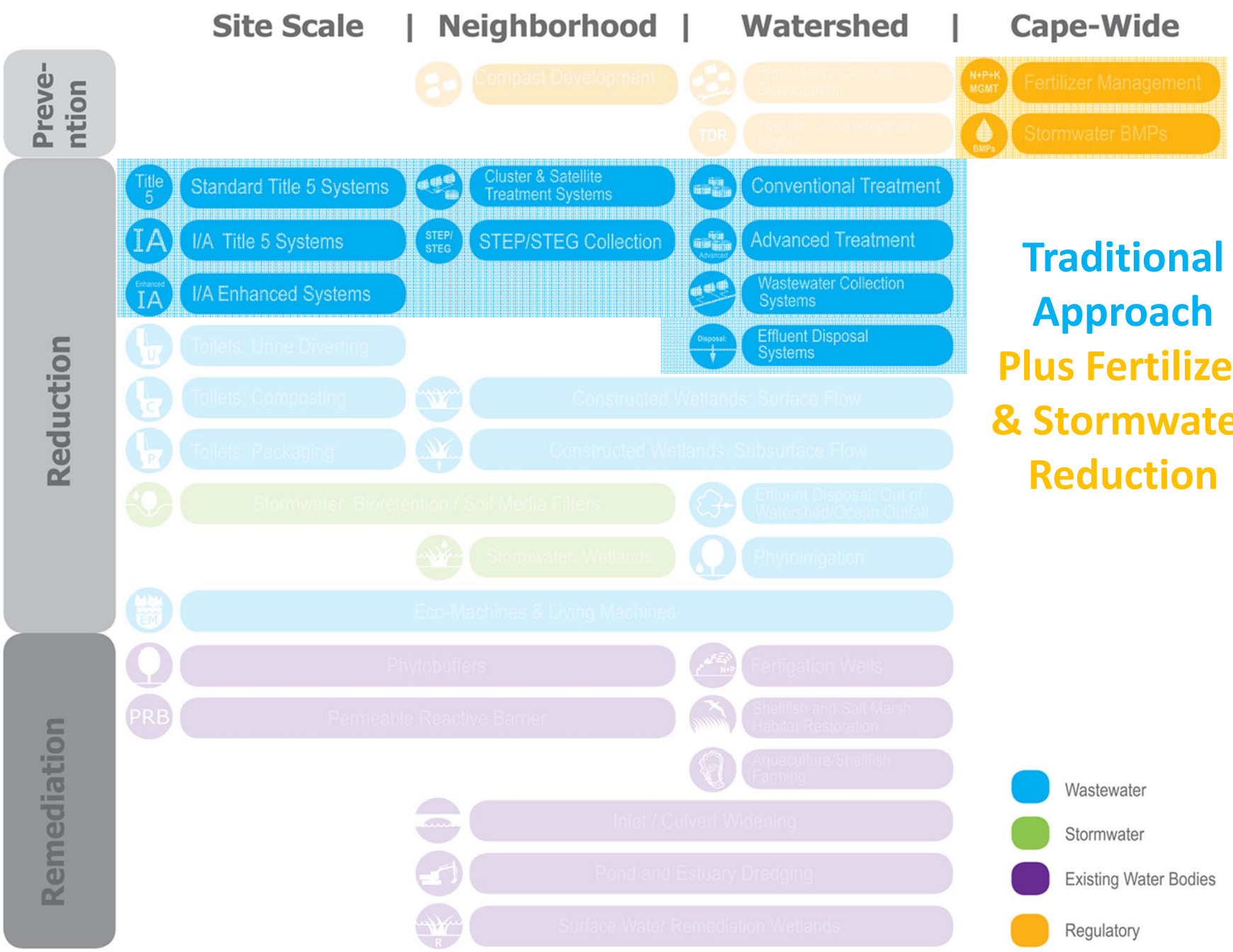
Stormwater
Existing Water Bodies
Regulatory



Traditional Approach


Site Scale | Neighborhood | Watershed | Cape-Wide
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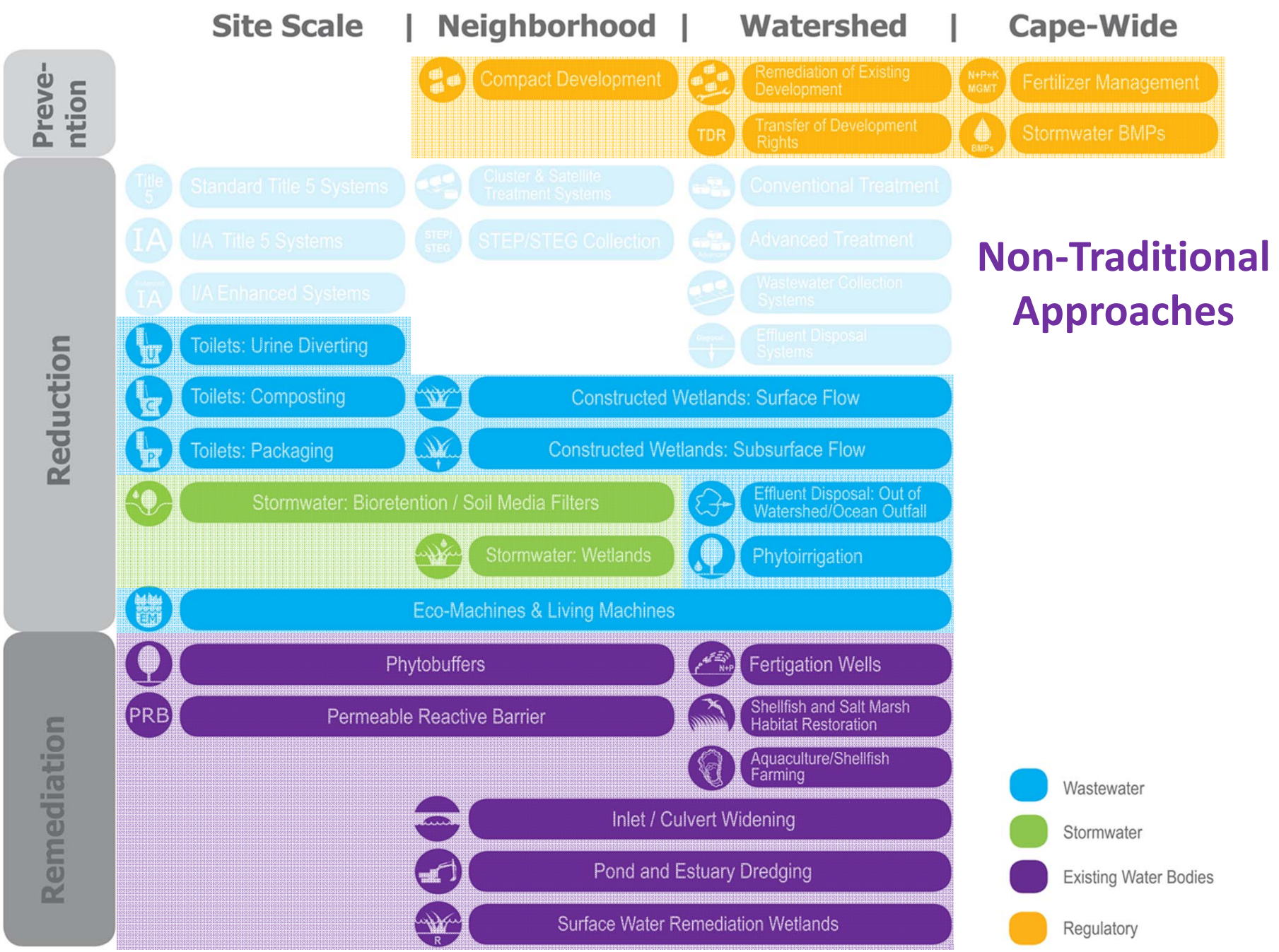
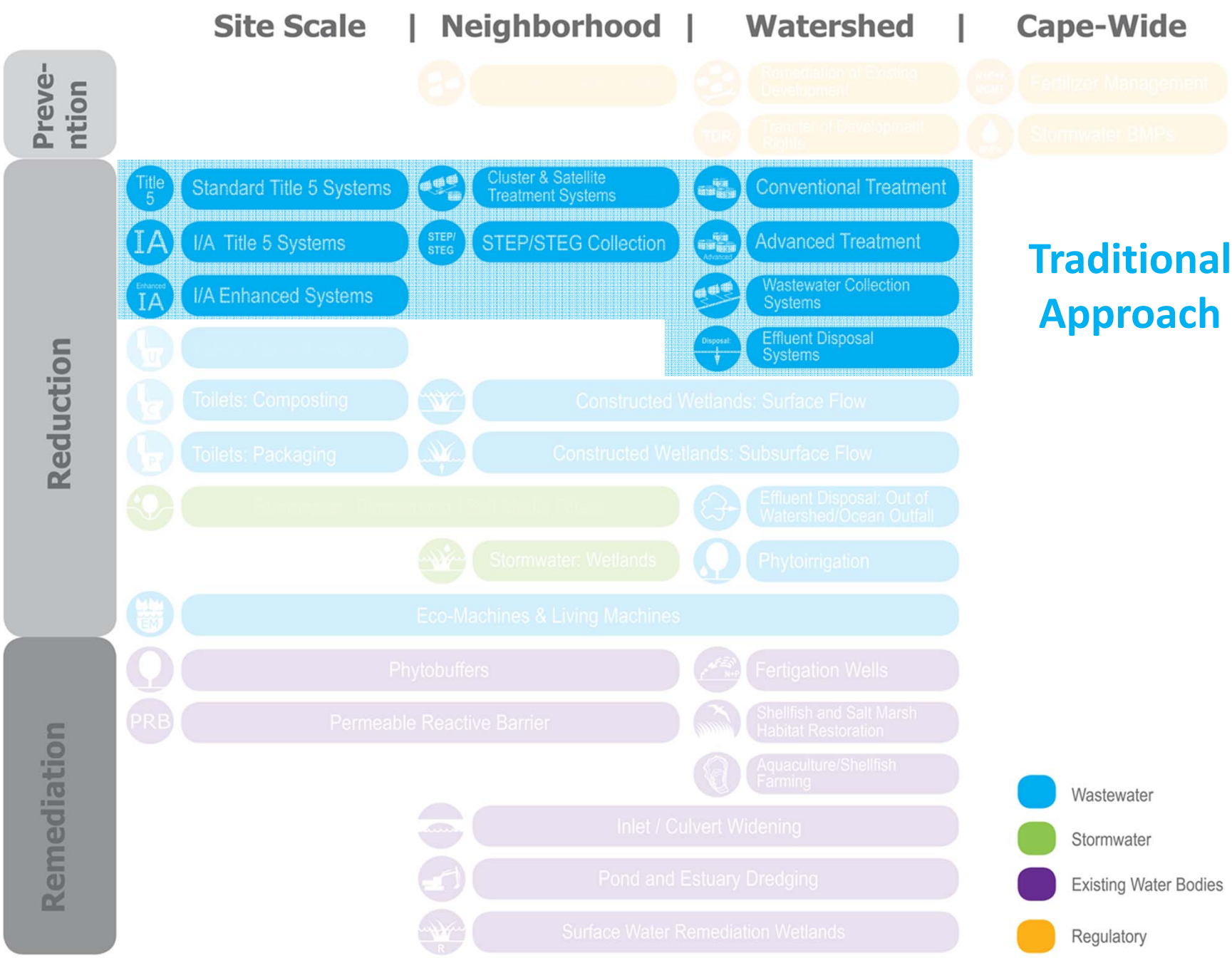
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands
Traditional Approach Plus Fertilizer & Stormwater Reduction
Wastewater
Stormwater
Existing Water Bodies
Regulatory

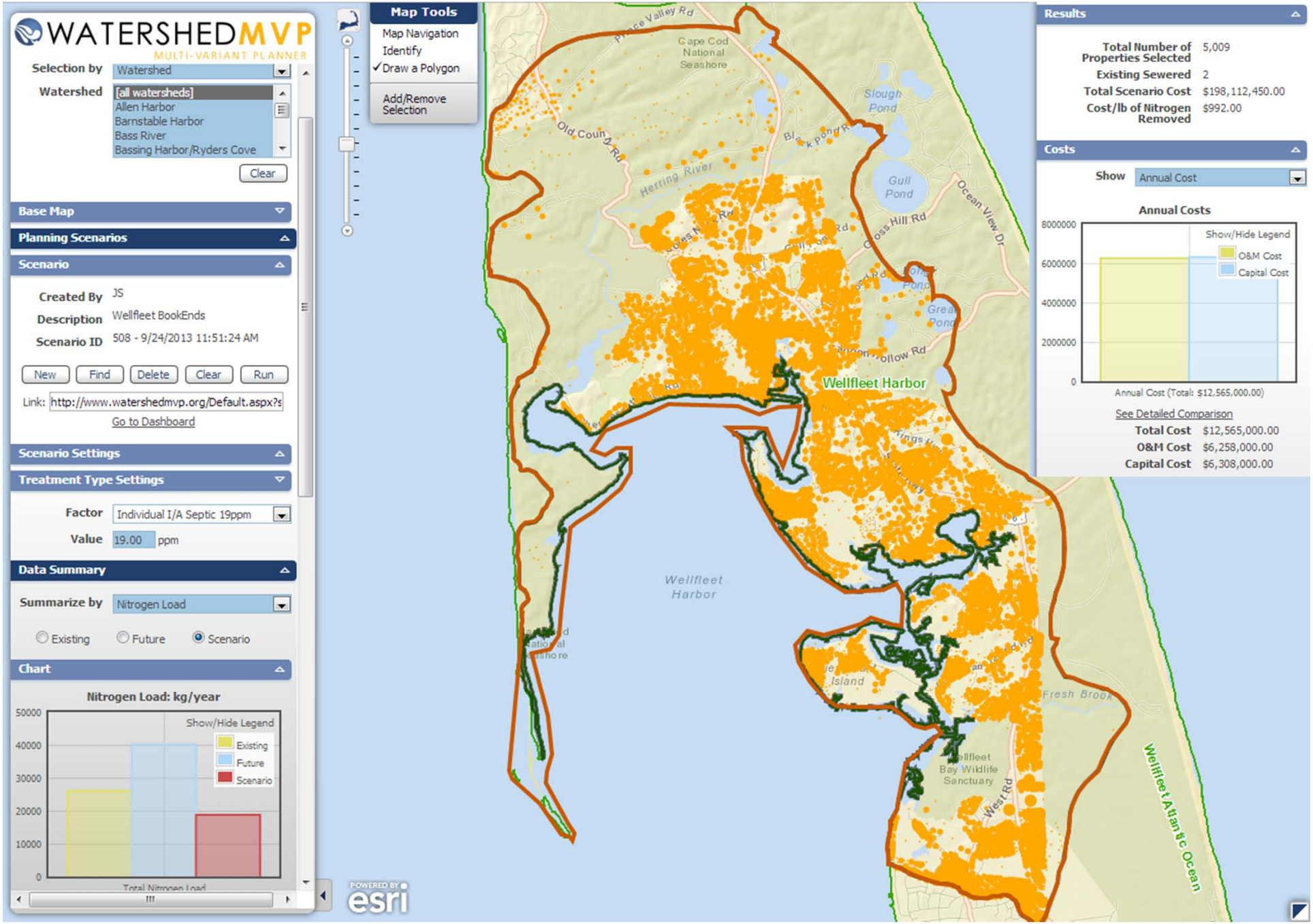


Non-Traditional Approaches

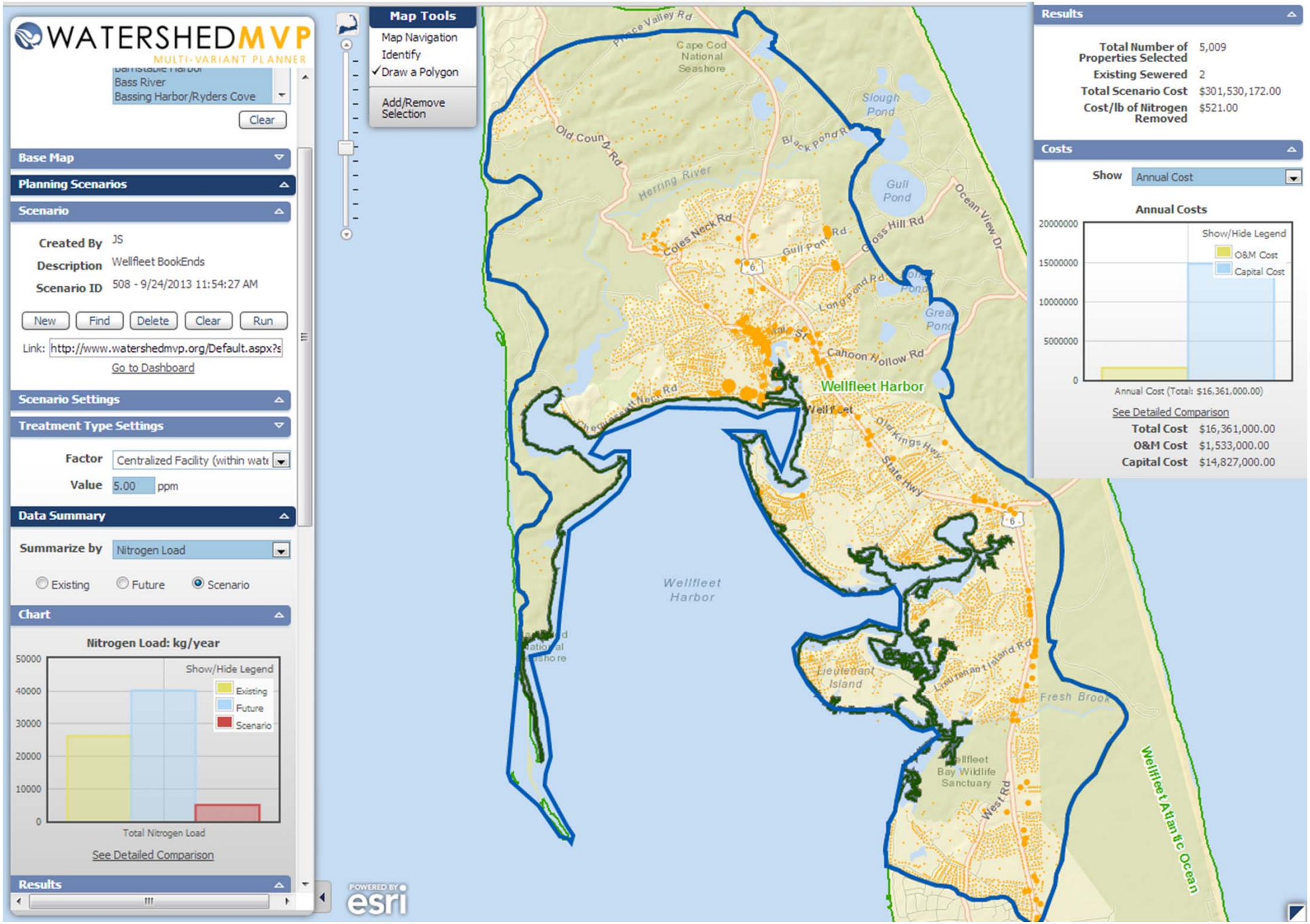


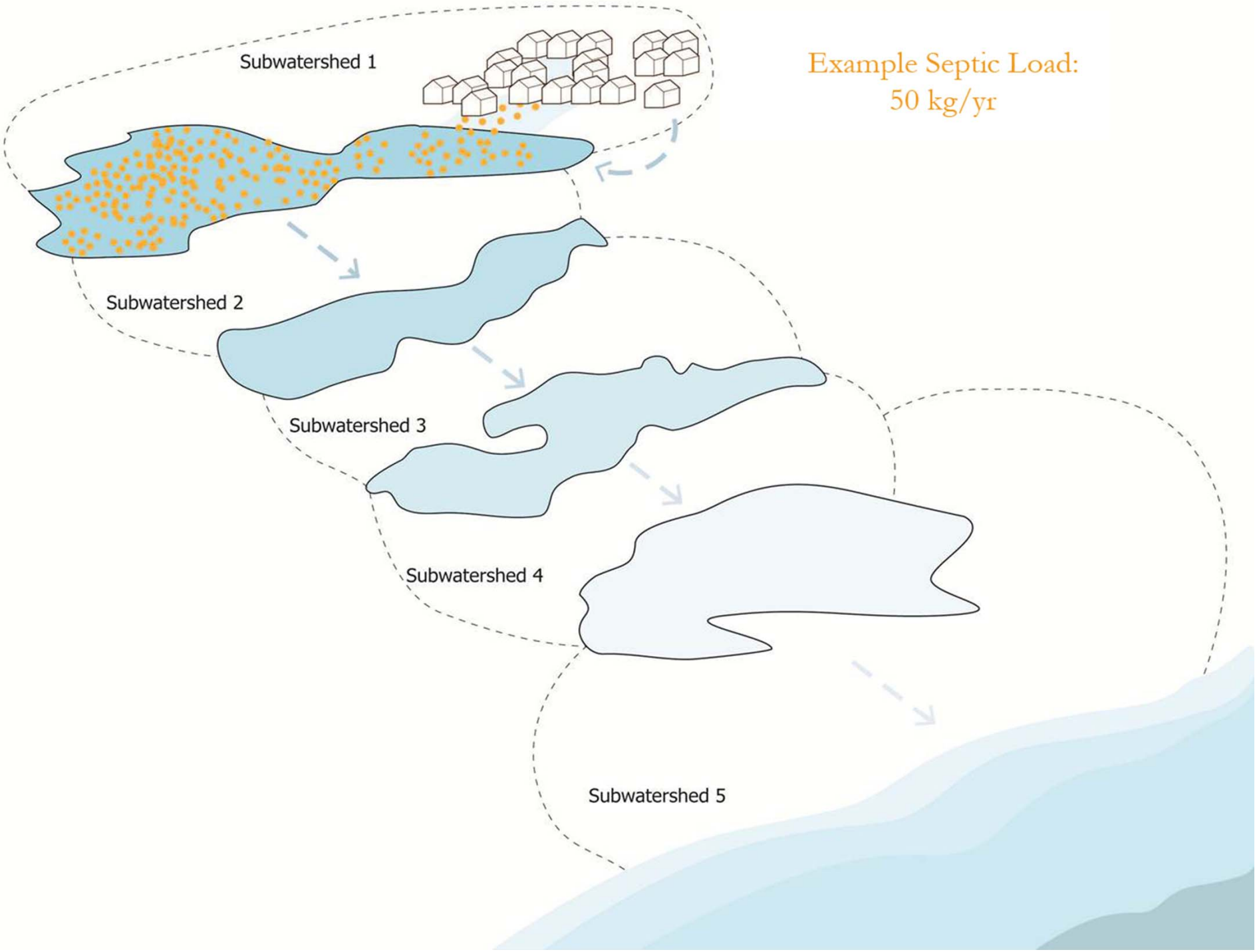
Traditional Approach

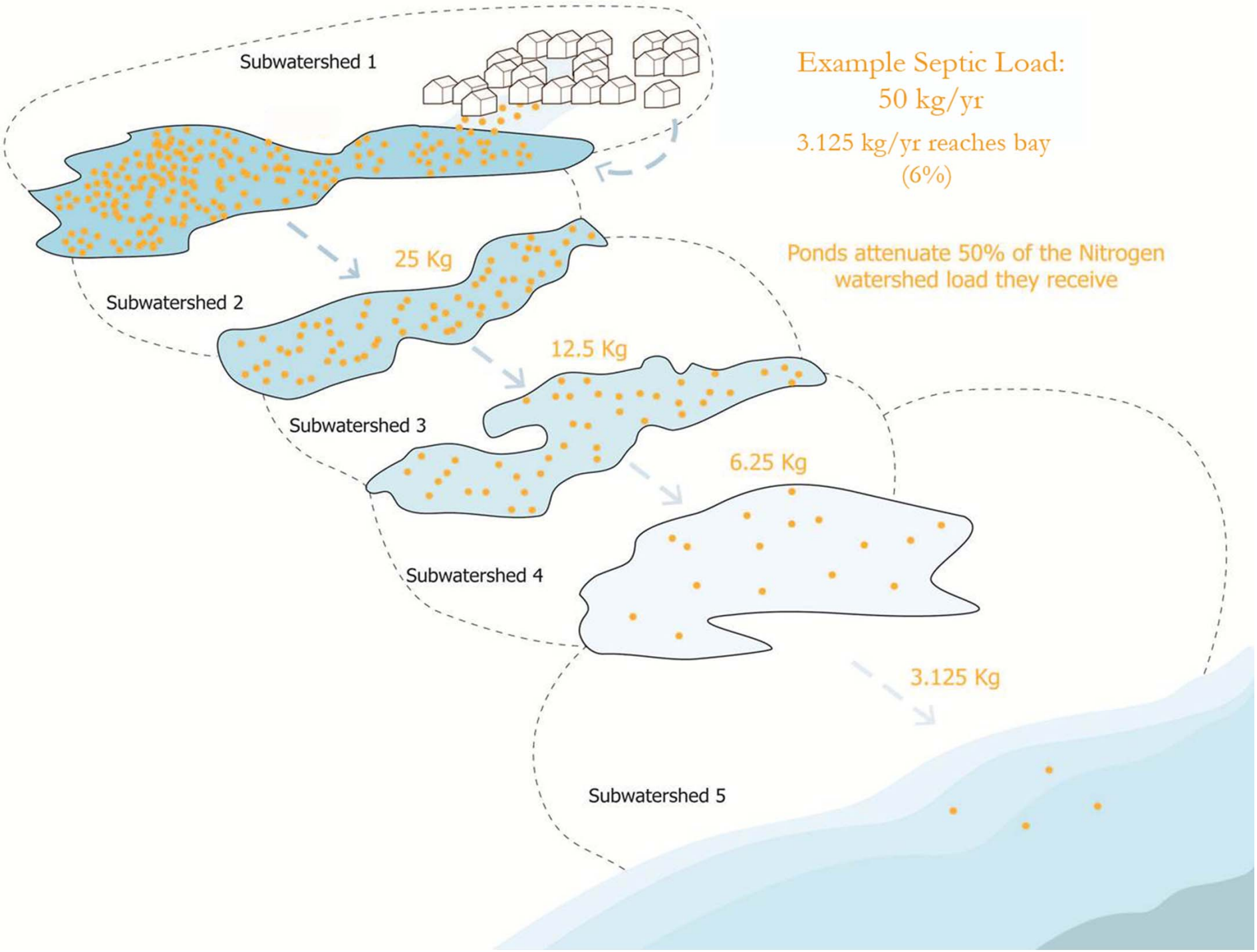
Watershed-Wide Innovative/Alternative (I/A) Onsite Systems

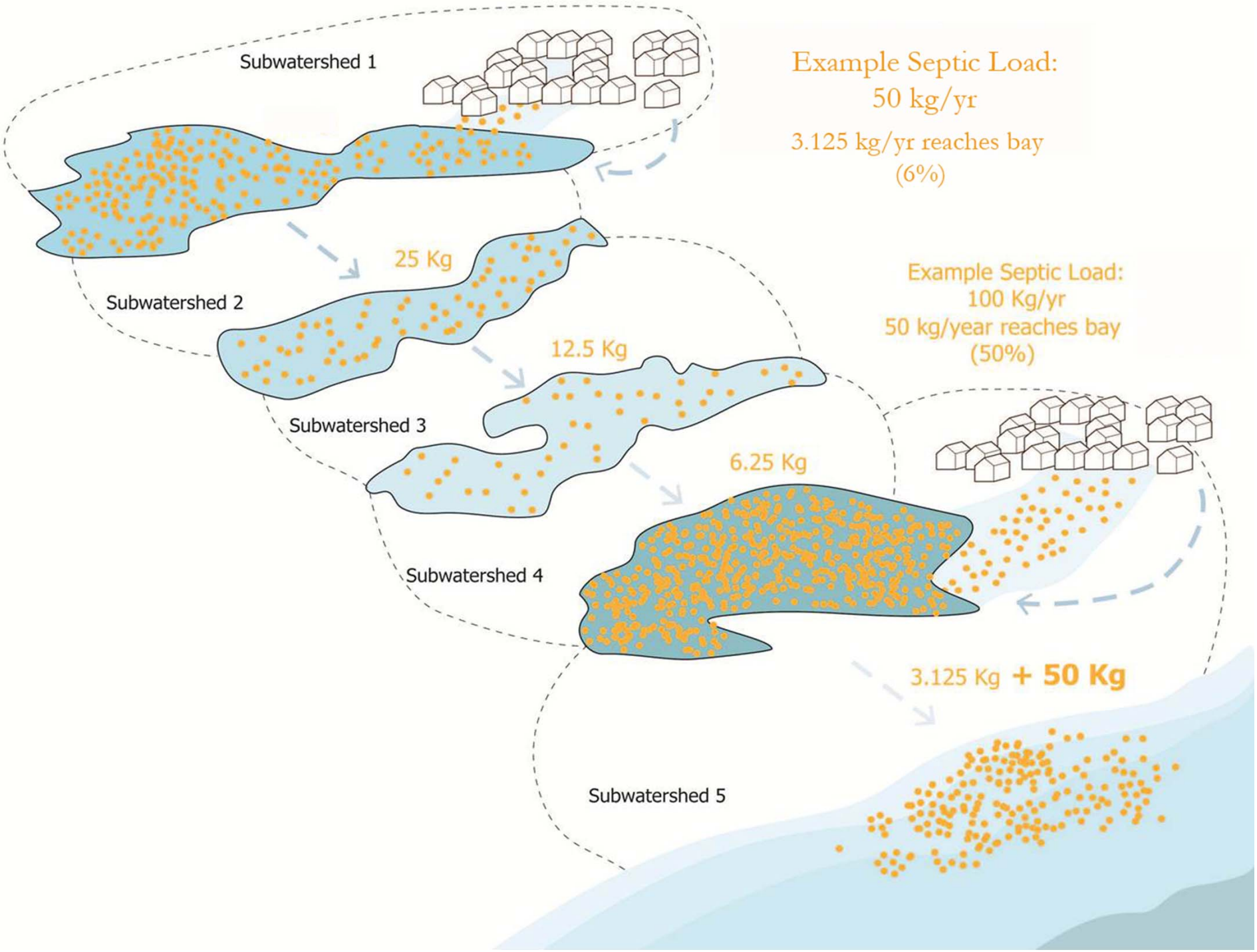


Watershed-Wide Centralized Treatment with Disposal Inside the Watershed

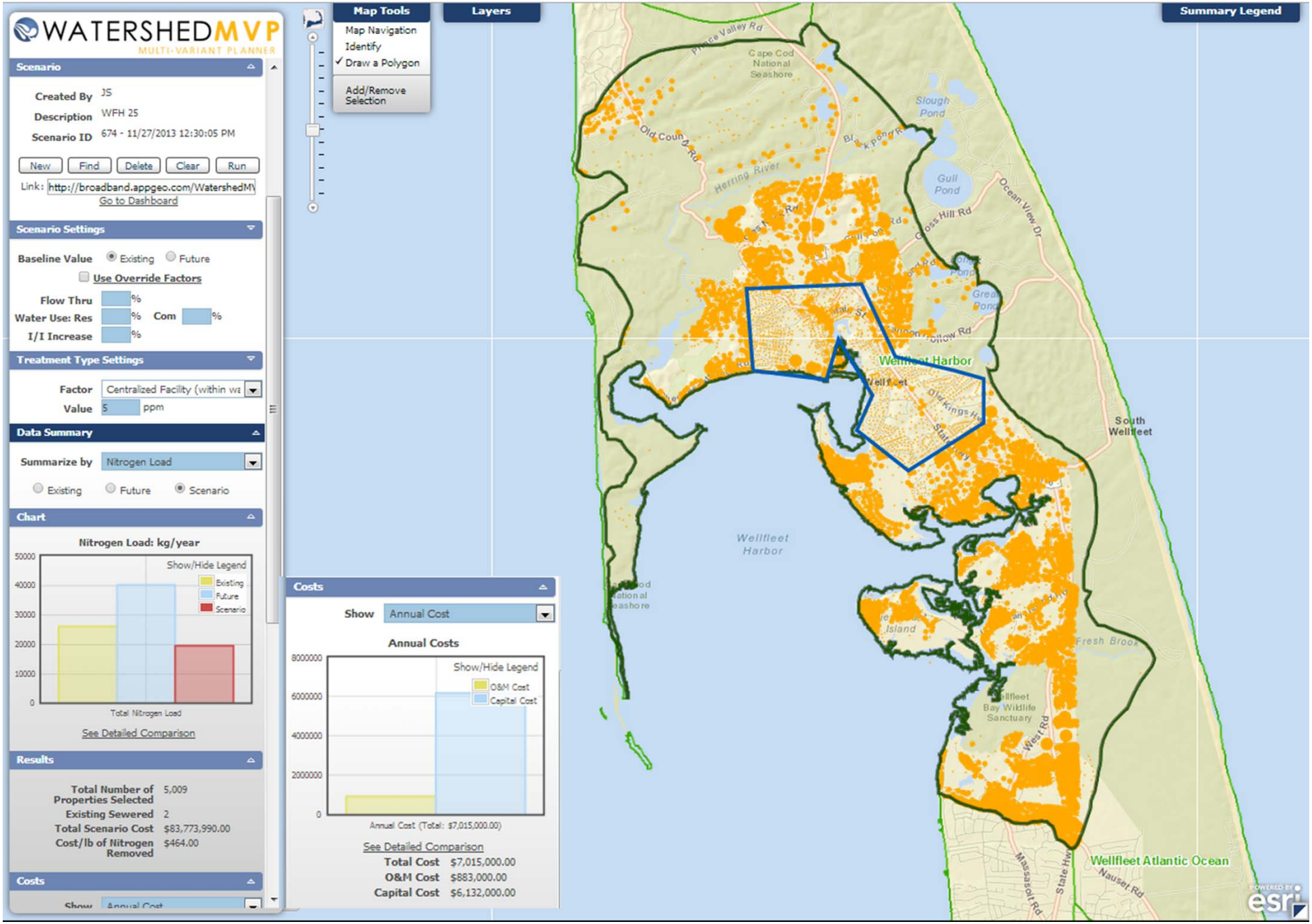



Subwatershed 1
Example Septic Load:
50 kg/yr
Subwatershed 2
Subwatershed 3
Subwatershed 4
Subwatershed 5

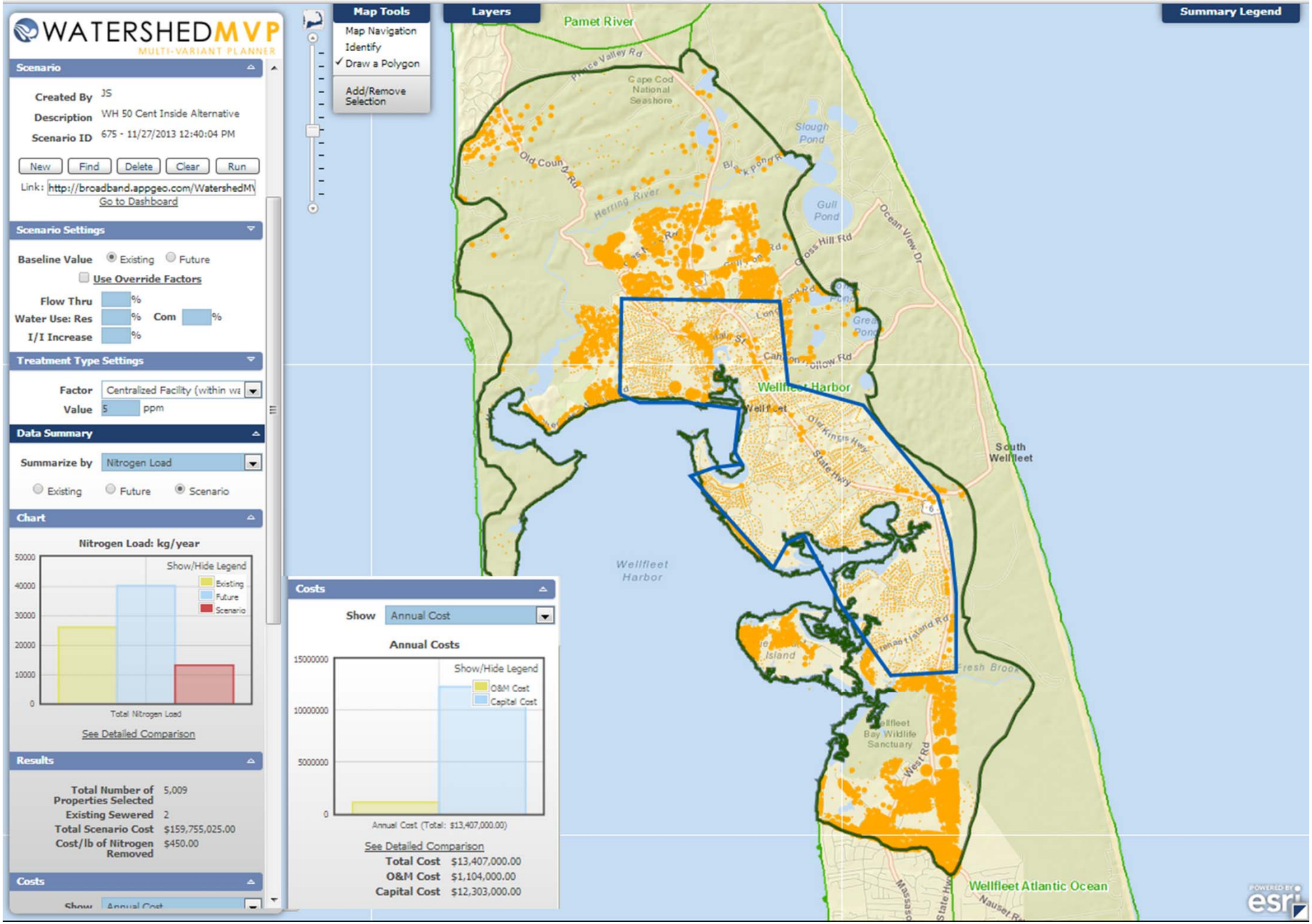

Subwatershed 1
Example Septic Load:
50 kg/yr
3.125 kg/yr reaches bay
(6%)
25 Kg
Subwatershed 2
Ponds attenuate 50% of the Nitrogen
watershed load they receive
12.5 Kg
Subwatershed 3
6.25 Kg
Subwatershed 4
3.125 Kg
Subwatershed 5


Subwatershed 1
Example Septic Load:
50 kg/yr
3.125 kg/yr reaches bay
(6%)
25 Kg
Subwatershed 2
Example Septic Load:
100 Kg/yr
50 kg/year reaches bay
(50%)
12.5 Kg
Subwatershed 3
6.25 Kg
Subwatershed 4
3.125 Kg + 50 Kg
Subwatershed 5

Targeted Centralized Treatment to achieve a 25% Reduction in Nitrogen

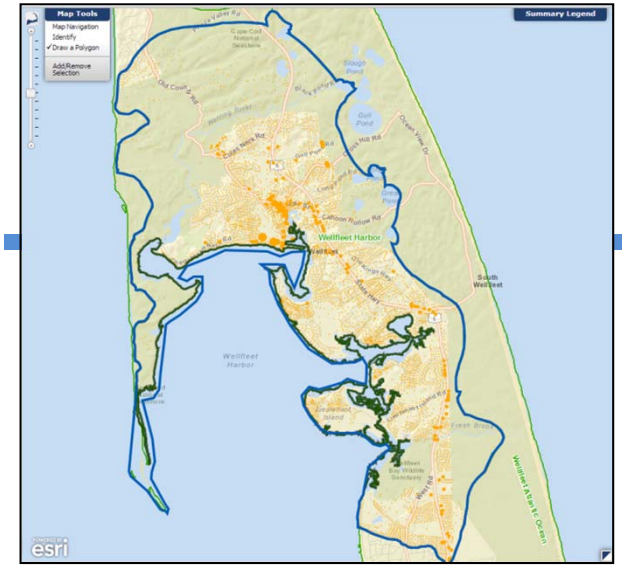


Targeted Centralized Treatment to achieve a 50% Reduction in Nitrogen



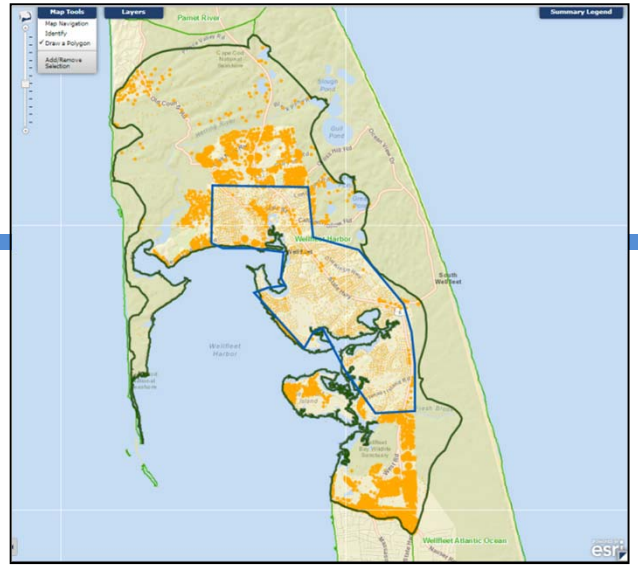
Scenario Comparison

Watershed-wide collection and treatment



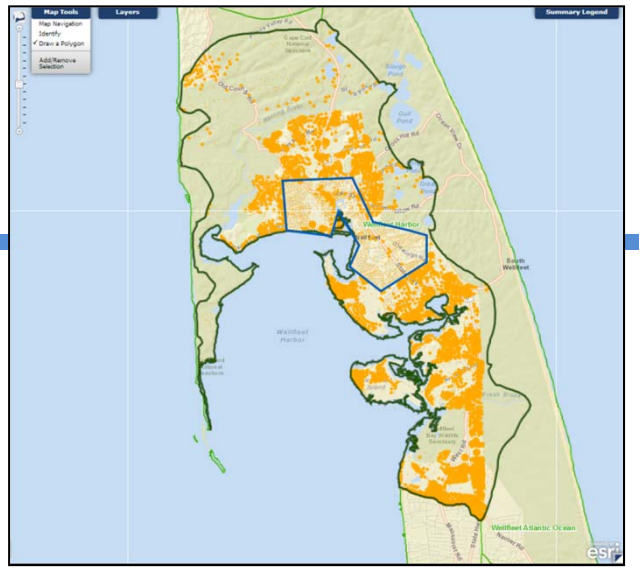
- Total Cost = $302 Million
- Cost/lb N = $521
- Treated Flow = 714,000 gpd

Targeted collection and treatment to achieve a 50% reduction in nitrogen



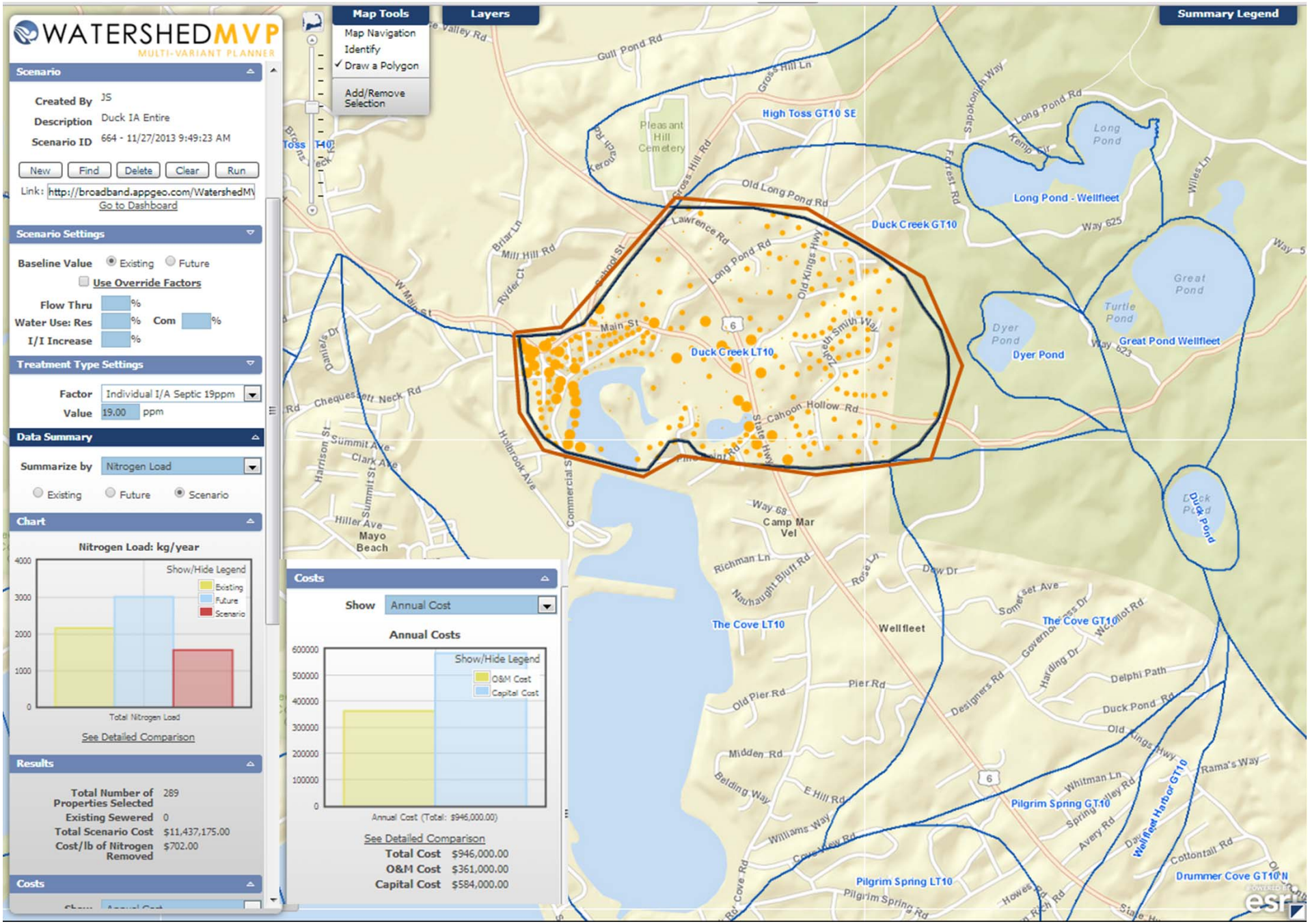
- Total Cost = $160 Million
- Cost/lb N = $450
- Treated Flow = 440,000 gpd

Targeted collection and treatment to achieve a 25% reduction in nitrogen

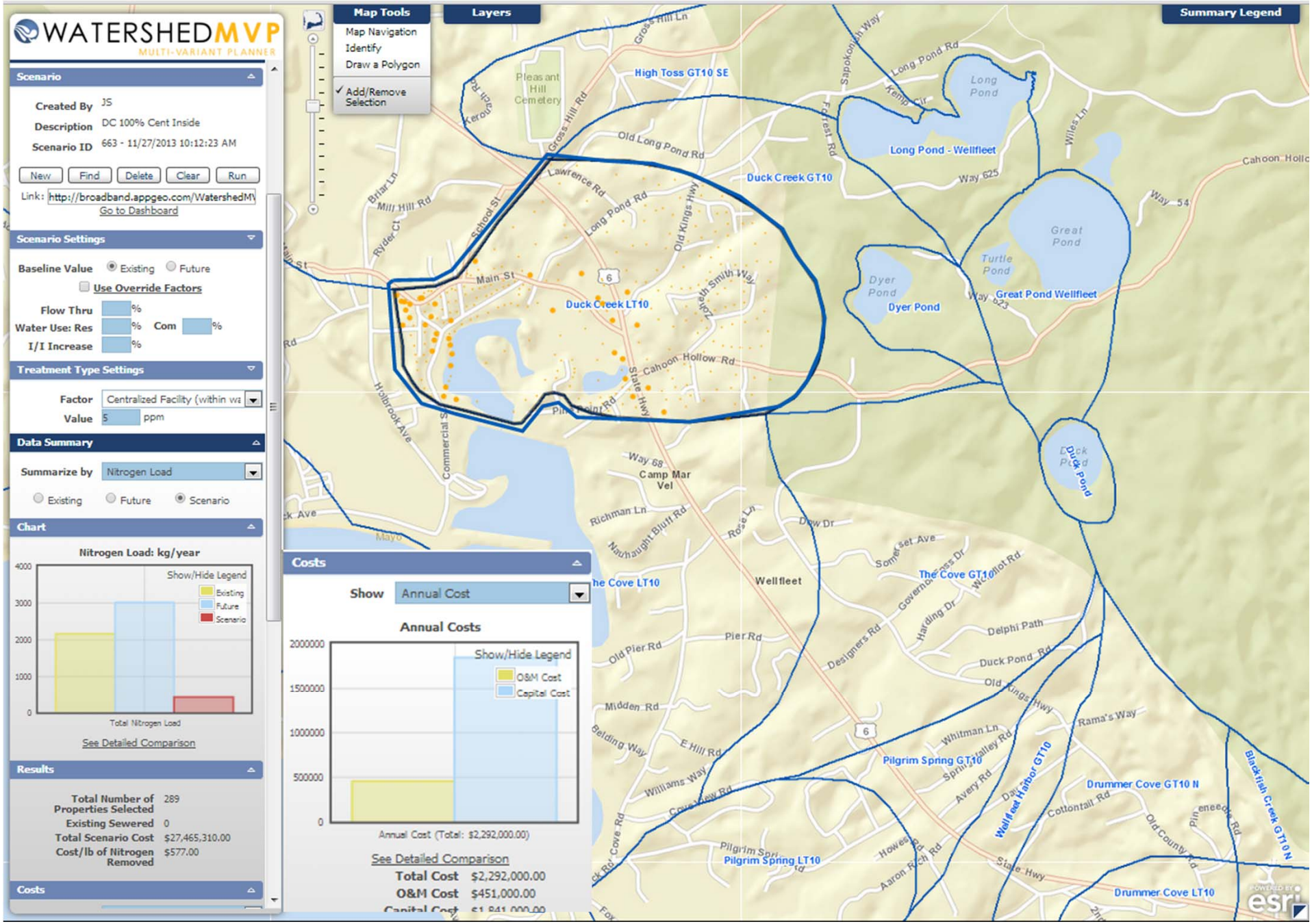


- Total Cost = $84 Million
- Cost/lb N = $464
- Treated Flow = 224,000 gpd

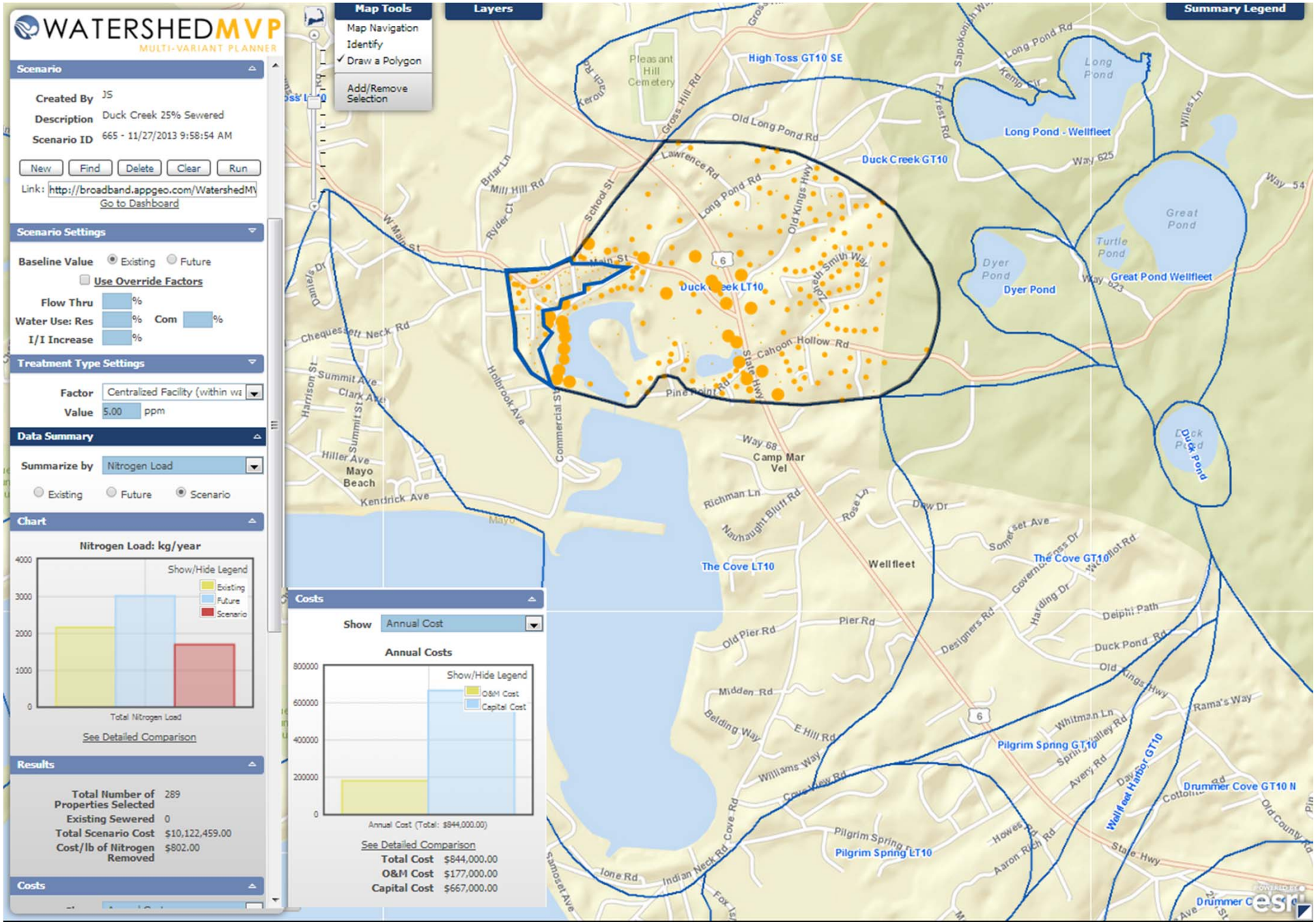
Duck Creek – Applying Innovative/Alternative On-Site Systems to the Entire Subwatershed



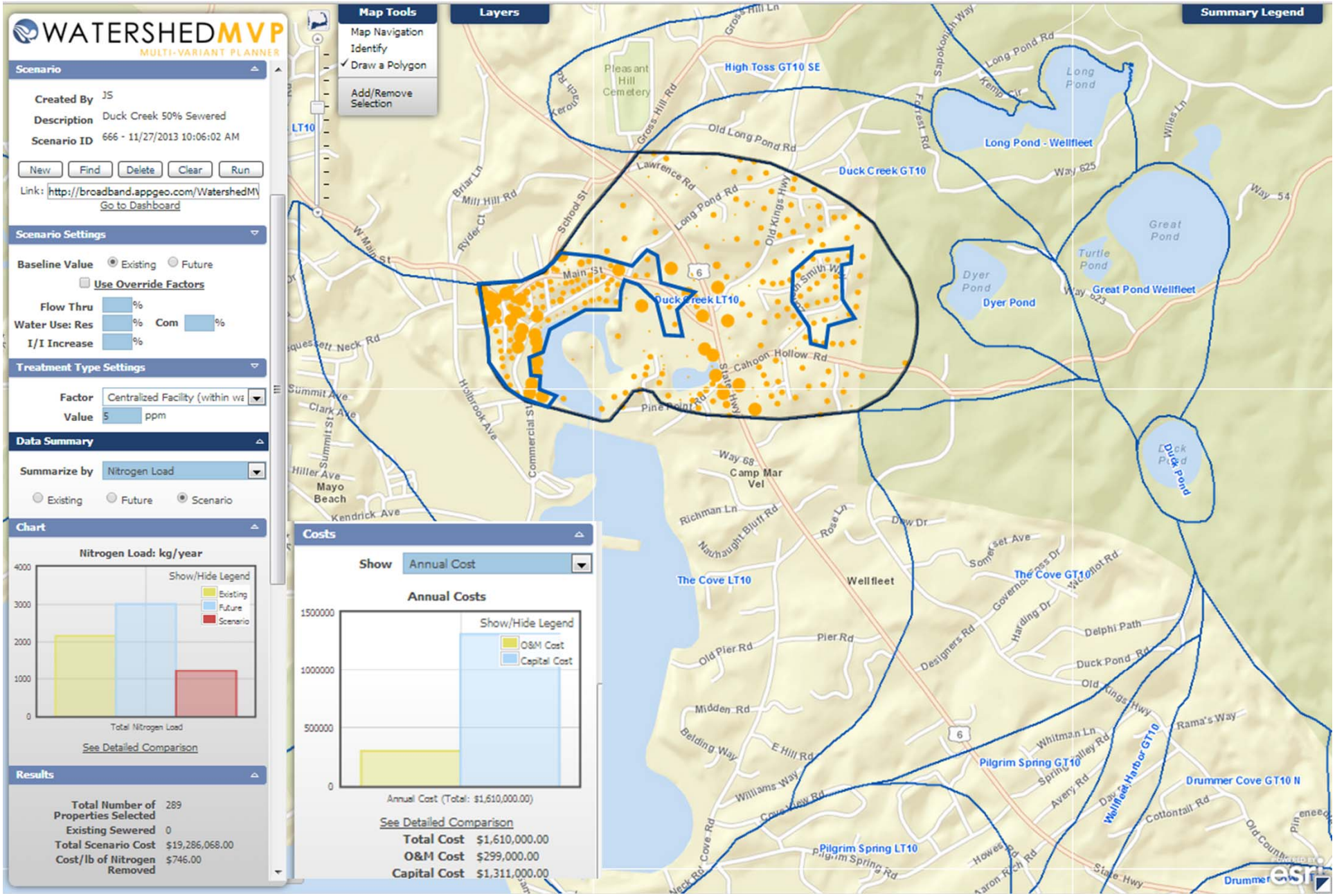
Duck Creek – Applying Centralized Treatment to the Entire Subwatershed



Duck Creek – Targeted Centralized Treatment to achieve a 25% Reduction in Nitrogen

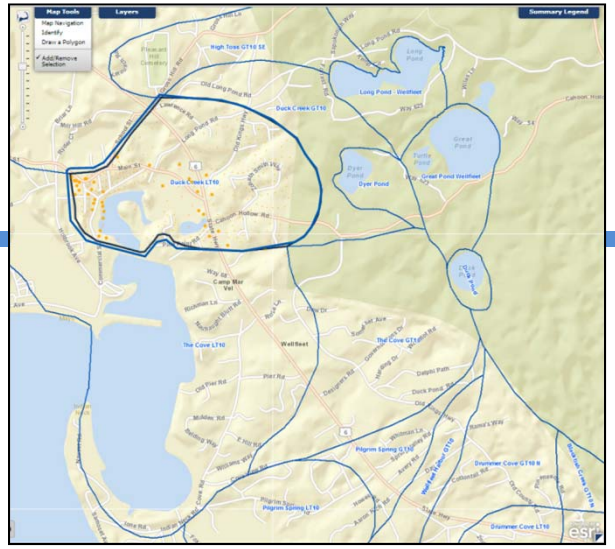


Duck Creek – Targeted Centralized Treatment to achieve a 50% Reduction in Nitrogen



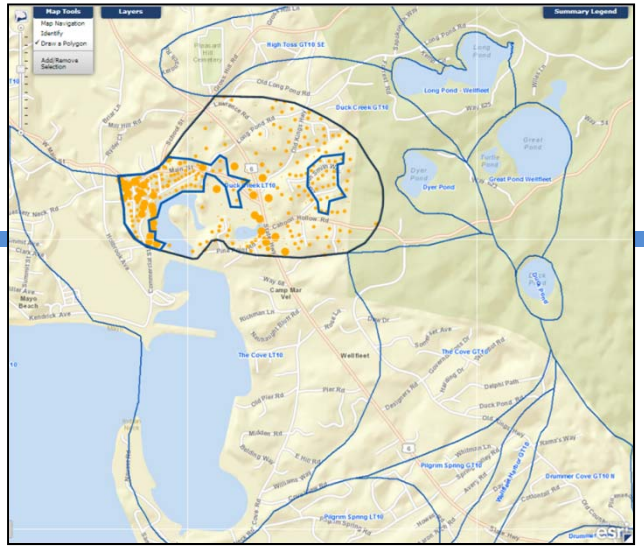
Scenario Comparison

Subwatershed-wide collection and treatment



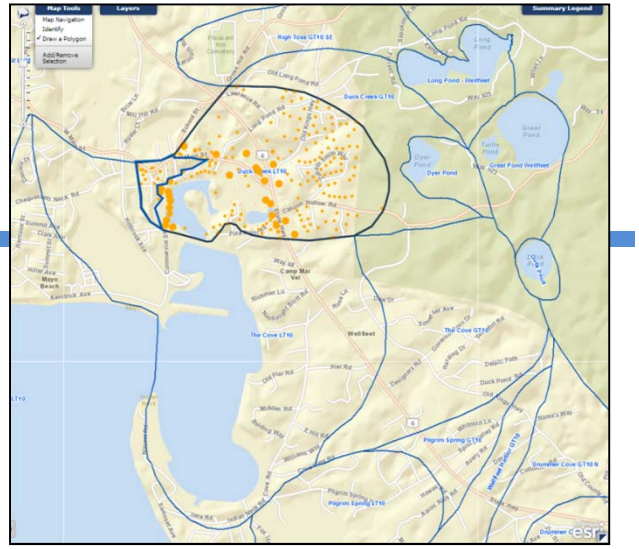
- Total Cost = $27 Million
- Cost/lb N = $577
- Treated Flow = 59,000 gpd

Targeted collection and treatment to achieve a 50% reduction in nitrogen

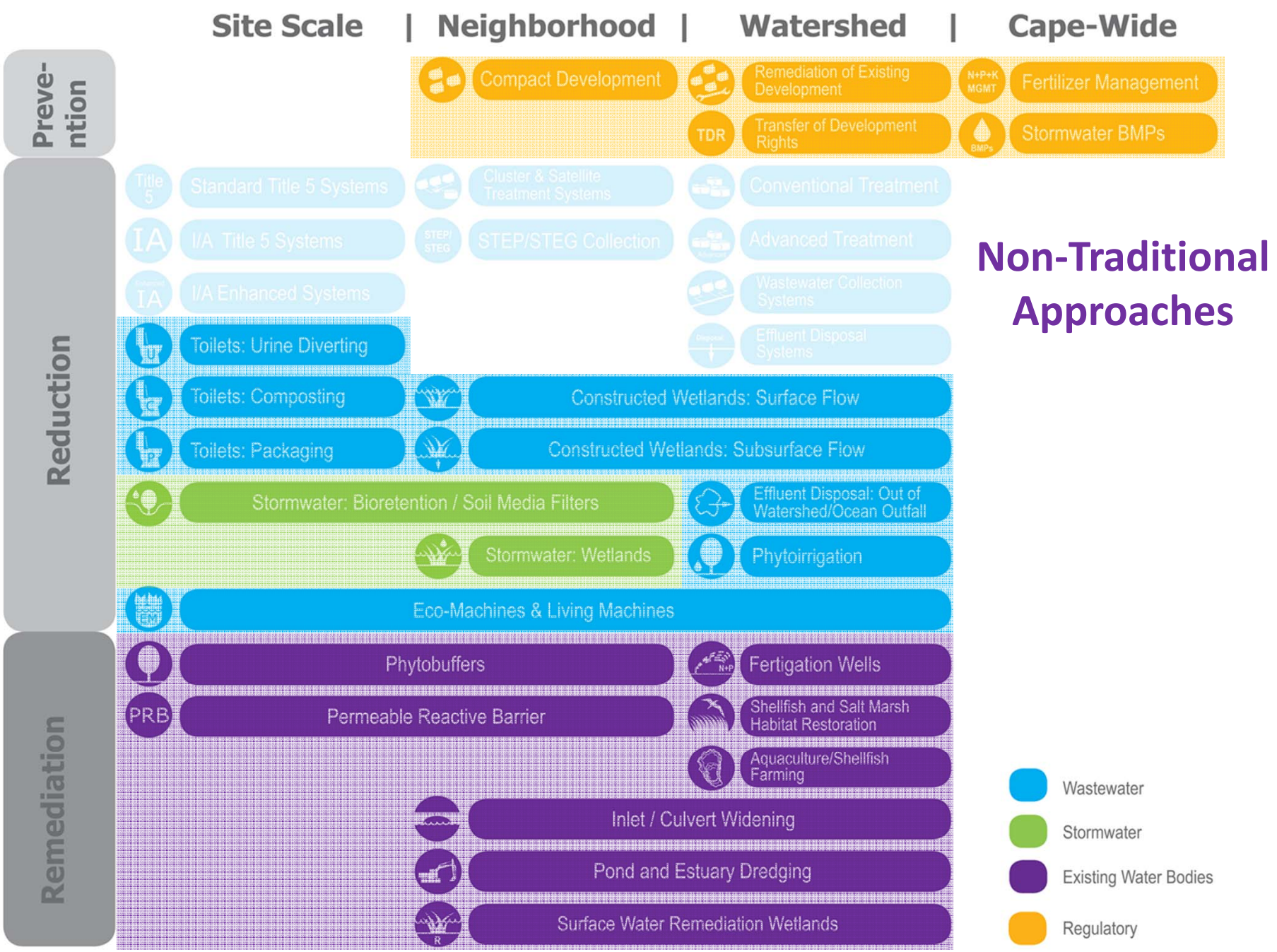


- Total Cost = $19 Million
- Cost/lb N = $746
- Treated Flow = 32,000 gpd

Targeted collection and treatment to achieve a 25% reduction in nitrogen



- Total Cost = $10 Million
- Cost/lb N = $802
- Treated Flow = 16,000 gpd


Site Scale | Neighborhood | Watershed | Cape-Wide
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Remediation
Compact Development
Remediation of Existing Development
N+P+K MGMT
Fertilizer Management
TDR
Transfer of Development Rights
BMPs
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/STEG
STEP/STEG Collection
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IA
I/A Enhanced Systems
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Eco-Machines & Living Machines
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
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
N+P+K MGMT
BMPs
Watershed/Embayment Options
A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture
PRB
R
Alternative On-Site Options
A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems
Title 5
Enhanced IA
IA
Priority Collection/High-Density Areas
A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones
Advanced
Disposal:
STEP/ STEG
Supplemental Sewering
Advanced

Watershed Calculator WELLFLEET HARBOR

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
Present Total Nitrogen Load:		0	0
wastewater		0	0
fertilizer			5,100
stormwater			5,100
Target Nitrogen Load:		0	
Nitrogen Removal Required:		**0**	
Total Number of Properties:	3000		

Watershed Calculator WELLFLEET HARBOR

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
Present Total Nitrogen Load:		0	0
wastewater		0	0
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Other Wastewater Management Needs	Ponds	Title 5 Problem Areas	Growth Management

Watershed Calculator WELLFLEET HARBOR

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Other Wastewater Management Needs	Ponds	Title 5 Problem Areas	Growth Management

Low Barrier to Implementation:	**Reduction by Technology (Kg/yr)**	**Cumulative Total Reduction (Kg/yr)**	**Unit Cost ($/lb N)**	**Total Annual Cost**
A) Fertilizer Management	2,550	2,550		
B) Stormwater Mitigation	2,550	5,100		

Watershed Calculator WELLFLEET HARBOR

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
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Nitrogen Removal Required:		**0**	
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Other Wastewater Management Needs Ponds Title 5 Problem Areas Growth Management

Low Barrier to Implementation:	**Reduction by Technology (Kg/yr)**	**Cumulative Total Reduction (Kg/yr)**	**Unit Cost ($/lb N)**	**Total Annual Cost**
A) Fertilizer Management	2,550	2,550		
B) Stormwater Mitigation	2,550	5,100		
Watershed/Embayment Options:				
Permeable Reactive Barrier (PRB) 170 Homes	523.6	5,624	$452	$520,668
Permeable Reactive Barrier (PRB) 120 Homes	369.6	5,993	$452	$367,530

Watershed Calculator WELLFLEET HARBOR

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
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Other Wastewater Management Needs	Ponds	Title 5 Problem Areas	Growth Management

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Watershed/Embayment Options:						
Permeable Reactive Barrier (PRB)	170	Homes	523.6	5,624	$452	$520,668
Permeable Reactive Barrier (PRB)	120	Homes	369.6	5,993	$452	$367,530
Fertigation Wells	1	Golf course	136	6,129	$438	$131,050

Watershed Calculator WELLFLEET HARBOR

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Nitrogen Removal Required:		**0**	
Total Number of Properties:	3000		

Other Wastewater Management Needs Ponds Title 5 Problem Areas Growth Management

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Fertigation Wells	1	Golf course	136	6,129	$438	$131,050
Oyster Beds/Aquaculture	20	Acres	5,000	11,129	$0	$0

Watershed Calculator WELLFLEET HARBOR

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Other Wastewater Management Needs Ponds Title 5 Problem Areas Growth Management

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Fertigation Wells	1	Golf course	136	6,129	$438	$131,050
Oyster Beds/Aquaculture	20	Acres	5,000	11,129	$0	$0
Coastal Habitat Restoration	1100	Acres	65,837	76,966	$444	$3,215,479

Watershed Calculator WELLFLEET HARBOR

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
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Other Wastewater Management Needs	Ponds	Title 5 Problem Areas	Growth Management

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Permeable Reactive Barrier (PRB)	120	Homes	369.6	5,993	$452	$367,530
Fertigation Wells	1	Golf course	136	6,129	$438	$131,050
Oyster Beds/Aquaculture	20	Acres	5,000	11,129	$0	$0
Coastal Habitat Restoration	1100	Acres	65,837	76,966	$444	$3,215,479
Alternative On-Site Options:						
Ecotoilets (UD & Compost)	150	Homes	594.0	76,372	$1,265	$1,653,102
Ecotoilets - Bakers Field	10	Homes	39.6	77,560	$1,265	$110,207

Watershed Calculator WELLFLEET HARBOR

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
Present Total Nitrogen Load:		0	0
wastewater		0	0
fertilizer			5,100
stormwater			5,100
Target Nitrogen Load:		0	
Nitrogen Removal Required:		**0**	
Total Number of Properties:	3000		

Other Wastewater Management Needs	Ponds	Title 5 Problem Areas	Growth Management

Low Barrier to Implementation:			**Reduction by Technology (Kg/yr)**	**Cumulative Total Reduction (Kg/yr)**	**Unit Cost ($/lb N)**	**Total Annual Cost**
A) Fertilizer Management			2,550	2,550		
B) Stormwater Mitigation			2,550	5,100		
Watershed/Embayment Options:						
Permeable Reactive Barrier (PRB)	170	Homes	523.6	5,624	$452	$520,668
Permeable Reactive Barrier (PRB)	120	Homes	369.6	5,993	$452	$367,530
Fertigation Wells	1	Golf course	136	6,129	$438	$131,050
Oyster Beds/Aquaculture	20	Acres	5,000	11,129	$0	$0
Coastal Habitat Restoration	1100	Acres	65,837	76,966	$444	$3,215,479
Alternative On-Site Options:						
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Ecotoilets - Bakers Field	10	Homes	39.6	77,560	$1,265	$110,207
		Cumulative Total Reduction (Kg/yr):		77,560	$535	$5,998,036

Adaptive Management:

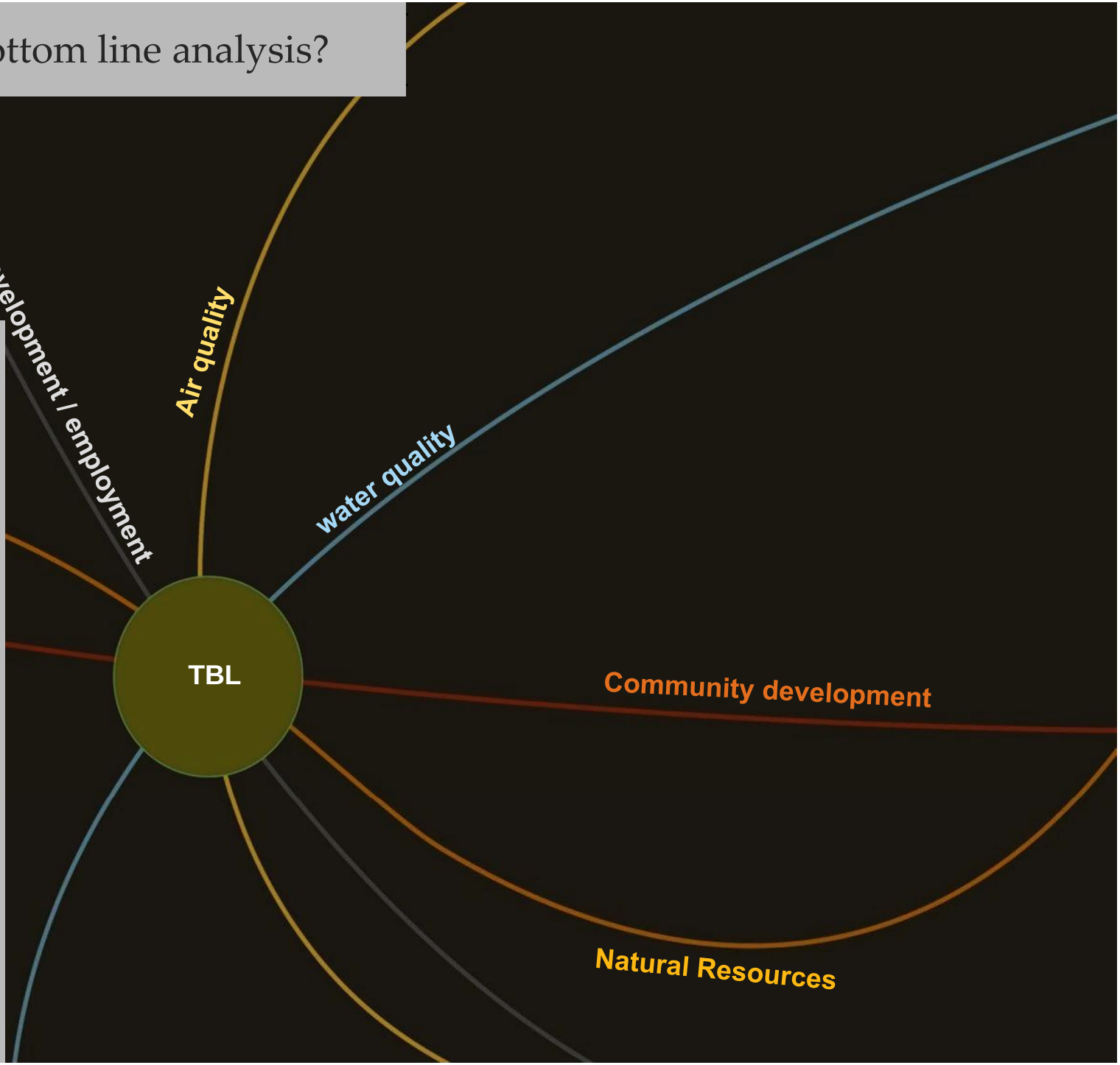
A structured approach for addressing uncertainties by linking science and monitoring to decision-making and adjusting implementation, as necessary, to increase the probability of meeting water quality goals in a cost effective and efficient ways.

Triple Bottom Line (TBL) Introduction

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

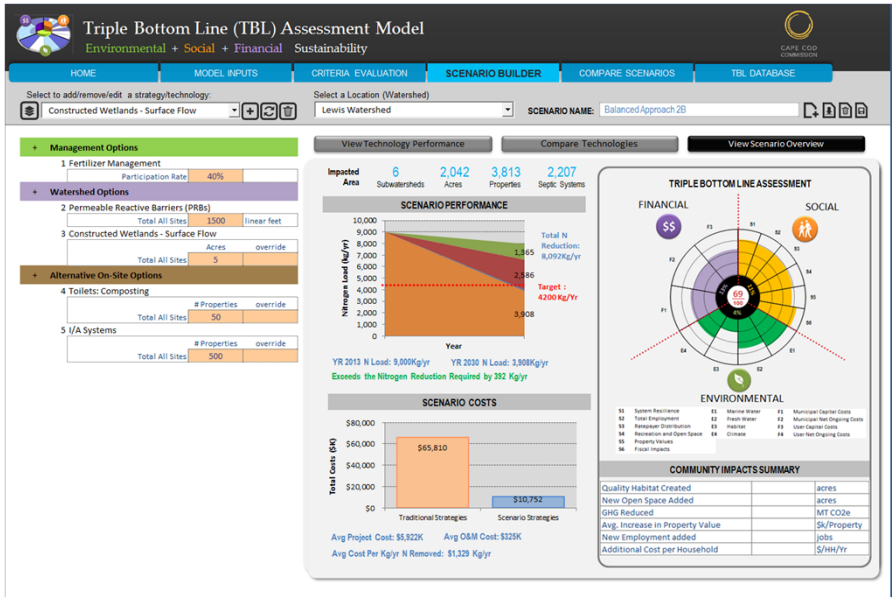
Often "TBL" analysis is used to identify the best alternative and to report to stakeholders on the public outcomes of a given investment.

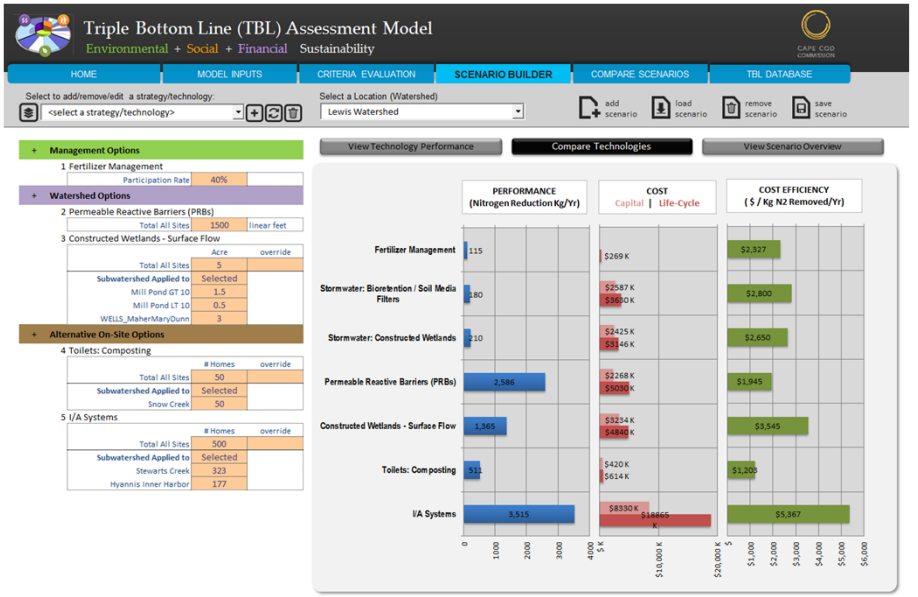


Why develop a TBL model?

- Develop triple bottom line 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

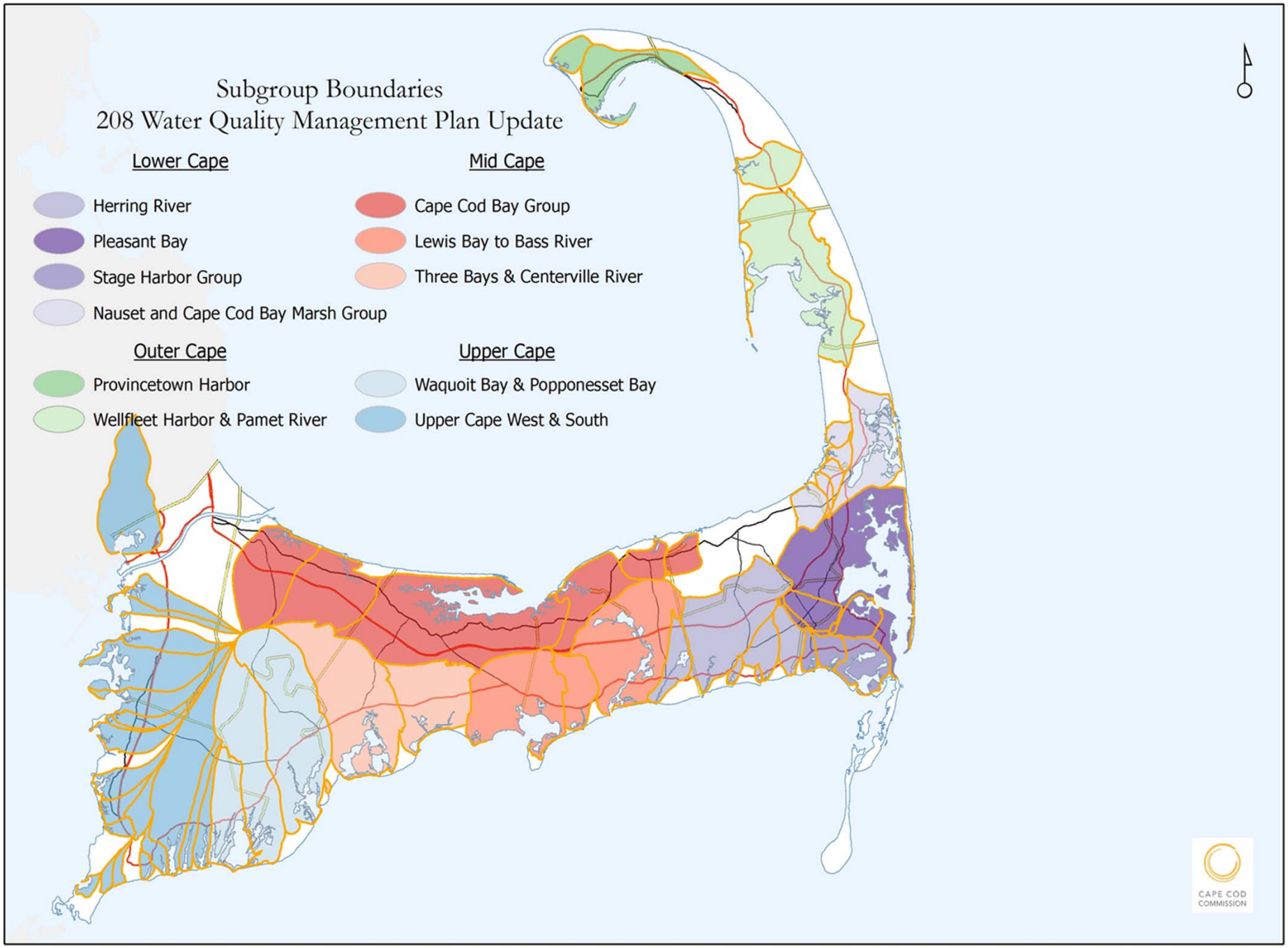
CAPE COD COMMISSION

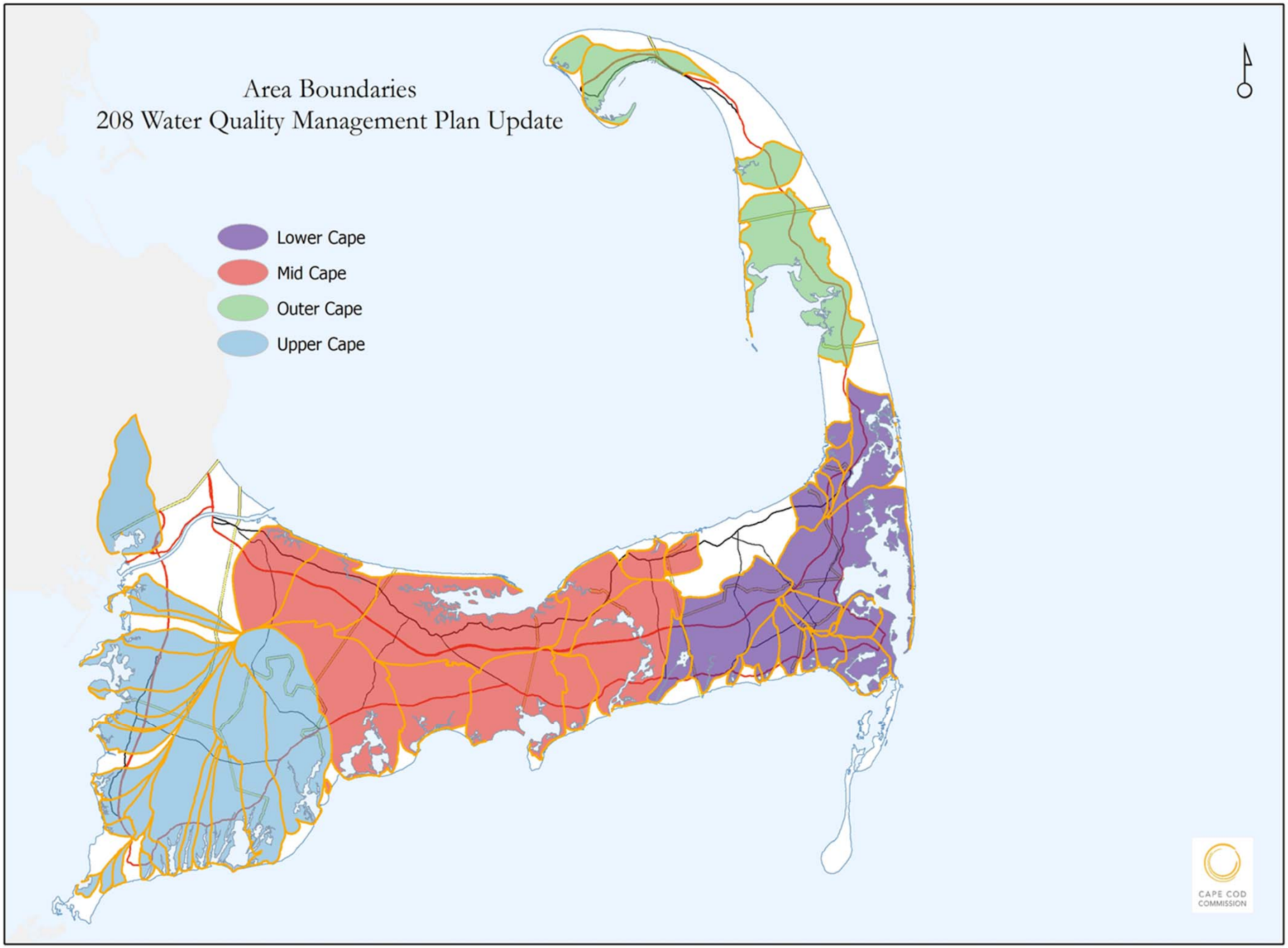
HOME | MODEL INPUTS | CRITERIA EVALUATION | SCENARIO BUILDER | COMPARE SCENARIOS | TBL DATABASE

Alternative Definition | Alternative Results | Alternative Scoring Rules

	Scenario 1	Scenario 2	Scenario 3
	Minimum Cost	Cost Effective	Maximum Performance
Criterion Scores			
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

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


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
CAPE COD COMMISSION


Area Boundaries
208 Water Quality Management Plan Update
Lower Cape
Mid Cape
Outer Cape
Upper Cape
CAPE COD
COMMISSION