Cape Cod 208 Area Water Quality Planning
Upper Cape West and South Watershed Working Group

Meeting Three Agenda
Falmouth Town Hall
59 Town Hall Square, Falmouth, MA
Monday, December 2, 2013
8:30 am - 12:30 pm

8:30 Welcome, Review 208 goals and Process and the Goals of today's meeting – *Cape Cod Commission Area Manager*

8:45 Introductions, Agenda Overview, Updates and Action Items– *Facilitator and Working Group*

9:00 Presentation of Initial Scenarios for each watershed – *Cape Cod Commission Technical Lead*

- Whole Watershed Conventional Scenarios
- Targeted Conventional Scenarios to meet the TMDLs (or expected TMDLs):
- Whole Watershed 7-Step Scenarios
- Working Group Reactions, Questions and Discussion

10:30 Break

10:45 Adaptive Management – *Cape Cod Commission and Working Group*

- Adaptive Management Sample Scenarios
- Key Adaptive Management Questions
- Defining Adaptive Management

11:30 Preparing for 2014 Jan-June – *Cape Cod Commission and Working Group*

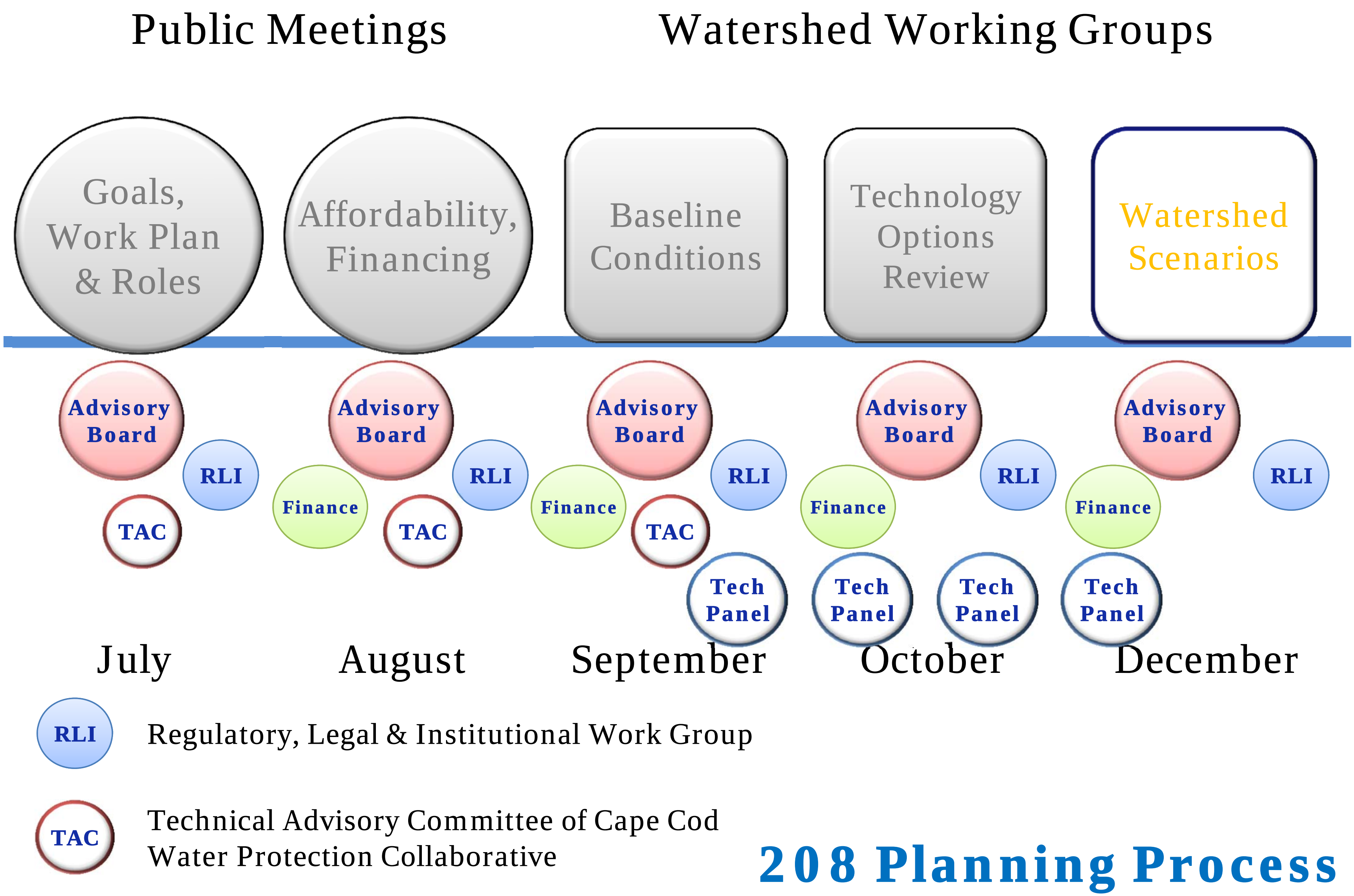
- Triple Bottom Line approach
- Identify Shared Principles and Lessons Learned
- Describe Next Steps

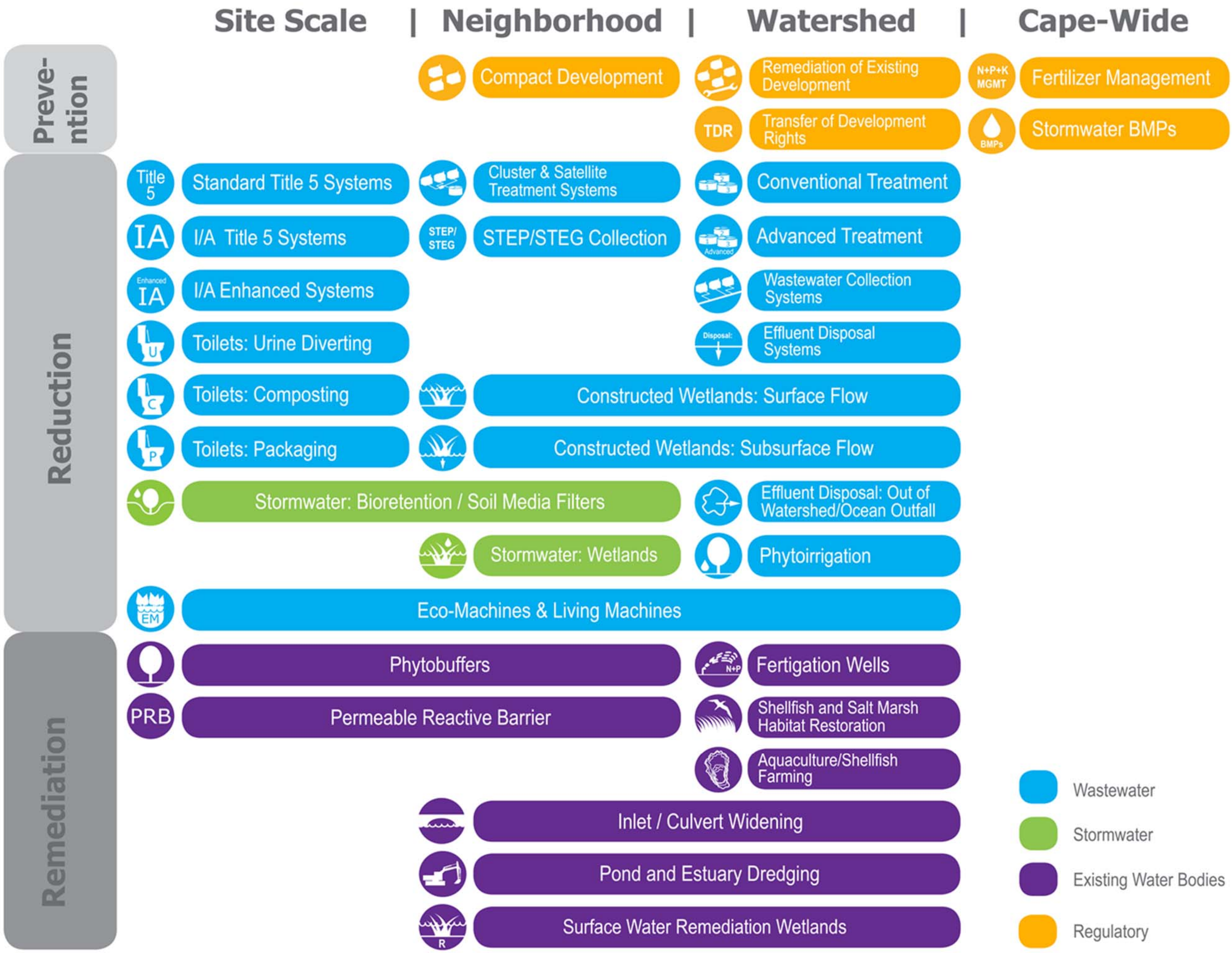
12:15 Public Comments

12:30 Adjourn

Upper Cape West & South Group

Watershed Scenarios


Public Meetings
Watershed Working Groups
Goals, Work Plan & Roles
Affordability, Financing
Baseline Conditions
Technology Options Review
Watershed Scenarios
Advisory Board
RLI
TAC
Finance
Tech Panel
July
August
September
October
December
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
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
Advanced
Advanced Treatment
Enhanced IA
I/A Enhanced Systems
Wastewater Collection Systems
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Toilets: Urine Diverting
Disposal
Effluent Disposal Systems
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Toilets: Composting
Constructed Wetlands: Surface Flow
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Toilets: Packaging
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EM
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Phytobuffers
N+P
Fertigation Wells
PRB
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Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
R
Surface Water Remediation Wetlands
Wastewater
Stormwater
Existing Water Bodies
Regulatory

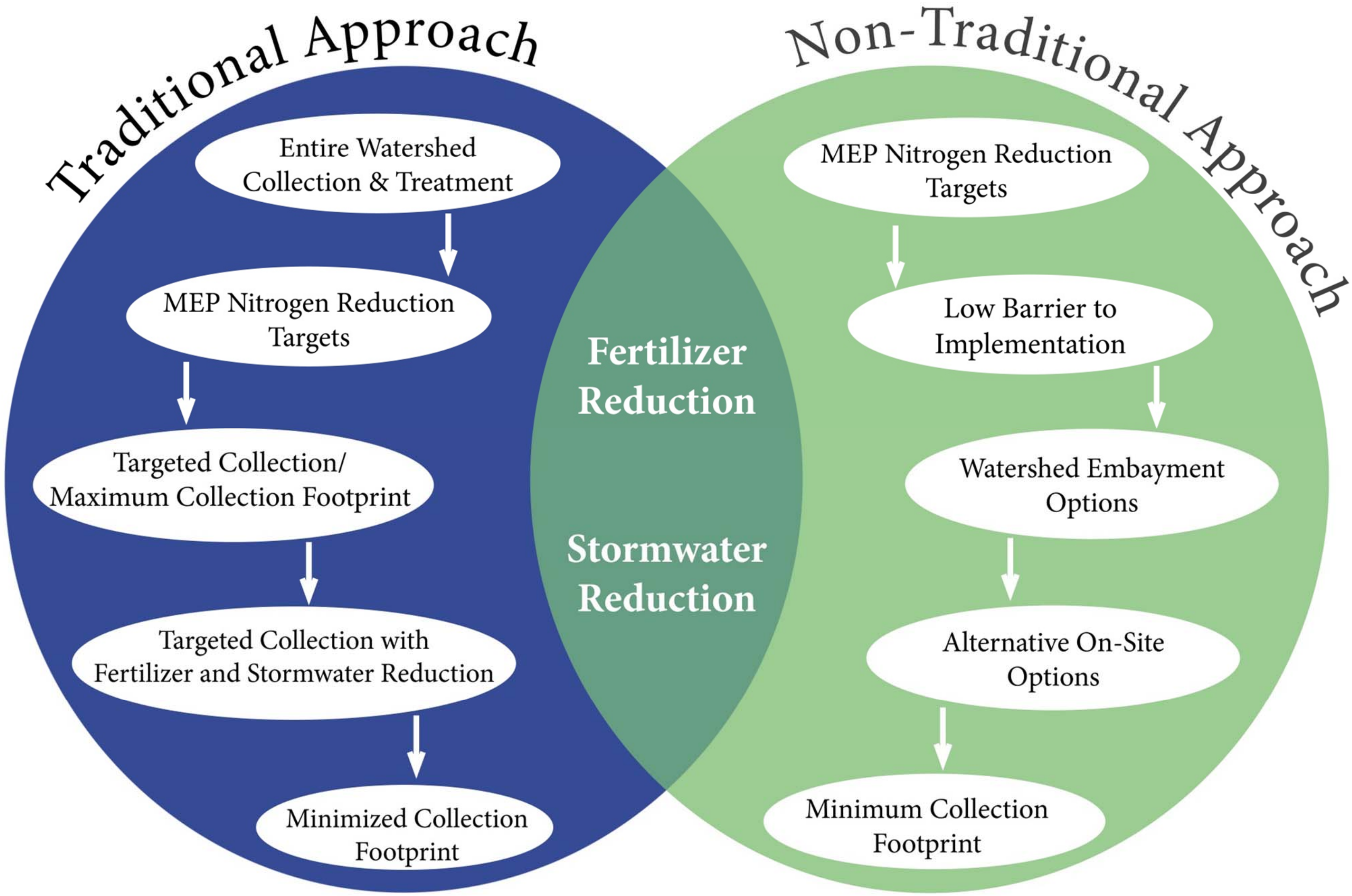
Watershed Scenarios

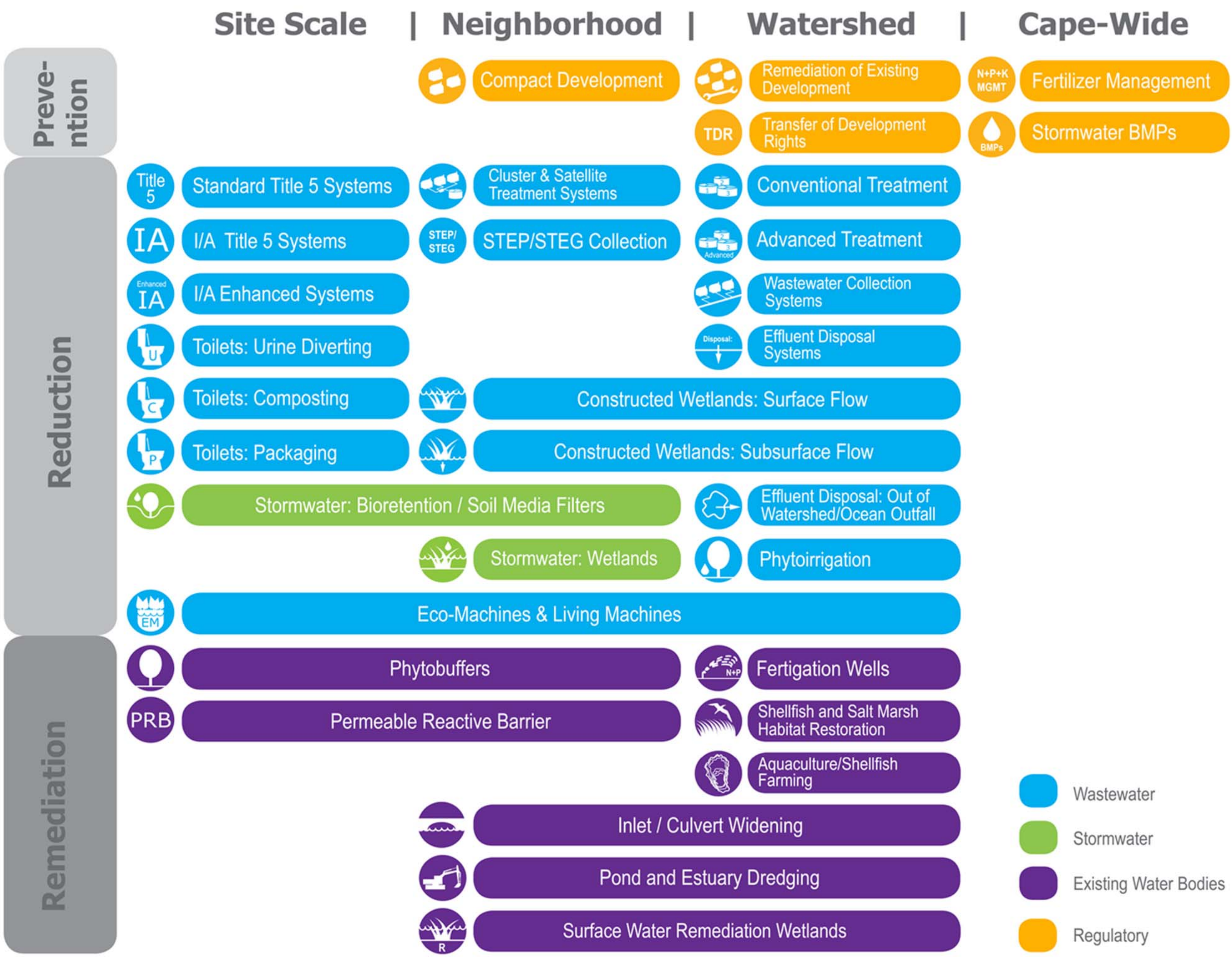
11 Working Group Meetings: Dec 2-11

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


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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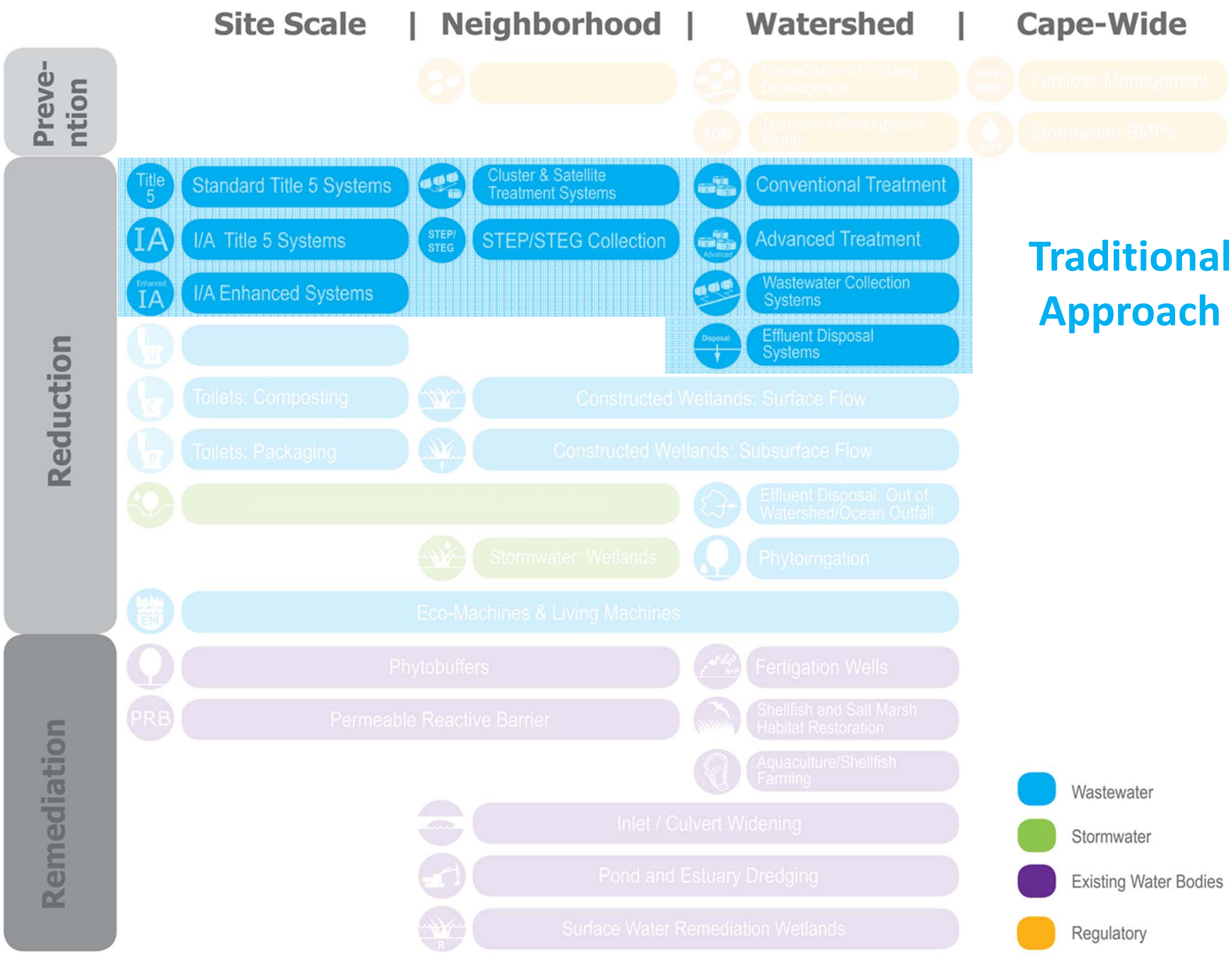
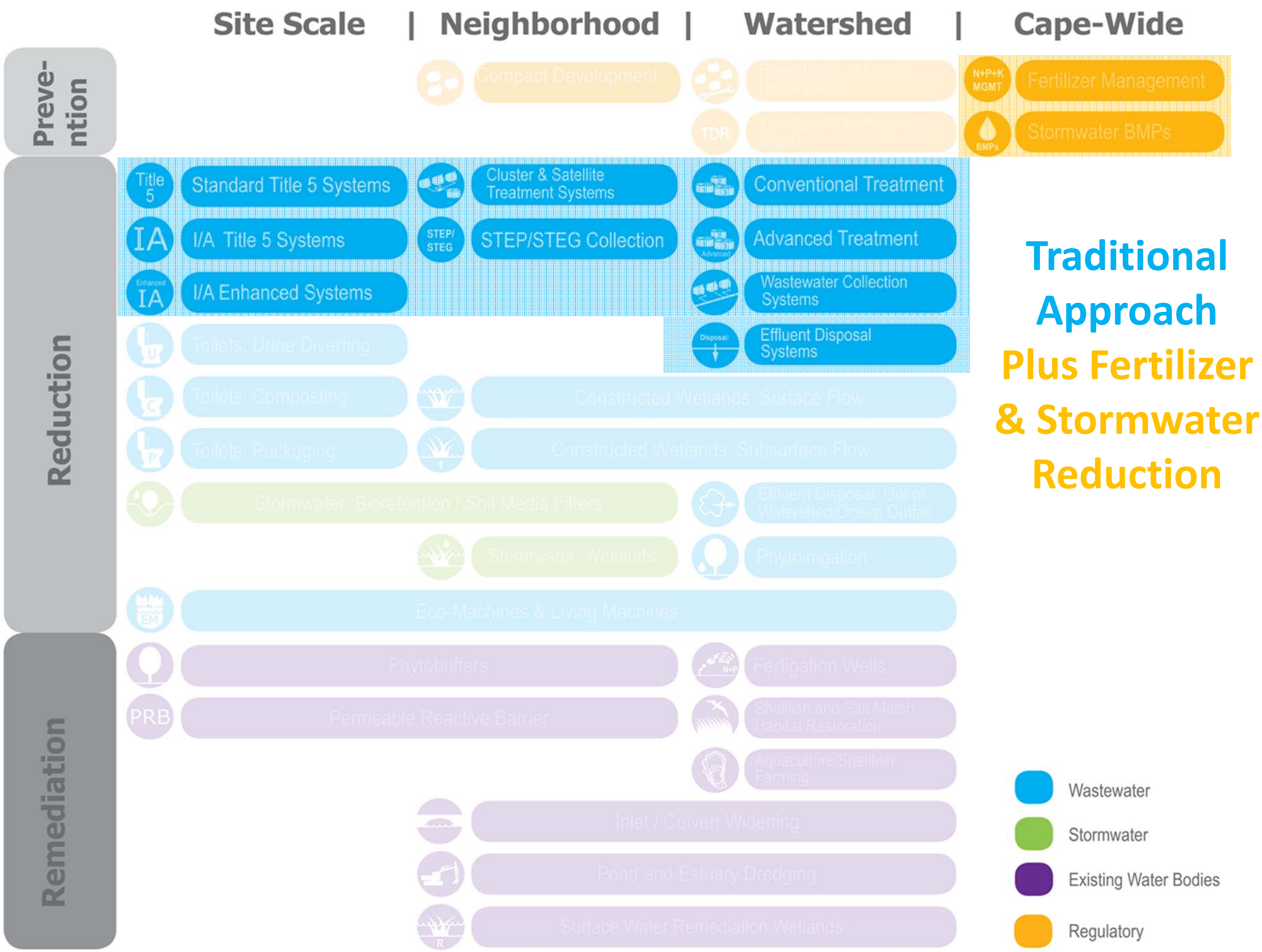
"Watershed Working Group - Upper Cape West/South - Workshop 3"

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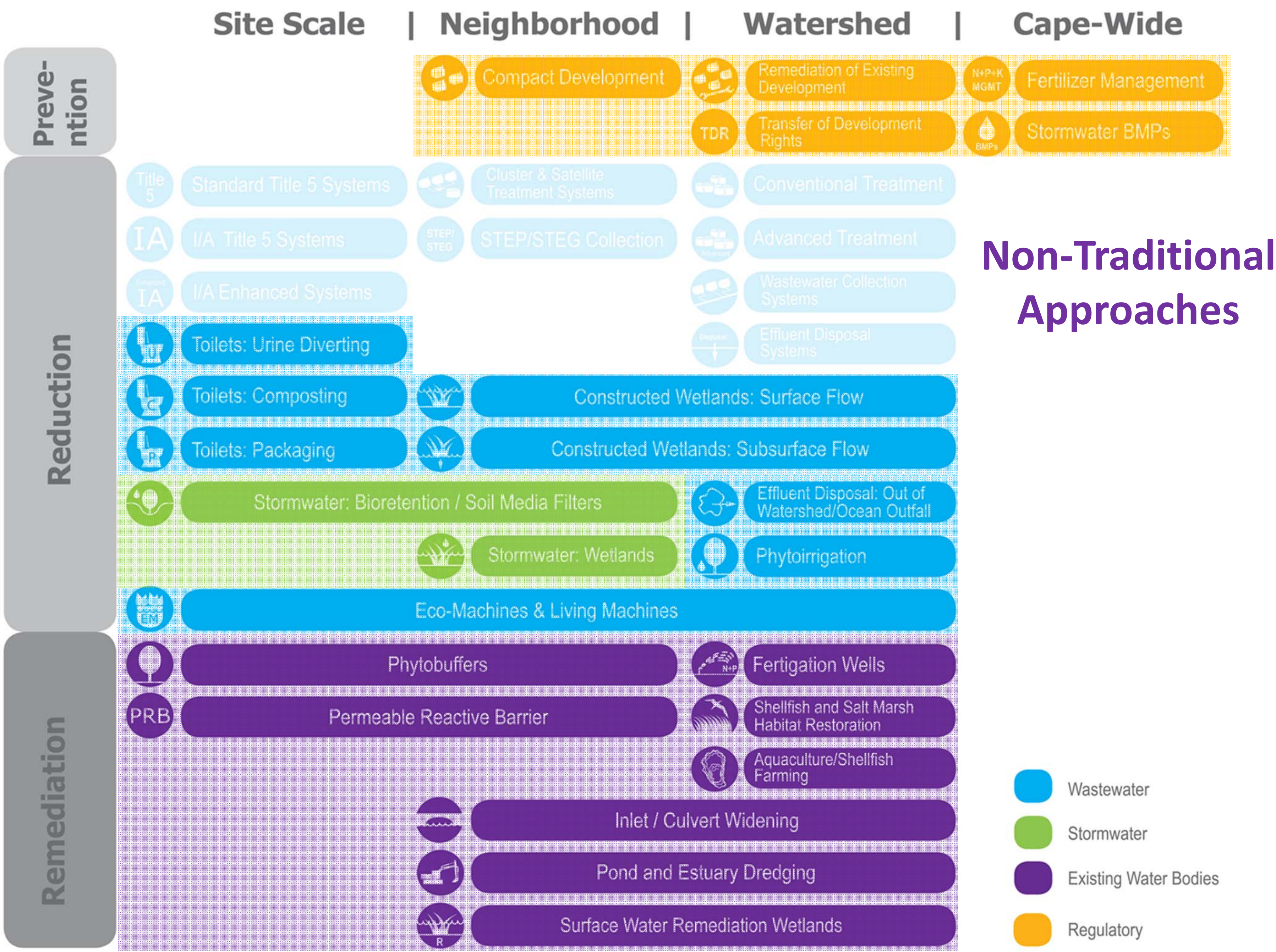
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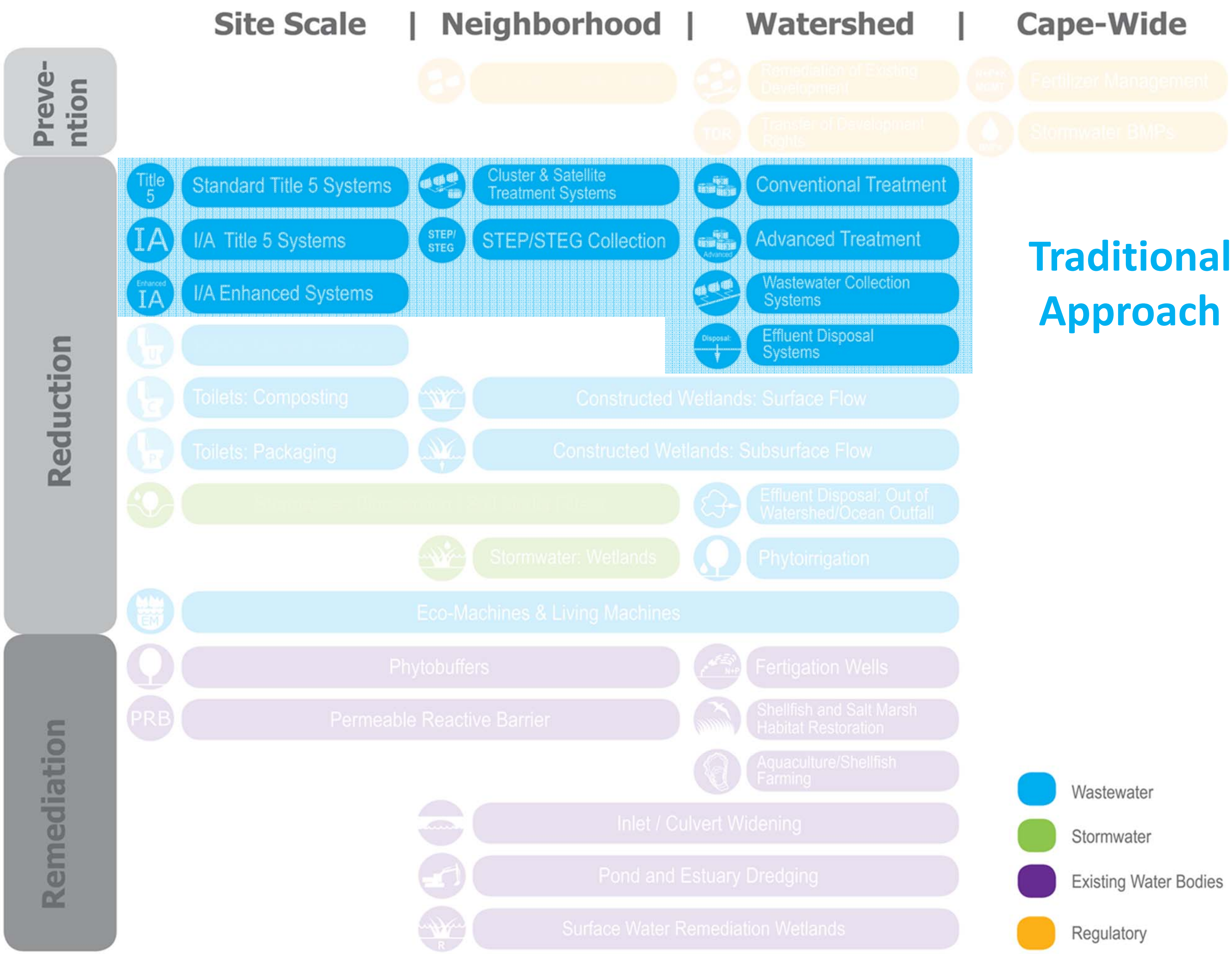

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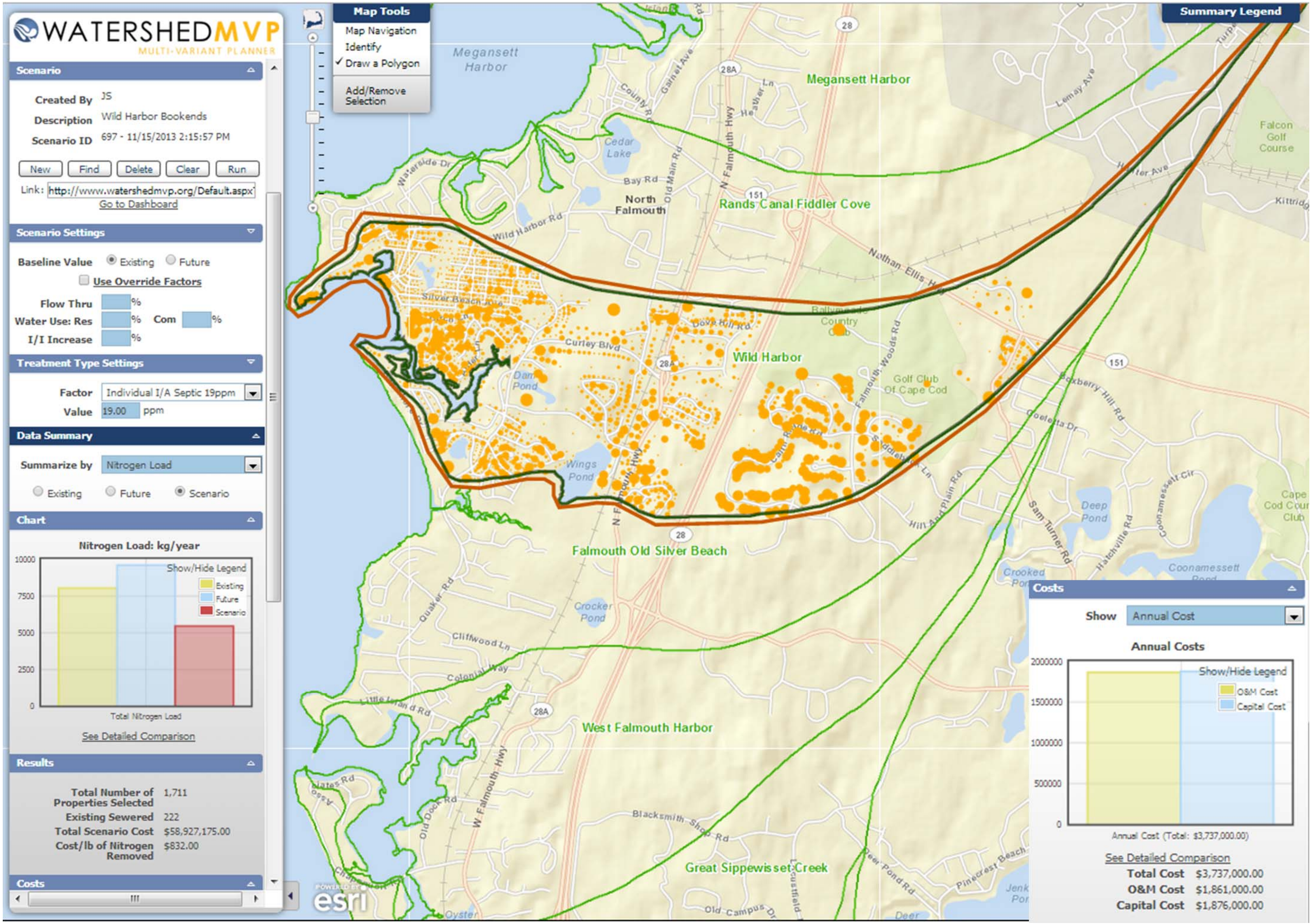
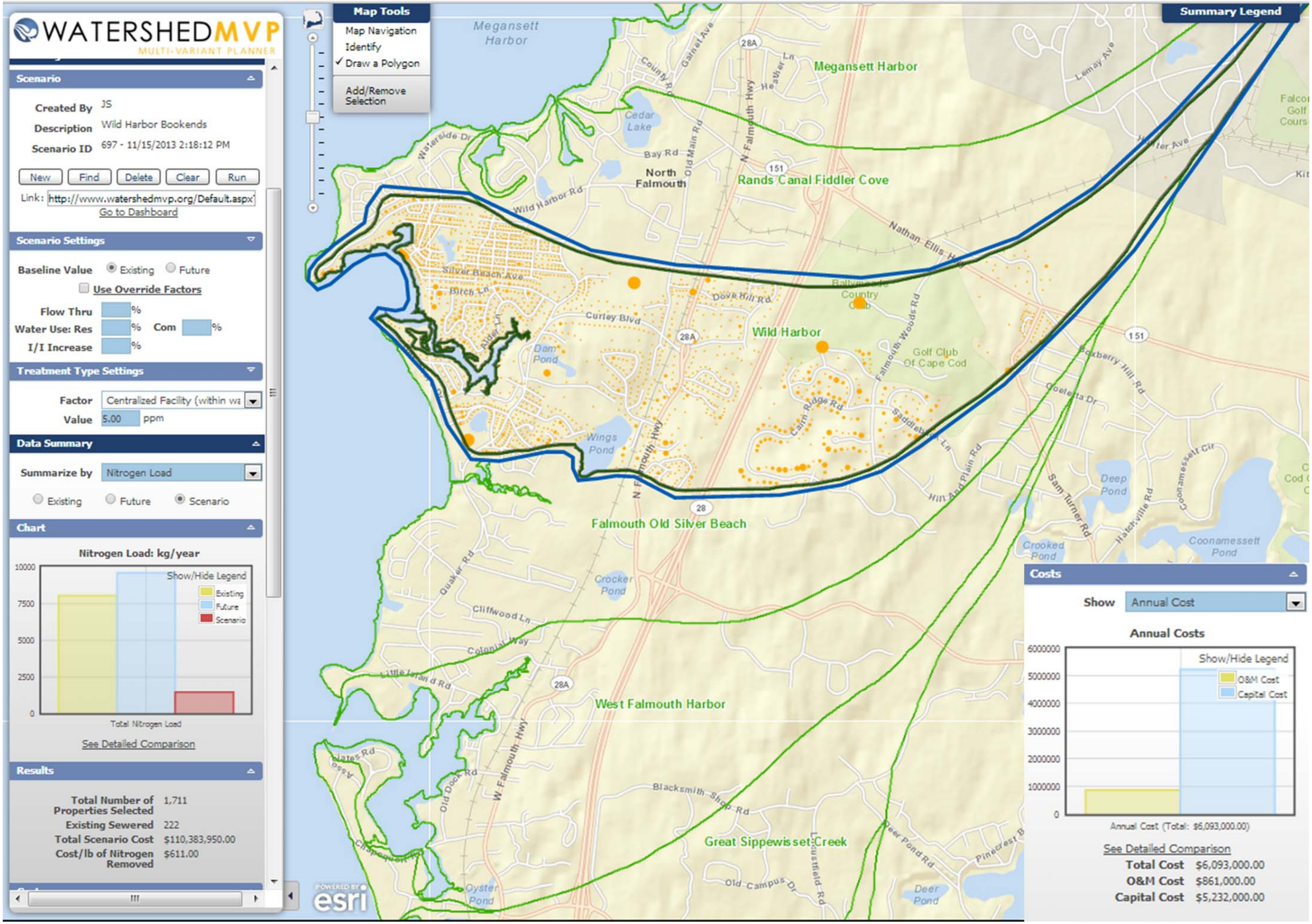
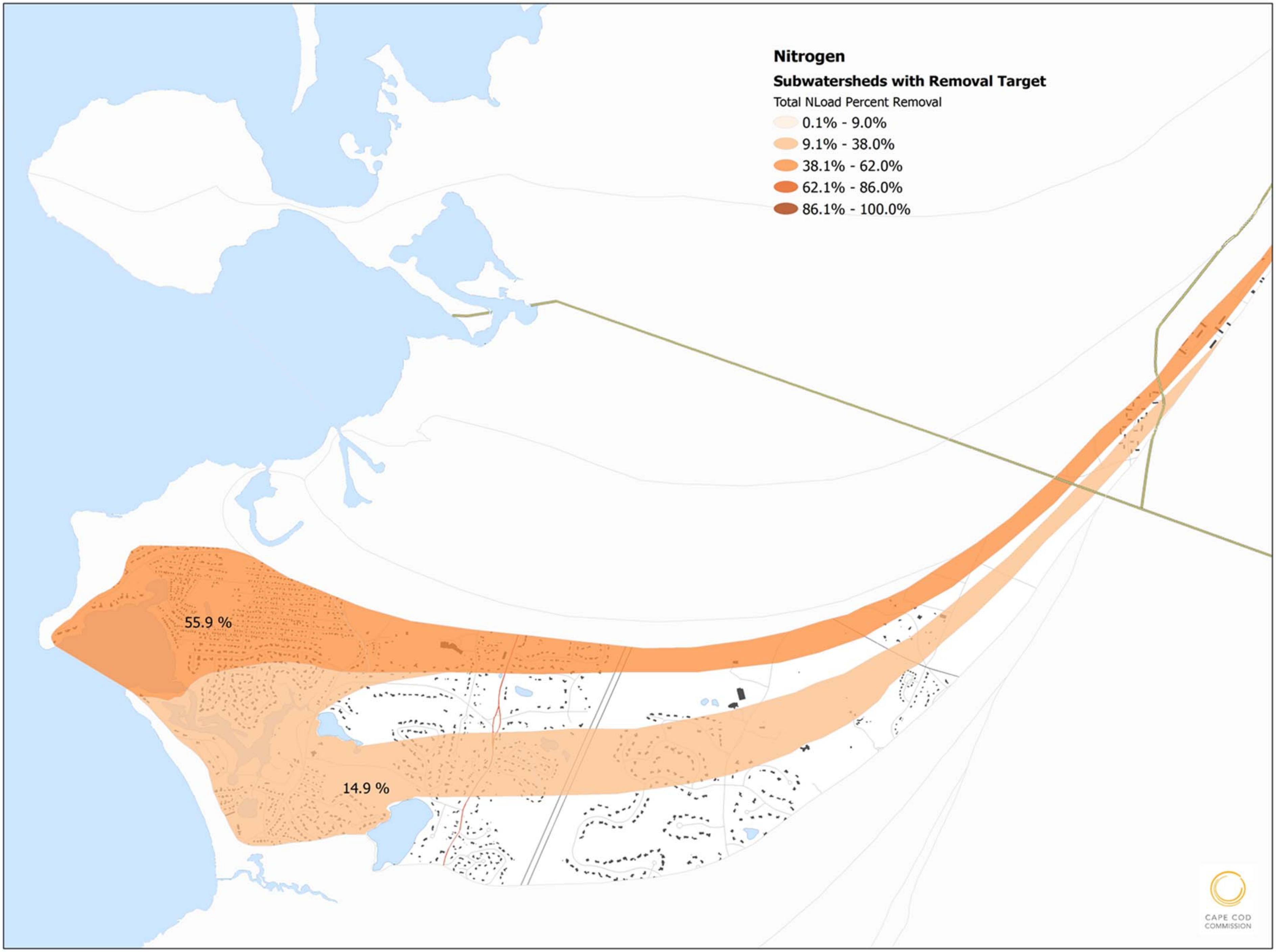
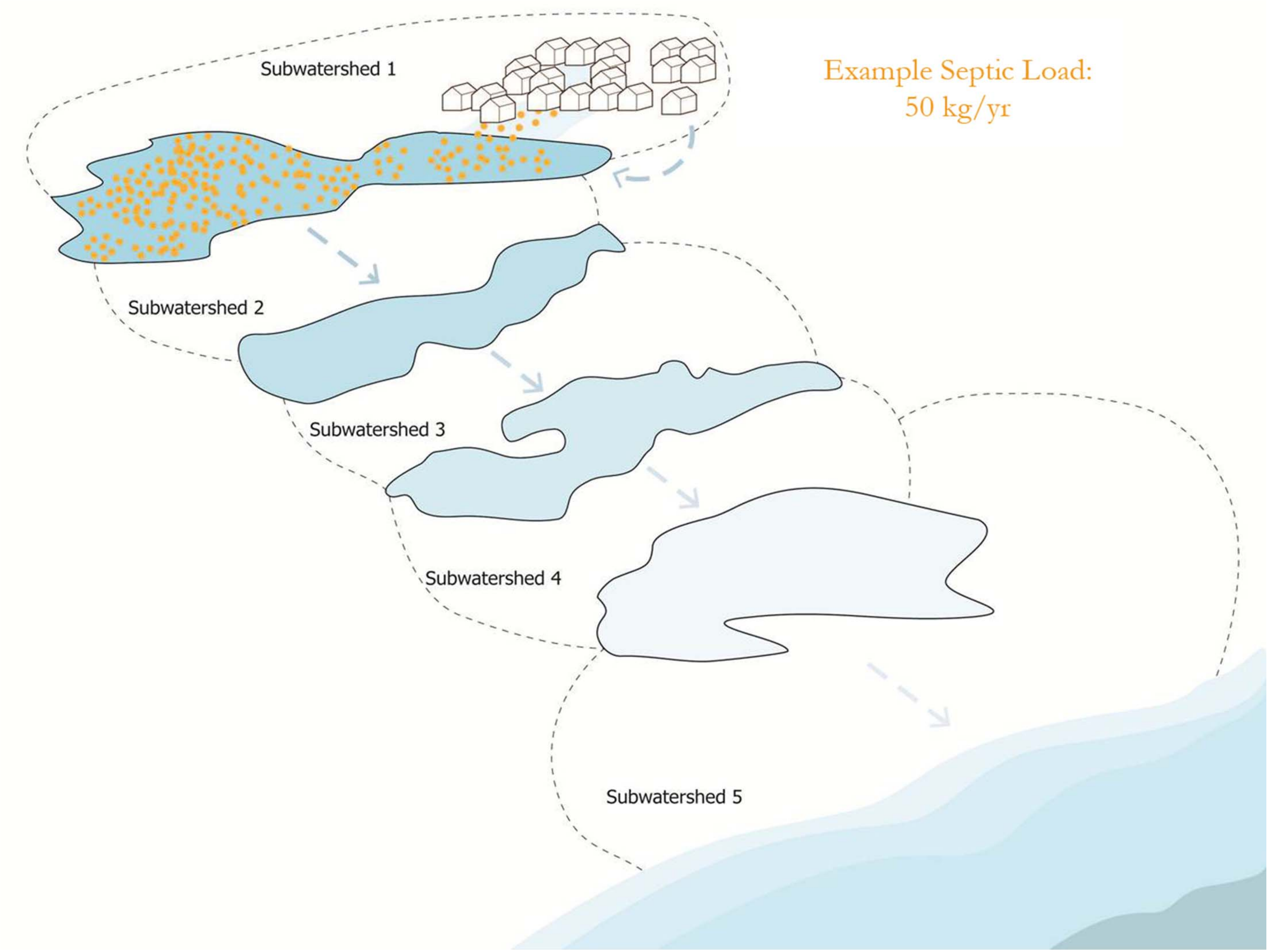
Watershed-Wide Innovative/Alternative (I/A) Onsite Systems

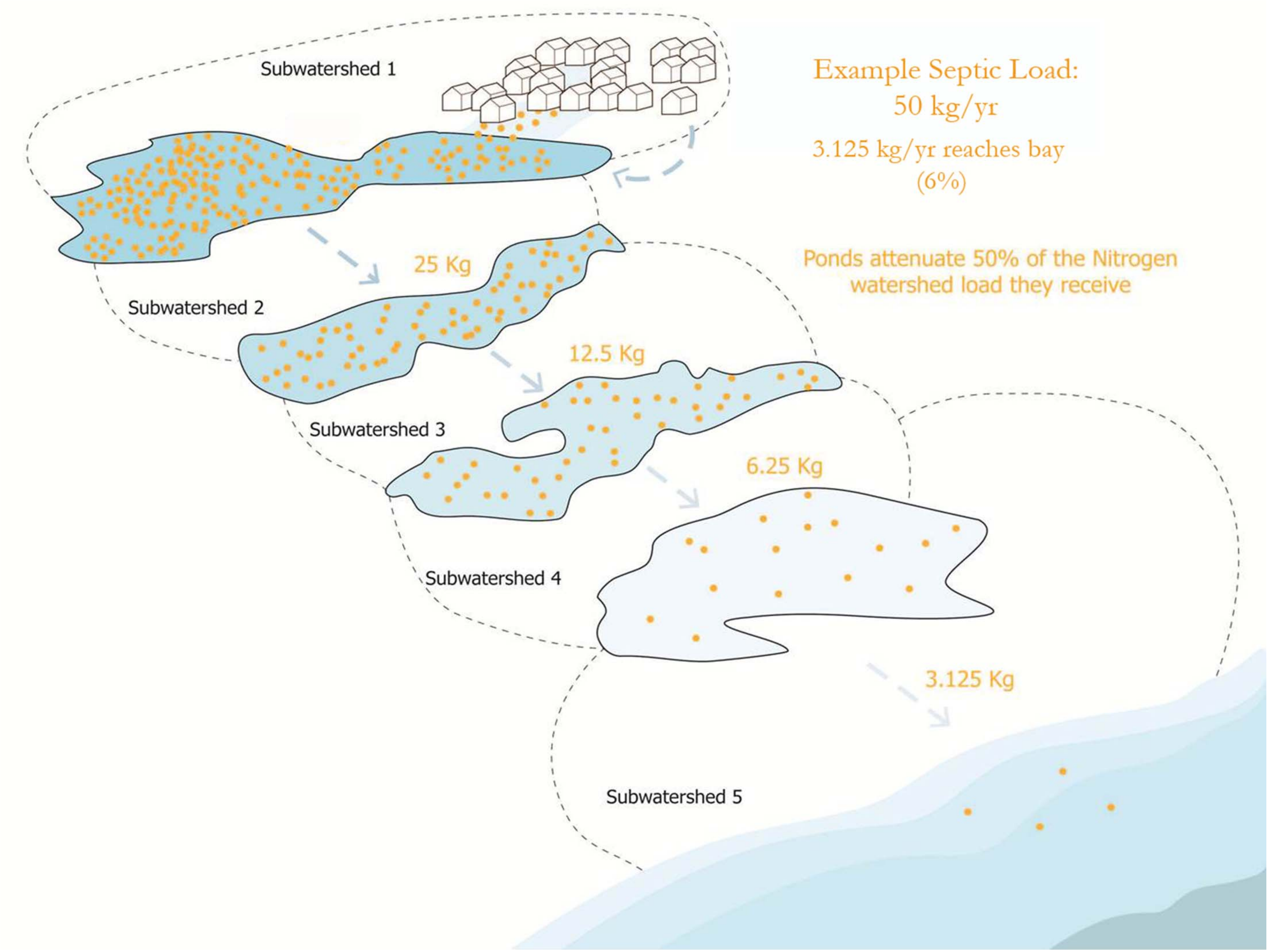


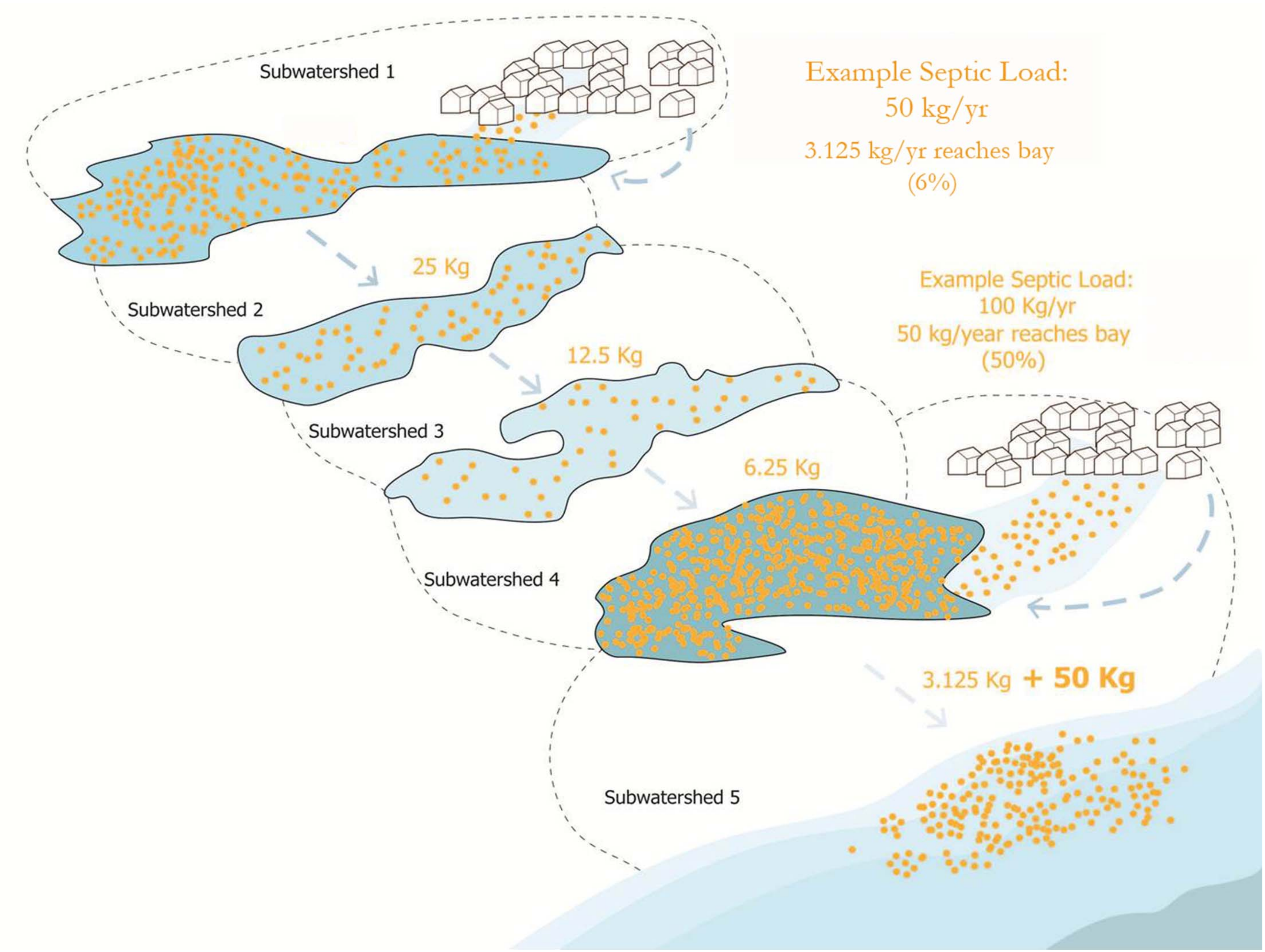
Watershed-Wide Centralized Treatment with Disposal Inside the Watershed




Nitrogen
Subwatersheds with Removal Target
Total NLoad Percent Removal
0.1% - 9.0%
9.1% - 38.0%
38.1% - 62.0%
62.1% - 86.0%
86.1% - 100.0%
55.9 %
14.9 %
CAPE COD COMMISSION


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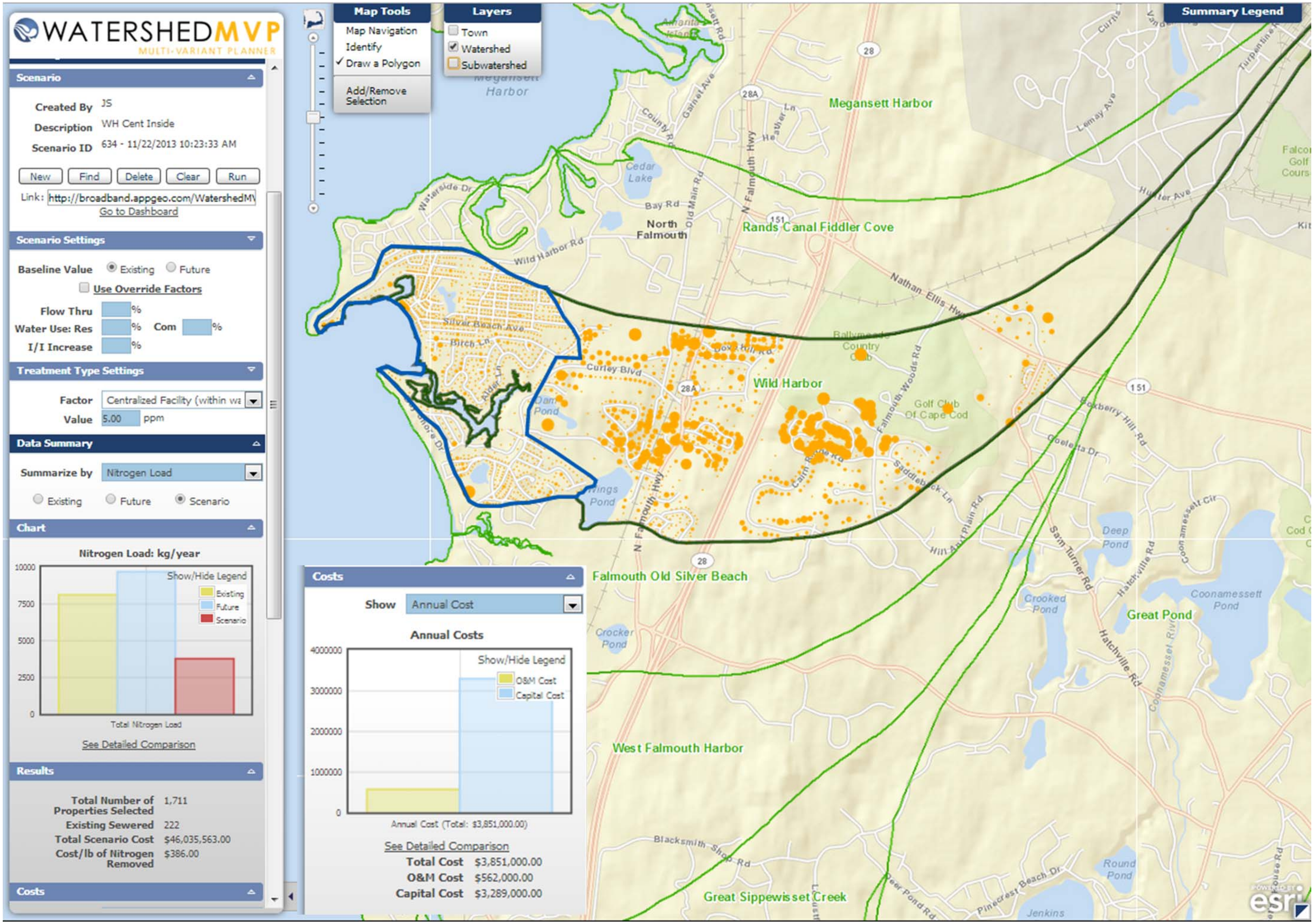
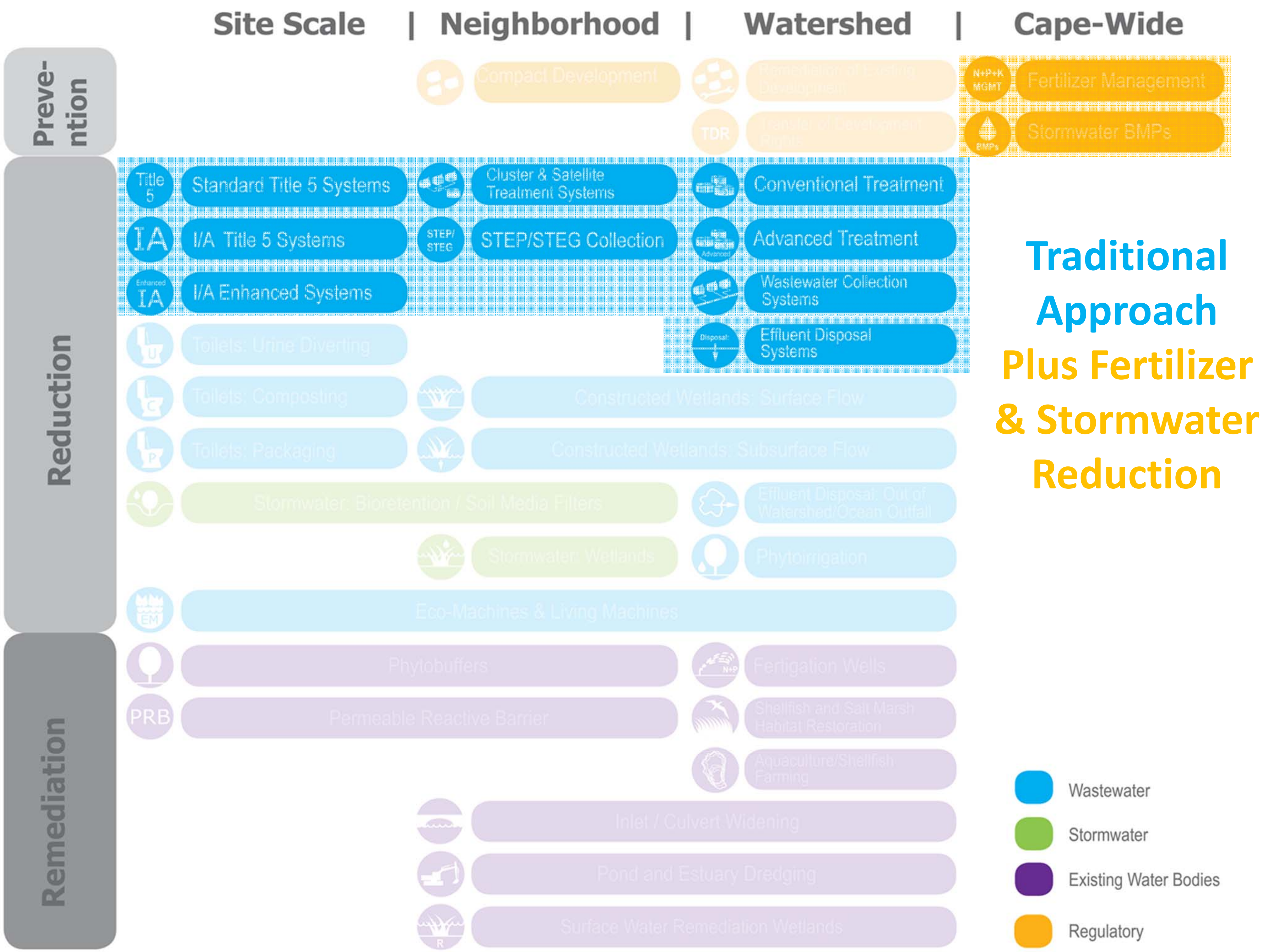
25 Kg
Subwatershed 2
Example Septic Load:
100 Kg/yr
50 kg/year reaches bay
(50%)
12.5 Kg
Subwatershed 3
6.25 Kg
Subwatershed 4
3.125 Kg + 50 Kg
Subwatershed 5

Targeted Centralized Treatment with Disposal Inside the Watershed

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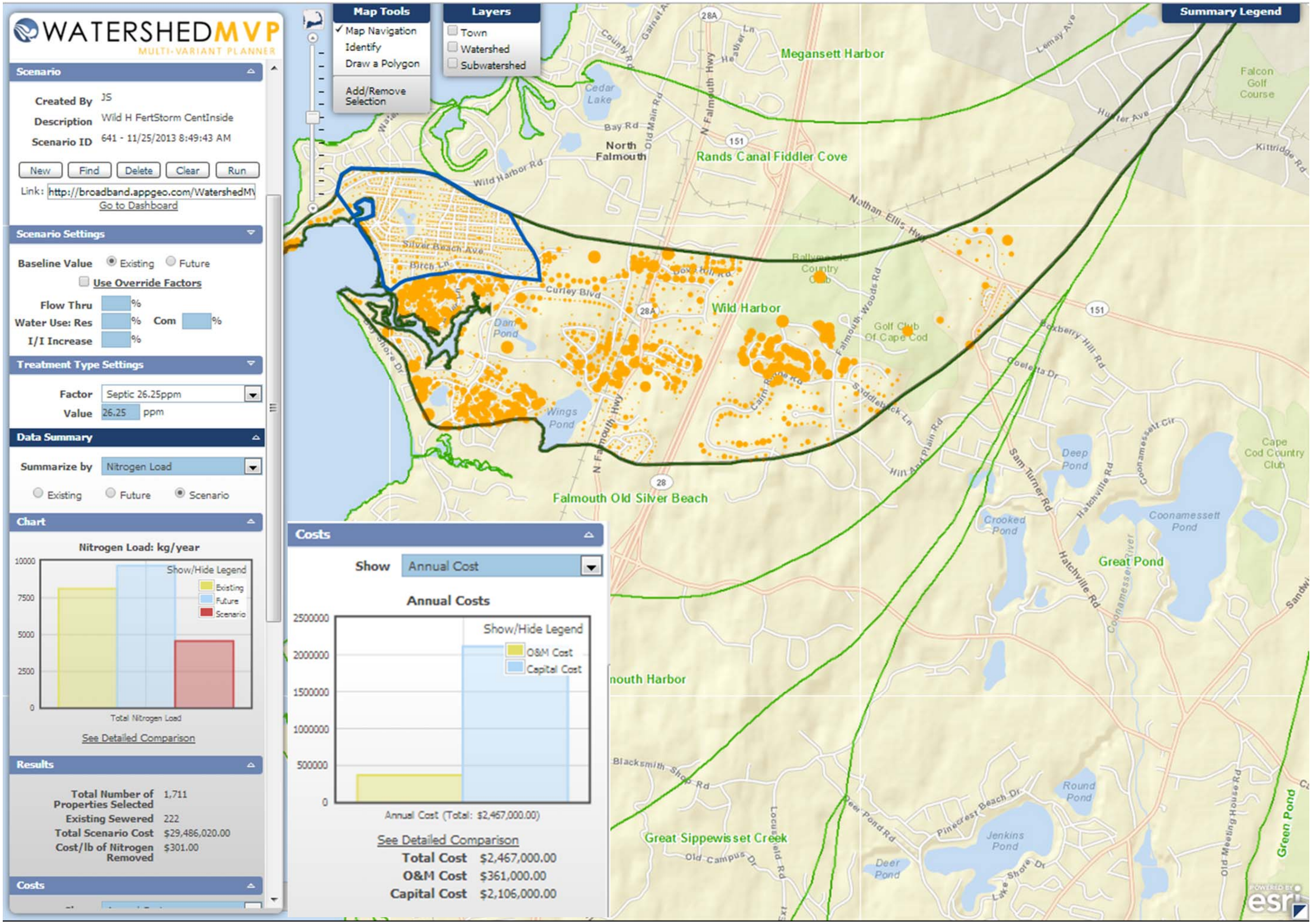
Targeted Centralized Treatment with a 50% Reduction in Fertilizer and Stormwater



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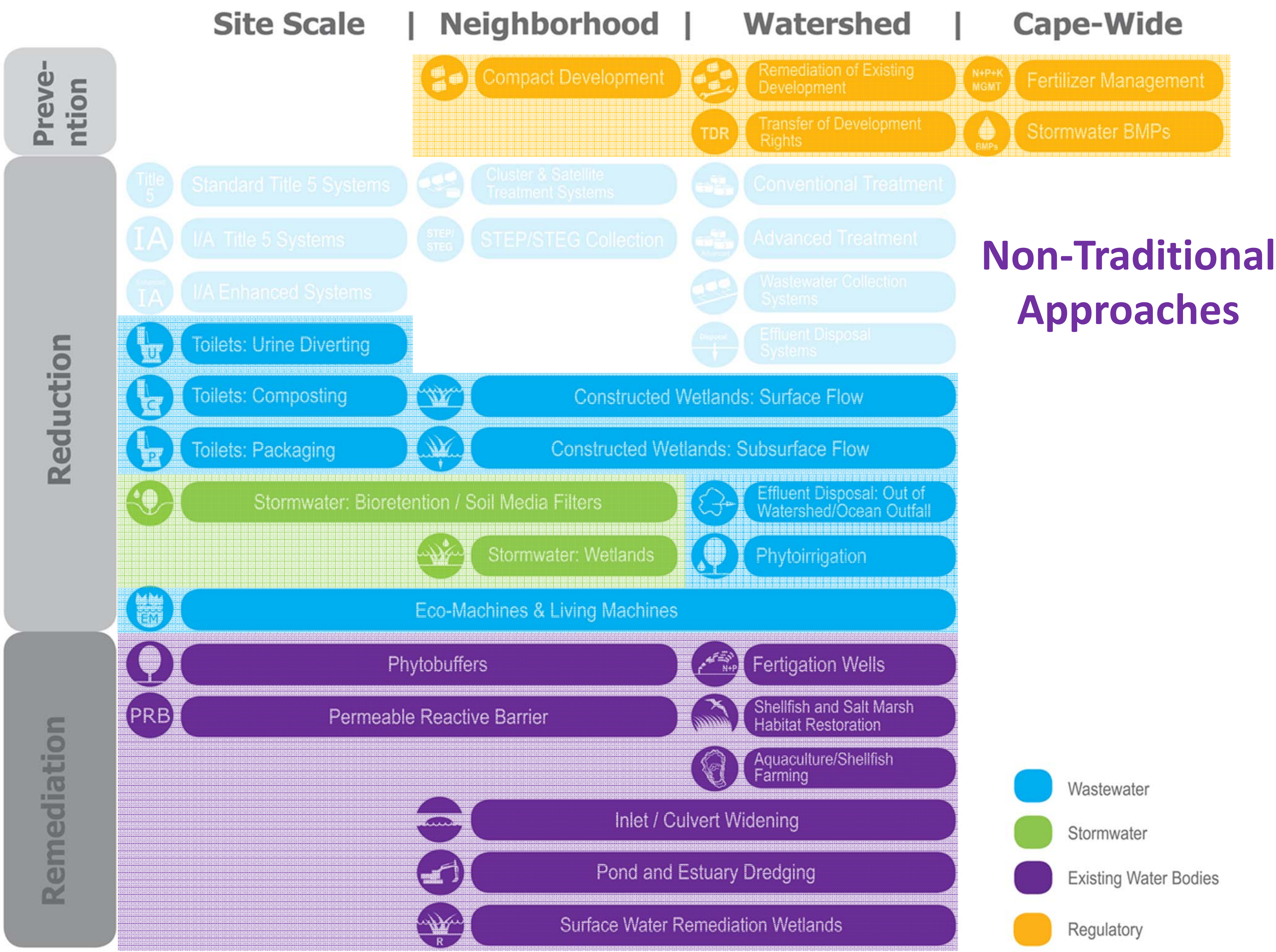


Problem Solving Approach
Wastewater
Existing Water Bodies
Regulatory
1
Targets/Reduction Goals
Present Load: X kg/day
–
Target: Y kg/day
=
Reduction Required: N kg/day
2
Other Wastewater Management Needs
A. Title 5 Problem Areas
B. Pond Recharge Areas
C. Growth Management
3
Low Barrier to Implementation
A. Fertilizer Management
B. Stormwater Mitigation
N+P+K MGMT
BMPs
4
Watershed/Embayment Options
A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture
PRB
R
5
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
C
IA
U
P
6
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
7
Supplemental Sewering
Advanced

Watershed Calculator Wild Harbor

MEP Targets and Goals:		**kg/day**	**Nitrogen (kg/yr)**
Present Total Nitrogen Load:		23.658	8635
wastewater		17.362	6337
fertilizer			1905
stormwater			764
Target Nitrogen Load:		16.121	5884
Nitrogen Removal Required:			**2751**
Total Number of Properties:	1474		

Watershed Calculator Wild 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)**	**Remaining to Meet Target (Kg/yr)**	**Unit Cost ($/lb N)**	**Total Annual Cost**
Fertilizer Management	953	1,799		
Stormwater Mitigation	382	1,417		

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Permeable Reactive Barrier (PRB)	144 Homes	443.5	973	$452	$441,036

Watershed Calculator Wild Harbor

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Other Wastewater Management Needs Ponds Title 5 Problem Areas Growth Management

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Oyster Beds/Aquaculture	1	Acres	250	587	$0	$0

Watershed Calculator Wild Harbor

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Oyster Beds/Aquaculture	1	Acres	250	587	$0	$0
Alternative On-Site Options:						
Ecotoilets (UD & Compost)	74	Homes	293.0	294	$1,265	$815,530

Watershed Calculator Wild Harbor

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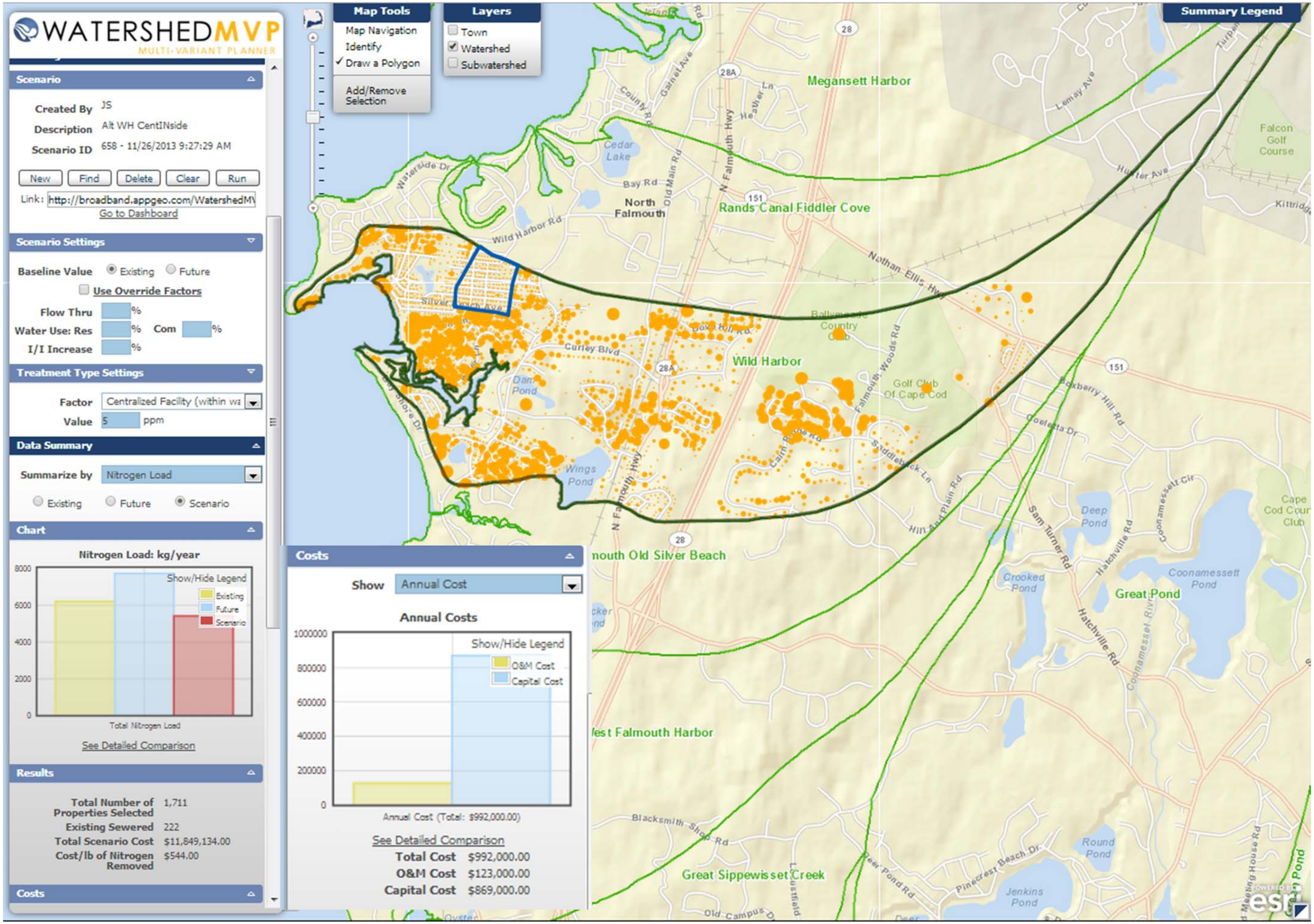
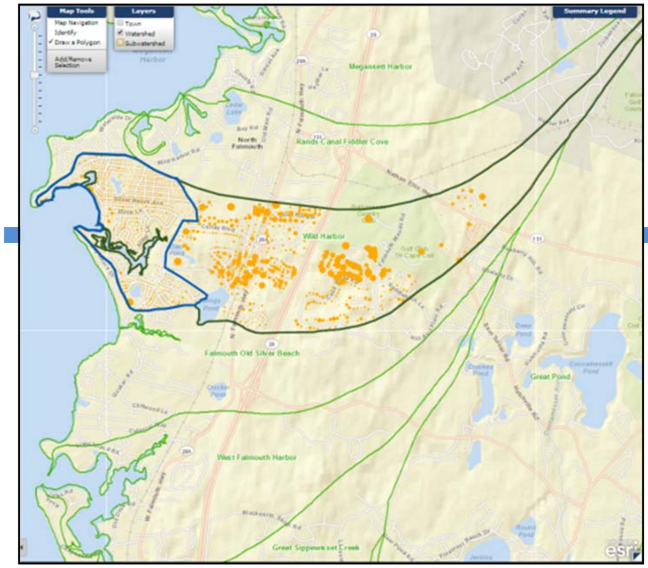
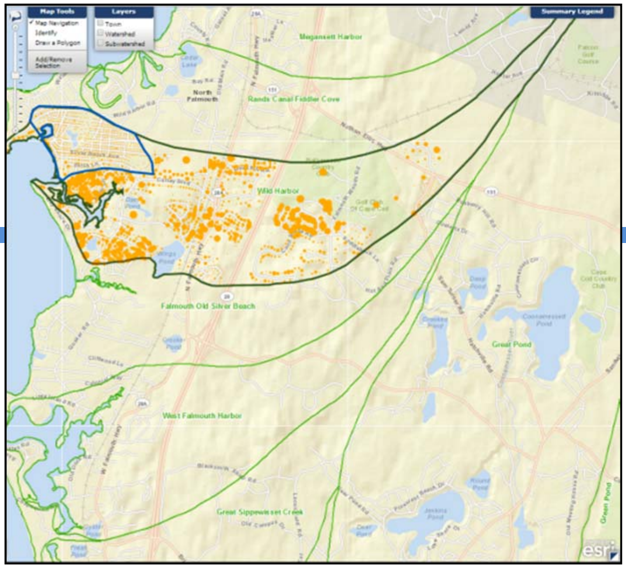
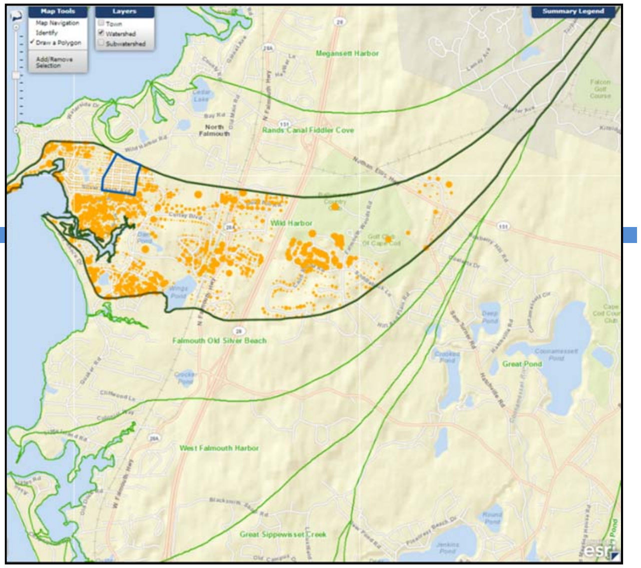
Alternative On-Site Options:						
Ecotoilets (UD & Compost)	74	Homes	293.0	294	$1,265	$815,530
Sewering	67	Homes	294	0	$1,000	$646,679
			Total To Meet Goal (Kg/yr):	0	$336	$2,034,295
			Comparison to Conventional		$1,000	$6,052,211

Targeted Centralized Treatment after Applying Alternative Strategies (293 kg N/yr)

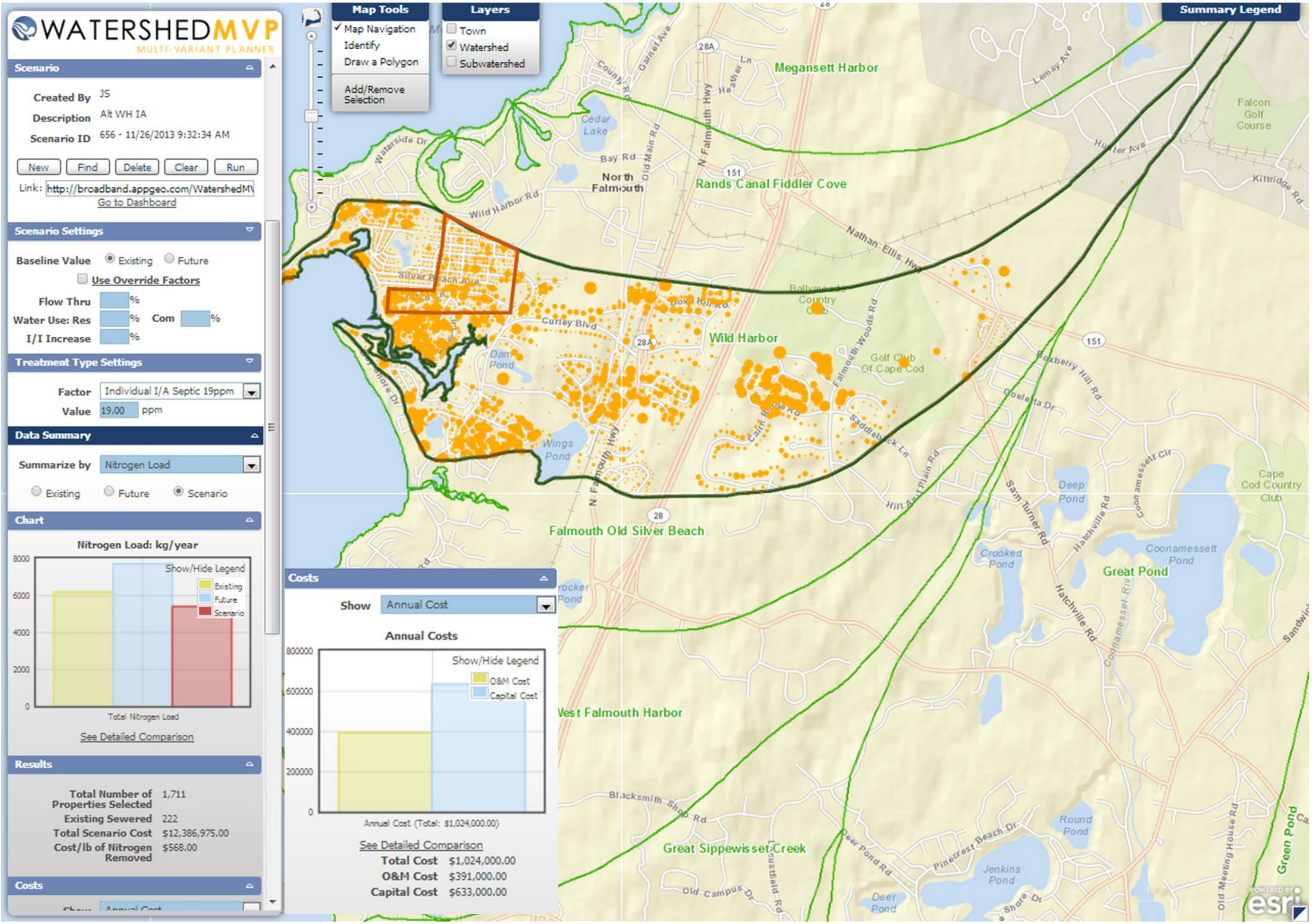


Scenario Comparison

Targeted Collection	Targeted Collection after a 50% reduction in fertilizer and stormwater	Targeted Collection after a 50% reduction in fertilizer and stormwater & after applying alternative approaches
		
➢ Achieves TMDL[1]	➢ Achieves TMDL[1]	➢ Achieves TMDL[1]
➢ Total Cost = $46 Million	➢ Total Cost = $29 Million	➢ Total Cost = $12 Million
➢ Cost/lb N = $386	➢ Cost/lb N = $301	➢ Cost/lb N = $544
➢ Treated Flow = 85,000 gpd	➢ Treated Flow = 42,000 gpd	➢ Treated Flow = 11,000 gpd

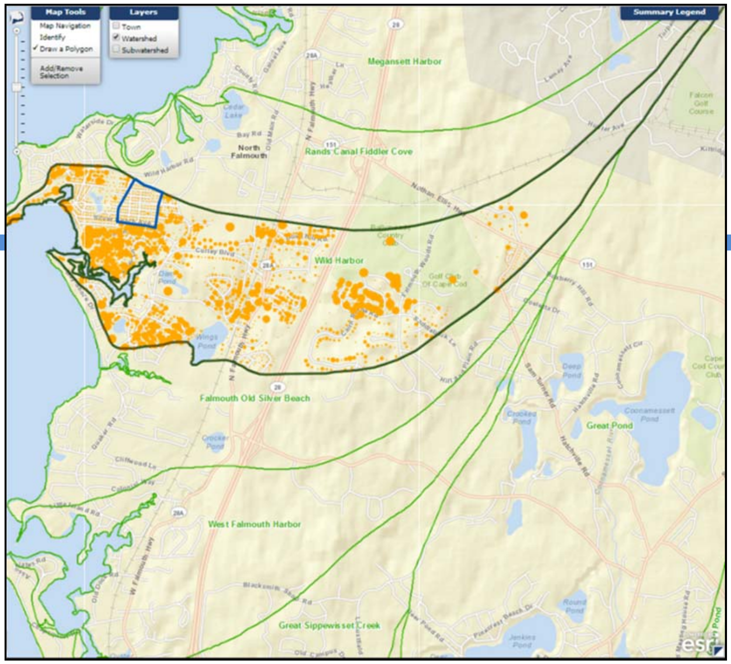
[1] within 5% of goal

Innovative/Alternative On-Site Systems after Applying Alternative Strategies (293 kg N/yr)



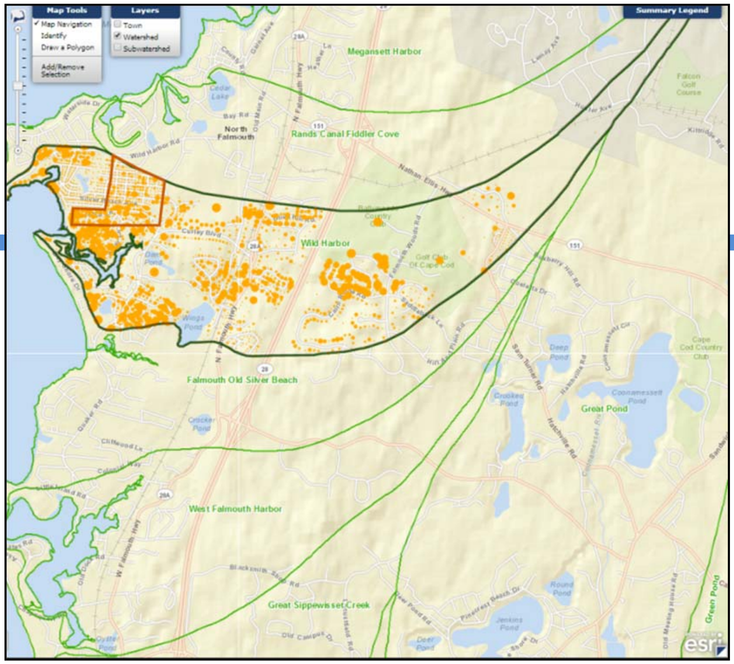
Scenario Comparison

Targeted Collection after a 50% reduction in fertilizer and stormwater & after applying alternative approaches



- Achieves TMDL[1]
- Total Cost = $12 Million
- Cost/lb N = $544
- Treated Flow = 11,000 gpd

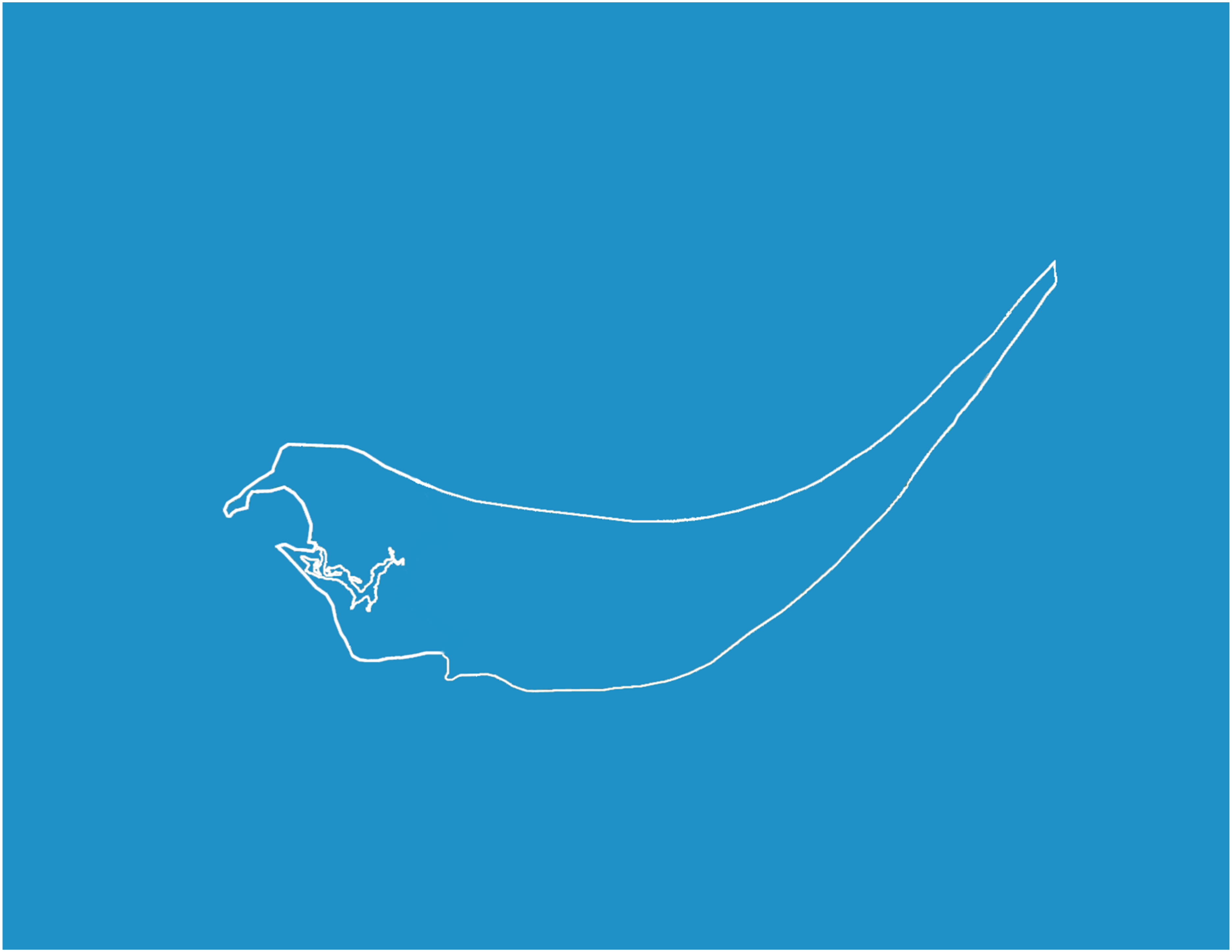
Innovative/alternative on-site systems after a 50% reduction in fertilizer and stormwater & after applying alternative approaches



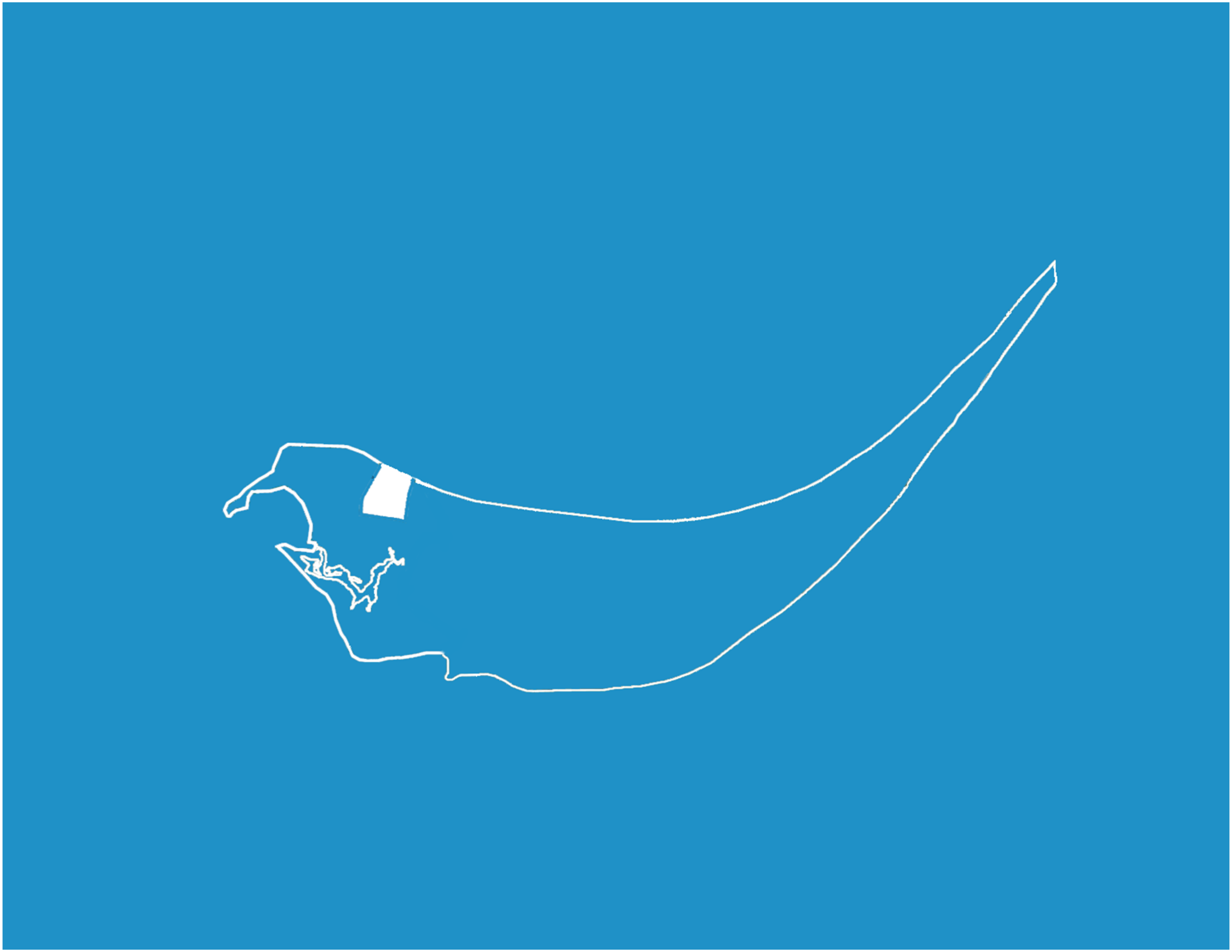
- Achieves TMDL[1]
- Total Cost = $12 Million
- Cost/lb N = $568
- Treated Flow = 32,000 gpd

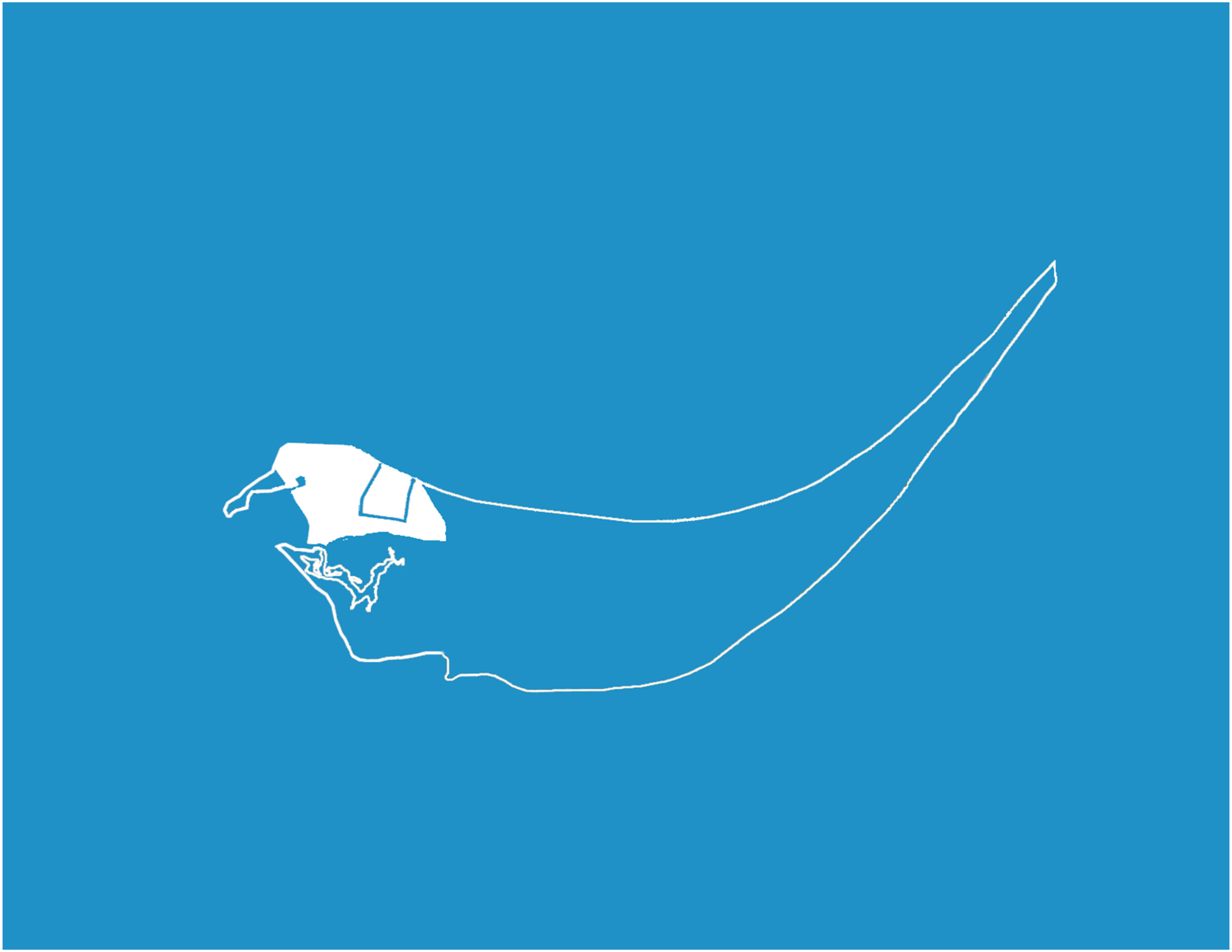
[1] within 5% of goal

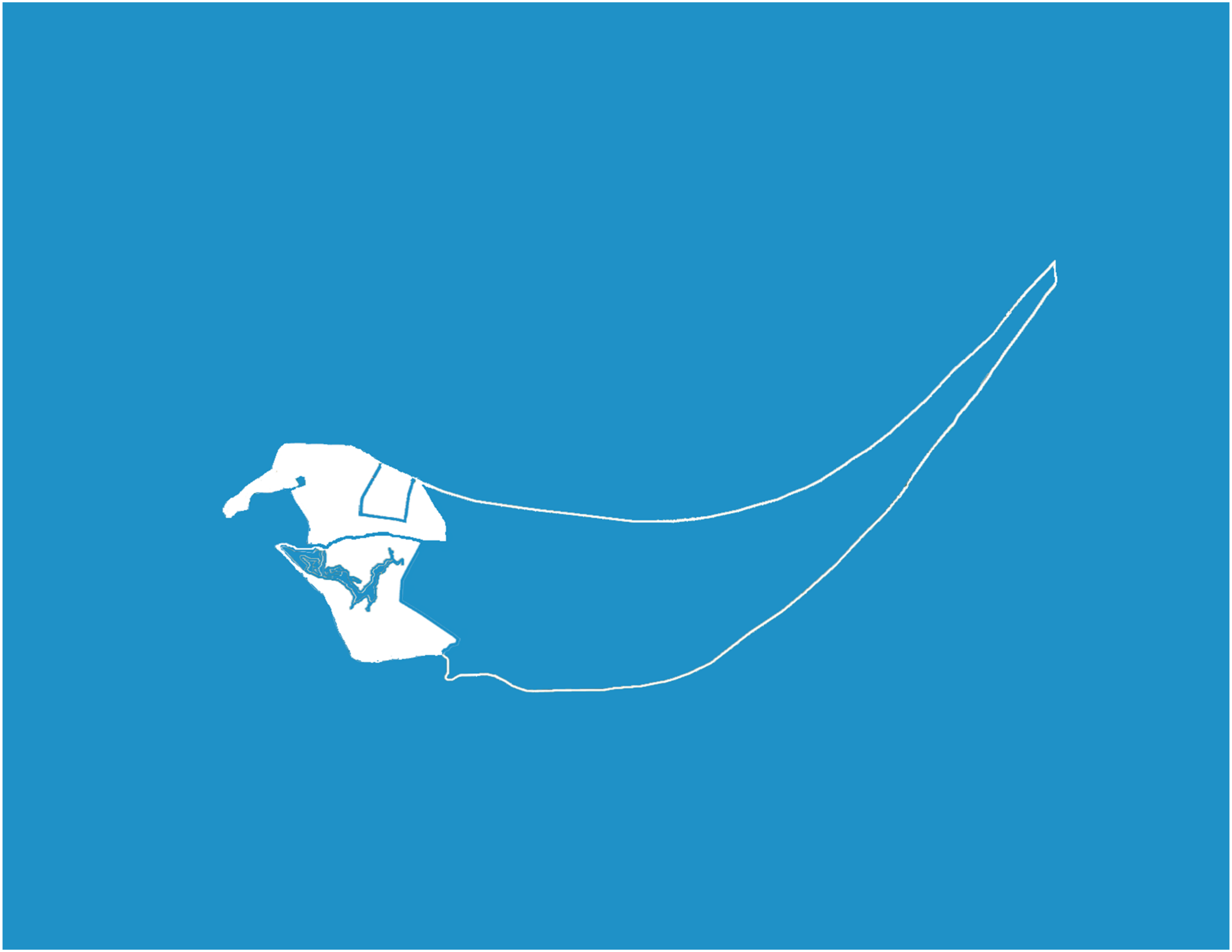
"Watershed Working Group - Upper Cape West/South - Workshop 3"



"Watershed Working Group - Upper Cape West/South - Workshop 3"







Adaptive Management:

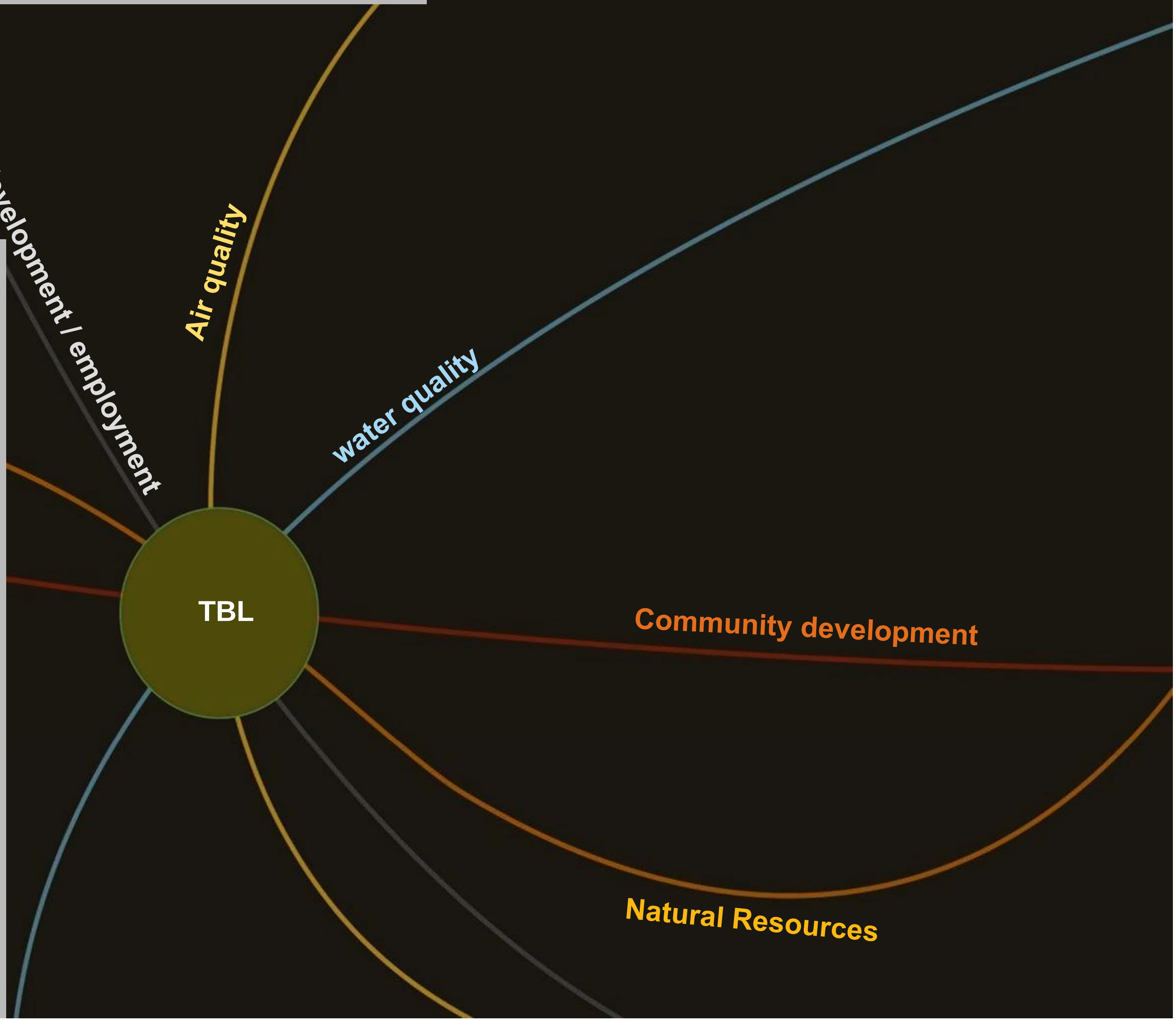
A structured approach for addressing uncertainties by linking science and monitoring to decision-making and adjusting implementation, as necessary, to increase the probability of meeting water quality goals in a cost effective and efficient ways.

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

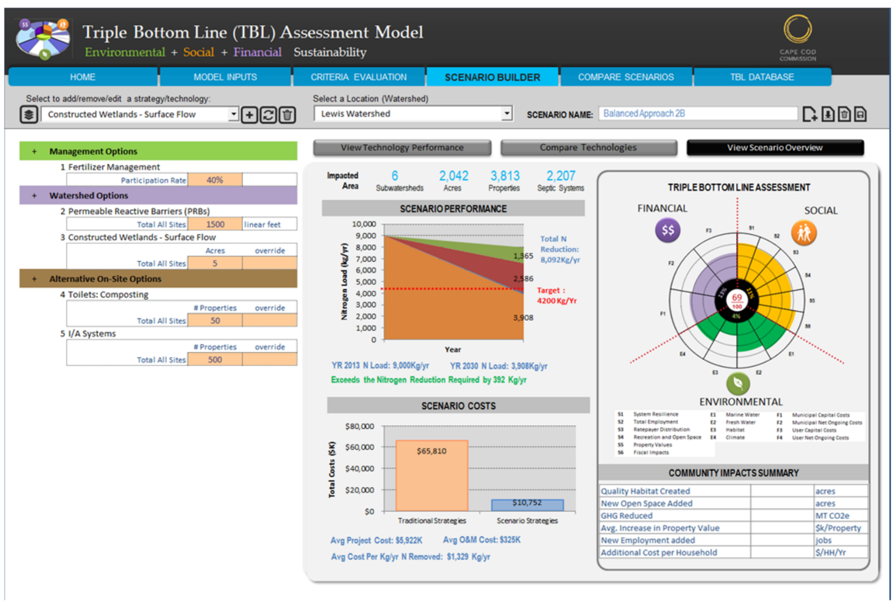
Often "TBL" analysis is used to identify the best alternative and to report to stakeholders on the public outcomes of a given investment.

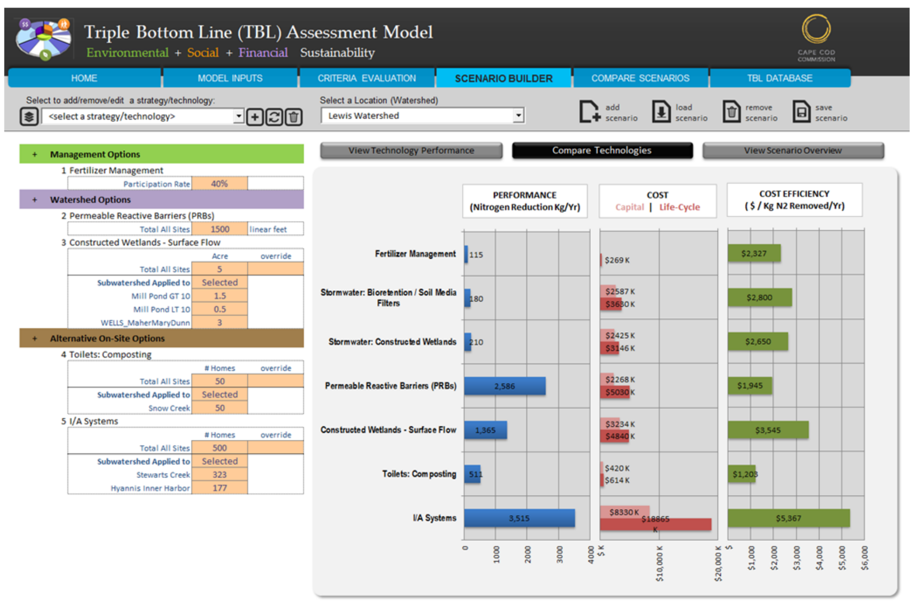


Why develop a TBL model?

- 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

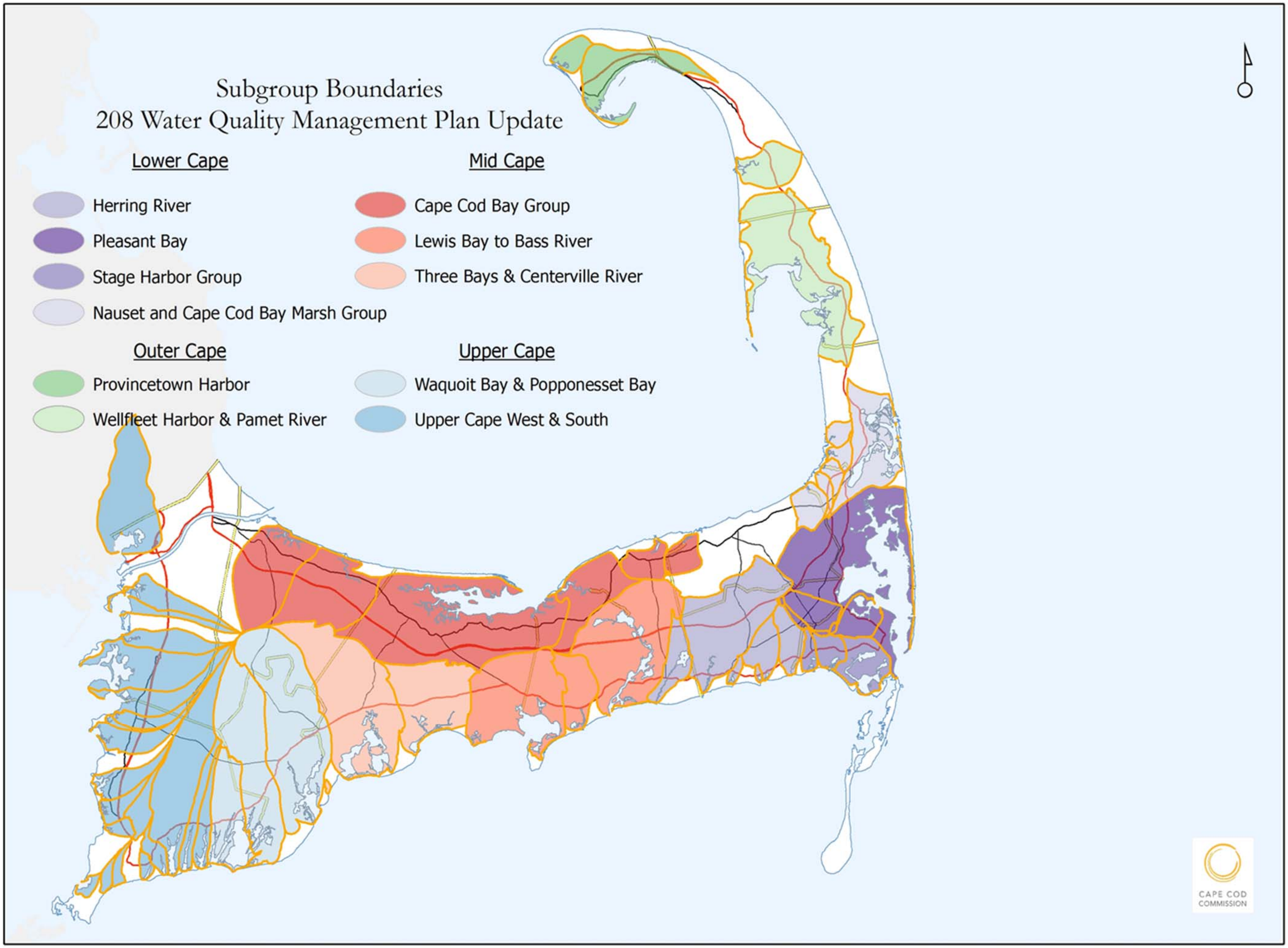
	Scenario 1	Scenario 2	Scenario 3
	Minimum Cost	Cost Effective	Maximum Performance

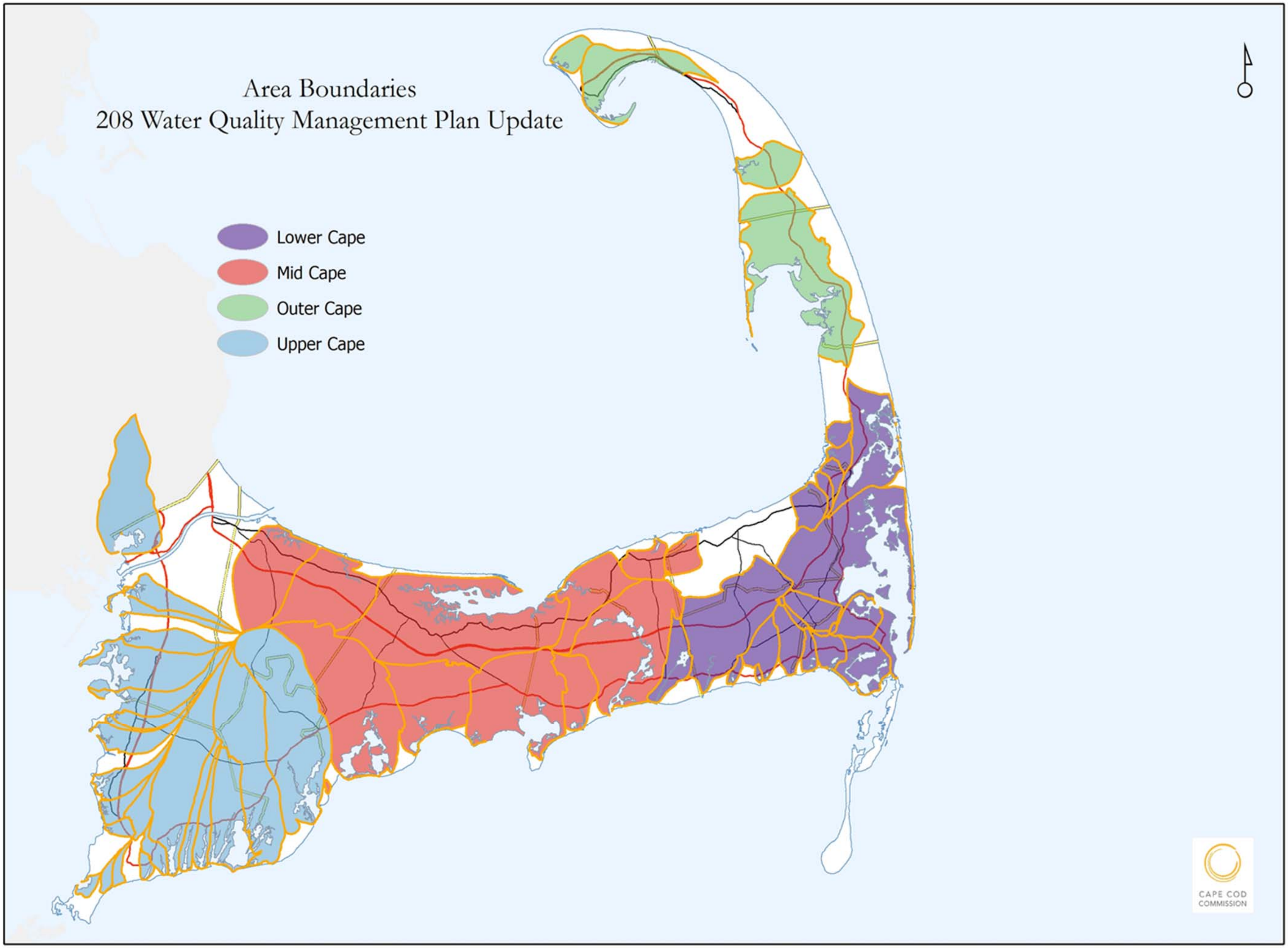
Criterion Scores

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	Scenario 1	Scenario 2	Scenario 3
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
CAPE COD COMMISSION


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

Cape Cod 208 Area Water Quality Planning
Upper Cape West and South Watershed Working Group

Meeting Three
Monday December 2, 2013
8:30 am- 12:30 pm
Falmouth Town Hall, 59 Town Hall Square, Falmouth, MA 02540

I. ACTION ITEMS

Working Group
- Provide any comments on the Meeting Two draft notes to Doug Thompson (dthomnpson@cbuilding.org).
- Provide comments and/or additional info on the town chronologies to Patty Daley.
- Provide comments on the Technology Matrix to Mark Owen at AECOM.
- Notify Doug Thompson to volunteer or nominate another for participation in the larger sub-basin working group meeting over the next several months.

Consensus Building Institute
- Facilitate communication between stakeholders and AECOM on assumptions and data used for ecotoilet calculations in the Technology Matrix.
- Finalize notes from Meeting Two, distribute to the Working Group, and post to the Cape Cod Commission's website.
- Send out draft notes from Meeting Three.

Cape Cod Commission
- Provide the Working Group with information on the assumptions behind the calculations of cost per pound of nitrogen removed for sewer, denitrifying septic systems, and I/A scenarios.
- Provide Working Group with the Commission's updated definition of adaptive management after incorporating feedback from the 11 working groups.
- Notify the Working Group of the selected date in January for the Stakeholder Summit.
- Remaining action item from Meeting Two: verify whether or not the eco machine example from South Burlington, Vermont was abandoned.

II. WELCOME, REVIEW 208 GOALS AND PROCESS AND THE GOALS OF MEETING

Doug Thompson, the facilitator from the Consensus Building Institute, and Ms. Patty Daley, Deputy Director of the Cape Cod Commission and Area Manager for the

Upper Cape West and South Watershed Working Group, welcomed participants. Ms. Daley offered a brief overview of the 208 Update Stakeholder Process, which started with public meetings in July and August. The first meetings of the eleven Watershed Working Groups, held in September, focused on baseline conditions in each of the watersheds, with the Upper Cape West and South Watershed Working Group looking specifically at the local conditions relevant to their represented area. The second workshop, held in October, explored the various technology options and approaches available. This third meeting in December is intended to focus on evaluating watershed scenarios, which are to be informed by the Working Groups' discussions about baseline conditions, priority areas, technology options/ approaches, and information provided in the Technology Matrix.

Ms. Daley shared the 208 Plan team's progress since Meeting Two, which includes:

- Meetings with the Advisory Board, the Tech Panel, the Finance Group, and the TAC.
- Development and distributed access to the Technology Matrix, which shows possible traditional and non-traditional technologies at the site, neighborhood, watershed, and cape-wide scales.
- Update of the town chronologies

Ms. Daley also shared the goals of Meeting Three:

- To discuss the approach for developing watershed scenarios that will remediate water quality impairments in the watersheds of concern to this group.
- 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.

Ms. Daley provided an overview of the various traditional approaches and non-traditional approaches possible to drive towards MEP nitrogen reduction targets. Both approaches also include a scenario with fertilizer reduction and stormwater mitigation that reduces the footprint of wastewater infrastructure needed. She noted that the presentation for Meeting Three is structured to explore evaluations of these various approaches in concert with fertilizer reduction and stormwater mitigation. She also noted that the goal is to minimize the infrastructure needed to meet water quality goals.

The facilitator then reviewed the agenda and led introductions. A participant list is found in Appendix A. Mr. Dan Milz, a doctoral student from University of Illinois at Chicago, announced that he would also be filming Meeting Three solely for research purposes (he also videotaped the second meeting). The facilitator reported that all action items from Meeting Two had been achieved, except for verifying whether the eco-machine in South Burlington, Vermont was abandoned, about which the Commission will report back to the Working Group.

Mr. Thompson reminded participants of the meeting guidelines and protocols for communication. He also noted that Virginia Valiela was absent but sent wishes that she could be present.

III. INITIAL SCENARIOS FOR THE WILD HARBOR WATERSHED

Mr. Scott Michaud, Hydrologist for the Cape Cod Commission, explained that management scenarios applied to the Wild Harbor Watershed would be used to explore the various traditional (permitted technologies such as sewers and I/A systems) and non-traditional treatment alternatives. He noted that Wild Harbor currently has a wastewater treatment facility that treats about 220 properties, and that the scenarios presented assume continued operation of that facility. He also noted that the MEP indicates that the nitrogen TMDL for this watershed can be met if 42% of existing wastewater nitrogen load is removed from the system.

He then introduced the Watershed MVP tool to develop traditional technology scenarios,.

Participants' questions and comments about the scenarios are included below *(in italics)*:

Traditional Scenarios

Mr. Michaud presented traditional wastewater management scenarios in the Wild Harbor watershed assuming denitrifying I/A onsite systems and centralized collection and treatment of wastewater with return load to thewatershed.

<u>Innovative/Alternative Septic Systems (I/A):</u> The first scenario presented applies I/A onsite septic systems to the entire Wild Harbor watershed. This scenario results in a 27% reduction in wastewater nitrogen load to the watershed, falling short of the wastewater nitrogen removal goal of 42%. The unit cost of this technology is about $800/lb of nitrogen removed.

<u>Conventional Sewer:</u> The second scenario that was presented applies centralized collection and treatment to the entire Wild Harbor watershed. This scenario results in a 74% reduction in wastewater nitrogen load to the watershed, exceeding the wastewater nitrogen removal goal of 42%. This scenario is estimated to cost approximately $600/lb of <u>wastewater</u> nitrogen removed. (The estimated 74% is below the general 81% presented for other watersheds because the nitrogen load from properties connected to the New Silver Beach treatment plant is assumed to remain unchanged.)

- *Several participants expressed concerns about the assumptions used to derive these cost calculations.*
    - The technical experts from the Commission said that they would get back to the Working Group about the assumptions and provide more information about how these calculations were derived (see Commission Action Items).
- *Specifically, one participant questioned why a smaller sewer infrastructure correlated to a less expensive cost per lb.*
    - Mr. Michaud explained that the difference derives from the fact that the targeted area is more densely populated and would require less pipeline distance.
- *Several participants also asked about how communities and individual homeowners would bear the cost burdens of additional sewer.*
    - The group concurred that a discussion on cost recovery should be revisited later, and that a comparative analysis of the unit costs per pound of nitrogen removed must be done first to determine which technologies are most cost effective.
- *Another participant suggested that the costs of sewer could have implications for approving future subdivisions.*

<u>The Role of Ponds/streams and Natural Nitrogen Attenuation in Targeting Sewer Installation:</u> *With the aid of a GIS image, Scott explained which areas of the watershed are up gradient versus down gradient of local ponds. He also explained natural attenuation of nitrogen and how that relates to overall loads. One possible solution is to collect wastewater in areas that are not attenuated naturally and move it to areas that are.*

- *One participant asked about the role of ponds in addressing excess phosphorous loads.*
    - Mr. Michaud assured that phosphorous would be included in future discussions, but that at this juncture, the Commission is focusing on the nitrogen issue.
- *Several participants showed concern that relying too much on natural attenuation will create adverse ecological impacts to pond ecosystems.*
    - The technical experts of the Commission pointed out that these attenuation processes are already occurring, and that their intent was only to illustrate the existing nitrogen dynamics within the natural environment. Mark Owen of AECOM added that nitrogen is not typically a limiting nutrient for ponds (though phosphorous is).
- *One participant asked whether the ratio of pond-to-watershed size influences the 50% nitrogen attenuation estimate.*
    - Mr. Michaud responded that attenuation rates do vary, but that the rate is generally assumed by the MEP to be 50% for ponds.

- *One participant asked if seasonality and variable rates of biological activity due to temperature were incorporated into the 50% nitrogen attenuation estimate.*
    - Mr. Michaud stated that he believes the estimate does factor in seasonal variability, and noted that the Commission is working to address that issue.
- *Another participant noted that the MEP studies factored in pond activity when determining the nitrogen TMDL.*

<u>Targeted Conventional Sewer:</u> The third scenario that was presented applies centralized collection and treatment to areas of the Wild Harbor watershed such that the wastewater nitrogen removal goal of 42% is met. This scenario results in the collection of wastewater from approximately 800 properties for centralized treatment. This scenario is estimated to cost approximately $670/lb of <u>wastewater</u> nitrogen removed.

The fourth scenario that was presented applies centralized collection and treatment to areas of the Wild Harbor watershed assuming that 50% of the fertilizer and stormwater nitrogen load is removed from the entire watershed and such that the wastewater nitrogen removal goal of 42% is met. This scenario results in the collection of wastewater from approximately 430 properties for centralized treatment. This scenario is estimated to cost approximately $610/lb of <u>wastewater</u> nitrogen removed.

Non-Traditional (7-Step) Scenario

Heather McElroy, Natural Resources and Land Protection Specialist for the Cape Cod Commission, presented one scenario in which a suite of non-traditional, green technologies is applied within the Wild Harbor Watershed to reach nitrogen reduction targets. Using the Watershed Calculator and a map of the watershed, she presented the reduction potential, costs, and potential locations of these various technologies.

Before running through the scenario, Ms. McElroy discussed further baseline conditions of the Wild Harbor Watershed. As studied by MEP, the current nitrogen load is about 8,900 kg/yr. Approximately 6,300 kg/yr is derived from wastewater, 1,900 kg/yr from fertilizer, and 760 kg/yr from stormwater. The total nitrogen reduction required is about 2,700 kg/yr. The watershed contains 1,474 properties, and other wastewater management needs persist, including ponds, Title V problem areas, and growth management.

<u>Fertilizer Reduction and Stormwater Mitigation:</u> For discussion purposes the Commission is anticipating that fertilizer nitrogen loads can be reduced by about 50% or 953 kg/yr, and stormwater mitigation loads reduced by 382 kg/yr, also roughly 50%. It is assumed that these options incur minimal costs to the town.

- *One participant asked about the likelihood that DEP would provide credit for 50% reductions in fertilizer and stormwater load.*

- The technical experts stated that DEP and EPA have been receptive to the use of credits, but that an actual number of nitrogen credits remain undetermined at this time.

Permeable Reactive Barriers (PRBs): Ms. McElroy shared a GIS map indicating suitable areas for PRBs within the Wild Harbor Watershed, i.e., areas close to where groundwater discharges to estuaries, where the water table is 20 or fewer feet below the surface, and where road lengths run perpendicular to groundwater flow. Under the scenario, two potential PRB locations could treat the nitrogen load from 144 homes, reducing by 443 kg/yr. The unit cost is $452/lb. While the Commission is currently using fairly long road lengths in its location screening analysis, the technology could also be installed on shorter road segments in various locations.

- *Several participants were interested in specific siting recommendations for this technology.*
    - The entire technical team reminded the group that the suggested sites are only offered for the purpose of running the scenario simulation, and consideration of them is preliminary and illustrative.
- *One participant asked how deep PRBs can be installed into unsaturated zones.*
    - Ms. McElroy responded that they can be installed down to 40 feet below the surface, but that it depends on the type of PRB used (there are two types). The first type is a reactive barrier 3-4 feet wide. The second type involves injecting a carbohydrate into a well – these can often be deeper. The depth is also determined by how deep the nitrogen levels are in the groundwater.
- *Another participant expressed concern for constraints to this technology created by existing utilities.*
- *One participant shared that his community anticipated its PRB study for feasibility on Quaker Rd. would be complete soon.*

Fertigation wells: A hypothetical fertigation well along a golf course was used to illustrate the potential results from this technology. A well is drilled down-gradient from the golf course, from which nitrogen-laden groundwater is pumped and used to irrigate the greens. The unit cost of removing nitrogen via this technology is $438/lb.

- *One participant shared that West Yarmouth installed this technology to irrigate three golf courses, and noted that, despite perceptions, there is not a considerable nitrogen load from the golf courses – perhaps 5-10 ppm. He suggested that there is an opportunity to get credits for this technology due to the minimal nitrogen load from golf courses and the fact that the natural filtration process as a result of the irrigation runoff removes 90% or more.*
- *The group agreed that golf courses are no longer as significant a nitrogen source as had once been the case. Participants think this technology should be sited, for example, next to a densely populated area.*

    - Ms. McElroy confirmed that this technology could also be sited down gradient of a densely populated area, and that this fact should be made clearer in the Commission's presentations. She also mentioned that while golf courses are less of a problem for nitrogen loading, they are a suitable place for using the nitrogen-heavy groundwater. This will be corrected in further presentations.
- *Another participant noted that tertiary-treated effluent could also be used for golf course irrigation.*

<u>Oyster beds and aquaculture:</u> Under the scenario, one acre of cultivated oysters would be designated in Wild Harbor. Conservative estimates indicate that this would remove nitrogen at a rate of 250 kg/yr. The unit cost of this option is $0 kg/yr. Using the Watershed Calculator, the group determines that about 7 acres of oysters, in addition to 50% fertilizer reduction and stormwater mitigation, would achieve the nitrogen reduction target.

- *The group overall agreed that this is a good option to look into further. They noted that this could create municipal recreation opportunities by allowing public harvesting, which could bring in revenue for the town, making the unit cost negative. The group overall agreed that $0 unit cost was a fair estimate.*
    - Ms. McElroy noted that aquaculture could have other social costs, e.g., impacting navigation and other recreational activities in the harbor.
- *One participant noted that if commercial players were managing the aquaculture, costs and profit would be transferred to them, but it would have to be in partnership with the town.*
    - Ms. McElroy noted that even if the profit from oyster sales is private, it's a co-benefit, and said that the Commission will be looking into this topic further.
    - *Another participant added that even private profits have economic benefits to the community.*
- *The group discussed the impacts of nitrogen uptake on oyster health and any related public health risks from consumption. One participant suggested this could be a possible white paper topic.*
    - Ms. McElroy also noted that, presumably, the oysters can be harvested and consumed, but they could also be left in to enhance the salt marsh ecosystem. Wellfleet is doing this.
- *Another participant expressed concern about impacts of this treatment option to the shellfish industry. He suggested that the oysters could be dumped in a deepwater area where they wouldn't be likely harvested, though noted that this would add cost.*
- *Another also expressed concern about increased nitrate levels as a result of expanded aquaculture.*

- *One participant questioned the assumptions about oyster size, growth rate, and nitrogen process used to calculate the nitrogen removal rate of oysters, and the variability of size and seasonality*
    - The technical experts indicated that they looked at how much nitrogen was taken up within the shell and meat, and that the removal rate of 250 kg/yr is at the low end of estimates, with a range of 250-1,000 kg/yr.

Ecotoilets: Under this scenario, it is assumed that 74 out of the 1474 homes will switch to ecotoilets, removing 293 kg/yr. The unit cost is estimated at $1,265/lb nitrogen removed.

- *One participant asked about the assumptions used to derive the unit cost and disputed the removal rate proposed. The participant added that Urine Diversion and compost ecotoilets differ and should be separated when estimating costs.*
    - Ms. McElroy explained the calculations included the costs of retrofitting a home, the cost of the toilet, and the cost of maintenance. She welcomed further discussion and feedback on how to make these calculations more accurate.
- *Another participant noted that there are about 2-3 ecotoilets already installed in Falmouth and that the town will be able to share further information about this option once they have more installed.*

Remaining sewer footprint required

Ms. McElroy then noted that the implementation of this suite of non-traditional technologies, as described in this scenario, would require 67 homes to be targeted for conventional sewer infrastructure, and showed the targeted area simulated on a GIS map.

She reiterated that this is only one possibility for how these technologies could be paired and implemented, and that a community could decide to rely upon one or all of them. The group spent some time inputting different combinations of technologies in the Watershed Calculator.

Constructed wetland and phytoremediation site screening

While not included in this scenario, Ms. McElroy also showed maps created through GIS analysis that highlighted screened locations for freshwater constructed wetland and phytotechnology projects, options included in the Technology Matrix. For the constructed wetlands location screening, several criteria were used including:

- Parcel-size over 5 acres
- Outside the 100-year floodplain
- Outside priority rare species protected areas
- Outside protected open space areas.

The technical experts confirmed that this can be a very effective nitrogen removal strategy, and that it is less expensive than sewering.

- *One participant cautioned about introducing invasive species, and about the need for a maintenance program that includes harvesting.*
- *Another mentioned that constructed wetlands could be incorporated into new developments, though this is less relevant to watersheds already built out, e.g. Falmouth.*
- *Several participants noted that some screened sites would be impractical to pursue, e.g., cranberry bogs. This would not be feasible in Falmouth.*
    - Ms. McElroy agreed with the concerns about converting cranberry bogs to wetlands for nitrogen attenuation, but noted that towns might pursue lease agreements with growers on town-owned bogs for decommissioning a bog.
    - *Another noted that Harwich has municipally-owned cranberry bogs, and this could be more likely there.*
- *Several participants were interested in whether saltwater constructed wetlands were an option.*
    - Mark Owen and Ms. McElroy shared that there is less information on them, but that experts believe they may also be effective.
- *One participant noted that a constructed wetland treating wastewater would require a collection system and that this would have to be factored into cost estimates.*
- *One participant raised the issue of seasonality in these calculations as well.*
- *On the topic of phytotechnology, one participant noted that removal of Phragmites could be an effective and potentially cost-free option. Some studies indicate that this can remove up to 16% of nitrogen.* The participant suggested that the stalks, leaves, and seeds of the phragmites (not roots), be harvested to remove the nitrogen in these parts of the plants. The roots would remain and the plant would regrow and be harvested in subsequent years. The harvested phragmites would then be mixed with other compostable materials.

Overall scenario comparison

Ms. Daley showed an overall comparison of three scenarios – 1) sewer only, 2) sewer after 50% reduction in fertilizer and stormwater, 3) sewer after 50% reduction in fertilizer and stormwater and the application of green infrastructure (non-traditional) technologies, and 4) Innovative/Alternative on-site systems after 50% reduction in fertilizer and stormwater and the application of non-traditional technologies.

Scenario (Infrastructure required)	**Total Cost**	**Cost /lb N**	**Treated flow (gpd)**
Sewer (i.e. targeted collection)	$46 M	$670	85,000

Sewer after 50% reduction in fertilizer and stormwater	$29M	$610	42,000
Sewer after 50% reduction in fertilizer and stormwater and the application of non-traditional techs	$12M	$544	11,000
Innovative/Alternative on-site systems after 50% reduction in fertilizer and stormwater and the application of non-traditional techs	$12M	$568	32,000

The sewer footprint associated with each was shown on a map, shrinking and expanding depending on the scenario considered.

General discussion of scenario exercise

The workgroup raised the following comments and questions:

- *Several participants brainstormed ways in which sewer could be avoided – e.g., via increased oyster acreage or eco-toilets.*
- *One participant commended this analysis, but reminded the group that only sewers and I/A systems are currently approved for meeting TMDLS. This kind of suite of non-traditional technologies will require a paradigm shift, and that there are significant amounts of regulatory and scientific uncertainty.*
    - Ms. Daley and Ms. McElroy replied that the concept of adaptive management is central to this issue. They also noted that DEP and EPA are willing to allow for experimentation with non-traditional alternatives first. If they prove to be ineffective, we can revert to a more traditional approach.
- *The group agreed that they'd like to see greater level of specificity in analysis moving forward to determine how feasible each technology is within a given community.*
    - Ms. McElroy stated that the Technology Matrix provides information about where it is possible to install particular technologies. She and Mark Owen will be looking further at the site-specific factors moving forward.
- *Several participants expressed concern that certain considerations were not being factored into the unit costs of technologies. They also were concerned about the unit inconsistencies (kg vs. lb).*
- *One participant raised again the issue of seasonality, and how large nutrient loads in the winter tend to dissipate before they create water quality problems due to decreased biological activity. A better understanding of these dynamics could impact the nitrogen removal rate estimates for these technologies and possibly allow greater discharge levels in the winter.*

- The technical experts from the Commission noted that they are considering a white paper of this issue. From regulatory standpoint, a TMDL is constant throughout the year, but it might be prudent to seek an adaptable standard based on seasonal factors (e.g., climatology, population flux).
- *Other participants disagreed with the statement that there is no water quality problem in the winter.*
- *It was shared that Falmouth has already started taking measurements to understand seasonal dynamics.*

- *One participant expressed concern that climate change and other externalities were not part of the discussion.*
  - The facilitator confirmed that climate change and other considerations will be carried forward in the next phase of meta-analysis.
  - *Other participants argued that it is not the town's responsibility to address climate change, but that of the federal and state government, and that the primary concern before these working groups is pollution control.*

Takeaways from the scenarios

The group agreed to the following main takeaways provided by the scenario analysis and discussion:

- *The use of non-traditional alternatives can avoid the need for sewer infrastructure.*
- *A suite of approaches will likely be necessary to achieve nitrogen reductions.*
- *The decision about what specific combination of technologies to apply must be locally-driven. It should also be based on specific constraints within a watershed as well as the community's priorities and risk-tolerance.*

IV. ADAPTIVE MANAGEMENT

Ms. Daley explained that an adaptive management approach is critical because of the degree of uncertainty present in many of these alternatives. The idea behind this concept is to implement and monitor the non-traditional technologies and if they prove to be ineffective in meeting target nitrogen reduction goals, to fall back on the traditional approaches.

Defining Adaptive Management

Ms. Daley provided the Commission's current definition of 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 cost effective and efficient ways."

She then solicited feedback and suggested revisions from the Working Group. Several participants offered revisions, including (see italicized texts):

"A[n] *integrated* and *iterative* approach for addressing *regulatory and performance* uncertainties by linking science and monitoring to decision-making and adjusting implementation , as necessary, to increase the probability of meeting water quality goals in cost effective*, socially acceptable, and ecologically sustainable ways, in a specified period of time."*

Ms. Daley explained that feedback on this definition from all 11 Work Groups would be considered, and that the Commission would share the proposed revisions after the third series of workshops.

- *One participant asked how an adaptive management plan might be implemented.*
    - Ms. Daley replied that the concept will be integrated into the 208 Plan Update. She also said that the Commission is talking to federal and state regulators about using the definition as a framework for approving local and municipal plans in the future.

V. PREPARING FOR JANUARY-JUNE 2014

Triple Bottom Line (TBL) Analysis

Kristy Senatori, Deputy Director of the Cape Cod Commission, presented on the work that the Commission has done in concert with AECOM to develop a Triple Bottom Line model. First, she defined Triple Bottom Line Analysis as a full accounting of the financial, social, and environmental consequences of investments or policies ("People, Profit and Planet"). She also noted that TBL analysis is often used to:

- Evaluate scenario alternatives and rank them against each other; and
- Report to stakeholders on the public outcomes of a given investment.

In explaining why the Commission has decided to pursue a TBL model, Ms. Senatori shared that it will allow it to:

- Consider the financial, environmental, and social consequences of water quality investments and policies in Cape Cod
- Evaluate the "ancillary" or downstream consequences of water quality investments, not just direct phosphorous or nitrogen level reductions.

She also explained that AECOM is working with Commission staff and stakeholders to develop criteria that integrate social, environmental, and financial considerations into the TBL model. These include:

- **Social**: System Resilience (i.e. how communities respond to natural hazards), Employment, Property Values, Ratepayer Distribution, Recreation and Open Space, Fiscal Impacts
- **Environmental**: Marine Water Quality, Fresh Water Quality, Climate, Habitat
- **Financial**: Municipal Capital Costs, Municipal Other Costs, Property Owner Capital Costs, Property Owner Other Costs.

Ms. Senatori then showed how three different hypothetical scenarios (minimum cost, cost effective, and maximum performance) run through the model ranked comparatively, taking into consideration these social, environmental, and financial factors. She explained the model will be finalized by January or February 2014, and that the Commission will be using it over the next six months to assist in scenario evaluations and to address the "no action" alternative to water quality management.

- *One participant asked if seasonal human population dynamics were considered?*
  - Ms. Senatori responded that yes, the Commission has spent a lot of time on that aspect.
- *Another was interested in whether affordability and adverse economic impacts to certain populations was factored in.*
  - Ms. Senatori responded that it is a great point and that it will come into play over next series of meetings.
- *Another noted that regulatory incentives and disincentives were left out of the TBL model.*
  - Ms. Senatori responded that these two components will be considered moving forward by the Regulatory, Legal, and Institutional group.
- The facilitator noted that EPA has been supportive of the TBL model in efforts made by other regions, e.g., New Hampshire.

Next Steps

Ms. Senatori explained to the Working Group the anticipated next steps of the 208 Plan Updated include:

January 2014	Assemble all 175 stakeholders across Cape Cod for a one-day Stakeholder Summit (tentatively scheduled for Jan 31) to discuss further planning, share the outcomes from stakeholder meetings, and form four sub-groups representing the Upper-, Mid-, Lower-, and Outer-Cape.

	These groups will likely meet three more times (February, March, April). Also likely assemble an *ad-hoc* meeting discuss monitoring protocols for different technologies. The four sub-groups meet to further develop local scenarios and run them through the TBL model, discussions related to the Regulatory, Legal and Institutional work group, and implementation and financing and affordability considerations.
June 1, 2014	Submit a draft plan to DEP.
June – Dec 2014	Collect and consider public comments on the draft plan.
January 2015	Submit final plan to DEP

Ms. Senatori noted that the Commission would send out more information about the sub-groups, and that they will have 10-15 participants on them.

Shared Principles

The facilitator discussed the following list of shared principles that have been vetted by this Working Group over the three meetings, and suggested that these principles be considered as the planning process moves forward and as more details emerge about the various technologies:

- Affordability
- Climate change (i.e., awareness of it as a dynamic, and what effect technologies have in contributing to it)
- Ease of implementation ("low hanging fruit")
- Growth assumptions
- Multiple benefits (e.g., wildlife)
- Reliability and confidence
- Regulatory/legal
- Resiliency
- Public acceptance
- Speed and timing (re: adoption, re: realization of benefits)
- Unintended consequences
- "Real costs" (financial as well as ecological)

Several group members added additional principles, including:

- *Consequences of no action*

- *Consideration of scarce/valuable resources*
- *Large scale benefits/impacts beyond Cape Cod*
- *Confidence in baselines*

Mr. Thompson then invited the group to nominate representatives from this work group to be sent to the larger sub-basin work group (see Action Items).

VI. PUBLIC COMMENT AND FINAL THOUGHTS

- *One participant asked if the fact sheets had been updated.*
    - Commission staff replied that, yes, they had incorporated the comments.

Mr. Thompson and Ms. Daley thanked the group for their participation and adjourned the meeting.

APPENDIX A

Upper Cape West & South Workshop Three
December 2, 2013
Participant List

1. Earle Barnhardt - The Green Center
2. Michael Ciaranca - Sate of MA, Joint Base Cape Cod
3. Cynthia Coffin - Bourne BOH
4. Wesley Ewell - Bourne Wastewater Coordinator
5. Nate Jones - Health Agent, Town of Sandwich
6. Sia Karplus - CWMP, Falmouth
7. Hilde Maingay - The Green Center
8. Dan Milz - University of Illinois, Inst. of Envir. Science and
9. Ed Nash - Golf Course Supt. Assoc.
10. Mark Owen - AECOM
11. Charles Passios - Golf Course
12. Jerry Potamis - Wastewater Superintendent, Falmouth
13. Sallie Riggs - Wastewater Advisory Committee, Bourne
14. Linda Zuern - Board of Selectmen, Bourne
15. Ron Zweig - Falmouth WQMC

Cape Cod Commission Staff:

Patty Daley - Deputy Director
Kristy Senatori - Deputy Director
Shawn Goulet - GIS Analyst
Heather McElroy - Natural Resources/Land Protection Specialist

Scott Michaud - Hydrologist
Maria McCauley - Fiscal Officer/Staff Support

CBI Staff

Facilitator: Doug Thompson
Note-taker: Lauren Dennis