# Cape Cod 208 Area Water Quality Planning
# Waquoit and Popponesset Bays Watershed Working Group

**Meeting Three**
**Wednesday, December 11, 2013**
**Mashpee Town Hall, 16 Great Neck Road North, Mashpee, MA**
**1:00 pm – 5:00 pm**

<u>Agenda</u>

1:00 Welcome, Review 208 goals and Process and the Goals of today's meeting – *Cape Cod Commission Area Manager*

1:15 Introductions, Agenda Overview, Updates and Action Items– *Facilitator and Working Group*

1:30 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

3:00 Break

3:15 Adaptive Management – *Cape Cod Commission and Working Group*

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

4:00 Preparing for 2014 Jan-June – *Cape Cod Commission and Working Group*

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

4:45 Public Comments

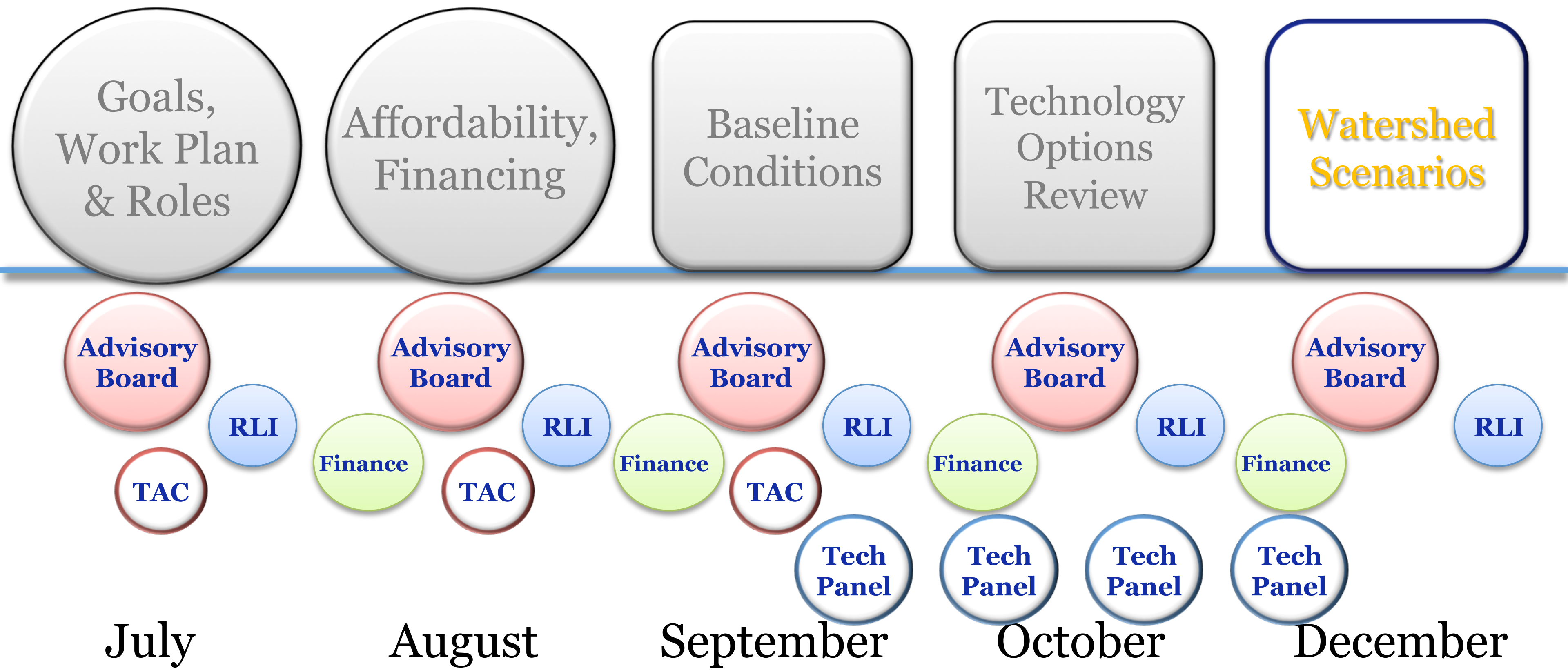
5:00 Adjourn

# Waquoit Bay & Popponesset Bay Group

## Watershed Scenarios

Public Meetings

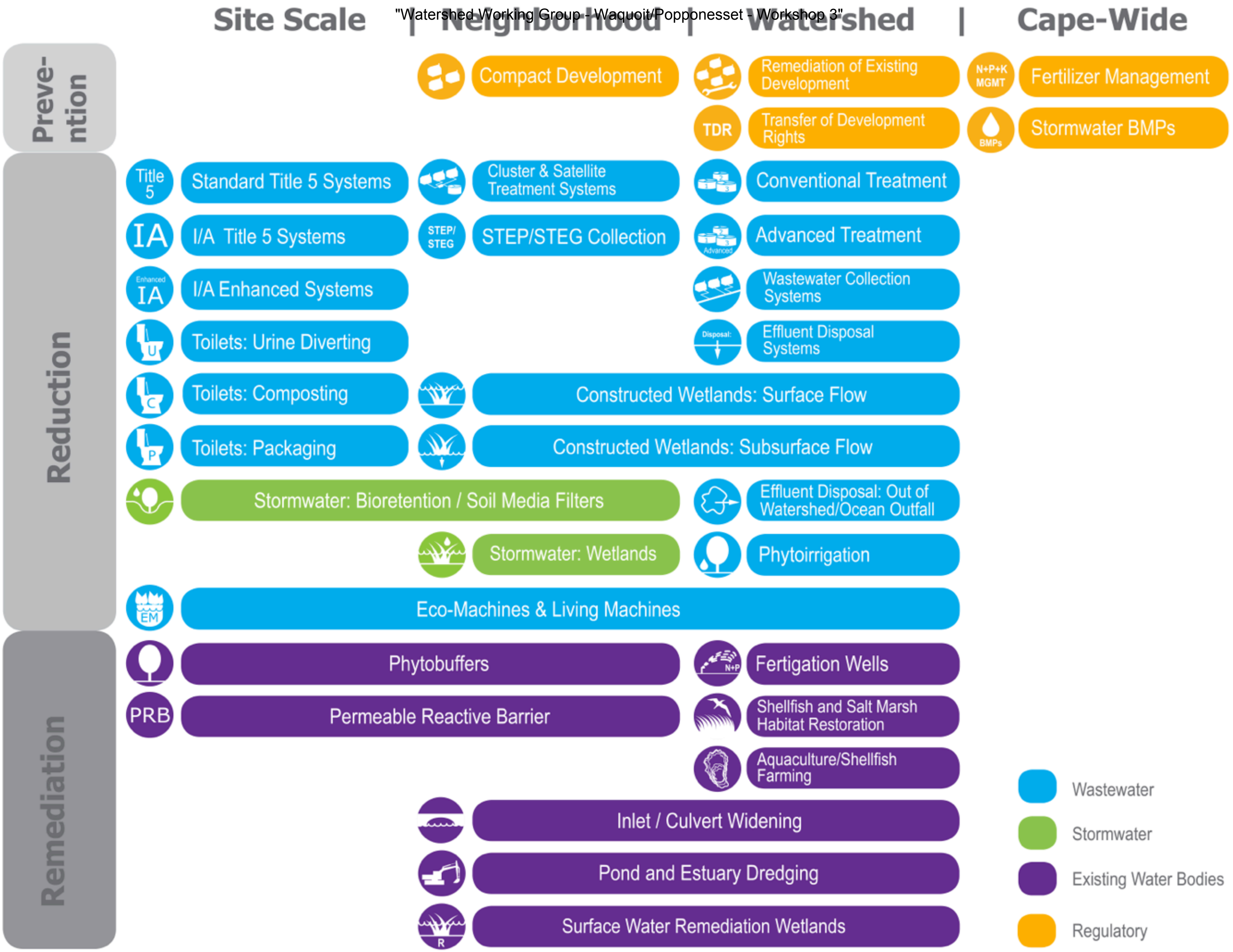
Watershed Working Groups




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
Preve-ntion
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Remediation
Compact Development
Remediation of Existing Development
N+P+K MGMT
Fertilizer Management
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Stormwater BMPs
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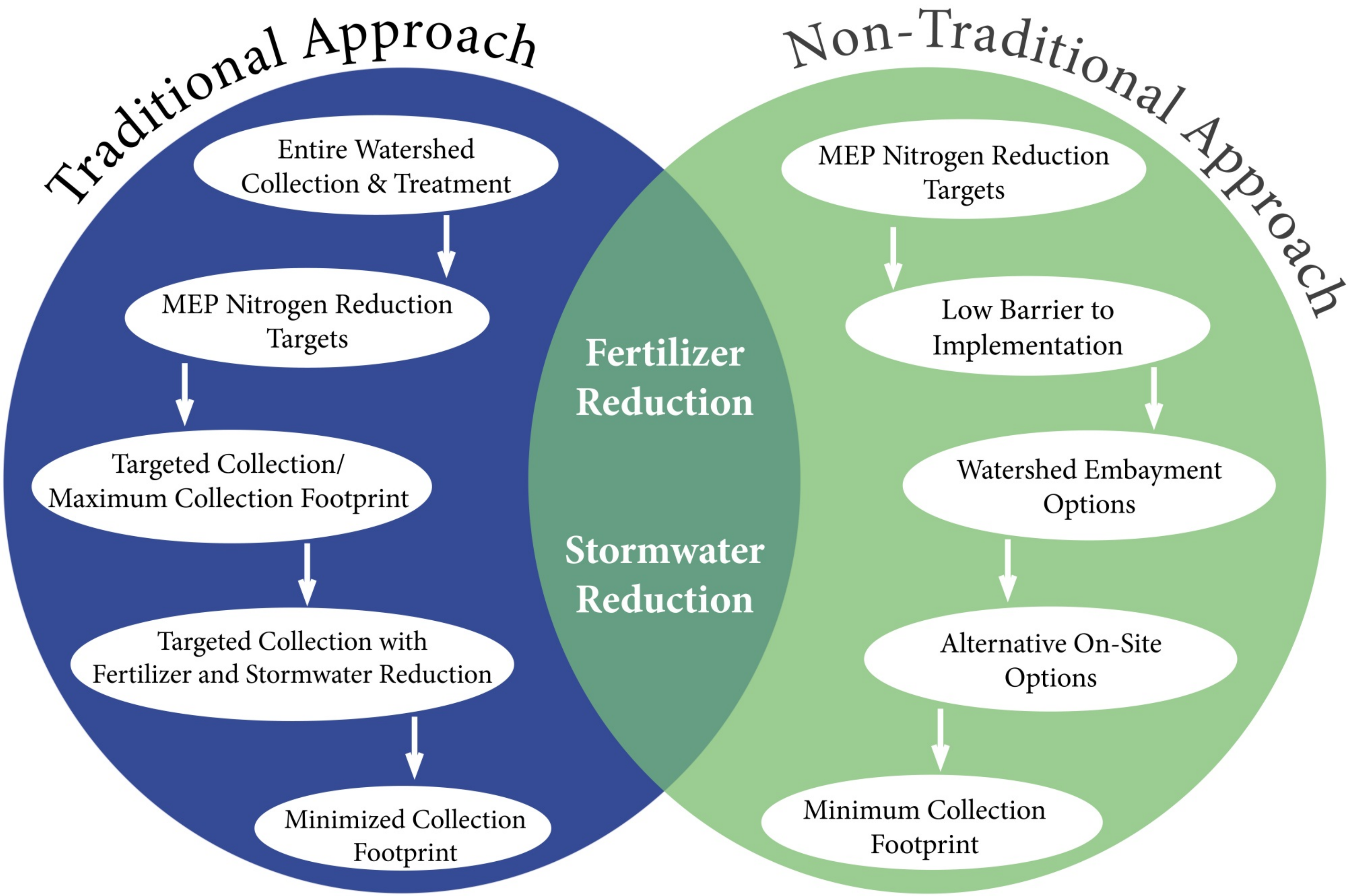
Existing Water Bodies
Regulatory

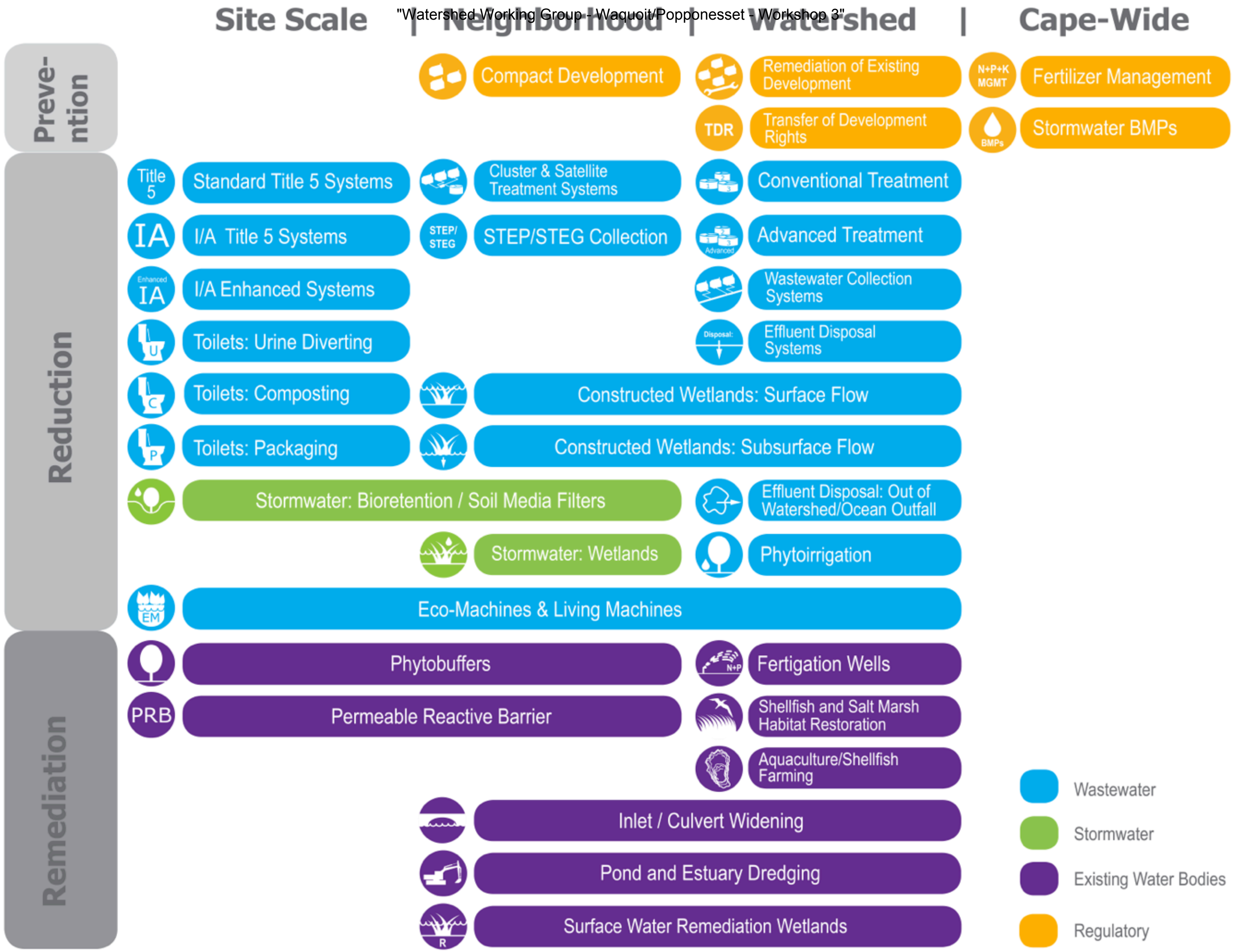
Watershed Scenarios

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.


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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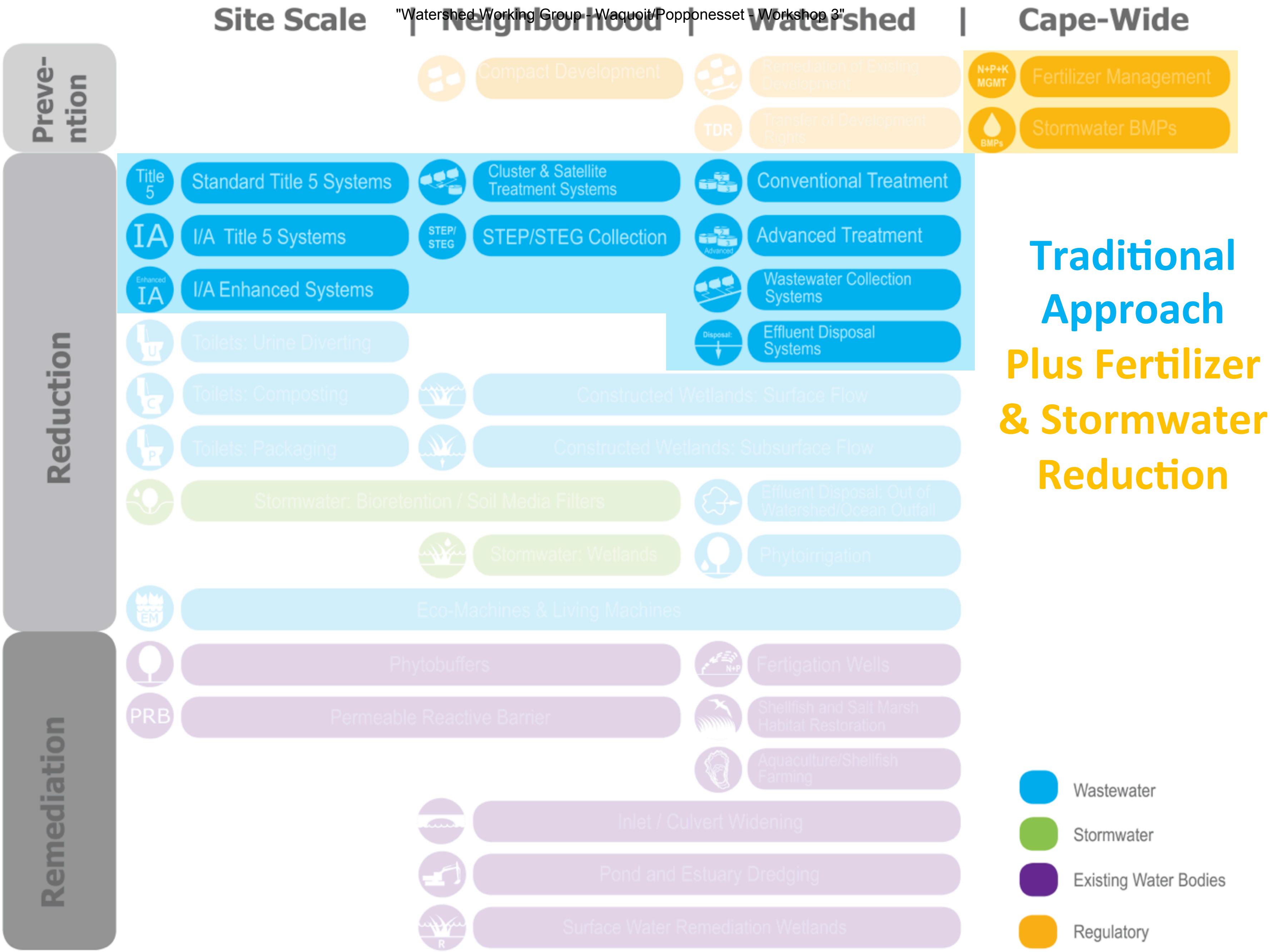
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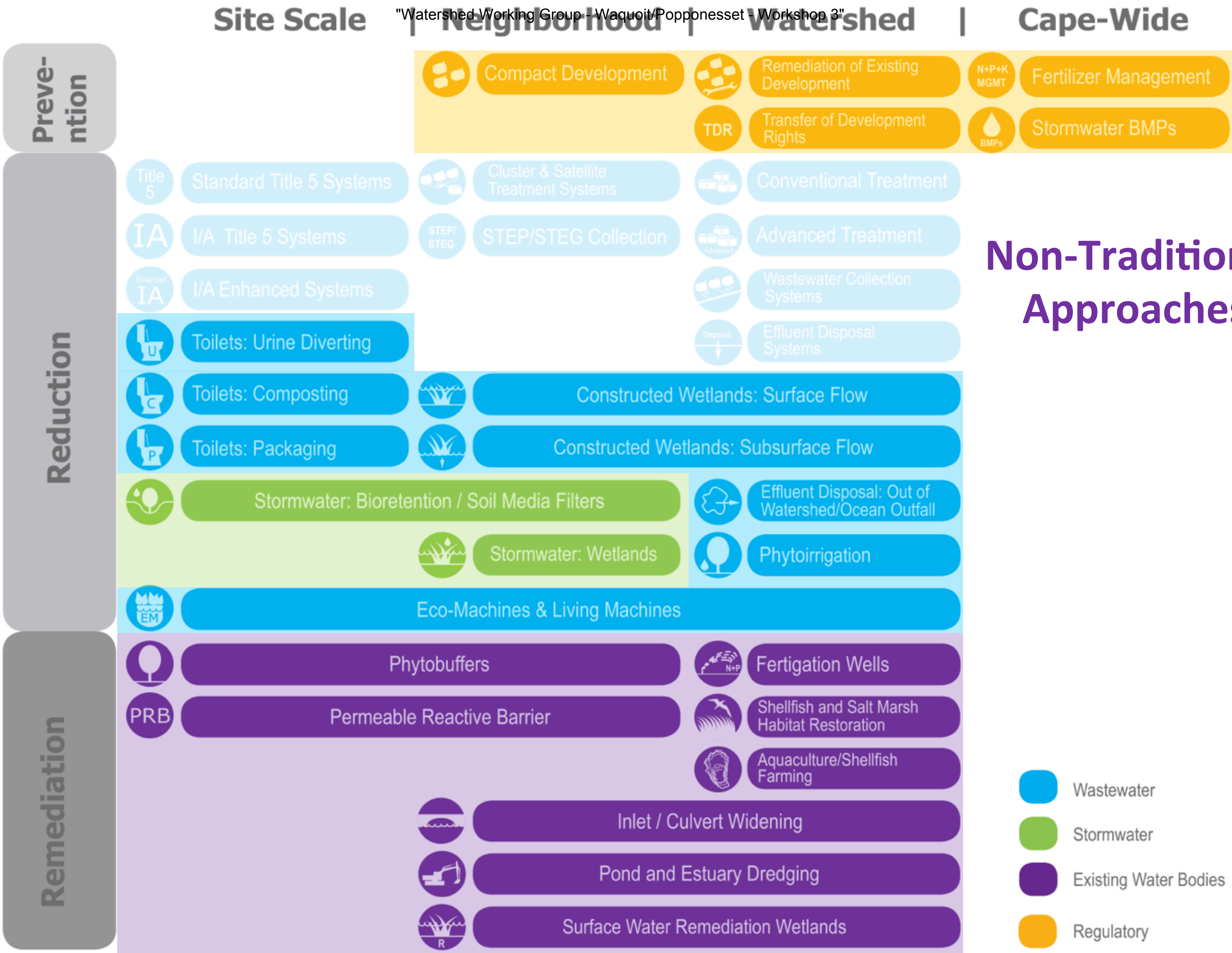
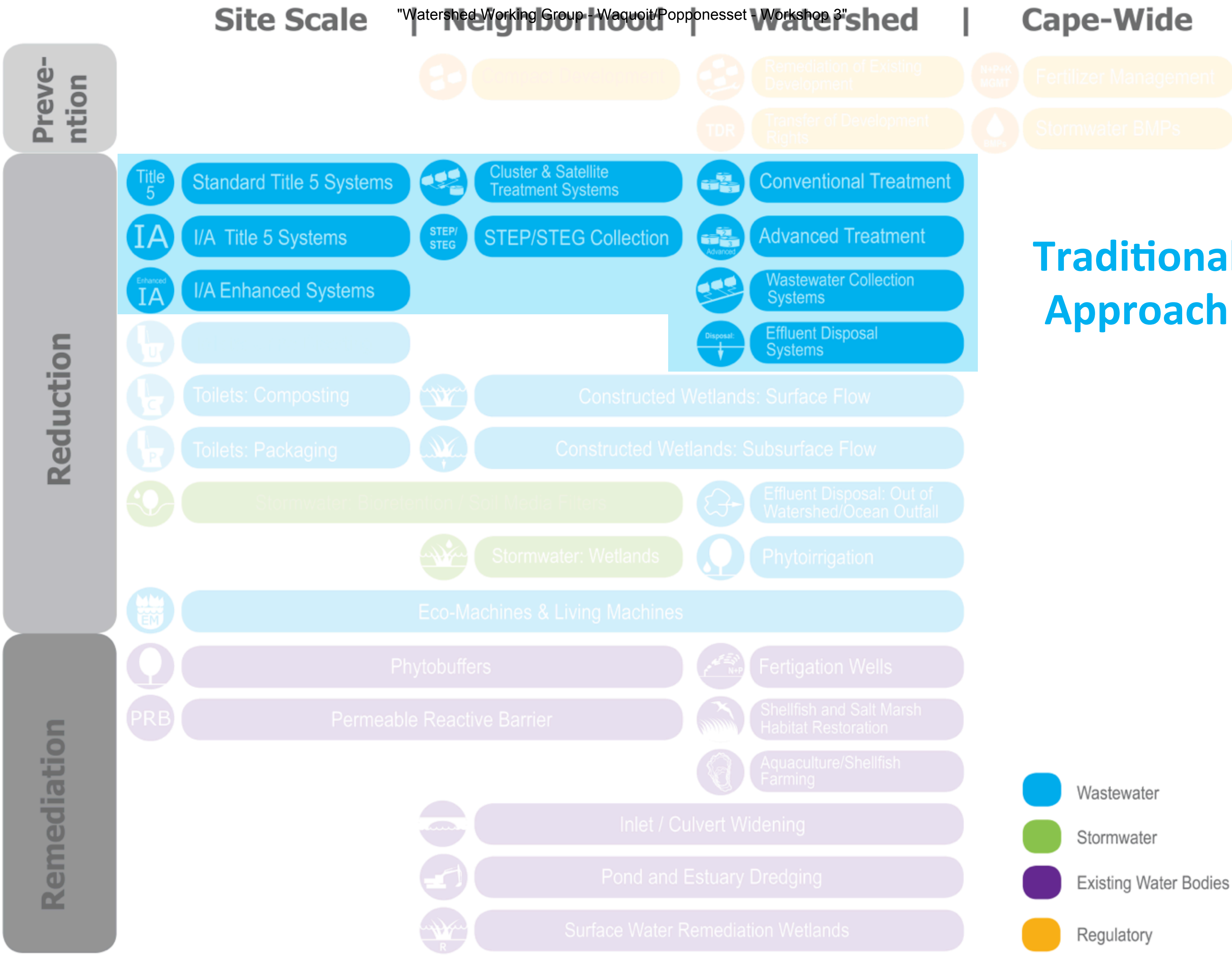
# Non-Traditional Approaches

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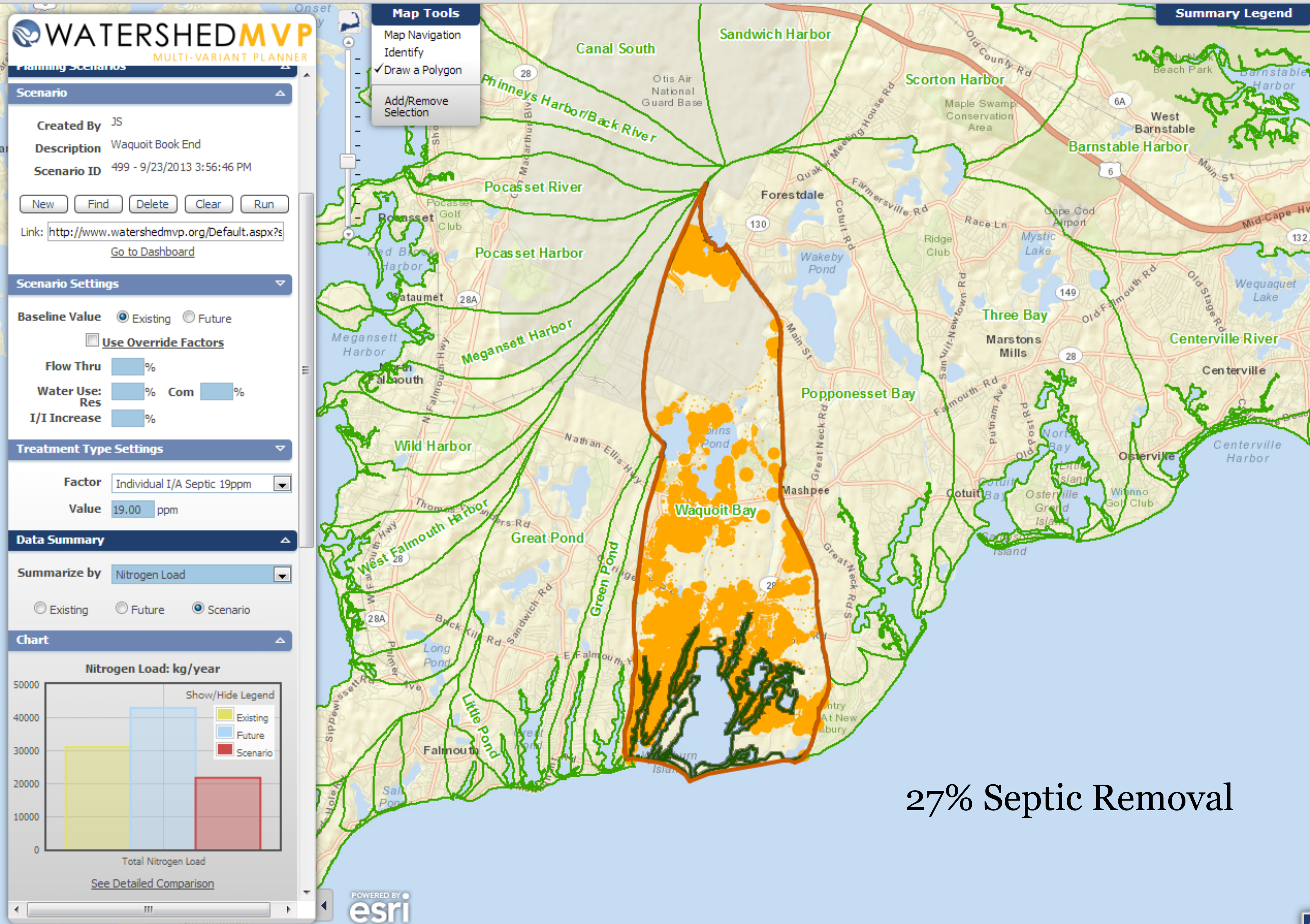
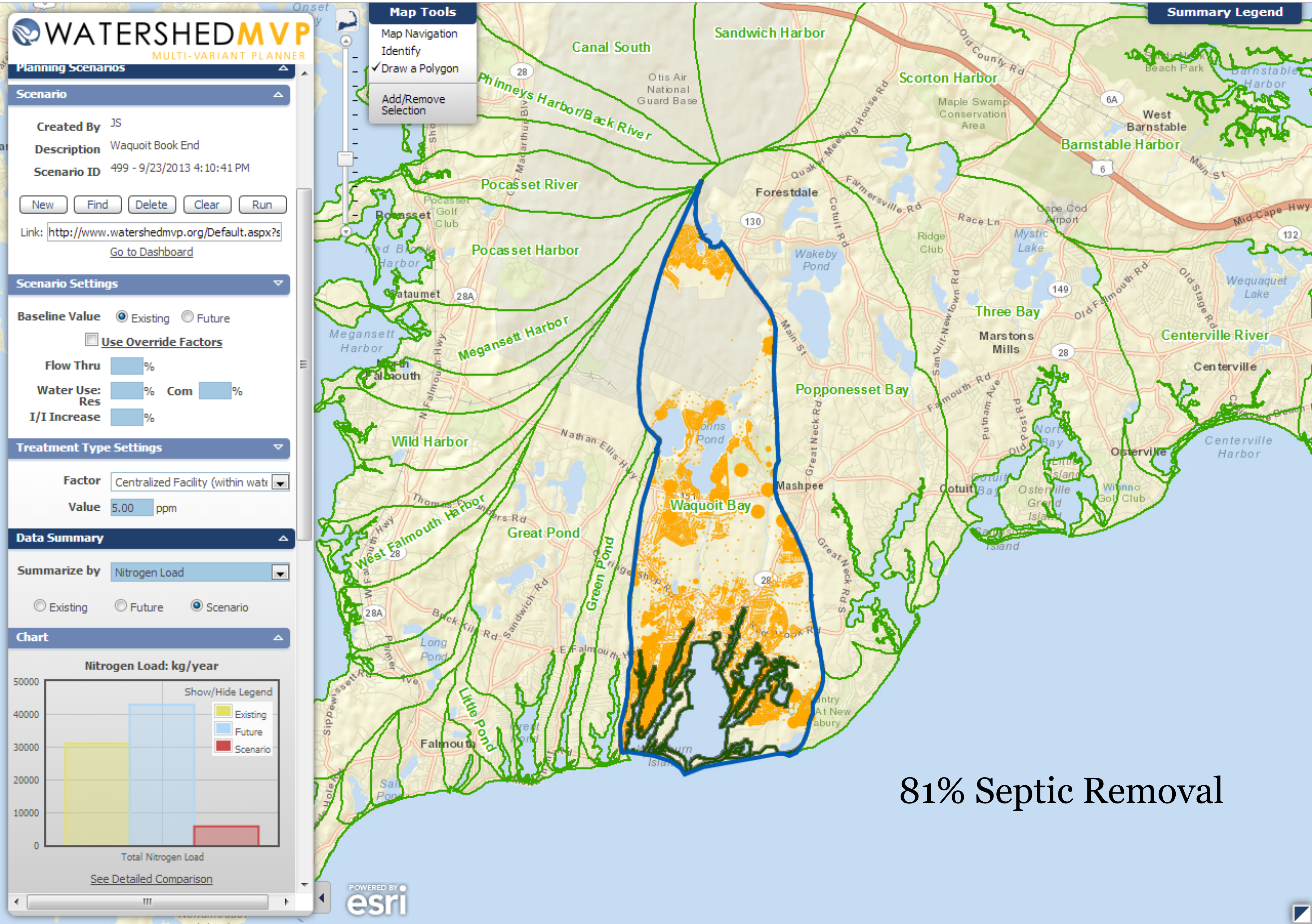
# Watershed-Wide Innovative/Alternative (I/A) Onsite Systems

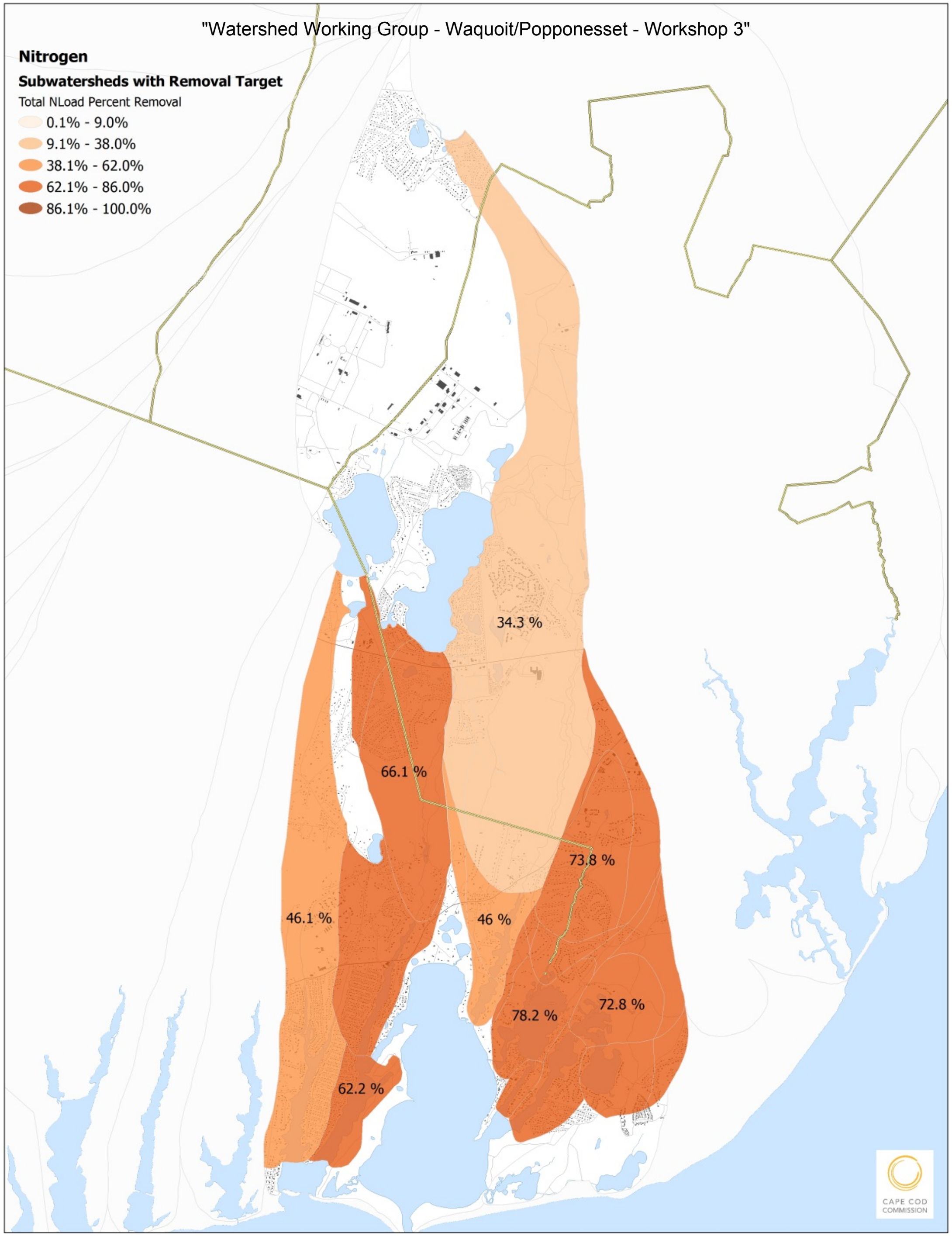


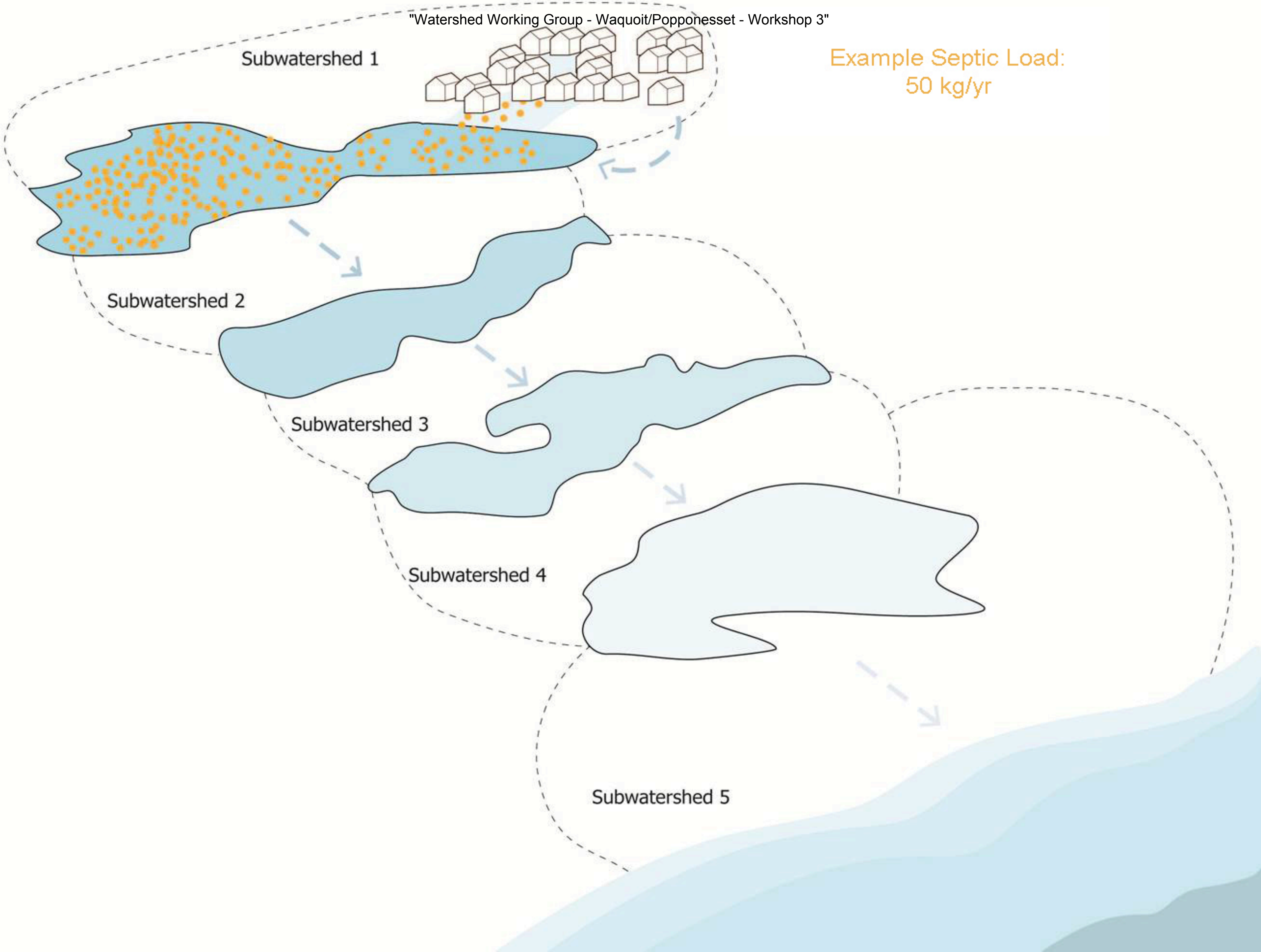

27% Septic Removal

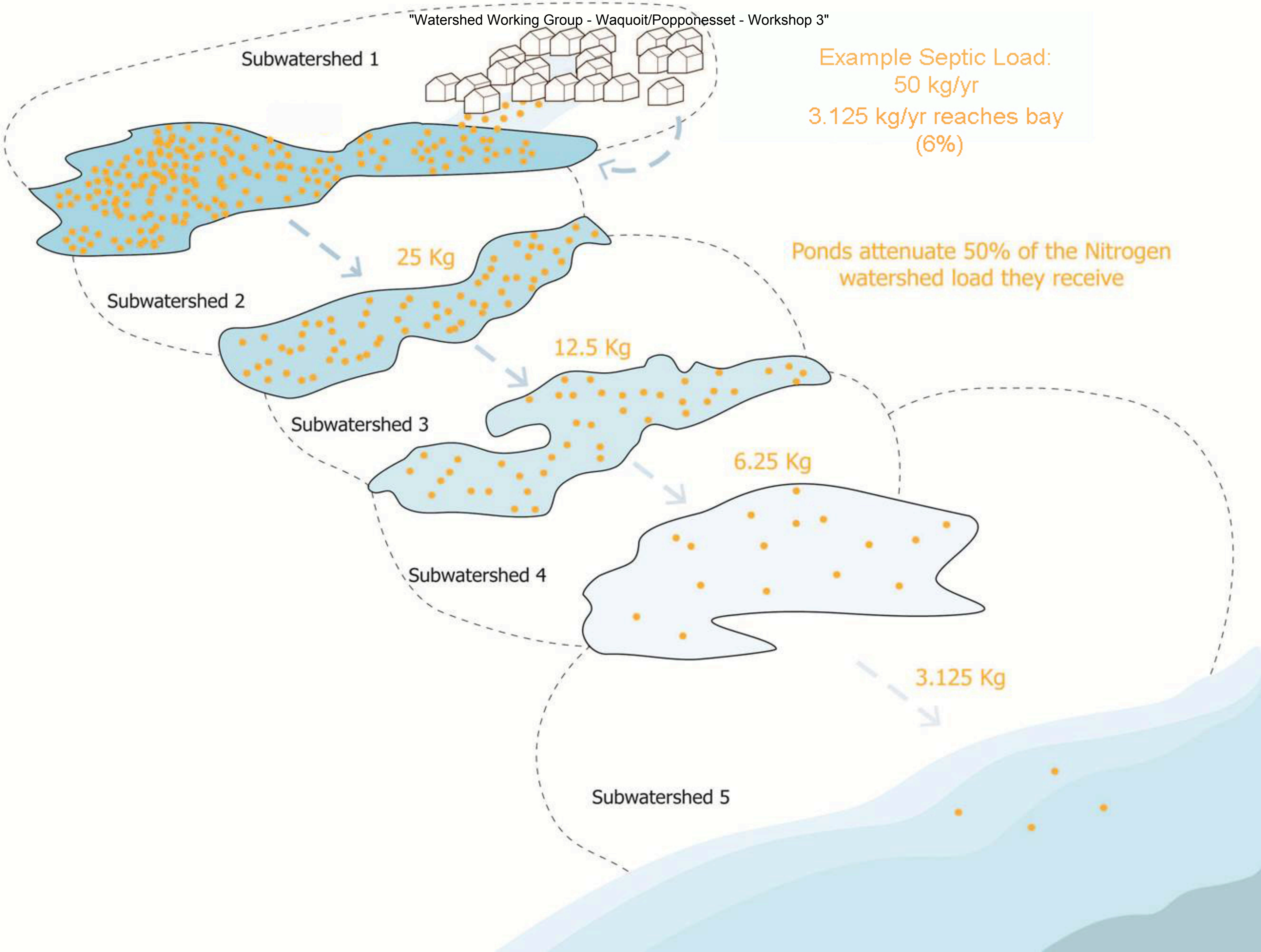
# Watershed-Wide Centralized Treatment with Disposal Inside the Watershed



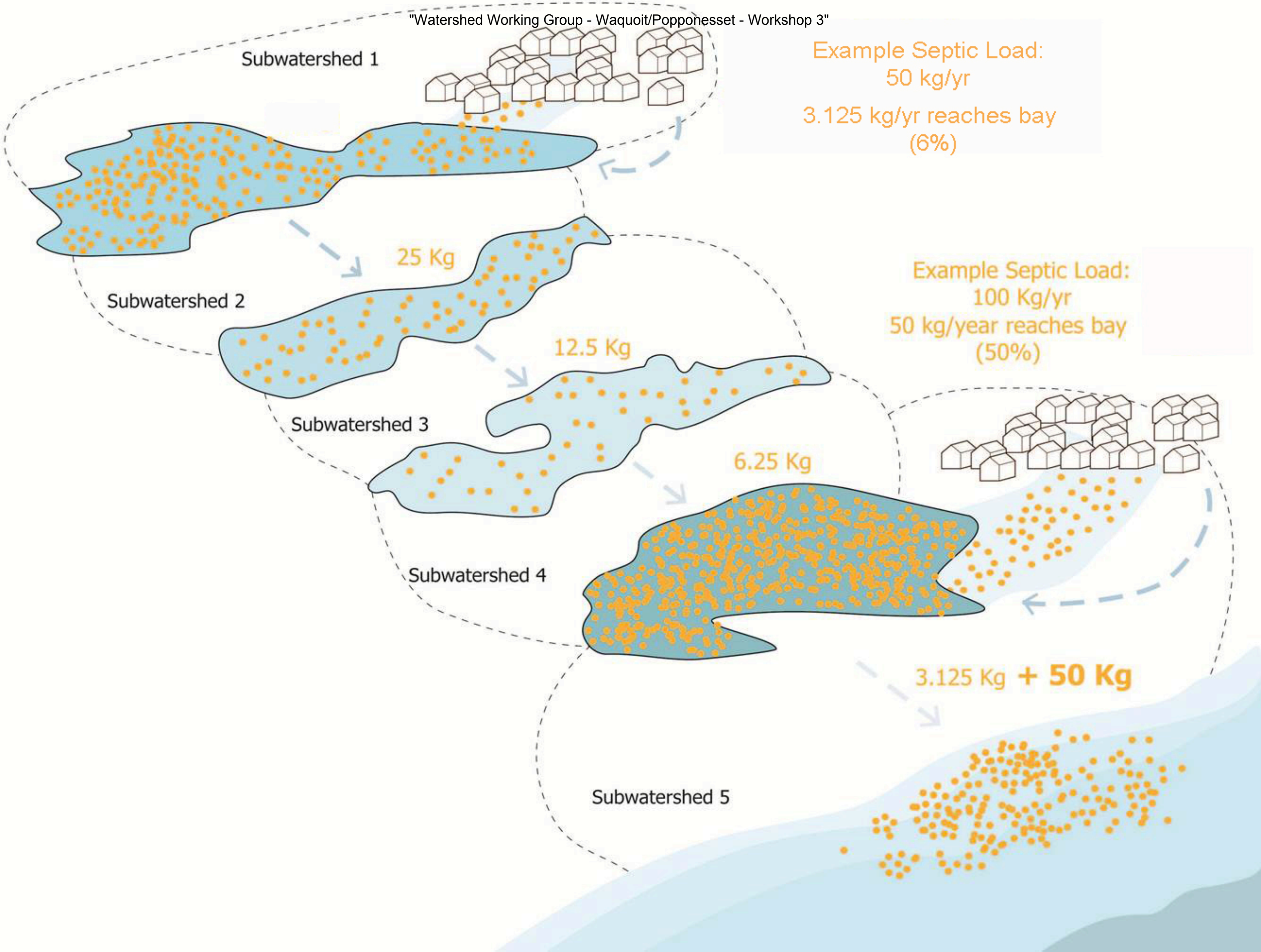

81% Septic Removal


"Watershed Working Group - Waquoit/Popponesset - Workshop 3"
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%
34.3 %
66.1 %
73.8 %
46.1 %
46 %
78.2 %
72.8 %
62.2 %
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
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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Example Septic Load:
50 kg/yr
3.125 kg/yr reaches bay
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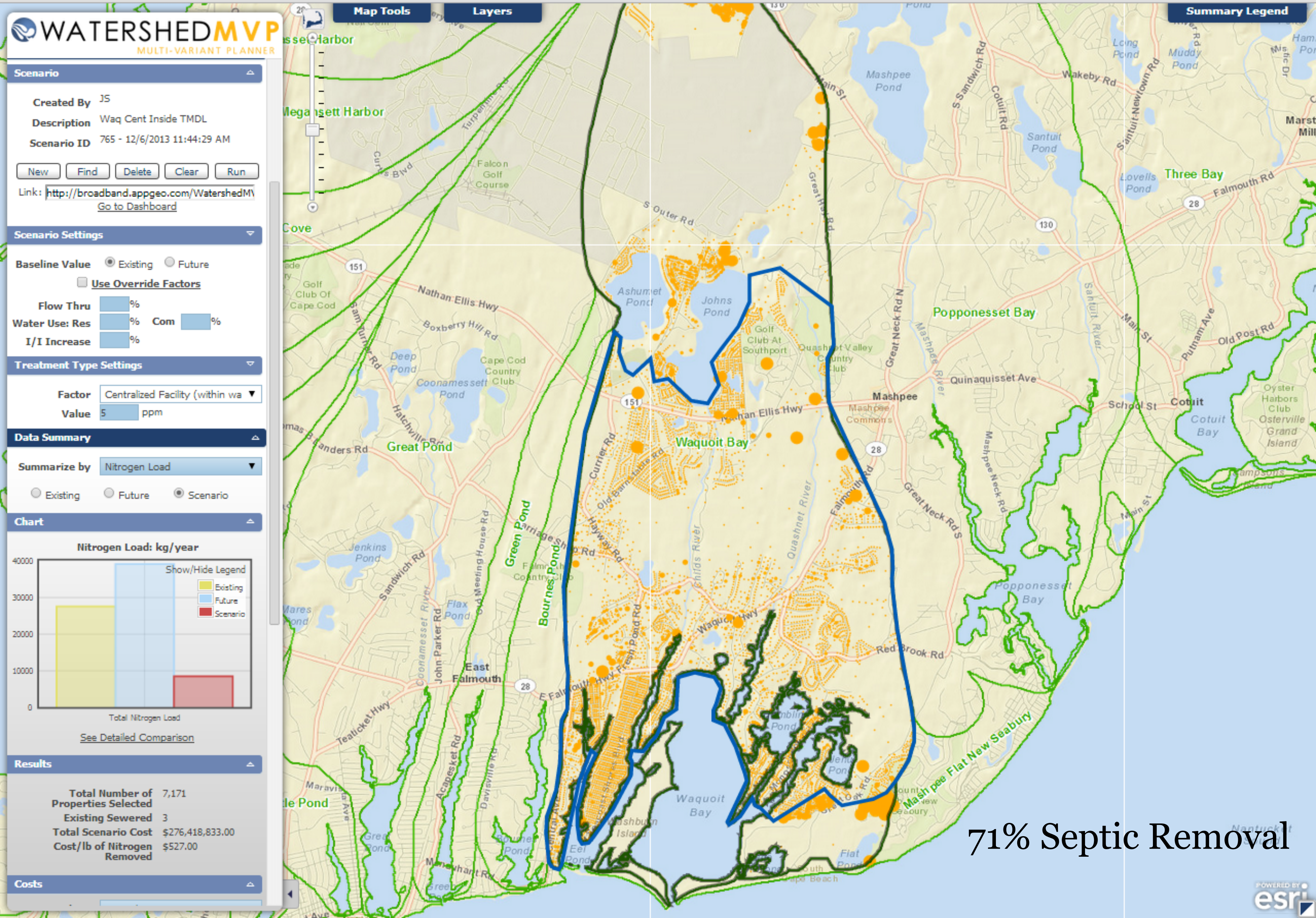
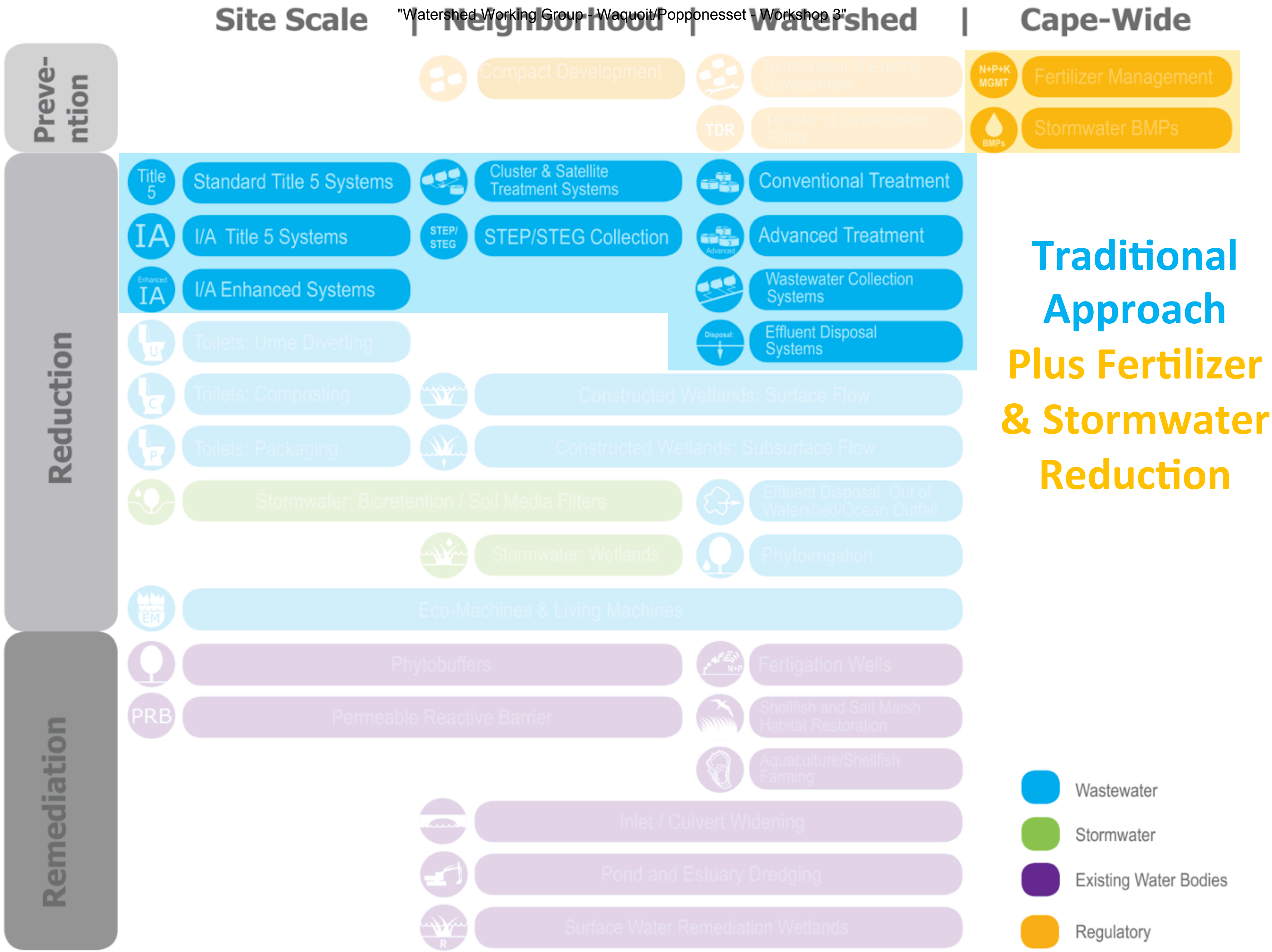
Subwatershed 2
Example Septic Load:
100 Kg/yr
50 kg/year reaches bay
(50%)
12.5 Kg
Subwatershed 3
6.25 Kg
Subwatershed 4
3.125 Kg + 50 Kg
Subwatershed 5

# Targeted Centralized Treatment with Disposal Inside the Watershed

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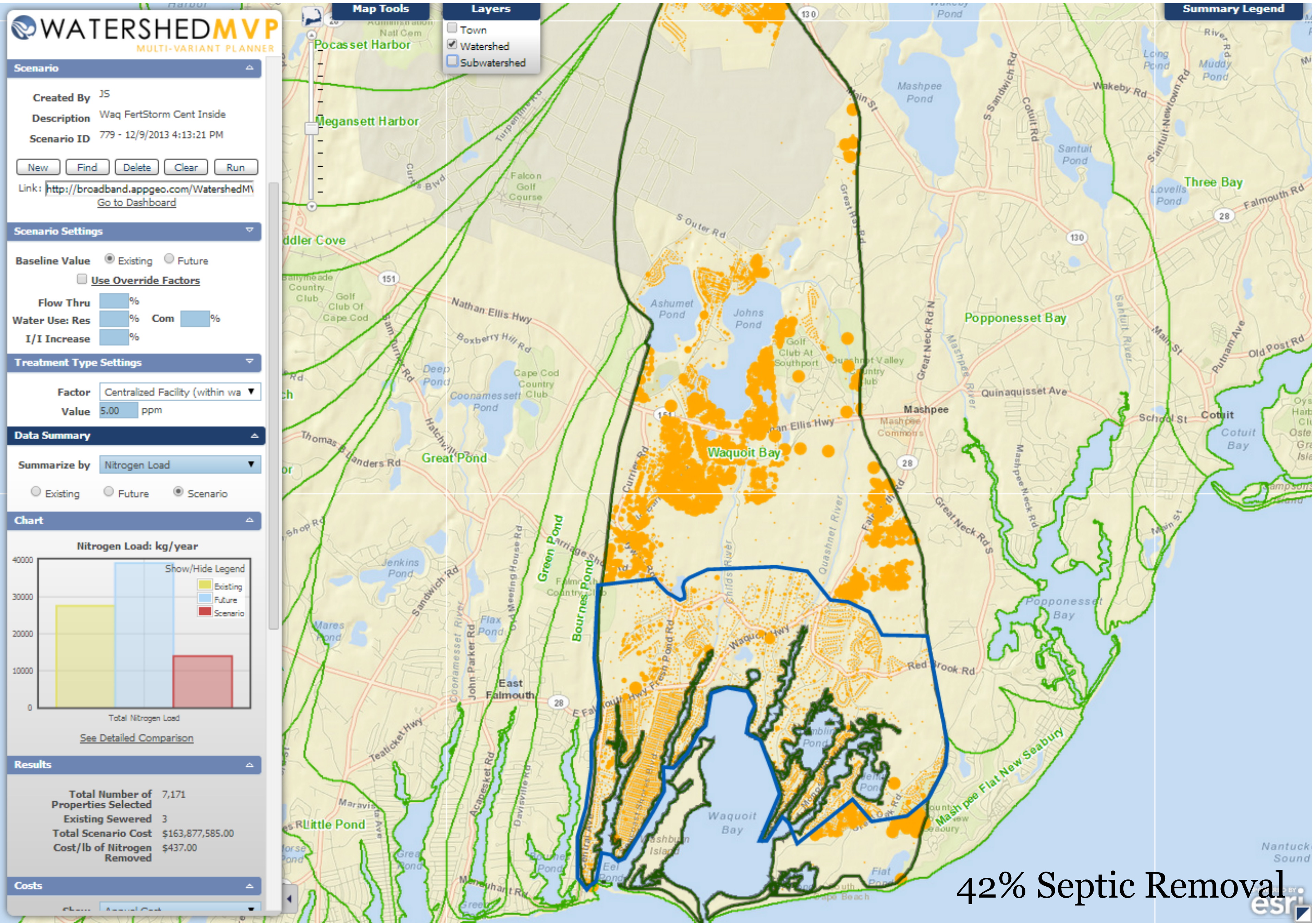
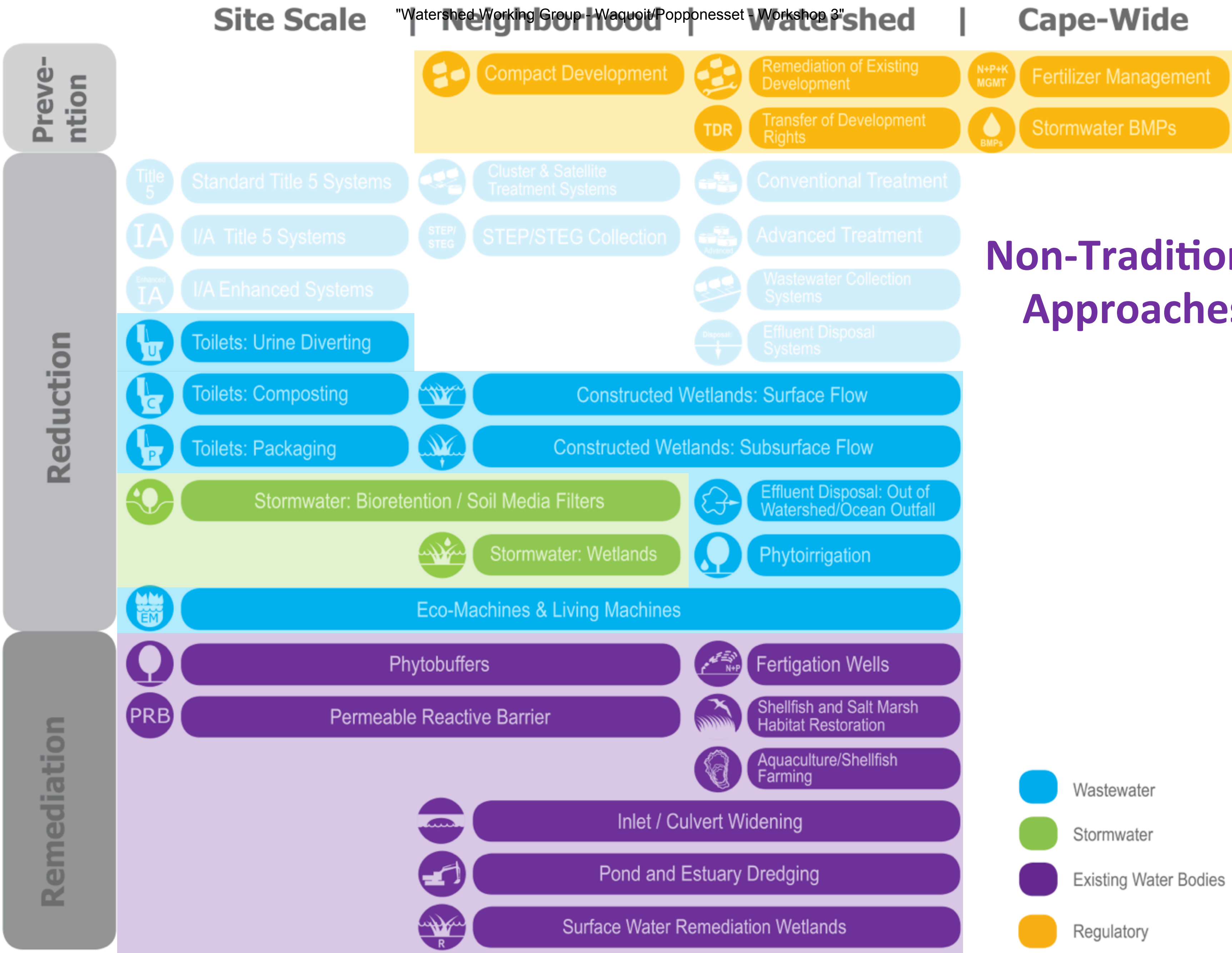
# Targeted Centralized Treatment with a 50% Reduction in Fertilizer and Stormwater




42% Septic Removal

# Non-Traditional Approaches



Wastewater | Existing Water Bodies | Regulatory

# Problem Solving Approach

## 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

## 4 Watershed/Embayment Options

A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture

## 5 Alternative On-Site Options

A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems

## 6 Priority Collection/High-Density Areas

A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

## 7 Supplemental Sewering

# Watershed Calculator — Waquoit Bay

| MEP Targets and Goals: | | kg/day | Nitrogen (kg/yr) |
|---|---|---|---|
| Present Total Nitrogen Load: | | 90.866 | 33,166 |
| wastewater | | 64.142 | 23,412 |
| fertilizer | | | 4,184 |
| stormwater | | | 4,775 |
| Target Nitrogen Load: | | 42.3 | 15,440 |
| Nitrogen Removal Required: | | **48.566** | **17,727** |
| Total Number of Properties: | 7171 | | |

**Watershed Calculator** **Waquoit Bay**

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| Other Wastewater Management Needs | Ponds | Title 5 Problem Areas | Growth Management |
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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) |
|---|---|---|---|
| Fertilizer Management | 2,292 | 15,435 | |
| Stormwater Mitigation | 2,585 | 12,850 | |

**Watershed Calculator** **Waquoit Bay**

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## Watershed Calculator Waquoit Bay



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**Other Wastewater Management Needs** Ponds Title 5 Problem Areas Growth Management

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| Constructed Wetlands | 5 | acres | 2,830 | 7,312 | $521 |

**Watershed Calculator** **Waquoit Bay**

"Watershed Working Group - Waquoit/Popponesset - Workshop 3"

| | | | | |
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| Oyster Beds/Aquaculture | 17 | acres | 4,250 | 2,812 | $0 |

## Watershed Calculator Waquoit Bay

"Watershed Working Group - Waquoit/Popponesset - Workshop 3"

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| Fertigation Wells | 2 | golf course | 272 | 7,062 | $438 |
| Oyster Beds/Aquaculture | 17 | acres | 4,250 | 2,812 | $0 |
| Floating Constructed Wetlands | 2500 | cu feet | 1,125 | 1,687 | $61 |

**Watershed Calculator** **Waquoit Bay** "Watershed Working Group - Waquoit/Popponesset - Workshop 3"

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| fertilizer | | | 4,584 |
| stormwater | | | 5,170 |
| Target Nitrogen Load: | | 42.3 | 15,440 |
| Nitrogen Removal Required: | | **48.566** | **17,727** |
| Total Number of Properties: | 7171 | | |

**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) |
|---|---|---|---|---|---|
| Fertilizer Management | | | 2,292 | 15,435 | |
| Stormwater Mitigation | | | 2,585 | 12,850 | |
| **Watershed/Embayment Options:** | | | | | |
| Permeable Reactive Barrier (PRB) | 879 | homes | 2,707 | 10,142 | $452 |
| Constructed Wetlands | 5 | acres | 2,830 | 7,312 | $521 |
| Fertigation Wells | 2 | golf course | 272 | 7,062 | $438 |
| Oyster Beds/Aquaculture | 17 | acres | 4,250 | 2,812 | $0 |
| Floating Constructed Wetlands | 2500 | cu feet | 1,125 | 1,687 | $61 |
| **Alternative On-Site Options:** | | | | | |
| Ecotoilets (UD & Compost) | 187 | homes | 740 | 947 | $1,265 |

**Watershed Calculator** **Waquoit Bay** "Watershed Working Group - Waquoit/Popponesset - Workshop 3"

| **MEP Targets and Goals:** | | **kg/day** | **Nitrogen (kg/yr)** |
|---|---|---|---|
| Present Total Nitrogen Load: | | 90.866 | 33,166 |
| wastewater | | 64.142 | 23,412 |
| fertilizer | | | 4,584 |
| stormwater | | | 5,170 |
| Target Nitrogen Load: | | 42.3 | 15,440 |
| Nitrogen Removal Required: | | **48.566** | **17,727** |
| Total Number of Properties: | 7171 | | |

| **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)** |
|---|---|---|---|---|---|
| Fertilizer Management | | | 2,292 | 15,435 | |
| Stormwater Mitigation | | | 2,585 | 12,850 | |
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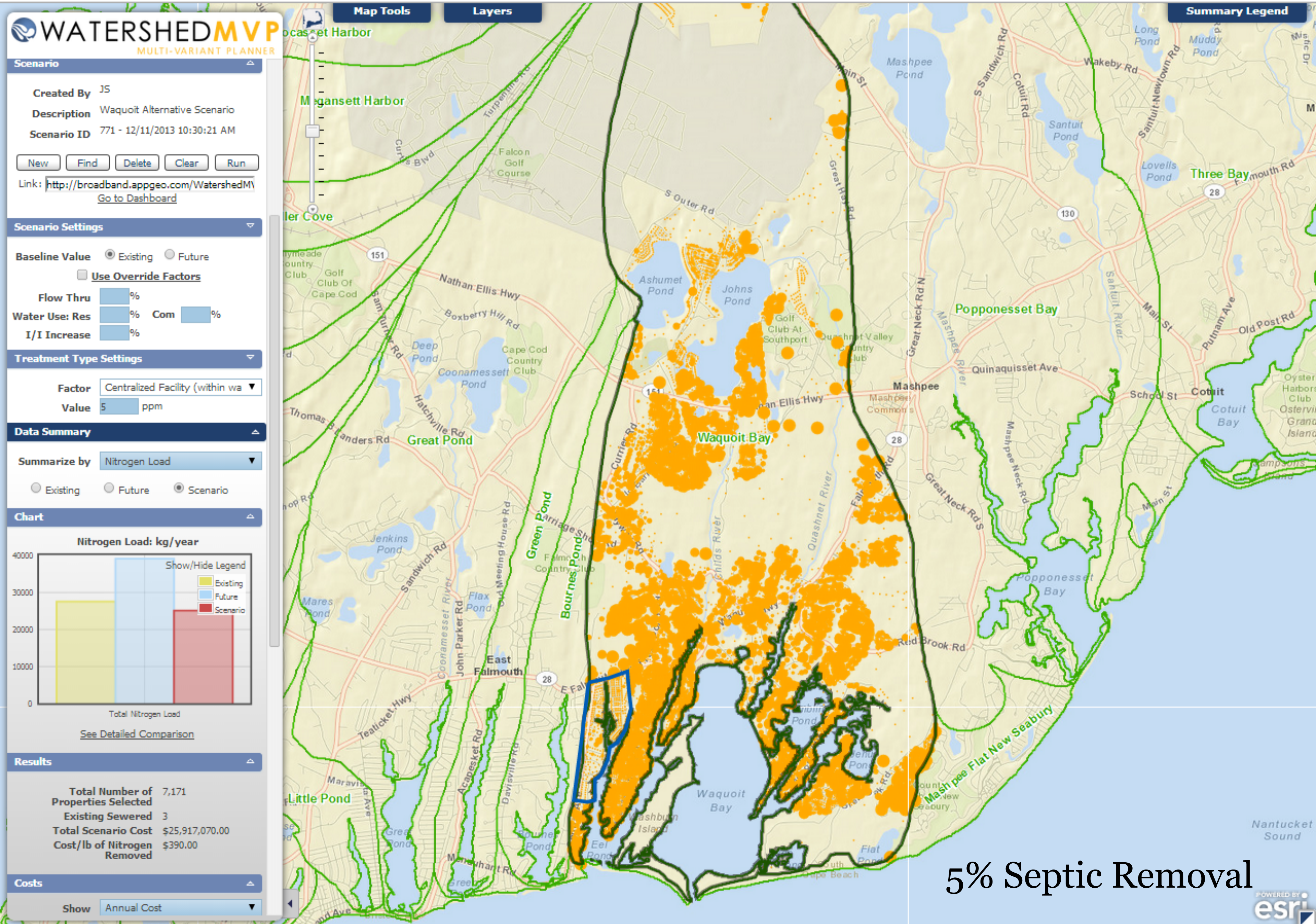
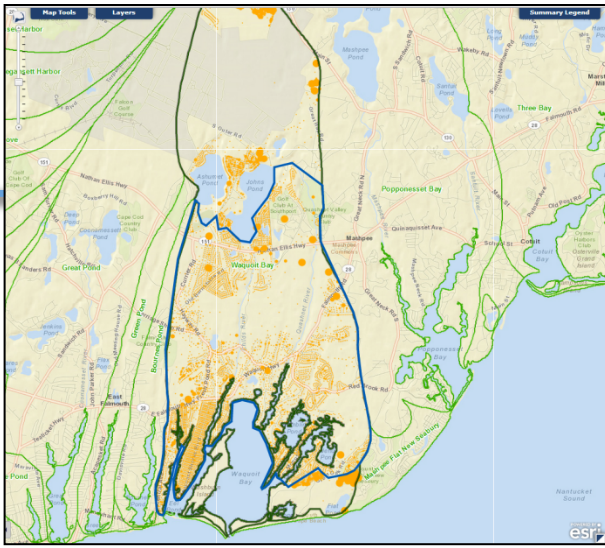
| Fertigation Wells | 2 | golf course | 272 | 7,062 | $438 |
| Oyster Beds/Aquaculture | 17 | acres | 4,250 | 2,812 | $0 |
| Floating Constructed Wetlands | 2500 | cu feet | 1,125 | 1,687 | $61 |
| **Alternative On-Site Options:** | | | | | |
| Ecotoilets (UD & Compost) | 187 | homes | 740 | 947 | $1,265 |
| **Sewering** | 301 | homes | 1322 | 0 | $1,000 |

# Targeted Centralized Treatment after Applying Alternative Strategies (1322 kg N/yr)



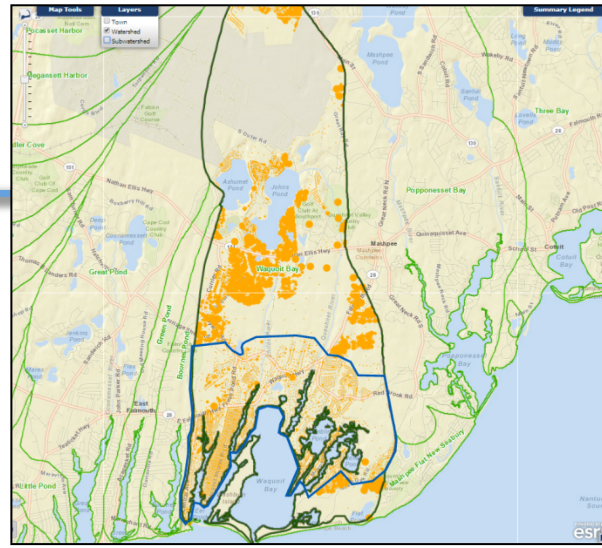
# Scenario Comparison

## Targeted Collection



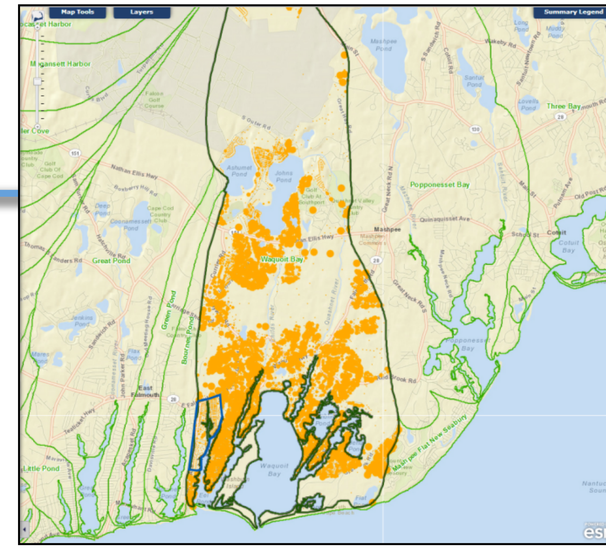
- Achieves TMDL[1]
- Cost/lb N = $527
- Treated Flow = 665,000 gpd

## Targeted Collection after a 50% reduction in fertilizer and stormwater



- Achieves TMDL[1]
- Cost/lb N = $437
- Treated Flow = 443,000 gpd

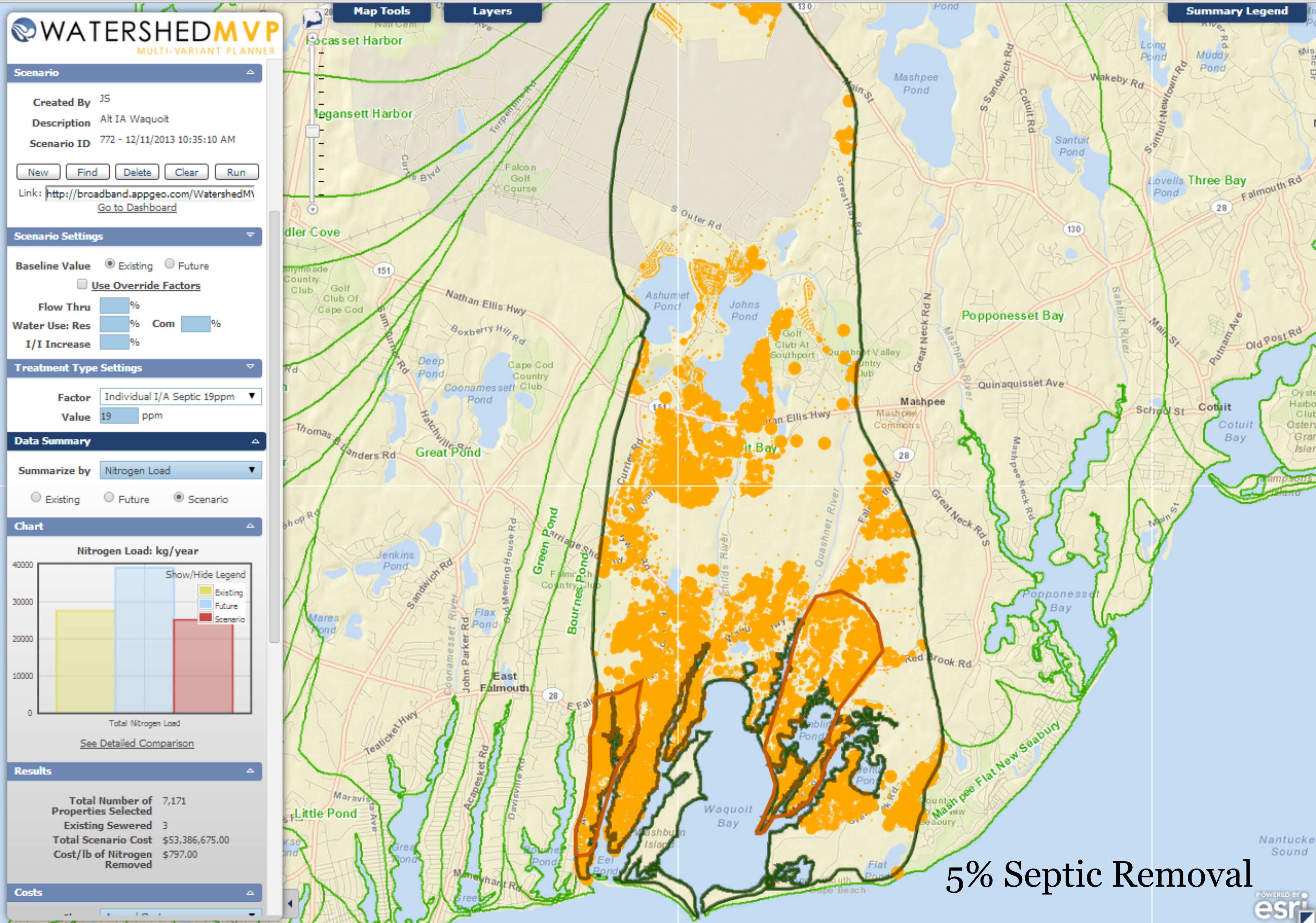
## Targeted Collection after a 50% reduction in fertilizer and stormwater & after applying alternative approaches



- Achieves TMDL[1]
- Cost/lb N = $402
- Treated Flow = 47,000 gpd

[1] within 5% of goal

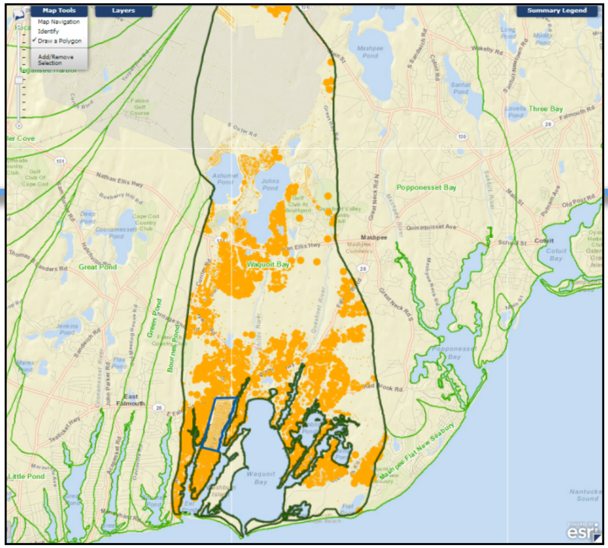
# Innovative/Alternative On-Site Systems after Applying Alternative Strategies (1322 kg N/yr)




5% Septic Removal

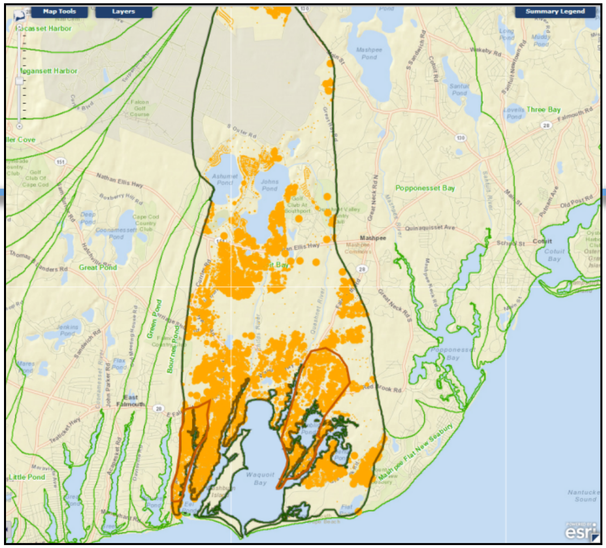
# Scenario Comparison

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




- Achieves TMDL[1]
- Cost/lb N = $402
- Treated Flow = 47,000 gpd

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




- Achieves TMDL[1]
- Cost/lb N = $912
- Treated Flow = 135,000 gpd

[1] within 5% of goal

# *Adaptive Management:*

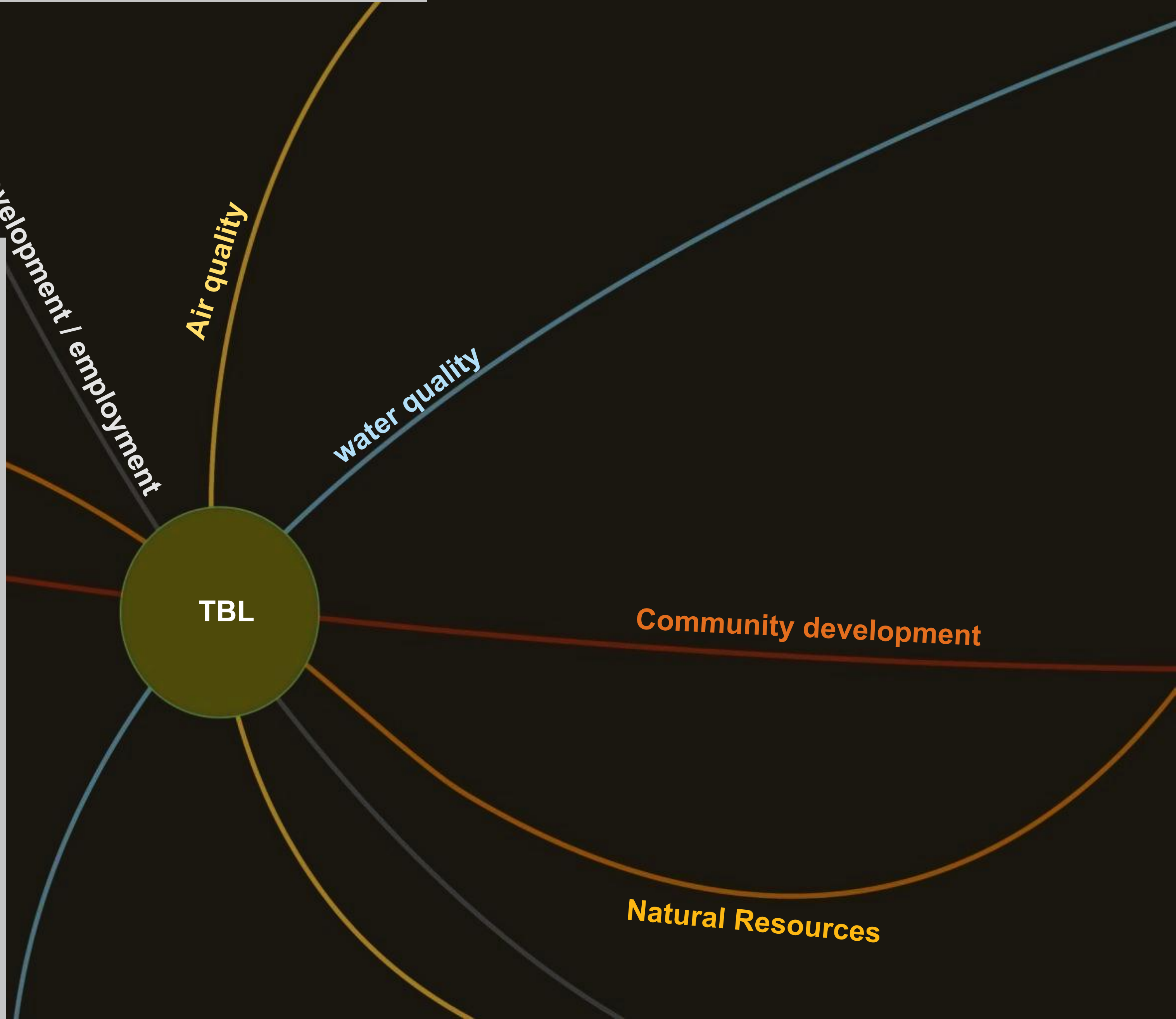
A structured approach for addressing uncertainties by linking science and monitoring to decision-making and adjusting implementation, as necessary, to increase the probability of meeting water quality goals in a cost effective and efficient way.

# Triple Bottom Line (TBL) Introduction

# 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

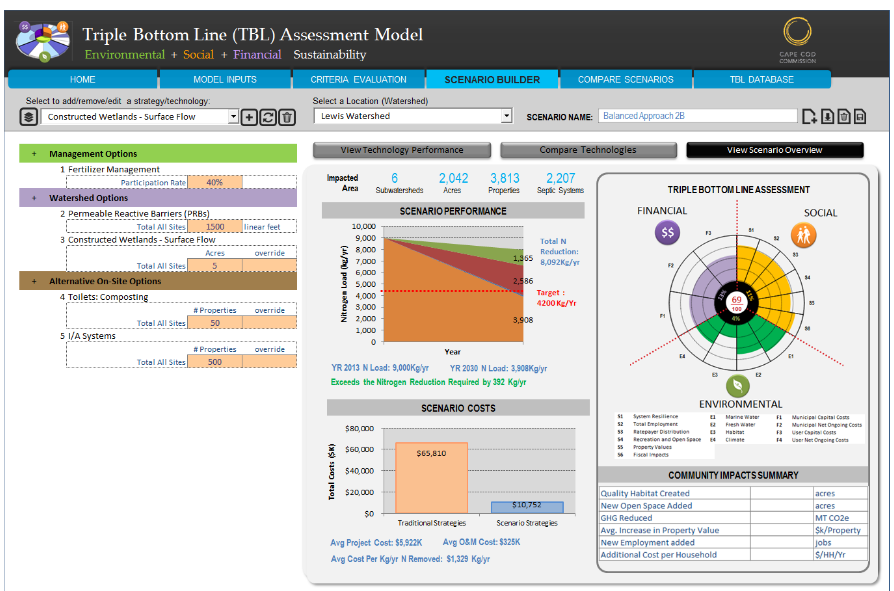
Often "TBL" analysis is used to identify the best alternative and to report to stakeholders on the public outcomes of a given investment.

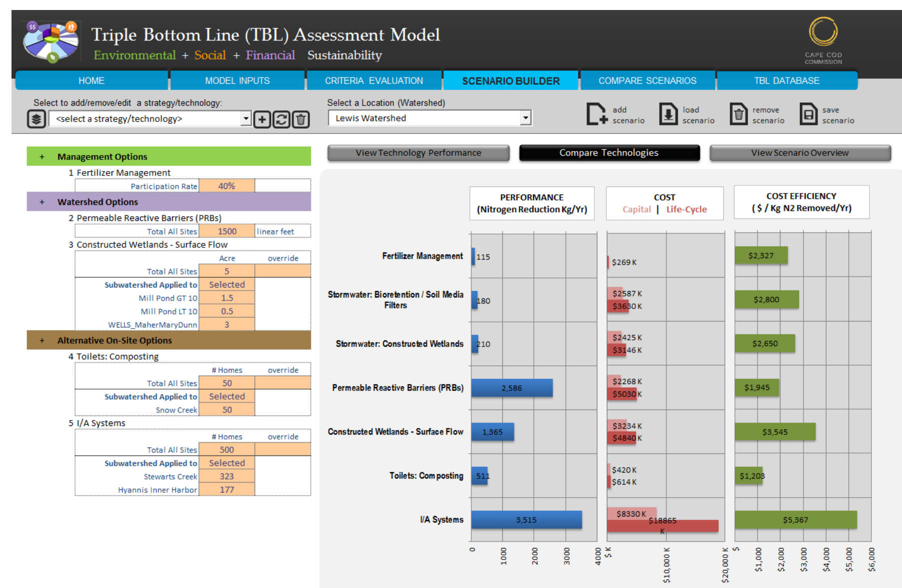


# Why develop a TBL model?

- 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

"Watershed Working Group - Waquoit/Popponesset - Workshop 3"

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

## 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 |

### Scenario 1

Minimum Cost


### Scenario 2

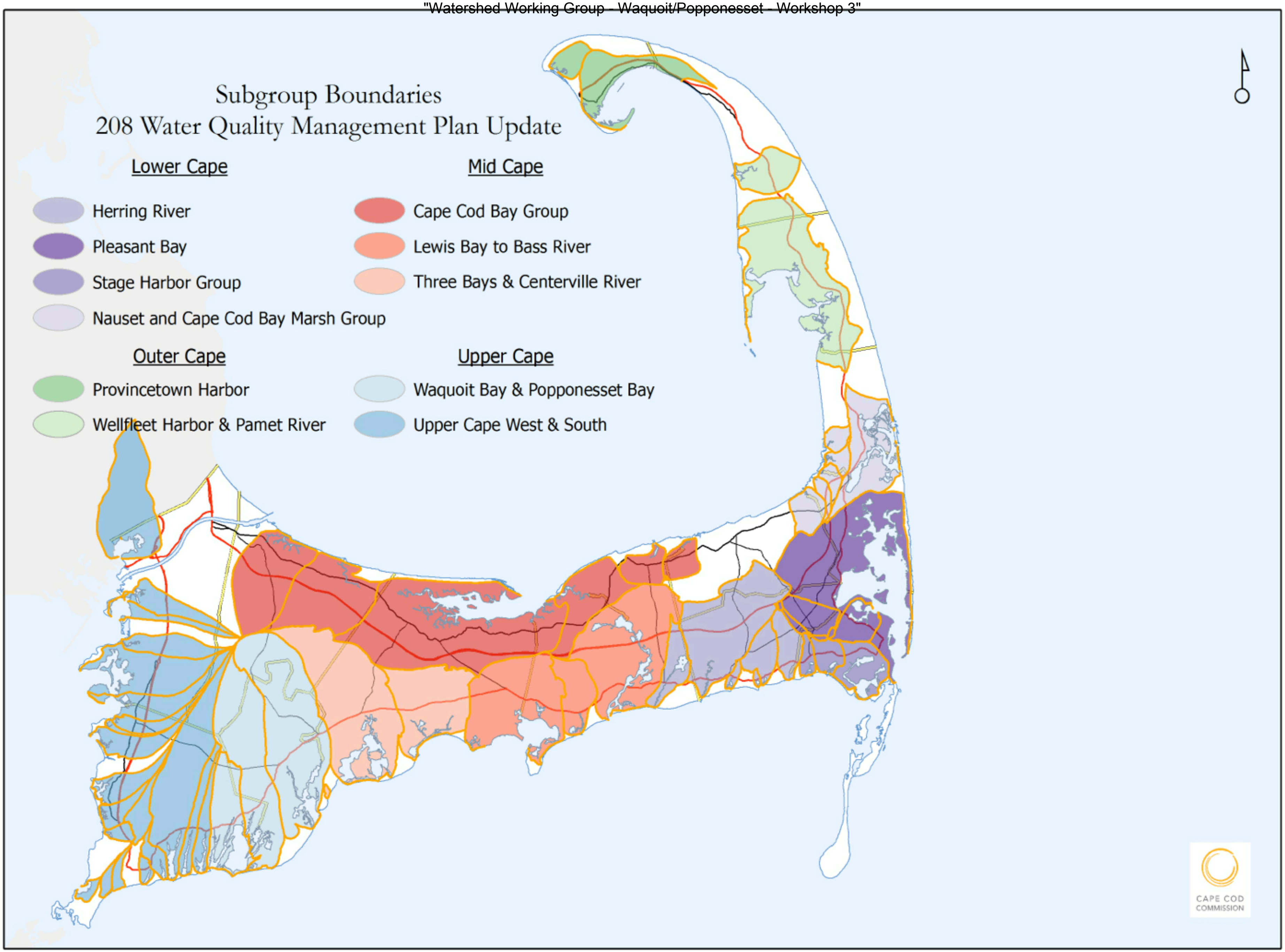
Cost Effective

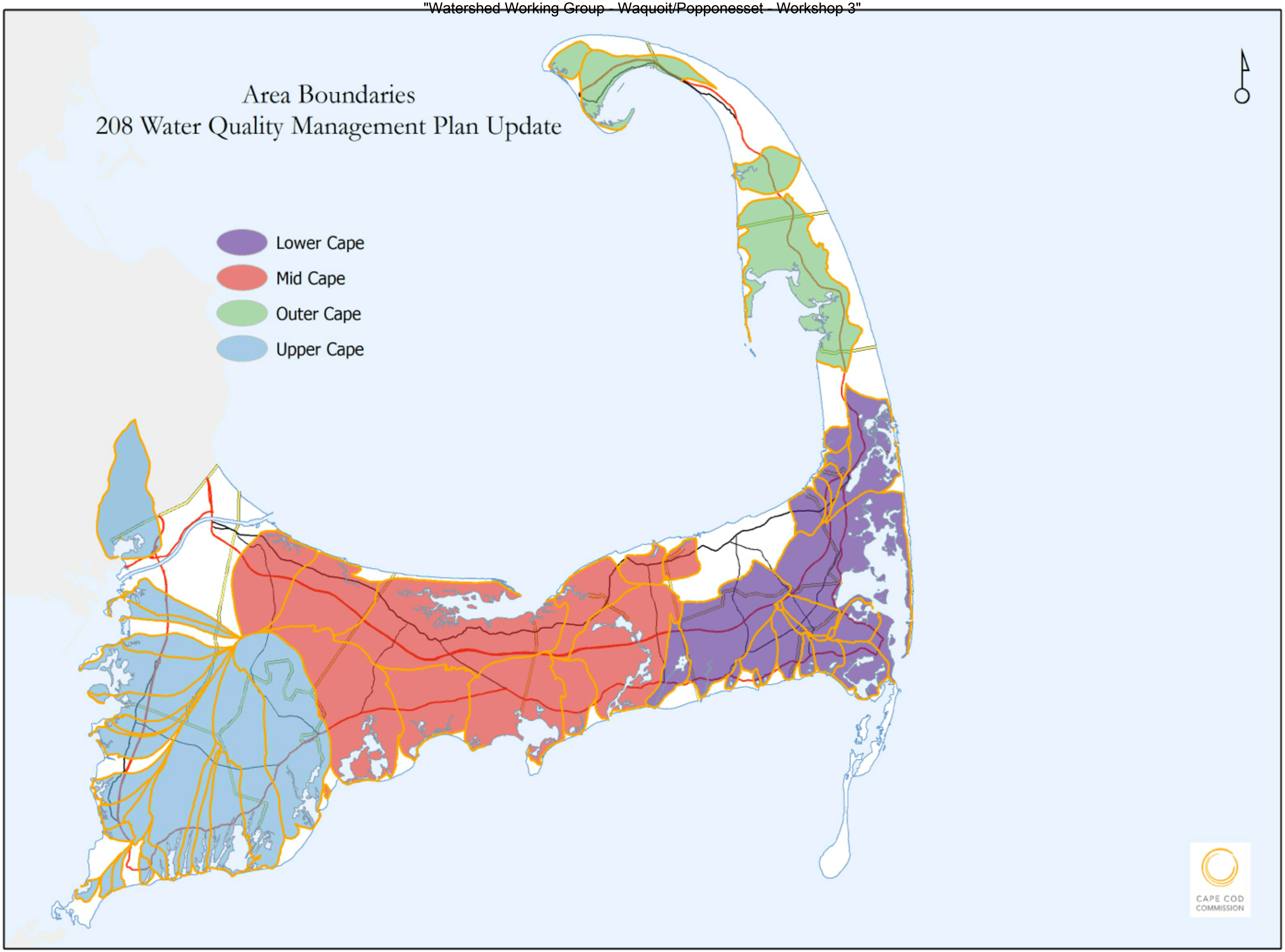

### Scenario 3

Maximum Performance


## Strategy/Technology Distribution

| | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|
| **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
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**
**Waquoit and Popponesset Bays Watershed Working Group**

**Meeting Three**
**Wednesday December 11, 2013**
**Mashpee Town Hall, 16 Great Neck Road North, Mashpee, MA**

## I. ACTION ITEMS

Working Group

- Provide comments or revisions to the Meeting Two draft notes to Doug Thompson (dthomnpson@cbuilding.org) by December 30.
- Provide comments and/or additional info on the town chronologies to Patty Daley.
- Notify Doug if interested in volunteering or nominating another to represent this working group in the larger sub-basin working group meeting to occur during the next several months.

Cape Cod Commission

- Provide each town represented in the Working Group with a copy of its respective chronology.
- Notify the Working Group of the selected date and location for the February Stakeholder Summit.

Consensus Building Institute

- Finalize notes from the second meeting, distribute to the Working Group, and post to the Cape Cod Commission's website.
- Send out draft notes from the Meeting Three.

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

Patty Daley, Deputy Director of the Cape Cod Commission, welcomed participants and offered an overview of the 208 Update stakeholder process. In July, public meetings were held across the Cape to present the 208 Plan Update goals, work plan, and participant roles. Public meetings were also held in August to present information on the affordability and financing of the updated comprehensive 208 Plan. The first meetings of the eleven Watershed Working Groups, held in September, focused on baseline conditions in each of the watersheds. The second meetings of the Watershed Working Groups in October and early November explored technology options and approaches. The third round of meetings of the Watershed Working Groups will focus on evaluating watershed scenarios. These scenarios are informed by Working Groups' discussions at previous meetings about baseline conditions, priority areas, and technology options/approaches.

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

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

Ms. Daley then reviewed the meeting goals:

- 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.
- To develop a set of adaptive management principles to guide sub-regional groups in refining scenarios for the 208 Plan

Mr. Doug Thompson, the meeting facilitator, led introductions. A participant list is found in Appendix A. He then reviewed the agenda and guidelines for communication. All action items from the second Meeting had been addressed. It was noted that the Commission was filming the meeting for internal use only.

## III. INITIAL SCENARIOS FOR THE WAQUOIT BAY WATERSHED

Ms. Daley explained Commission's process to develop watershed scenarios. Two approaches are being investigated: a traditional approach, using technologies that are already permitted (e.g. conventional sewering and I/A systems) for nitrogen reduction, and a non-traditional approach, consisting of alternative "green infrastructure" technologies that are not yet necessarily creditable in the TMDL context. With both approaches, reductions in fertilizer and stormwater are also considered. She noted that the scenarios presented are illustrative examples for what is possible in the Waquoit Bay Watershed, and are meant to inspire discussion for how technologies could be applied locally.

Ms. Daley also noted that the unit costs per pound of nitrogen removed for each technology are derived from the 2010 Barnstable Country Report and the Technology Matrix; where a cost range exists, typically the average of that range is used. The Commission chose to present costs this way to facilitate comparative analysis across the technologies and across watersheds.

Tom Cambareri, Water Resources Program Manager for the Cape Cod Commission, introduced the Watershed MVP, a web-based GIS tool developed by the Commission to screen potential sites for technologies based on a variety of factors specific to each watershed. He also discussed the Watershed Calculator used to help evaluate scenarios, estimating by technology the nitrogen load reduction potential (kg/yr), the remaining nitrogen reduction needed to meet the target load (kg/yr), and the unit cost per pound of nitrogen removed ($/lb).

The TMDL nitrogen removal target for the entire Waquoit Bay Watershed, as identified by MEP, is 76% of the total load.

**Traditional Approaches**

Mr. Cambareri presented the following traditional approaches and how they might be applied in the Waquoit Bay Watershed, including potential implementation sites as screened by Watershed MVP:

<u>Watershed-Wide I/A onsite systems:</u> I/A systems as permitted by DEP treat septic wastewater nitrogen to a 19 ppm concentration. If I/A onsite systems are installed across the watershed, nitrogen would only be reduced by 27%, falling short of the 76% removal target.

<u>Watershed-Wide Sewering:</u> If conventional sewer (i.e. centralized treatment) was installed across the entire watershed, 81% of the nitrogen load would be removed, exceeding the TMDL target.

<u>Targeted Sewer:</u> Mr. Cambareri showed a map with variable nitrogen removal targets for total controllable load (from septic, stormwater, and fertilizer) across the Waquoit Bay subwatersheds. He explained that the natural nitrogen attenuation of ponds (each removing on average 50% of the nitrogen load received) accounts for this variation. He added that infrastructure is best targeted in lower subwatersheds that have less natural attenuation, higher nitrogen removal targets, and more direct interaction with the embayment.

If sewer installation is targeted to within these lower subwatersheds with higher nitrogen loads, the sewer footprint is reduced and 71% of nitrogen removal is possible. The unit cost for removal is $527/lb N.

Participants offered the following comments and questions:

- *The suitability of sewer infrastructure in the lower watersheds depends on whether the housing stock is occupied seasonally or year-round.*
- *What are the effects on water quality in freshwater ponds, and will these be taken into consideration in the plan?* Mr. Cambareri replied that water quality of freshwater ponds has been and will continue to be considered. He noted that there are freshwater pond data, and that water quality varies widely from pond to pond. Each pond will require a site-specific assessment and restoration program, and this need will be taken into consideration. The Commission is aware of measures to control phosphorous input (e.g. buffers), which has greater ecological implications than nitrogen. It will be a challenge to find

appropriate disposal locations for effluent, but the Commission is sensitive to this issue.

- *How accurate is the 50% nitrogen attenuation rate, and how much variation is there?* Mr. Cambareri replied that 50% is a conservative average, but that there is considerable variation; for example, there is data that indicates 79% attenuation for certain ponds. More focused site-specific studies can calculate exact site-specific attenuation.
- *Is dissolved organic nitrogen, ammonia, and nitrate included in this rate? The dissolved load in particular can be high.* MEP considers total nitrogen, which includes these forms.

<u>Target sewer with 50% fertilizer reduction and stormwater mitigation:</u> If targeted sewer is combined with a 50% reduction of fertilizer and stormwater across the watershed, 71% of nitrogen load is removed (42% from sewer) at a unit cost of $437/lb N. The collection area footprint decreases further in the lower reaches of the watershed.

Participants offered the following comments and questions:

- *What is basis for fertilizer and stormwater reduction estimates?* Mr. Cambareri explained that the numbers are from MEP report. In this watershed, the current load from these sources is roughly 8000 kg/yr (9,754 kg/yr), so the assumption is that reductions would be roughly 4000 kg/yr (4,877 kg/yr). How these reductions are demonstrated to DEP to receive credit remains a matter for discussion.
- *How would these reductions be made?* Mr. Cambareri noted that the EPA and MS4 program requires communities to address stormwater, so stormwater reductions are already being pursued. Communities can also institute low impact development requirements.
- *There is a state-designed demonstration project at Crocker Pond in Falmouth with infiltration basins that is reducing approximately 50% of the receiving nitrogen load. With the right filters, a lot of reduction is possible at low cost; this site filters 9000 gallons per day. The state can be a partner in these kinds of projects, as they are required to address nitrogen loads too.*
- *These scenarios assume that septic is treated and disposed in the watershed, and that there is some leaching. If it is disposed outside, the nitrogen removal rate could improve.* Mr. Cambareri verified that treatment outside of the watershed would allow further decreases in the sewer footprint.
- *According to the MEP models, fertilizer and stormwater are about 20% of overall load. A 50% reduction of 20% is only 10%, not the roughly 30% that this assumes.* Mr. Cambareri noted that the Commission will revisit these numbers. Fertilizer and stormwater nitrogen make up 27% of the total Waquoit Bay Load and 43% of the septic load.

**Non-Traditional (7-Step) Scenario**

Mark Owen of AECOM presented one potential scenario in which a suite of non-traditional alternative technologies is applied within the Waquoit Bay Watershed to reach the nitrogen reduction target. Using the Watershed Calculator and Watershed MVP, he shared the reduction potential and costs of these various technologies as well as potential locations for their implementation. He noted that the scenario is not a recommendation, but is an illustration of what is possible when combining these technologies, and soliciting feedback from the group.

Before running through the scenario, Mr. Owen discussed further baseline conditions of the Waquoit Bay Watershed. As studied by MEP, the current nitrogen load is about 33,000 kg/yr. Approximately 23,000 kg/yr is derived from wastewater, 4,000 kg/yr from fertilizer, and 5,000 kg/yr from stormwater. The total nitrogen reduction required to meet the TMDL is about approximately 18,000 kg/yr. The watershed contains 7,171 properties.

<u>Fertilizer Reduction and Stormwater Mitigation:</u> It is anticipated that fertilizer nitrogen loads can be reduced by about 50% or 2,000 kg/yr, and stormwater mitigation loads reduced by 2,400 kg/yr, also roughly 50%. These reductions in the nitrogen load are subtracted from total N load.

- *One participant noted that if fertilizer is reduced 100%, it could meet 25% of the total nitrogen reduction target at no cost. Arizona is doing this through subsidies in support of xeriscaping. It is helpful to look at it as a percentage of the solution, not of the load.* Mr. Cambareri noted that it may be difficult to get credit for more than 50% in the short-term future, but that this is a good point to keep in mind.

<u>Permeable Reactive Barriers (PRBs):</u> Mr. Owen shared a map indicating four areas suitable for PRBs within the Waquoit Bay Watershed, i.e. subwatershed areas with a higher nitrogen load, where the water table is 20 or fewer feet below the surface, and where road lengths run is perpendicular to groundwater flow. He made the distinction between trenched PRBs filled with organic materials and drilled well PRBs, in which a carbohydrate is injected. Trenched PRBs often require utilities to be disconnected. Drilled well PRBs can be installed around utilities. It is assumed that overall, PRBs capture about 70-80% of the nitrogen load they interact with.

Under the scenario, four PRBs could treat the nitrogen load from 879 homes, reducing nitrogen load by approximately 2,700 kg/yr. The unit cost is approximately $452/lb N. these costs are very preliminary there are many site specific details that cannot be addressed in these numbers.

Participants shared the following questions:

- *Does the unit cost consider construction only, or ongoing maintenance and other expenditures?* Mr. Owen explained that the estimated unit cost is based on construction, design, and includes annual O&M costs. The modeling team included replacement of small components in the estimate. For this and all the other technologies, the unit cost ($452/lb N here) is not an accurate, but rather an estimated cost. Cost will depend on the variability of the site; for PRBs relevant factors include utility presence in the targeted area and the level of the water table.

- *Taking into consideration this variability, do you have an estimated cost range for PRBs?* Mr. Owen noted that Technology Matrix includes a cost range for each technology. The scenarios use the average of the range. Ms. Daley added that the Technology Matrix is online on the group's watershed page.
- *Is the cost presented for injection well or trench PRBs? It would be nice to show the different costs of each.* Mr. Owen responded that he believed the rate used was $1000-1500 per foot of PRB, and invited further input on cost considerations.
- *At Sea Coast Shores, the feasibility of PRBs is low with beaches, the yacht club, etc. At what point in process does the site-specific information come into play?* Ms. Daley said that the experts will look at more specific site considerations, but that communities will ultimately be provided the tools to make these decisions. The 208 Plan Update will not outline the final site-specific options.
- *This will be a challenging option for our watershed.*

<u>Constructed wetlands:</u> Mr. Jay Detjens, GIS Analyst of the Cape Cod Commission presented the results of Watershed MVP's screening for constructed wetlands locations. He explained there will need to be further screening for practicability of these sites, but for this exercise the screening criteria used included:

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

Mr. Owen further added that constructed wetland sites include those near a wastewater facility where the nitrogen load from effluent can be further treated. Constructed wetlands can also be used in stormwater retention areas. This technology presents an efficient method of reducing nitrogen load and requires less maintenance than other options.

Under the scenario, five acres of constructed wetlands would reduce approximately 2,800 kg/yr of nitrogen at a unit cost of $521/lb N.

Participants shared the following questions:

- *Do the nitrogen removal rates consider year-round fluctuations in biological activity?* Mr. Owen explained that all seasons, including winter when there is less nitrogen reduction, are included in the removal rate estimate.

- *Do cost estimates consider land acquisition?* Mr. Owen noted that the estimates do not include land costs. The modeling team has discussed this and is going to develop a range of costs for one acre of land and include that in the unit cost for this technology. Land costs will range significantly depending on location.

(Several low lying areas in the watershed were also screened as potential phytoremediation buffer sites, where the roots of planted tree roots would intersect the water table and naturally attenuate the nitrogen load. As with constructed wetlands, additional screening is needed to determine practicability of the proposed sites. It was not included in this scenario, but mentioned as another option.)

<u>Fertigation wells:</u> Mr. Owen explained that this technology uses irrigation wells to pump nitrogen-laden groundwater and apply it as irrigation water on golf courses, open space areas, or landscaping. Wells are sited down-gradient of an existing wastewater treatment facility or a dense neighborhood on septic. Under the scenario, two golf courses using fertigation wells would result in 272 kg/yr in nitrogen reductions, at a unit cost of $438/lb N.

- *One participant noted that the nitrogen reduction rate may be high. The nitrogen contributions from golf courses have decreased significantly over the last years, and comprise 10% or less of fertilizer loads. Total fertilizer load across the watershed is probably 7-12% percent. Mr. Owen explained that golf courses we considered target sites for using and treating high nitrogen groundwater. The groundwater could be collected from other locations such as down gradient form high density development and wastewater treatment facility discharges.*

<u>Oyster beds / aquaculture:</u> Watershed MVP screened 17 acres of shellfish, across 7 sites of differing sizes. Additional site-specific feasibility studies are needed. Mr. Owen noted that the aquaculture could be commercially run, or could be incorporated into salt marsh restoration efforts. In order to remove nitrogen from the system and take credit for the removal, the shellfish would need to removed and used. Assuming that 17 acres is installed, the nitrogen removal rate is 4,250 kg/yr – the highest among non-traditional technologies – with a unit cost of $0/lb N.

Participants shared the following questions and comments:

- *The Moonakis River is not open for harvesting and should be taken off the map of proposed sites. Another screened site is already a commercial farm.* Mr. Owen noted that the town could potentially grow submerged oysters in a non-harvesting site and remove them.
- *Why is the unit cost for aquiculture/oyster beds $0/lb N?* Mr. Owen explained that if the town manages the aquaculture, there would be some costs, though the option is highly cost-effective. If the aquaculture is run commercially, the costs and profits are transferred to a private entity.

- *A participant noted that a project has been started in Great River using quahogs, which do better than oysters in higher salinity areas. Pests and disease often threaten oysters. The entire area has the potential for additional aquaculture through town management due to ample sandy bottom. An addition of 20 -25 million shellfish would remove a significant amount of nitrogen and, across 30 acres, would have a low density of 20 individual shellfish per square foot. We're interested in restoring the fishery to its historic population.* Mr. Owen added that there are other co-benefits of this technology as well: it provides resiliency in storms and a low-cost alternative to sewering. If using aquaculture as an option, the nitrogen reduction target could probably be met with a combination of I/A systems and reductions in fertilizer stormwater.

<u>Floating constructed wetlands:</u> This technology consists of floating rafts of nitrate- and phosphate-absorbing plants. It works well in freshwater and in estuaries, and is best suited where there is flow (e.g. the mouth of freshwater pond or harbor), though water circulators can increase flow and enhance nitrogen reduction as well. Currently there is more information on freshwater use of this technology. The rafts are 1-2 feet deep but hanging oysters, shellfish, and seaweed can add depth as well as the potential for marginal revenue. This approach has been tested on Long Island. Under the Waquoit Bay scenario, 2,500 cubic feet would be installed, reducing nitrogen by 1,125 kg/yr at a unit cost of approximately $61/lb N.

<u>Eco-toilets:</u> Under the scenario, eco-toilets would be installed at a 5% participation rate amongst homeowners (187 properties), achieving 740 kg/yr in nitrogen reduction with a unit cost of $1,265/lb. N. Mr. Owen mentioned the unit cost is an average over the range of urine diversion and composting technologies and that is likely to change dramatically as better information is incorporated into the Technology Matrix.

- *One participant noted that while eco-toilet constituents are still trying to provide better estimates of cost, it is not likely that this option will be more expensive than sewer, as depicted here.*

<u>Remaining sewer needed:</u> Mr. Owen noted that using this scenario of non-traditional technologies, a total of 301 homes would still require sewer infrastructure to reduce the final 1,300 kg/yr. of nitrogen reductions to meet the TMDL. As such, 5% of the nitrogen reductions would be met by sewer. The unit cost associated with this sewering is roughly estimated at $1,000/lb. N. He showed the targeted sewering area on a map (with dense development and higher nitrogen loads), and reiterated that this is only one possibility for how these technologies could be paired and implemented – a community could decide to rely upon one or all of them. For example, clustered, on-site I/A could be pursued instead of the remaining sewer required, though this would require a larger footprint (see scenario comparison table below).

**Scenario Comparison**

Mr. Owen then showed an overall comparison of four scenarios described in the exercise – 1) targeted sewer only, 2) targeted sewer after 50% reductions in fertilizer and stormwater, 3) targeted sewer after 50% reduction in fertilizer and stormwater and the application of non-traditional technologies, and 4) Innovative/Alternative on-site systems after 50% reduction in fertilizer and stormwater and the application of non-traditional technologies. All scenarios are assumed to achieve the TMDL for the watershed (see table below). The sewer footprint associated with each was shown on a map, shrinking and expanding depending on the scenario considered.

| Scenario | Cost /lb. N | Treated flow (gpd) |
|---|---|---|
| Targeted sewer | $527 | 665,000 |
| Targeted sewer after 50% reduction in fertilizer and stormwater | $437 | 443,000 |
| Targeted sewer after 50% reduction in fertilizer and stormwater and the application of non-traditional technologies | $402 | 47,000 |
| I/A on-site systems after 50% reduction in fertilizer and stormwater and the application of non-traditional technologies | $265 | 135,000 |

**General Discussion of the Scenarios and Methodology**

Participants presented the following questions and comments:

- *MEP assumes that every household produces the same amount of wastewater. Its estimates are based on the average use across the watershed, not on individual households that vary based on seasonal or year-long use. A seasonal area will require a larger footprint.* Mr. Cambareri explained that the Commission used actual water use data on the parcel scale from the water district in this analysis.
- *This analysis should factor in growth and future development.* Mr. Owen and Ms. Daley shared that Watershed MVP incorporates existing building stock data from 2009-2011. The Commission is first considering infrastructure currently required, and will take into consideration the additional need from added growth over the next six months. Watershed MVP is adaptable to analyze build-out scenarios. The discussion at this round of workshops is centered on how different approaches and combinations of technologies can impact the need for sewer infrastructure.

- *This analysis creates the impression that the sewershed will be in a tiny area, when we know it will be larger as a result of future development.* Ms. Daley noted this and responded that the Commission wants feedback on how to integrate growth.
- *There are at least five TMDLs across the Waquoit Bay Watershed; are these considered?* Mr. Owen noted that Watershed MVP can be applied at the subwatershed level and to other contaminants. Another tool, called the Wastewater Tracker, has been developed to track percent nitrogen removals across subwatershed in the context of subwatershed TMDL attainment and total watershed removals required.
- *This is great work. Are the baseline nitrogen conditions and contributions by fertilizer and stormwater in this watershed similar to those of other watersheds across the Cape?* Mr. Cambareri responded that the ratios of stormwater and fertilizer differ across watersheds, and depend in part on watershed size. There are similarities (generally the nitrogen contributions from each of these inputs are less than 20% of the total load); however there are subwatersheds that could achieve the nitrogen target entirely through stormwater and fertilizer reductions.
- *The model presents a level of precision in cost and reduction rate estimates that doesn't exist. Participants recommended that the Commission round the numbers, e.g. $452/lb. to $450/lb.* The Commission staff noted that this suggestion has been raised by others and makes sense.
- *There should be better consistency in units -- kg/yr. and $/lb. is confusing. Also, think about what consumer-relevant language is. I think cost per home would be a good way to present unit costs of technologies, although this may not make sense for all cost distribution scenarios. One way to handle this may be to have several columns depicting different financing scenarios, i.e., spread across the tax base and cost per household.* The Commission staff noted that unit consistency has been mentioned by other working groups as well, and that as public outreach continues over the next six months, they will keep in mind how to best communicate cost to broader audiences. The Commission thinks that showing different financing options in the scenario tables is a good idea. Affordability of options is of great concern.
- *It would also help to show the current scenario and the unit cost of existing septic. The cost of doing nothing needs to be understood.* Ms. Daley noted that this was a good point.
- *Location is important in this discussion. Certain technologies will have different costs depending upon the watershed or subwatershed of implementation. For example, sewering at Little Pond is relatively inexpensive.*
- *Each approach has associated benefits – for example, improved natural habitat. It would be useful to show an economic multiplier effect that indicated direct and indirect economic benefits. If you focus more on the co-benefits of these options,*

*the public may be more willing to invest in them, and it may show that the cheapest alternatives may not be the most preferable.*

- *Is the cost column adapting with the utilization of technologies? The cost per pound will be different if 200 vs. 2,000 homes are sewering.* Mr. Owen explained that there wastewater treatment facility treatment options that changes the total cost of $/lb. N. Watershed MVP and the Technology Matrix consider this.
- *Does the model take into account the distance to a sewering plant?* Mr. Detjens noted that, in an effort to be conservative, it assumes a distance of 2 miles from the treatment plant to a disposal site, as well as the construction of a new treatment plant with added sewer. Ms. Daley added that the Commission would look at use of existing plants over the next six months. *Two miles from the plant to a discharge is too far; most discharges are adjacent.* Mr. Detjens replied that the team can incorporate existing plant locations into the screening analysis of disposal sites.
- *The Technology Matrix is an extraordinary tool that may have national influence, but the best way to present this information to communities may be to create a fact sheet for each technology option and present the columns as subsections within that fact sheet. This would create a manual or reference document that can be distributed, much like the stormwater manual.*
- *We have the long-term issue of sea level rise. It might be good to look at areas in the community that are subject to storm damage and to consider self-contained systems for those areas, e.g. composting toilets or I/A units. These high-risk areas should be significant in your considerations.* The Commission staff noted that sea level rise considerations will be integrated into the 208 Plan Update.
- *In our Facilities Plan, we are required to consider greenhouse gas impacts. Is the Commission addressing this too and do you have numerical evaluations? It would be helpful to have this.* Mr. Owen noted that some of the technologies presented (e.g., constructed wetlands) have positive effect when it comes to greenhouse gas impacts. This factor is integrated in the Technology Matrix as an eco-benefit, though it does not present actual numbers on greenhouse gas emissions. Other eco-benefits include system resilience, energy use, and chemical use. The team can reevaluate the presentation of this information.
- *Several of these technologies can be separated into classes for analysis because they have variable costs. These include PRBs, eco-toilets, and sewer (gravity or step fed).*
- *Can towns develop cost estimates? That would be very helpful. We are close to having numbers on the shellfish project and eco-toilets.* Mr. Owen encouraged feedback from pilot projects so that those results could be considered in the Technology Matrix.
- *Will the model be set up so that towns can explore different options on their own?* Ms. Daley noted that the Watershed Calculator tool will be available to communities.

- *Will communities be able to modify the baseline conditions in the Watershed Calculator? If the seaweed bed in Waquoit Bay is compromised, the baseline nitrogen load would be significantly larger.* Yes, you can manipulate the baseline watershed conditions.
- *The model assumes that treated effluent is disposed within the watershed. How does outside disposal influence these calculations?* Mr. Owen noted that Watershed MVP doesn't incorporate that consideration, but that it can be modified to do so. The model currently assumes that 5 mg/L of nitrogen is leached out from effluent (with pretreatment at 40 mg/L). Ms. Daley added that out of 105 watersheds on the Cape, only 57 directly flow into an embayment. The remainder could be used for disposal.
- *USGS has developed a 3D model of the watershed in Popponesset Bay. The groundwater is discharged beyond the shoreline and probably going to Nantucket Sound. There could be impacts on water quality there. The hydrogeology of the area is complex and varies greatly, but it is key when considering these technologies, especially PRBs. We need a regional hydrogeology model for the Cape. Maybe USGS could develop this.*
- *If effluent is disposed where groundwater transport takes 100 years, does it attenuate?* Mr. Owen noted that MEP assumes not much attenuation occurring outside of pond or surface water habitats. *Some participants challenge this assumption.*

Mr. Owen then led the group through an exercise using the Watershed Calculator to look at different options and levels of implementation. Through this exercise, the group learned that:

- 30 acres of oysters/aquaculture would achieve all nitrogen reductions and avoid the need for other technologies.
- Dredging and inlet widening is also an option. *Hamlin Pond could be a good, though expensive, candidate for this option. There are no inlets in the area to be widened, but bottom dredging is a good technology to add to the scenario for this watershed.*
- *Reductions greater than 50% in fertilizer use can significantly alter technology needs.*

In sum, the group agreed to the following main takeaways provided by the scenario analysis and discussion:

- *The right combination of non-traditional alternatives can avoid or greatly minimize the need for sewer infrastructure.*
- *A feasible combination of technologies must be based on site-specific constraints within a watershed, community priorities, projected storm damage areas, etc.*
- *A higher resolution of cost and reduction rate information is desired so that these site-specific decisions can be made.*

## IV. ADAPTIVE MANAGEMENT

Ms. Daley explained that an adaptive management approach is critical to wastewater planning on the Cape 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

She 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."

Ms. Daley noted that a final definition would be shared with federal and state partners, and solicited comments on the one provided. The group offered the following thoughts:

- *The definition should incorporate the idea that updates should be made on the basis of new science and technology.*
- *The definition should be more consumer-friendly and accessible so that the public can appreciate and understand it. This is something that people will vote on. We don't want to confuse them with a wordy definition.*
- *The word "probability" could problematic depending upon how it is construed: The MEP targets ultimately need to be met.*

### General Discussion on Adaptive Management

Participants discussed other considerations of adaptive management, including:

- *Monitoring is key to adaptive management.*
- *Science and monitoring are on a longer temporal scale than regulatory change, action plan development, and stakeholder-driven processes. We need to add a temporal component that captures that.* Ms. Daley noted that over the next sixth months, the Commission will pull together a monitoring group to talk about these issues.
- *There is also the issue of phasing technologies, which presents another temporal component. We should first implement those technologies that have a high probability of success.*

- *Has there been any attempt to address risk management associated with non-traditional approaches, and to look at the viability of these alternative technologies? There is a risk of lost public investment and public backlash.* Mr. Owen noted that the Technology Matrix factors increased costs associated with a wide range of uncertainty. Ms. Daley added that risk tolerance is specific to each community.
- *We need to remember that no technology can meet the TMDL unless DEP provides credit. Eco-toilets are allowed 50% credit for nitrogen reduction, but we are trying to change that. It's going to take time and bureaucratic effort to prove to DEP how much a technology actually reduces and how much we should get credit for.* Ms. Daley noted that DEP is open to looking at results from demonstration and pilot projects to determine credit allocations. The agency also wants to see a back-up plan of traditional technologies as well, however, in case the alternatives prove to be ineffective. The Commission is talking to DEP about the possibility of a watershed-wide permit, wherein DEP would issue a permit to all towns within a particular watershed. They are providing time to pilot alternative technologies.
- *Timelines will vary for each technology. We need to determine a timeline for each approach.* Mr. Detjens added that some of the Watershed Working Groups have been discussing potential time periods for their adaptive management plans, i.e. length of monitoring efforts, when to move to traditional technologies if the non-traditional are ineffective.
- *The cost of implementation for different technologies is contingent on place and the constraints of each watershed. These are other important factors to consider as well.*

## V. PREPARING FOR 2014 JAN-JUNE

### Triple Bottom Line (TBL) Analysis

Ms. Daley 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. She also noted that TBL analysis is often used to 1) evaluate scenario alternatives and rank them relative to each other and 2) report to stakeholders on the public outcomes of a given investment. Using algorithms, it provides a graphic representation of the potential impacts of technology scenarios.

In explaining why the Commission has decided to pursue a TBL model, Ms. Daley said that it will allow interested parties to:

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

She also explained that the 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. Daley 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 2013, and that the Commission will be using it over the next six months to assist in scenario evaluations.

**Next Steps in the Stakeholder Process**

Ms. Daley then explained to the Working Group the next immediate steps of the 208 Plan Update, which 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 (Feb, March, April). Also likely is the creation of an *ad-hoc* committee to discuss monitoring protocols for different technologies.<br><br>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 |

- *Several participants showed interest in the process and how representatives for the four-subgroups would be chosen.* Ms. Daley responded that the Commission has yet to finalize how representatives will be chosen, but the subgroups will be formed at the Stakeholder Summit. The Commission will report to the watershed working groups in advance of that meeting on the protocol for selecting subgroup members. Subgroup meetings will be open to the public, however, and the public comment section of each will be expanded to allow interested stakeholders to continue providing input. Additionally, the Stakeholder Summit will be open to the public.

**Shared Principles**

The facilitator summarized the following list of shared principles (listed alphabetically) that have been vetted by this Working Group over the three meetings, and asked for confirmation that the group wished them to be considered as the planning process moves forward and as more details emerge about the various technologies:

- Affordability
- Climate change
- Ease of implementation
- Growth assumptions
- Multiple (or co-) benefits
- Reliability and confidence
- Regulatory and legal landscapes
- Resiliency and adaptability
- Public acceptance
- Speed and time (re: adoption and realization of benefits)
- Unintended consequences
- Confidence (or lack of) in the baselines
- Importance of local context

## VI. PUBLIC COMMENT

No public comments were made.

Mr. Thompson and Ms. Daley thanked the group for time and input.

## APPENDIX A

## Waquoit & Popponesset Bay Working Group Workshop Three
**December 11, 2013**
**Participant List**

1. Rob Adler - US EPA
2. Victoria Brisson - AmeriCorps CC, Town of Mashpee
3. David Dow - Sierra Club
4. Tom Fudala - Mashpee Planning, Sewer & Water District
5. Paul Gobell - Town of Mashpee, Sewer Department
6. Jessica Rapp Grassetti - Town of Barnstable, Town Councilor
7. Peter Hargraves - FACES
8. Alison Leschen - WBNERR
9. Win Munro - Wastewater Committee, Falmouth
10. Ed Nash - Golf Superintendents Assoc.
11. Mark Owen - AECOM
12. Tonna Marie Rogers - WBNERR
13. Francis J. Sheehan, MD - Sandwich Board of Health
14. Art Traczyk - Town of Barnstable, Design/Regulatory Review Planner
15. Richard York - Town of Mashpee, Shellfish Constable

CCC Staff:

16. Patty Daley - Deputy Director
17. Philips "Jay" Detjens - GIS Analyst II/Database Administrator
18. Tom Cambareri - Watershed Management Director
19. Maria McCauley - Fiscal Officer/Staff Support

Consensus Building Institute Staff:

20. Doug Thompson, Facilitator
21. Lauren Dennis, Note taker