Cape Cod 208 Area Water Quality Planning
Three Bays Watershed Working Group
Second Meeting

COMM Fire Station
1875 Falmouth Rd, Centerville, MA 02632
October 29, 2013
8:30 a.m.-12:30 p.m.

Agenda

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

8:40 Introductions, Agenda Overview, Updates and Action Items– *Facilitator and Working Group*

9:00 Range of Possible Solutions – *Cape Cod Commission and Working Group*
- Technology Matrix
- Technologies Overview
- Survey Questions and Comments
- Additional Questions and Discussion

10:30 Break

10:45 Problem Solving Process and Principles – *Cape Cod Commission and Working Group*
- Overview of 7-steps for Problem-Solving Process
- Examination of Categories of Solutions and their impacts on the Environment, Economy, and Community (triple bottom line)
- Discussion – Identify Considerations and Priorities for Application

12:00 Preparing for Meeting 3 and Beyond – *Cape Cod Commission*
- Review Tools, Alternatives Analysis Approach
- Evaluating Scenarios for Meeting Nitrogen Goals
- Other Process Next Steps

12:15 Public Comments

12:30 Adjourn

Three Bays & Centerville River

Technologies and Approaches

What is the stakeholder process?

Public Meetings

Watershed Working Groups

Goals, Work Plan & Roles

Affordability, Financing

Baseline Conditions

Technology Options Review

Watershed Scenarios

July

August

September

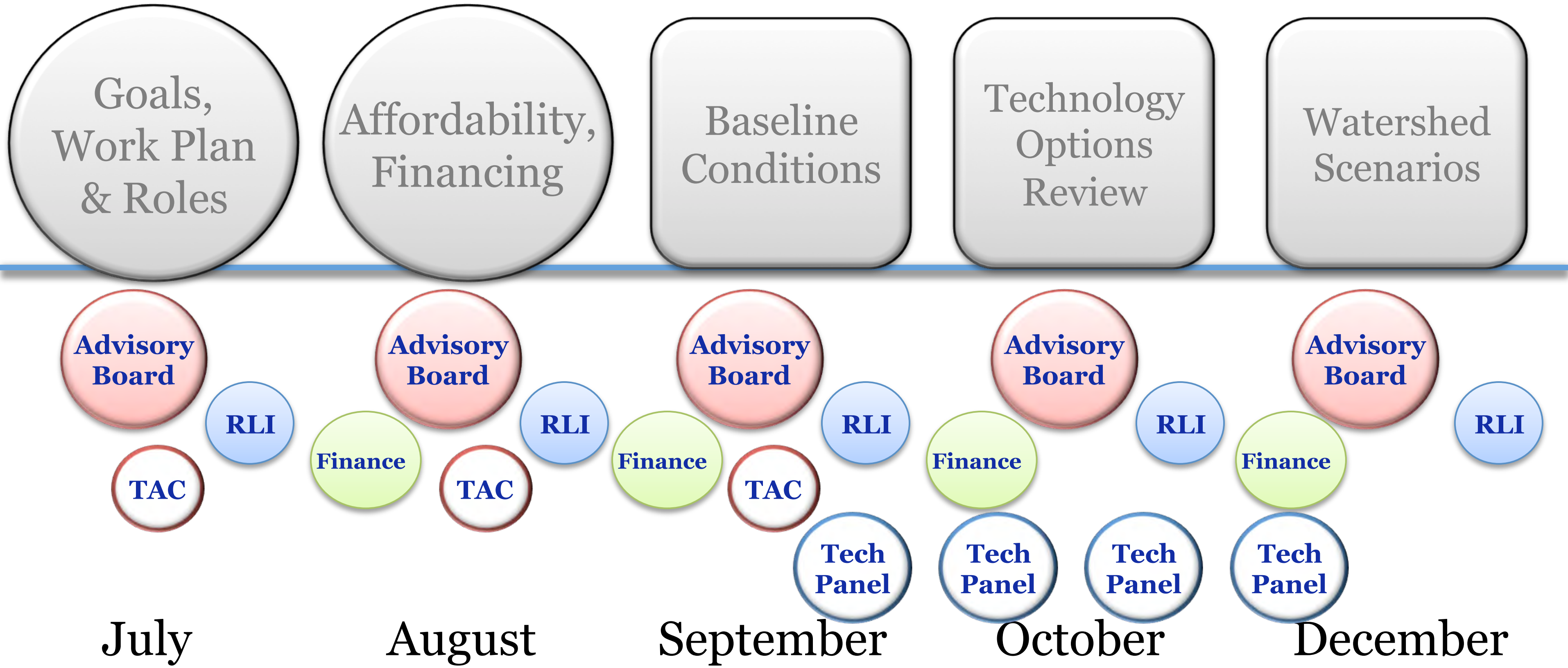
October

December

208 Planning Process

Public Meetings

Watershed Working Groups



RLI — Regulatory, Legal & Institutional Work Group

TAC — Technical Advisory Committee of Cape Cod Water Protection Collaborative

208 Planning Process

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Goal of the First Meeting:

To review and develop shared understanding of the characteristics of these watersheds, the work done to date, existing data and information available, and how to apply all of this to planning for water quality improvements for these watersheds moving forward.

Progress since last meeting

- ❑ Meeting materials

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers

Progress since last meeting

- ❑ Meeting materials
- ❑ GIS data layers
- ❑ Chronologies

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

208 Planning Process

Baseline Conditions

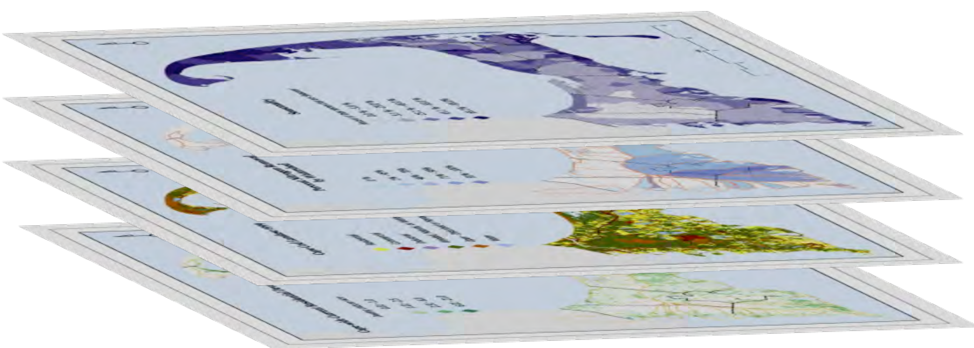
11 Working Group Meetings: Sept 18-27

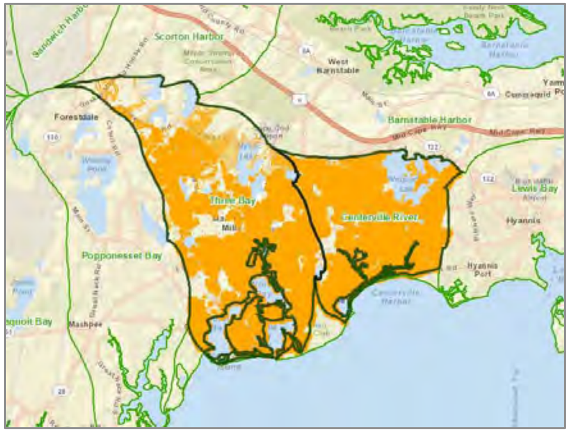
Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11





208 Planning Process

Baseline Conditions

11 Working Group Meetings: Sept 18-27

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Watershed Scenarios

11 Working Group Meetings: Dec 2-11

Watershed Event

November 13

Center for the Arts Dennis

Wrap up of Cape2O: ur in charge!

Summary of planning process to date

Outline of second 6 months of the 208 planning process

208 Planning Process

Technology Options Review

11 Working Group Meetings: Oct 21-Nov 5

Goal of Today's Meeting:

To develop a shared understanding of the potential technologies and approaches identified to date, and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

Technologies and Approaches for Improving Water Quality

Technologies and Approaches for Improving Water Quality

- The Fact Sheets present various information on the technologies being considered.
- Additional information is contained on the Technology Matrix including the following:
  - Site Requirements
  - Construction, Project and Operation and Maintenance Costs
  - Reference Information
  - Regulatory Comments
- Input from the Stakeholders is requested regarding a technology's Public Acceptance

Technologies and Approaches for Improving Water Quality

- Comprehensive analysis of nutrient control technologies and approaches.

Technologies and Approaches for Improving Water Quality

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- ❑ Not all of the technologies and approaches will be applicable to Cape Cod.

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- Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.

Site Scale | Neighborhood | Watershed | Cape-Wide

Solutions

- Compact Development
- Remediation of Existing Development
- Fertilizer Management
- Transfer of Development Rights
- Stormwater BMPs
- Standard Title 5 Systems
- Cluster & Satellite Treatment Systems
- Conventional Treatment
- I/A Title 5 Systems
- STEP/STEG Collection
- Advanced Treatment
- I/A Enhanced Systems
- Wastewater Collection Systems
- Toilets: Urine Diverting
- Effluent Disposal Systems
- Toilets: Composting
- Constructed Wetlands: Surface Flow
- Toilets: Packaging
- Constructed Wetlands: Subsurface Flow
- Stormwater: Bioretention / Soil Media Filters
- Effluent Disposal: Out of Watershed/Ocean Outfall
- Stormwater: Wetlands
- Phytoirrigation
- Eco-Machines & Living Machines
- Phytobuffers
- Fertigation Wells
- Permeable Reactive Barrier
- Shellfish and Salt Marsh Habitat Restoration
- Aquaculture/Shellfish Farming
- Inlet / Culvert Widening
- Pond and Estuary Dredging
- Surface Water Remediation Wetlands

Solutions: Site

Site Scale | Neighborhood | Watershed | Cape-Wide

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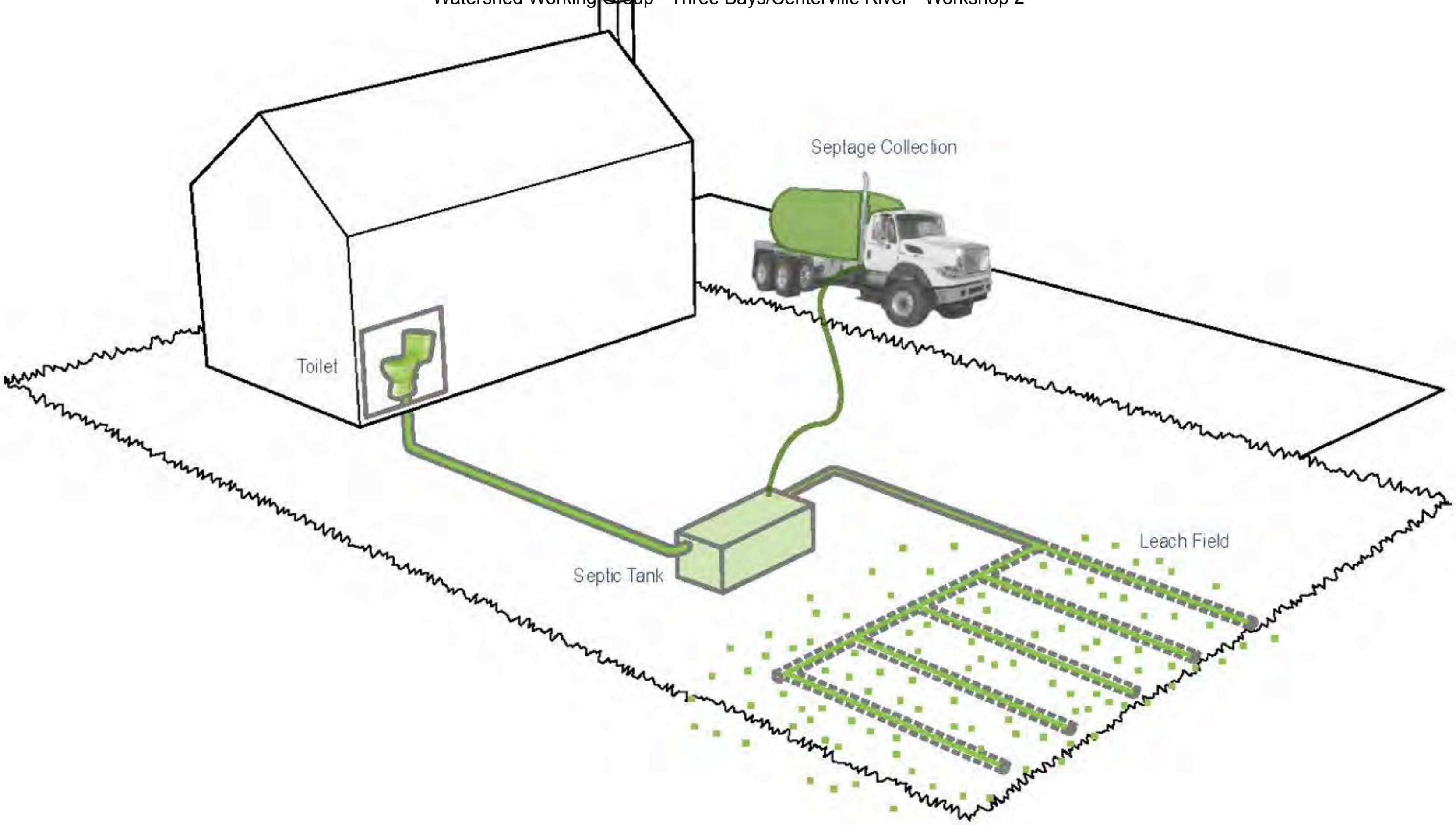
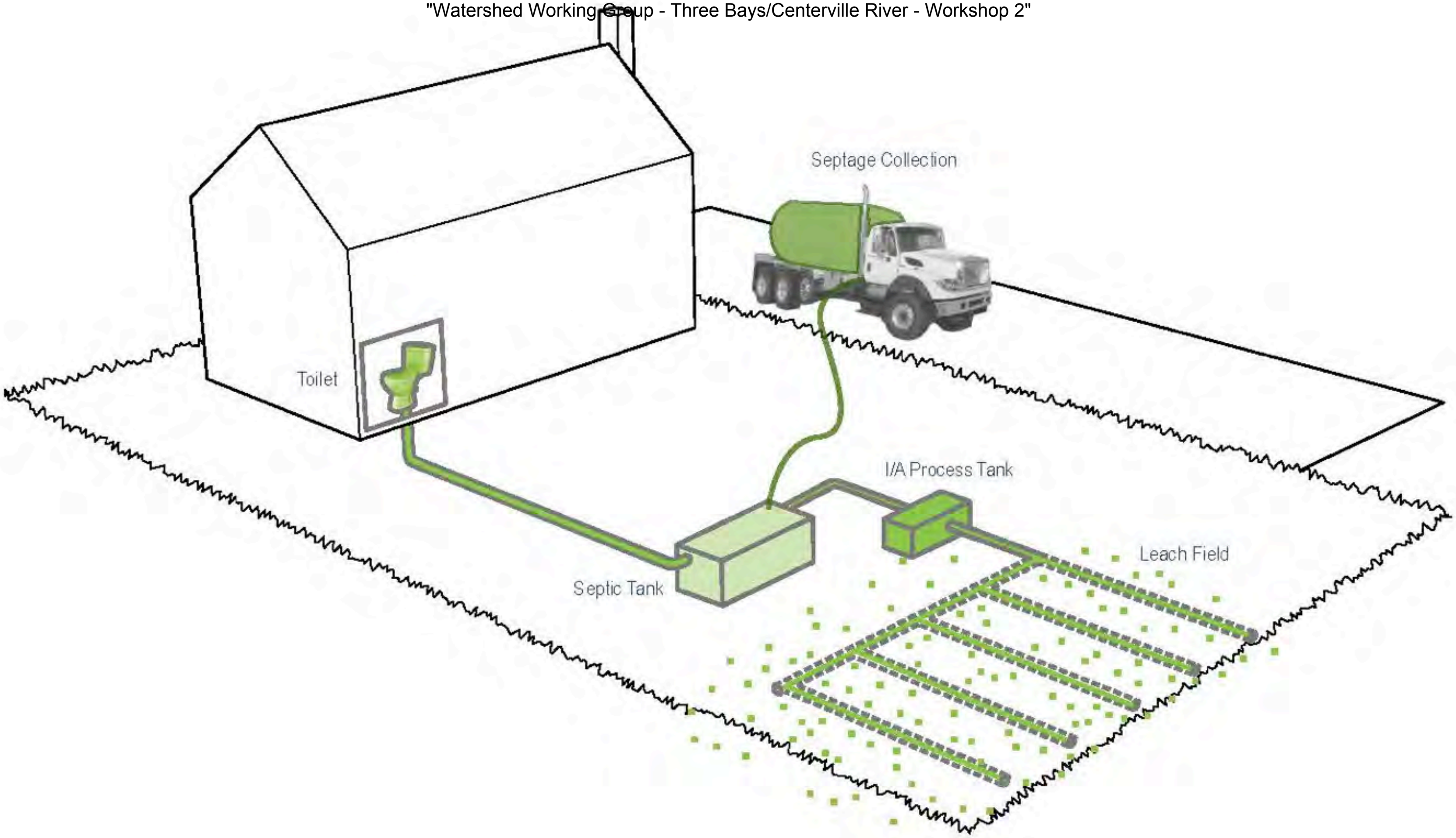


Scale: SITE
Target: WASTEWATER

Standard Title 5 Systems

Title 5



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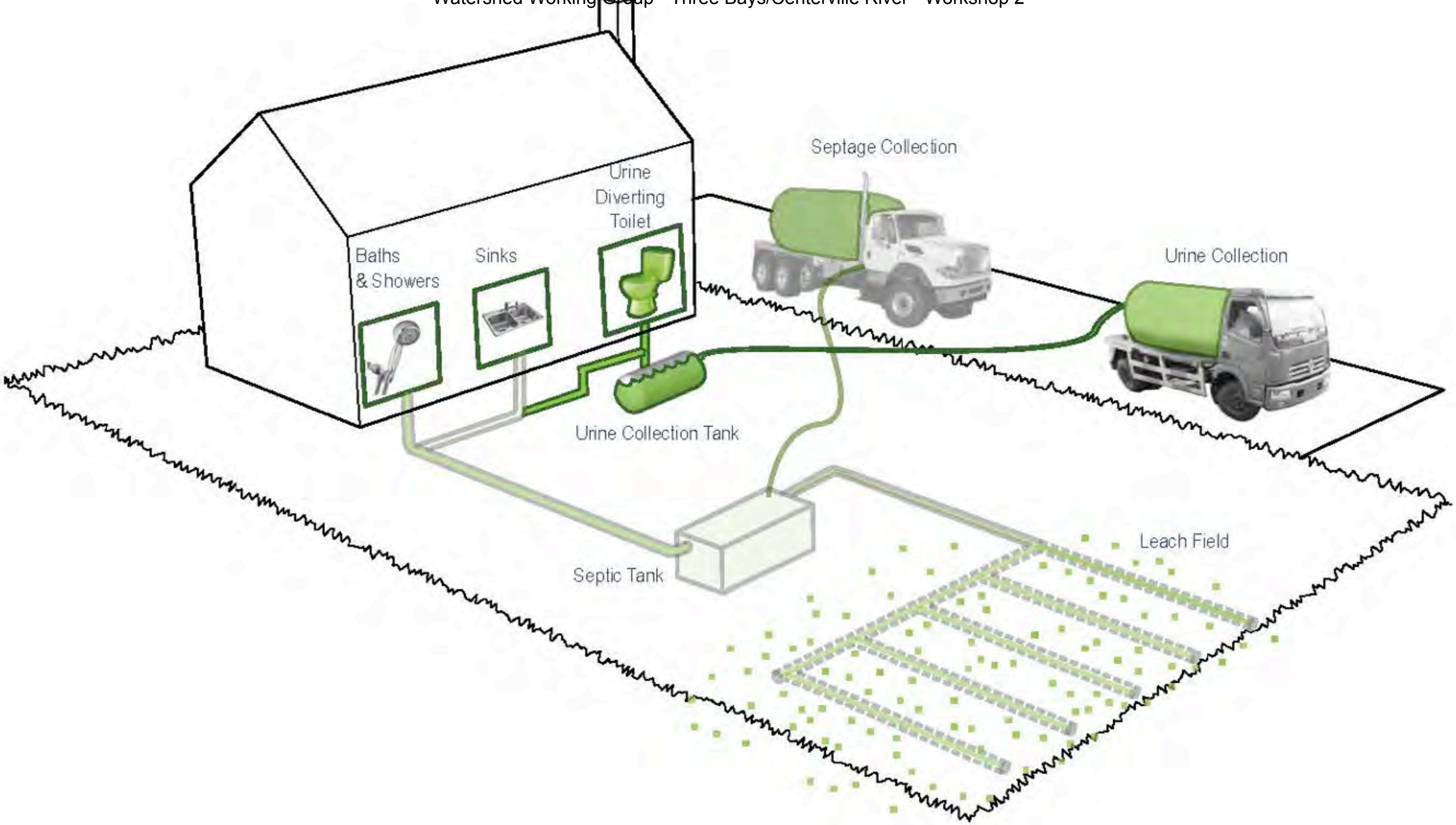
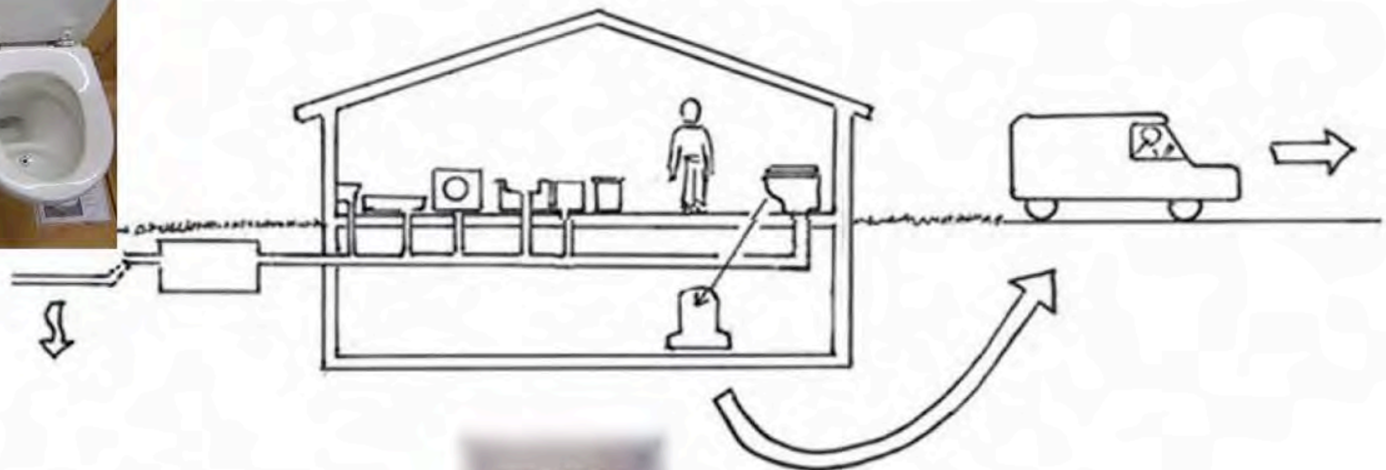
Target: WASTEWATER

I/A Title 5 Systems



Scale: SITE
Target: WASTEWATER

Toilets: Urine Diverting



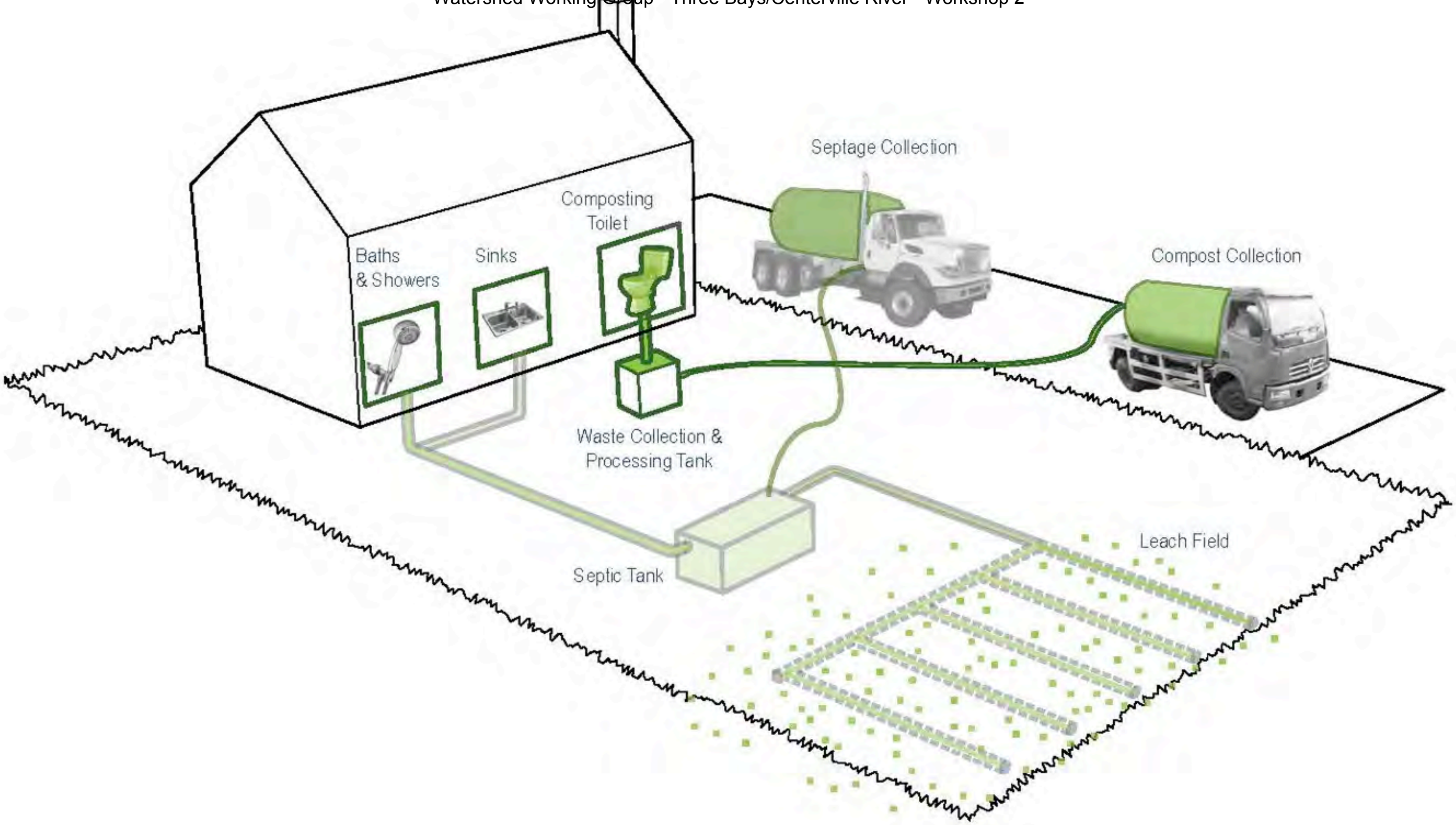
Waterless
Urinal

IBC container
(220 gallons)

40" x 40" x48"

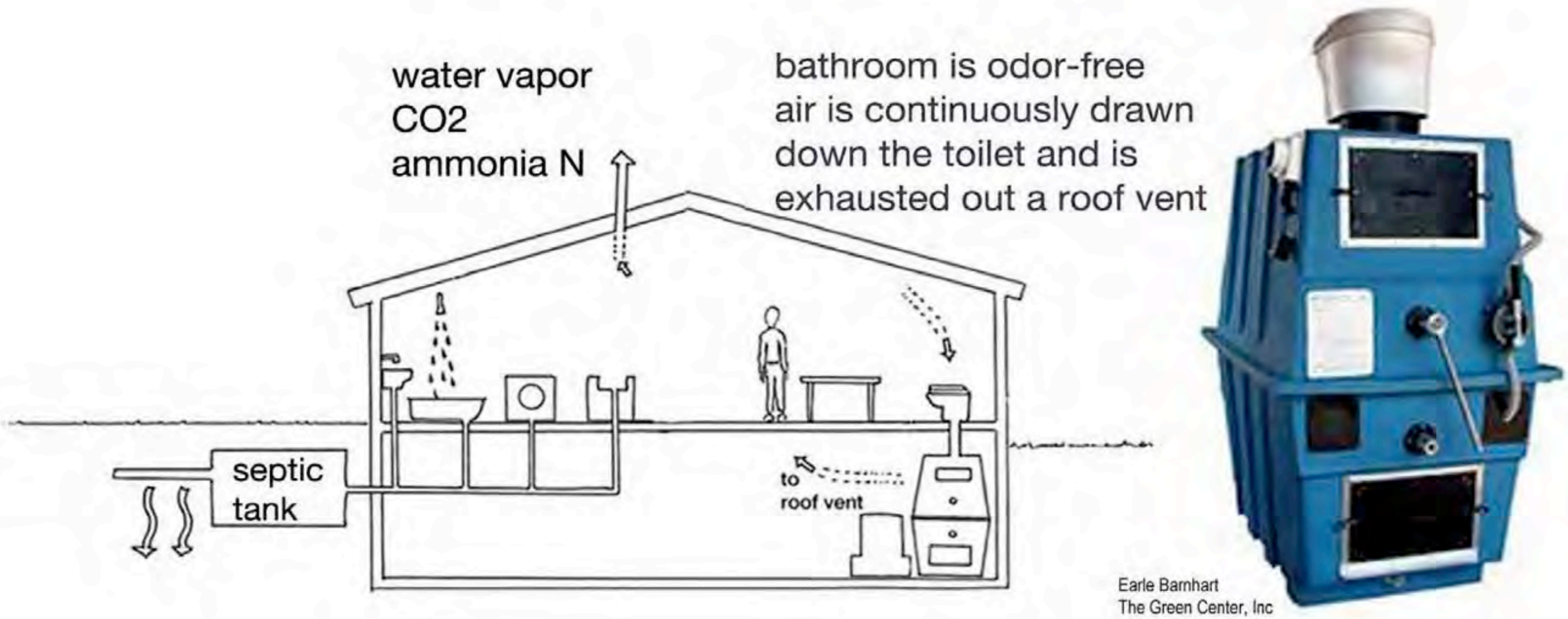
Source: Earle Barnhart, The Green Center Inc. and Horsley-Witten Group Inc.

Toilets: Urine Diverting



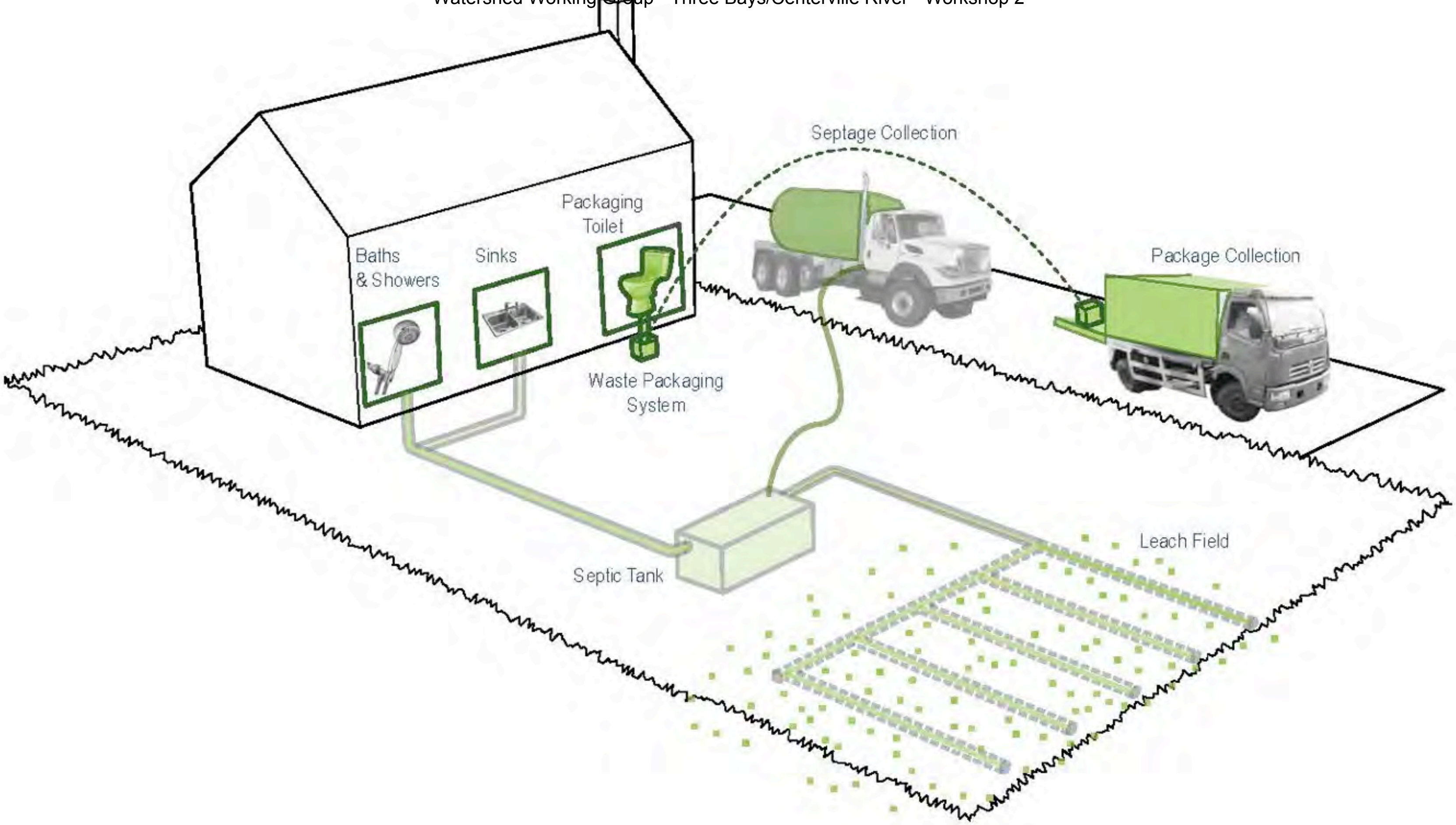
Scale: SITE
Target: WASTEWATER

Toilets: Composting



Source: Earle Barnhart, The Green Center Inc.

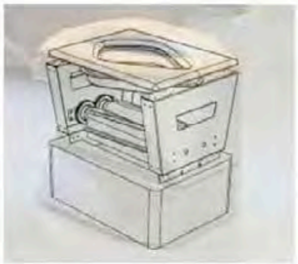
Toilets: Composting



Scale: SITE
Target: WASTEWATER

Toilets: Packaging

PACTO®



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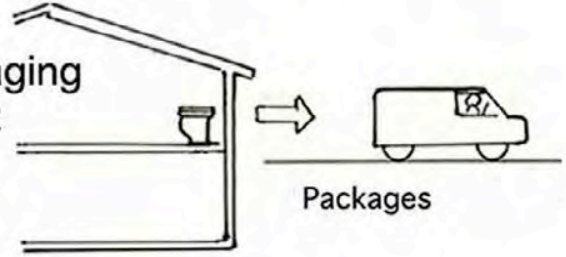
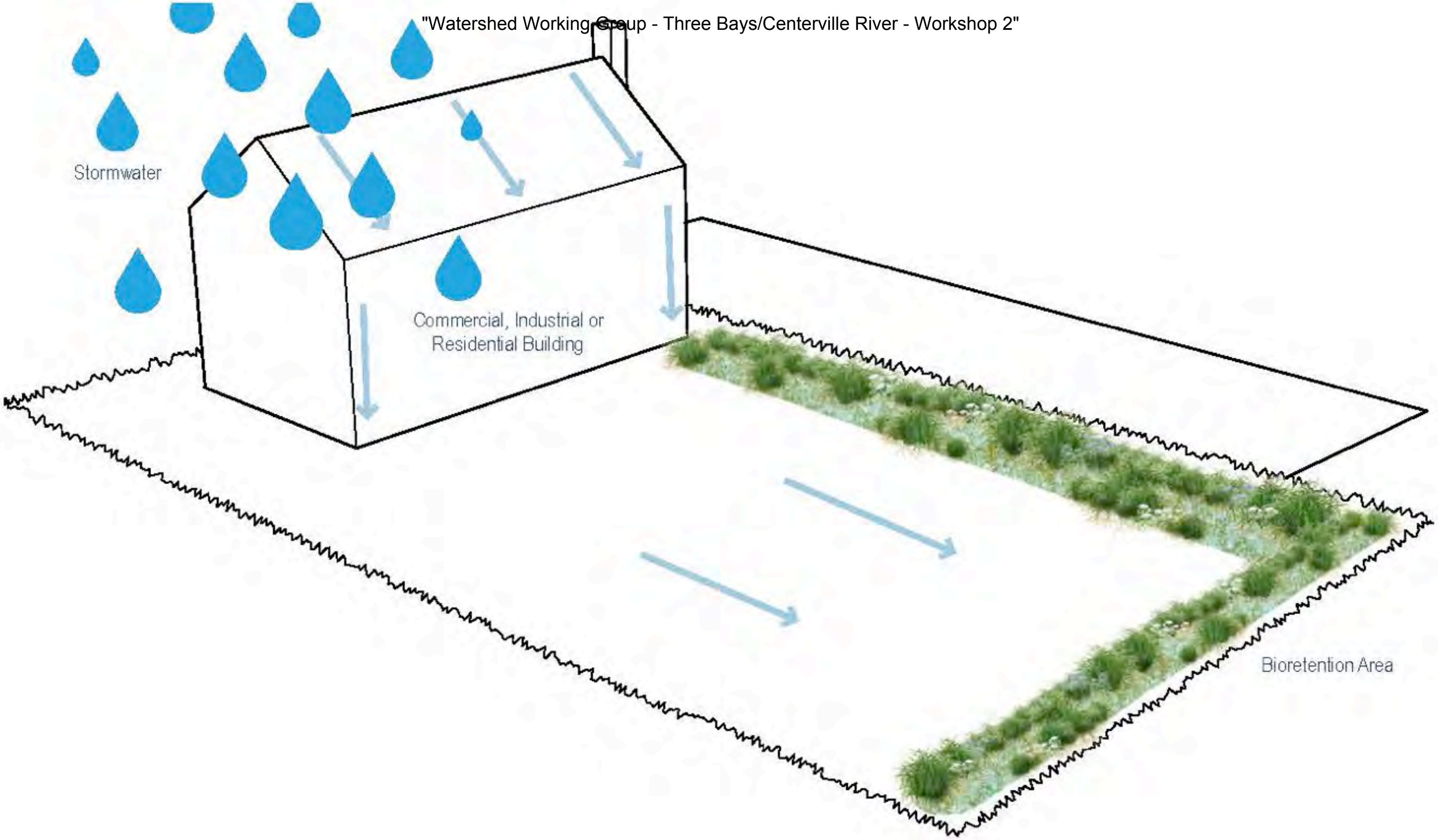


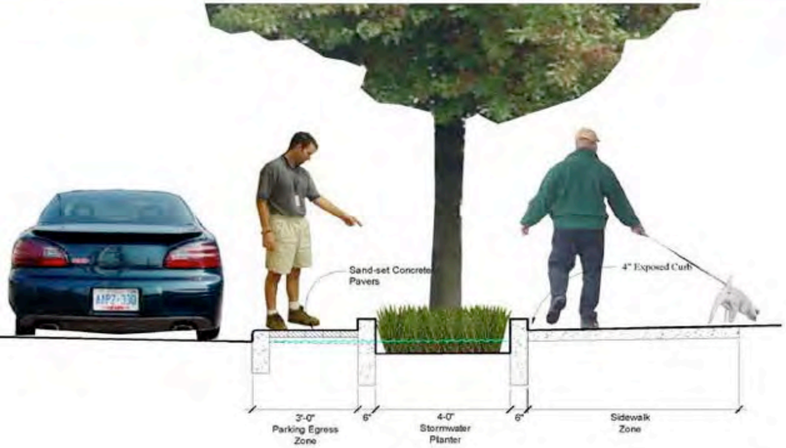
Source: Earle Barnhart, The Green Center Inc.

Toilets: Packaging



Scale: SITE
Target: STORMWATER

Stormwater: Bioretention / Soil Media Filters



Precedent: 12th Ave. Stormwater Project, Portland, OR

Source: City of Portland

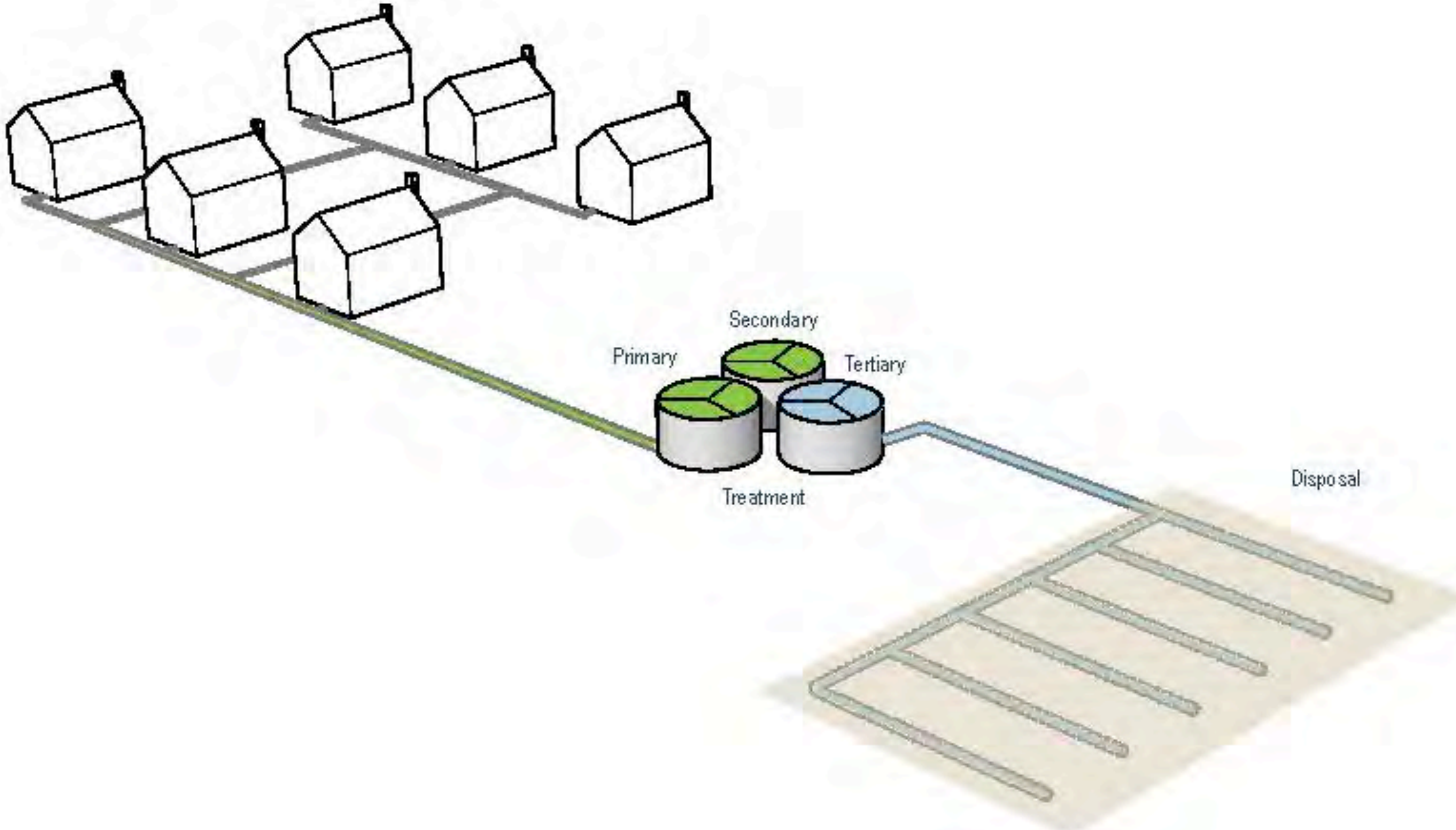
Stormwater: Bioretention / Soil Media Filters

Rain Gardens

Solutions: Neighborhood

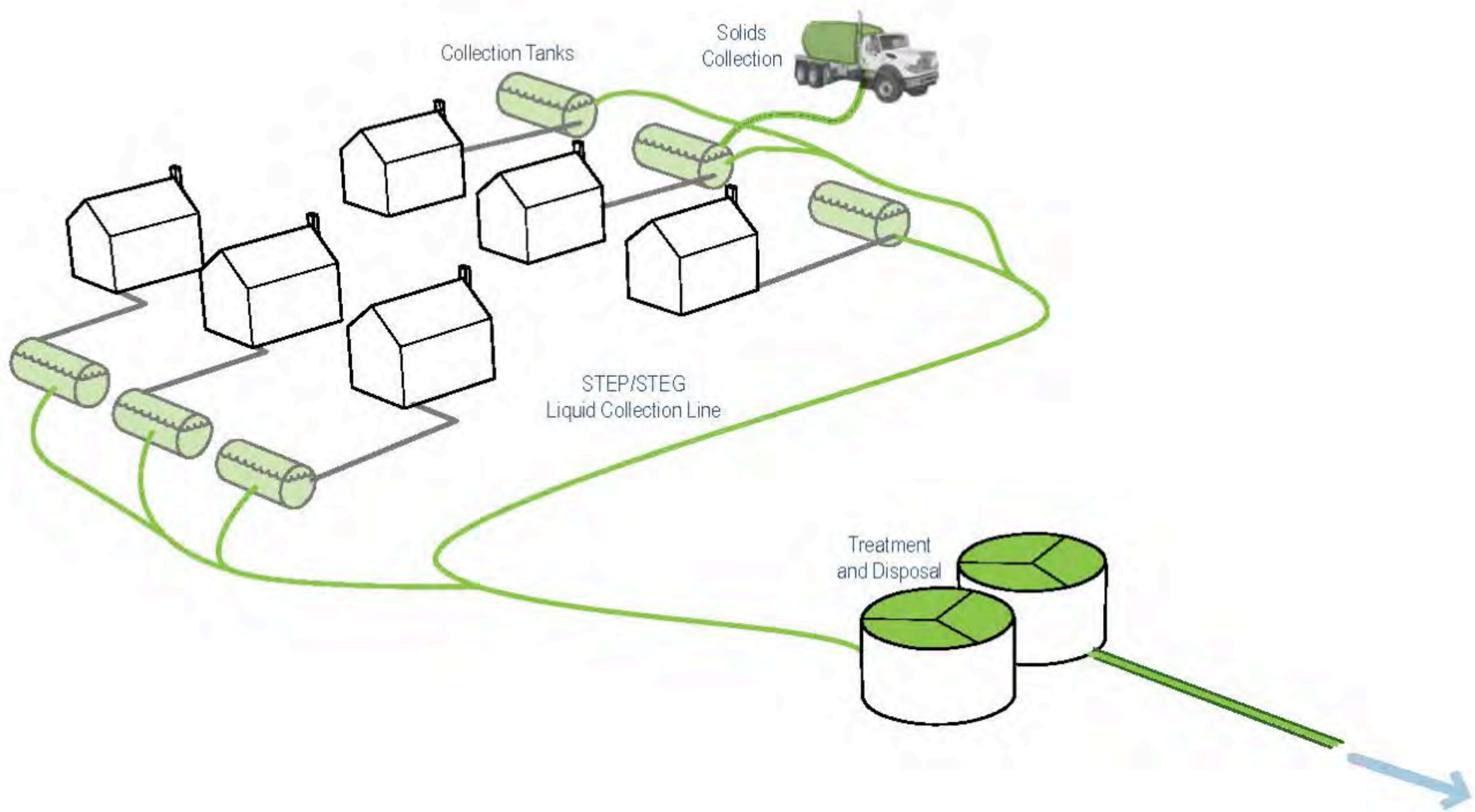
Site Scale | Neighborhood | Watershed | Cape-Wide

- Compact Development
- Remediation of Existing Development
- Fertilizer Management (N+P+K MGMT)
- Transfer of Development Rights (TDR)
- Stormwater BMPs
- Standard Title 5 Systems (Title 5)
- Cluster & Satellite Treatment Systems
- Conventional Treatment
- I/A Title 5 Systems (IA)
- STEP/STEG Collection (STEP/STEG)
- Advanced Treatment
- I/A Enhanced Systems (Enhanced IA)
- Wastewater Collection Systems
- Toilets: Urine Diverting (U)
- Effluent Disposal Systems (Disposal)
- Toilets: Composting (C)
- Constructed Wetlands: Surface Flow
- Toilets: Packaging (P)
- Constructed Wetlands: Subsurface Flow
- Stormwater: Bioretention / Soil Media Filters
- Effluent Disposal: Out of Watershed/Ocean Outfall
- Stormwater: Wetlands
- Phytoirrigation
- Eco-Machines & Living Machines (EM)
- Phytobuffers
- Fertigation Wells (N+P)
- Permeable Reactive Barrier (PRB)
- Shellfish and Salt Marsh Habitat Restoration
- Aquaculture/Shellfish Farming
- Inlet / Culvert Widening
- Pond and Estuary Dredging
- Surface Water Remediation Wetlands (R)



Scale: NEIGHBORHOOD
Target: WASTEWATER

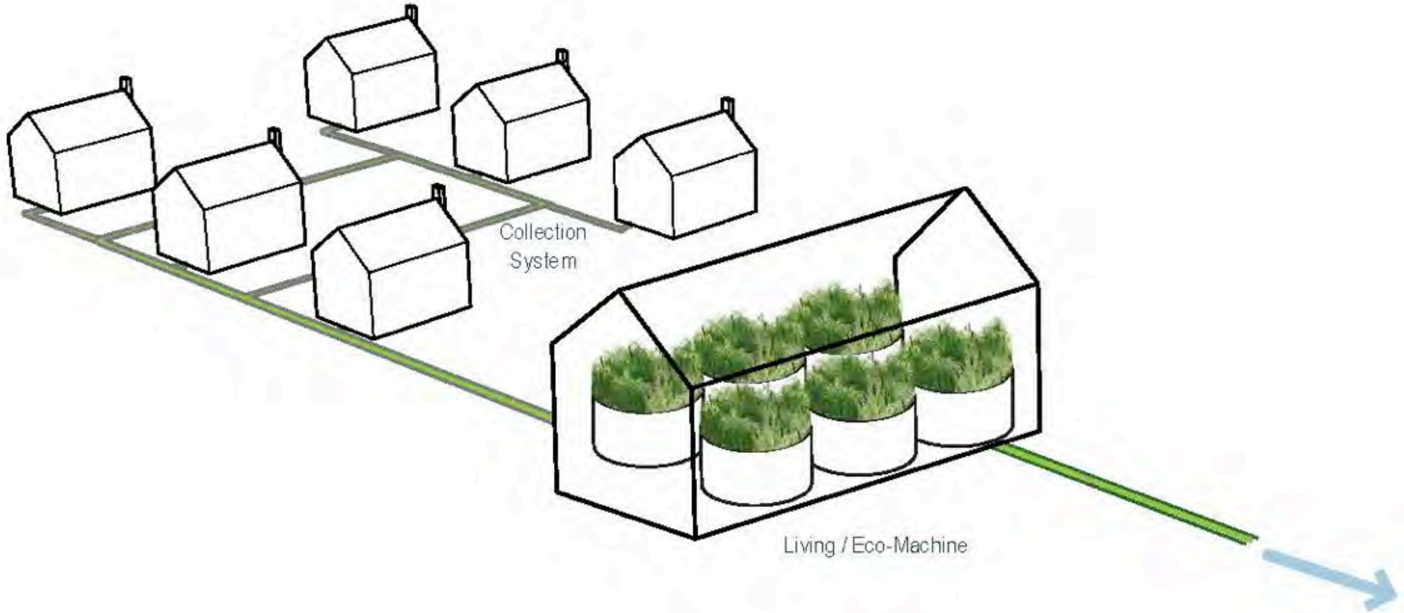
Cluster & Satellite Treatment Systems



Scale: NEIGHBORHOOD
Target: WASTEWATER

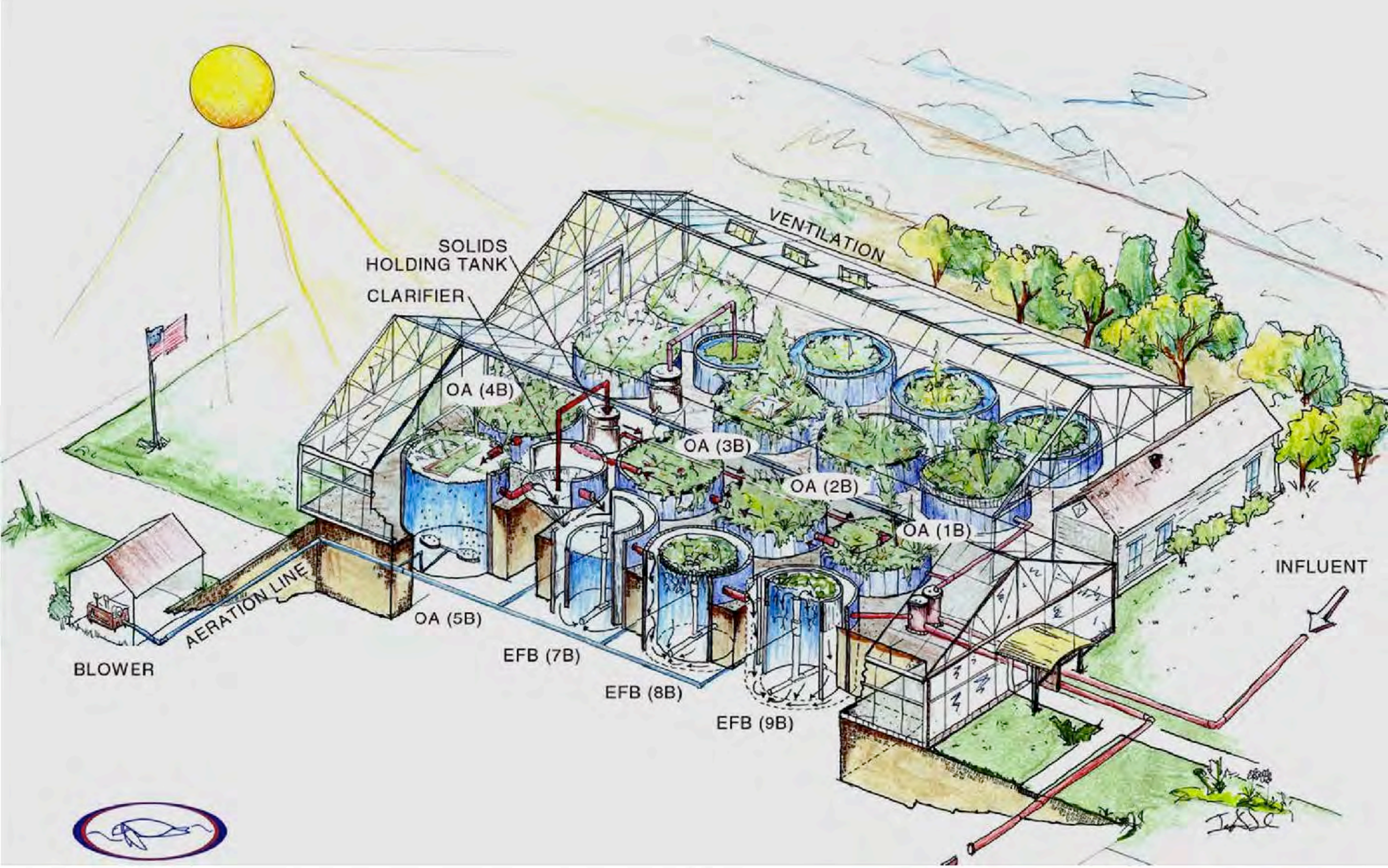
STEP / STEG Collection

STEP/
STEG



Scale: NEIGHBORHOOD
Target: WASTEWATER

Eco-Machines and
Living Machines

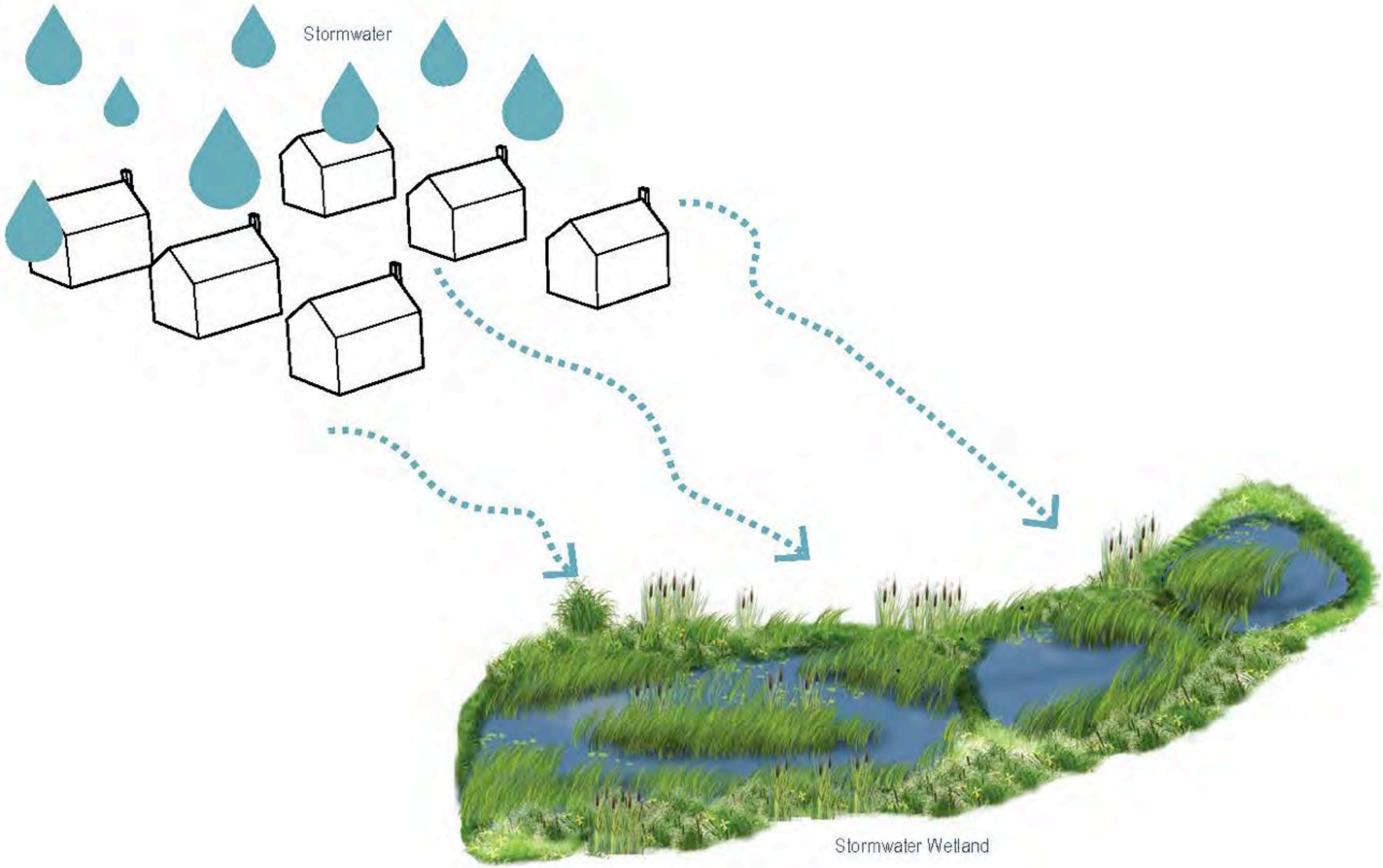


Precedent: Living Machine, South Burlington, VT
Source: Todd Ecological

Eco-Machines and Living Machines

Precedent: Living Machine - South Burlington, VT + Photobioreactors - Falmouth, MA
Source: Todd Ecological and Tom Cambareri

Eco-Machines and
Living Machines



Scale: NEIGHBORHOOD
Target: STORMWATER

Stormwater Wetlands

Precedent: Missouri
Source: AECOM

Stormwater Wetlands

Solutions: Watershed

Site Scale | Neighborhood | Watershed | Cape-Wide

Compact Development

Remediation of Existing Development

Fertilizer Management

Transfer of Development Rights

Stormwater BMPs

Standard Title 5 Systems

Cluster & Satellite Treatment Systems

Conventional Treatment

I/A Title 5 Systems

STEP/STEG Collection

Advanced Treatment

I/A Enhanced Systems

Wastewater Collection Systems

Toilets: Urine Diverting

Effluent Disposal Systems

Toilets: Composting

Constructed Wetlands: Surface Flow

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Stormwater: Bioretention / Soil Media Filters

Effluent Disposal: Out of Watershed/Ocean Outfall

Stormwater: Wetlands

Phytoirrigation

Eco-Machines & Living Machines

Phytobuffers

Fertigation Wells

Permeable Reactive Barrier

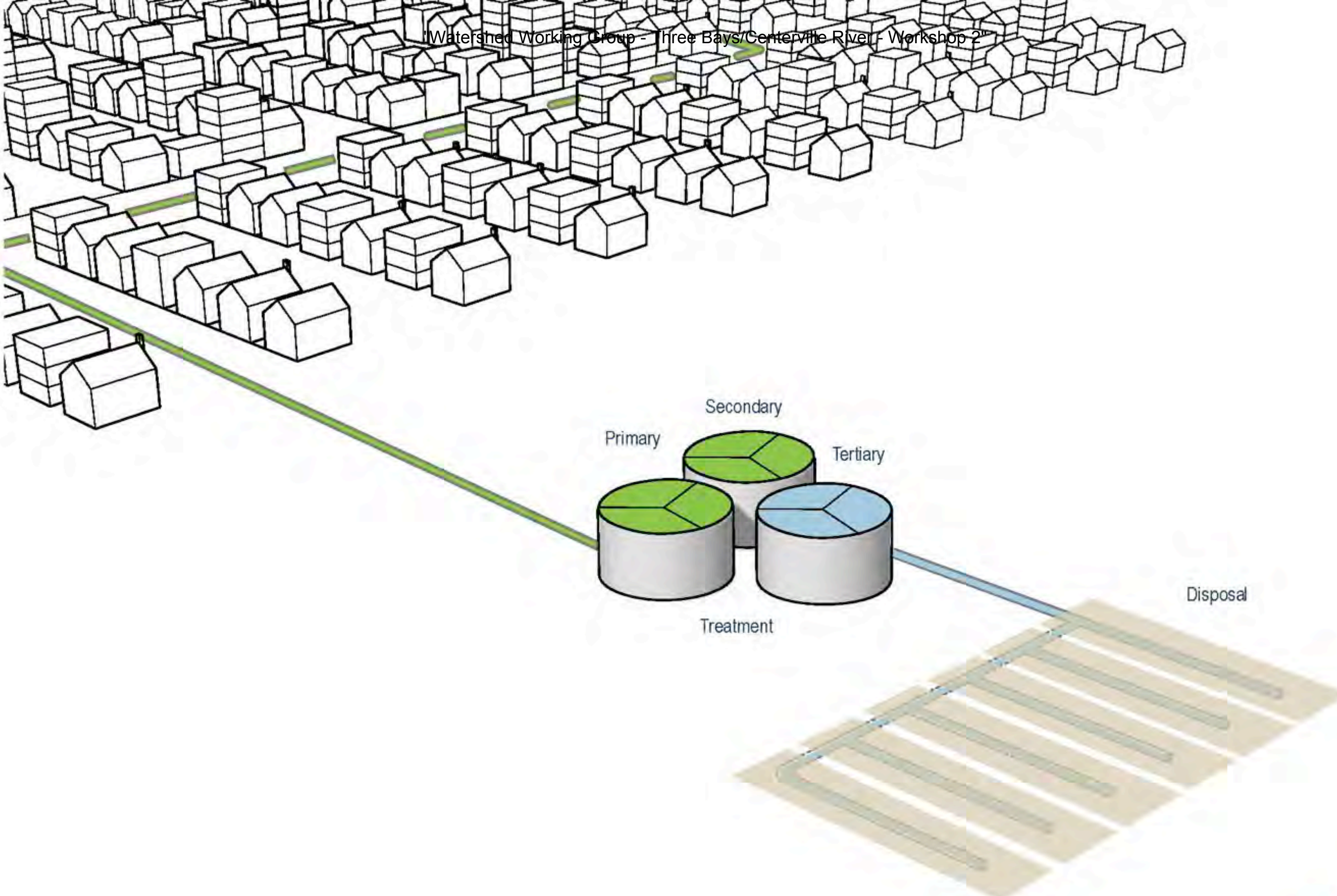
Shellfish and Salt Marsh Habitat Restoration

Aquaculture/Shellfish Farming

Inlet / Culvert Widening

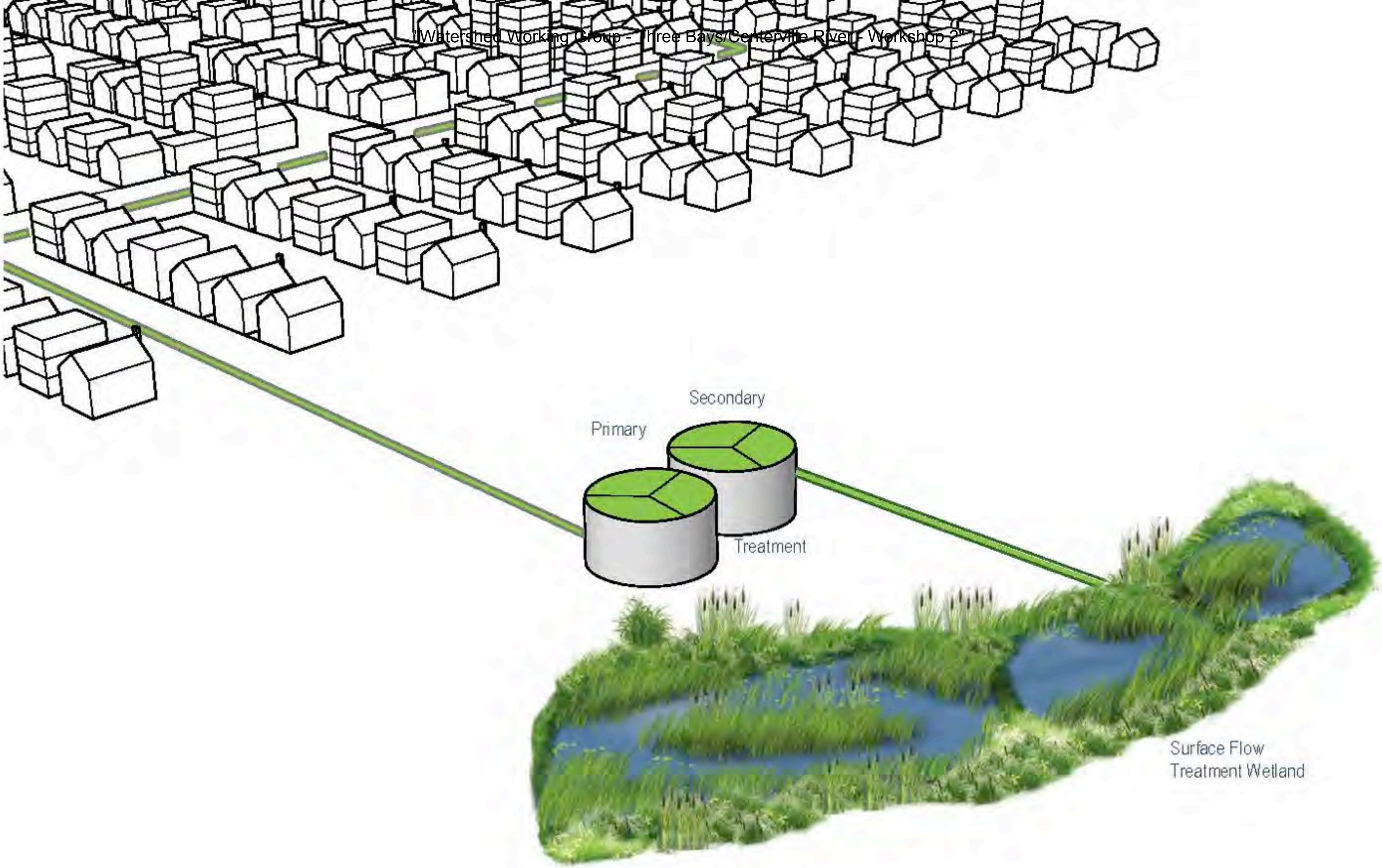
Pond and Estuary Dredging

Surface Water Remediation Wetlands



Scale: WATERSHED
Target: WASTEWATER

Conventional Treatment

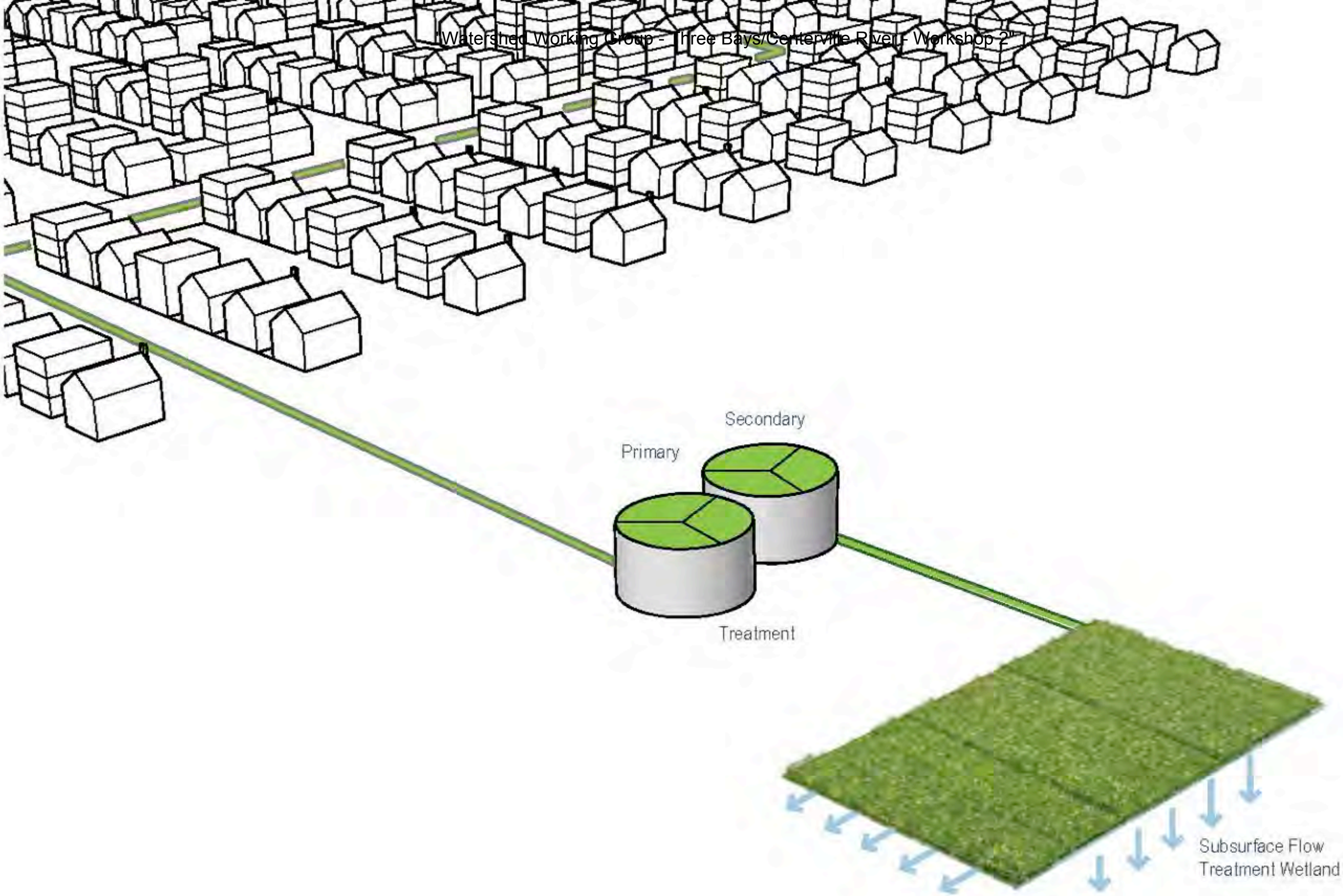


Scale: WATERSHED
Target: WASTEWATER

Constructed Wetlands:
Surface Flow

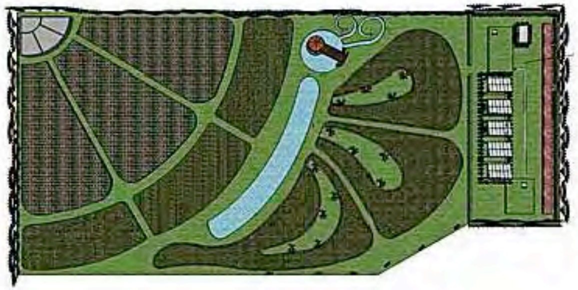
Precedent: Talking Waters Garden - Albany, OR
Source: Kate Kennen

Constructed Wetlands:
Surface Flow



Scale: WATERSHED
Target: WASTEWATER

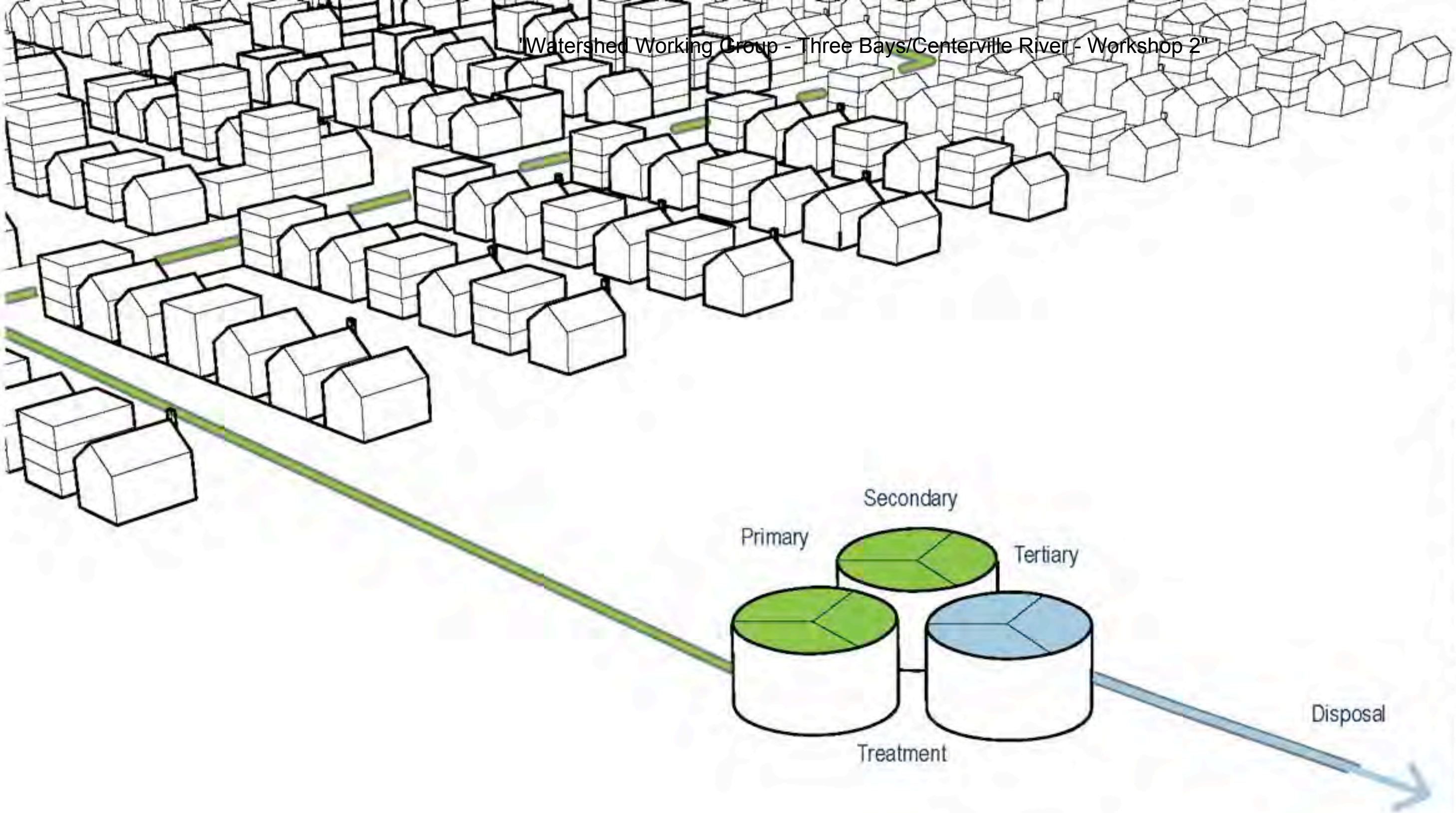
Constructed Wetlands: Subsurface Flow

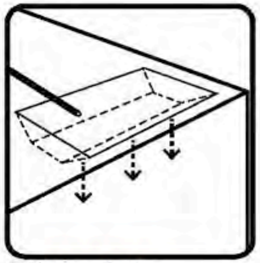


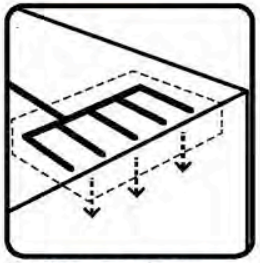
Precedent: Koh Phi Phi Treatment Wetland, Thailand
Source: Hans Brix

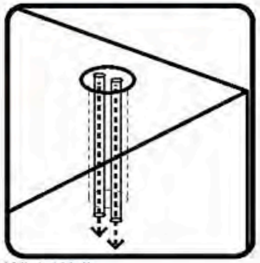
Constructed Wetlands: Subsurface Flow

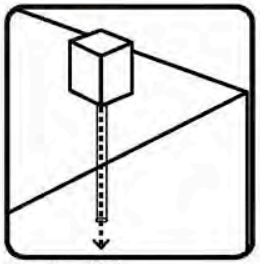
Effluent Disposal Systems




Infiltration Basins

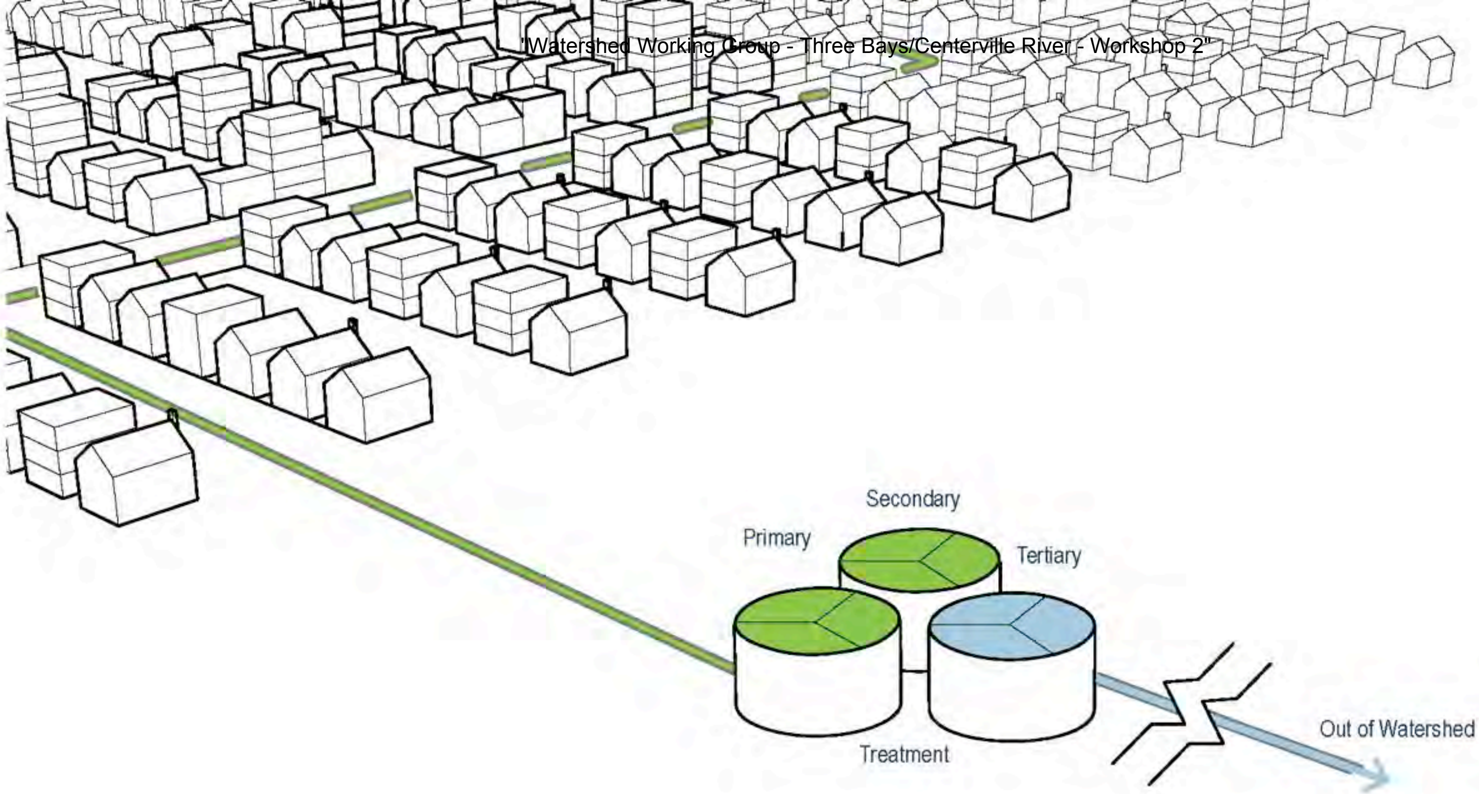

Soil Absorption System


Wick Well


Injection Well

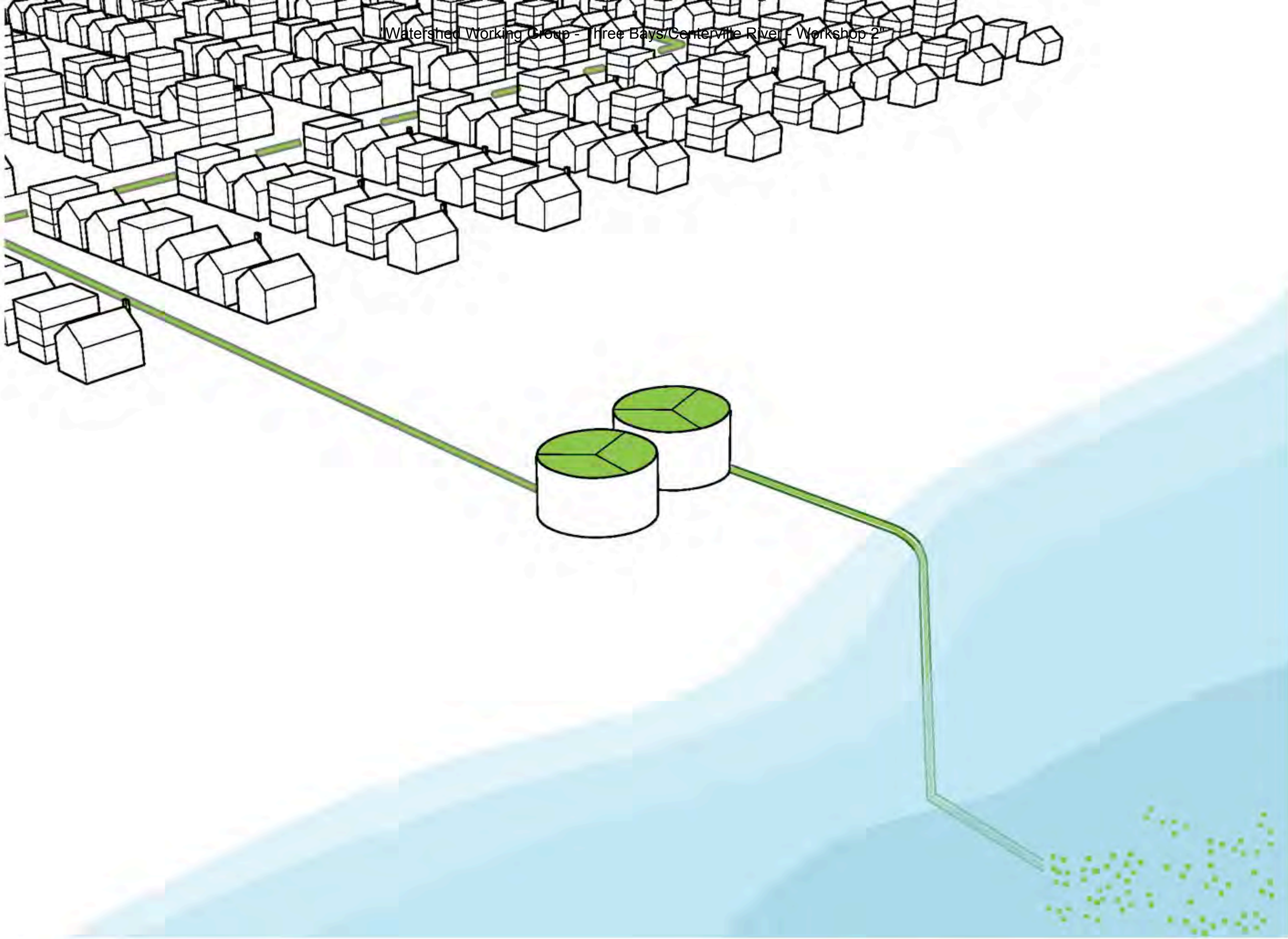
Scale: WATERSHED
Target: WASTEWATER

Disposal:



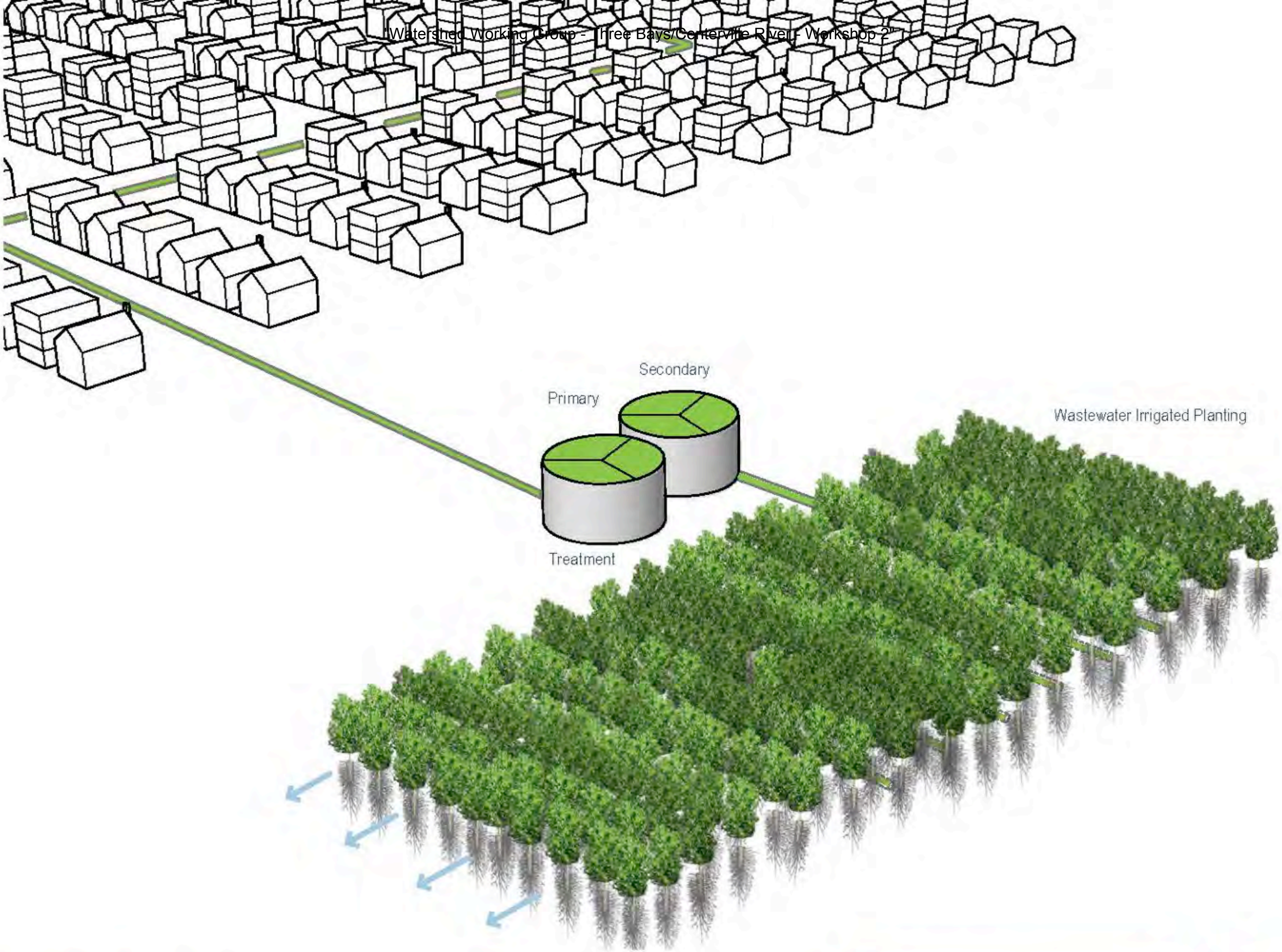
Scale: WATERSHED
Target: WASTEWATER

Effluent Disposal: Out of Watershed



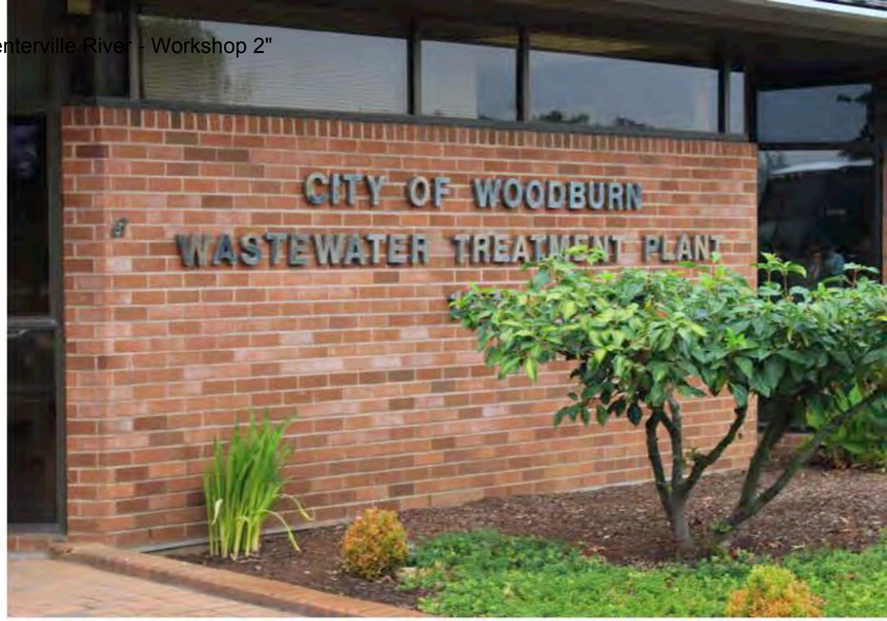
Scale: WATERSHED
Target: WASTEWATER

Effluent Disposal: Ocean Outfall



Scale: WATERSHED
Target: WASTEWATER

Phytoirrigation



Precedent: Woodburn OR, Wastewater Treatment Facility
Source: CH2MHill

Phytoirrigation

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Source: CH2MHill

Phytoirrigation

"Watershed Working Group - Three Bays/Centerville River - Workshop 2"

Solutions: Ex. Water

Site Scale | Neighborhood | Watershed | Cape-Wide

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

U — Toilets: Urine Diverting

Disposal — Effluent Disposal Systems

C — Toilets: Composting

Constructed Wetlands: Surface Flow

P — Toilets: Packaging

Constructed Wetlands: Subsurface Flow

Stormwater: Bioretention / Soil Media Filters

Effluent Disposal: Out of Watershed/Ocean Outfall

Stormwater: Wetlands

Phytoirrigation

EM — Eco-Machines & Living Machines

Phytobuffers

N+P — Fertigation Wells

PRB — Permeable Reactive Barrier

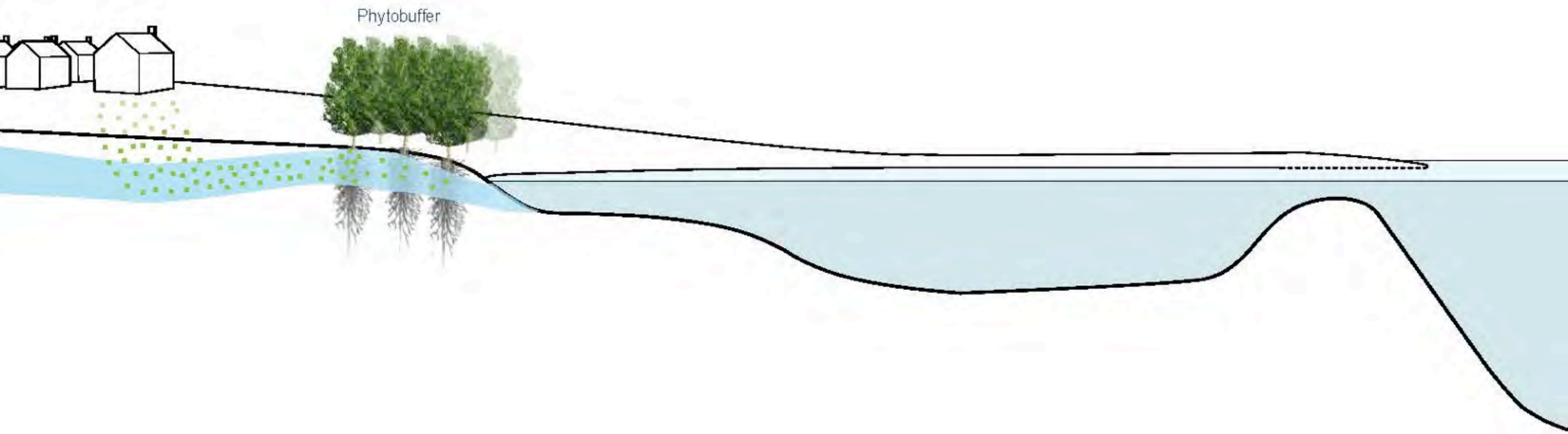
Shellfish and Salt Marsh Habitat Restoration

Aquaculture/Shellfish Farming

Inlet / Culvert Widening

Pond and Estuary Dredging

R — Surface Water Remediation Wetlands

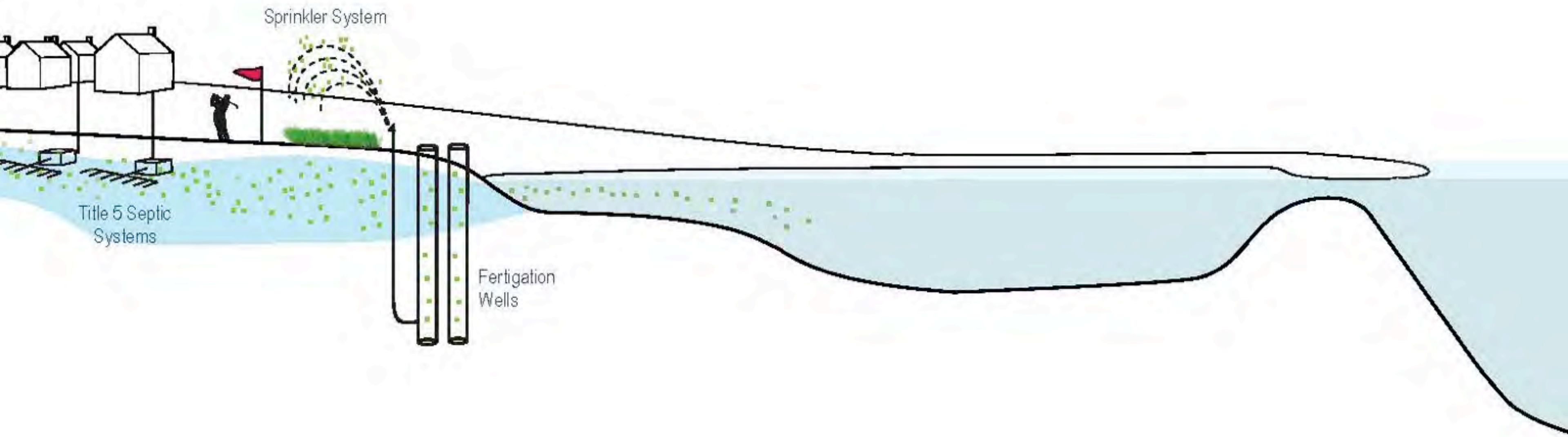


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Phytobuffers

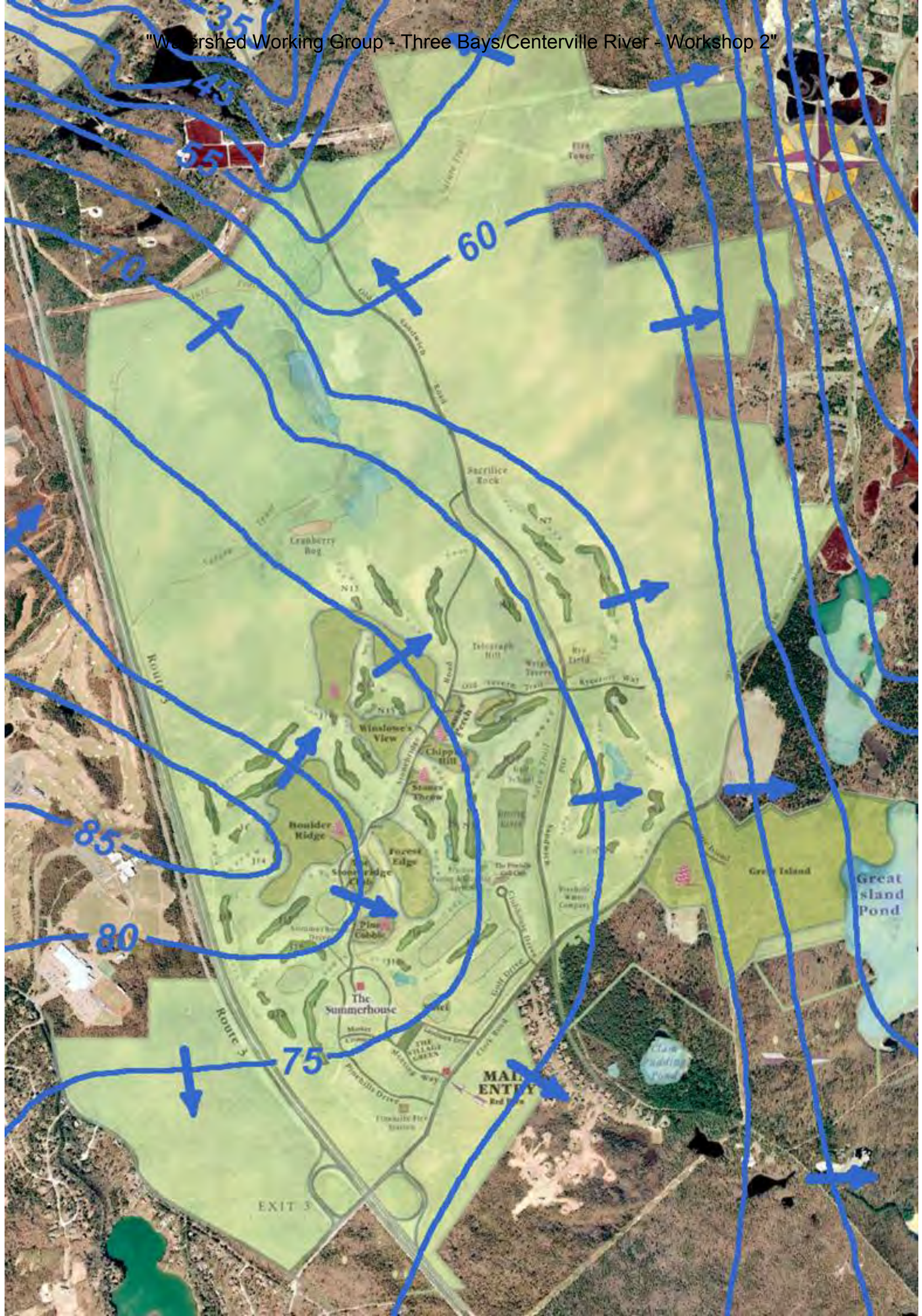
Precedent: Phytobuffer - Kavcee, WY
Source: Sand Creek Consultants

Phytobuffers

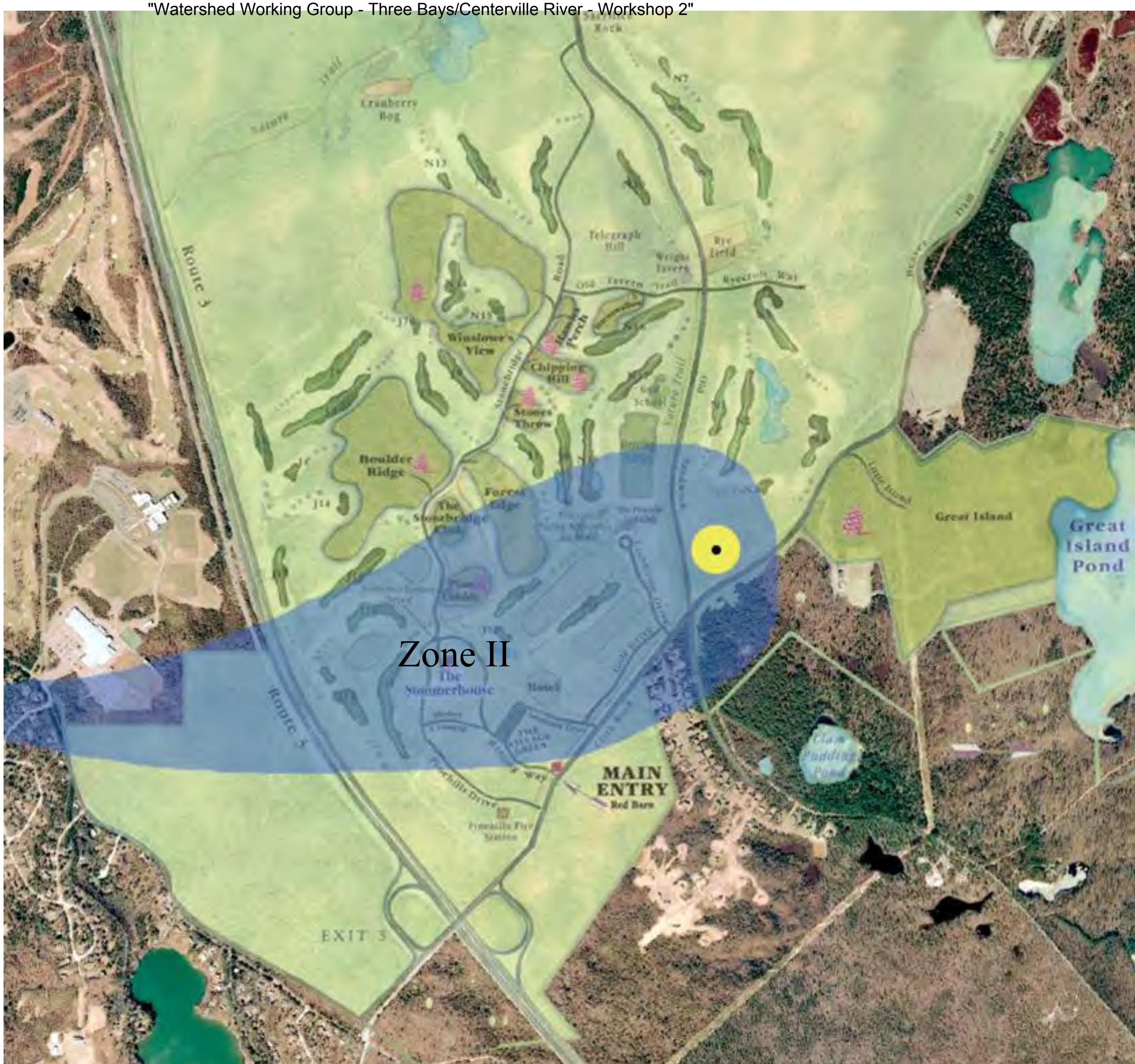


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Fertigation Wells



Precedent:
Pine Hills
Plymouth, MA



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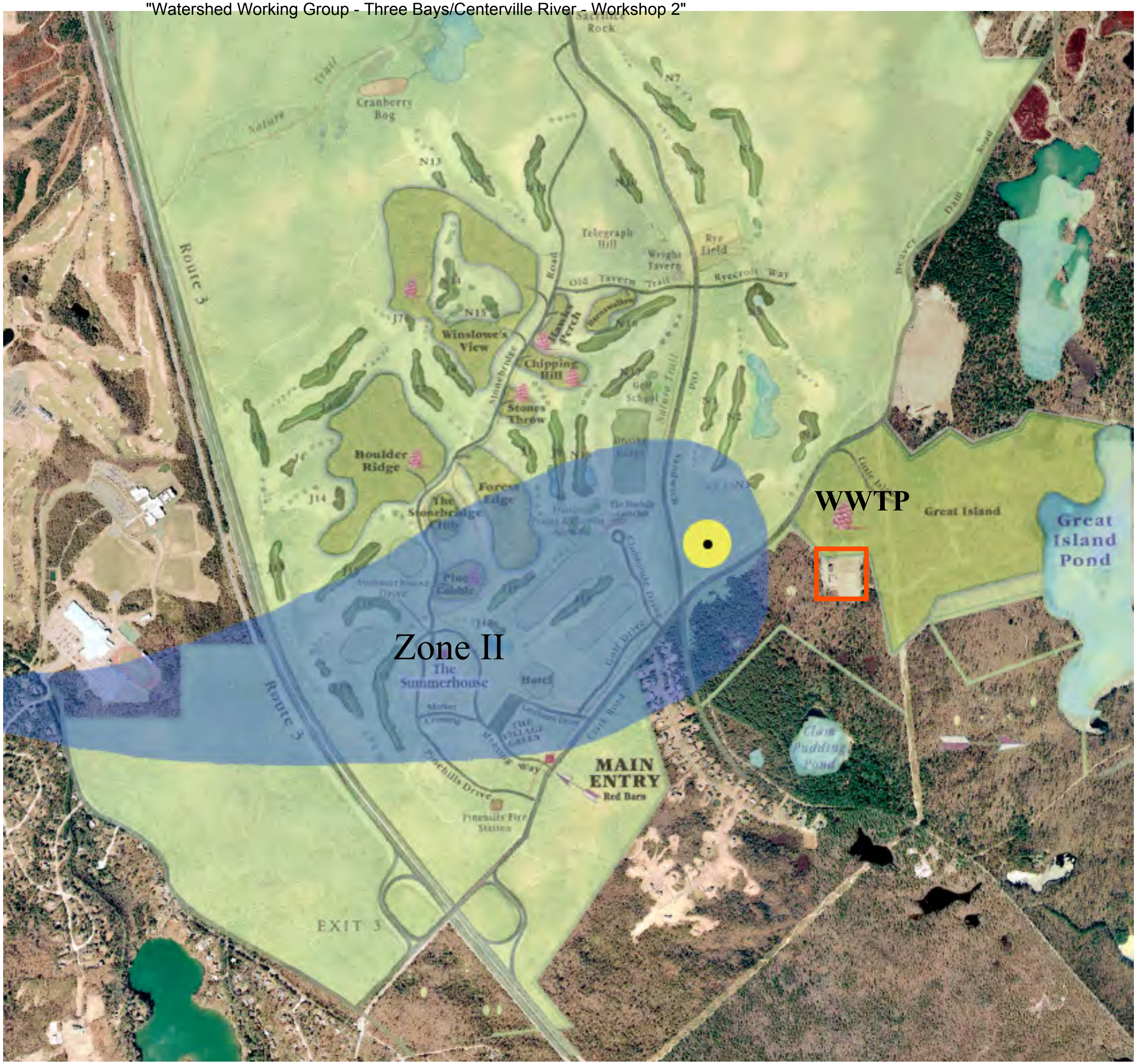

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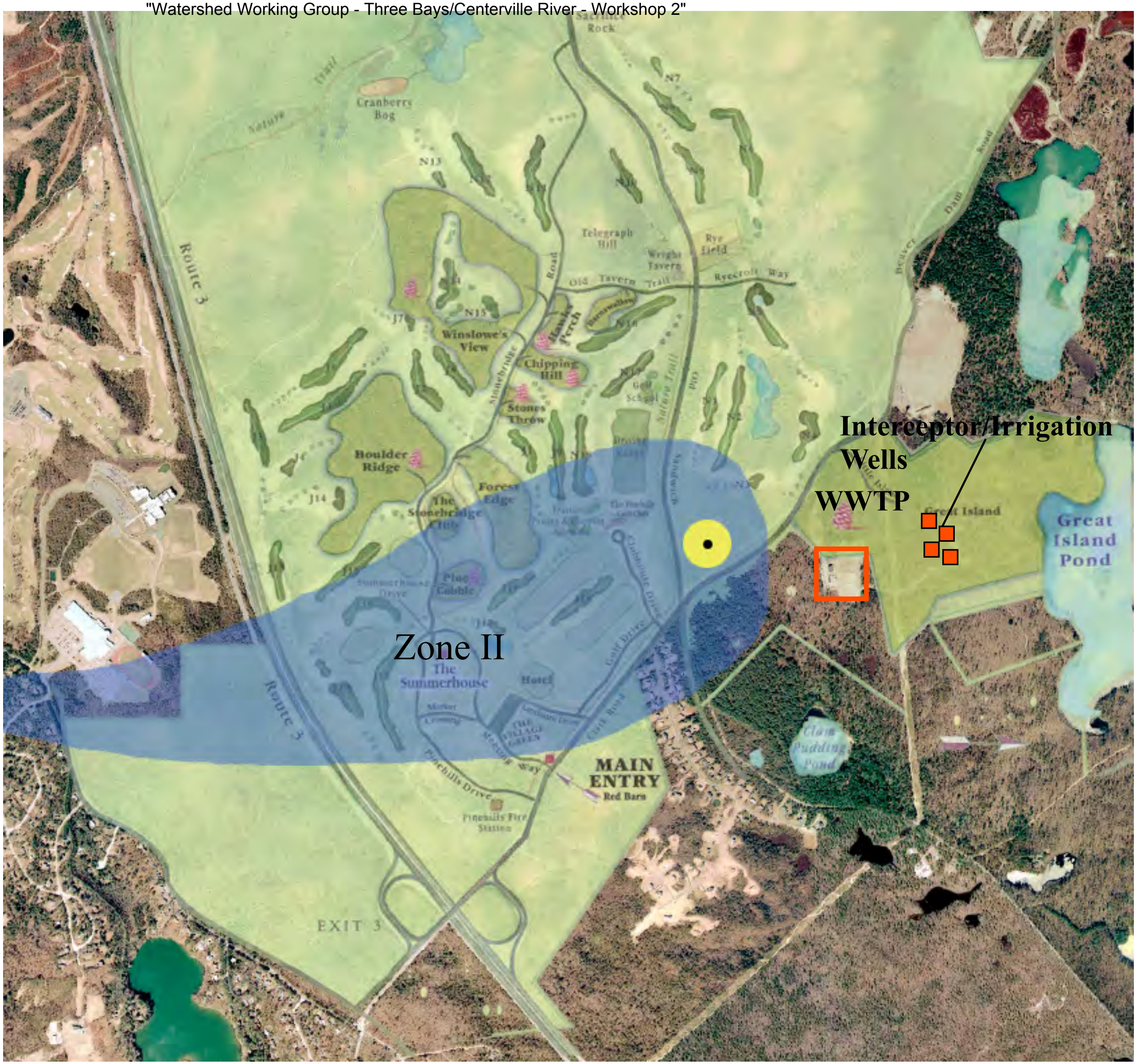
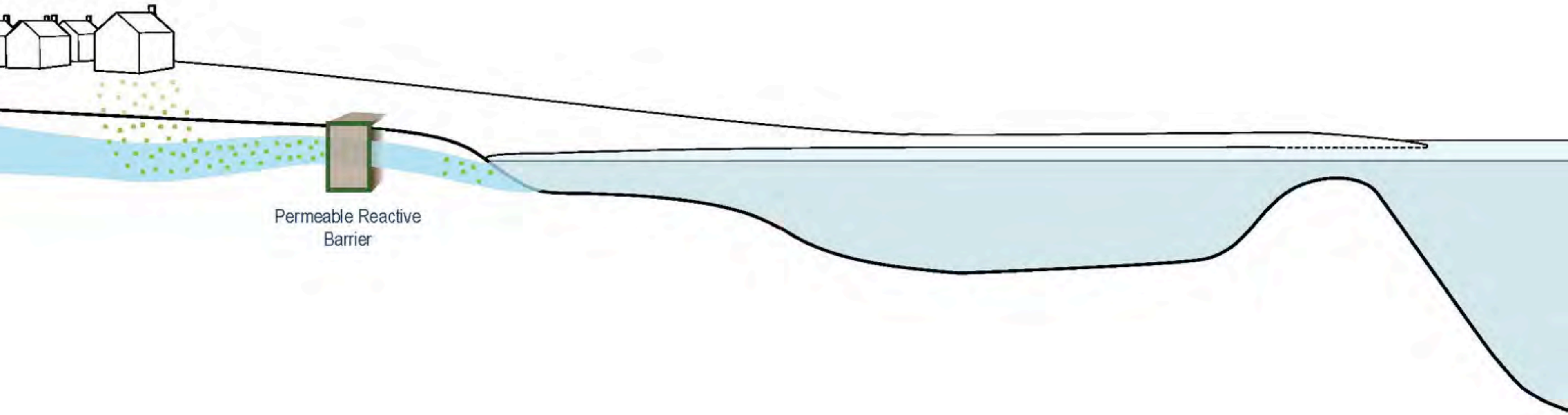


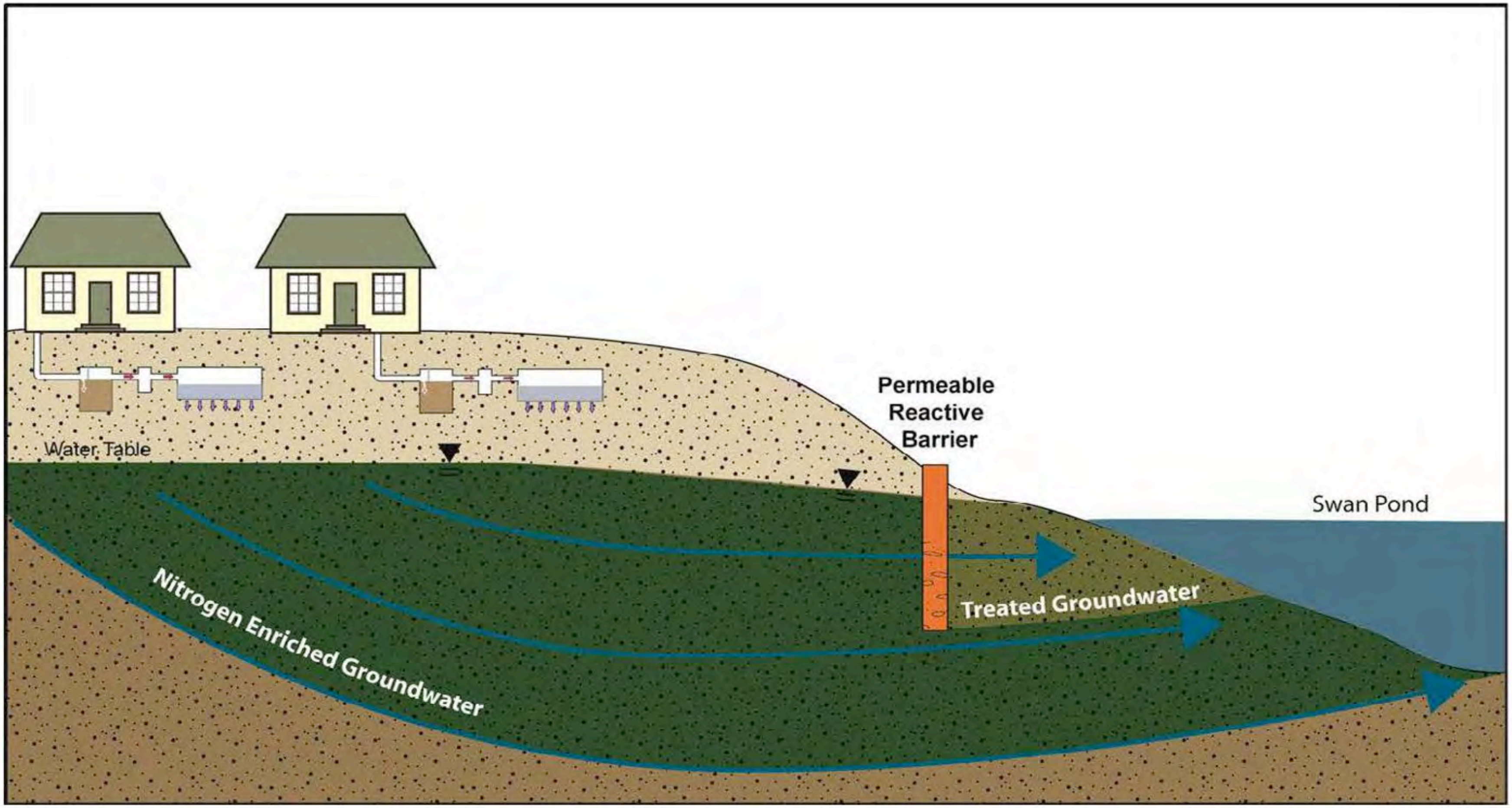
Precedent:
Pine Hills
Plymouth, MA



Scale: SITE / NEIGHBORHOOD / WATERSHED
Target: EXISTING WATER BODIES

Permeable Reactive Barrier

PRB



Precedent: PRB

Source: Horsley Witten Group Inc.

Permeable Reactive Barrier

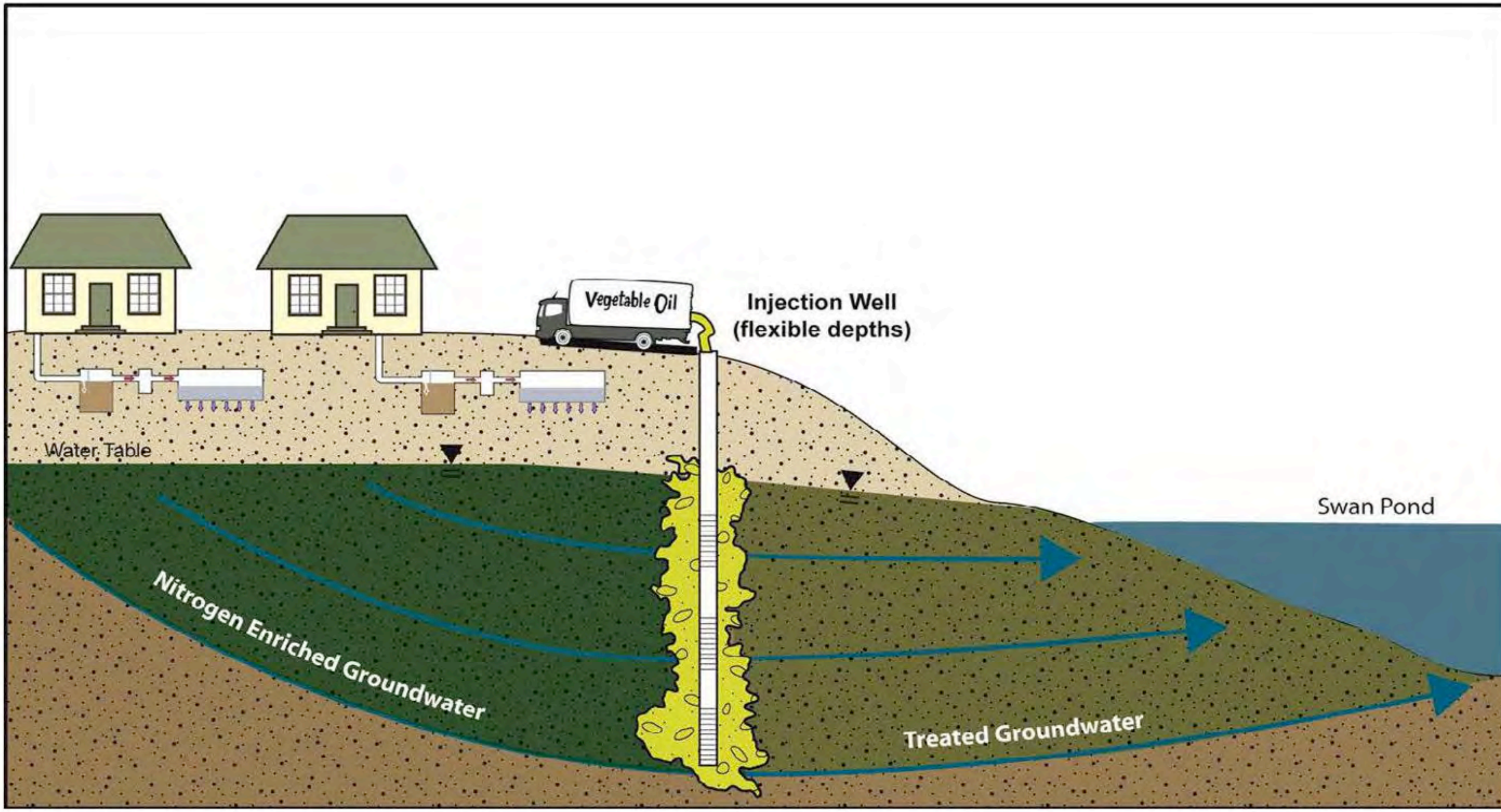
PRB

Precedent: Falmouth PRB

Source: Mike Domenica

Permeable Reactive Barrier

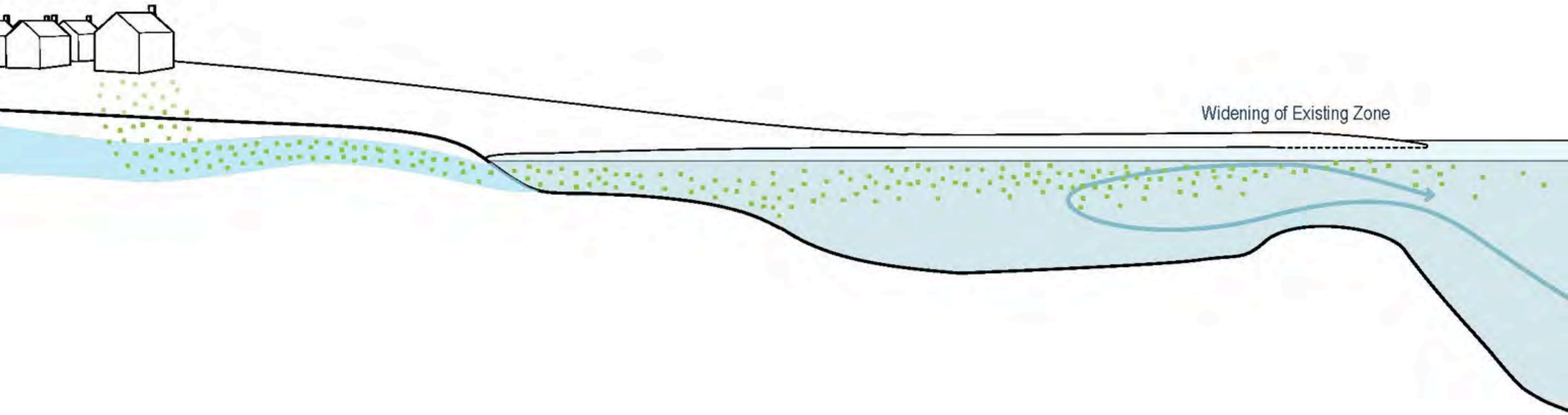
PRB



Precedent: PRB
Source: Horsley Witten Group Inc.

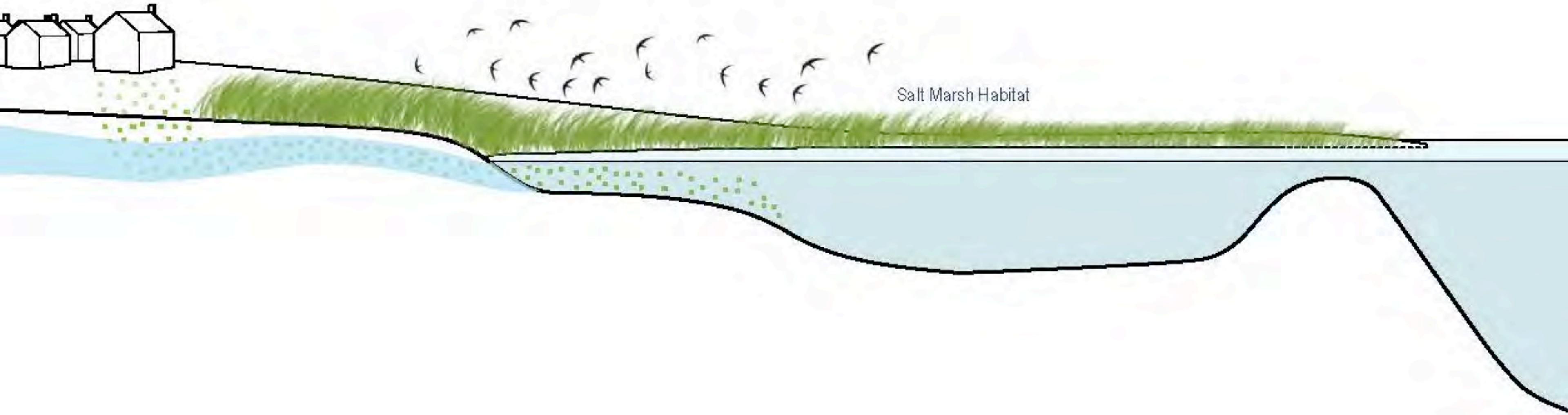
Permeable Reactive Barrier

PRB



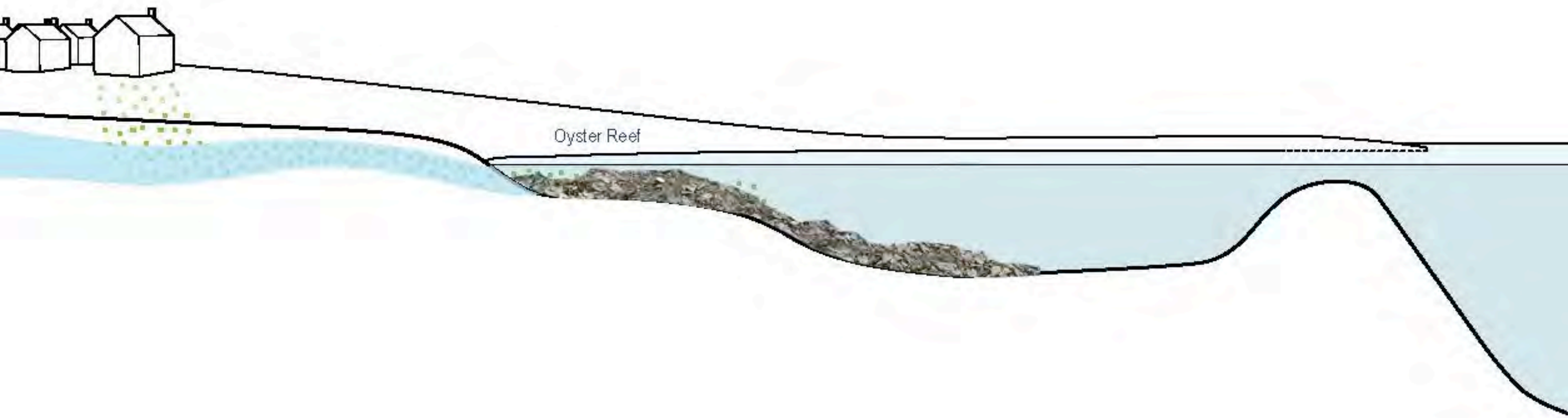
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Inlet and Culvert Widening



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Salt Marsh Habitat Restoration



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Shellfish Habitat Restoration

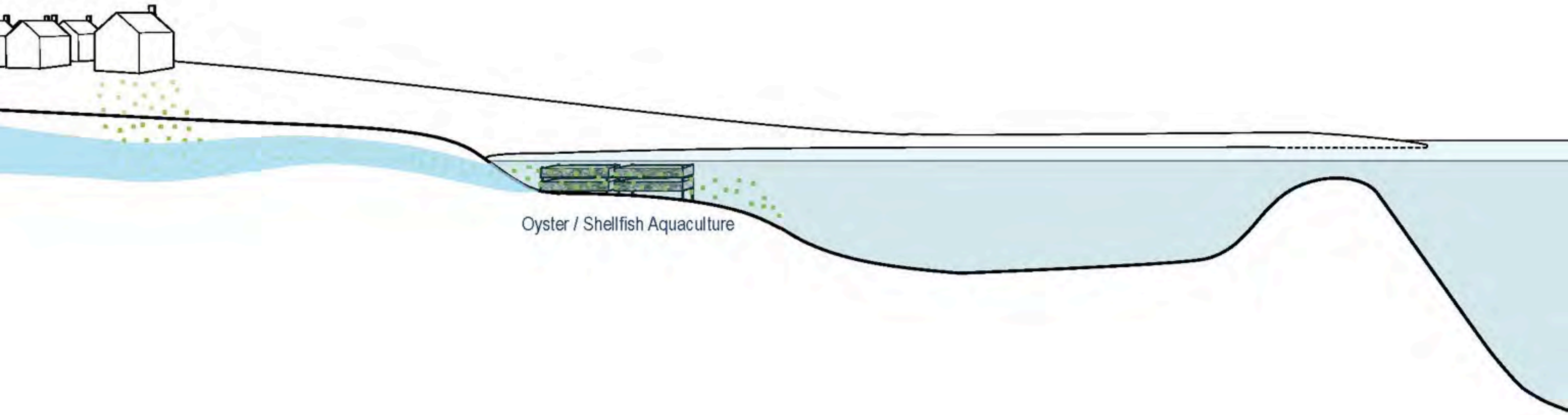
Precedent: Wellfleet Oyster Restoration Project

Source: Anamarija Francik

Shellfish Habitat Restoration

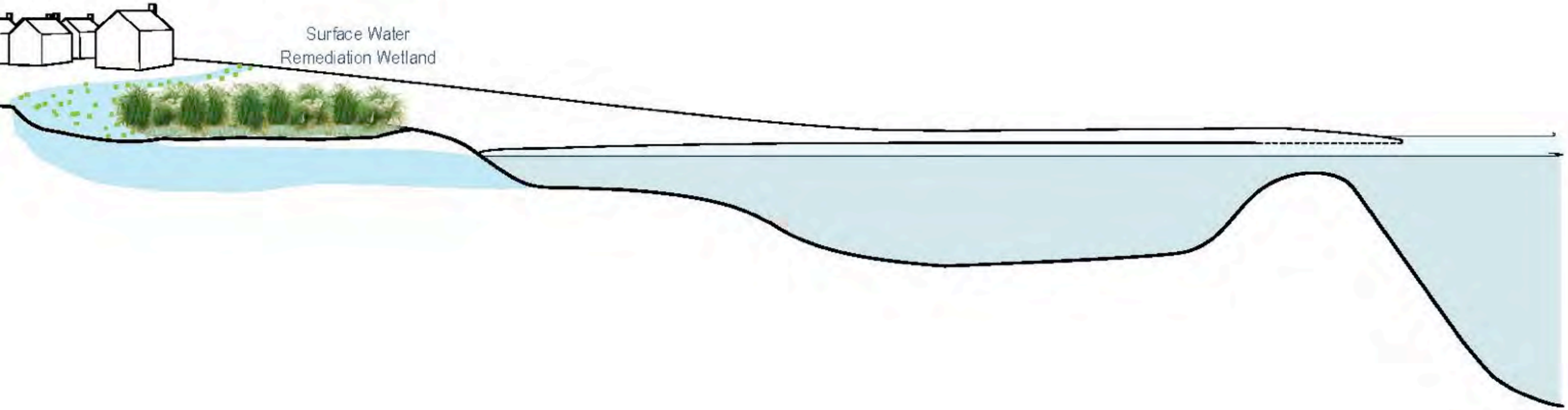
Precedent: Wellfleet Oyster Restoration Project
Source: Anamarija Francik

Shellfish Habitat Restoration



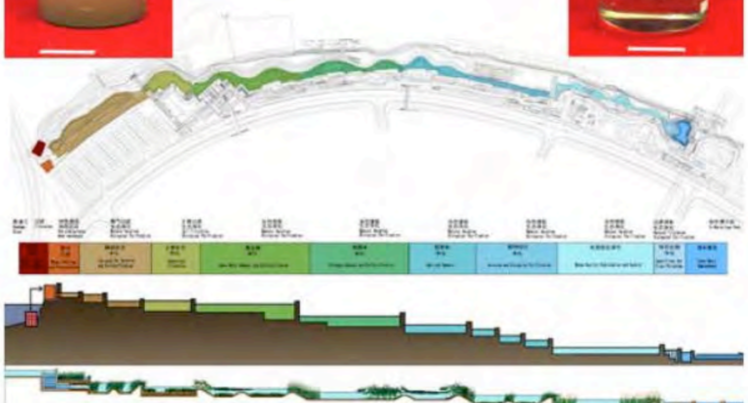
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Aquaculture / Shellfish Farming



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

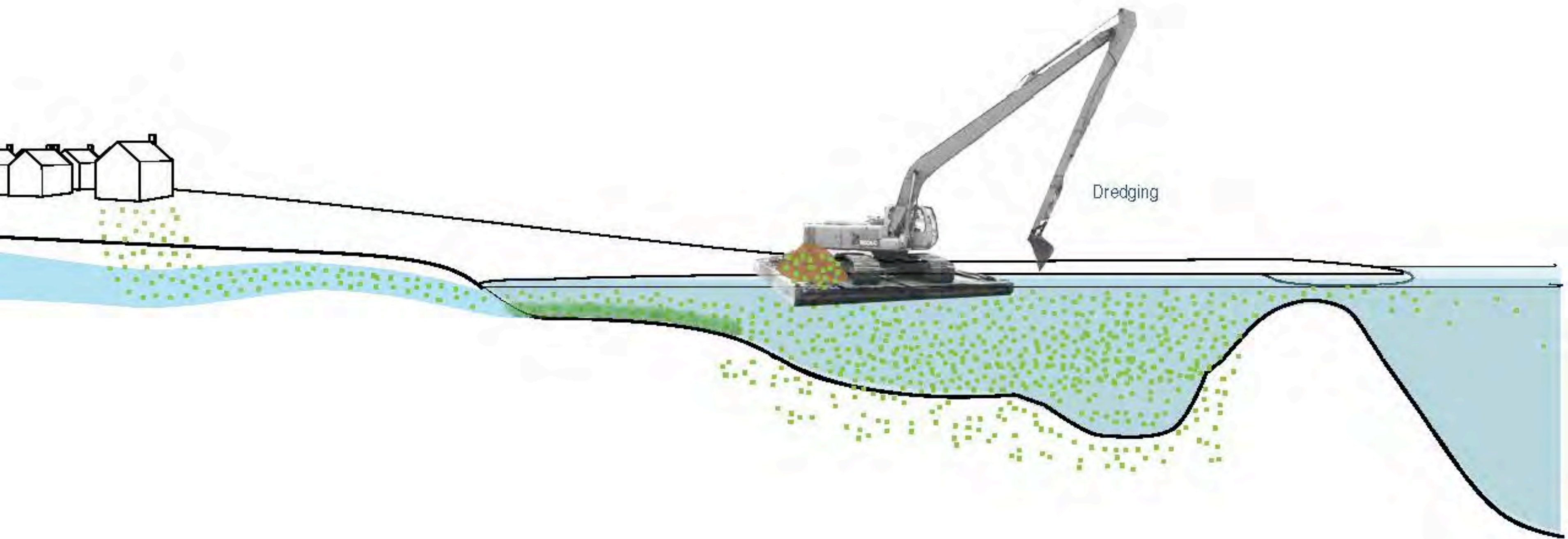
Surface Water
Remediation Wetlands



Precedent: Shanghai Houton Park

Source: Turenscape

Surface Water Remediation Wetlands



Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Pond and Estuary Dredging

Precedent: Pond and Estuary Dredging - Dennis, MA
Source: Cape Cod Times

Solutions: Cape-Wide

Site Scale | Neighborhood | Watershed | Cape-Wide

- Compact Development
- Remediation of Existing Development
- Fertilizer Management
- Transfer of Development Rights
- Stormwater BMPs
- Standard Title 5 Systems
- Cluster & Satellite Treatment Systems
- Conventional Treatment
- I/A Title 5 Systems
- STEP/STEG Collection
- Advanced Treatment
- I/A Enhanced Systems
- Wastewater Collection Systems
- Toilets: Urine Diverting
- Effluent Disposal Systems
- Toilets: Composting
- Constructed Wetlands: Surface Flow
- Toilets: Packaging
- Constructed Wetlands: Subsurface Flow
- Stormwater: Bioretention / Soil Media Filters
- Effluent Disposal: Out of Watershed/Ocean Outfall
- Stormwater: Wetlands
- Phytoirrigation
- Eco-Machines & Living Machines
- Phytobuffers
- Fertigation Wells
- Permeable Reactive Barrier
- Shellfish and Salt Marsh Habitat Restoration
- Aquaculture/Shellfish Farming
- Inlet / Culvert Widening
- Pond and Estuary Dredging
- Surface Water Remediation Wetlands

Scale: CAPE-WIDE
Target: REGULATORY

Compact Development

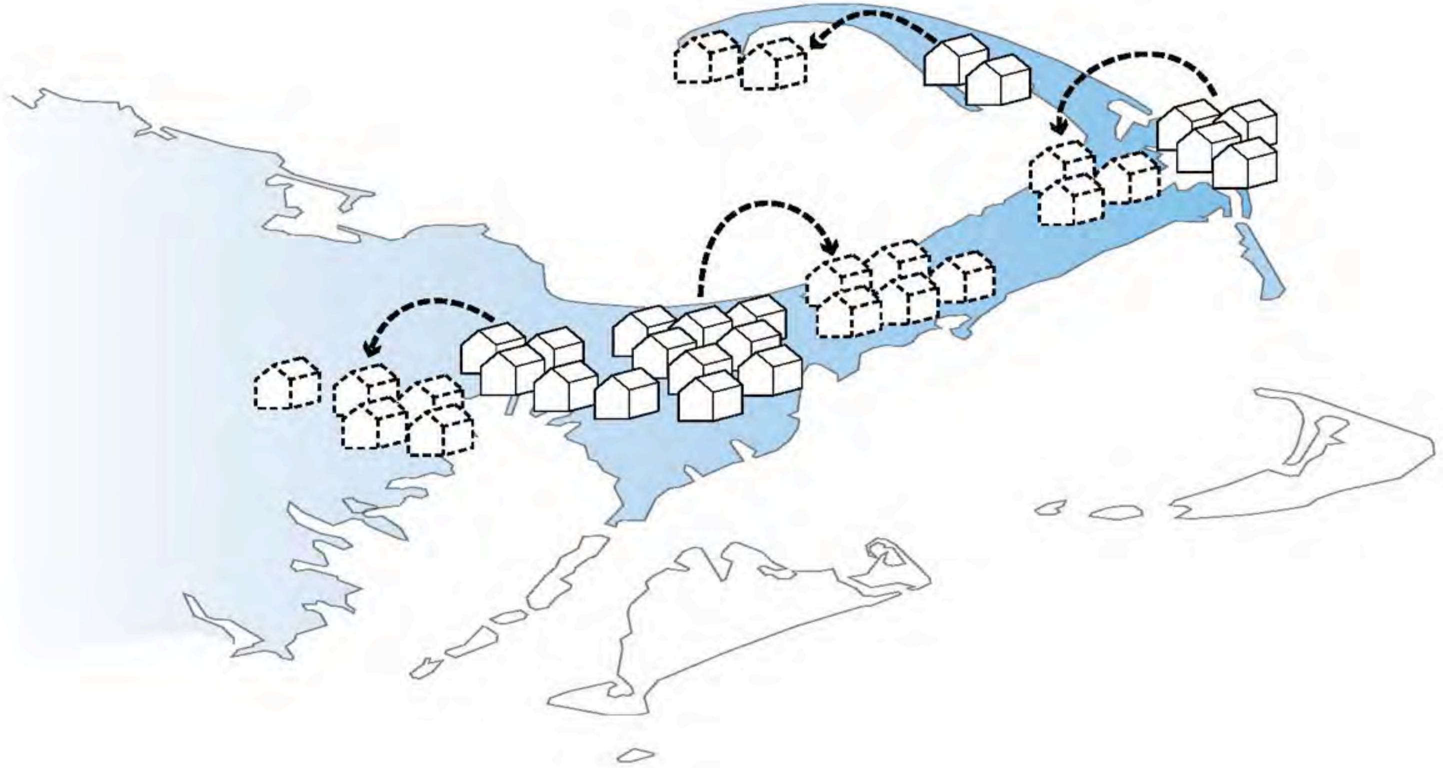
Scale: CAPE-WIDE
Target: REGULATORY

Fertilizer Management

N+P+K MGMT

Scale: CAPE-WIDE
Target: REGULATORY

Remediation of Existing Development



Scale: CAPE-WIDE
Target: REGULATORY

Transfer of Development Rights

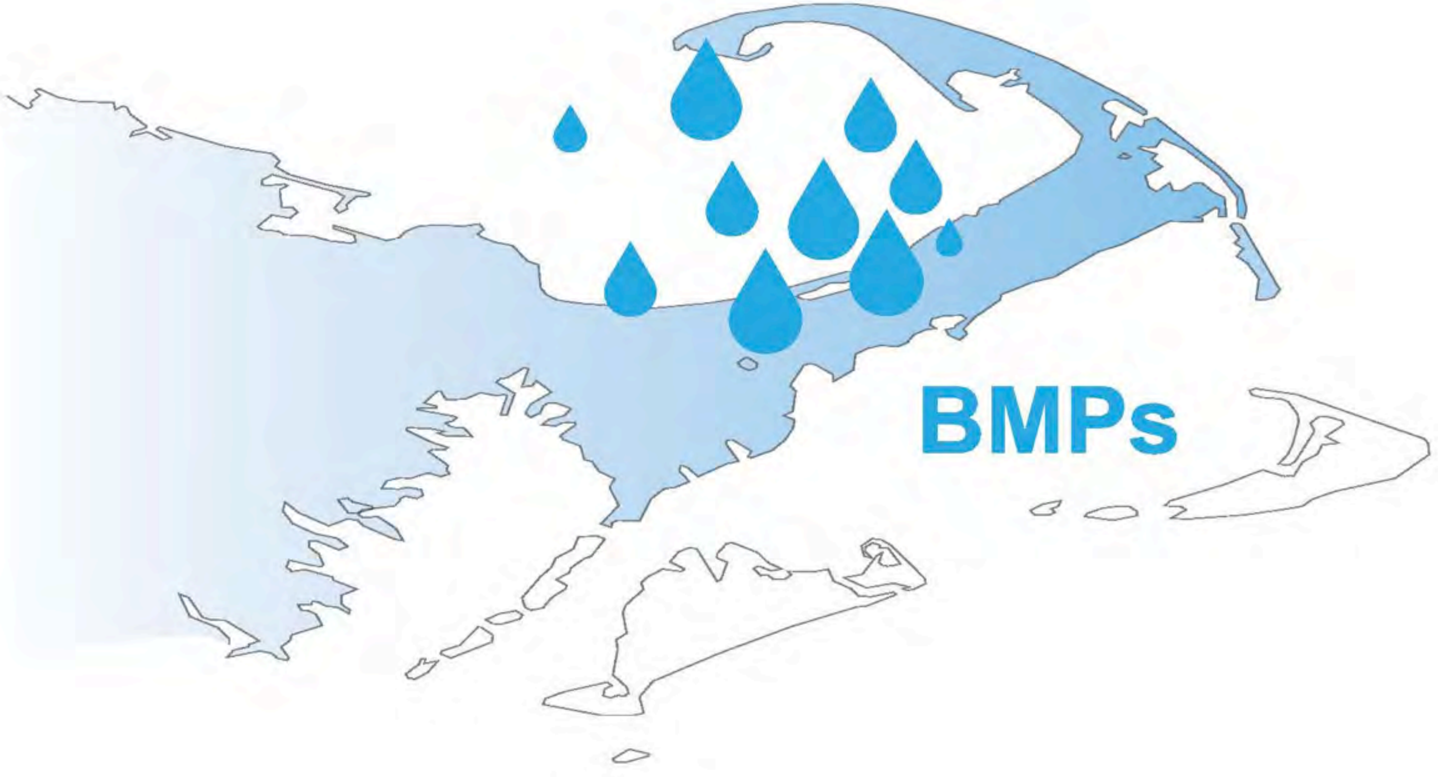
TDR

Transfer of Developments Rights
The Concept

Owner of "sending" parcel sells development rights in exchange for permanent conservation easement.

Owner of "receiving" parcel buys development rights to build at densities higher than allowed under base zoning.

Source: Massachusetts Smart Growth Toolkit



Scale: CAPE-WIDE
Target: REGULATORY

Stormwater BMPs

BMPs

Town Consideration of Alternative Technologies & Approaches

Wellfleet-	*Coastal habitat restoration & aquaculture*
Mashpee-	*Aquaculture & Expanding Existing Systems*
Brewster-	*PRB & Bioswales*
Orleans-	*Fertilizer Control By-Law*
Harwich &- Chatham	*Muddy Creek & Cold Brook Natural Attenuation*
Falmouth-	*Aquaculture* *Inlet Widening* *Eco-Toilet Demonstration Project* *PRBs* *Stormwater Management (Little Pond Watershed)* *Fertilizer Control By-Law* *Subsurface Nitrogen Removal Septic Systems*

"Watershed Working Group - Three Bays/Centerville River - Workshop 2"

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

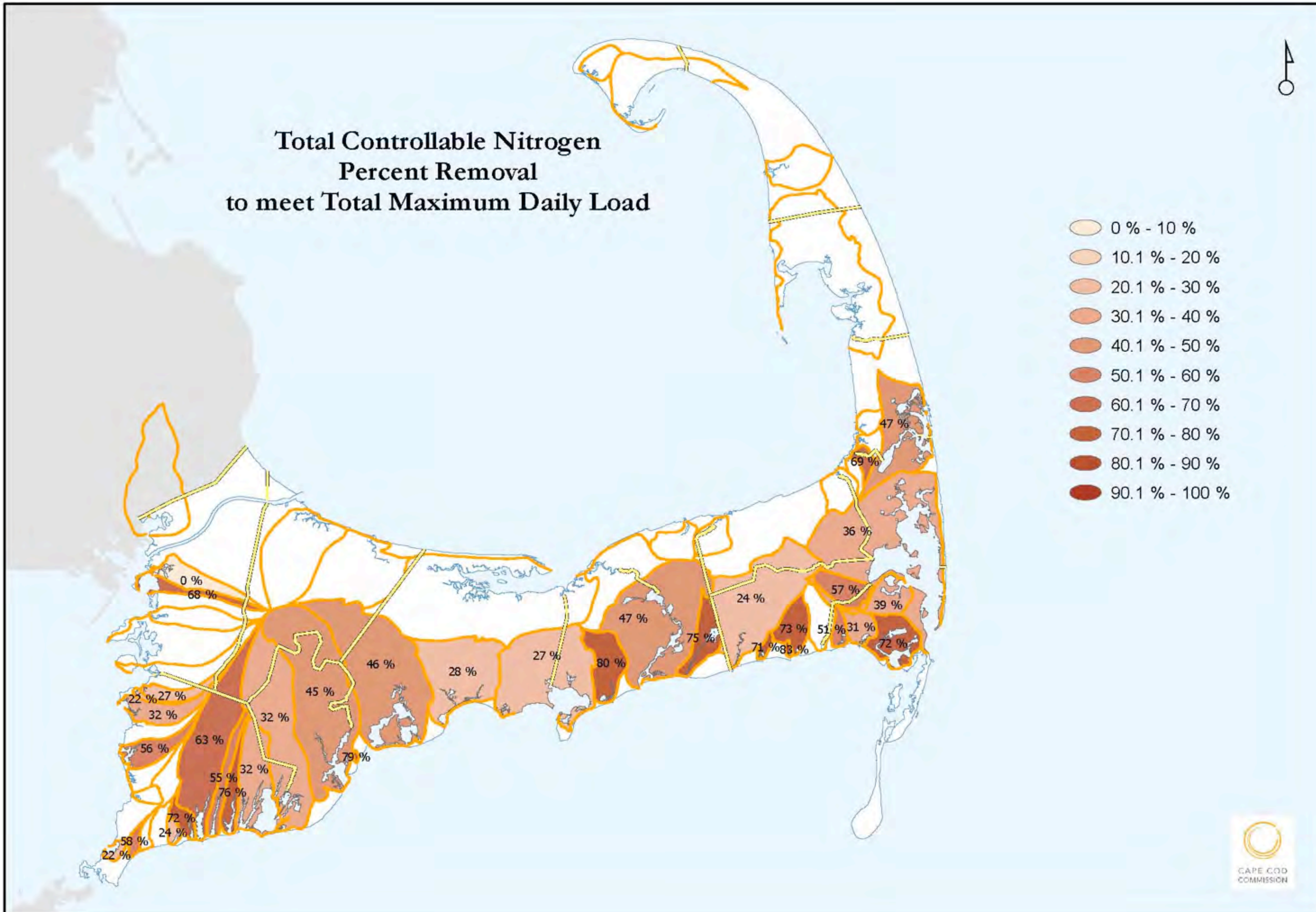
5 Alternative On-Site Options

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

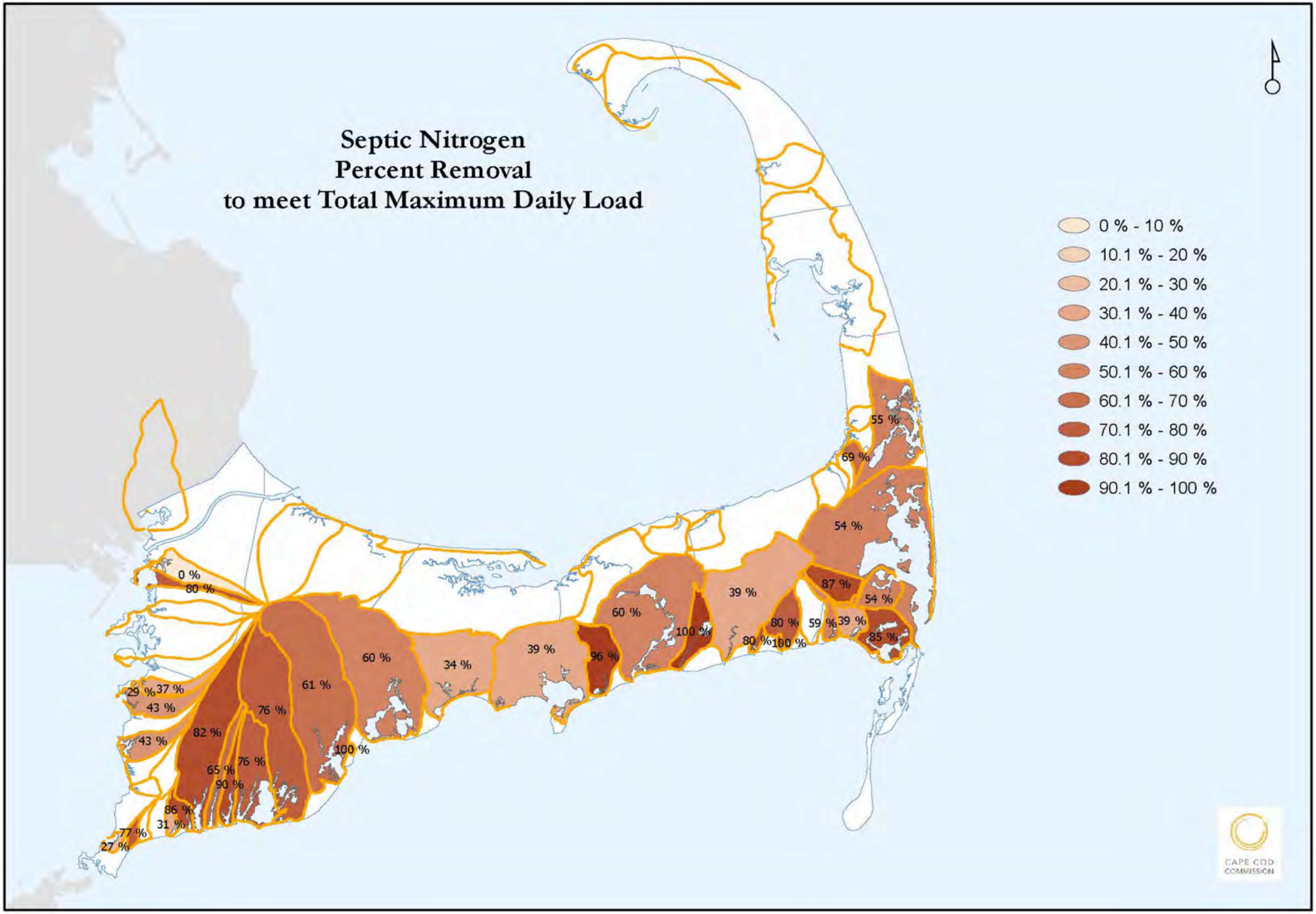
6 Priority Collection/High-Density Areas

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

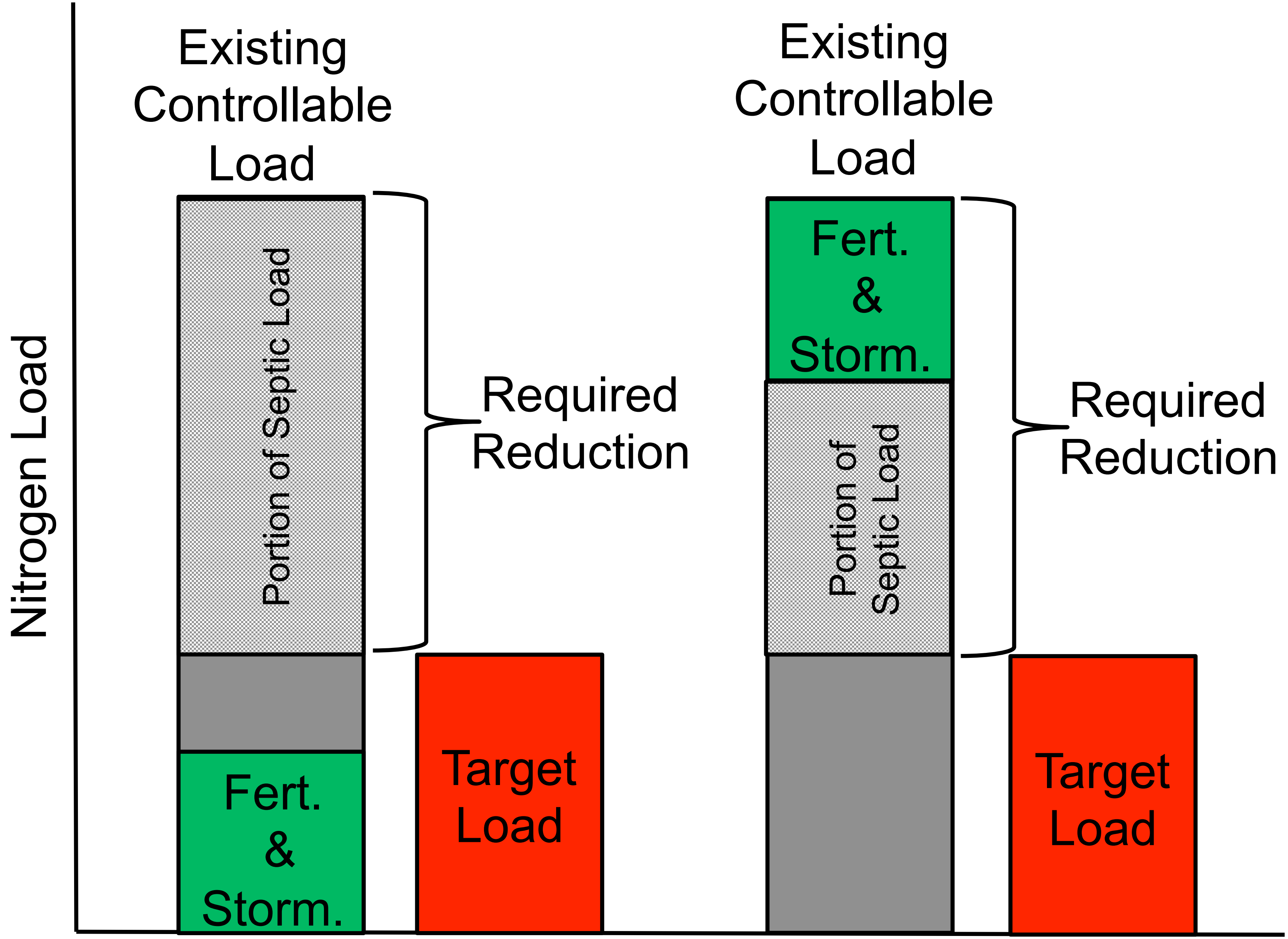
7 Supplemental Sewering



Total Controllable Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %
0 %
68 %
22 %
27 %
32 %
56 %
63 %
32 %
45 %
46 %
55 %
32 %
76 %
79 %
72 %
24 %
58 %
22 %
28 %
27 %
80 %
47 %
75 %
24 %
71 %
73 %
83 %
51 %
57 %
39 %
31 %
72 %
36 %
69 %
47 %
CAPE COD COMMISSION



Septic Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %
55 %
69 %
54 %
87 %
54 %
39 %
59 %
39 %
85 %
80 %
100 %
80 %
100 %
60 %
96 %
39 %
34 %
60 %
61 %
100 %
76 %
82 %
76 %
65 %
90 %
86 %
31 %
77 %
27 %
43 %
29 %
37 %
43 %
0 %
80 %
CAPE COD
COMMISSION


Nitrogen Load
Existing Controllable Load
Portion of Septic Load
Fert. & Storm.
Required Reduction
Target Load
Existing Controllable Load
Fert. & Storm.
Portion of Septic Load
Required Reduction
Target Load

Wastewater | Existing Water Bodies | Regulatory

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D. Growth Incentive Zones

7 Supplemental Sewering

Triple Bottom Line

Impacts of Technologies and Approaches

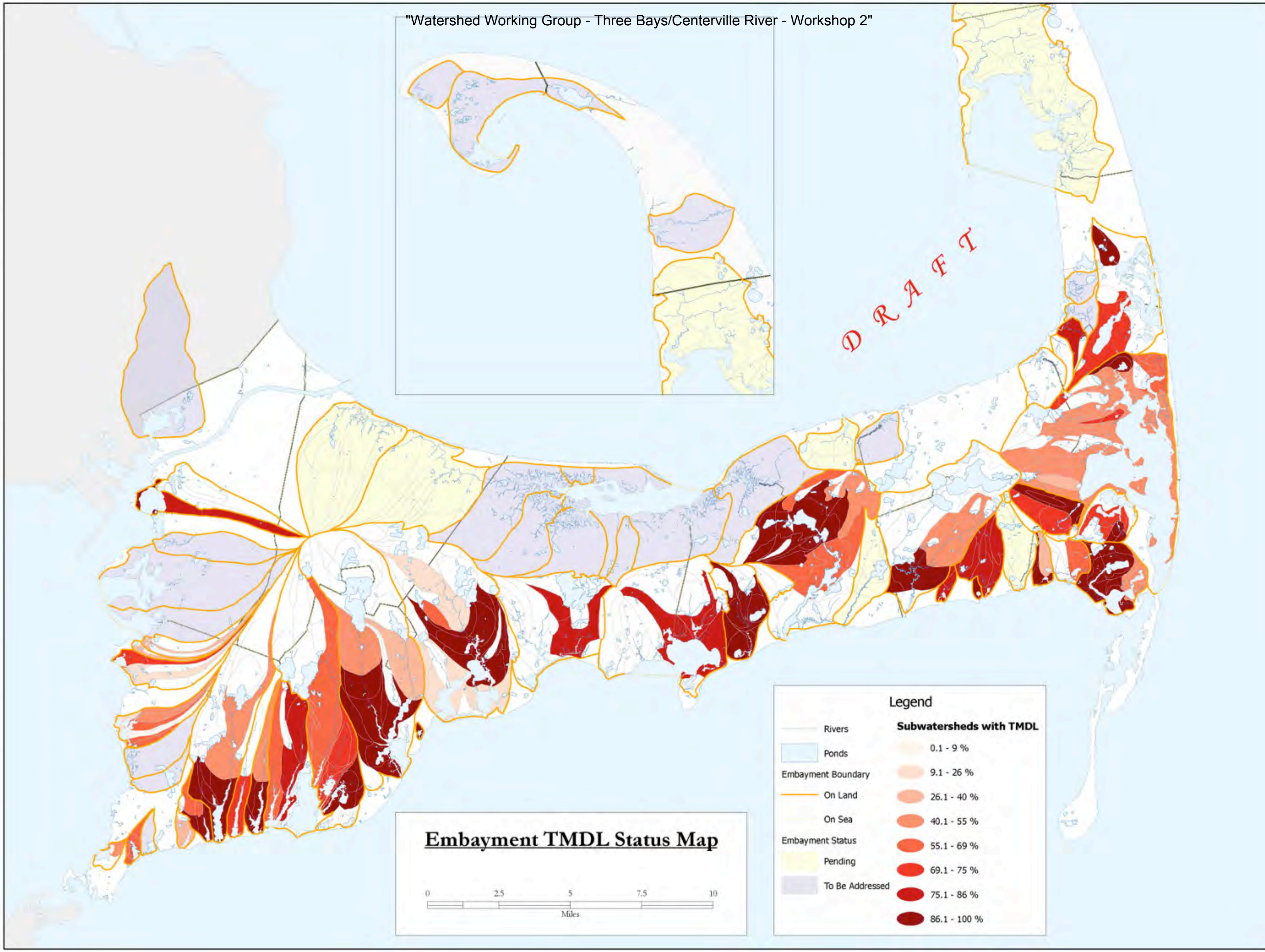
Environmental

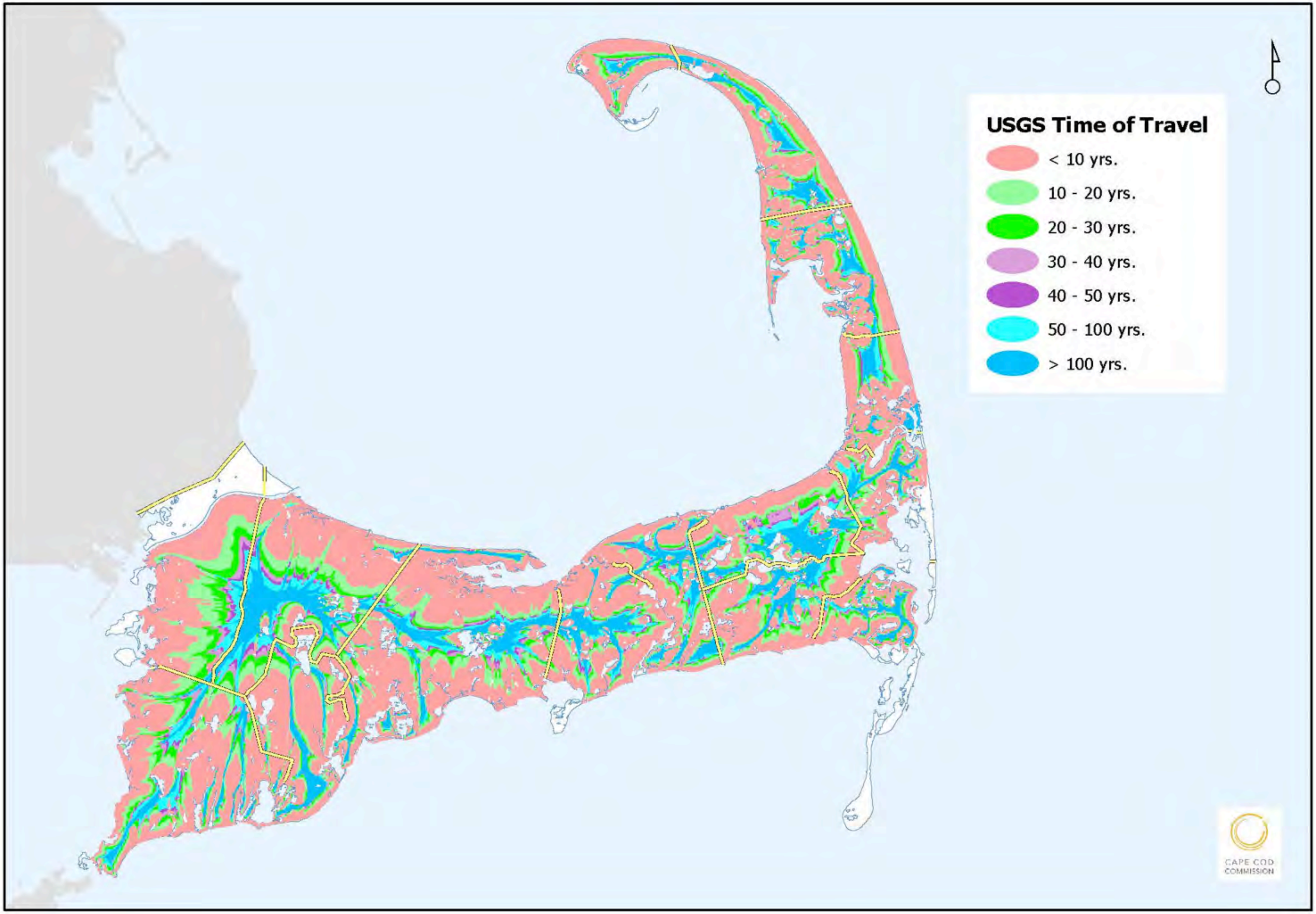
Economic

Social

Technology Selection: Process and Principles

- 100% septic removal subwatershed
- Scale: On-Site vs. Collection System vs. Natural System
- Nutrient intervention and time of travel
- Permitting Status
- Land use and Impacts of Growth


"Watershed Working Group - Three Bays/Centerville River - Workshop 2"
DRAFT
Embayment TMDL Status Map
0
2.5
5
7.5
10
Miles
Legend
Rivers
Ponds
Embayment Boundary
On Land
On Sea
Embayment Status
Pending
To Be Addressed
Subwatersheds with TMDL
0.1 - 9 %
9.1 - 26 %
26.1 - 40 %
40.1 - 55 %
55.1 - 69 %
69.1 - 75 %
75.1 - 86 %
86.1 - 100 %


USGS Time of Travel
< 10 yrs.
10 - 20 yrs.
20 - 30 yrs.
30 - 40 yrs.
40 - 50 yrs.
50 - 100 yrs.
> 100 yrs.
CAPE COD COMMISSION

Preparing for Meeting 3 and Beyond

- ❑ Review tools and alternatives analysis approach
- ❑ Evaluating scenarios for meeting water quality goals
- ❑ Attend the November 13th meeting:

6:00
Cape Cod Museum of Art
Dennis, MA

Cape Cod 208 Area Water Quality Planning
Three Bays & Centerville River Watershed Working Group

Meeting Two
Tuesday, October 29, 2013
8:30 am- 12:30 pm
COMM Fire Station, Centerville, MA

Meeting Summary Prepared by the Consensus Building Institute

I. ACTION ITEMS

Working Group

- Next meeting: Meeting Three
  Wednesday, December 4, 2013
  8:30AM -12:30PM
  COMM Fire Station, 1875 Falmouth Road, Centerville, MA 02632
- Send Ms. Carri Hulet any additional comments on Meeting One summary (by Oct 31)
- Continue to prepare thoughts about which technologies/approaches you would like to learn more about for application in the Three Bays Watershed. Different scenarios and options will be discussed during Meeting Three.

Consensus Building Institute

- Send link with presentation to participants
- Finalize Meeting One summary
- Draft and solicit feedback from Working Group on Meeting Two summary

Cape Cod Commission

- Share Technology Matrix with Working Groups
- Share updated Chronologies with Working Groups

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

Erin Perry, Special Projects Coordinator at the Cape Cod Commission, welcomed participants and offered an overview of the 208 Update stakeholder process.[1] 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 were held in September and focused on baseline conditions in each of the watersheds. The second meetings of the Watershed Working Groups will be held in October and early November and are

[1] The PowerPoint Presentation made at this meeting is available at: http://watersheds.capecodcommission.org/index.php/watersheds/mid-cape/three-bays-centerville-river.

focused on exploring technology options and approaches. The third meetings of the Watershed Working Groups will be held in December and focus on evaluating watershed scenarios which will be informed by Working Groups' discussions about baseline conditions, priority areas, and technology options/approaches. This conversation will also be informed by information shared in the Technology Matrix, which was developed by the Cape Cod Commission with technical input from the Technology Panel. The Technology Matrix builds on the information presented in the Technology Fact Sheets, which Working Group members reviewed in advance of the meeting[2]. Once it is finalized by the Cape Cod Commission, the Technology Matrix will be shared with Working Group Members.

Ms. Perry shared the 208 Plan team's progress since Meeting One which includes:

- Meeting materials distributed to stakeholders and available at http://watersheds.capecodcommission.org
- GIS data layers accessible at: http://watersheds.capecodcommission.org
- Chronologies are being updated and will be made available soon

Ms. Perry also shared that the second round of the Cape-2-O game launched on October 22. She noted that over 400 people registered for the first round of the Cape-2-O game and encouraged Working Group members to participate in the interactive, online game which provides valuable education and input to the Cape Cod Commission.

Ms. Perry announced that there will also be a Cape Cod wide event on November 13 at the Cape Cod Center for the Arts in Dennis. Participants from across the eleven Watershed Working Groups and the public are invited to attend the event which will include: Wrap up of Cape-2-O: ur in charge!; a summary of planning process to date; discussion of the stakeholder role in the second 6 months of the 208 planning process.

Dan Milz, a doctoral candidate at the University of Illinois at Chicago, introduced himself and explained that he would like to videotape the meeting for purposes of his dissertation research. He indicated that, although the meeting is public, the recording would be kept private and that he would withhold names and affiliations in his work. Ms. Hulet asked if anyone had a concern with Dan filming the meeting. No one objected.

Ms. Perry reviewed the goal of the meeting:

- To develop a shared understanding of the potential technologies and approaches identified to date , and the benefits and limitations of each; to explore the environmental, economic, and community impacts of a range of categories of solutions; and to identify priorities and considerations for applying technologies and approaches to remediate water quality impairments in your watershed.

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[2] Technology Fact Sheets are available at: http://watersheds.capecodcommission.org/index.php/watersheds/mid-cape/three-bays-centerville-river.

Working Group members asked the following questions about the context and goals of the meeting and the 208 planning process:

- *To what extent is the 208 process supposed to involve freshwater resources? Freshwater resources can be a resource to capture nitrogen, but we do not seem to be dealing with these as much as the estuaries, embayments, and other salt water areas.* Ms. Perry responded by explaining that, while the 208 process is driven by nitrogen loads, the Working Group should not ignore the presence and effects of phosphorus in freshwater resources. The Commission is also looking at ponds for their capacity to attenuate nitrogen.
- *Is the Working Group's task in this meeting to look at the different remediation options and technologies strictly from a technological perspective or should the Working Group also look at the different options from political and sociological perspectives?*
    - Ms. Perry responded that the Cape Cod Commission would definitely like to hear from Working Group members about the political and sociological perspectives. The Commission would like to hear about which options are palatable and which ones are not.
    - Carri Hulet, the facilitator from the Consensus Building Institute, added that gaining political and sociological perspectives is precisely the value of convening Working Groups. Input from informed residents is exactly what the Commission is interested in receiving and these Working Group meetings also allow for residents to share their perspectives with one another. If remediation plans were going to be created on purely technical grounds, then the Commission would not need to create a stakeholder process involving Working Groups.

Ms. Hulet reviewed the agenda and led introductions. A participant list can be found in Appendix A. She also requested that anybody with additional comments or edits to the Meeting 1 meeting summary send them to her within the next two days.

III. RANGE OF POSSIBLE SOLUTIONS

Scott Horsely, Area Manager for the Outer Cape, led the discussion of the range of possible solutions. As Working Groups learn more and consider the pros and cons of the technologies and approaches, he encouraged participants to keep in mind that:

- The Cape Cod Commission has engaged in a comprehensive analysis of nutrient control technologies and approaches. This analysis is distilled into: the Technology Fact Sheets, which present various information on the technologies being considered; the Technology Matrix, which includes additional information on site requirements, construction, project and operation and maintenance costs, reference information, and regulatory comments; and ongoing input from stakeholders on the public acceptance of technology options and approaches.
- Not all of the technologies and approaches will be applicable to Cape Cod.
- Some technologies are so promising that we should identify them for demonstration and pilot projects.
- Workshop 3 will focus on hands-on problem solving in each watershed to meet target load

reductions.

- Certain technologies or approaches will be effective at preventing nutrients from entering the water body. Others will be effective at reducing or remediating nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing development and future development.

Mr. Horsely offered a brief overview of the technologies and approaches. The following section briefly describes each technology. Participants' questions and comments about the technologies are also discussed below *(in italics)*:

Site level technologies/approaches

Standard Title V System*:* This is a standard septic system that consists of a septic tank and soil adsorption system (leaching field). The system was primarily designed to address public health concerns related to waste in drinking water (e.g. coliform bacteria); they were not designed to remove nutrients (e.g. nitrogen).

I/A title V System: Innovative/Alternative (I/A) on-site nutrient reducing systems typically consist of standard septic system components augmented to remove more nutrients than a standard Title 5. I/A systems refer to a class of systems intended to be designed as recirculating sand filter (RSF) equivalents by meeting the same treatment limits in a smaller footprint.

- *Could some information about costs of different systems be provided, both for these I/A Title V systems and for the other technologies?*
  - Mr. Horsely responded that the Commission is working to develop cost estimates but that these are still in progress.
  - Dr. Dale Saad, Senior Project Manager for Water, Sewer, and Green Energy at Barnstable DPW, added that an I/A system is roughly $30,000, generally about twice the cost of a standard Title V system.

Urine Diverting Toilets: Urine diversion systems send urine into a holding tank where the urine is stored and periodically utilized on-site as a fertilizer or is collected by a servicing company. The servicing company empties the tank for either treatment and disposal or recycling such as conversion to a fertilizer. Through these means, the nitrogen may be removed from the watershed. With urine diverting toilets, the remainder of the human waste and all other water uses (sink and shower) continue to go to the septic system. (Case example, Falmouth, MA).

- *Do nitrogen levels vary by people's diets?* Mr. Horsely responded that diet is unlikely to cause significant variation in the nitrogen content of urine. He added, however, that current estimates of 85% of nitrogen in septic system coming from urine may be too high due to organic food wastes in kitchen water.

Composting toilets: A toilet system which separates human waste from shower, sink and other household water uses. The composting toilets use no or minimal water. The human waste captured by the composting toilets is decomposed and turned into compost. The compost generated is removed from the site and nutrients can be recycled. Composting toilets require the replacement of existing toilet(s) and room in the basement for a container to capture and compost the human waste. Household water use (sink and shower uses) continue to flow to the septic system. (Case example, Falmouth, MA).

- *How has public reception to these been?*
    - A Working Group member explained that reception has been mixed. While toilets have been installed successfully in some cases, there remain some issues to be resolved relating to loads, insects, etc.
    - Mr. Horsely added that the toilets also require space underneath, such as in the basement, to install a composter.

Packaging toilets: A packaging toilet encapsulates human waste in a durable material for removal from the site. The package is stored beneath the toilet and removed and taken away when full. The nutrients can be recycled by the servicing company that picks up the packages.

Stormwater bioretention: Bioretention systems utilize natural plant and soil functions to capture and treat stormwater runoff for a variety of contaminants including nutrients. A typical system consists of an underdrain/gravel layer, a layer of bioretention soil mix (a mix of sand, compost, woodchips and loam), and a surface layer containing appropriate plantings. The treated water can be discharged into a water body or used for open space irrigation after treatment. The reclaimed water can also be discharged into a subsurface infiltration system for discharge to the groundwater. (Case example, Portland, OR).

- *What are the key sources of nitrogen when considering the individual home or business?* Most nitrogen is coming from people's lawns and parking lots.
- *It is somewhat deceiving to say that regulatory agencies would be able to monitor nitrogen runoff effectively at the lot-level. In order to implement stormwater bioretention systems and receive credit from DEP and EPA for these, the regulatory agencies would have to basically say that simply installing a system will trigger a credit for, say, a 15% reduction in nitrogen load. Otherwise, the regulatory agencies do not have the resources to monitor the effects of bioretention systems at the site-specific level.* Mr. Horsely responded that monitoring would likely take place at the watershed level. In general, and not only in relation to stormwater bioretention, it will be difficult to identify exactly which sites, and even which technologies, are effectively capturing or mitigating nitrogen flows.

General Comments about Site level technologies/approaches:

- *Some of these technologies may not work under all environmental conditions. For example, some (specifically septic systems) may not work if the water table is too high.*
- *The difference in nitrogen-removal efficiency between urine-diversion and composting toilets needs further investigation.*
- *As we look into these different options, it is tempting to look at traditional Title V Systems as "the problem." But it is important to remember that, since Title V has already been implemented, policy and procedures for this regime are already in place. With other systems, that process of policy creation and implementation would still be ahead of us. We need to*

think about the likelihood of successful implementation and the timeframe that would require. Mr. Horsely responded that implementation of other technologies may also occur over the course of decades. Title V took many years to implement, and any new solutions may similarly require a longer timeframe to develop policies and procedures.

- *Could regulatory trade-offs be instituted to entice people to install these sorts of technologies? For example, allowing 3 bedrooms instead of 2 bedrooms, or allowing additional construction on the coast, could entice residents and developers to adopt some of these technologies.*
    - *A working group member stated that a homeowner had approached the Barnstable Land Trust to ask if he could use the Land Trust's development rights to expand his property. These sorts of considerations ultimately come down to money.*
    - Mr. Horsely added that it does come down to money, and some people will prefer to pay more to install sewering and others will prefer to save money and install an eco-toilet. He noted that Barnstable has already instituted some provisions to entice residents to install nitrogen-remediation technologies and that this approach could be explored further.
    - *A working group member responded that the cost of an eco-toilet may be cheaper from a public perspective but a homeowner who has to retrofit her house with new plumbing to accommodate an eco-toilet may end up paying more.*
    - *A working group member suggested that denser growth may not be preferable everywhere on the Cape. Policies to encourage density and adoption of other remediation technologies would need to be placed in the context of how residents want to see the Cape develop and in terms of environmental impacts.*
- *A working group member commented that Title V systems are an appropriate technology in non-sensitive areas. For example, if nitrogen discharges are flowing directly to the ocean, then Title V systems do not present an issue. Nitrogen flows only present an issue in ecologically-sensitive areas.*
    - Mr. Horsely responded that, while that is true, there are not many non-sensitive areas present on the Cape.
- *It is important to document the comments and pros and cons about each technology option that working group members are contributing so that members of the general public, who will look at this information later, can follow our thinking and do not worry about ulterior motives and other issues.*
- *A working group member suggested that, with regard to site-level technologies, not all homeowners will follow recommendations for installing technologies to mitigate nitrogen loads. In that case, would it be up to municipalities to enforce provisions and pay for improvements?*
    - Mr. Horsely responded that, currently, contractors are responsible for enforcing provisions of this nature, but that this system rates at a C or C- grade in terms of efficacy. Ultimately, the costs of any system will be shared between the municipality and individual homeowners. Upgrading existing Title V to I/A Title V systems is an expense that is difficult for many residents to bear.

Neighborhood level technologies/approaches

Cluster and satellite treatment systems: A cluster or satellite system is a collection and treatment system treating wastewater flows from multiple properties.

STEP/STEG collection: Septic Tank Effluent Pumping (STEP) and Septic Tank Effluent Gravity (STEG) systems convey liquid wastewater from on-site septic tanks to sewer systems; Only the liquid component of the wastewater may be conveyed by pumps or by gravity.

Eco machines and living machines: Living or Eco-Machines are natural systems that treat septic tank effluent or primarily treated wastewater. In these systems, aeration and clarification chambers are combined with constructed wetlands to treat the influent. The wetlands are a series of chambers allowing for microbial communities to engage with and treat the wastewater. Plants are often suspended on racks with their roots systems doing the work. Solids removal is generally onsite, after which water is pumped through the gravel filled cells (similar to subsurface wetlands.) This process transfers more oxygen to the wastewater and completes the pollutant removal process. (Case example, South Burlington, VT).

- *There is an Eco Machine-type wastewater treatment plant in Weston Massachusetts, and dozens elsewhere outside of Massachusetts. Harwich had one as a pilot system but it is no longer in operation.*

Stormwater wetlands: Constructed wetlands provide aerobic chambers followed by subsurface anaerobic chambers that facilitate nitrification followed by denitrification, respectively. This process mimics that of natural systems coupled with engineering design guaranteeing residence time within a chamber containing anaerobic conditions. (Case example, China).

- *The slide should clearly state that this would involve constructed, not natural, wetlands.*
- *Has research been conducted on how stormwater runoff affects the wetlands?*
    - Mr. Horsely responded that, while he was not sure about research findings, Massachusetts state regulations state that water must be treated before it can be discharged to wetlands.
    - James Sherrard, hydrologist with the Cape Cod Commission, added that, in New Hampshire, the water flowing into wetlands is required to be of higher quality than the existing water in the wetlands.
- *The fact sheet on stormwater wetlands says "does not allow for year round nutrient removal efficiencies." Do these wetlands systems work year-round?*
    - Mr. Horseley explained that wetlands systems do work year-round, as most nutrient treatment occurs in the root zones of plants, where the temperature is much warmer than air temperature during the winter. Removal efficiencies may decrease during the winter, but the system does keep working.

General Comments about Neighborhood-level technologies/approaches:

- *Are there space requirements and limitations for each of these different options?*
    - Mr. Horsely answered that yes, these options require different amounts of space and that a stormwater wetland, for example, may require a significant amount of

open space. In areas with new construction, municipalities can require developers to include different remediation technologies, but finding space can present a larger challenge when retrofitting in built-out areas. That being said, approaches such as bioretention gardens are being installed in portions of sidewalk in Manhattan, so not all of these options require significant open space.

Watershed level technologies/approaches

Conventional treatment: A conventional wastewater treatment facility typically treats wastewater collected from homes and businesses. A groundwater discharge permit is required. Treatment generally results in less than 10 mg/L Nitrogen.

- *Does the $34,000 per household figure that Mr. Horsely quoted for sewer installation in Falmouth apply to the entire town or just to a limited area of Falmouth.* Mr. Horsely and a working group member answered that that figure likely applied to just a subset of the town. They added that the cost of sewering in Provincetown would likely be much cheaper, but that Provincetown is much more densely developed than are most other areas on the Cape.

Constructed wetlands: surface flow: Constructed wetlands can be utilized to intercept ambient groundwater or to treat partially processed wastewater. They can be built in targeted areas downgradient of high-density septic systems to intercept and treat nitrogen-enriched groundwater. After secondary treatment at a wastewater treatment facility, water can also be fed into a surface flow constructed wetland. Surface flow constructed wetlands closely mimic the ecosystem of a natural wetland by utilizing water loving plants to filter wastewater through their root zone, a planted medium, and open water zones. Surface flow wetlands are systems where open water is exposed much like in a natural marsh. The reclaimed water from the wetland can be discharged into a water body or used for open space irrigation after treatment as well as discharged into a leach field. (Case example, Albany, OR).

- *How much space is required for constructed wetlands?* Mr. Horsely responded that the size can be variable, with some being an acre large and some being 3 or 4 acres large.
- *We would not want to turn the entire Cape into wetlands just to deal with nitrogen loads, so some sort of guidelines should be developed in terms of what the size of the wetlands should be or their locations.*
- *Is hydrologic balance a consideration? Would some of these approaches take water out of certain watersheds?* Mr. Horsely said that, yes, this could be a concern. Additionally, a participant in the Technology Panel the previous day pointed out that freshwater resource stress may be exacerbated by climate change.

Constructed wetlands: subsurface flow: Constructed wetlands can be utilized to intercept ambient groundwater or to treat partially processed wastewater. They can be built in targeted areas downgradient of high-density septic systems to intercept and treat nitrogen-enriched groundwater. They can also be used to process partially treated wastewater from a septic system or treatment plant by pumping the effluent water slowly through subsurface gravel beds where it is filtered through plant root zones and soil media. Water flows 3-8" under the surface to prevent public exposure to wastewater and mosquito breeding. A combination of horizontal and vertical flow subsurface systems must be utilized to provide total nitrogen removal. This solution can also offer opportunities for recreation activities on land above the subsurface system. (Case example, Thailand).

Effluent disposal: out of watershed: Effluent disposal can take a variety of forms, including infiltration basins, a Soil Absorption System, Injection Wells or Wick Wells. These disposal methods place highly treated effluent back into groundwater. Effluent Transport out of the watershed has the advantage of removing the nitrogen load to another watershed. Transport to another watershed requires the receiving watershed to be able to accommodate the additional nitrogen load.

- *These different effluent disposal systems each have pros and cons, with some being better for more densely-developed areas. Some systems may be good for recharging groundwater and could even hold back saltwater infiltration of freshwater aquifers.*
- *There are a number of areas where groundwater levels are dropping due to use. For example, the Marsten Mills River is being depleted and water is being redistributed to other areas. We need to be aware of these sorts of issues and have to be careful that water is redistributed in a way that does not harm the environment.*
    - Mr. Horsely responded that it is very important to keep that in mind and that it can be important to remediate water withdrawals from certain areas. It is also important to take into account how much water is being withdrawn in relation to the size of the entire watershed.

Effluent disposal: ocean outfall: Similar to out of watershed effluent disposal, highly treated effluent is transported out of the watershed and into the ocean. This solution requires a high level of regulatory oversight, but is being considered because there is limited land availability for disposal on Cape Cod.

Phytoirrigation: After secondary treatment, wastewater treatment facility effluent is irrigated onto plants to remove nutrients and other contaminates. Fast growing poplar and willow trees are typically used. (Case example, Woodburn, OR).

- *Could crops be grown using this methodology?*
    - Mr. Horsely said that the second largest crop in the United States is lawn. The example that was shown from Oregon involves harvesting of the trees that are grown. A rhododendron nursery in Sandwich also uses phytoirrigation. These could all be revenue streams and co-benefits that are important to consider.
    - *In other words, we could think about wastewater as a resource, not as a problem or a waste to be disposed of.*

General Comments about Watershed-level technologies/approaches:

- *The notes for a number of these options indicate that they are only viable for six months of the year, not year-round. What happens during the rest of the year?*

- Mr. Horsely responded that some of the technologies, such as wetlands, do work year-round, but sometimes at slower rates in the winter. The incoming load is also slower in the winter, however.

Neighborhood or Watershed level technologies/approaches

Phytobuffers: Using trees with a deep root system to capture nutrients in the groundwater, particularly willows and poplars. Green plants with deep tap roots are planted as a buffer to intercept existing groundwater. The plants and their associated microorganisms reduce contamination in soils and ground water. Often phytohydraulics cause the groundwater plume to be redirected and pulled towards the plants. (Case example, Kavcee, WY).

- *Harvesting bio-phragmites could also be a means of reducing nitrogen loads. This would be a type of phytobuffering.*

Fertigation wells: Fertigation wells can capture nutrient enriched groundwater, typically from a wastewater treatment facility discharge, and recycle it back to irrigated and fertilized turf grass areas. These irrigated areas include golf courses, athletic fields and lawns. Fertigation can significantly reduce nutrient loads to downgradient surface waters while reducing fertilizer costs to the irrigated areas. (Case example, Plymouth, MA).

- *Is micro-fertigation, such as a residence picking up leachings from its own lawn and using this as fertilizer, an option?*
  - Mr. Horsely noted that Eastham is basically doing this already, since they use wells.

Permeable reactive barrier (PRB): A permeable reactive barrier (PRB) is an in-situ (installed within the aquifer) treatment zone designed to intercept nitrogen enriched groundwater. Through use of a carbon source, microbes in the groundwater uptake the nitrogen, denitrifying the groundwater. PRB systems typically use vertical trenches, sequences of bored columns or injection methods to introduce the carbon source into the groundwater to reduce the nitrogen load to an estuary, removing it from the watershed. (Case example, Falmouth, MA).

- *Could PRBs be dovetailed with an approach to sequester carbon dioxide from the atmosphere?*
  - Mr. Horsely suggested that this sort of approach could be explored, as a variety of materials could be installed to serve as a carbon source. For example, the Massachusetts Military Reservation (MMR) used iron filings.

Inlet and culvert widening: Re-engineering and reconstruction of bridge or culvert openings to increase the tidal flux through the culvert or inlet. This solution generally works better with a larger tidal range but could be feasible on both the Cape Cod Bay side (approximately nine feet tidal range) and Nantucket Sound side (approximately 3 feet of tidal range).

- *This method may only have a marginal effect on nitrogen concentrations, such as 3-5%.*
- *While the impact may be small, if the widening project is happening for other reasons, we might as well take advantage of it to account for the co-benefits in terms of nitrogen load reductions.*

Salt marsh habitat restoration: Salt marsh is one of the most productive ecosystems in the world, surpassing rainforest in productivity per acre. Approximately 65% of historic salt marsh has been lost in MA. Salt marshes cycle and remove nitrogen as well as provide critical habitat and spawning sanctuary for a wide variety of birds, mammals and marine life in addition to hosting a range of plant species and important biogeochemical processes. The capacity of salt marsh to intercept nitrogen is significant and well researched worldwide. Substantial areas of former salt marsh on the Cape are either under consideration for restoration or could be restored providing storm surge and coastal flooding protection in addition to water quality benefits in certain watersheds.

Shellfish habitat restoration: Oyster reefs were historically one of the main consumers and recyclers of nitrogen in the coastal environment on Cape Cod. According to the Nature Conservancy, populations have declined by 95%. In conjunction with the natural transition from land to sea in estuaries, bays and inlets; salt marsh, oyster reef and eel grass function as critical buffer that can reduce eutrophication. Restoring Oyster populations leads to increased shellfish productivity as well as improved commercial and recreational fisheries for other species, increased protection from shoreline erosion and flooding, and buffering from ocean acidification. (Case example, Wellfleet, MA).

- *Work around shellfish habitat restoration has been done in a number of places, including the Southeast Coast, Chesapeake Bay, and in southern Georgia. In all of these places, oyster populations undergo large population swings and humans have not been able to understand why this is the case. Seeing this, it may not make sense to rely on this technology by itself.*
    - Mr. Horsely said that this is an excellent point and, because shellfish populations are highly-variable, this technology could not be implemented on its own.
- *Salt march and shellfish habitat restoration both seem to be very promising approaches but we need to keep in mind that, with climate change, coastlines and marshes will move inland.*
- *Shellfish populations declined over time due to the types of environmental problems that we are currently trying to address. How would it be possible to restore shellfish populations to deal with nitrogen loads if the environmental challenges that caused population declines are still currently in place?*
    - Mr. Horsely responded that this is a valid question that needs further exploration, perhaps by the Technology Panel. He added that, while the question is valid, shellfish populations do seem to have been successfully reintroduced in Wellfleet. Shellfish restoration is really premised on shellfish habitat restoration, not simply reintroducing the shellfish.
    - *A working group member added that today's environmental conditions may not be identical to those that caused a die-off in shellfish populations in earlier decades, as clear-cutting was a major issue and environmental driver in the past.*

Aquaculture / shellfish farming: Oysters have been proposed as a potential method for reducing nitrogen levels and eutrophication in estuaries. Nitrogen removal rates from oysters have been well documented and the harvest of oysters physically removes the nitrogen they sequester in addition to the nitrogen removed by their biological cycling which puts nitrogen directly back into the atmosphere. Aquaculture can be done on man-made structures (e.g. cages, floating bags) or natural reefs.

- *The type of oyster or shellfish operation that is implemented would also make a difference. For example, a put-and-take operation would work differently than an aquaculture operation.*
    - Working group members and Commission staff members discussed the facets of different types of oystering operations. They noted that caged-aquaculture is more manageable and predictable, but that this also limits the size and scope of the oyster industry.
    - *A working group member added that aquaculture is likely to change the nature of the waterfront, including reducing public access, and that this is likely to provoke some public pushback.*

<u>Surface water remediation wetlands</u>: Constructed to aid in water quality improvements to surface water bodies, usually streams or rivers. Water is pumped or allowed to flow naturally through treatment cells containing wetlands. Surface water remediation wetlands are often used in combination with groundwater recharge or potable water reuse systems. Surface water remediation wetlands are generally used with Free-Water Surface wetlands due to their larger size, and lower capital and operation and maintenance costs. (Case example, China).

<u>Pond and estuary dredging</u>: Lakes, ponds, streams and estuaries store nutrients within their sediments. These sediments tend to accumulate over time. Subsequently, these nutrients can be release into the overlying water column and can become a major source of nitrogen and phosphorus. Dredging and removing these sediments and accumulated nutrients removes the nutrients from the water body and potentially the watershed. (Case example, Dennis, MA).

Cape-wide level technologies/approaches

<u>Compact development</u>: Both Compact Development and Open Space Residential Development (OSRD) of subdivisions result in smaller lots and less maintained lawn acres. The higher density development reduces wastewater collection costs while providing a common disposal area. Compact development is also referred to as “Smart Growth”.

<u>Fertilizer management</u>: Managing fertilizer application rates to lawns, golf courses, athletic facilities and cranberry bogs. Residential lawn loading rates could be reduced on existing developed parcels through an intensive public education/outreach program. This could include a “Cape Cod Lawn” branding program, replacing some turf areas with native vegetation, establishing naturally-vegetated buffer strips on waterfront lots, and reducing application rates. Fertilizer loading rates for new development could be accomplished by reducing lot sizes (cluster development), by restricting lawn sizes and/or by incorporating more naturally-vegetated open space areas. Municipalities could directly reduce fertilizer applications on athletic fields and other properties. Golf courses can significantly reduce nitrogen loading rates by using slow-release fertilizers and reducing application rates in rough areas. Cranberry bog fertilizer exports from the bogs can be reduced using tail water recovery systems. Site-specific assessments are needed to estimate load reductions. The Cape Cod

Commission designated a cape-wide Fertilizer Management District of Critical Planning Concern (DCPC) which authorizes the towns to adopt local fertilizer management regulations (state law prohibits local fertilizer management except under the DCPC). The DCPC does not require towns to adopt fertilizer regulations, but paves the way for their adoption. Barnstable County will be conducting a public education process around fertilizer use.

Remediation of existing development: Existing developments or schools with excess wastewater treatment capacity allow existing nearby developments to connect to their underutilized wastewater treatment infrastructure. A town can operate the wastewater treatment facility if the existing owner prefers to not take the responsibility for treating the off-site wastewater. An example of this is the Kingman Marina in Bourne, which was permitted to expand its development footprint in exchange for hooking up adjacent, existing homes to its wastewater treatment facility.

Transfer of development rights: A regulatory strategy that transfers development and development rights from one property (sending area) to another (receiving area) to direct growth and associated nutrient loading away from sensitive receiving watersheds or water bodies. The protected parcels (sending areas) receive a deed restriction that limits the level of future development. The deed restriction can limit the number of homes or tie development to the availability to future wastewater treatment facility infrastructure.

- *The water suppliers occasionally talk about selling their land, and there should be a provision that they can only sell for the purposes of transferrable development rights. It is important to preserve these open spaces.*

Stormwater best management practices (BMP): Non-Structural Stormwater strategies include: street sweeping, maintenance of stormwater utilities, education and public outreach programs, land use planning, and impervious cover reduction and control.

General questions and comments:

- *Are there any interactive models available that would be able to tell us how effective different approaches and technologies would be in different places? In Meeting 1, the Commission showed a map that identified different areas as having different nitrogen removal targets, such as "100% removal", "80% removal", etc. Are there models that would show how effective different mitigation technologies would be in specific geographies?*
    - Representatives from the Cape Cod Commission answered that there are two models of this sort. One is the Multi-Variable Planning (MVP) scenario planning tool, but this model largely focuses on traditional approaches, such as sewering. A second tool, which will be used in Meeting 3, is a spreadsheet calculator for the alternative and innovative approaches.

- *We should remember that MA DEP must approve of any remediation plan and sign off on it. Either DEP would need to agree to simply award credits for installing certain systems that cannot be monitored after installation, such as various site-scale systems, or Cape communities will have to present a reasonable and defensible model and estimate of likely* *reduction rate(s) from different technologies and approaches.*

- *It would be helpful to think about the actions that individuals and individual homeowners can take. For example, if a homeowner plants a tree on the downgrade-side of the leach field, how much of a nitrogen-reduction impact would it have? This is the sort of action that an individual could take.*

- *What was the importance of the historical timelines (chronologies) for different towns that the working group reviewed in the previous meeting?*
    - Ms. Hulet and Mr. Horsely explained that the Commission wanted to demonstrate transparency and clarity that it understands the history of wastewater management in each town. The timelines will also be included in the Section 208 update plans.
    - *A working group member suggested that looking at what actions have been proposed in the past and whether those actions have received public support, or not, and how well implementation worked could inform the working group's current work.*

IV. PROBLEM SOLVING PROCESS AND PRINCIPLES

Overview of 7-steps for Problem-Solving Process

Mr. Horsely reiterated that the goal the Working Groups is to develop remediation options that would achieve water quality targets with a focus on first targeting low cost, low barrier options to reduce nitrogen and then considering more costly and traditional options later (e.g. sewering). He then described the alternatives screening process the group will apply:

1) Establish targets and articulate project goals.
2) Identify priority geographic areas (e.g. high nitrogen reduction areas, Title V problem areas, pond recharge areas).
3) Determine which management activities should definitely be implemented. These might be the easiest and least costly management activities that should be undertaken regardless of other management actions (e.g. fertilizer management and stormwater mitigation – two approaches that Cape Cod towns are already actively pursuing).
4) Assess alternative options to implement at the watershed or embayment scale (e.g. innovative and lower-cost solutions)
5) Assess options to implement at the site-level
6) Examine priority collection/high density areas
7) Consider traditional sewering or other grey infrastructure management options

He further explained that the Working Groups will focus on total controllable nitrogen load. The technologies and approaches selected should aim to reduce the total controllable nitrogen load by identifying options that reduce the portion of *septic* load that needs to be reduced. For example, the portion of septic load that needs to be reduced could be made smaller if Cape Cod takes on fertilizer and stormwater solutions first. Additionally, the percentages of controllable nitrogen that need to be removed to meet TMDLs change depending on the characteristics of the watershed.

He noted that in many instances, one of the solutions may not achieve the TMDL, but if you pair multiple solutions you may be able to reach the goal. For example, many towns are already using and pairing some of the technology options and approaches:

- Wellfleet- *Coastal habitat restoration & aquaculture*
- Mashpee- *Aquaculture & Expanding Existing Systems*
- Brewster- *PRB & Bioswales*
- Orleans- *Fertilizer Control By-Law*
- Harwich- *Muddy Creek & Cold Brook Natural Attenuation*
- Falmouth- *Aquaculture, Inlet Widening, Eco-Toilet Demonstration Project, PRBs, Stormwater Management (Little Pond Watershed), Fertilizer Control By-Law, Subsurface Nitrogen Removal Septic System*

Categories of Solutions and their Impacts on the Environment, Economy, and Community

Mr. Horsely commented that evaluation of the technologies and approaches would be informed by their impacts (positive and negative) on the environment, economy, and community (Triple Bottom Line). He asked participants to consider the environmental, economic, and community impacts of the possible technologies and approaches and asked them what evaluation criteria/factors they might consider in guiding evaluation of the range of possible solutions. Working Group members offered the following suggestions:

Environmental

- *Time of travel:* Some options address the problem before it enters the groundwater. These might be preferable in many circumstances.
    - *A working group member added that time of travel is also important to consider because current impacts on estuaries result from the nitrogen loads of 20 or 50 years ago (whatever the relevant time of travel is). Water with today's nitrogen loads, which may be much higher, will not even hit the estuaries for a few years yet.*
    - *Since most existing development tends to be near the shoreline, the time of travel estimates will not be as long as those that are assumed to be coming from the spine of the Cape.*
- *Possibility of catastrophic impacts*: Considering the potential that nutrient-rich water that is already moving towards the estuaries could catastrophically impact the estuaries before a "tried-and-tested" remedy such as sewering could be implemented and sufficiently mitigate nutrient flows at the source, it may be more attractive to the permitting agencies that some alternative, in-situ technologies be implemented now, before it is too late.

Economic

- *Costs:*
    - Costs will always be important. In considering the different options that are contained in the fact sheets, it would be helpful to have more information about costs and also to have information about which options have previously been rejected as too costly or as socially undesirable for some reason.

    - Each option should be considered in terms of a 20-year lifecycle cost analysis.
    - Mr. Horsely explained that the financial analysis accompanying different scenarios that is presented in Meeting 3 will be pretty detailed and will include different financing options.
        - A working group member added that it would be important to include co-benefits in these financial calculations.

Social

- *Opportunity to shift social perceptions:* This process provides an opportunity to shift social perceptions. For example, while people may prefer their current toilet system over installing a urine-diversion toilet, they may also change their mind when the trade-off of $12,000 to install urine-diversion toilets is set against the $60,000 that it may cost to implement another type of solution, or the estimated $43,000 per household cost of sewering in Falmouth.
- *Education:* Each homeowner sees his or her situation as only his or her own and does not recognize that costs are necessarily going to be shared. We need to engage in an educational process to try to help people understand that costs are going to be shared between households in one form or another.
- *Factors for Successful Implementation:* Thinking about successful implementation of any of the remedies will require that we look at policy and the social sciences in addition to technology. We need to think about how to motivate people and what factors are present and necessary in any technology adoption.
    - More valuable than concepts like "the public interest" or "the long-term good" is probably a process of emphasizing regulatory trade-offs and alternatives as well as cost-benefit analyses.

Priorities for this Watershed

Ms. Hulet asked participants to hone in on the specific environmental, economic, and social trade-offs or consequences that they felt would be important to consider for this watershed. Working Group members offered the following suggestions:

- *Local Planning:* Land Use Vision Maps that have been developed by local communities should be taken into consideration when considering remediation options. Infrastructure should be concentrated in areas that have been targeted for growth by the local communities.

- *Keep Longer-term Options Open:* Promising options for longer-term remediation should be identified and taken into account now. For example, if open spaces are developed now, it would take certain longer-term options off the table. This process should operate according to the "do no harm" principle.

- *Be Realistic:* In some areas, it is not really practical or feasible to achieve a condition of true restoration, as defined by the geology of each embayment. For example, not all areas are going to see the return of eelgrass. For some areas, avoiding algae blooms would be a measure of success. For example, it would be much too expensive and infeasible to restore Warren's Cove to a pristine state. This process should be honest about these circumstances and set realistic expectations. It is important to set the parameters of what you are trying to achieve, similar to the methodology employed when remediating hazardous waste sites.

- *Focus on the Achievable:* The "A" in the SMART acronym stands for "achievable." If a remedy is not achievable in a political or economic sense, it will not work. We should be able to rank the different approaches in terms of what is achievable.

- *All Politics are Local:* While an area such as Lawrence Cove may be harder to remediate than some other areas, the residents there are also wealthier than in some other areas. Local residents have more of an investment and sense of buy-in to the health and condition of their local environment and, in the case of Lawrence Cove, there may be a greater capacity for taxation and other mechanisms to pay for remediation. Particularly since a lot of high-value property is located along the coast, if local residents are willing to pay more for a more comprehensive remediation approach, those approaches may take higher priority.
    - Another working group member commented that the implication of this principle seems to be that residents who do not live adjacent to the watershed would not have any incentive to pay for remediation.
    - A working group member added that there has to be something in the solution for everybody and it has to be relatively immediate.

- *Alternative Financial Models:* Non-taxation financial models, such as gift accounts, could be considered to support remediation.

- *Who pays*: Cost-sharing is both important and necessary, but it can be a difficult political sell. A few years ago, a tax increase to cover maintenance of private roads was proposed and was voted down even though it would have benefited almost all residents.

- *Economic Costs versus Political Costs*: While land use regulations could be seen as "low cost" in a public sense, they can be politically very costly and difficult to implement.

Concrete Suggestions for this Watershed
Ms. Hulet asked participants to provide feedback about specific technologies and remediation approaches. Working Group members offered the following suggestions:

- Could widening the outflow from Rushing Marsh help reduce nitrogen concentrations?
    - A working group member responded by saying that this was tried previously using "soft" approaches, but not with "hard" engineering. It did not work at the time.

- Natural approaches to remediation would be preferable.

- Controlling the development that has not yet occurred would address 40% of the nutrient issue. That seems like the biggest bang for the buck.

- Shared systems work in many neighborhoods. For example, although a shared septic system in Craigville has not completely eliminated nitrogen, and the nitrogen will still eventually flow to the estuary, it has made houses livable because sewage is routed further away. In many places where houses are closer together and the septic systems are older, this can be a good option.
    - A working group member responded that, while these sorts of shared septic systems may work in certain remote places, if they are implemented en masse, the operations and maintenance burden would be quite significant and may become difficult to maintain by the group of people that they serve. As a result, the operations and maintenance responsibilities would likely fall to the municipalities.

- Permeable reactive barriers seem very promising. The challenge seems to be whether the water flows through the barrier or around it, but this seems like a surmountable challenge. It seems cost effective and unobtrusive.

- Aquaculture seems very promising.

- Title V systems are already widely installed and adding I/A systems to these existing systems seems straightforward. If there is a concern about people switching off their systems to save electricity, these I/A systems could be connected with solar photovoltaic panels in order to provide constant, minimal-cost electricity.

- Framing nitrogen as a resource is a smarter approach than framing it as a pollutant. For example, dry toilets can produce a fertilizer resource .

- In response to a question from the Cape Cod Commission about whether participants and their neighbors would choose to pay $12,000 for an alternative toilet or $36,000 towards the cost of installing sewer infrastructure, working group participants provided the following responses:
    - The structure and options for financing those costs would be significant in making a decision. For example, people will pay more to lease a car than to pay cash to buy one outright because of cash-flow considerations.
    - People will go with what they know.
    - Part of the consideration is the age of the system on the property. If someone would have to replace the system soon anyways, he or she may be more willing to switch to an alternative toilet.

- How we, as a society, think about this challenge is key: currently, we pollute the water and then clean it. How do we get to a point where we do not pollute the water?

- What is the actual cost of polluting water? If people had to write checks for their own pollution, they would be much less likely to pollute.

- A Cape Cod Commission representative noted that the Commission is working on a study about this issue.
- Another participant said if someone does not want to adopt one of these alternatives, he or she can pay for the cost of dealing with their own nitrogen waste.

- Citizens may expect that, once they pay $35,000 to install sewering or implement some other technology, that the issue has been addressed for the foreseeable future. They may be very resistant about being asked to pay again in five years time if, for example, regulations evolve and become more stringent or if the initial solution does not work as expected.
    - A working group member noted that the Barnstable Board of Health did not recommend the adoption of alternative systems because they were concerned about the unfairness of imposing a future cost down the line if the system did not perform as expected.

Technology Selection: Process and Principles

Mr. Horsely noted that the Working Group had identified many of the principles that the Cape Cod Commission hoped would guide technology/approaches selection. These process and principles include:

- *100% septic removal subwatershed*: Combinations of technologies can be used to reduce septic load that needs to be removed.
- *Scale: On-Site vs. Collection System vs. Natural System*: There will be tradeoffs between the scale of systems that can be used. On-site, collection, and natural systems all have their pros and cons and all require different levels of investment and infrastructure. These tradeoffs will be important from an implementation and public acceptance point of view.
- *Nutrient intervention and time of travel*: Some technologies/approaches intercept nutrients at their point of entry into the system, while others deal with it later on (e.g. once it is in the watershed). There are pros/cons to each approach which need to be considered.
- *Permitting Status*: The level of effort required to permit technologies will be a consideration.
- *Land use and Impacts of Growth*: Unintended consequences and opportunities for planned growth are important to consider.

V. PLANNING FOR THE NEXT MEETING

Meeting Three will be held:
Wednesday, December 4, 2013
8:30AM -12:30PM
COMM Fire Station, 1875 Falmouth Road, Centerville, MA 02632

During this meeting the Working Groups will examine various scenarios (i.e. combinations of solutions) and their potential impacts (e.g. nutrient reduction, economic impacts, environmental impacts, social impacts, etc.). During the meeting, the Cape Cod Commission will use tools to calculate ideas/options and their impacts. Working Group participants should come prepared to offer their ideas about what solutions they'd like to explore further given their understanding of the baseline conditions, issues, and priorities in this watershed.

VI. PUBLIC COMMENTS

- Ed Nash, Golf Course Superintendents Association of Cape Cod. I have not seen any discussion of pond aerators as a way of de-nitrifying water bodies, which is done in a lot of places. In addition, another option could be purchasing properties in low-lying areas. It may be cheaper to deconstruct properties in these areas than it is to install mitigation technologies to deal with their nutrient flows.

- Fred Dempsey, Barnstable Association for Recreational Shellfishing. As a first time observer, I am impressed with the thoughtful consideration that is being taken for these issues.

APPENDIX ONE: MEETING PARTICIPANTS

Name	Affiliation
Representatives	
Mary Barry	Resident of Barnstable
Jaci Barton	Barnstable Land Trust
Steve Brown	Red Lily Pond Project, Inc.
JoAnne Miller Buntich	Town of Barnstable
Fred Chirigotis	Barnstable Town Councilor
Tom Colombo	Hyannisport Club
Lindsey Counsell	Three Bays Preservation
Beth Ferranti	Citizen
Conrad Geyser	Cotuit Solar / Cotuit Dry Toilet
Tamar Haspel	Indian Ponds Association
Holly Hobart	Indian Ponds Association
Tom Klein	Citizen
Darren Meyer	Sandwich Health Department
Mark Robinson	Director of Compact of Cape Cod Conservation Trusts
Rob Steen	Barnstable Public Works
Public Attendees	
Fred Dempsey	Barnstable Association for Recreational Shellfishing
Monica Mejia	Tufts University
Ed Nash	Golf Course Superintendents Association of Cape Cod
Dale Saad	Barnstable Department of Public Works
Staff	
Scott Horsley	Area Manager, Cape Cod Commission
Erin Perry	Special Projects Coordinator, Cape Cod Commission
Scott Michaud	Hydrologist, Cape Cod Commission
Anne McGuire	Community Relations Specialist, Cape Cod Commission
James Sherrard	Hydrologist, Cape Cod Commission
Carri Hulet	Consensus Building Institute
Tushar Kansal	Consensus Building Institute