Cape Cod 208 Area Water Quality Planning
Lewis Bay to Bass River Watershed Working Group
Dennis Town Hall
Second Meeting

485 Main St, South Dennis, MA 02660
November 4, 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

Lewis Bay to Bass River Group

Technologies and Approaches

What is the stakeholder process?

208 Planning Process

Public Meetings		Watershed Working Groups		
Goals, Work Plan & Roles	Affordability, Financing	Baseline Conditions	Technology Options Review	Watershed Scenarios
July	August	September	October	December

Public Meetings

Watershed Working Groups

Goals, Work Plan & Roles

Affordability, Financing

Baseline Conditions

Technology Options Review

Watershed Scenarios

Advisory Board

Advisory Board

Advisory Board

Advisory Board

Advisory Board

July

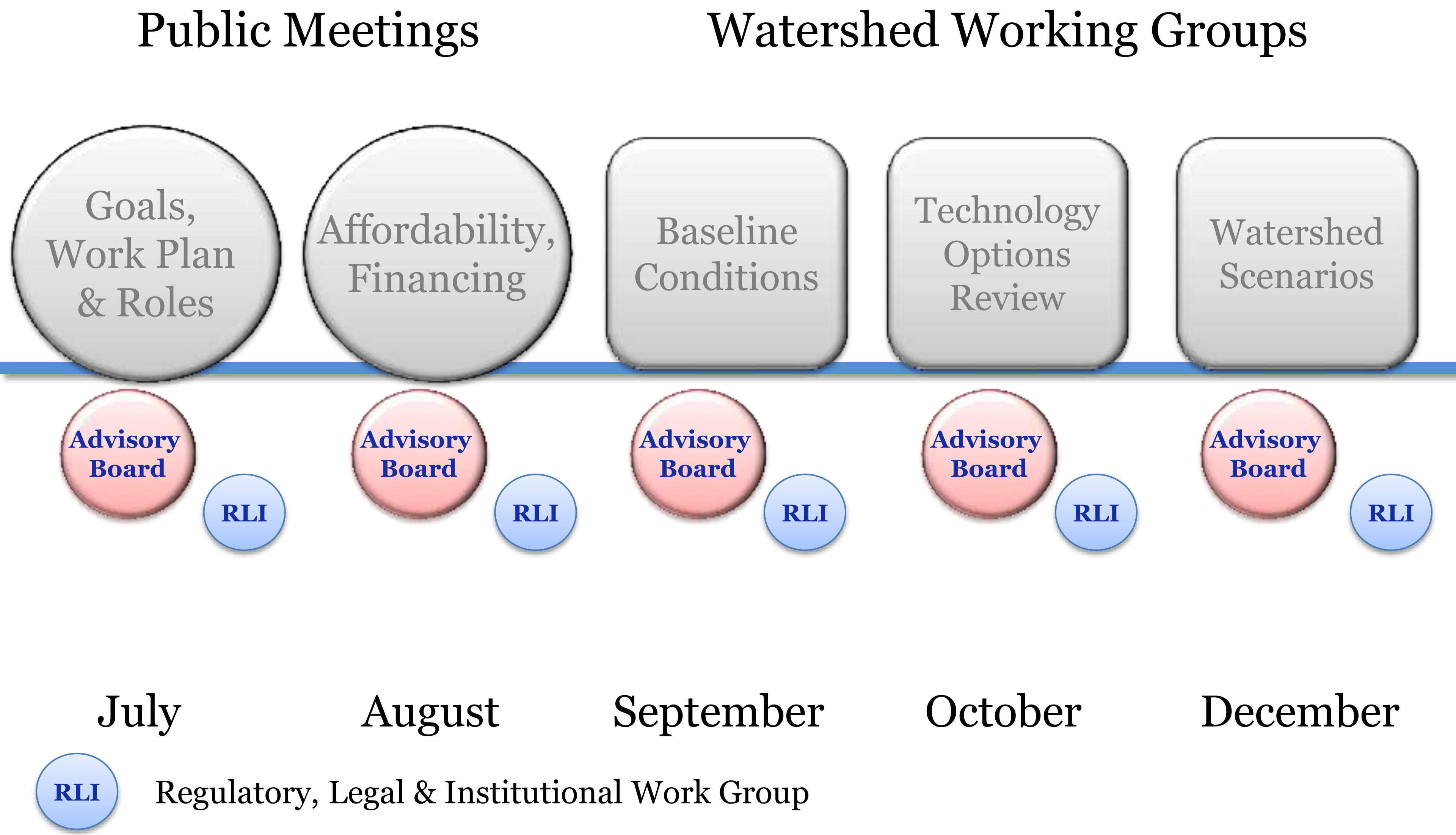
August

September

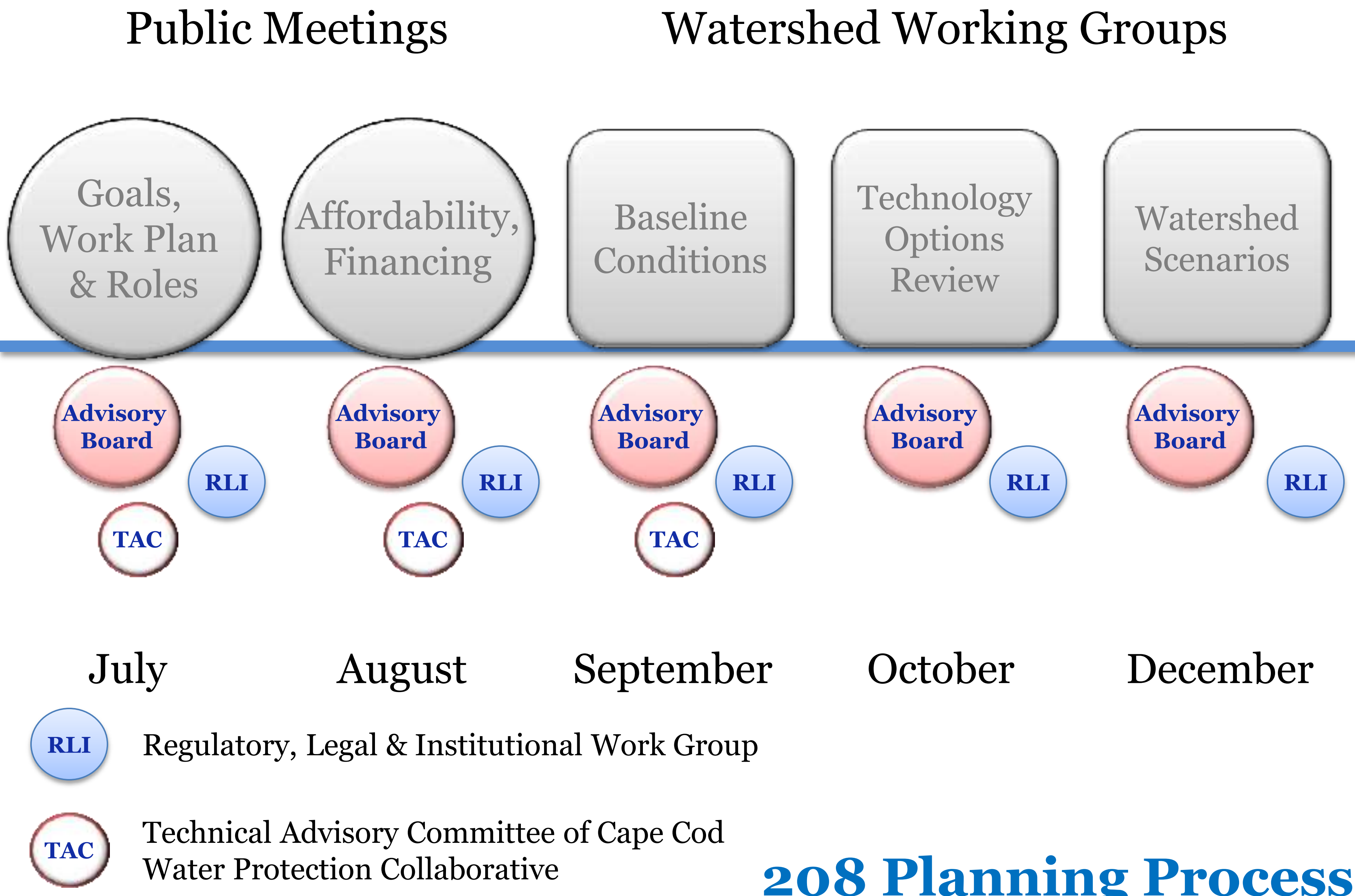
October

December

208 Planning Process



208 Planning Process


Public Meetings
Watershed Working Groups
Goals, Work Plan & Roles
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Technology Options Review
Watershed Scenarios
Advisory Board
RLI
TAC
Advisory Board
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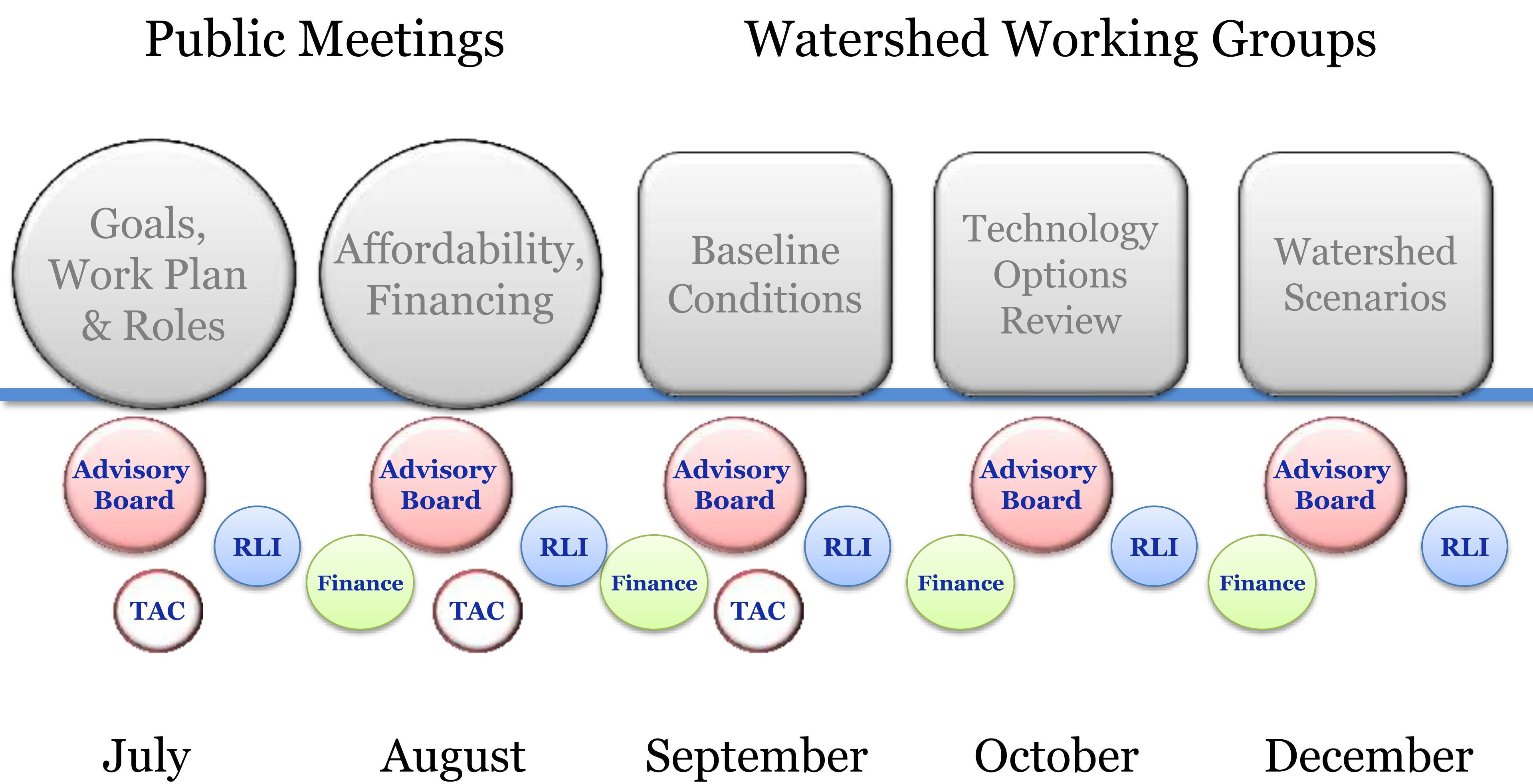
July
August
September
October
December
RLI
Regulatory, Legal & Institutional Work Group
TAC
Technical Advisory Committee of Cape Cod Water Protection Collaborative
208 Planning Process

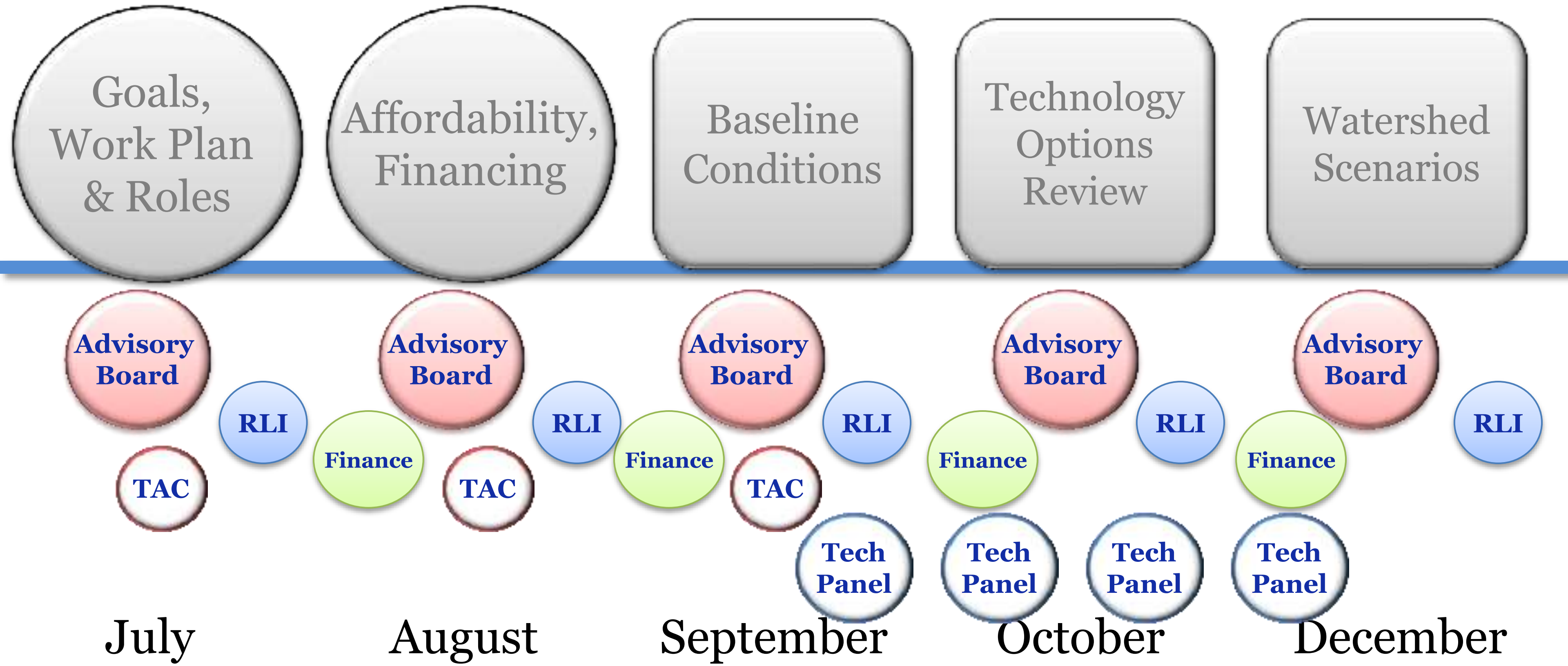


RLI Regulatory, Legal & Institutional Work Group

TAC Technical Advisory Committee of Cape Cod Water Protection Collaborative

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

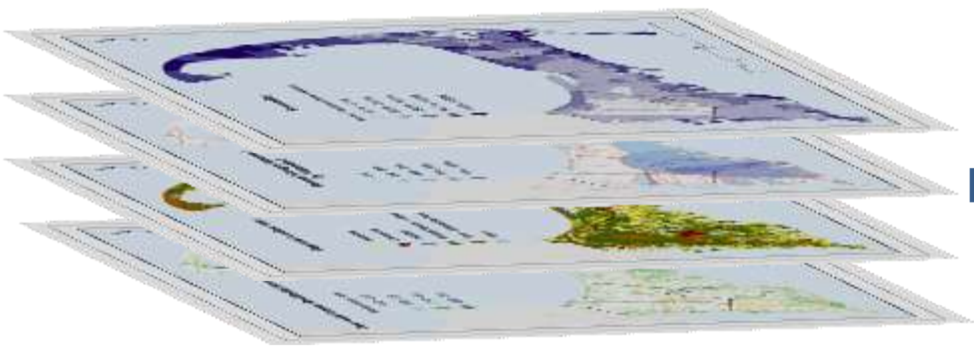
11 Working Group Meetings: Sept 18-27

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.

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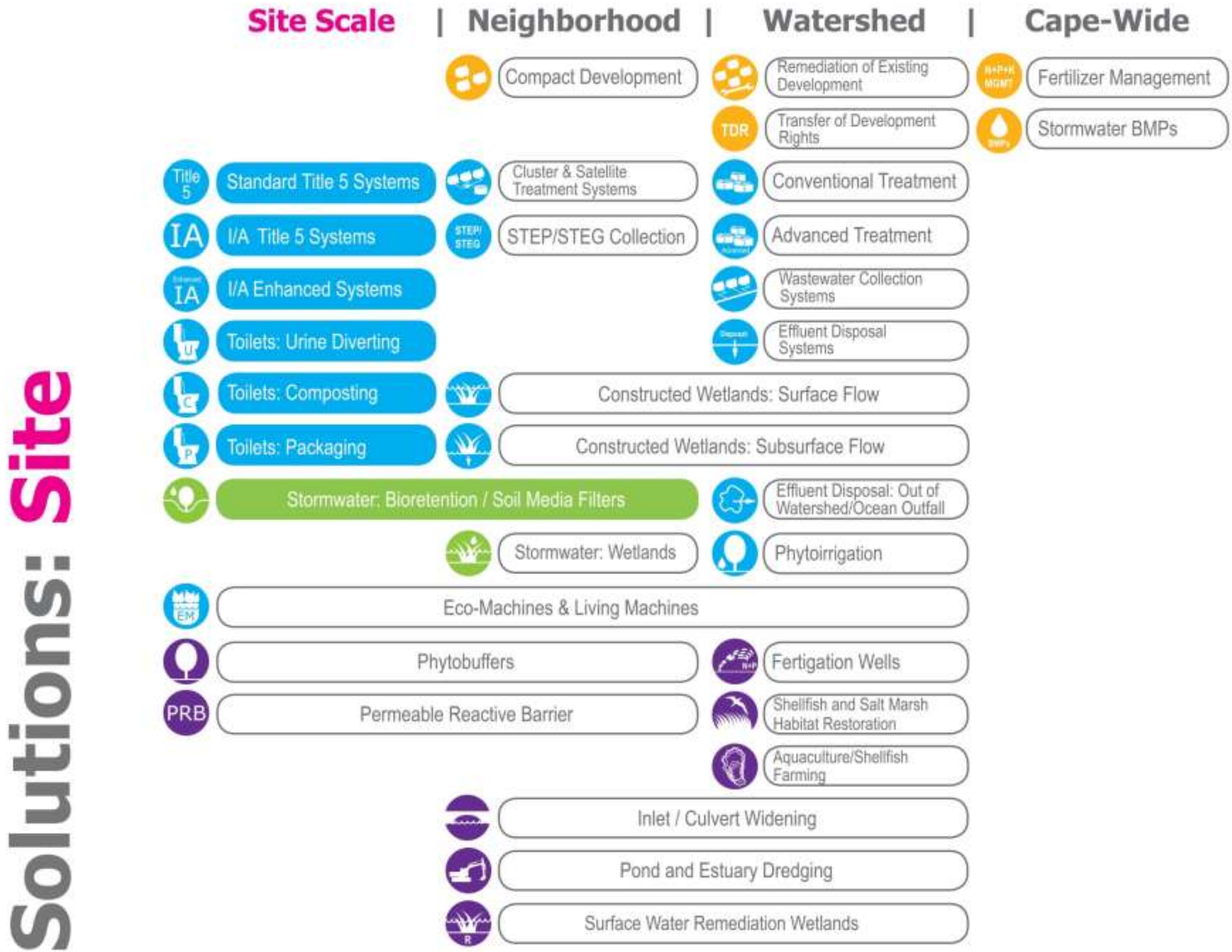
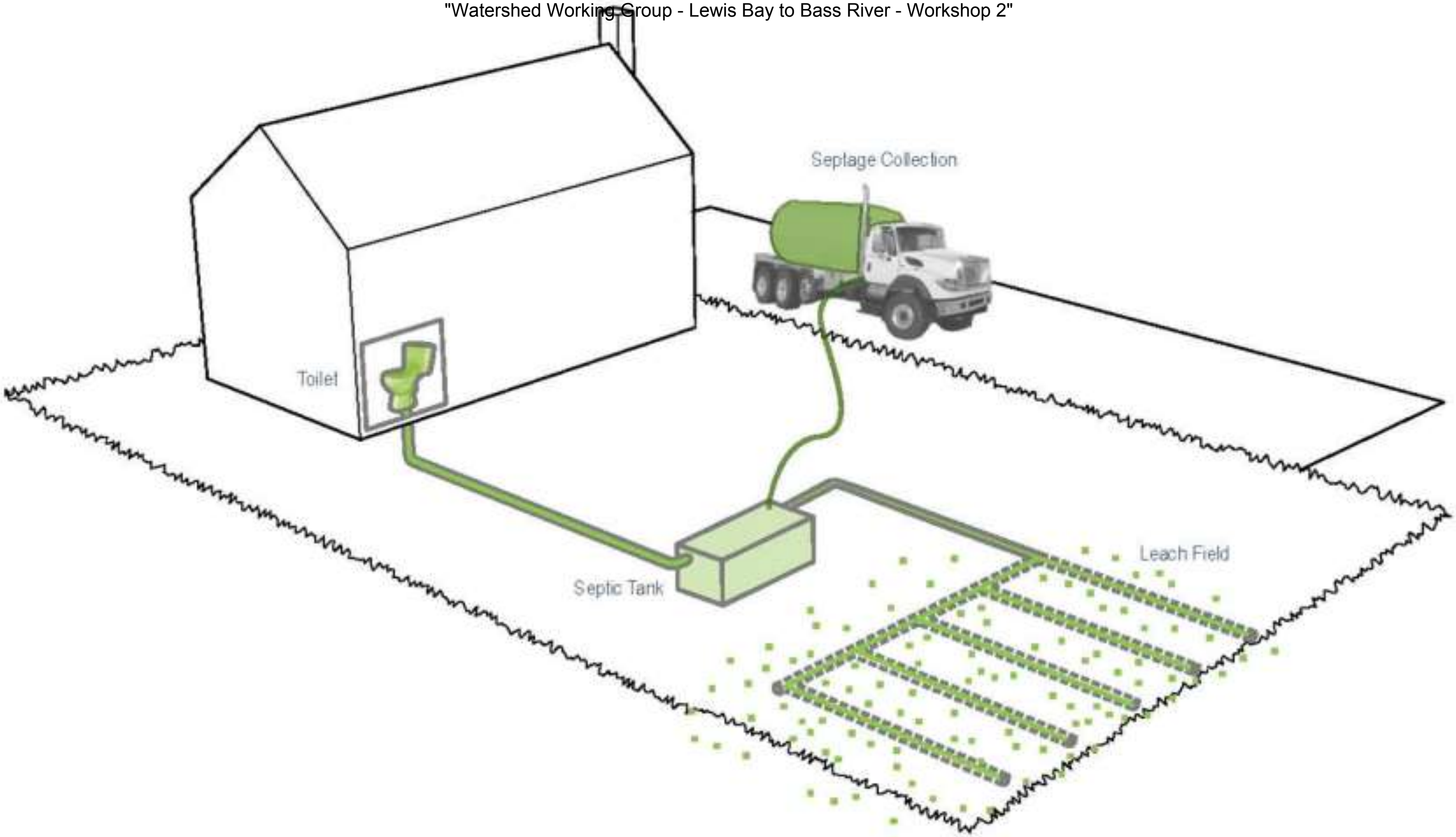
- Certain technologies or approaches will be effective at **preventing** nutrients from entering the water body. Others will be effective at **reducing** or **remediating** nutrients that are already in the groundwater or water body.
- Regulatory programs can address nutrient controls for both existing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

"Watershed Working Group - Lewis Bay to Bass River - Workshop 2"

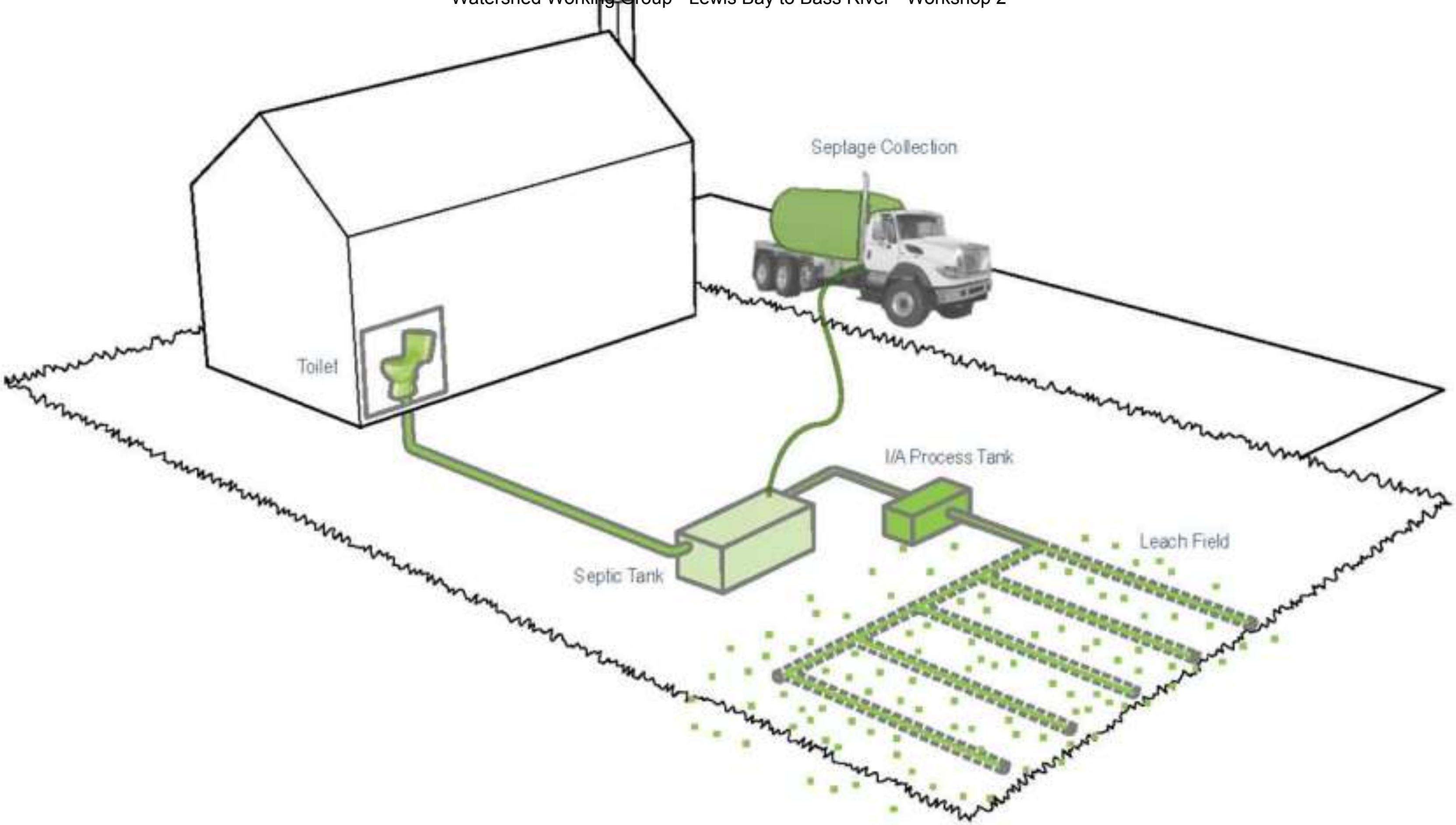

Solutions: Site
Site Scale | Neighborhood | Watershed | Cape-Wide
Compact Development
Remediation of Existing Development
N+P+K MGMT
Fertilizer Management
TDR
Transfer of Development Rights
BMPs
Stormwater BMPs
Title 5
Standard Title 5 Systems
Cluster & Satellite Treatment Systems
Conventional Treatment
IA
I/A Title 5 Systems
STEP/ STEG
STEP/STEG Collection
Advanced Treatment
IA
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
EM
Eco-Machines & Living Machines
Phytobuffers
Fertigation Wells
PRB
Permeable Reactive Barrier
Shellfish and Salt Marsh Habitat Restoration
Aquaculture/Shellfish Farming
Inlet / Culvert Widening
Pond and Estuary Dredging
Surface Water Remediation Wetlands



Scale: SITE
Target: WASTEWATER

Standard Title 5 Systems

Title 5



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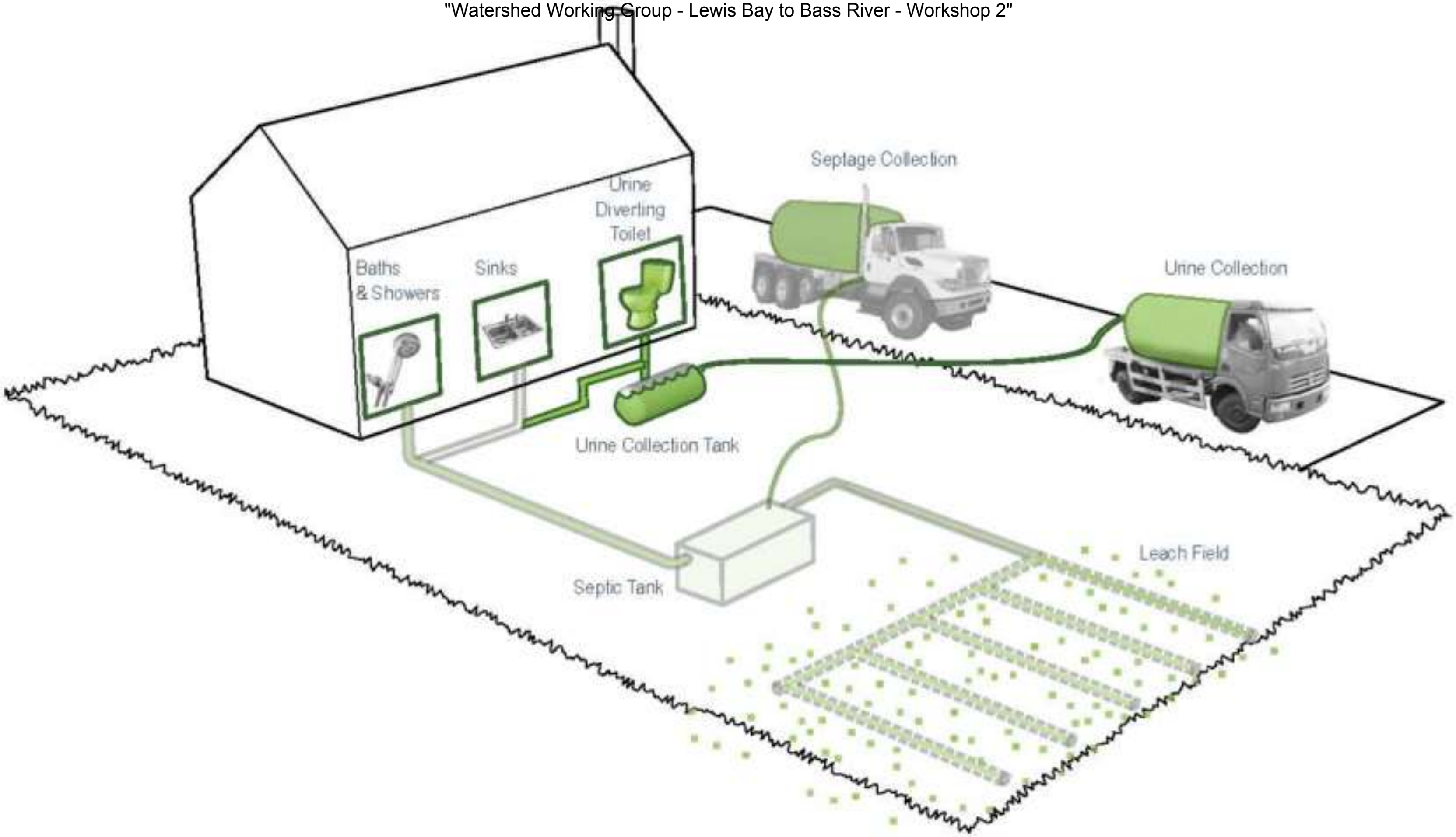
Target: WASTEWATER

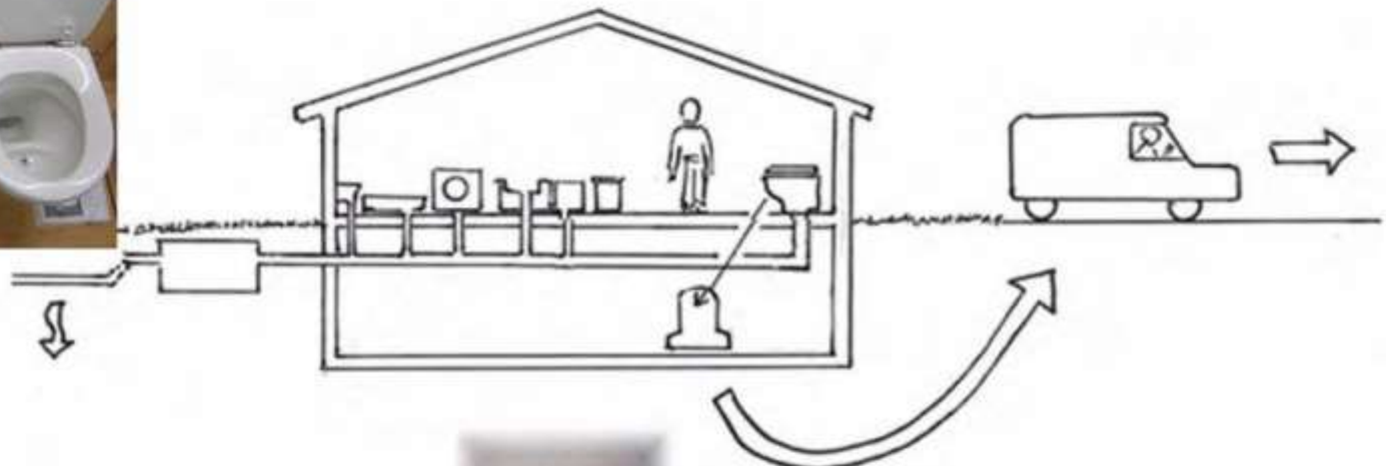
I/A Title 5 Systems

IA



Scale: SITE
Target: WASTEWATER

Toilets: Urine Diverting



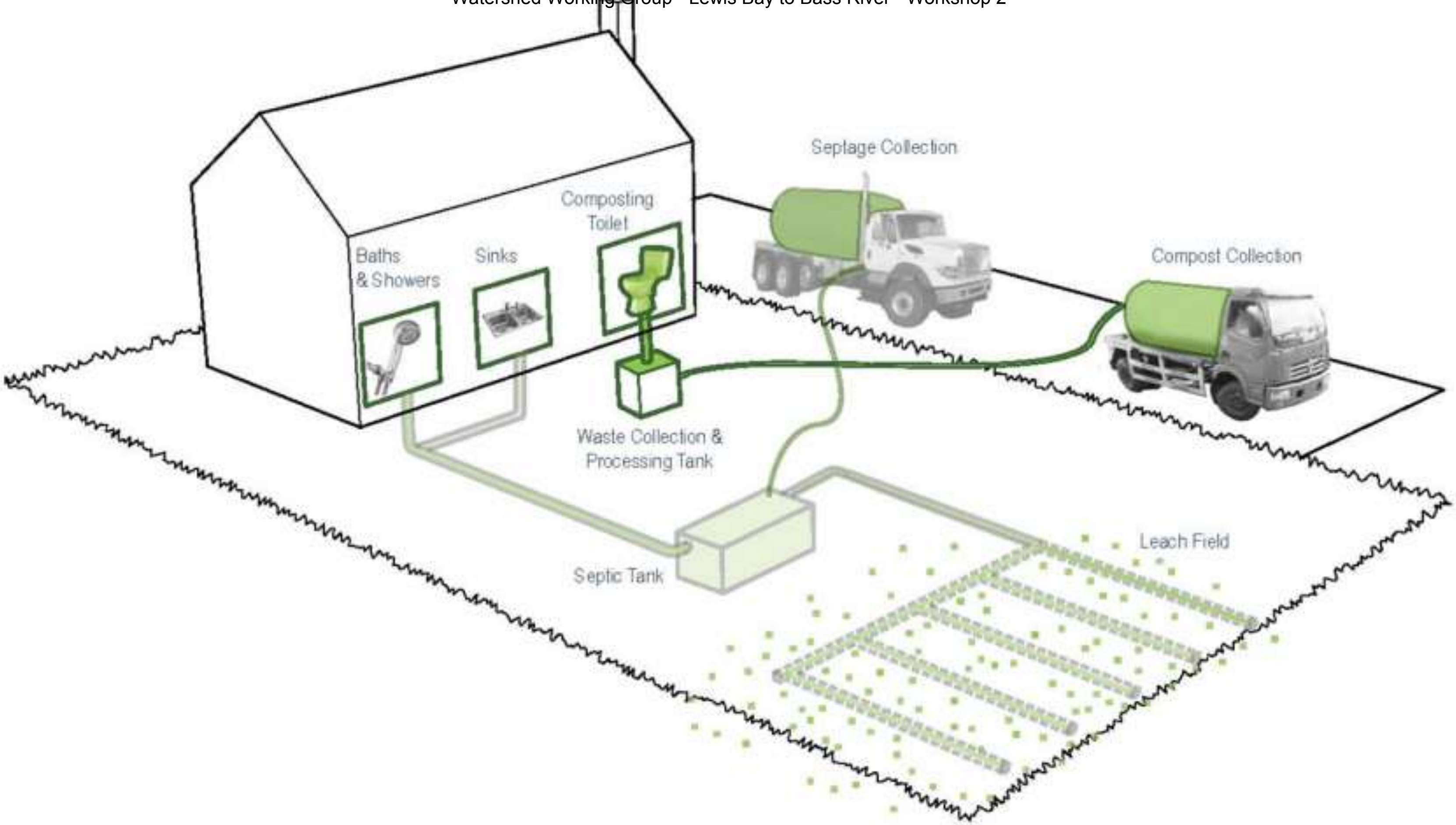
Waterless
Urinal

IBC container
(220 gallons)

40" x 40" x48"

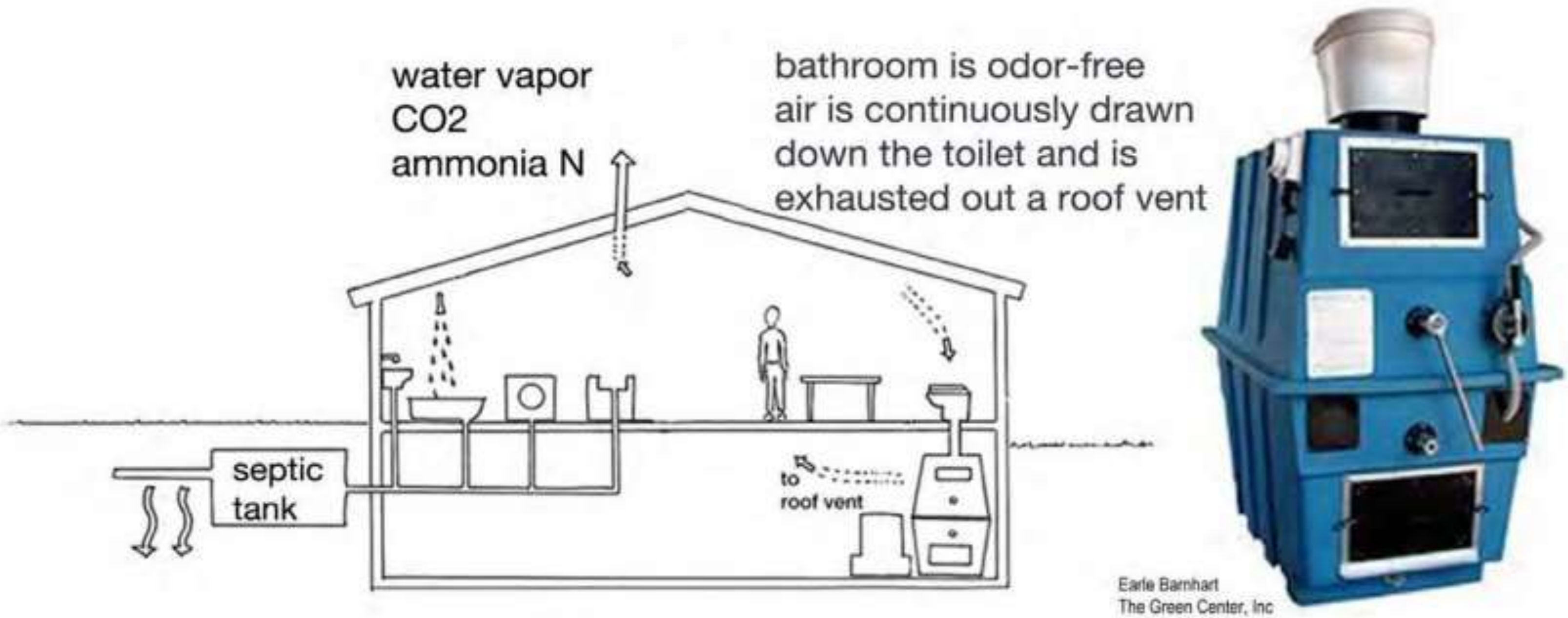
Source: Earle Barnhart, The Green Center Inc. and Horsley-Witten Group Inc.

Toilets: Urine Diverting



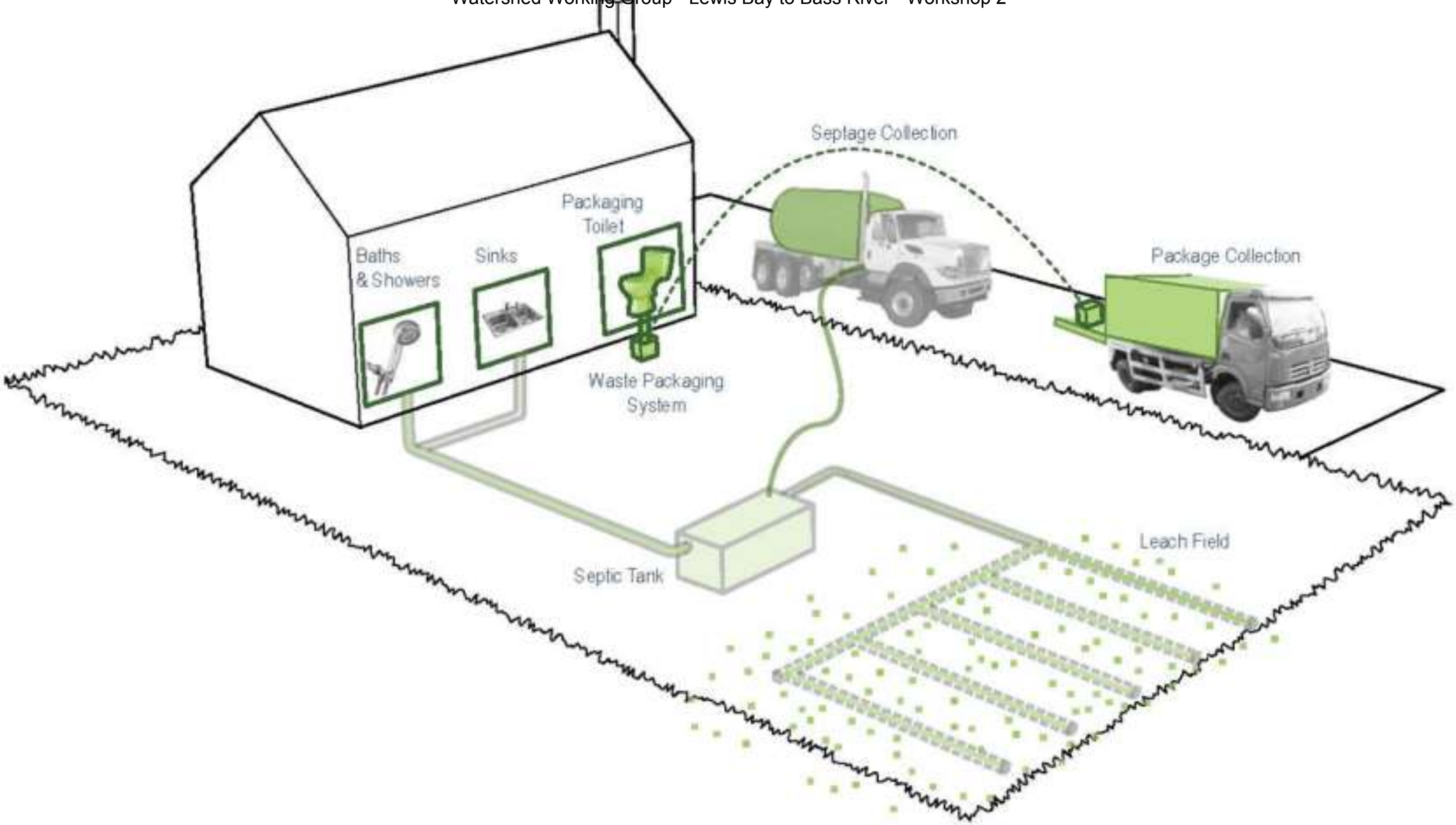
Scale: SITE
Target: WASTEWATER

Toilets: Composting



Source: Earle Barnhart, The Green Center Inc.

Toilets: Composting



Scale: SITE
Target: WASTEWATER

Toilets: Packaging

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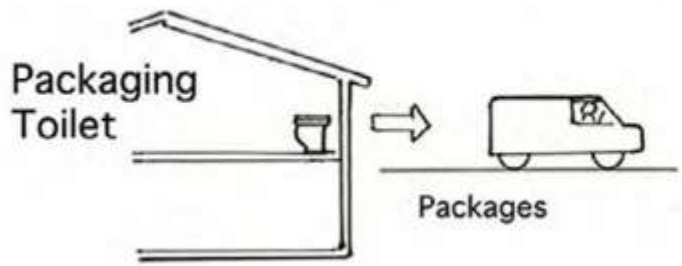
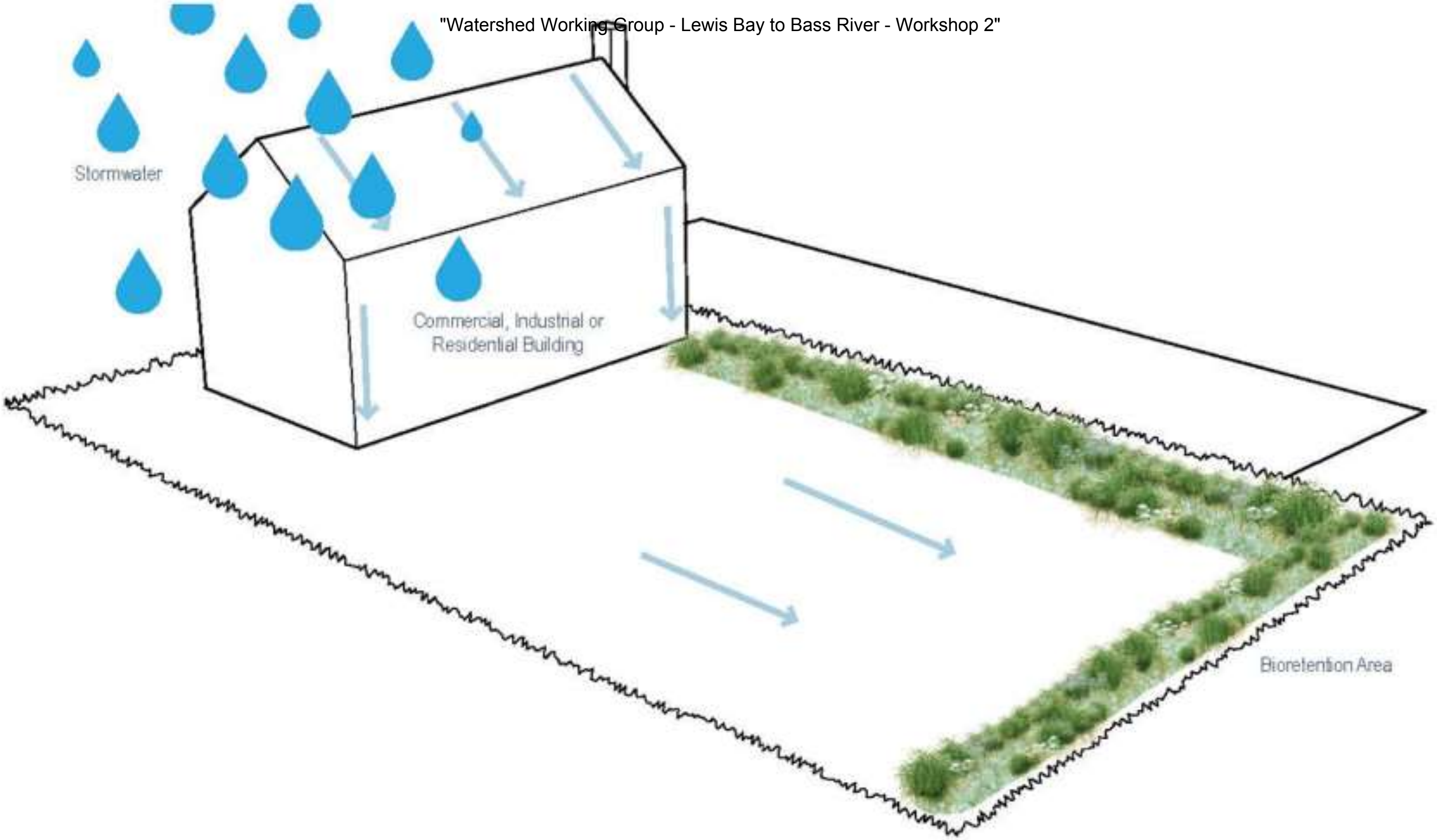


Source: Earle Barnhart, The Green Center Inc.

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
- 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
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- 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
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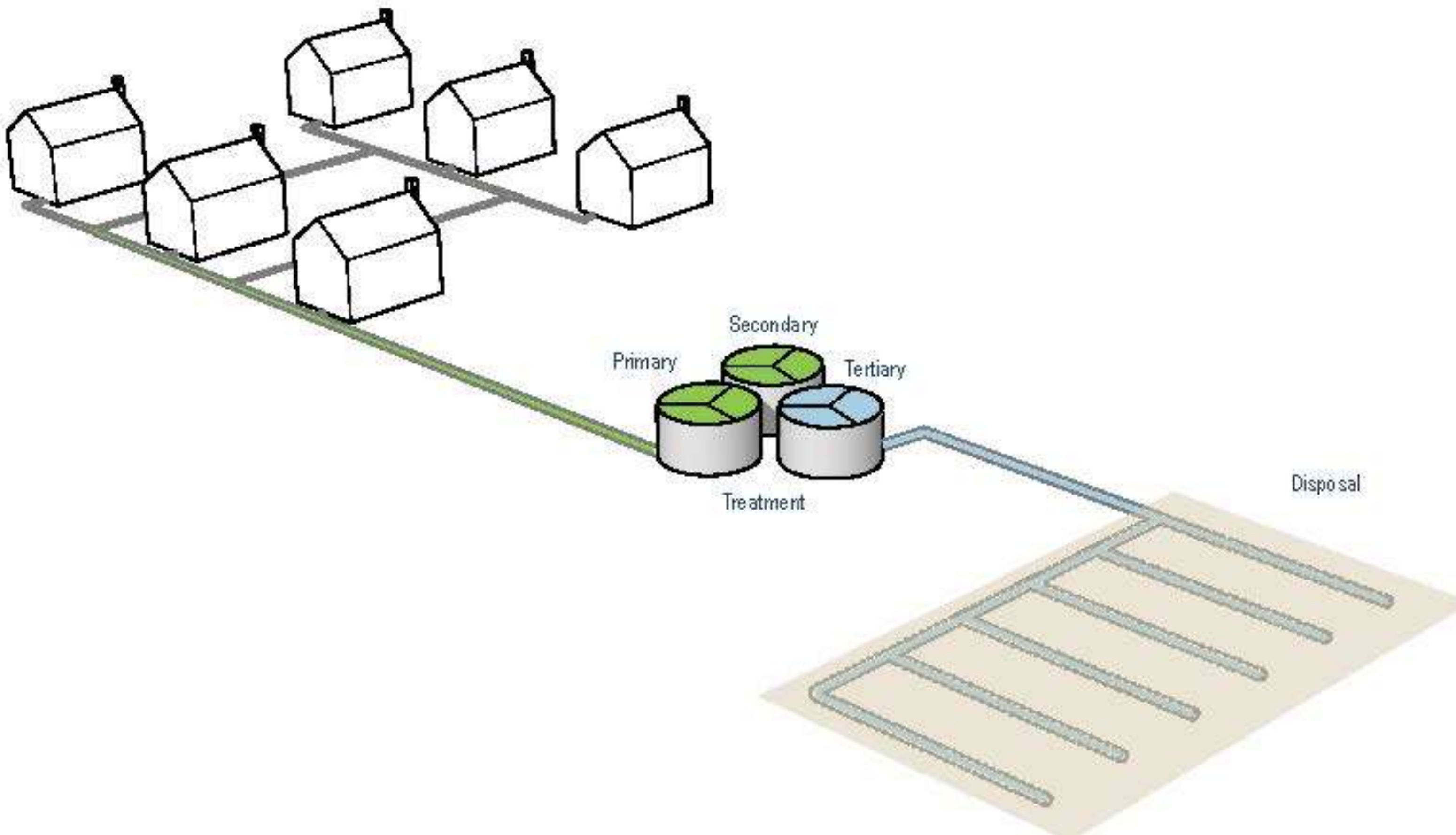
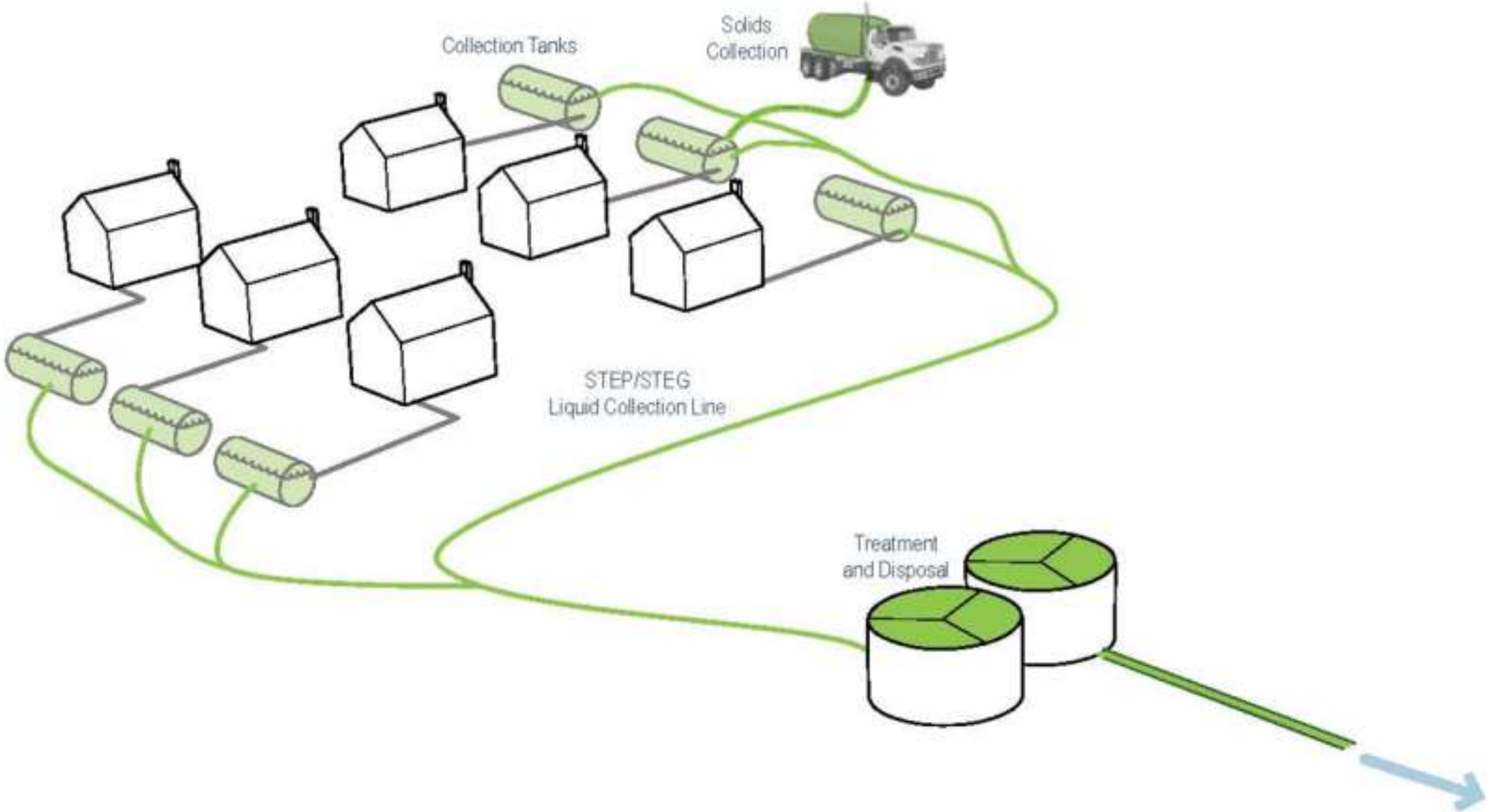


Scale: NEIGHBORHOOD
Target: WASTEWATER

Cluster & Satellite Treatment Systems



Scale: NEIGHBORHOOD
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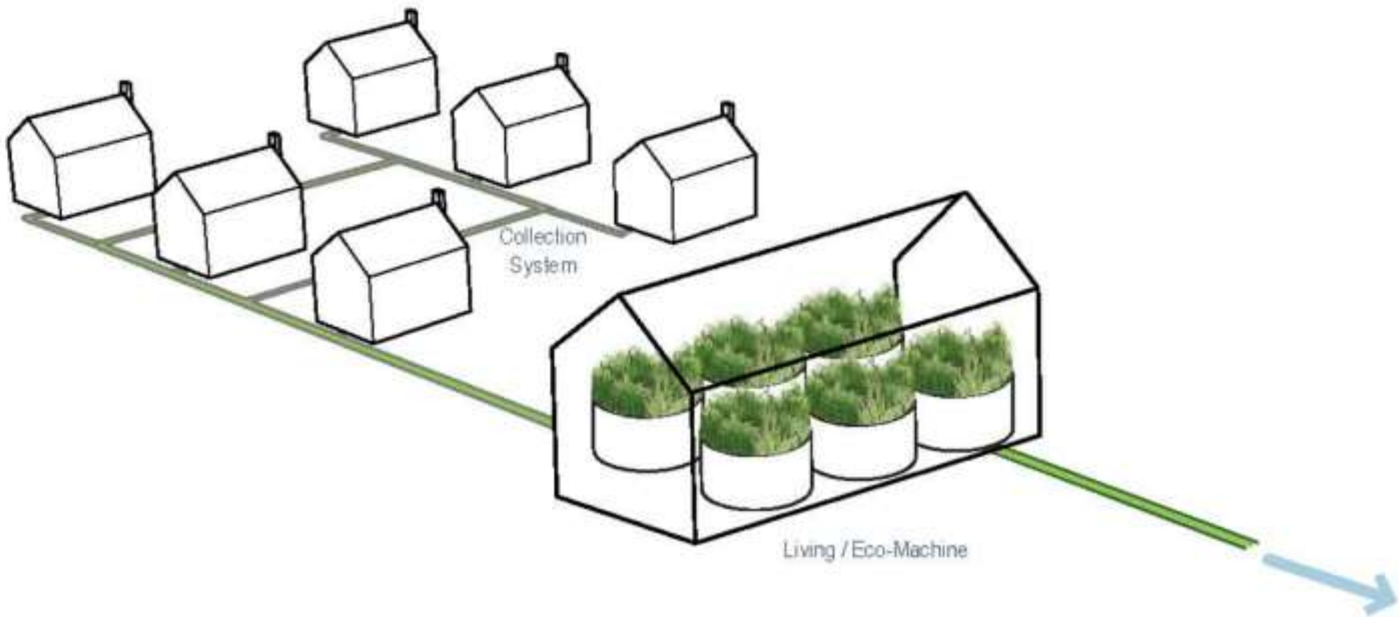
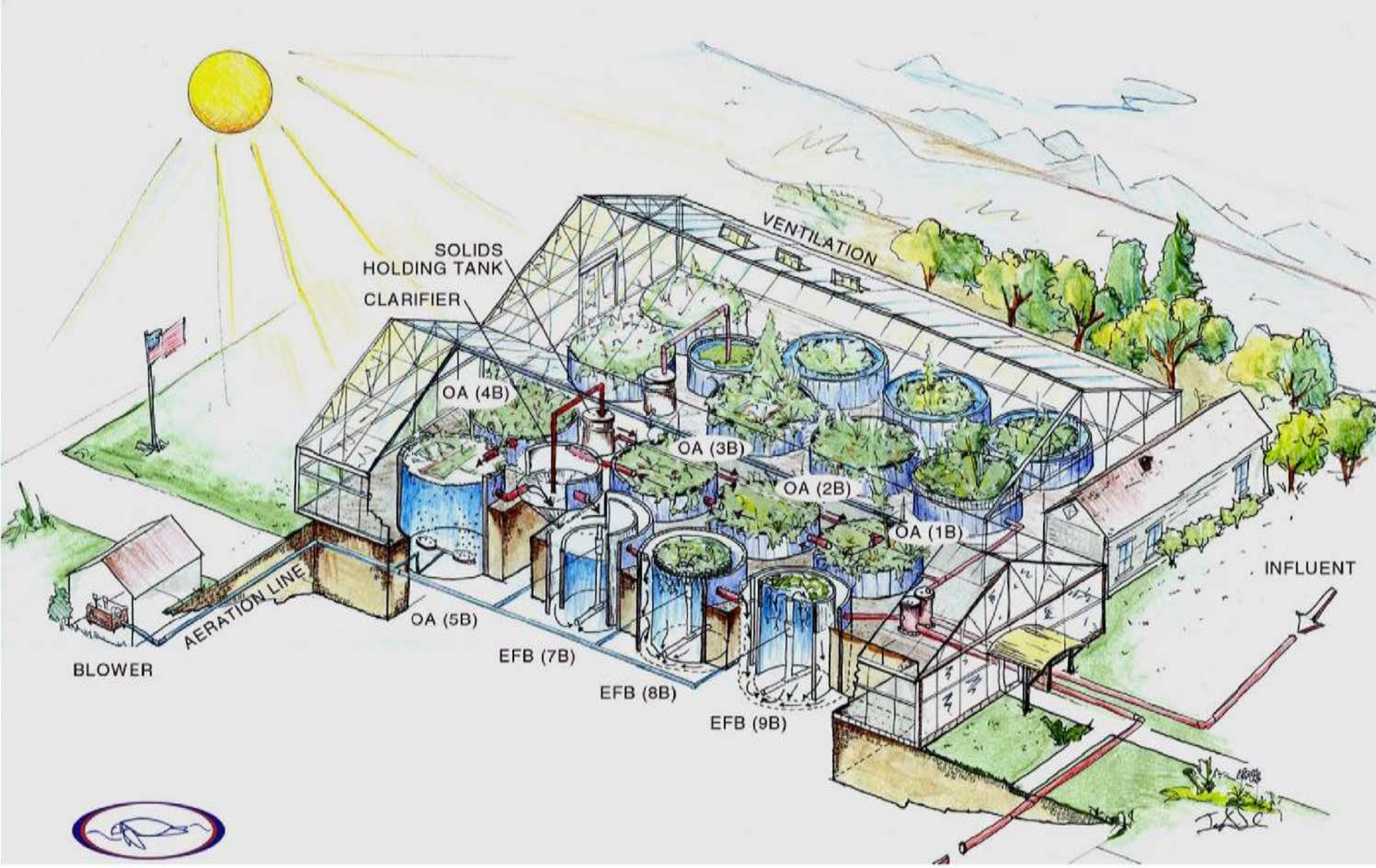
STEP / STEG Collection

STEP/ STEG



Scale: NEIGHBORHOOD
Target: WASTEWATER

Eco-Machines and
Living Machines



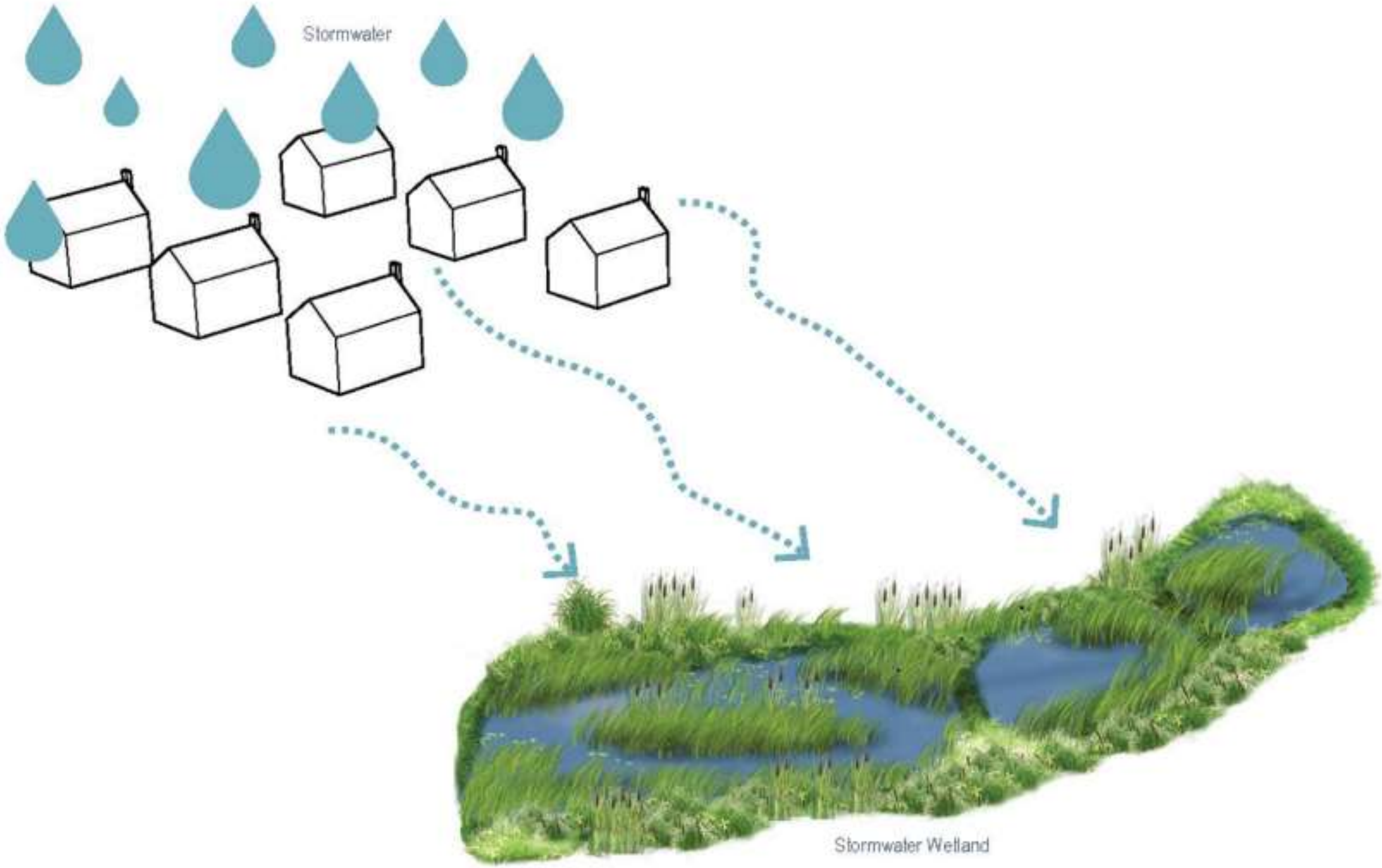
Precedent: Living Machine, South Burlington, VT

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

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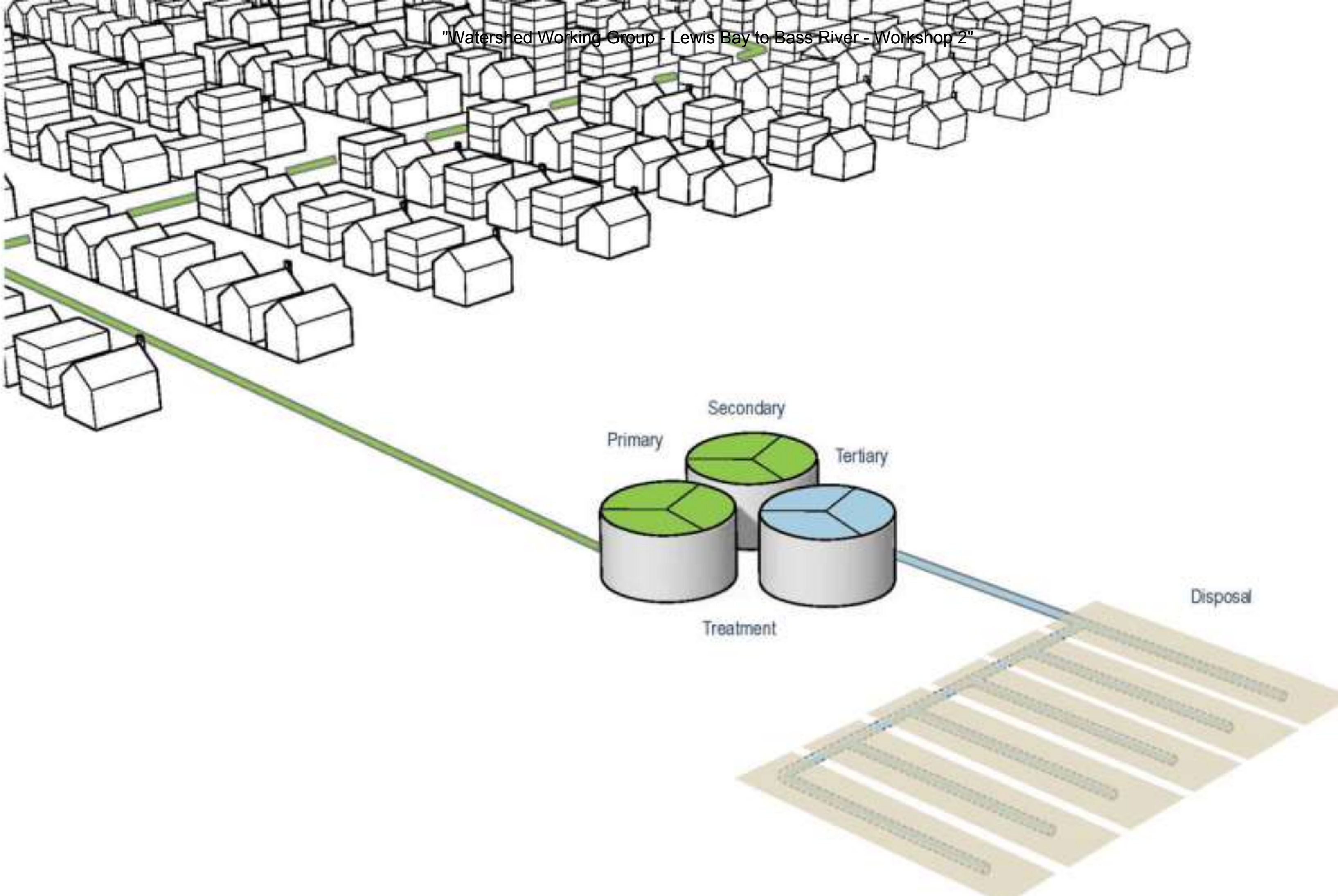
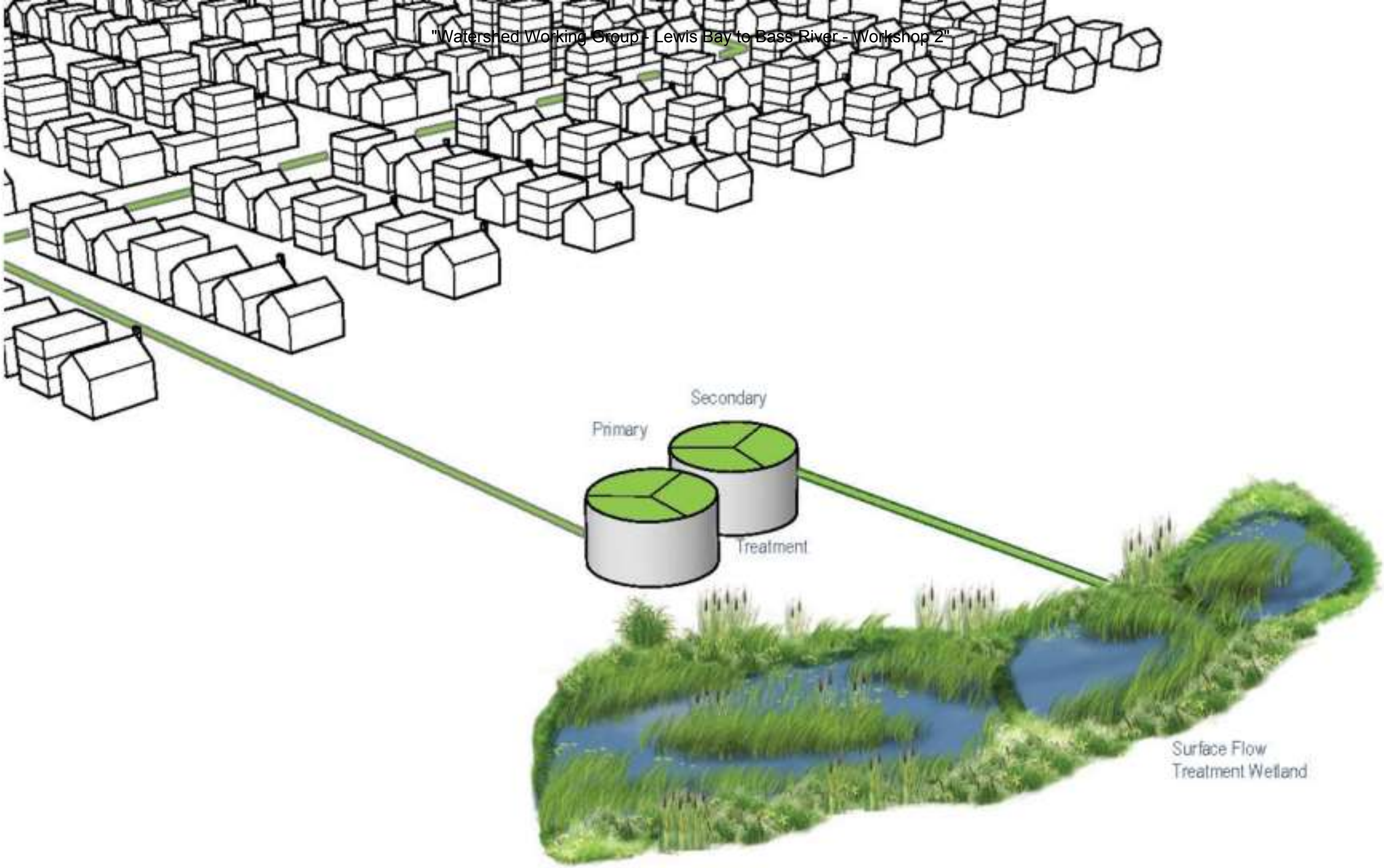


Scale: WATERSHED
Target: WASTEWATER

Conventional Treatment



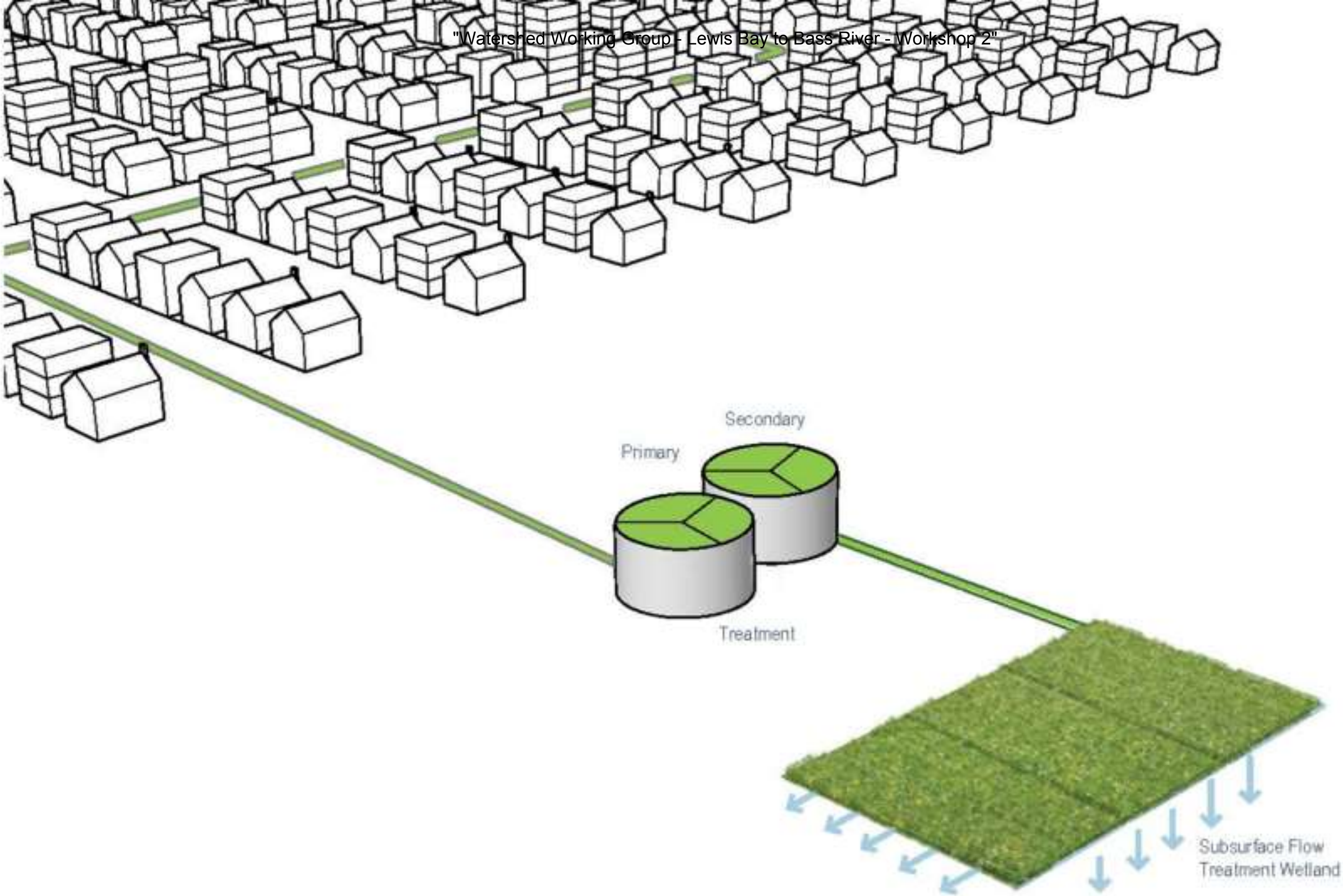
Scale: WATERSHED
Target: WASTEWATER

Constructed Wetlands:
Surface Flow

Precedent: Talking Waters Garden - Albany, OR

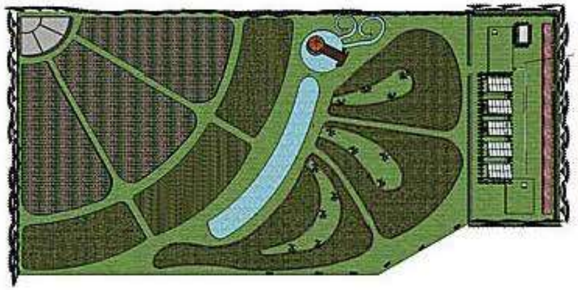
Source: Kate Kennen

Constructed Wetlands: Surface Flow



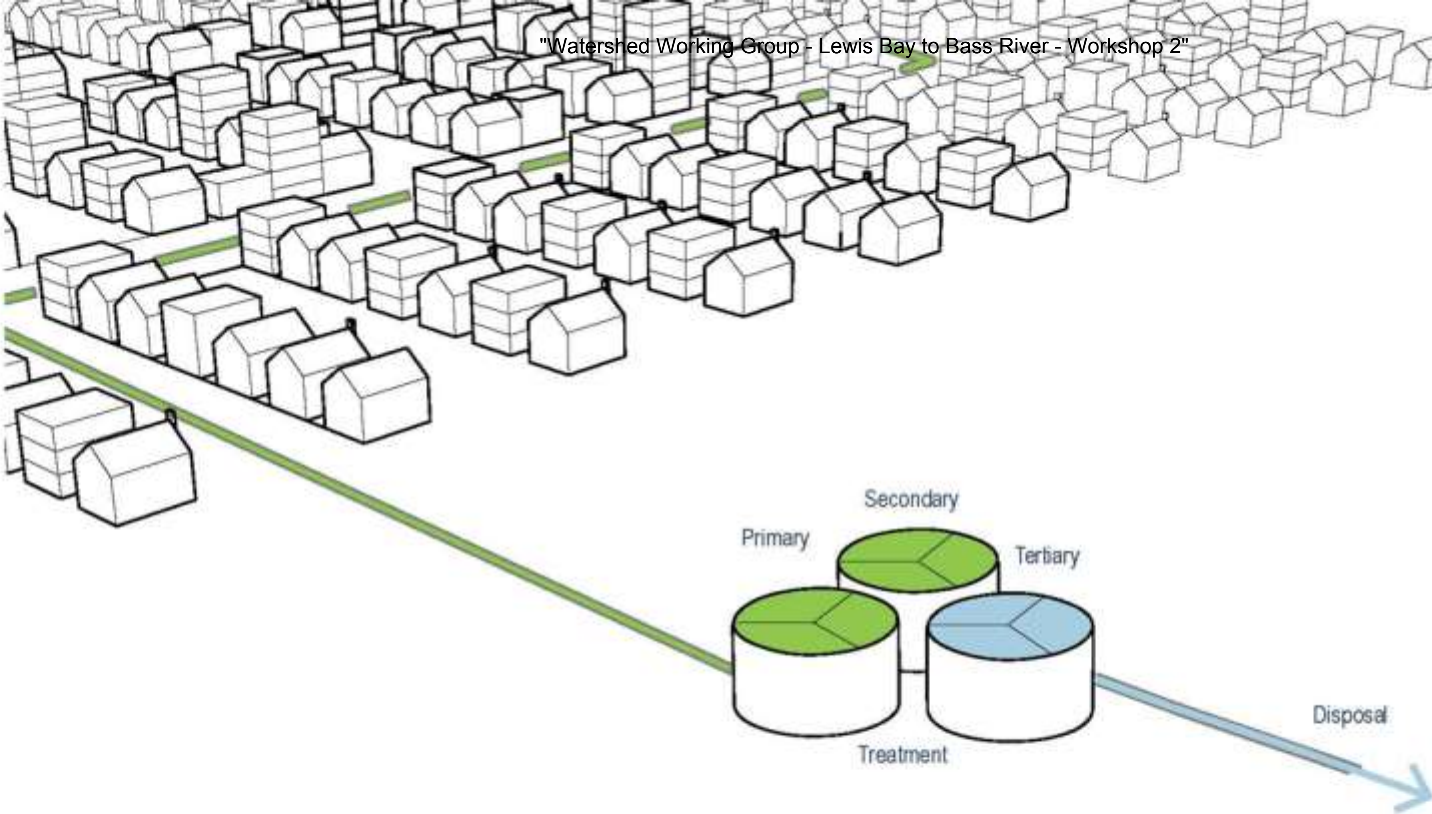
Scale: WATERSHED
Target: WASTEWATER

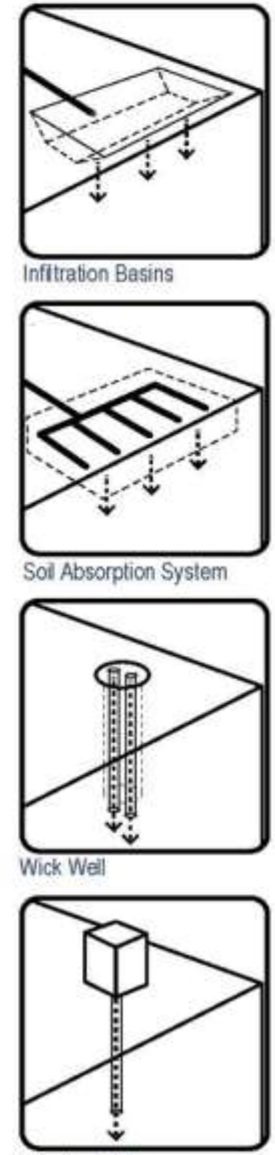
Constructed Wetlands:
Subsurface Flow



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

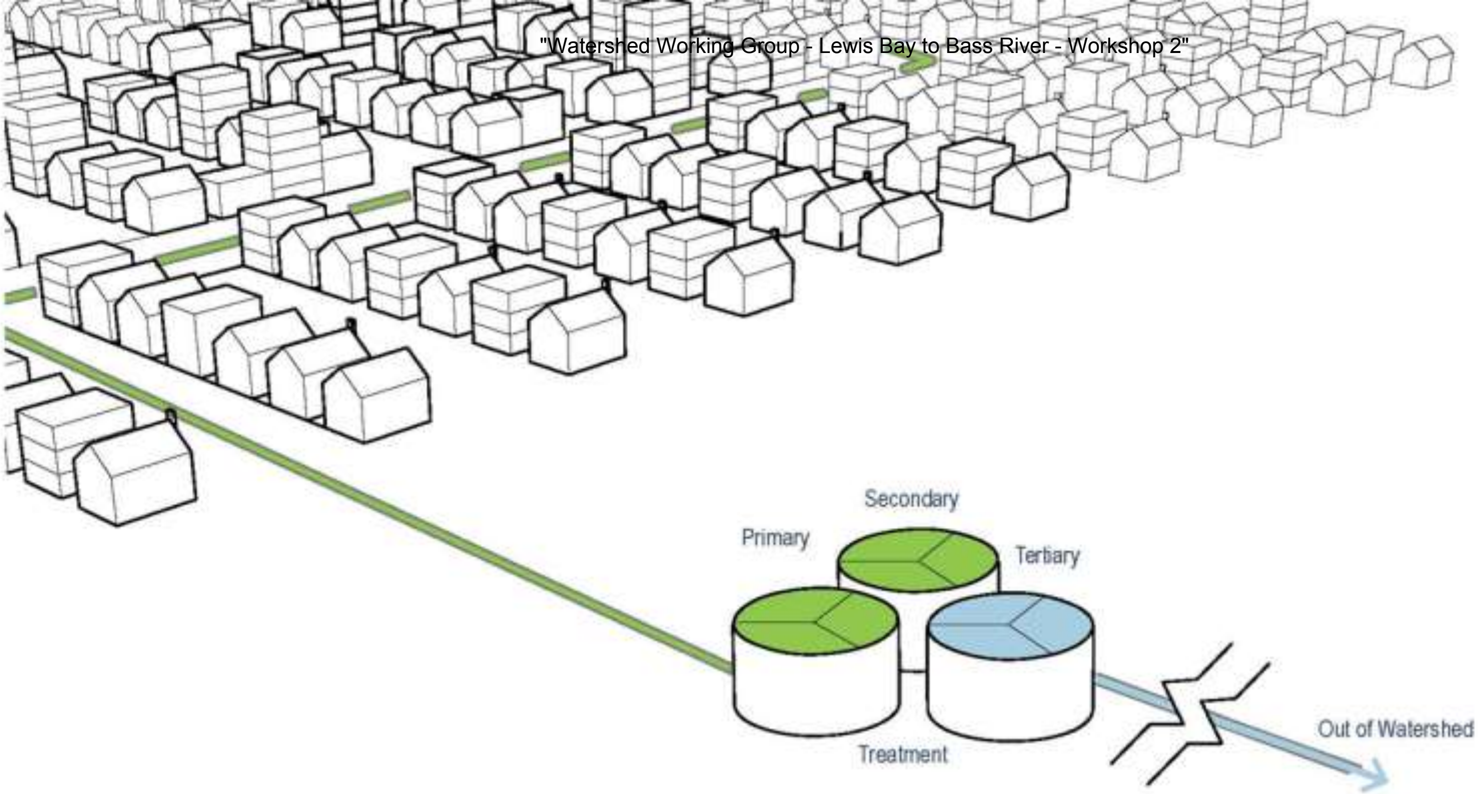
Constructed Wetlands:
Subsurface Flow





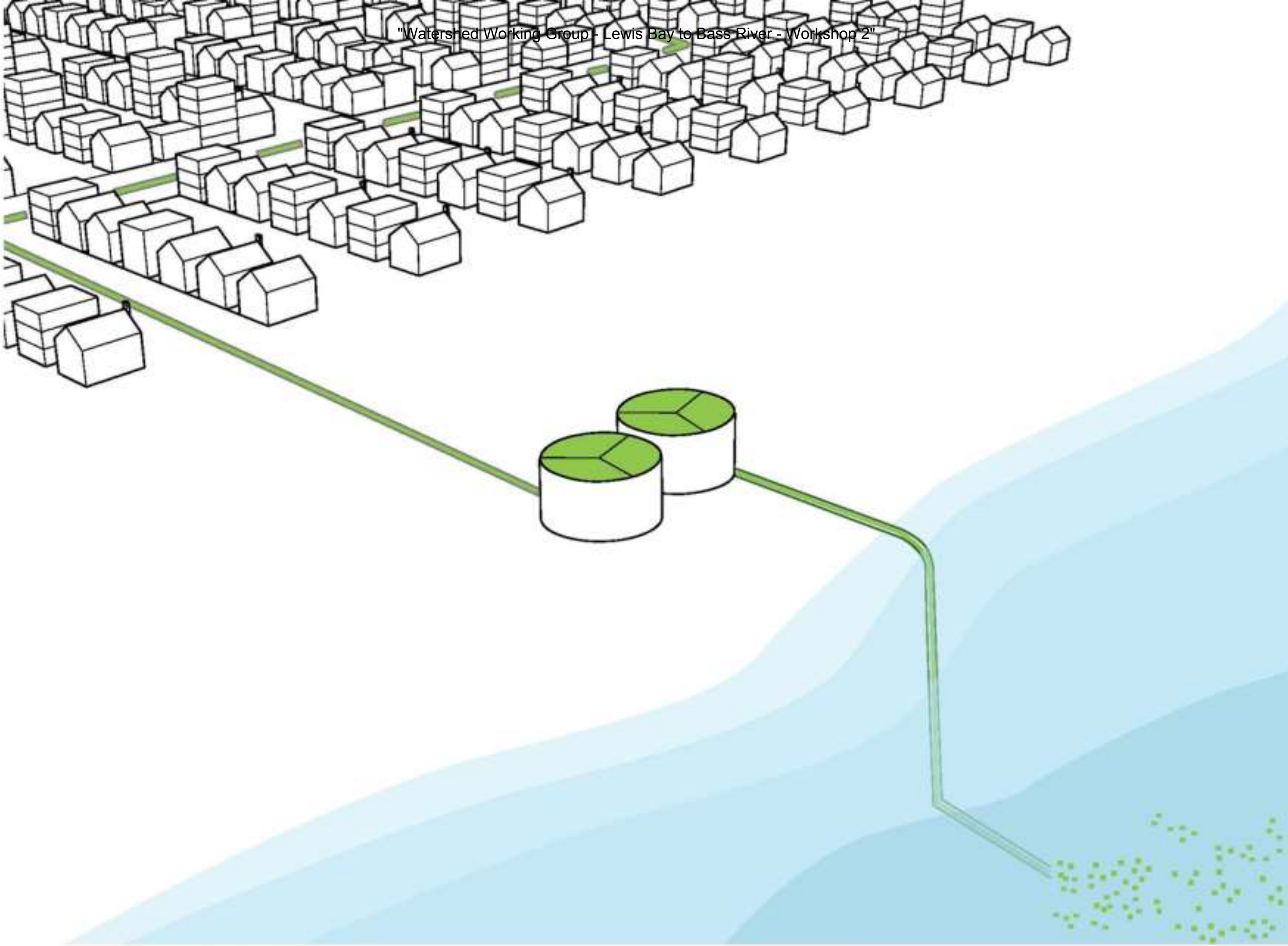
Scale: WATERSHED
Target: WASTEWATER

Effluent Disposal Systems



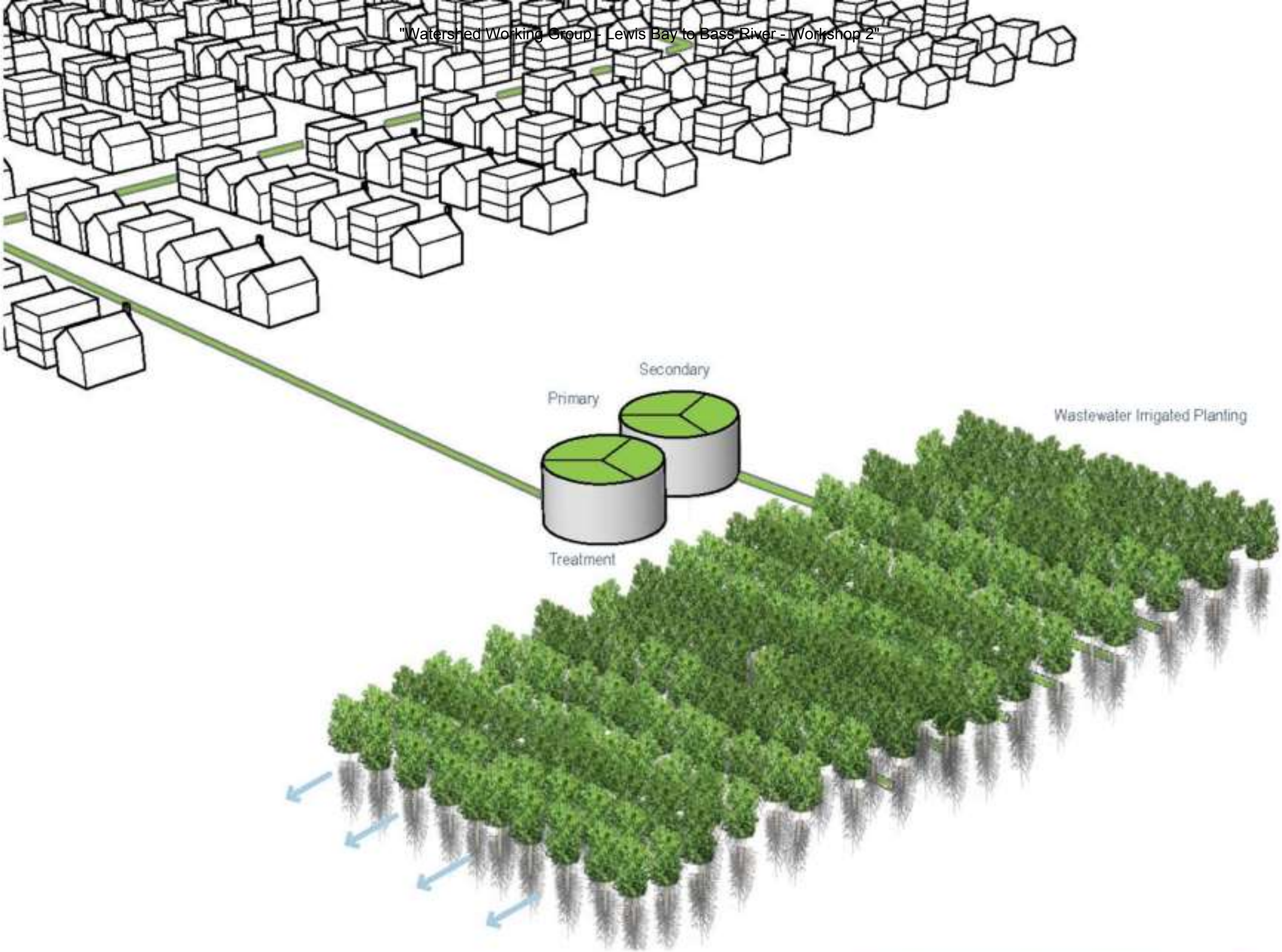
Scale: WATERSHED
Target: WASTEWATER

Effluent Disposal: Out of Watershed



Scale: WATERSHED
Target: WASTEWATER

Effluent Disposal: Ocean Outfall



Scale: WATERSHED
Target: WASTEWATER

Phytoirrigation

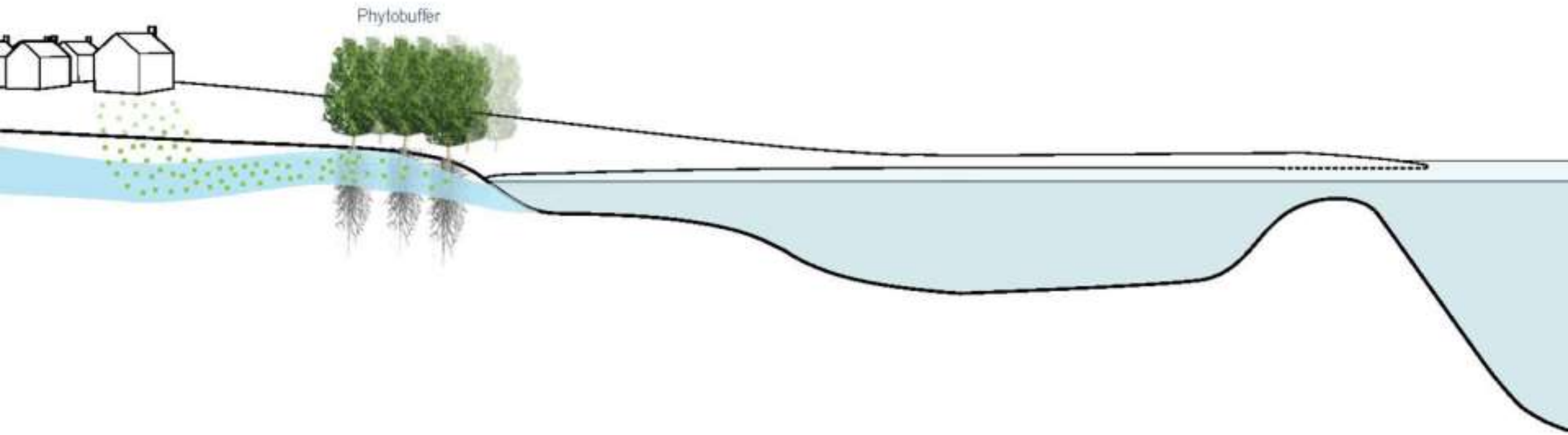
Precedent: Woodburn OR, Wastewater Treatment Facility
Source: CH2MHill

Phytoirrigation

Precedent: Woodburn OR, Wastewater Treatment Facility
Source: CH2MHill

Phytoirrigation

"Watershed Working Group - Lewis Bay to Bass River - Workshop 2"

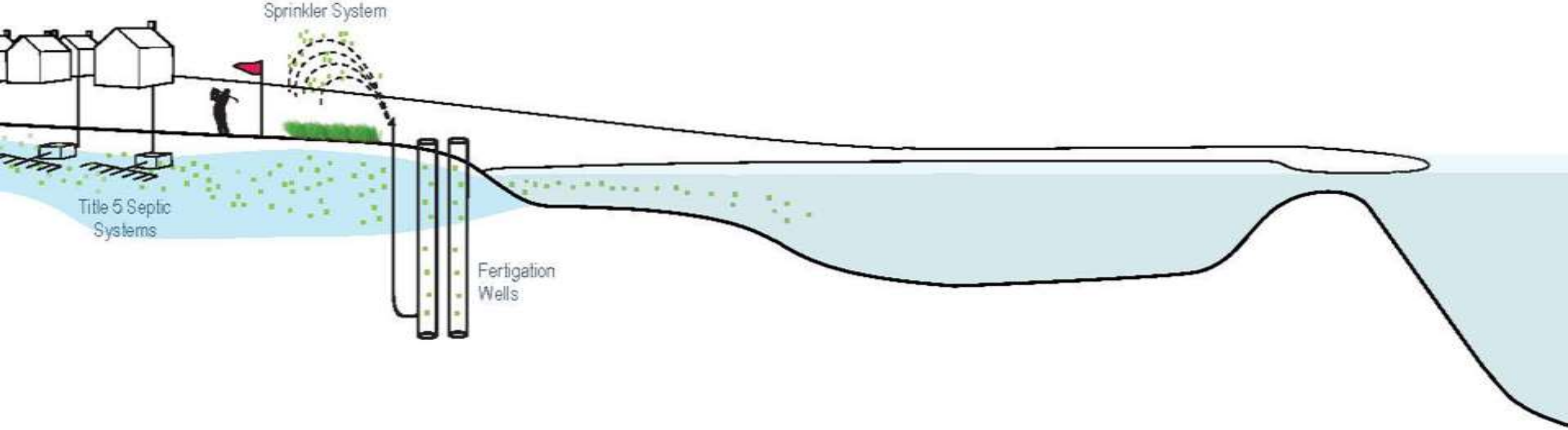


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Phytobuffers

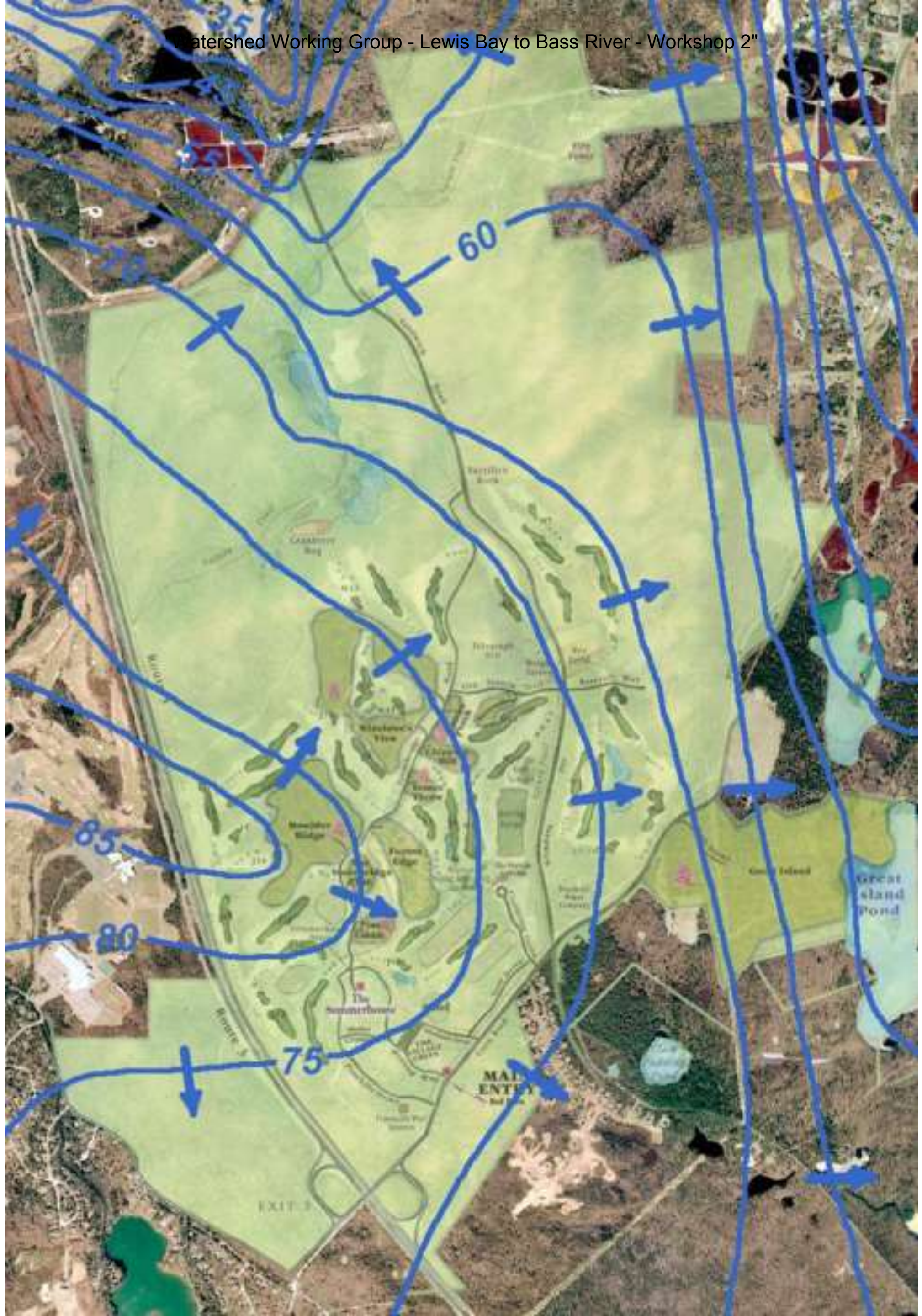
Precedent: Phytobuffer - Kavcee, WY
Source: Sand Creek Consultants

Phytobuffers

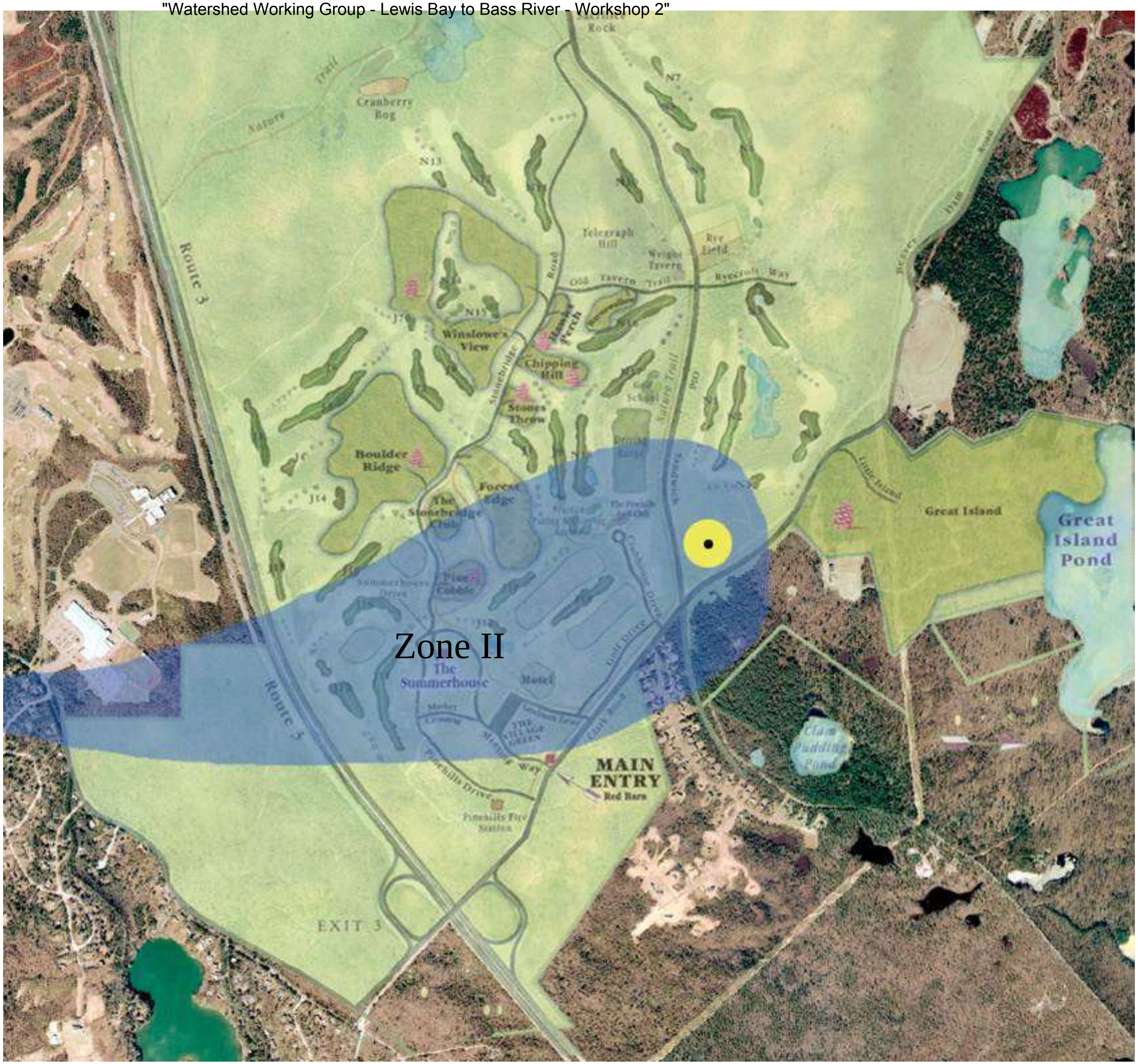


Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Fertigation Wells



Precedent:
Pine Hills
Plymouth, MA



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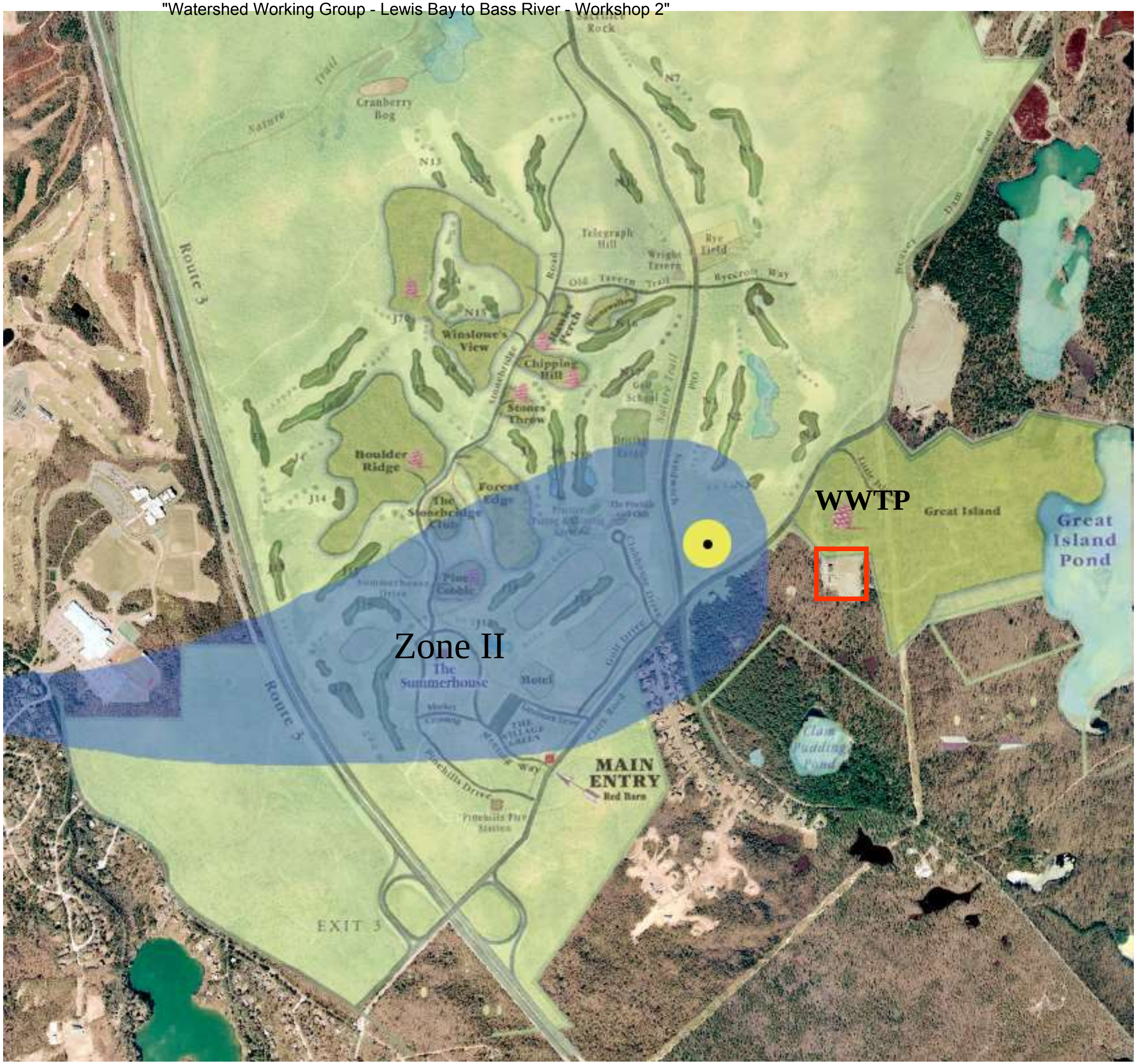

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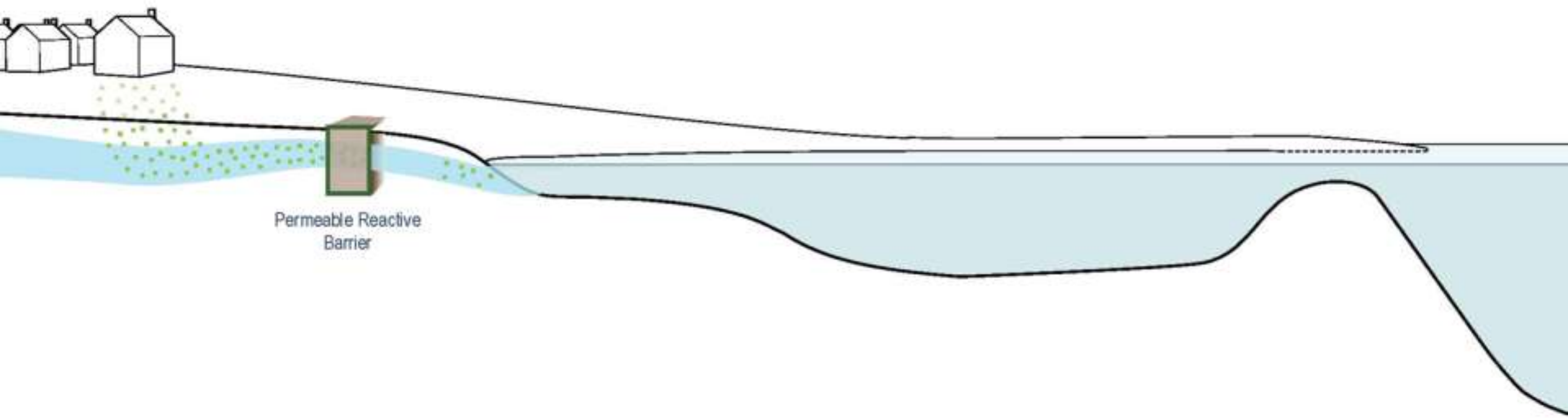
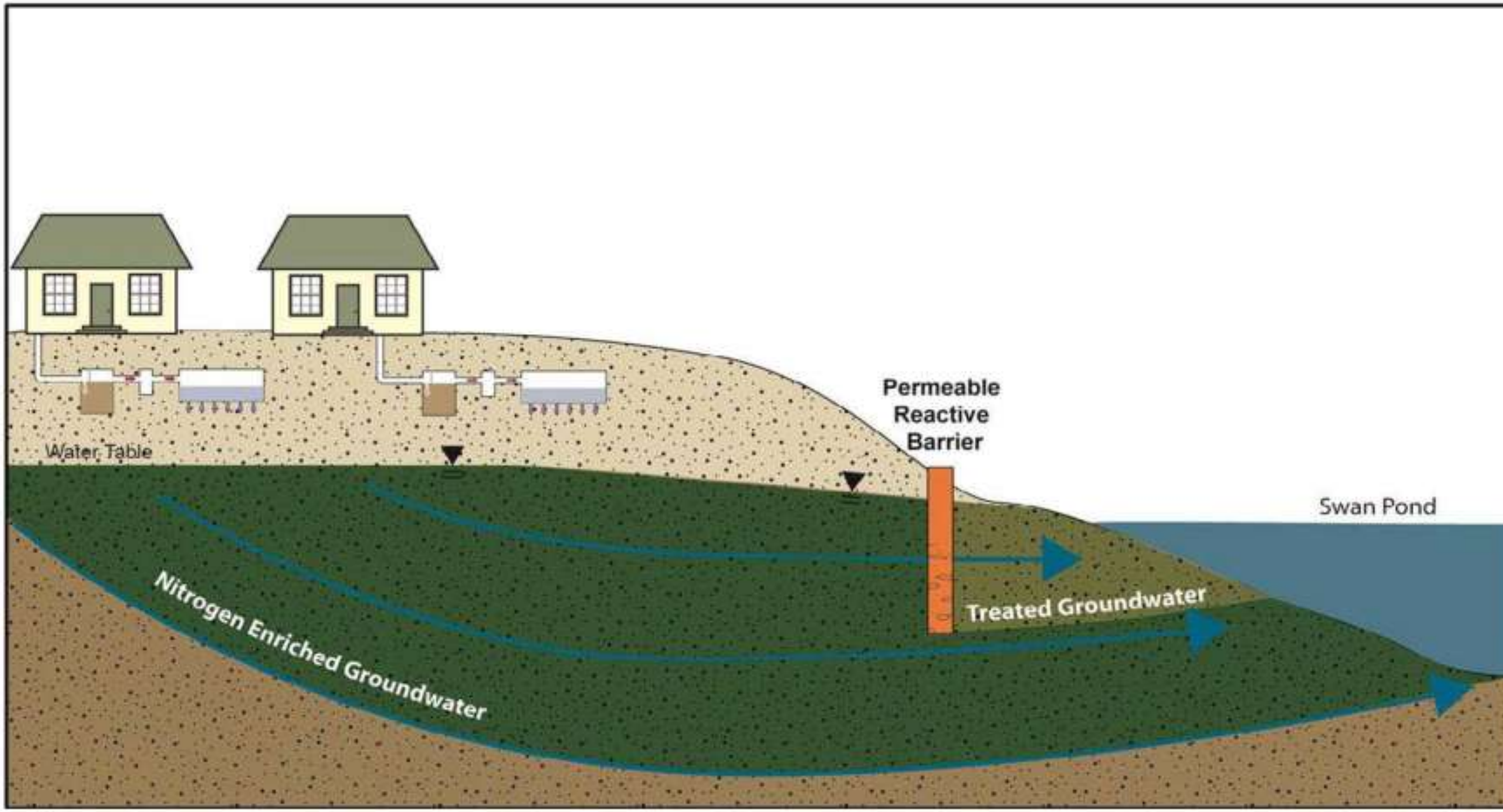


Scale: SITE / NEIGHBORHOOD / WATERSHED
Target: EXISTING WATER BODIES

Permeable Reactive Barrier PRB



Precedent: PRB
Source: Horsley Witten Group Inc.

Permeable Reactive Barrier

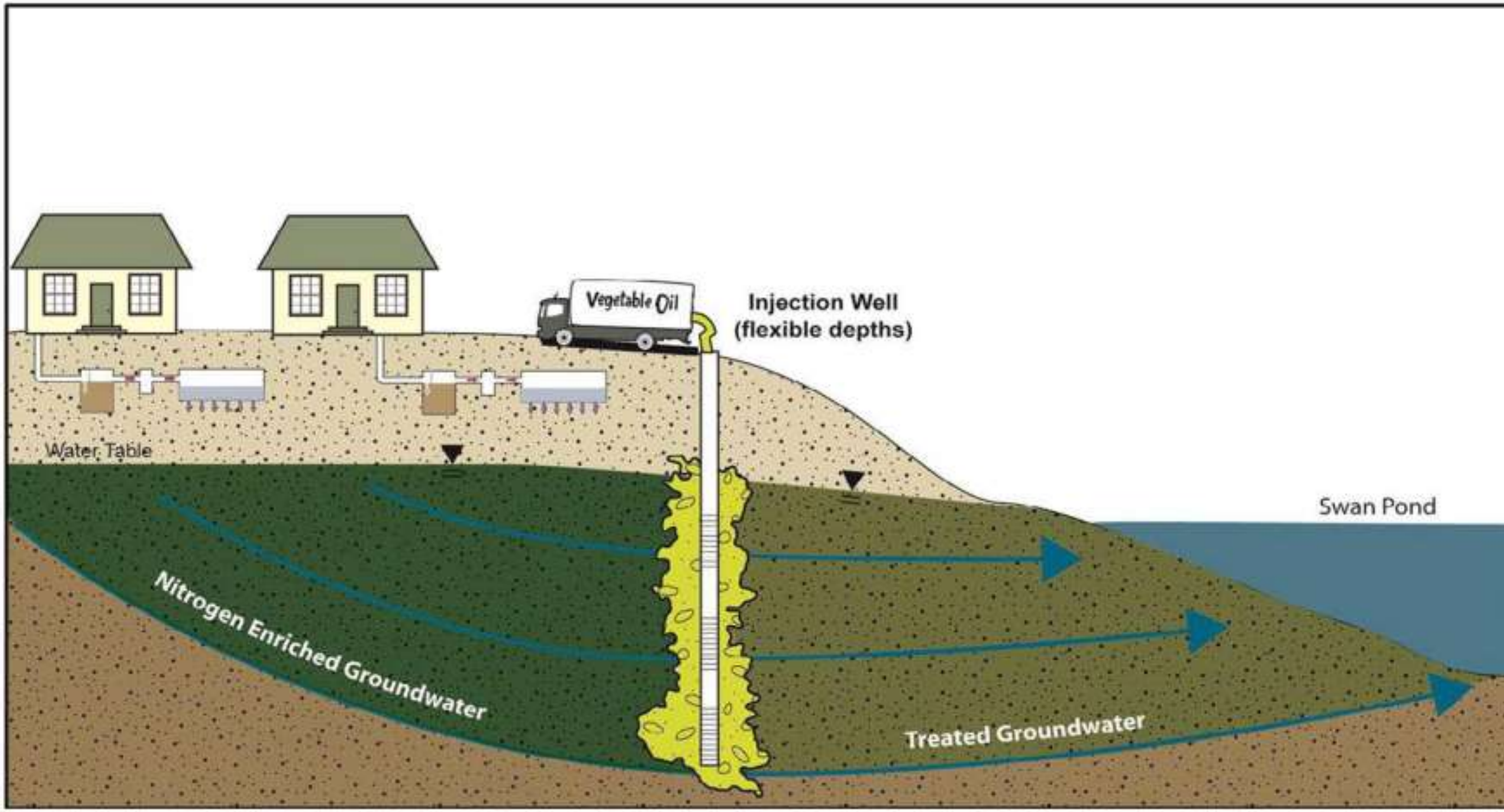
PRB

Precedent: Falmouth PRB

Source: Mike Domenica

Permeable Reactive Barrier

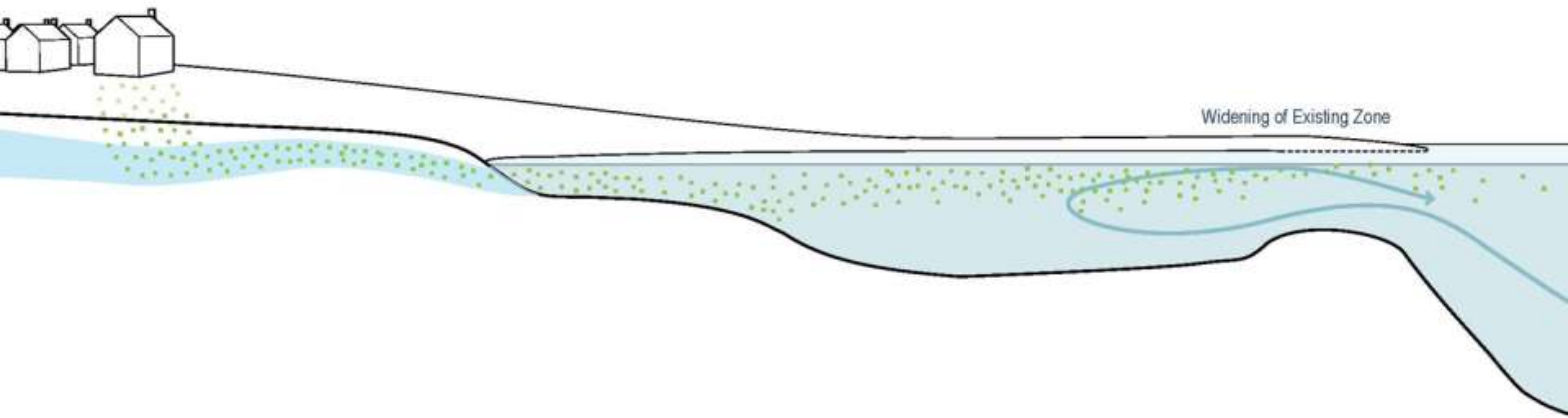
PRB



Precedent: PRB
Source: Horsley Witten Group Inc.

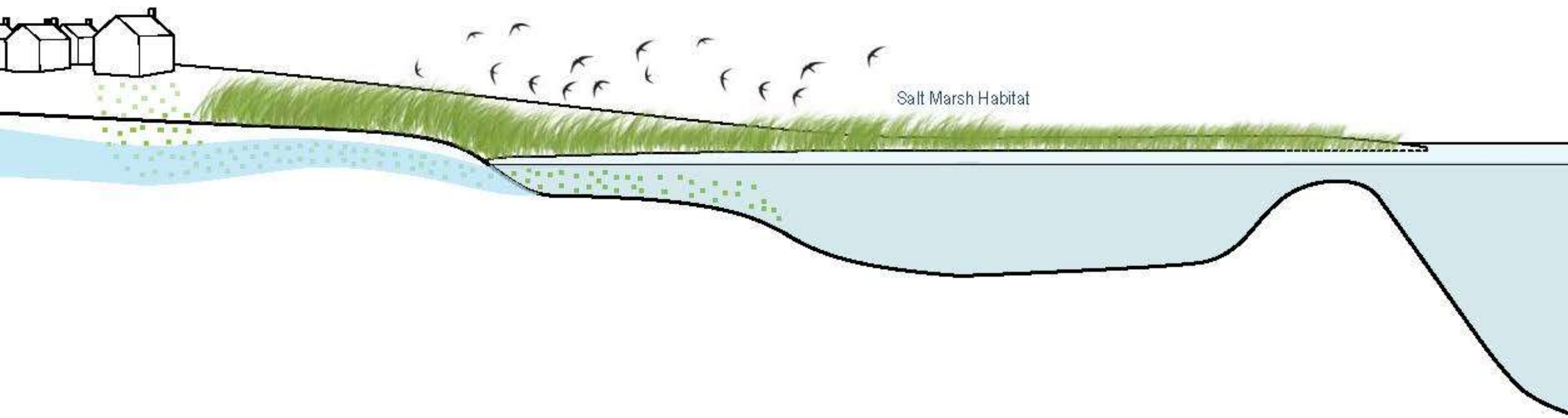
Permeable Reactive Barrier

PRB



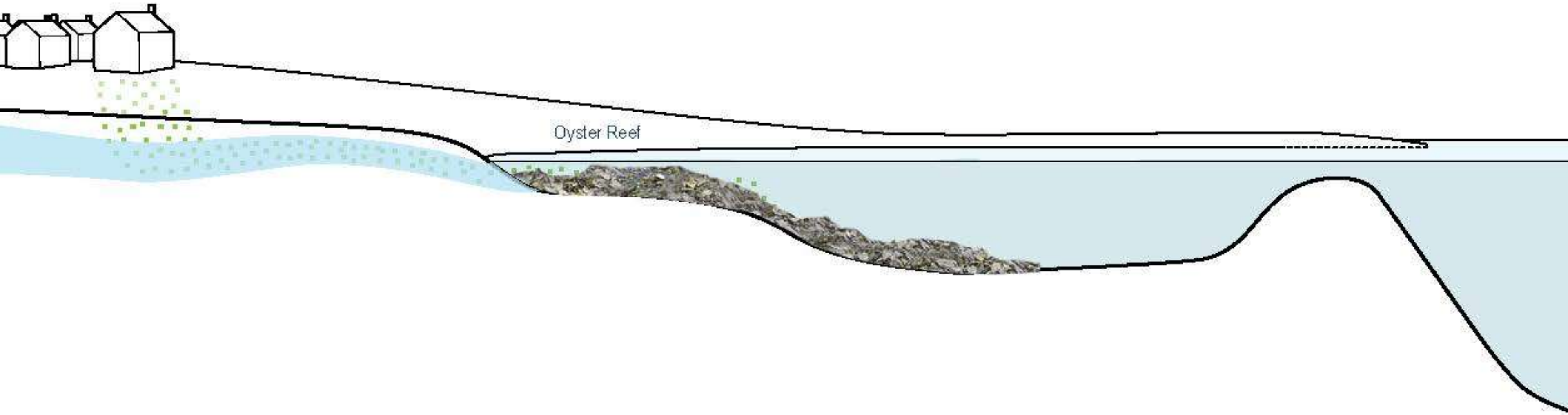
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

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

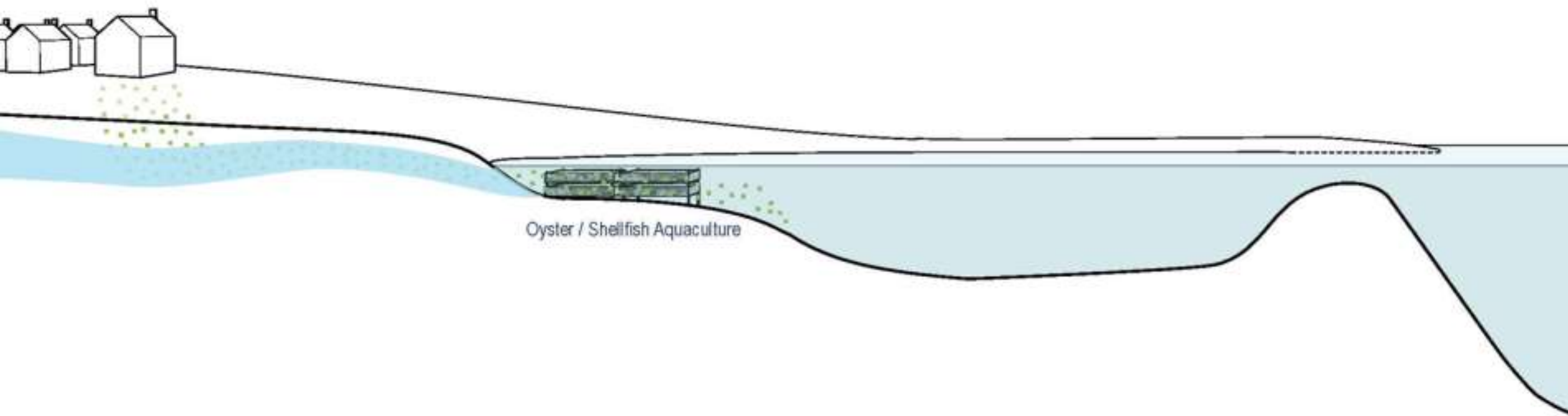
Precedent: Wellfleet Oyster Restoration Project

Source: Anamarija Francik

Shellfish Habitat Restoration

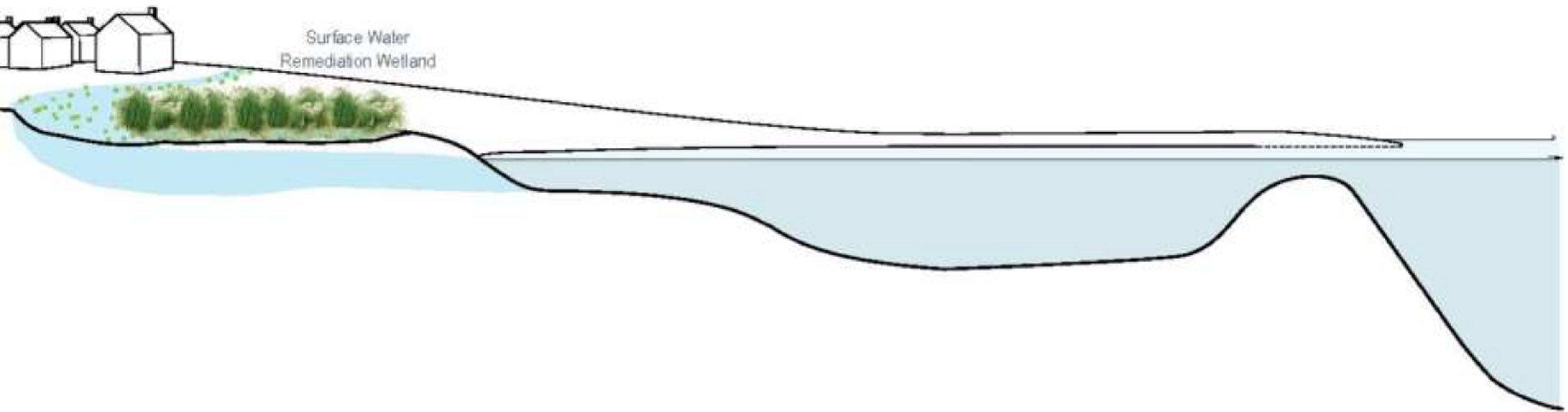
Precedent: Wellfleet Oyster Restoration Project
Source: Anamarija Francik

Shellfish Habitat Restoration



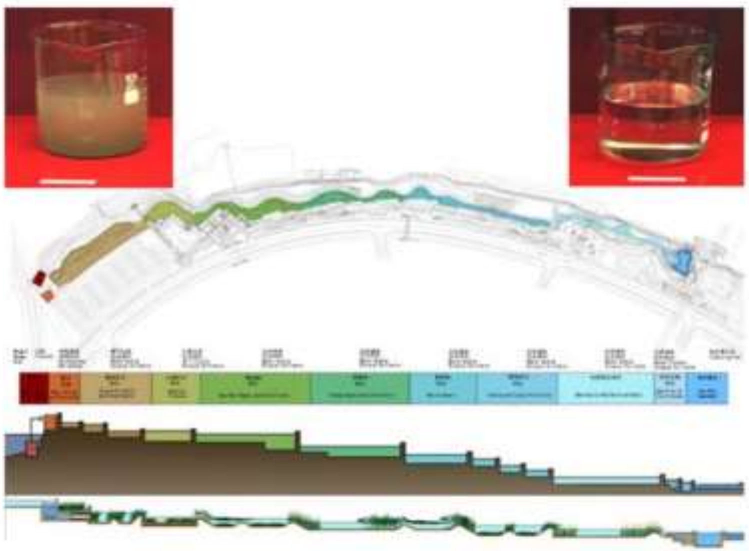
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

Aquaculture / Shellfish Farming



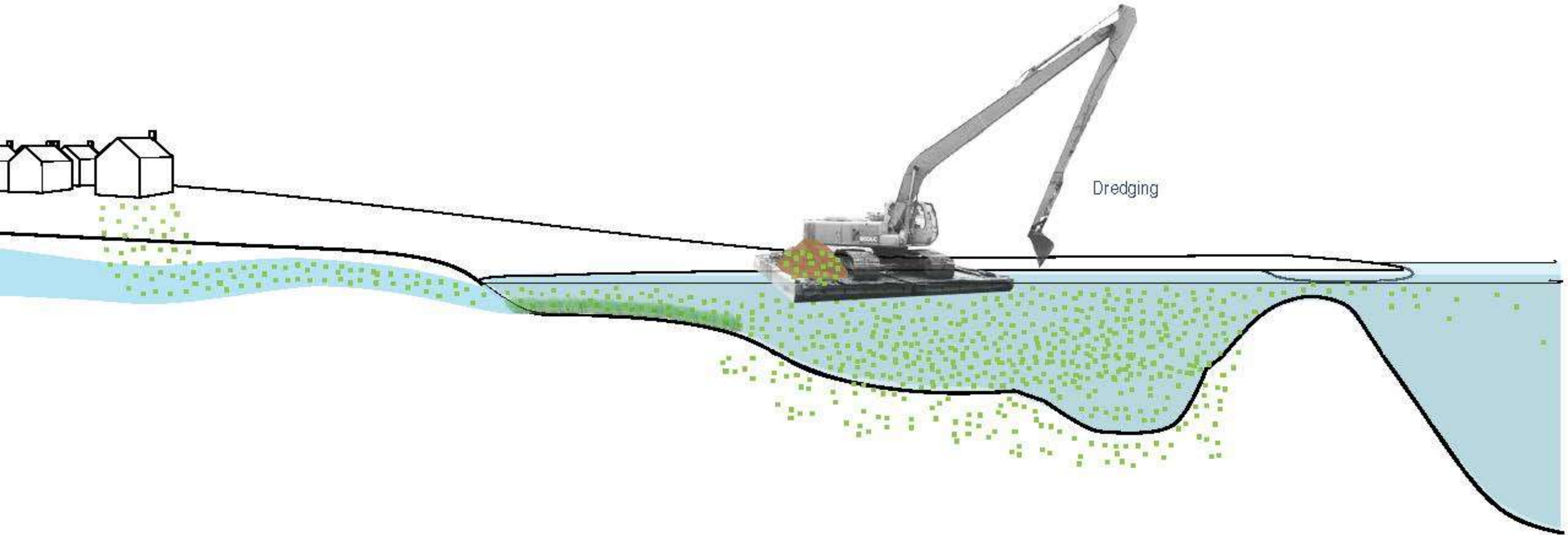
Scale: NEIGHBORHOOD/ WATERSHED
Target: EXISTING WATER BODIES

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

Town Consideration of Alternative Technologies & Approaches

Wellfleet- *Coastal habitat restoration & aquaculture*

Mashpee- *Aquaculture & Expanding Existing Systems*

Brewster- *PRB & Bioswales*

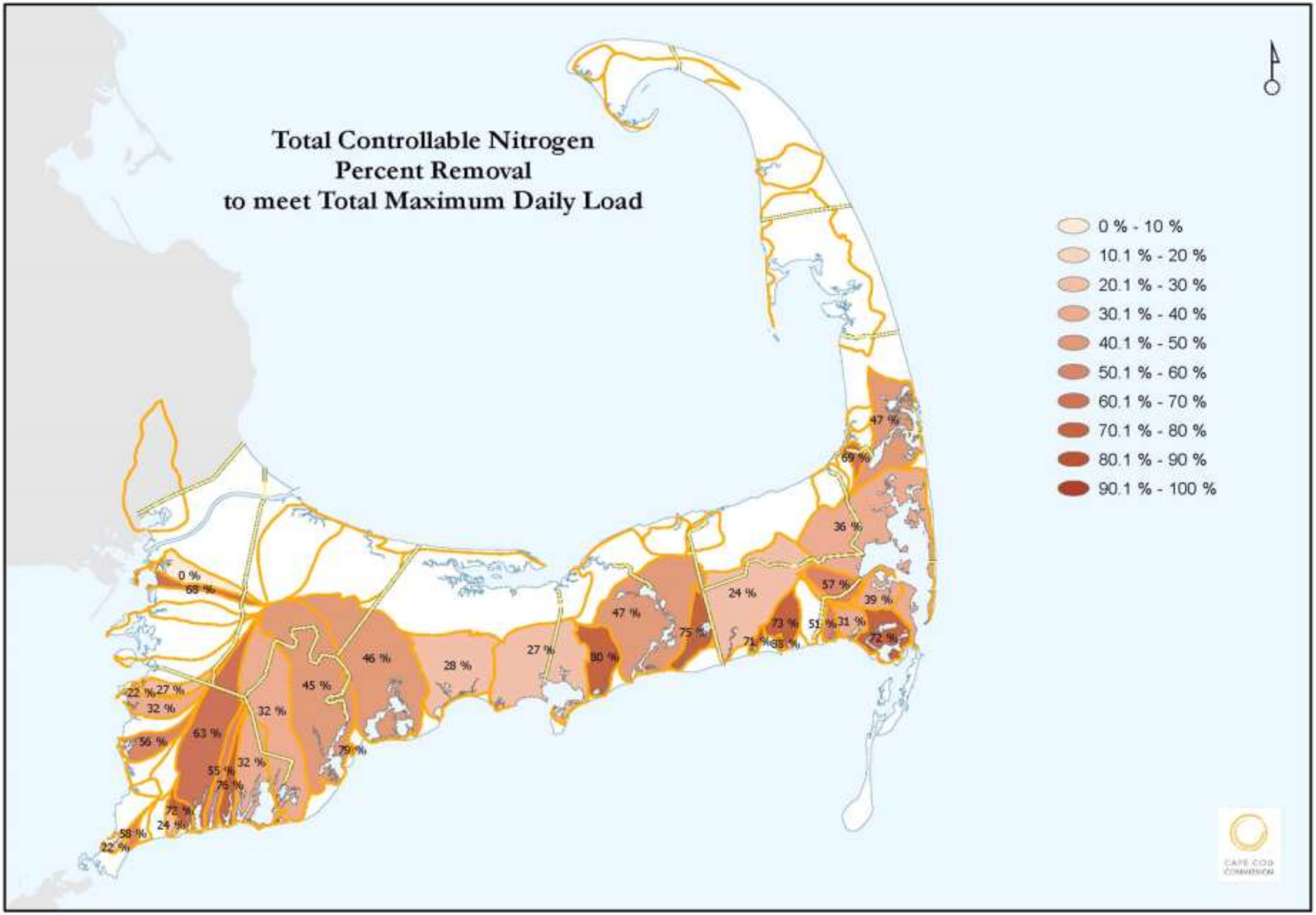
Orleans- *Fertilizer Control By-Law*

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 - Lewis Bay to Bass 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
N+P+K MGMT
BMPs
4
Watershed/Embayment Options
A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Aquaculture
PRB
5
Alternative On-Site Options
A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems
Title 5
IA
IA
6
Priority Collection/High-Density Areas
A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones
STEP/ STEG
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 %
47 %
69 %
36 %
57 %
39 %
24 %
73 %
51 %
31 %
72 %
71 %
47 %
75 %
80 %
27 %
28 %
46 %
45 %
0 %
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72 %
24 %
58 %
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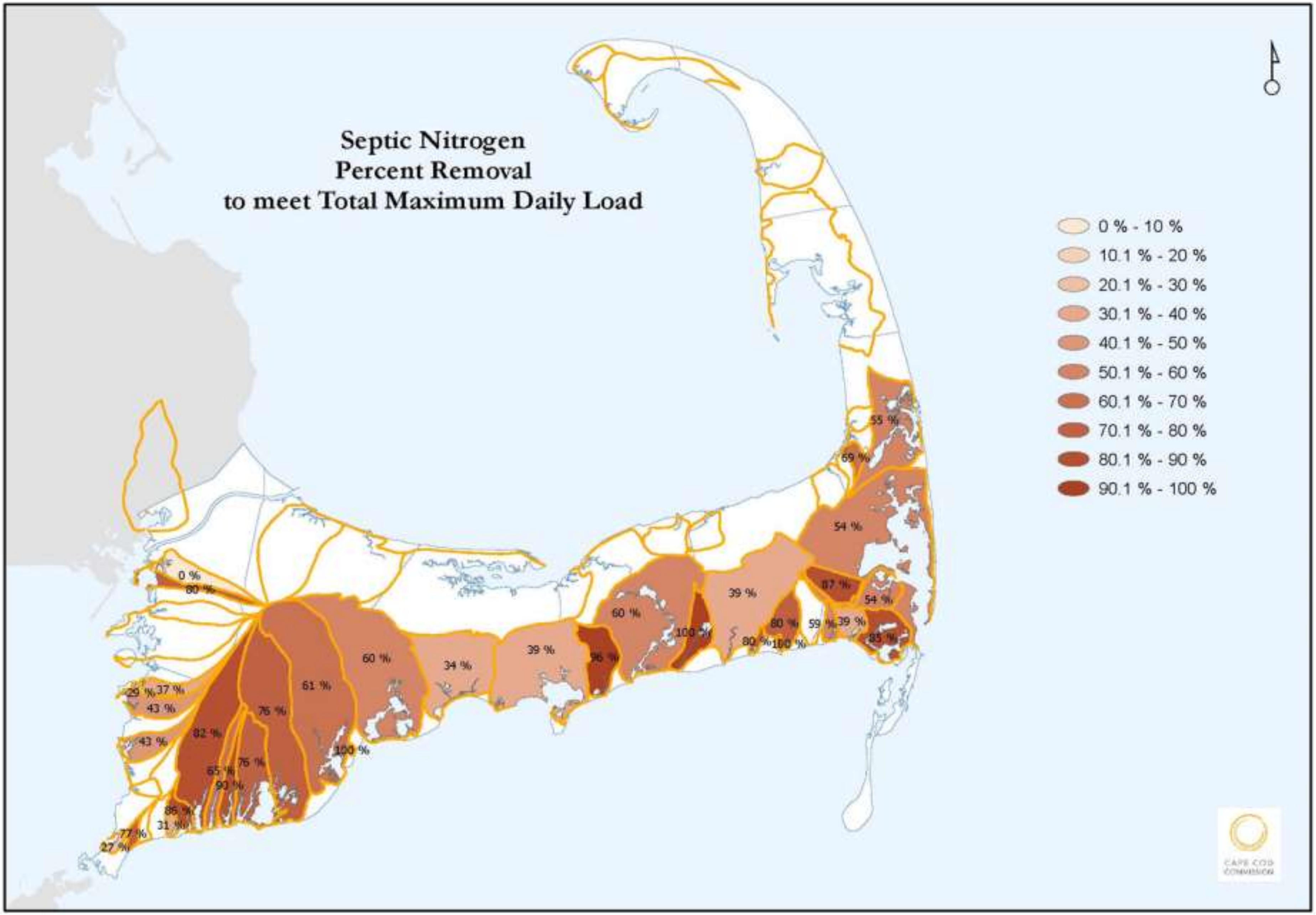
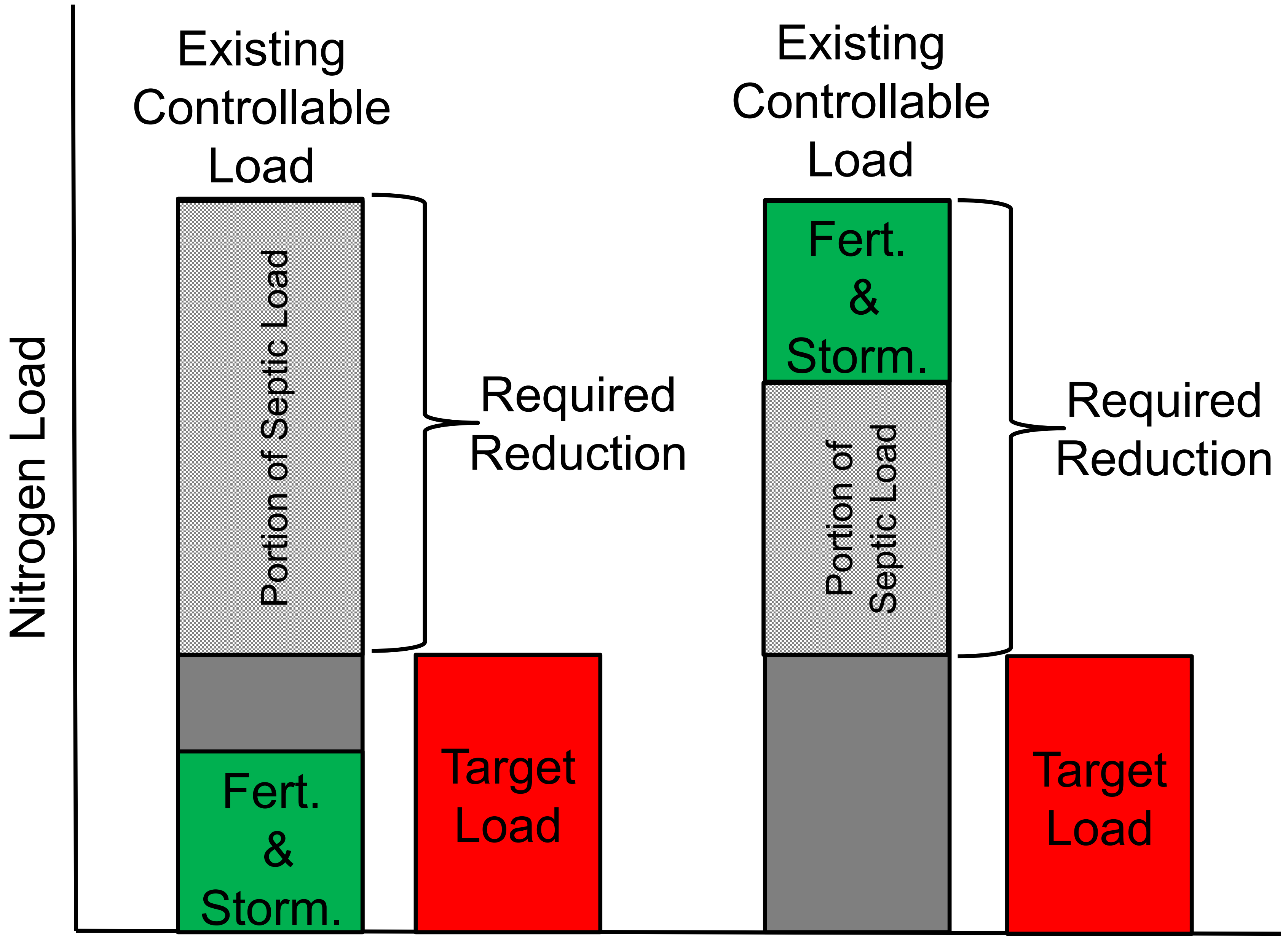

Septic Nitrogen
Percent Removal
to meet Total Maximum Daily Load
0 % - 10 %
10.1 % - 20 %
20.1 % - 30 %
30.1 % - 40 %
40.1 % - 50 %
50.1 % - 60 %
60.1 % - 70 %
70.1 % - 80 %
80.1 % - 90 %
90.1 % - 100 %
55 %
69 %
54 %
87 %
54 %
39 %
59 %
39 %
85 %
80 %
80 %
100 %
100 %
60 %
96 %
39 %
34 %
60 %
61 %
76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

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

Triple Bottom Line

Impacts of Technologies and Approaches

Environmental

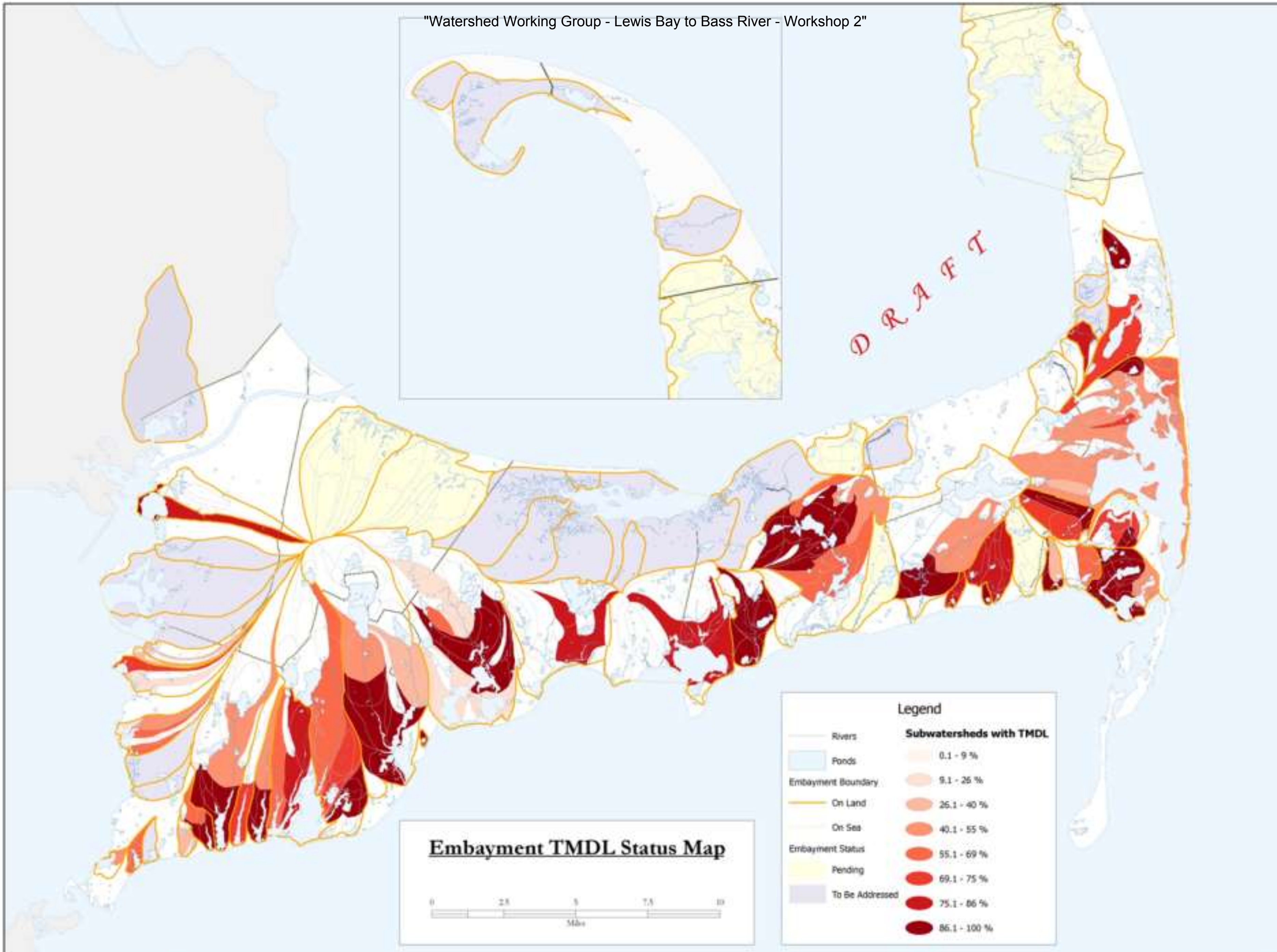
Economic

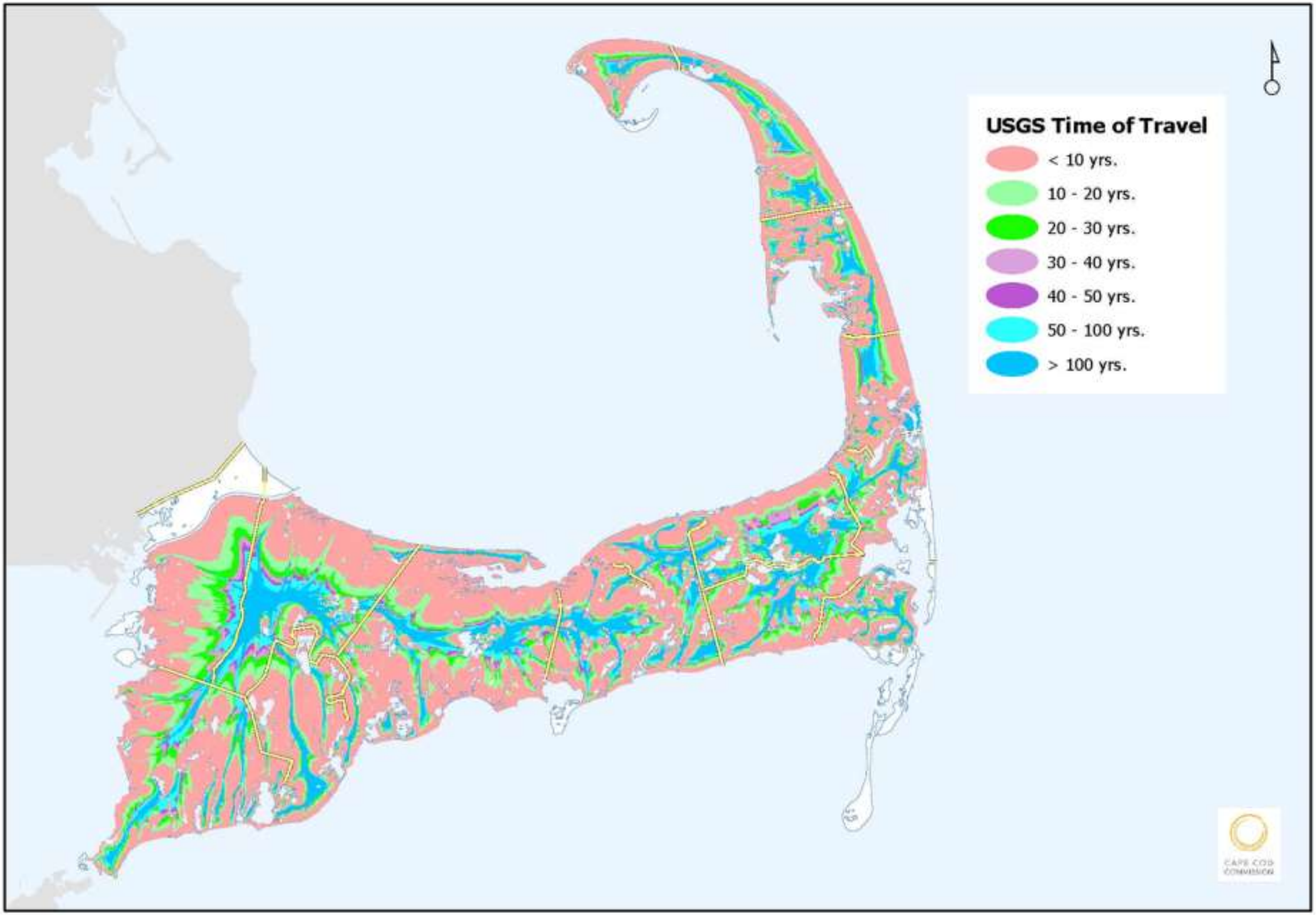
Social

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 - Lewis Bay to Bass River - Workshop 2"




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
Lewis Bay to Bass River Watershed Working Group

Meeting Two
Monday, November 4, 2013
8:30 am- 12:30 pm
Dennis Town Office

Draft Meeting Summary Prepared by the Consensus Building Institute

I. ACTION ITEMS

Next meeting:
Thursday, December 5th, 2013
8:30am - 12:30pm
485 Main Street; Dennis Town Hall; South Dennis

Working Group

- Send Carri Hulet any comments on the Meeting One summary

Consensus Building Institute

- Finalize Meeting 1 Summary
- Send Meeting 2 draft summary

Cape Cod Commission

- When preparing scenarios, take into account:
    - Helpful to know how many cluster and satellite systems there are currently operating in Cape Cod.
    - Consistency on solids management
    - Consistency on operation and maintenance (long term)
    - Issues of seasonality
    - Public education
    - Costs per site where feasible
    - In these watersheds, there is a higher median age and fixed incomes so approaches with pay-out in the long term are less attractive.

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

Carri Hulet, the facilitator from the Consensus Building Institute, welcomed participants and reviewed the agenda. Erin Perry, Special Projects Coordinator, Cape Cod Commission, offered an overview of the 208 Update stakeholder process.[1] In July, public meetings were held across the

[1] The PowerPoint Presentation made at this meeting is available at: http://watersheds.capecodcommission.org/index.php/watersheds/mid-cape/lewis-bay-to-bass-river

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 are now being held in October and early November and are 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 Cape2O game is launching on October 22. She noted that over 400 people registered for the first round of the Cape2O 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 Cape2O: 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

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.

Ms. Hulet led introductions. A participant list is found in Appendix A.

III. RANGE OF POSSIBLE SOLUTIONS

[2] Technology Fact Sheets are available at: http://watersheds.capecodcommission.org/index.php/watersheds/mid-cape/lewis-bay-to-bass-river

Scott Horsley, Area Manager and Consultant to the Cape Cod Commission, 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 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.
- Meeting Three 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. Horsley 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

<u>Standard Title V System</u>*:* 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).

<u>I/A title V System:</u> 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.

<u>Urine Diverting Toilets</u>: Urine diversion systems send urine into a holding tank where the urine is stored and periodically collected by a servicing company. The servicing company empties the tank for 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).

- *What is done with the urine?* Mr. Horsley responded that it is pumped, much like septic tanks, and then delivered to a centralized processing facility. There might be the possibility of processing it into fertilizer for golf courses and other turf areas. This has been done in Europe and Australia.
- *The slides and presentation do not clearly acknowledge the infrastructure necessary for dealing with solids and other waste.*
- *What about treating the urine for drinking water?* This is technologically possible, but there are easier solutions for managing the urine waste.

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 "idiot proof" are composting and urine diverting toilets? This is especially important for landlords installing them in rentals.* There are various homeowner errors (e.g. unplugging the electric pump to reduce electricity costs) that are important to take into account.
- *The composting toilet emits carbon dioxide, so, if these were used on a large scale, this could have an effect on air quality.*

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.

Questions from the online survey:

- *How would these alternative toilets affect the resale value of a house?* Mr. Horsley responded that the answer to this question would be different in 2013 vs. 2030. The group discussed the fact that it may be difficult to get widespread acceptance of these alternative toilets now, but may change in the future.
- *Would the composting toilet smell?* The newer system is said to have less of a chance of smelling than a flush toilet.

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).

- *Are rain gardens currently required in any Cape towns?* Mr. Horsley responded that they are not required now, but it would be an option for towns to pass regulation on this.

- *How do rain gardens affect groundwater recharge?* They allow a lot of water to flow back into the water table.

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.

- *Are there any land savings on the size of the leach field if treating a cluster of properties?* No, more houses require a larger leach field.
- *Would a variable flow (for instance, higher in some seasons than others) make it more difficult to run treatment systems like this?* Cape Cod is very seasonal, but these plants can be designed with variable operation and maintenance to meet seasonal needs.
- *It would be helpful if the CCC could provide information on examples of where this is already working and the total number of systems like this that are currently in place on the Cape.*

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).

- *Why is solids management especially highlighted for this technology, is it more difficult than with others?* Another participant responded that this could be because, in addition to solid waste, this technology can generate so much plant matter that it can be difficult to know what to do with it.
- *Are these plants contaminated?* This is an outstanding research and development question. A participant explained that it depends on the wastewater that is used in the system (strictly residential vs. industrial waste with toxins) and what you're using the plants for. There are places in Connecticut where they sell the plants from eco machines for landscaping and make a profit.
- *Solids management needs to be taken into account for each of these technologies.* Mr. Horsley responded that they have added a category for residuals management to every technology on the matrix.

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).

- *Can these also be used to control flooding?* Yes, however when designing them for flood control and water quality treatment they require different amounts of land area. Mr. Horsely cited an example of a constructed wetland near Alewife in Cambridge that addresses both runoff and flood problems, and is also a nice recreational area.
- *What sort of maintenance do these wetlands require? If there is a dry year, will the plants die and stop the wetland from functioning?* Mr. Horsley responded that it depends on the design. If they are designed well, they will function almost like a natural wetland and need minimal maintenance.
- *Do solids get into these wetlands?* Massachusetts requires wastewater to go through a lot of pre-treatment before solids go into these wetlands. Small organic particles make their way into the wetland, and these are taken up by the ecosystem.

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.

Constructed wetlands: surface flow: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, water is 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).

Constructed wetlands: subsurface flow: After primary treatment in a septic tank or wastewater treatment facility or secondary treatment at a wastewater treatment facility, wastewater is treated by pumping 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).

- *Do you need to keep introducing bacteria to subsurface wetlands?* No, you can take measures to encourage its growth, but it is naturally occurring.
- *Can subsurface flow wetlands also treat surface water?* They can be designed to do so (e.g. to catch stormwater).
- *These types of solutions are fairly land intensive.*
- *It is against regulation to use natural wetlands to do these sorts of treatments. If there were a natural wetland nearby, you would have to construct an artificial one upstream from it.*

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.

- *This option could be very relevant to this watershed because it is next to Hyannis, which already has a sewer disposal system.*

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.

- *Depending on how much you're removing from the Cape Cod aquifer and depositing in the ocean, this could have hydrologic implications. Another participant responded that the amount of water Cape residents use is only a very small percentage of the aquifer, so this would probably not have a large hydrologic effect, though it should still be taken into account.*

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).

Neighborhood or Watershed level technologies/approaches

Phytobuffers: Using trees with a deep root system to capture nutrients in the soil, 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 causes the groundwater plume to be redirected and pulled towards the plants. (Case example, Kavcee, WY).

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).

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).

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).

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).

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.

Surface water remediation wetlands: 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).

Pond and estuary dredging: 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

Compact development: 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".

Fertilizer management: 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.

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.

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 some of these technologies innovative enough to merit retrofitting, or are you planning to reserve innovative technologies for new development? We need to address our water quality problem now, not only in the future.* Mr. Horsley responded that some of these technologies are more "retrofittable" than others. Another factor is the cost of innovative technologies in relation to the cost of sewering. The cost of sewering depends on density.
- *Participants discussed the importance of ensuring that renters, vacationers, and seasonal residents are educated in the proper operation and management of any technologies that are installed. Operation and management and education require funding; who will pay for*

these costs? Ms. Perry said the commission is attempting to take these things into account, but are still working out how to capture all of the pieces.

- *Regarding the issue of reusing nutrients to make fertilizer, these fertilizer products can be much more expensive than other fertilizer.*
- *Participants discussed numerous issues around oysters: For public education, you can bring a cloudy tank of oysters to a meeting, and by the end of the meeting it will be clear, illustrating how well oysters filter water. Many of the estuary areas that have the lowest water quality and would be most benefited by oysters are closed to shellfish. They are sometimes closed because of stormwater and sometimes because of worries about septic systems that are not working properly. Whenever oysters are grown, people steal them, even if the oysters are not safe to be harvested. If people sell contaminated oysters on the market, the state government is worried that this could impact the whole state's shellfish industry.*
- *Are there other shellfish that also filter the water?* Yes, most of them do, however oysters are probably the most efficient.
- *A participant requested that costs of collection systems, both vacuum and gravity-fed, be added to the technology matrix. Add costs per site where feasible.*
- *Most people have already committed to a Title 5 cost. Whether they use it or not, it's in their mortgage and could be a sunk cost. Thinking about these various solutions, we need to take into account the fact that we still have to address pathogens and so we will likely keep using our Title 5 systems.*
- *What are the impacts of sea level rise?* The water table is rising at the same rate as sea-level rise. If you add two to three feet to the groundwater level, the groundwater will get much closer to people's Title 5 systems. One of the I/A technologies can be installed only 6 inches below the surface rather than 2-3 feet as most systems are currently installed.
- *A participant raised concerns about road runoff pollutants.*
- *Regarding permeable reactive barriers, how deep do the high levels of nitrogen in groundwater go?* This is still being studied. Some studies have shown (e.g. in Waquoit) that the higher levels of nitrogen are down near the bottom of the groundwater, and therefore possibly below the barrier. It can vary a lot depending on the area. If we decide to go with the innovative solutions, there will be more testing required. These solutions will have to have a flexible and adaptive management system.

IV. PROBLEM SOLVING PROCESS AND PRINCIPLES

Overview of 7-steps for Problem-Solving Process

Mr. Horsley 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*

Participants offered the following comments:

- *A participant voiced support for step four of the problem solving process (Assess alternative options to implement at the watershed or embayment scale) because the earlier we target the problematic estuaries, the cheaper it will be overall. The participant also raised the concern that steps five, six, and seven should be taken collectively.*
- *A participant commented that, given long flow times, we may not have seen the worst impact on the embayments yet.* Mr. Horsley added the comment that different options have different timelines in terms of how soon improvements occur. E.g. oysters will show benefits in the first year. Sewering may have over ten or fifteen years of flow time before you'll see a change in the embayment.
- *Participants discussed the possibility of offering incentives for the people who want to implement alternative solutions individually. In addition to incentives, there is also the option of changing the law. What entity would be giving these incentives out to people? There also need to be protections for people who take these early risks, so that they don't take a hit in the future if, for instance, the town later decides to sewer their area.*

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

Mr. Horsley 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).

A participant raised the issue of focusing overmuch on the technological or engineering aspects and highlighted the importance of dealing with the political system. How can we implement these good ideas in a way that compels people to make good decisions? How can we reintroduce remediation, reduction and production? How can we separate private costs from community leadership when a lot of the prevention stuff is only done at the town level? What is the guiding principle that will allow the communities to institute prevention processes, zoning, etc?

Ms. Hulet 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. She asked that participants focus specifically on the 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:

Timeline considerations:

- The working group is attempting to answer two questions: 1) what we'll do for remediation immediately; and, 2) what will we do long-term so that these problems don't occur again. We have a way to evaluate our near term plan after a few years and then adapt the long-term plan (adaptive management).
- What will the town do after all the remediation takes place? Does the town have any continuing stewardship; will costs to taxpayers go up in the future? Should the town be assigned a cost and can that run on a different cost-timeframe than individual costs?
- Be realistic about people's view of the long term: it's hard for most people to think beyond their lifetimes.

Cost-benefit analysis:

- Is this solution giving us "the biggest bang for our buck" in the near term, and does it make sense in the overall long-term context?
- When measuring costs and benefits, take into account:
    - The "softer" side of costs and benefits: people's risk and vulnerability.
    - The costs and benefits of educating people and getting public buy-in.
    - The benefit of an incremental approach: start with visible, high impact projects to increase public acceptance and make it easier to get buy-in to tackle more difficult issues later.
    - The cost of doing nothing.

Political

- Develop a process/plan for public buy-in
  - There have been examples of other projects on the Cape where policy-makers have made decisions that seemed in the best interest of everybody, but, because they didn't have public buy-in, the public rejected the decisions.
- Figure out how to reach people with information. In some projects, the CCC does everything they can think of to publicize information, and some people still don't receive it.
- Internalize costs
- How to work across and between towns?
  - The planning process is taking place at the watershed level, but decision processes and regulation will happen exclusively at the town level. Ms. Hulet responded that in some places on the Cape, towns have come together to do the decision making jointly. One thing this planning process can aim to do is to provide examples of how towns have worked together in the past, and encouragements for them to do so more. There is no way to require it.

Social:
- Target large contributors first
- How to get smaller contributors (individual homeowners) to make behavior changes?
  - The general public is not very aware of the problem and therefore doesn't understand the incentive to try to solve it.
- Important factors when dealing with individual contributors in this watershed:
  - Median age
  - Cannot absorb high costs for changes
  - Little equity in houses now

General:
- Ongoing evaluation and review of the plan (for adaptive management)
- How do we include in each watershed's plan the things that are common to all: education, monitoring, demonstration, model regulations, etc?
- Take into account what's already being done around water quality remediation

Technology Selection: Process and Principles
Mr. Horsley 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:
Thursday, December 5th, 2013
8:30am - 12:30pm
485 Main Street; Dennis Town Hall; South Dennis

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 Working Group will be able to 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

There were no additional public comments.

APPENDIX ONE: MEETING PARTICIPANTS

Name	**Affiliation**
Working Group Members	
George Allaire	Town of Yarmouth, Public Works
Linda Bollinger	Hyannis Park Civic Association
Debra Dagwan	Barnstable Town Council
Steven Didsbury	Nitrogen Neutral, Centreville
Jan Hively	Civic Groups, Yarmouth
Scott Horsley	Consultant, Watershed Area Manager
Rick Lawlor	Golf Course Superintendents Assoc., Yarmouth
Spiro Mitrokostas	Dennis Chamber of Commerce
Ed Nash	Golf Course Superintendents Assoc.
Dale Saad	Barnstable DPW
Charles Spooner	Resident of Yarmouth
Mike Trovato	Town of Barnstable
Sam Wilson	Sotheby Realty, Barnstable
CCC Staff / Facilitators	
Tom Cambareri	Cape Cod Commission
Erin Perry	Cape Cod Commission
Maria McCauley	Cape Cod Commission
Carri Hulet	Consensus Building Institute
Carly Inkpen	Consensus Building Institute
Public/observers	
Dan Milz	University of IL, Inst. of Envir. Science & Policy