



# Cape Cod Bay Group

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Technologies and Approaches

**What is the stakeholder process?**

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## 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

Goals,  
Work Plan  
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Affordability,  
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Scenarios

Advisory  
Board

Advisory  
Board

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Board

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Board

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Board

July

August

September

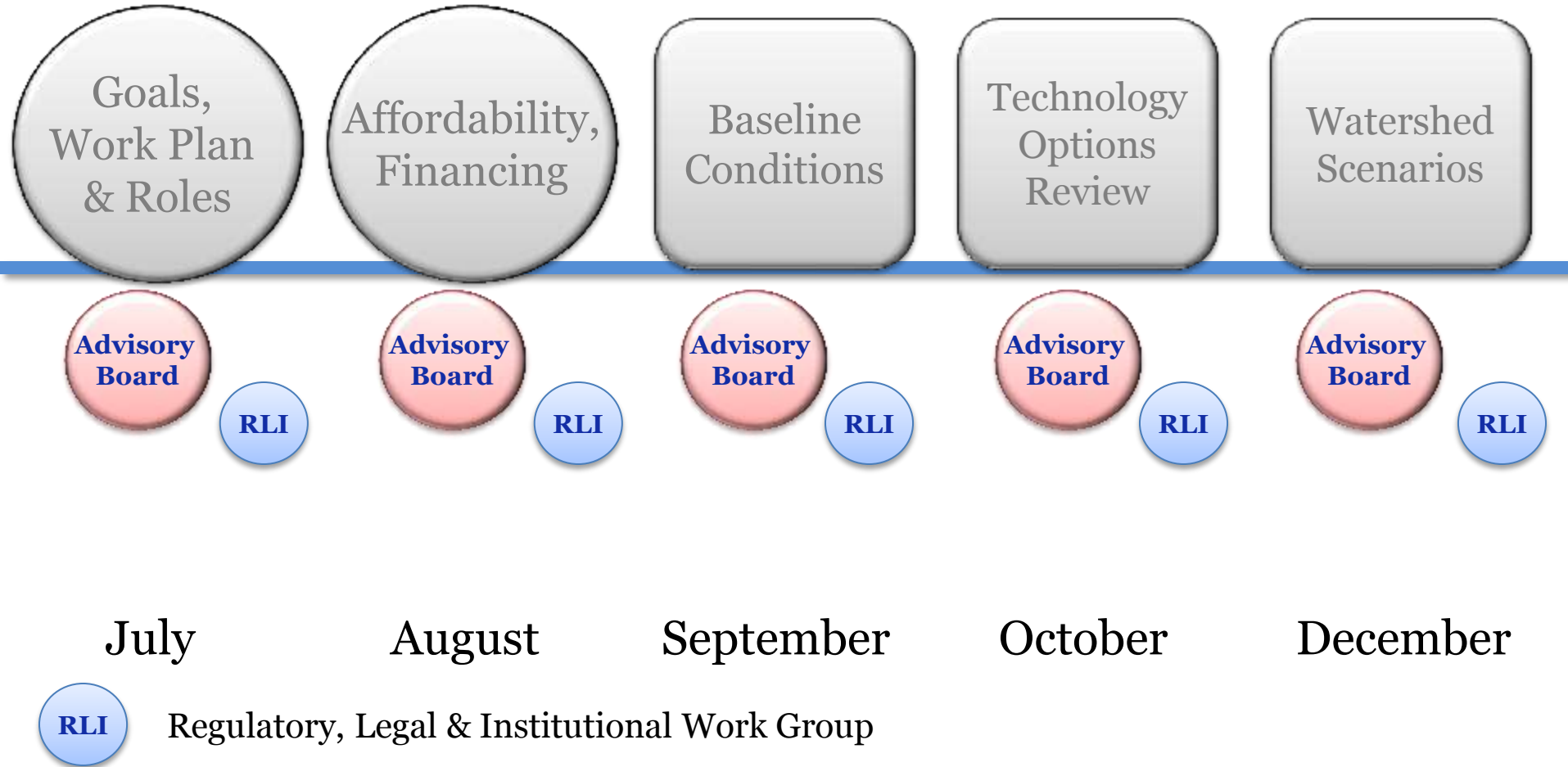
October

December

**208 Planning Process**

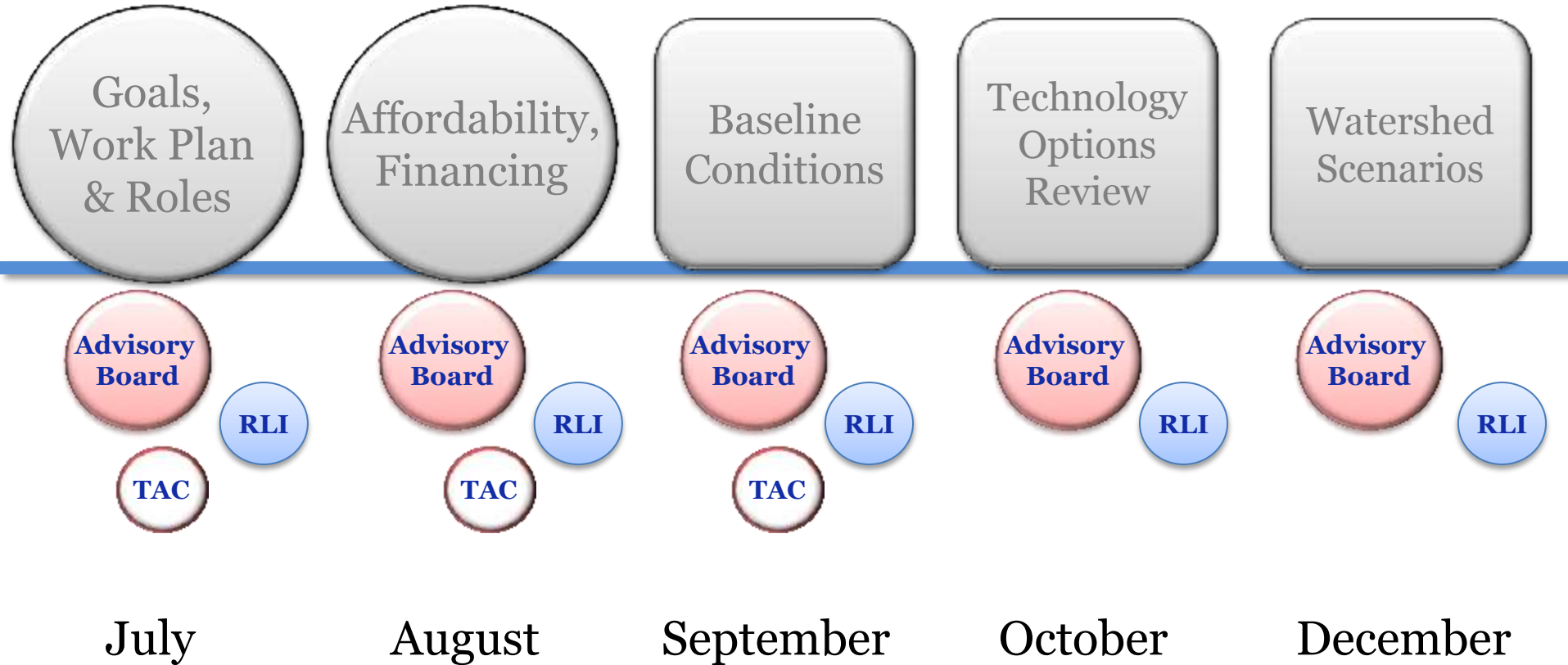
## Public Meetings

## Watershed Working Groups



## Public Meetings

## Watershed Working Groups



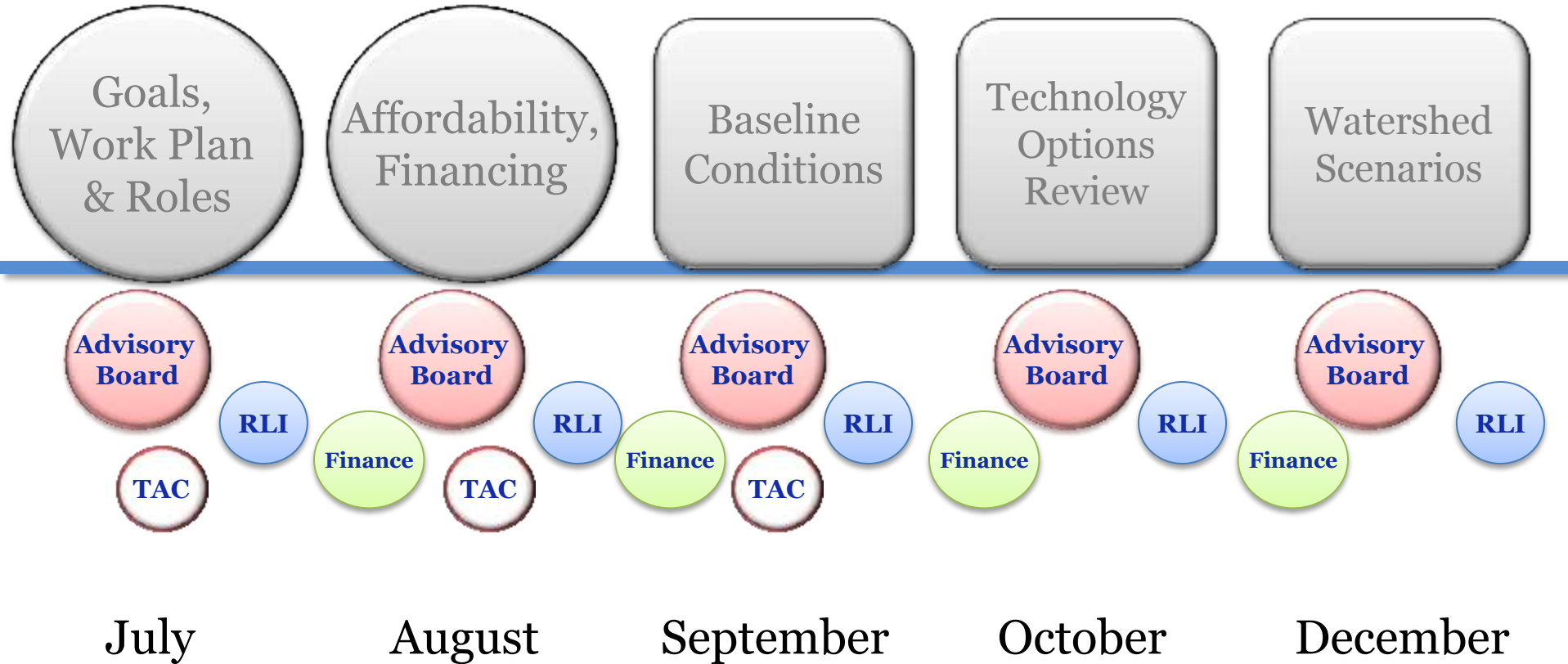
**RLI** Regulatory, Legal & Institutional Work Group

**TAC** Technical Advisory Committee of Cape Cod Water Protection Collaborative

**208 Planning Process**

# Public Meetings

# Watershed Working Groups

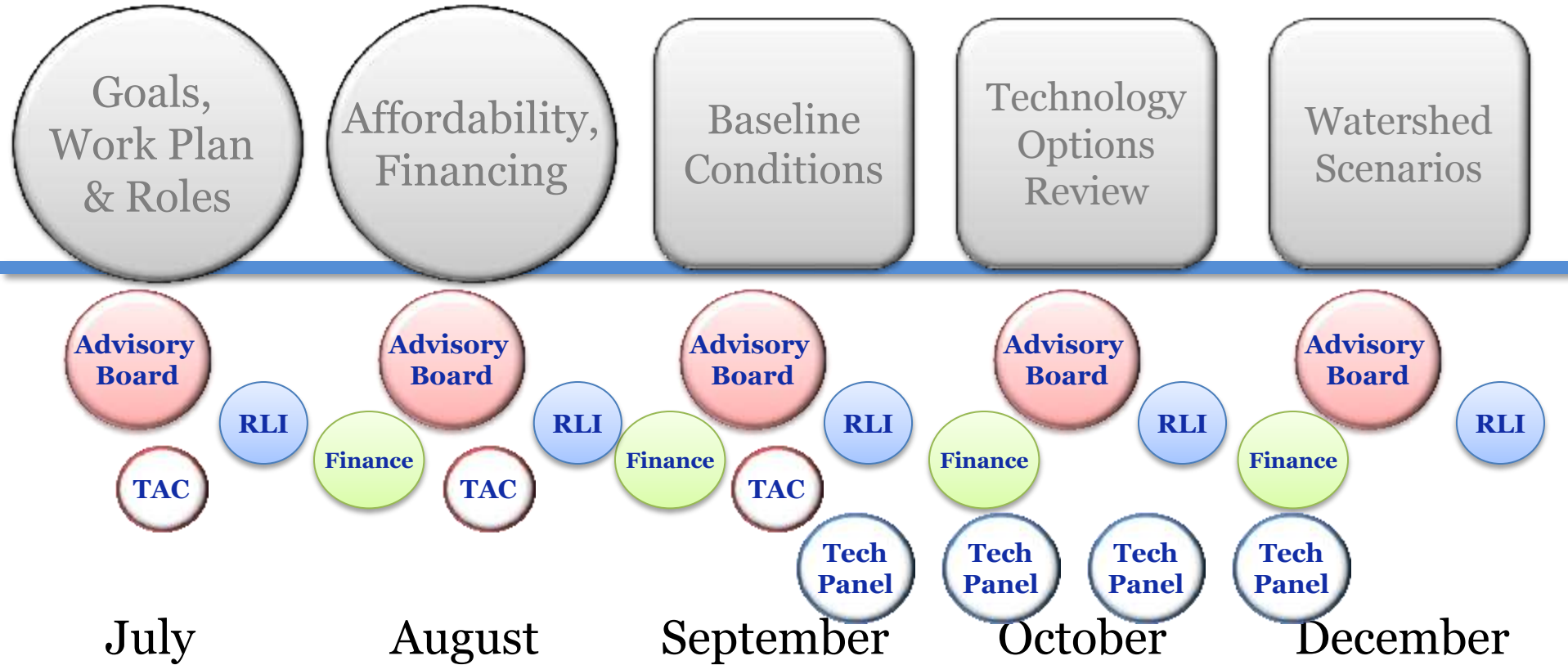


**RLI** Regulatory, Legal & Institutional Work Group

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# Public Meetings

# Watershed Working Groups



**RLI** Regulatory, Legal & Institutional Work Group

**TAC** Technical Advisory Committee of Cape Cod Water Protection Collaborative



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

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- Meeting materials

# Progress since last meeting

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- Meeting materials
- GIS data layers

# Progress since last meeting

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- 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

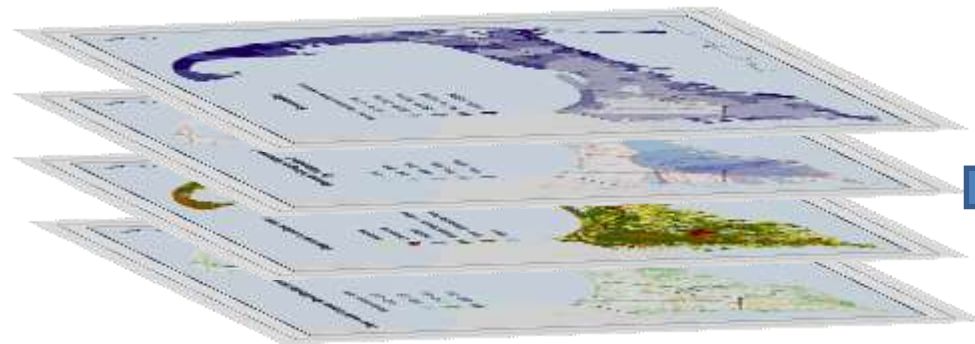
11 Working  
Group Meetings:  
Sept 18-27

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 Cape20: 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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# Technologies and Approaches for Improving Water Quality

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- ❑ Workshop 3 will embark on hands on problem solving in each watershed to meet target load reductions.

# Technologies and Approaches for Improving Water Quality

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# Technologies and Approaches for Improving Water Quality

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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.

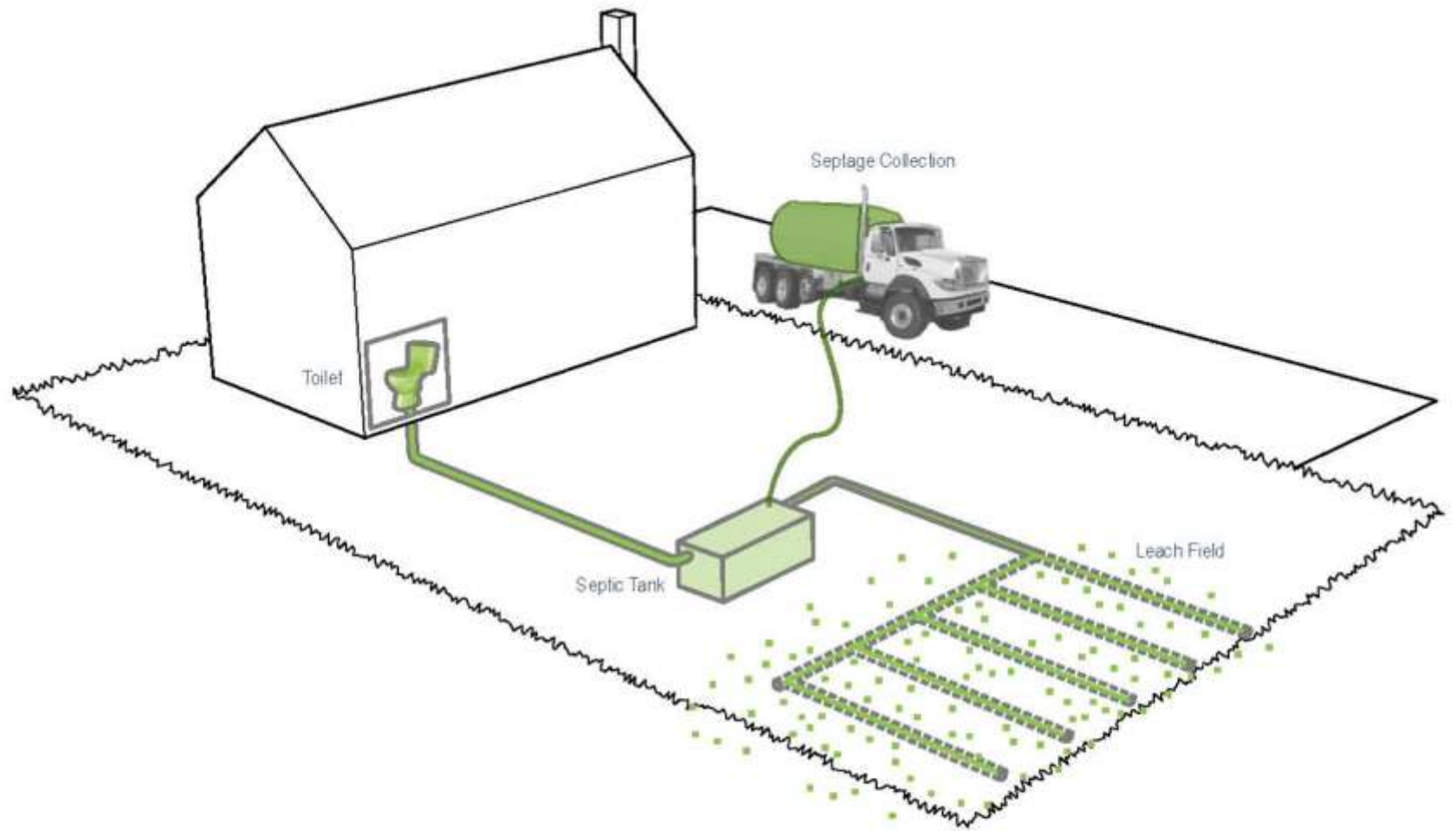


# Solutions



# Solutions: Site

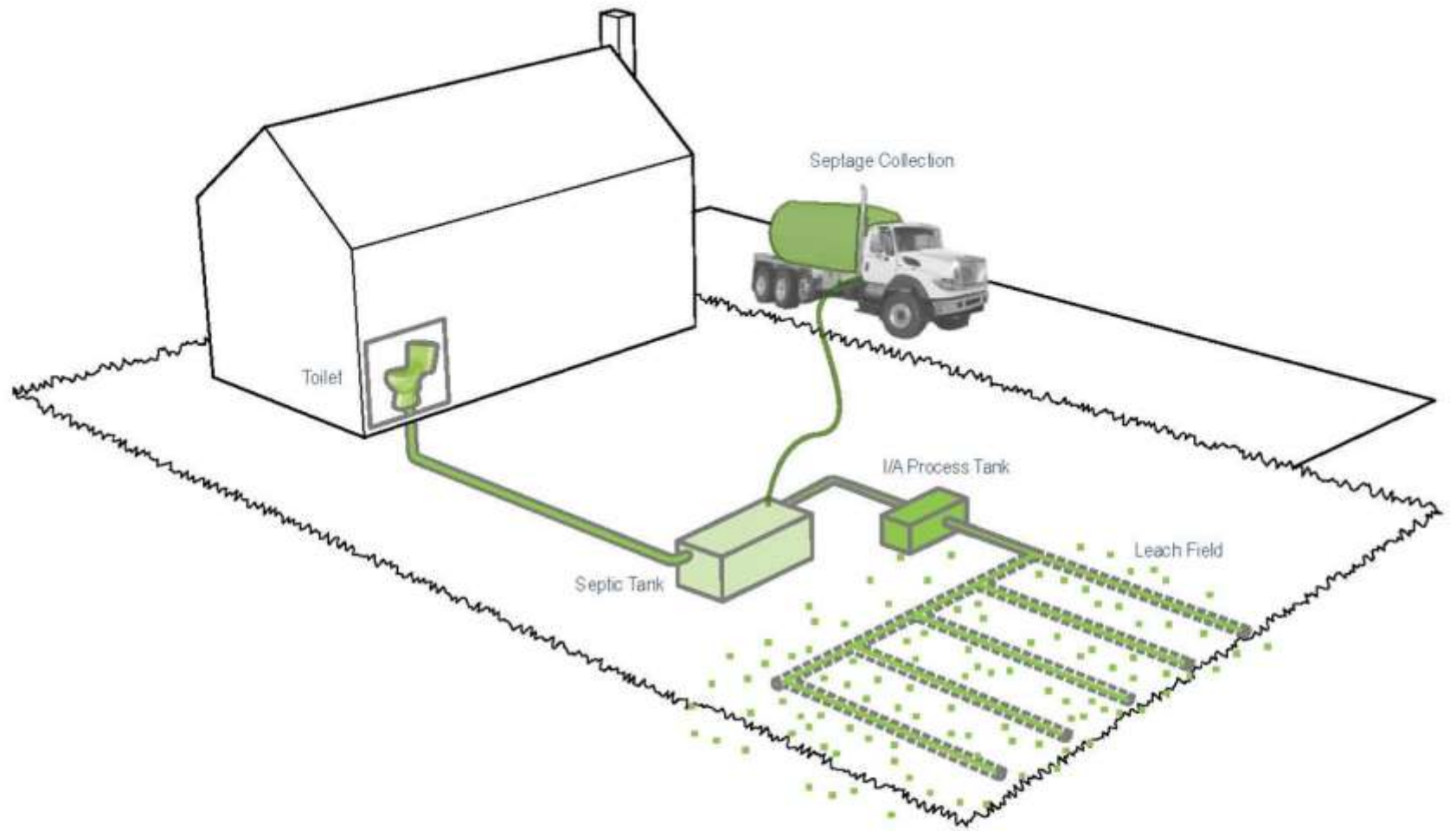




**Scale:** SITE  
**Target:** WASTEWATER

Standard Title 5 Systems

Title  
5

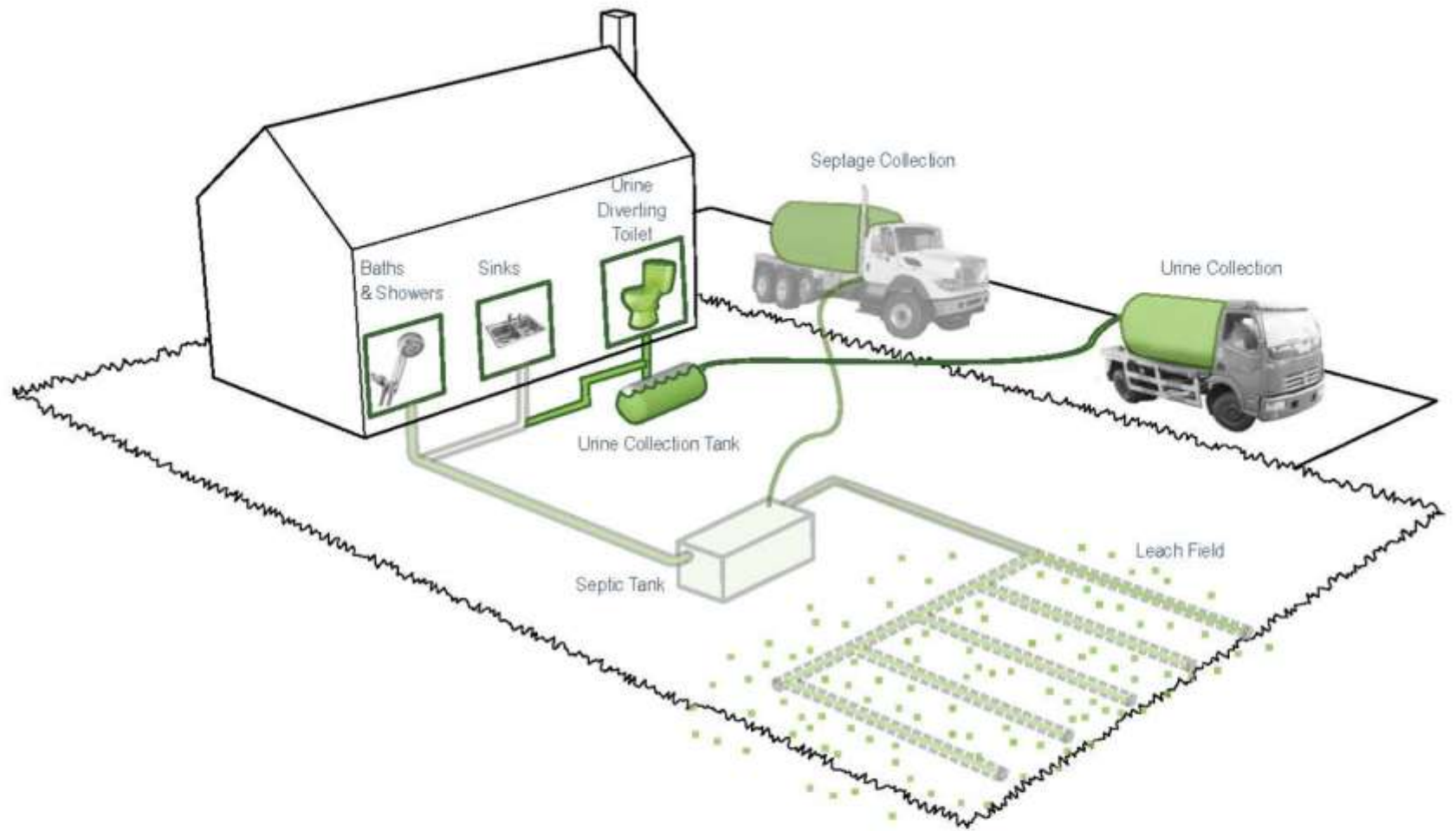


**Scale:** SITE  
**Target:** WASTEWATER

I/A Title 5 Systems



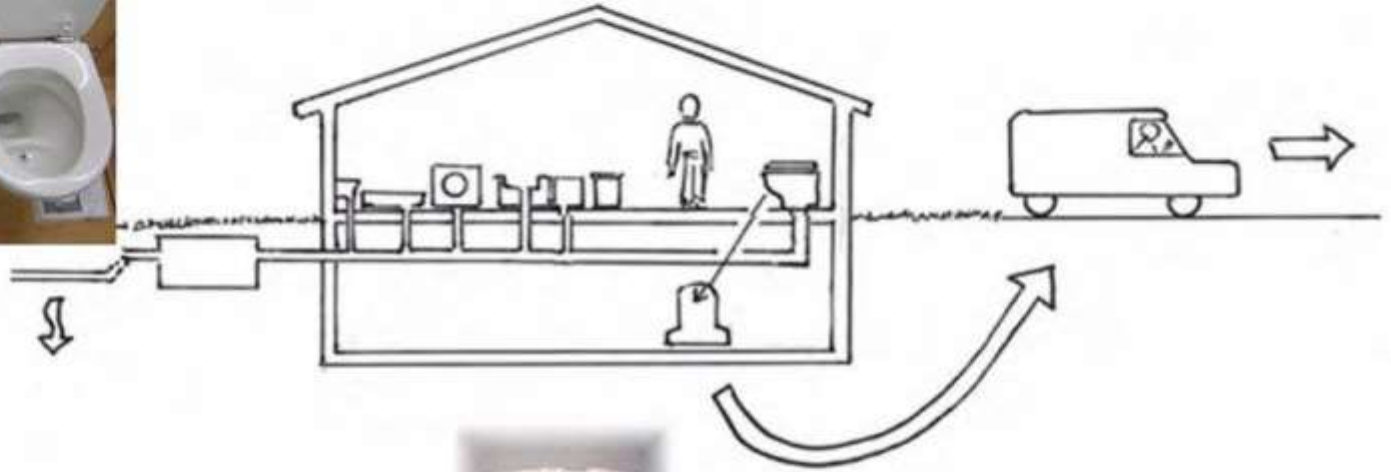




Scale: SITE  
Target: WASTEWATER

Toilets: Urine Diverting





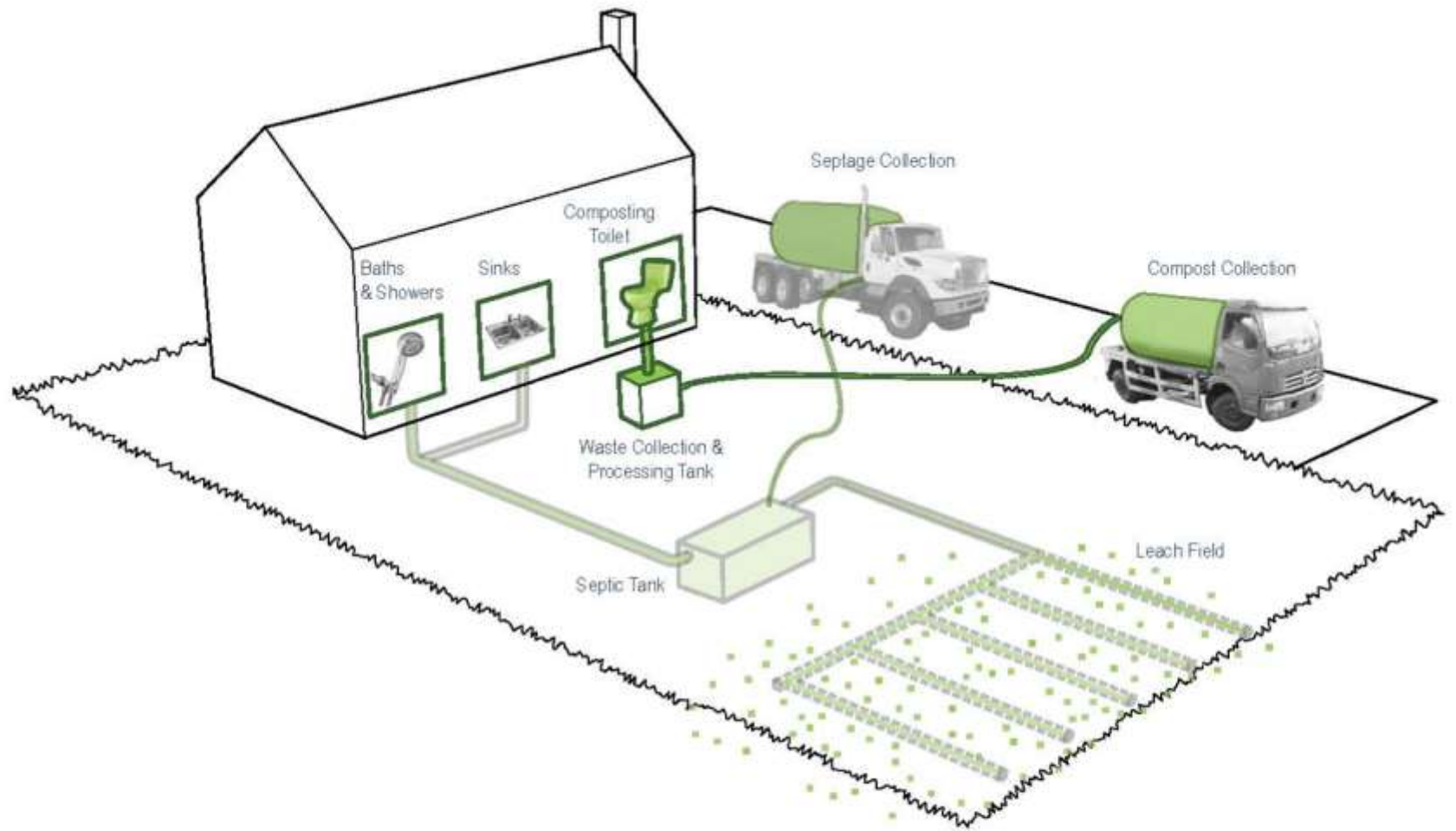
**Waterless  
Urinal**

**IBC container  
(220 gallons)**



**40" x 40" x 48"**

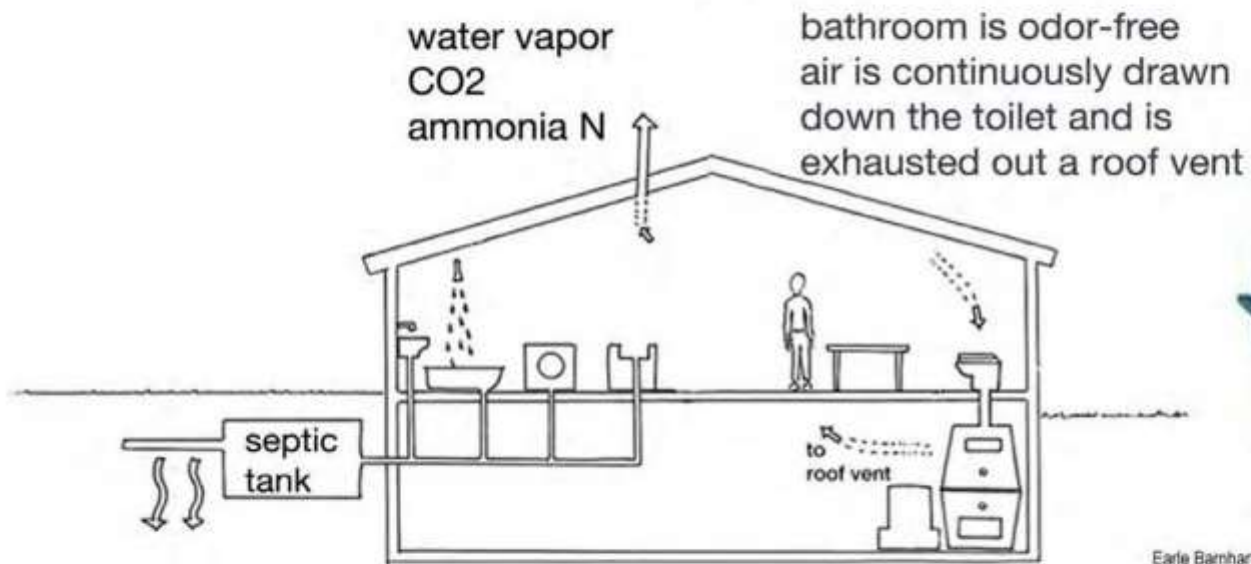




**Scale:** SITE  
**Target:** WASTEWATER

Toilets: Composting

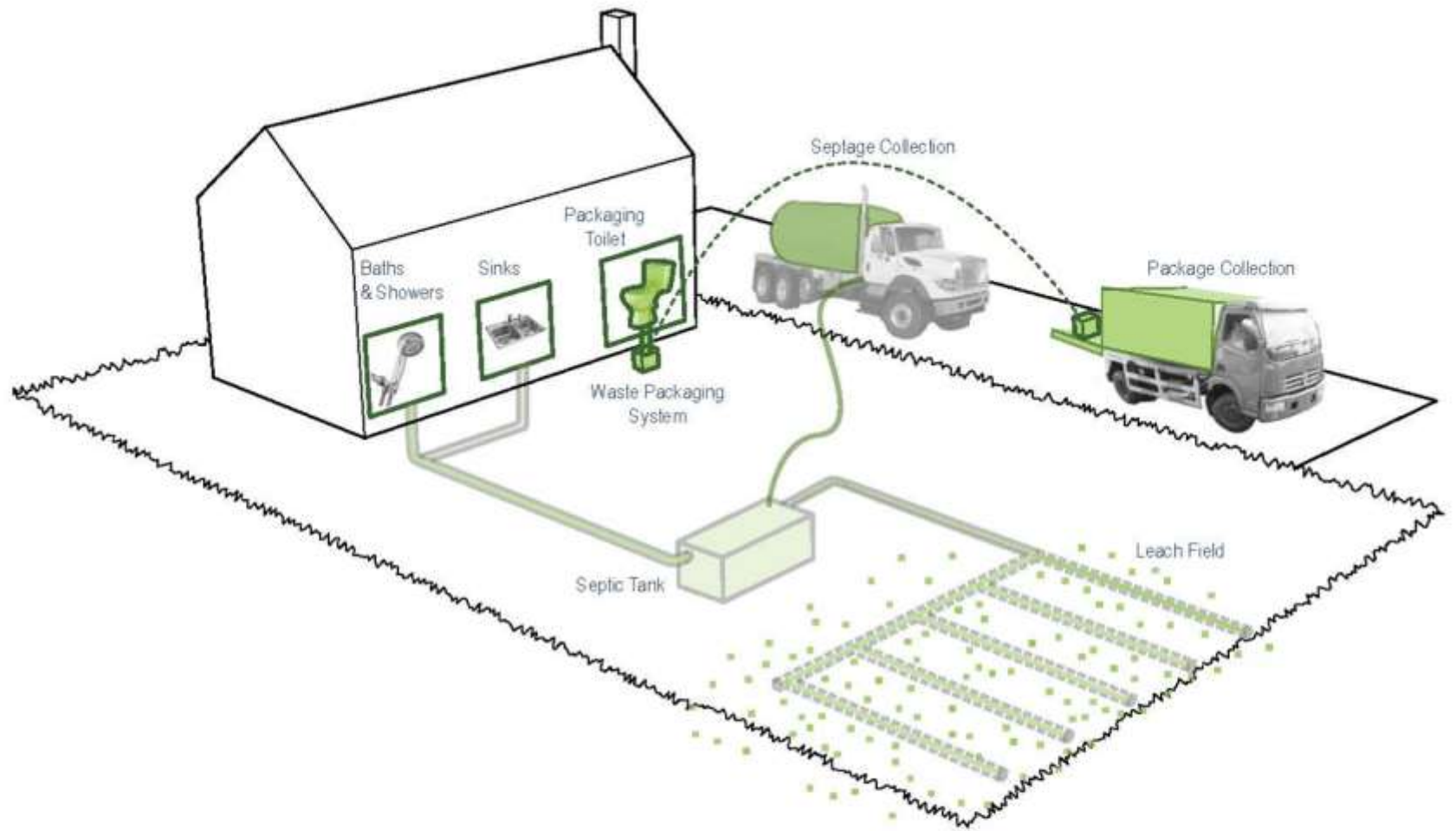




Earle Barnhart  
The Green Center, Inc







**Scale:** SITE  
**Target:** WASTEWATER

Toilets: Packaging

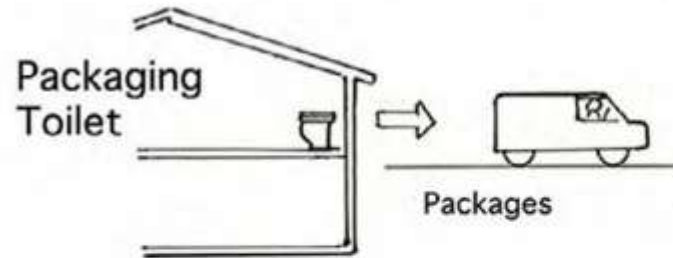


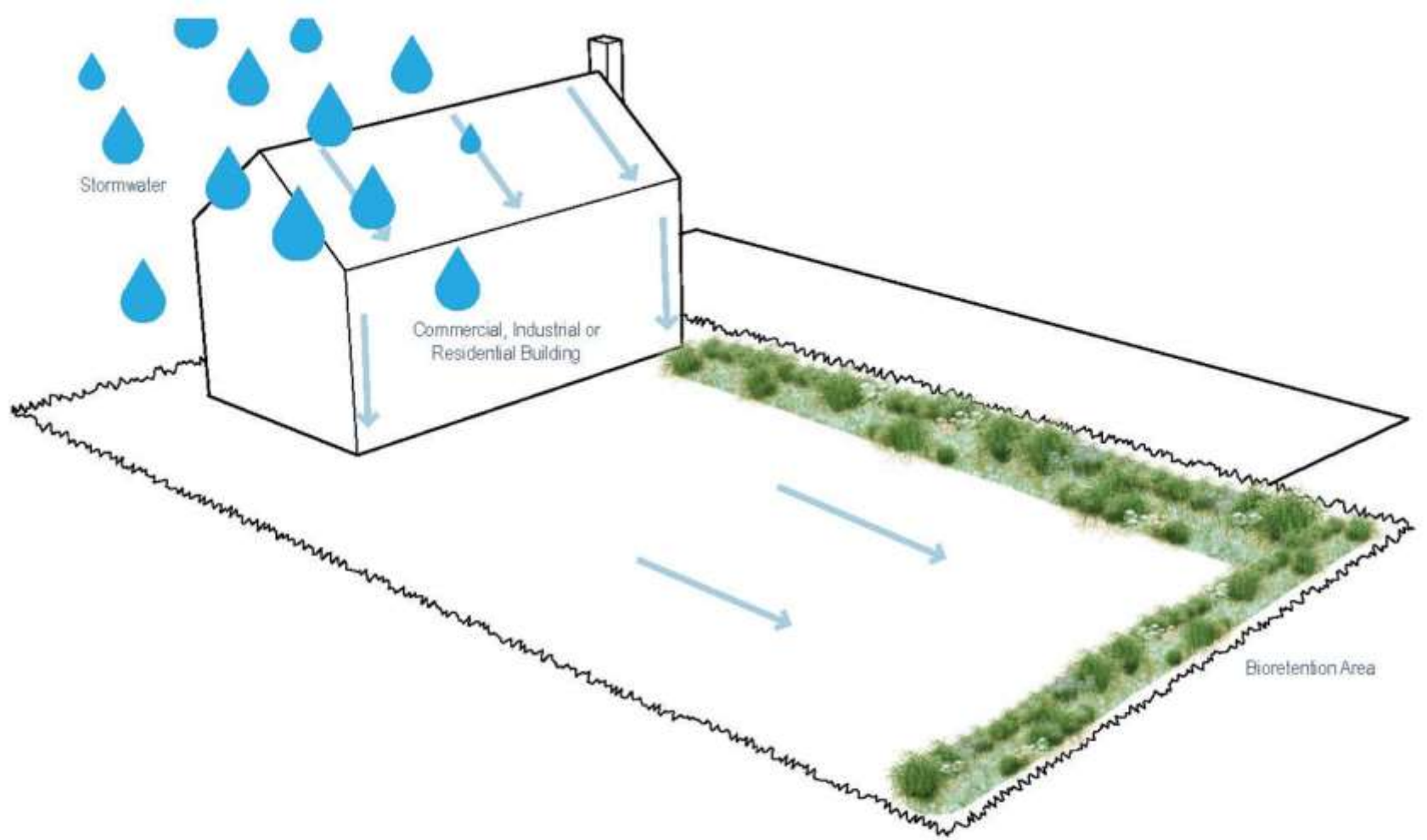


**PACTO**<sup>®</sup>



**LOOWATT**



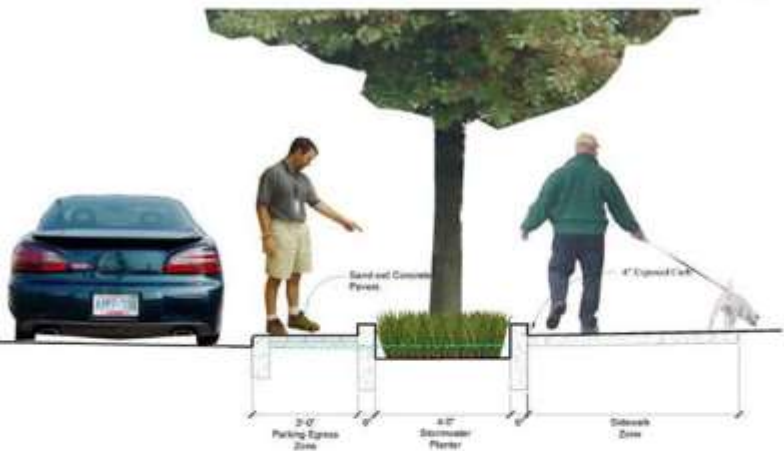


**Scale:** SITE  
**Target:** STORMWATER

Stormwater: Bioretention /  
Soil Media Filters







**Precedent:** 12th Ave. Stormwater Project, Portland, OR  
Source: City of Portland

Stormwater: Bioretention /  
Soil Media Filters





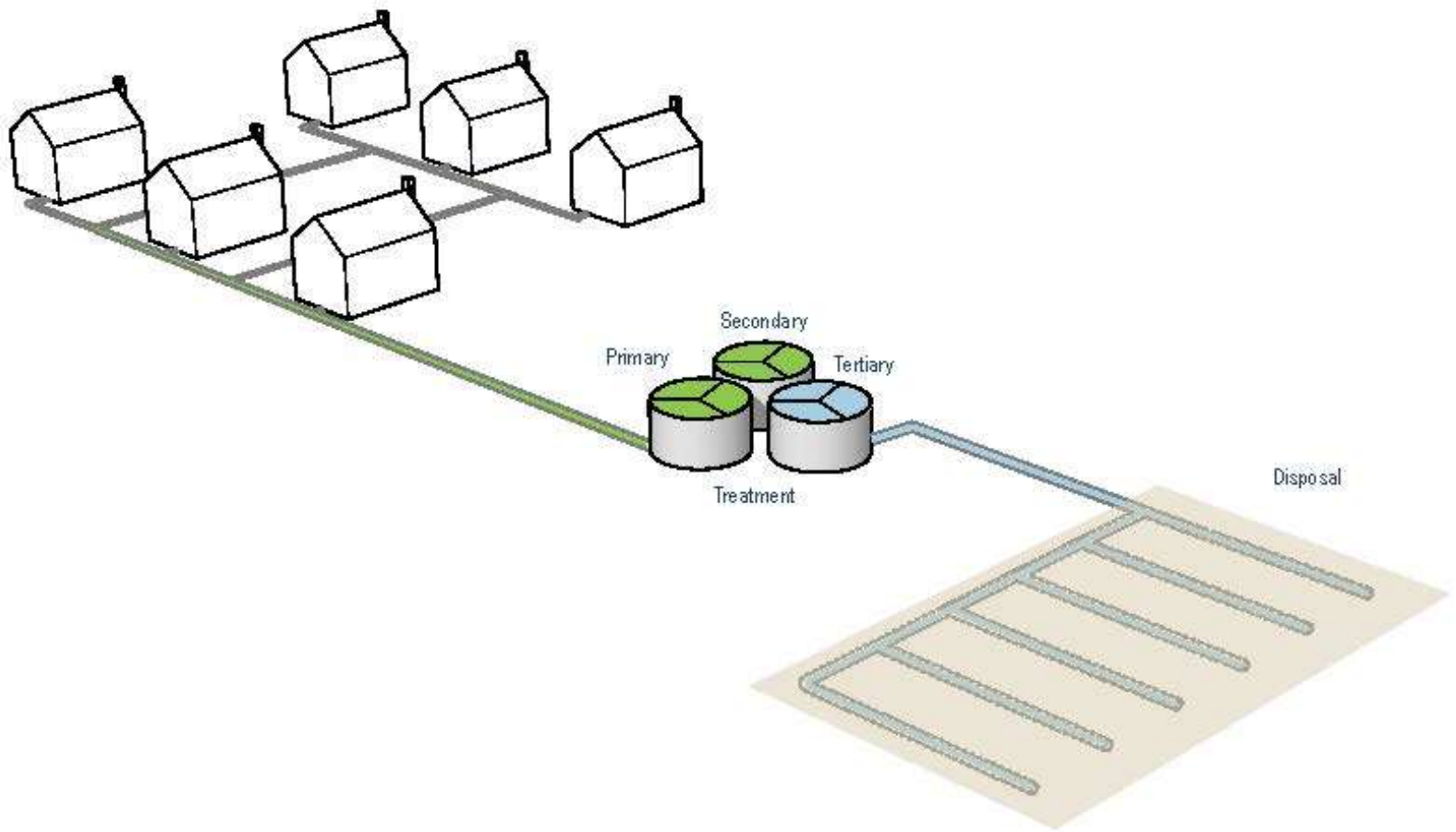


Rain Gardens



# Solutions: Neighborhood

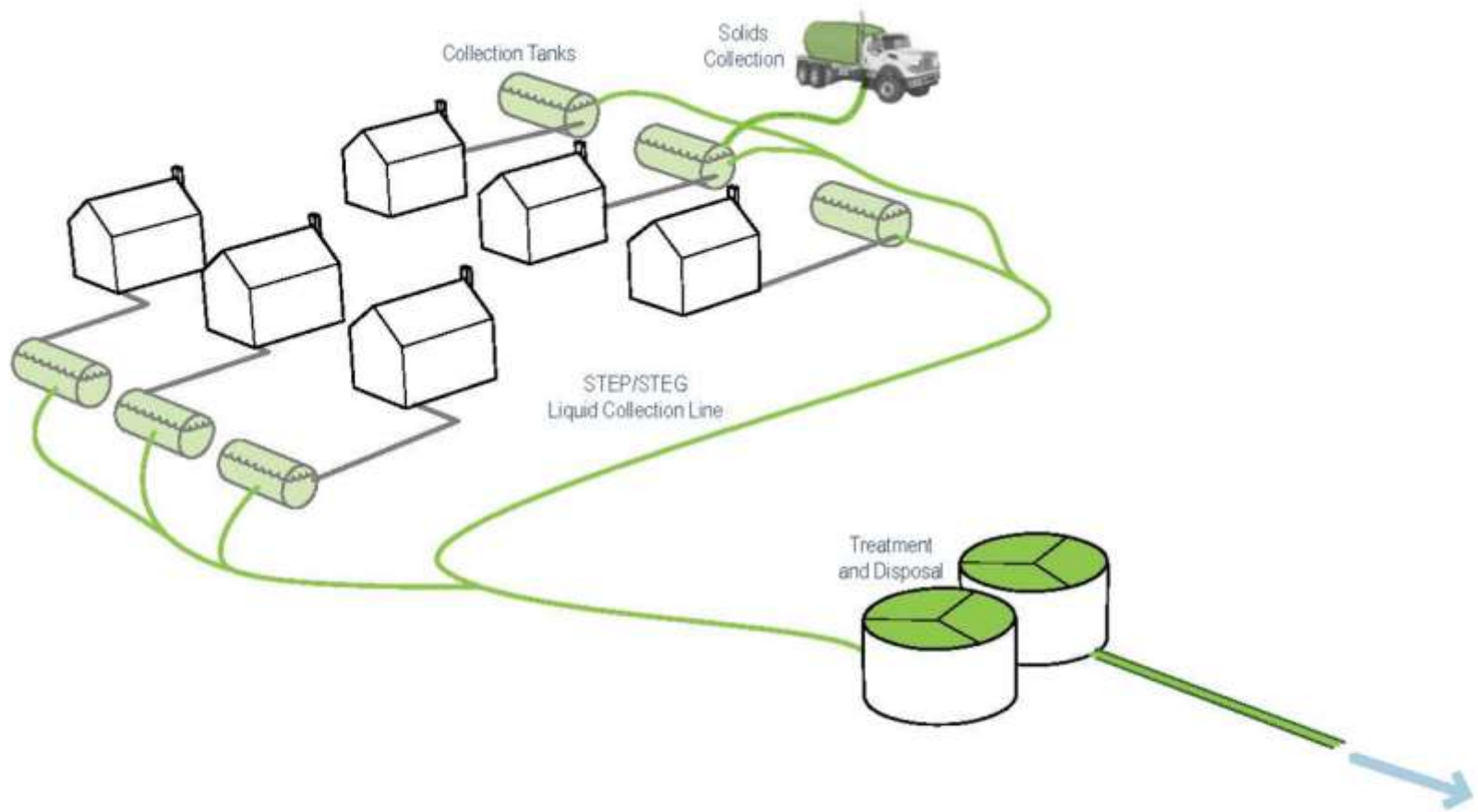




**Scale:** NEIGHBORHOOD  
**Target:** WASTEWATER

Cluster & Satellite  
Treatment Systems



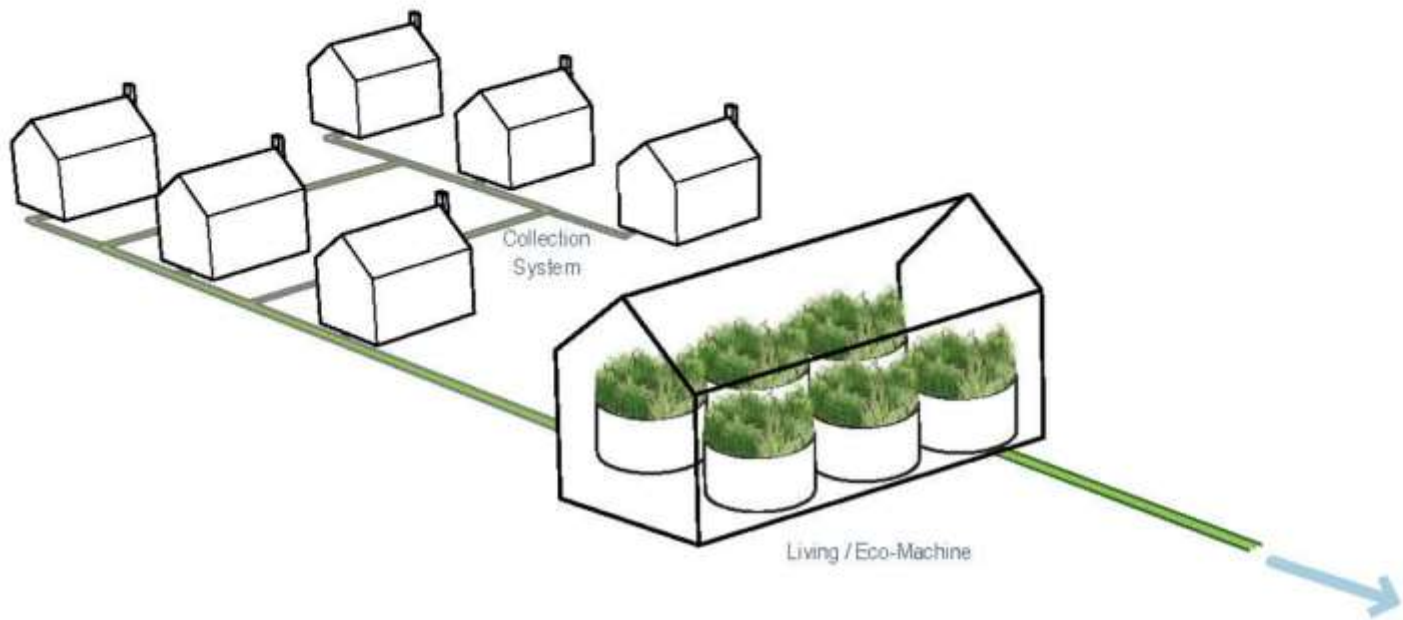


**Scale:** NEIGHBORHOOD  
**Target:** WASTEWATER

STEP / STEG Collection

STEP/  
STEG

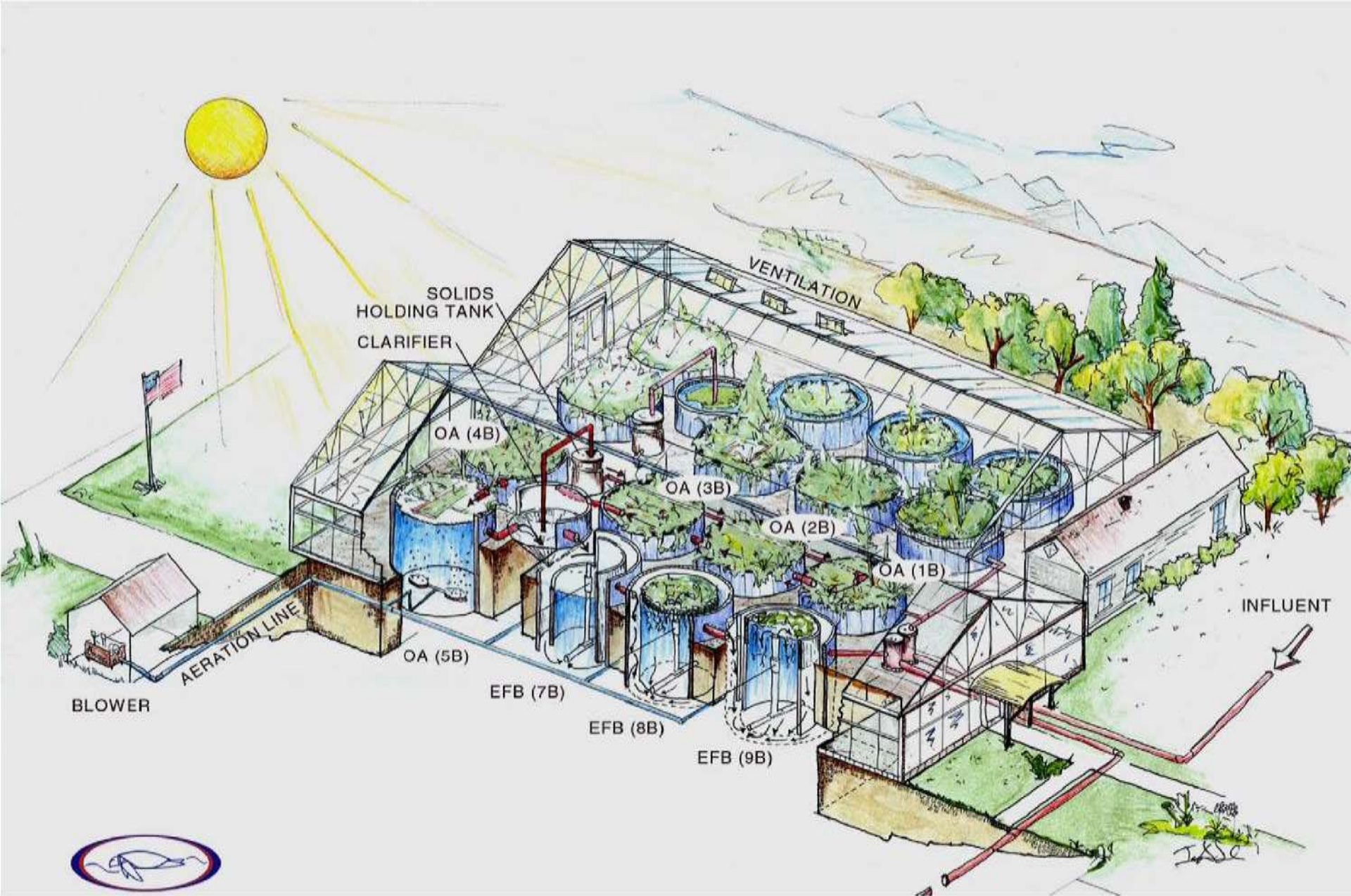




**Scale:** NEIGHBORHOOD  
**Target:** WASTEWATER

Eco-Machines and  
Living Machines





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

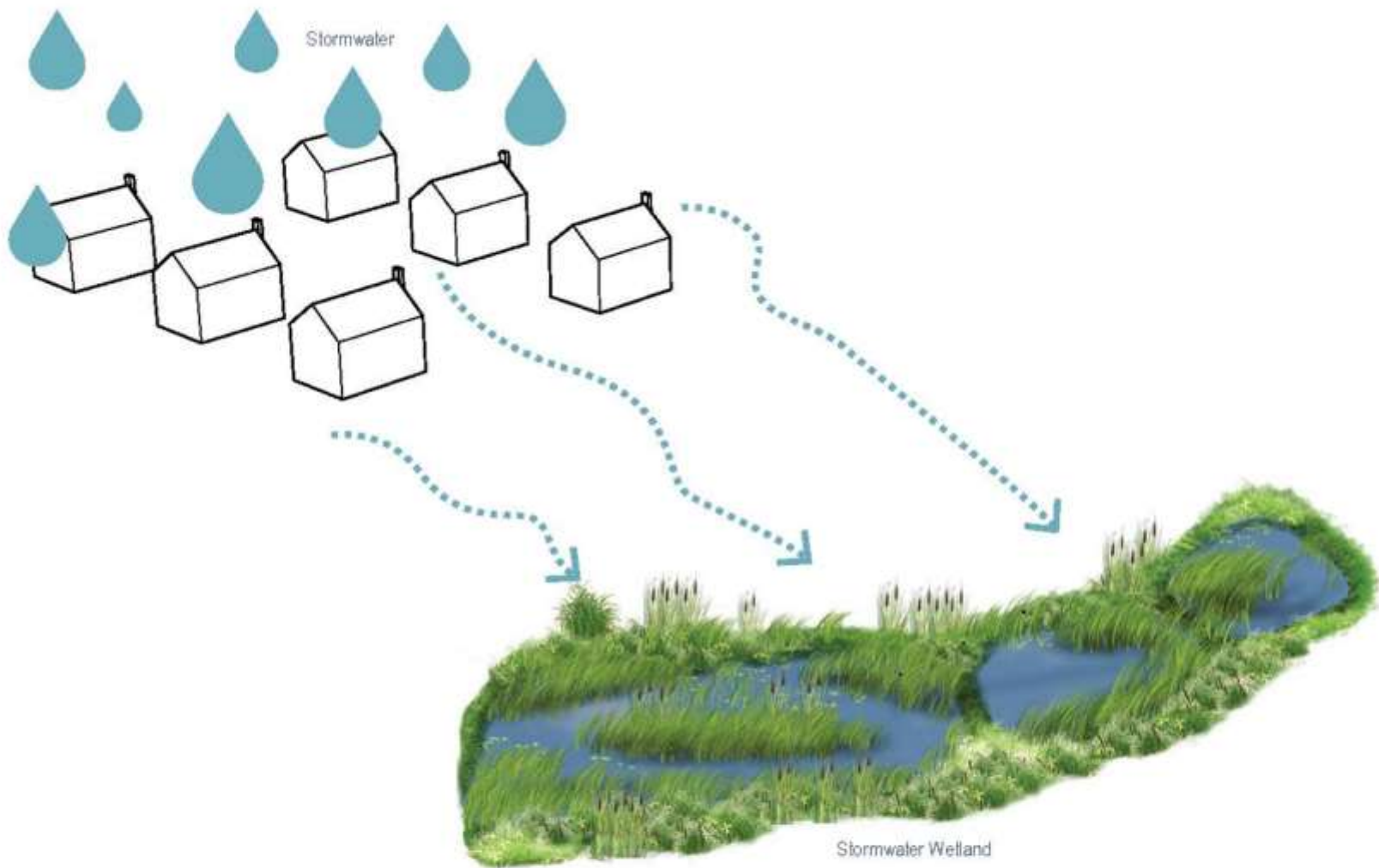




**Precedent:** Living Machine - South Burlington, VT + Photobioreactors - Falmouth, MA  
Source: Todd Ecological and Tom Cambareri

Eco-Machines and  
Living Machines





**Scale:** NEIGHBORHOOD  
**Target:** STORMWATER

Stormwater Wetlands

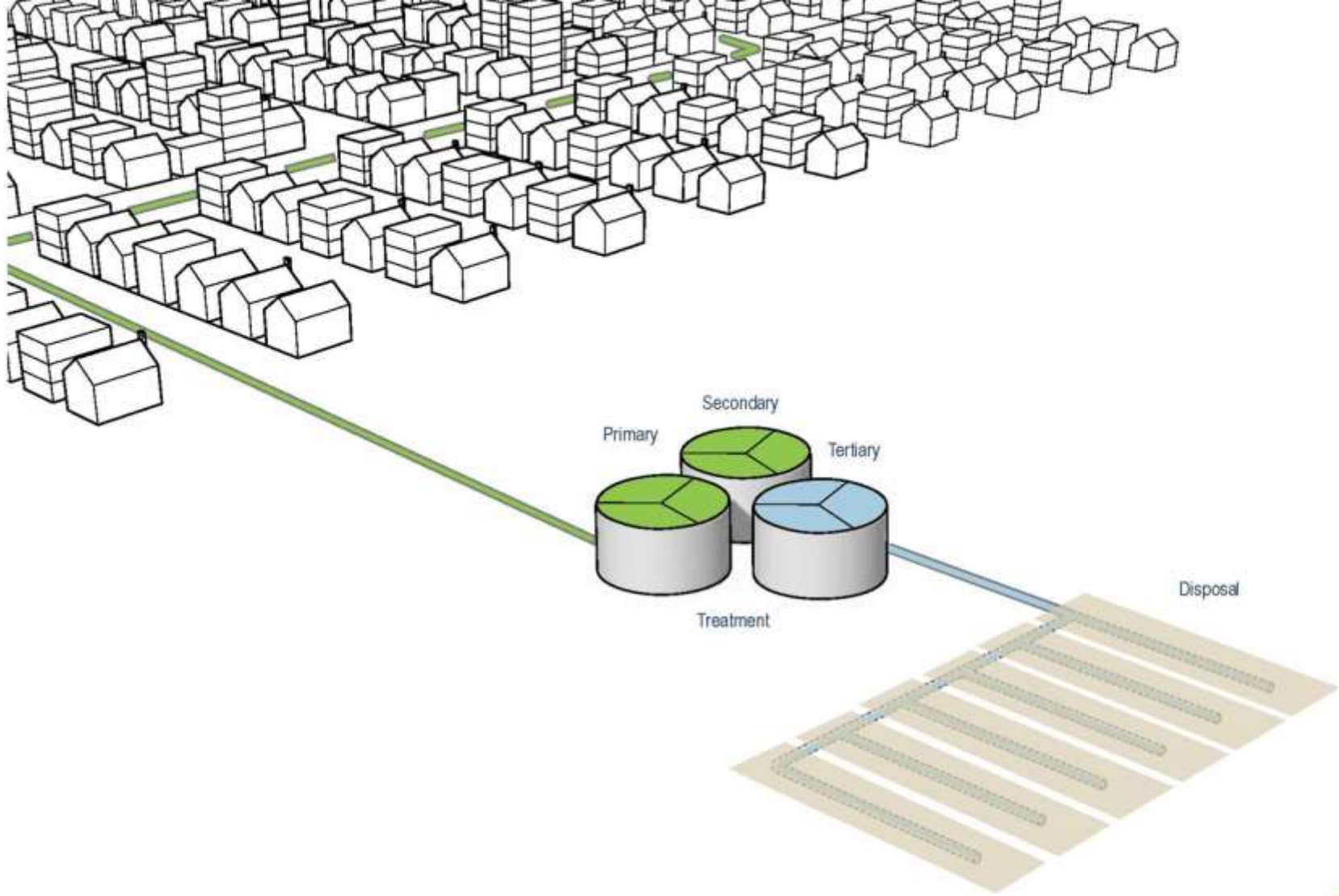




# Solutions: Watershed



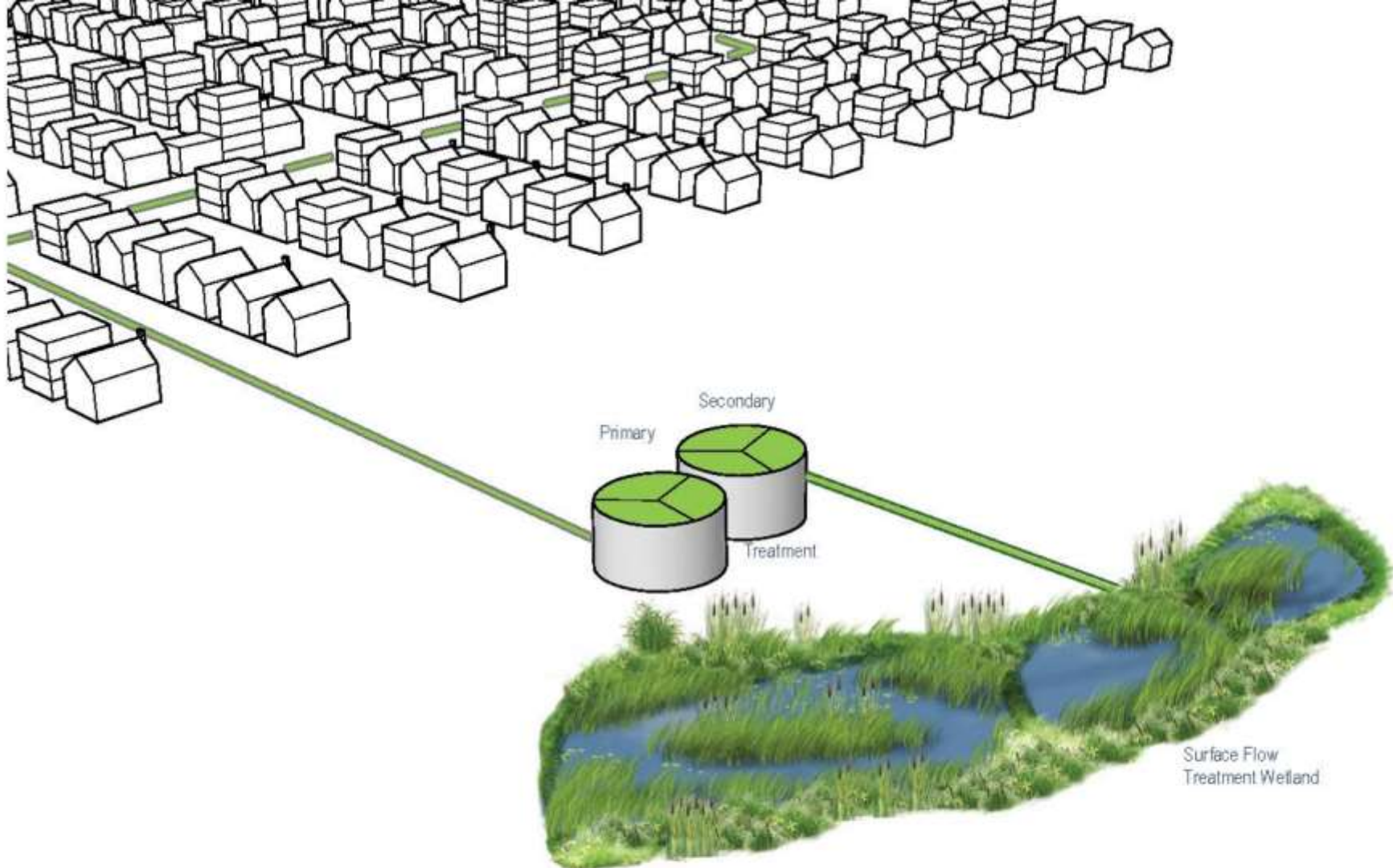




**Scale:** WATERSHED  
**Target:** WASTEWATER

Conventional Treatment





**Scale:** WATERSHED  
**Target:** WASTEWATER

Constructed Wetlands:  
Surface Flow



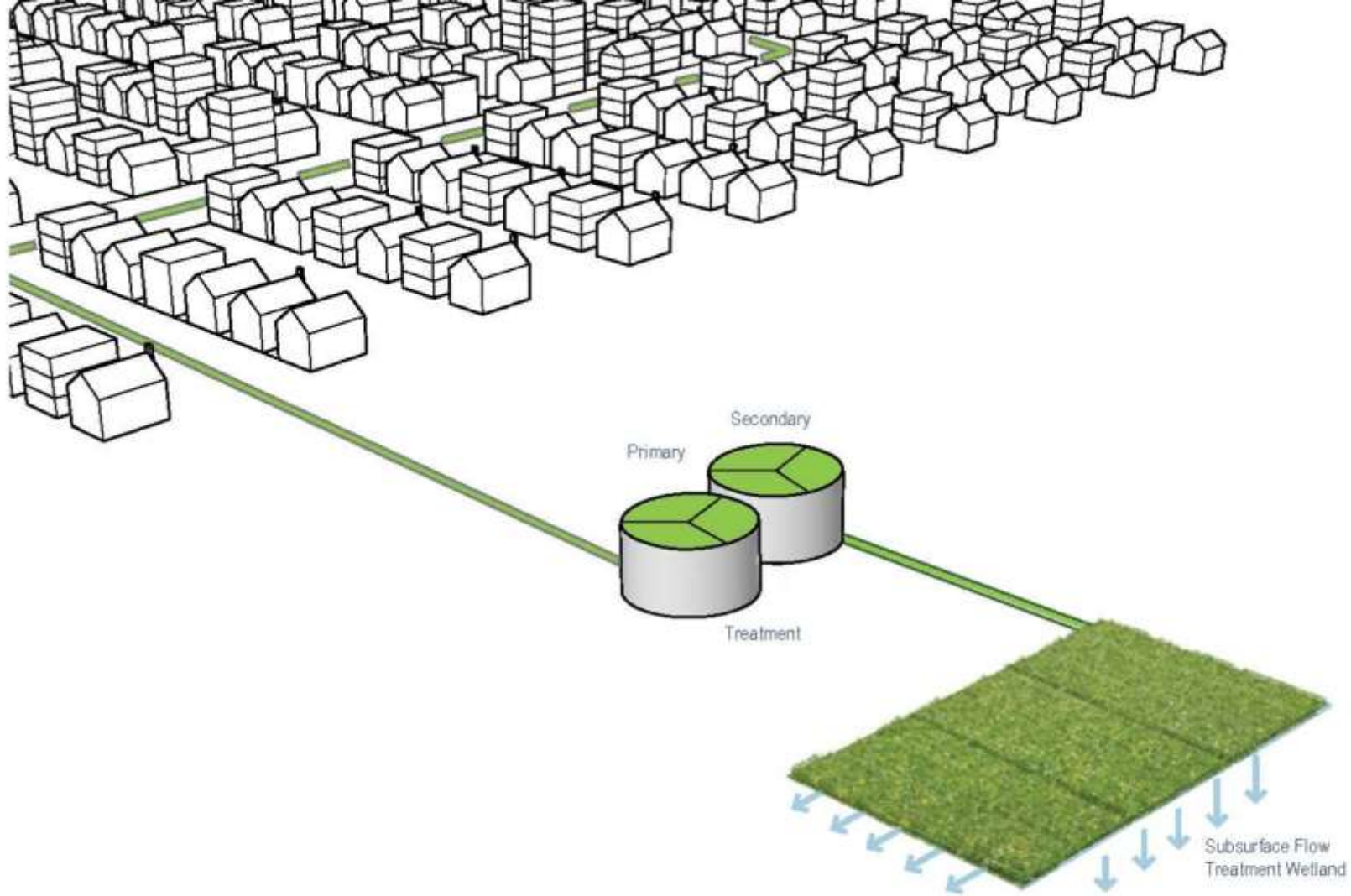




**Precedent:** Talking Waters Garden - Albany, OR  
Source: Kate Kennen

Constructed Wetlands:  
Surface Flow



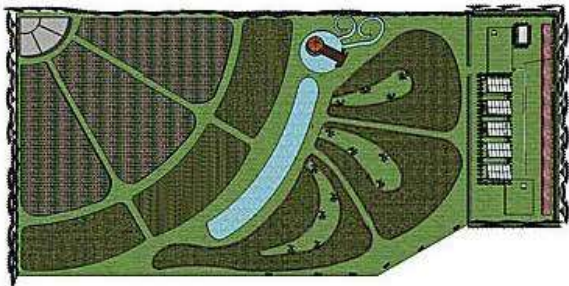


**Scale:** WATERSHED  
**Target:** WASTEWATER

Constructed Wetlands:  
Subsurface Flow





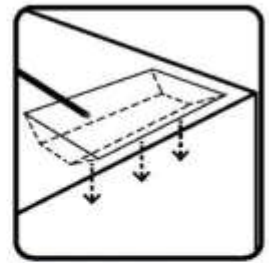
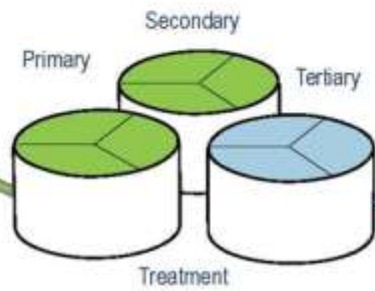
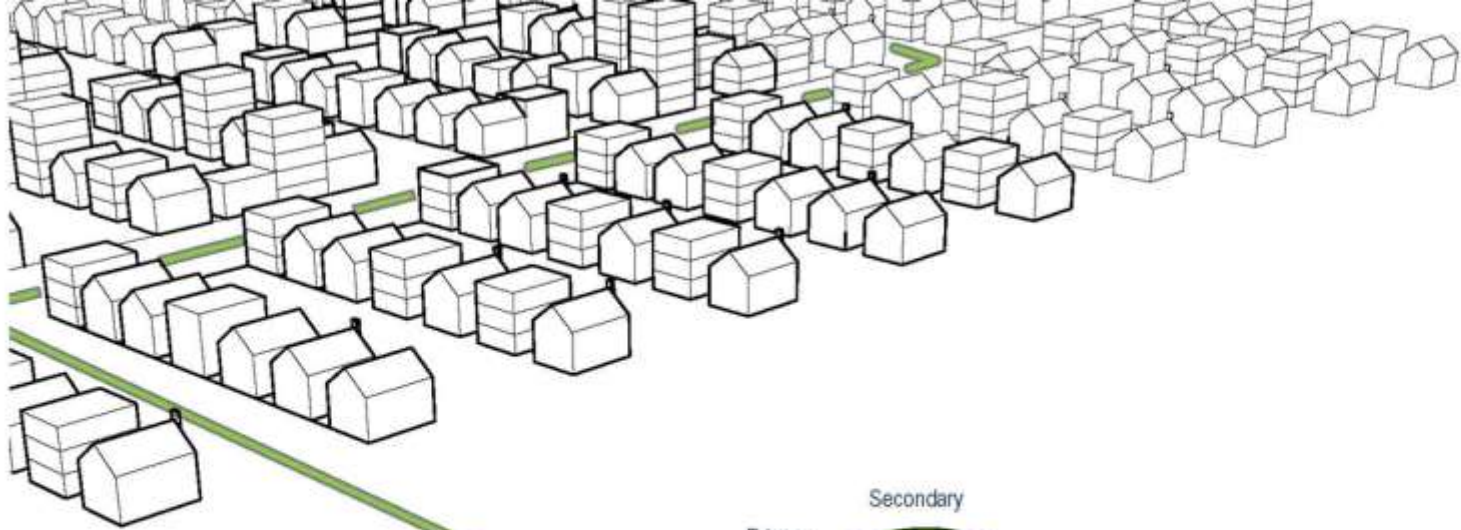


**Precedent:** Koh Phi Phi Treatment Wetland, Thailand  
Source: Hans Brix

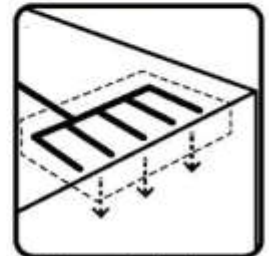
Constructed Wetlands:  
Subsurface Flow



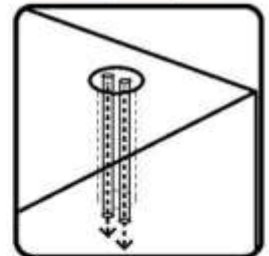




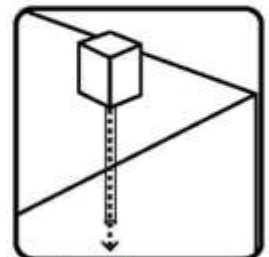
Infiltration Basins



Soil Absorption System



Wick Well

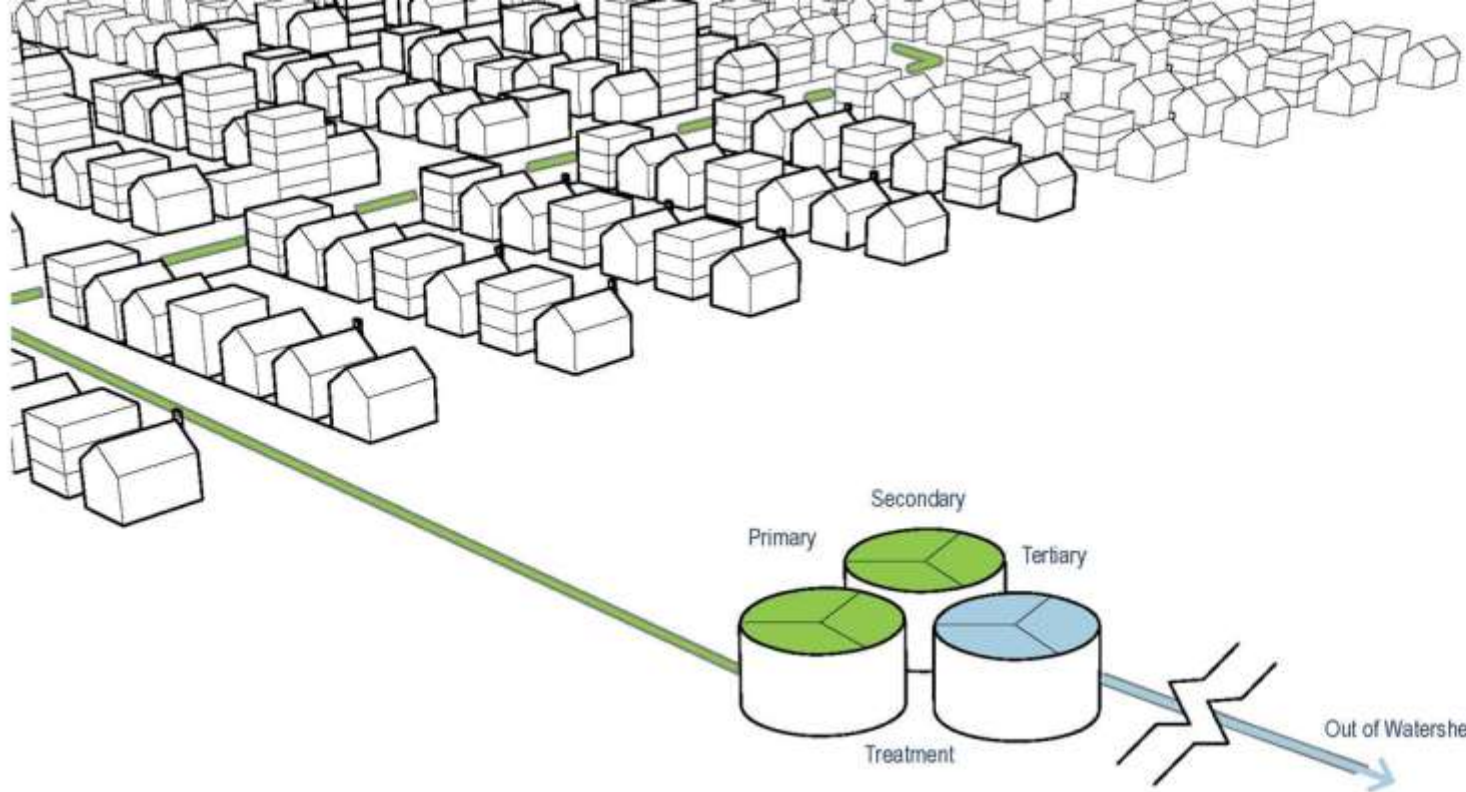


Injection Well

Scale: WATERSHED  
Target: WASTEWATER

Effluent Disposal Systems

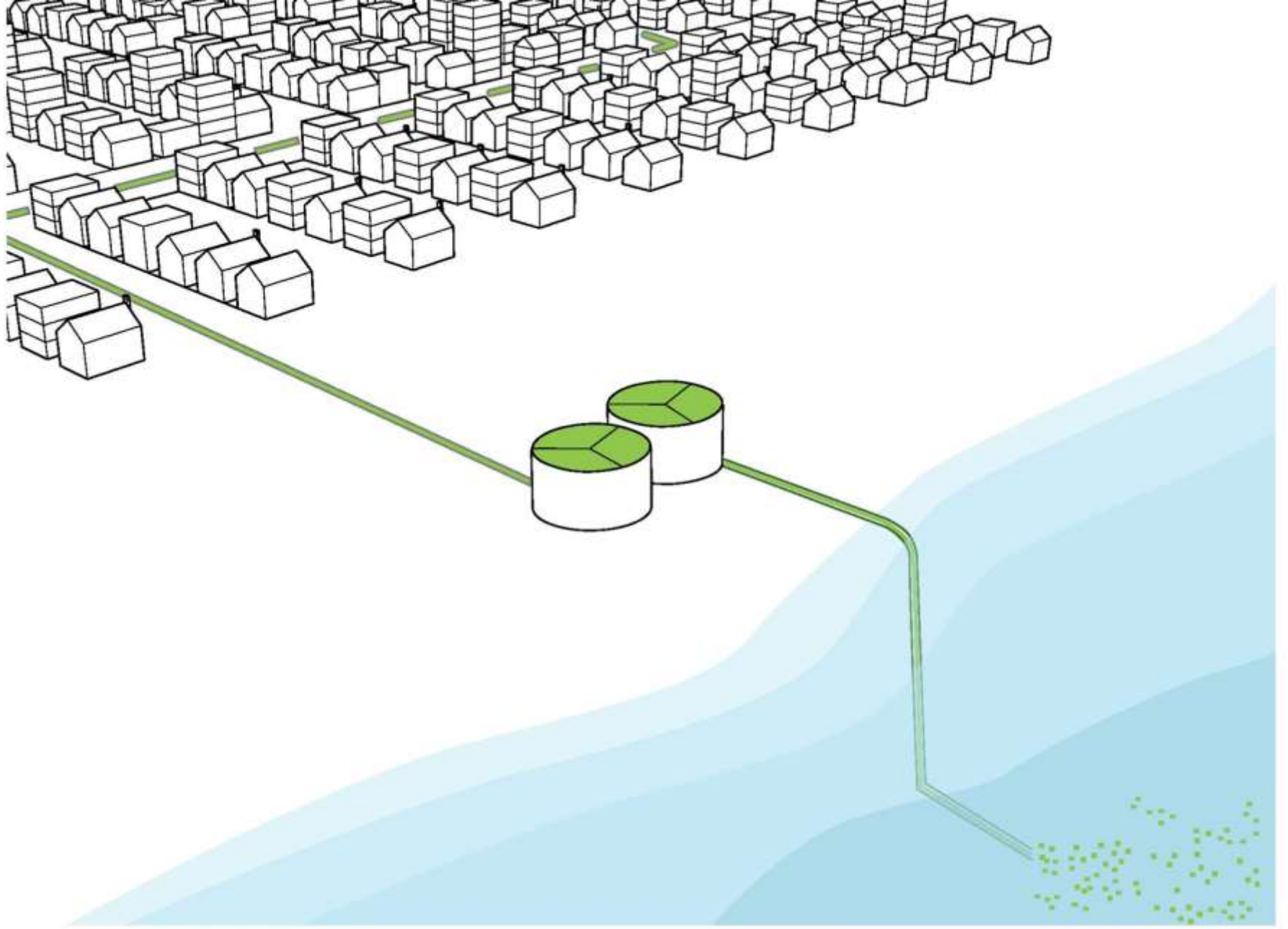




**Scale:** WATERSHED  
**Target:** WASTEWATER

Effluent Disposal: Out of Watershed



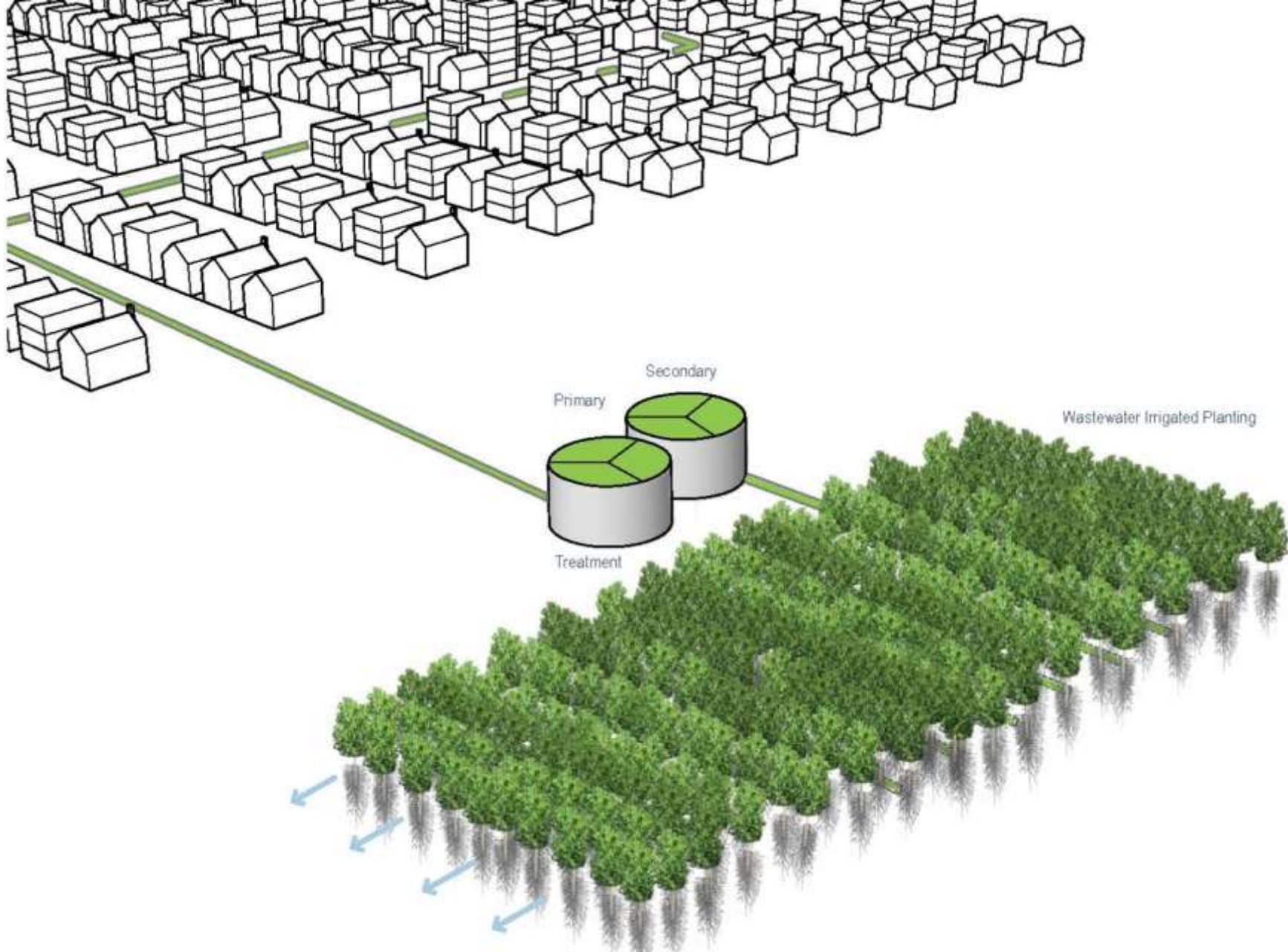


**Scale:** WATERSHED  
**Target:** WASTEWATER

Effluent Disposal: Ocean Outfall







**Scale:** WATERSHED  
**Target:** WASTEWATER

Phytoirrigation





**Precedent:** Woodburn OR, Wastewater Treatment Facility  
Source: CH2MHill

Phytoirrigation





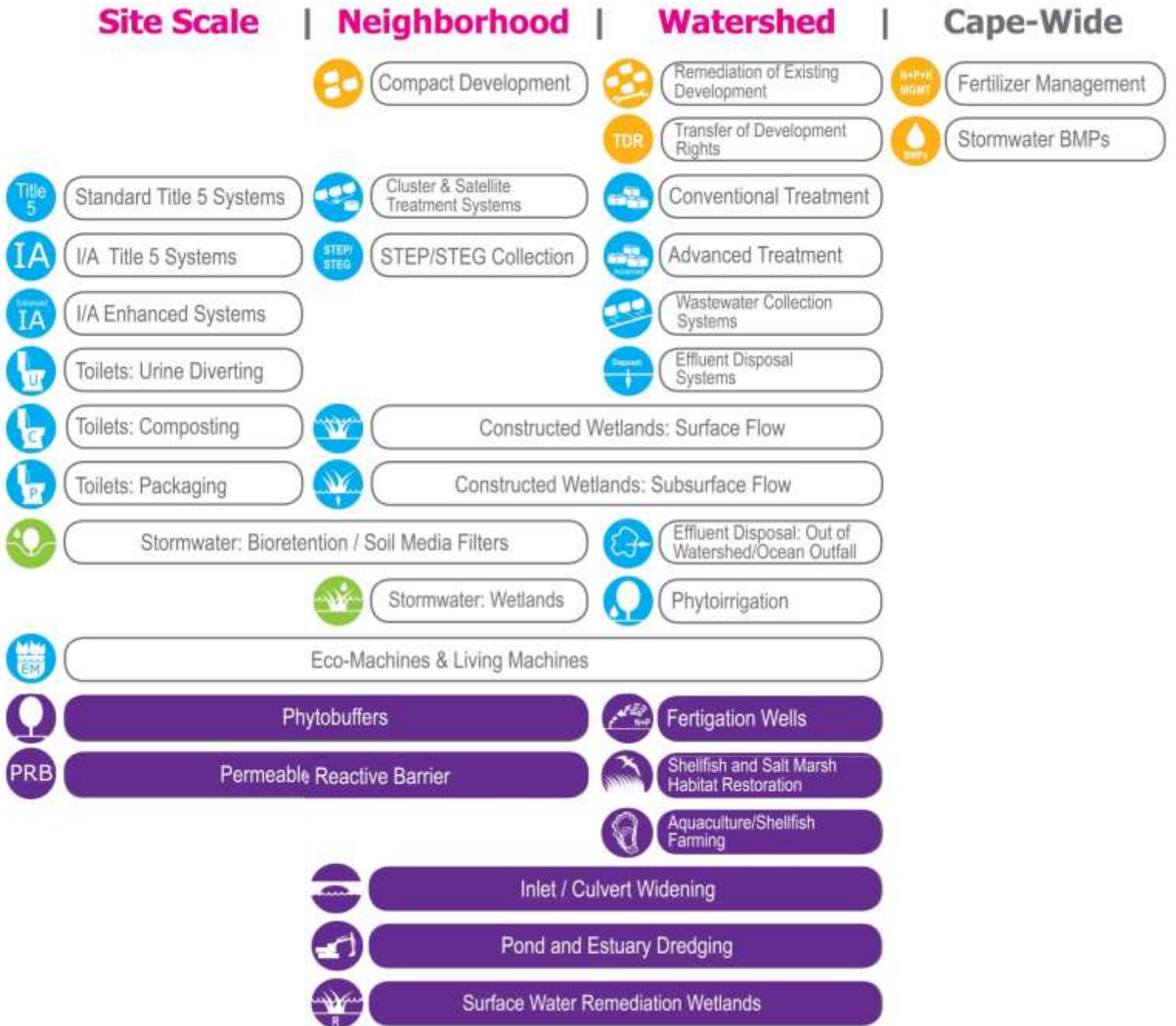


**Precedent:** Woodburn OR, Wastewater Treatment Facility  
Source: CH2MHill

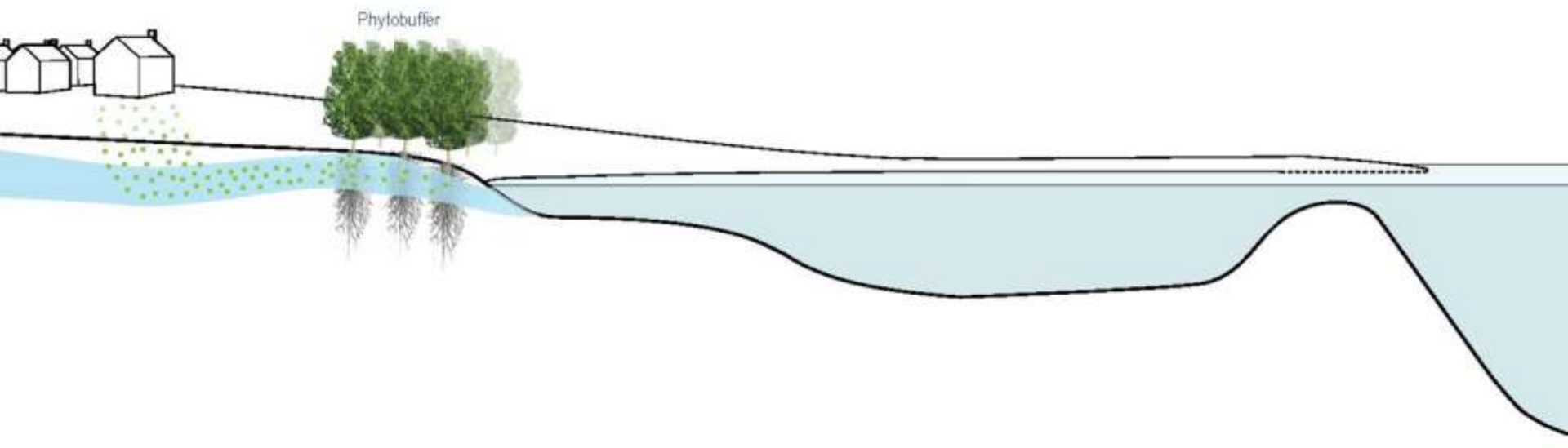
Phytoirrigation



# Solutions: Ex. Water







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

Phytobuffers

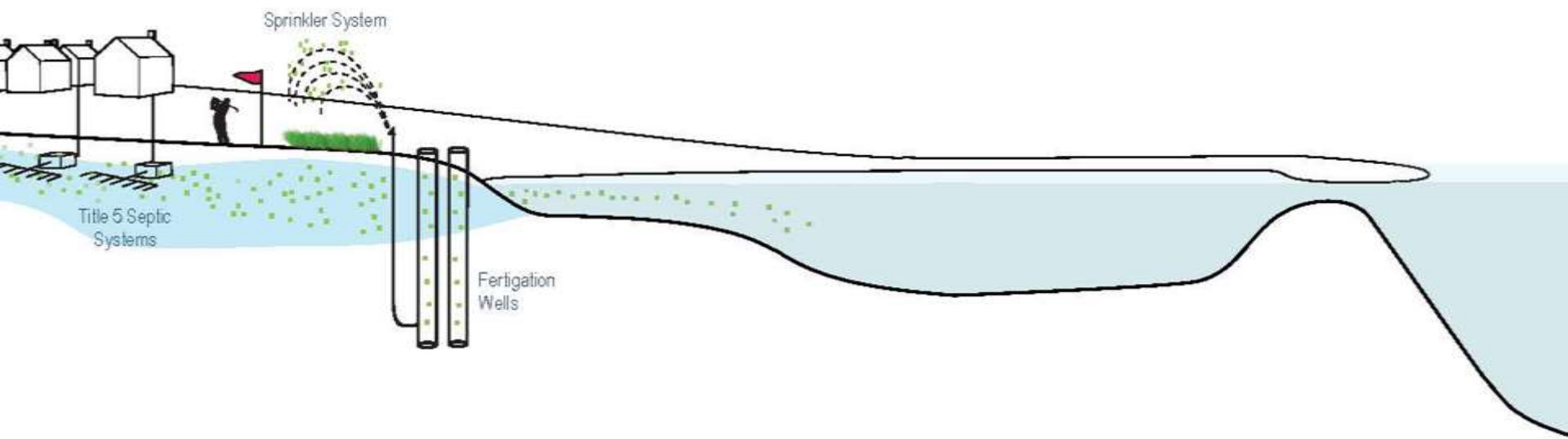




**Precedent:** Phytobuffer - Kavcee, WY  
Source: Sand Creek Consultants

Phytobuffers





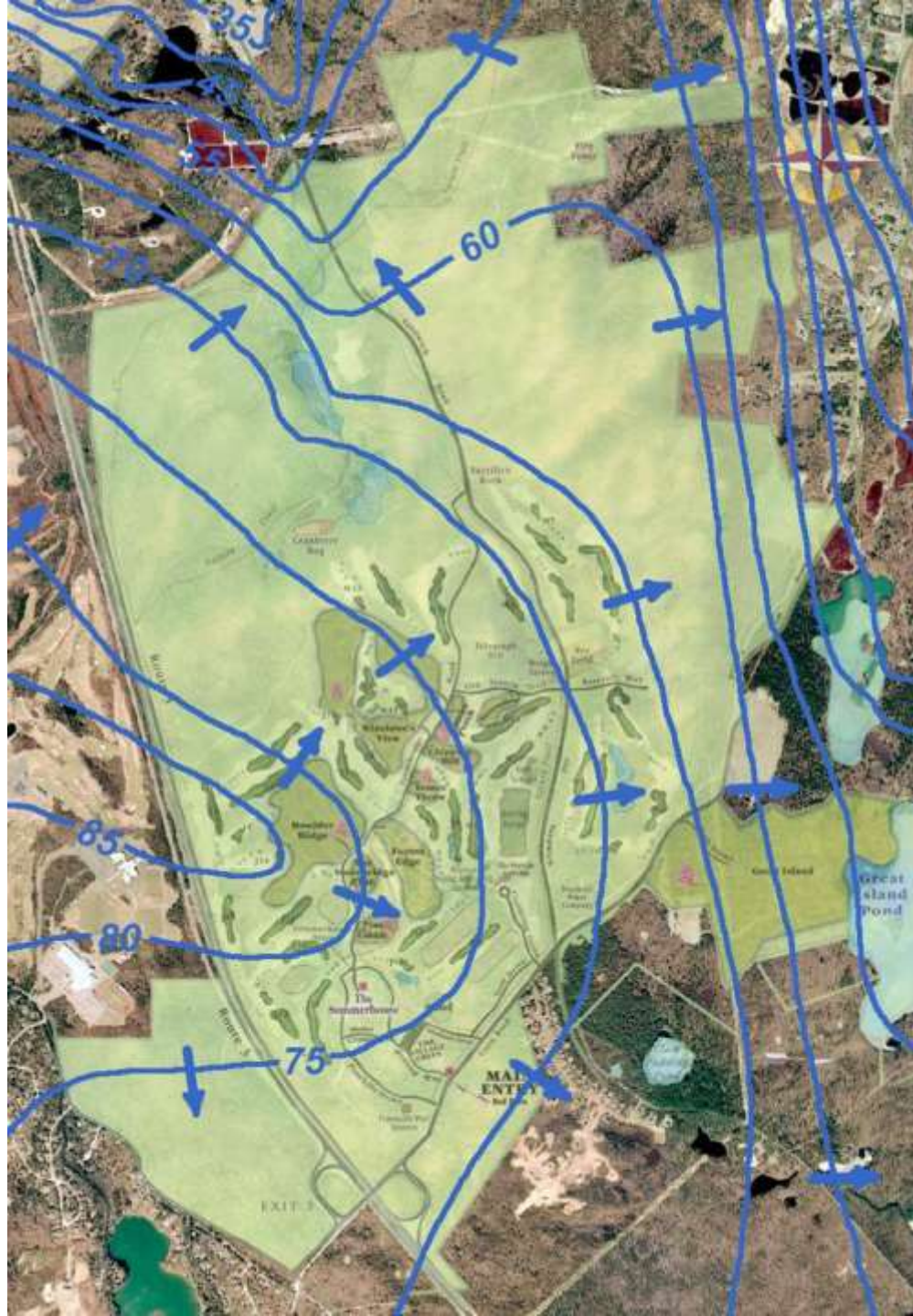
**Scale:** NEIGHBORHOOD/ WATERSHED  
**Target:** EXISTING WATER BODIES

Fertigation Wells

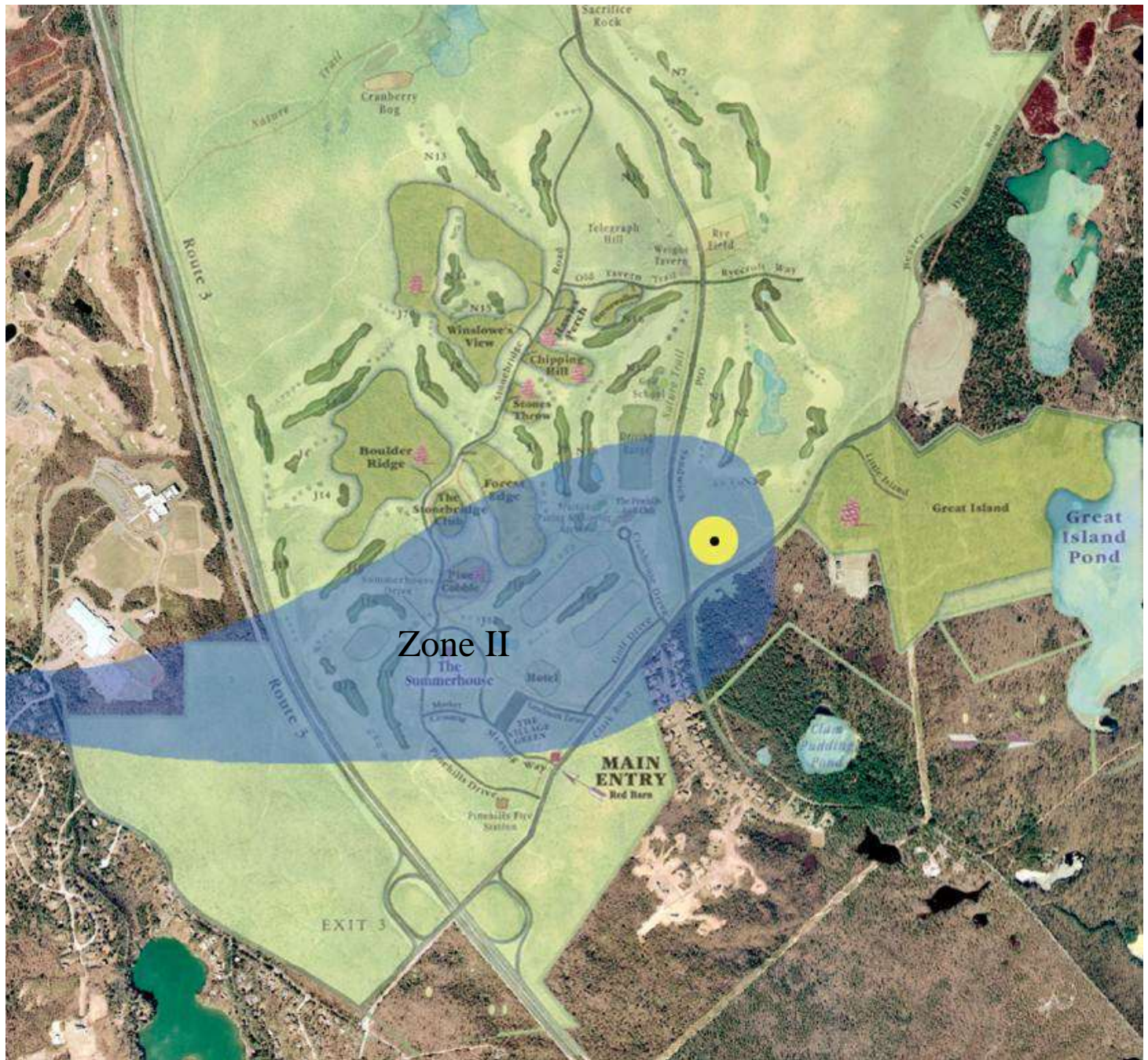




**Precedent:**  
Pine Hills  
Plymouth, MA





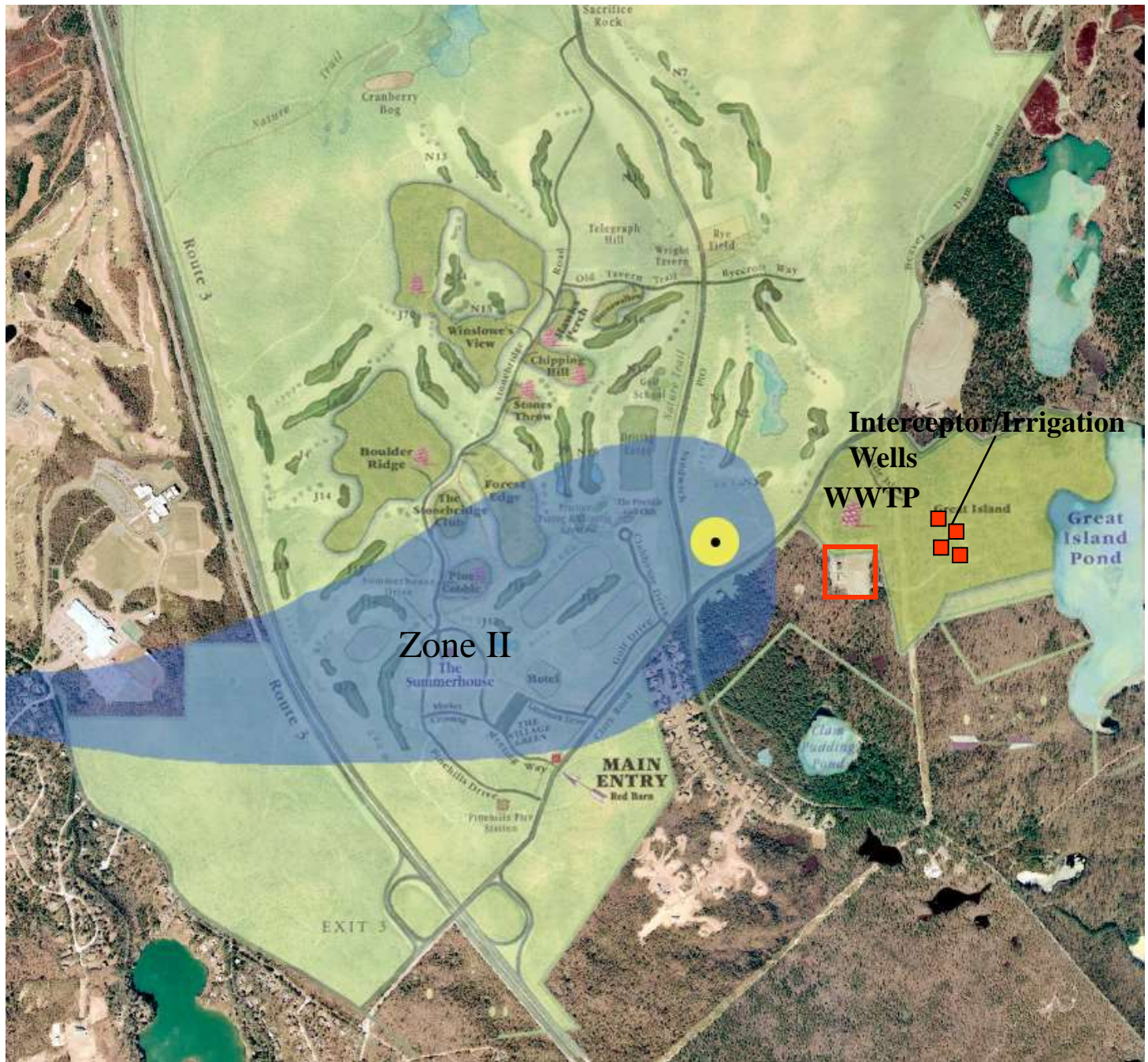


**Precedent:**  
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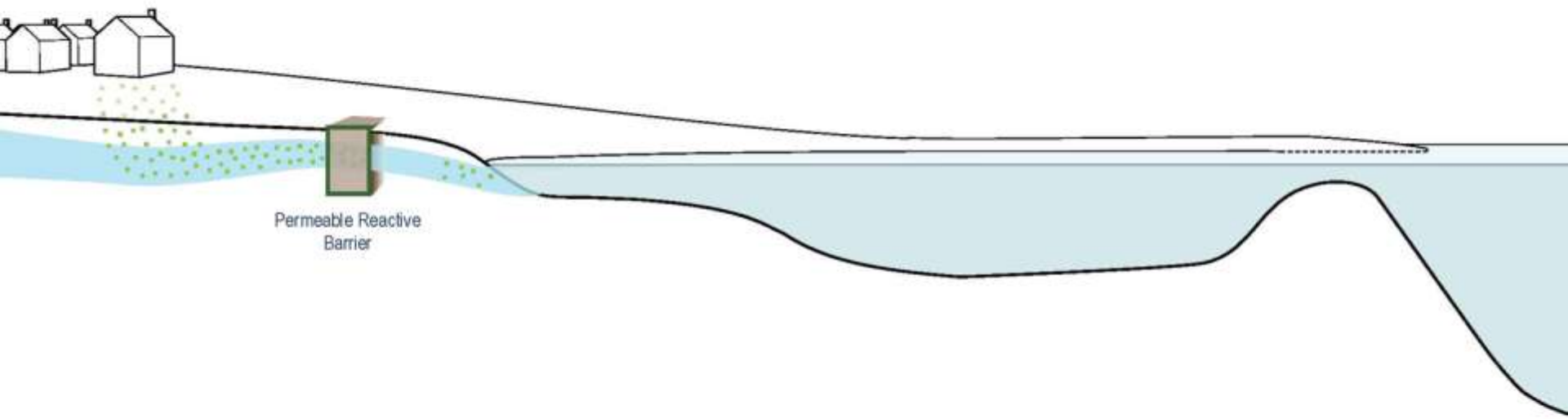








**Precedent:**  
Pine Hills  
Plymouth, MA



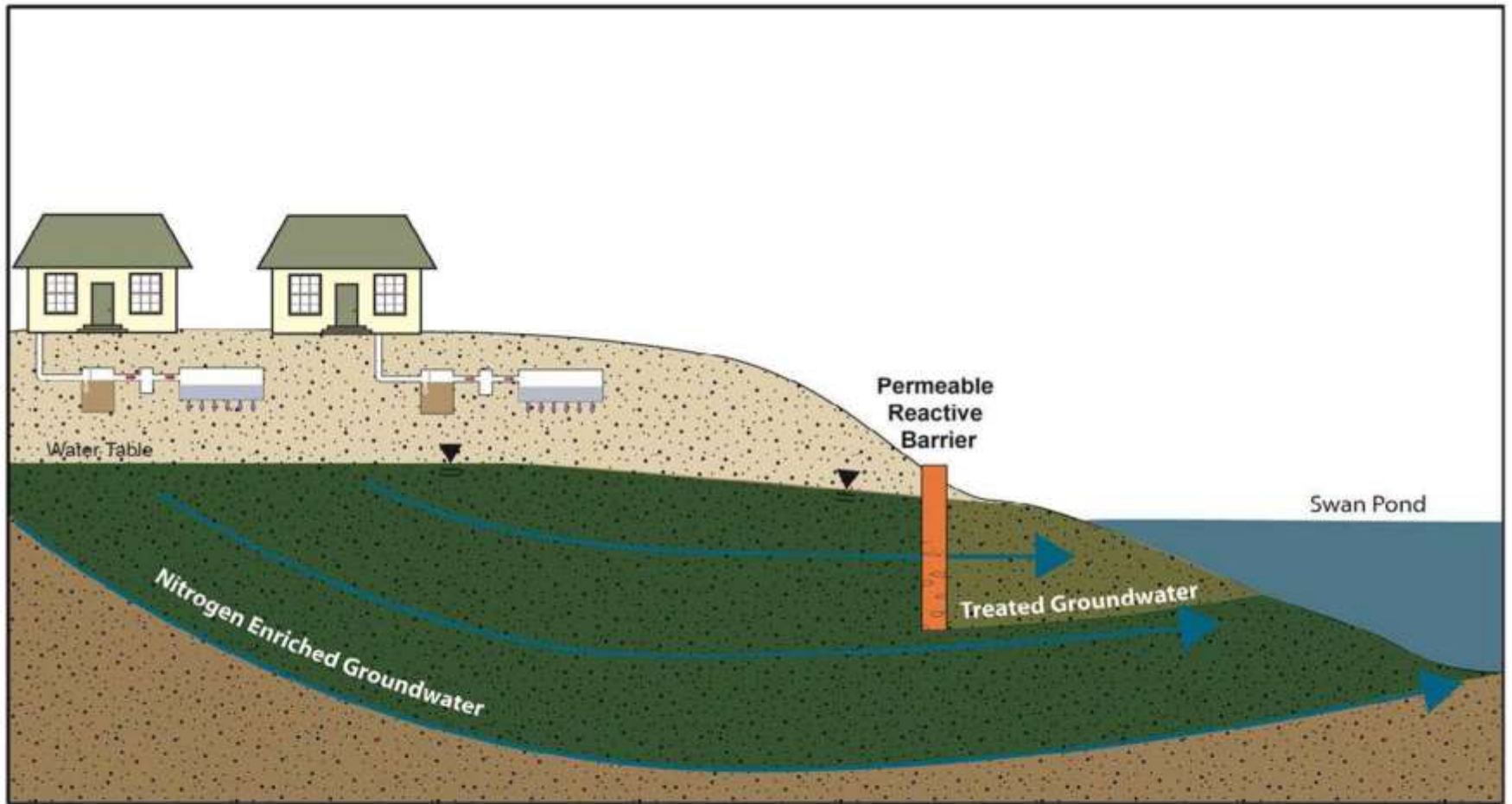
Permeable Reactive Barrier

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

Permeable Reactive Barrier







**Precedent: PRB**  
Source: Horsley Witten Group Inc.

Permeable Reactive Barrier

PRB



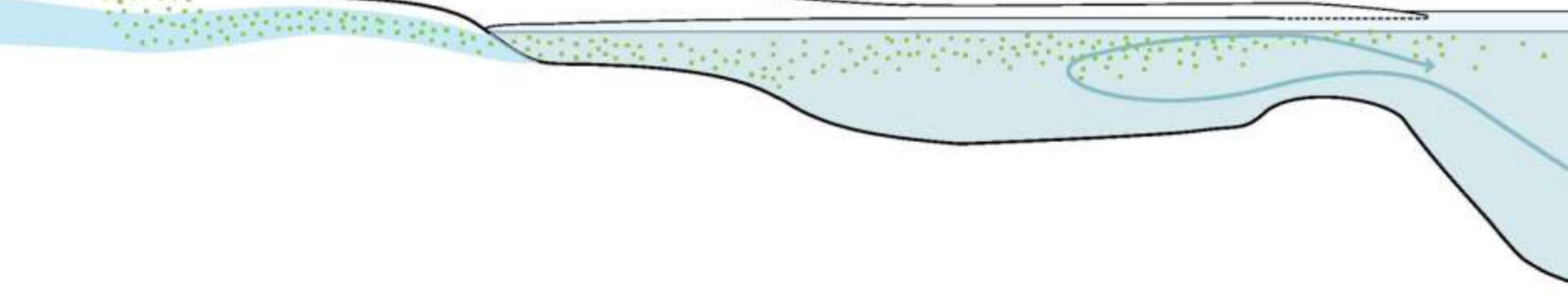
**Precedent:** Falmouth PRB  
Source: Mike Domenica

Permeable Reactive Barrier





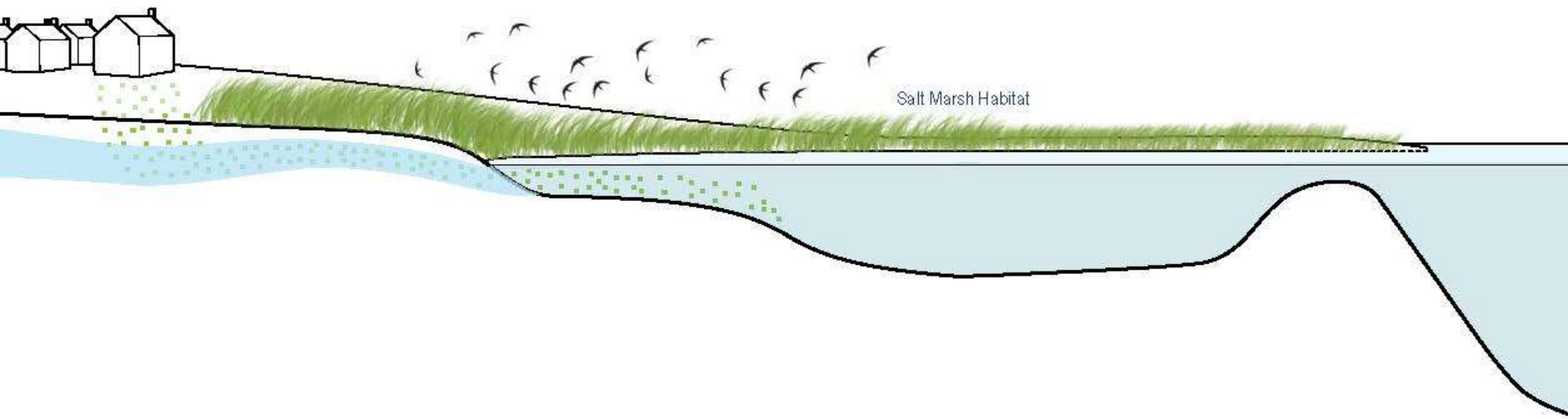




**Scale:** NEIGHBORHOOD/ WATERSHED  
**Target:** EXISTING WATER BODIES

Inlet and Culvert Widening



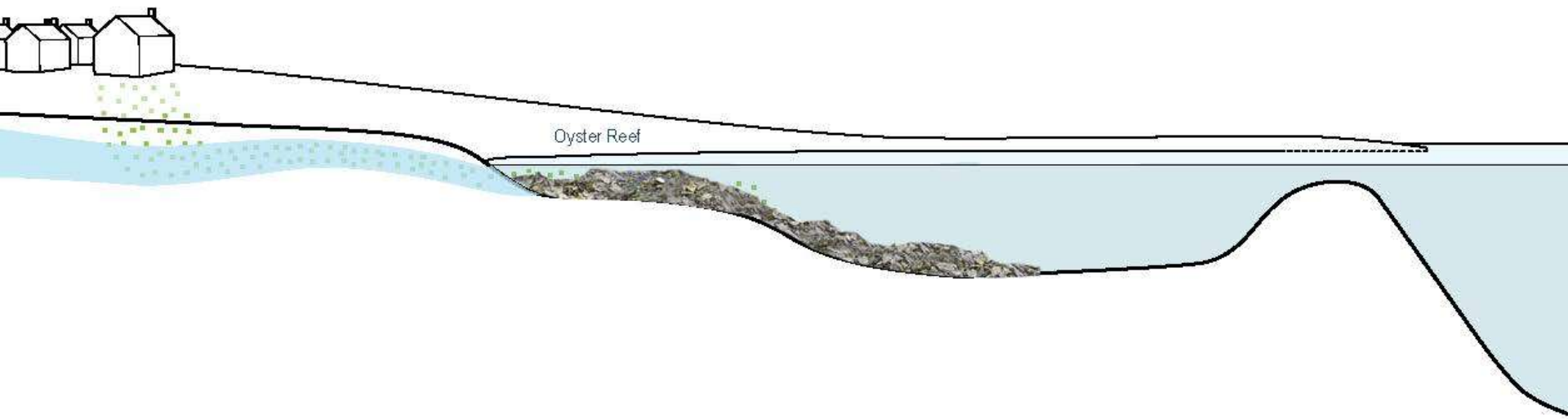


Salt Marsh Habitat

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

Salt Marsh Habitat Restoration





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

Shellfish Habitat Restoration



### Measuring Oysters' Improvements on Water Quality

**Overall project area with new caulk**

- already 2-3 million additional oysters
- past 5,000 pounds of nitrogen removed per year
- likely increase in commercial shellfish value of \$1 million/year
- increased water filtration approximately 100 million gallons/day
- erosion control
- sediment reduction
- increased mean, red, juvenile fish habitat

**Oyster Spawning Grounds (2.04 acres)**

**New type of traction caulk (small black particles)**

**132 Meter**

**Precedent:** Wellfleet Oyster Restoration Project  
 Source: Anamarija Francik

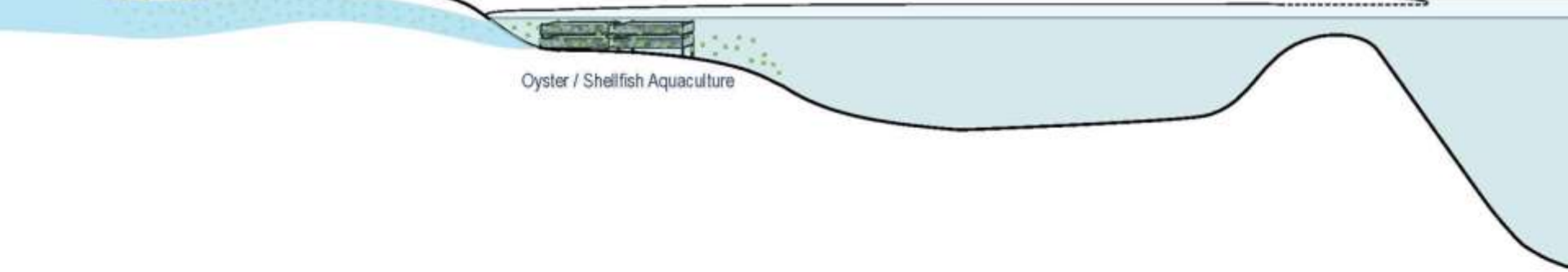




**Precedent:** Wellfleet Oyster Restoration Project  
Source: Anamarija Francik

Shellfish Habitat Restoration



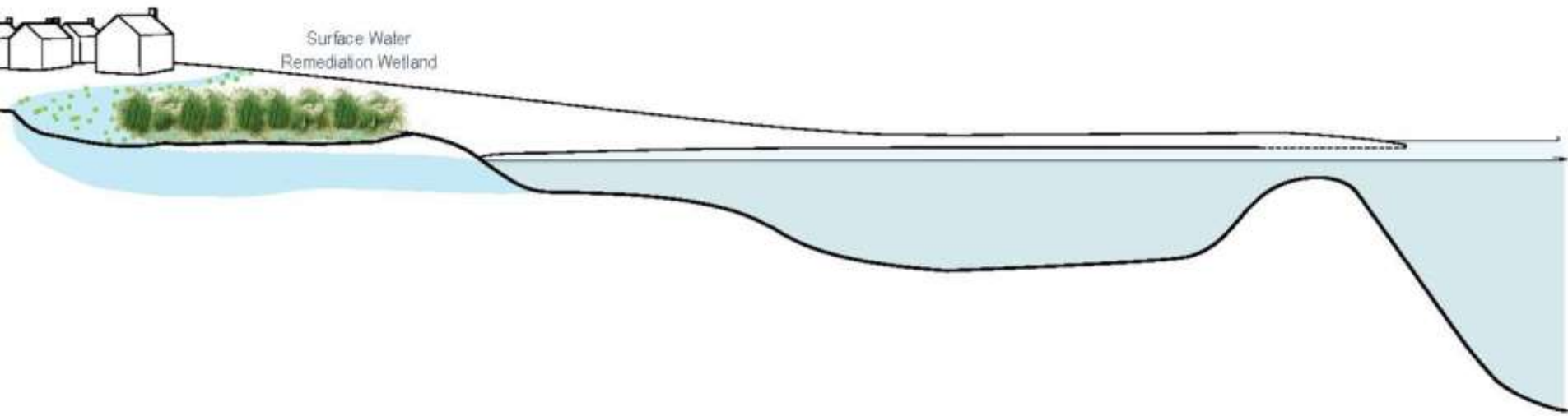


Oyster / Shellfish Aquaculture

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

Aquaculture / Shellfish Farming





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

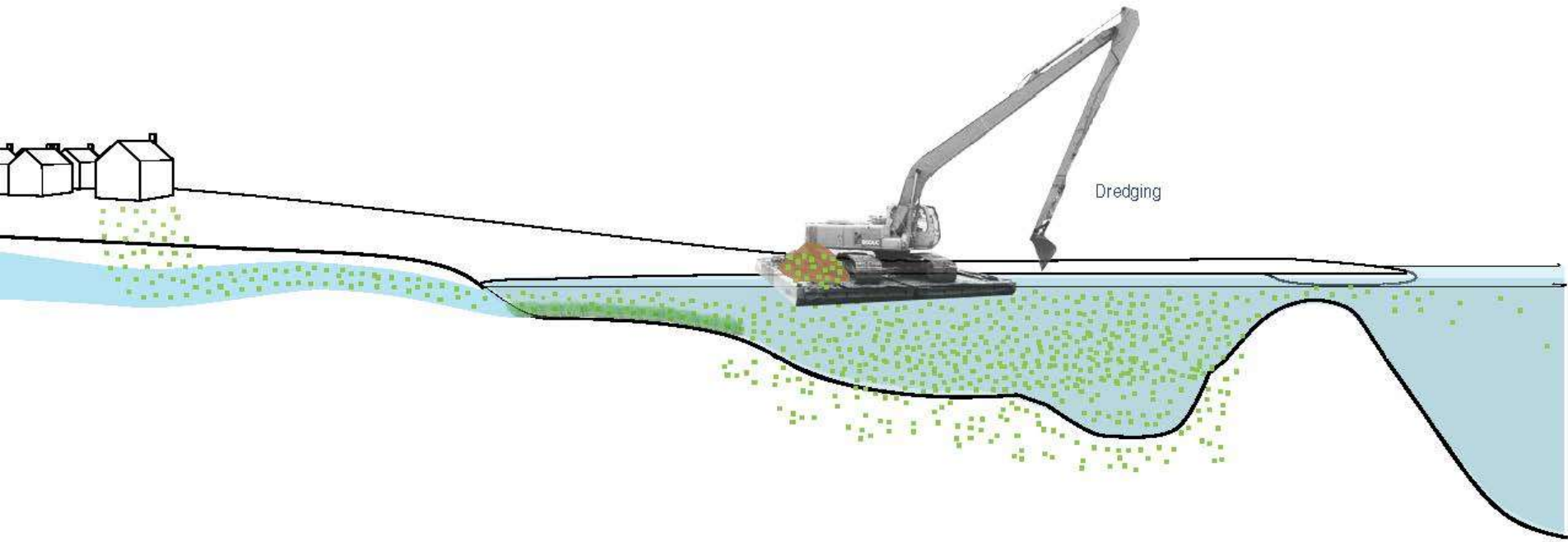
Surface Water  
Remediation Wetlands











**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





**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

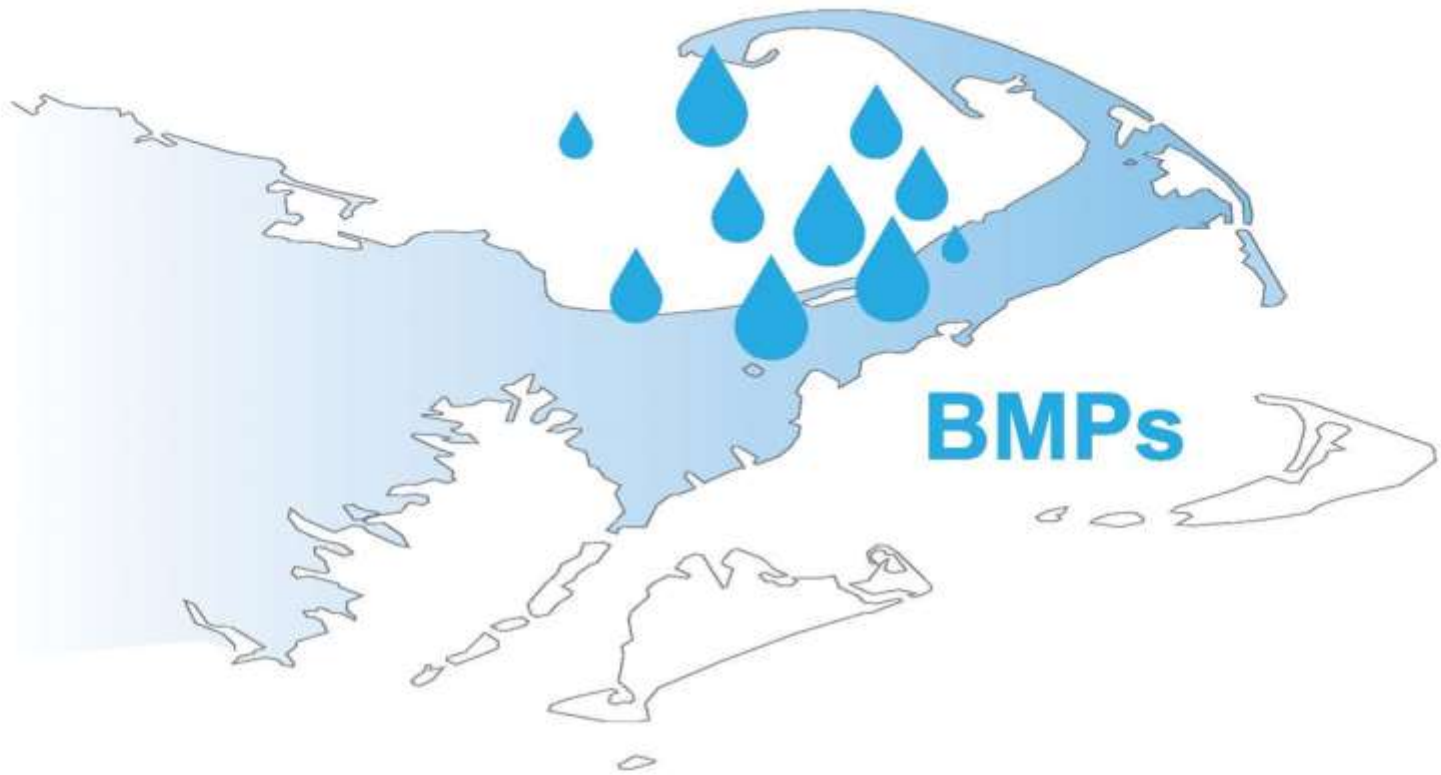
## The Concept

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.





**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*

# Solutions



# Problem Solving Approach

1  
2  
3  
4  
5  
6  
7



Wastewater



Existing Water Bodies



Regulatory

## Targets/Reduction Goals

**Present Load:**

X kg/day

—

**Target:**

Y kg/day

=

**Reduction Required:**

N kg/day

## Other Wastewater Management Needs

A. Title 5 Problem Areas

B. Pond Recharge Areas

C. Growth Management

## Low Barrier to Implementation

A. Fertilizer Management

B. Stormwater Mitigation



## Watershed/Embayment Options

A. Permeable Reactive Barriers

B. Inlet/Culvert Openings

C. Constructed Wetlands

D. Aquaculture



## Alternative On-Site Options

A. Eco-toilets (UD & Compost)

B. I/A Technologies

C. Enhanced I/A Technologies

D. Shared Systems



## Priority Collection/High-Density Areas

A. Greater Than 1 Dwelling Unit/acre

B. Village Centers

C. Economic Centers

D. Growth Incentive Zones

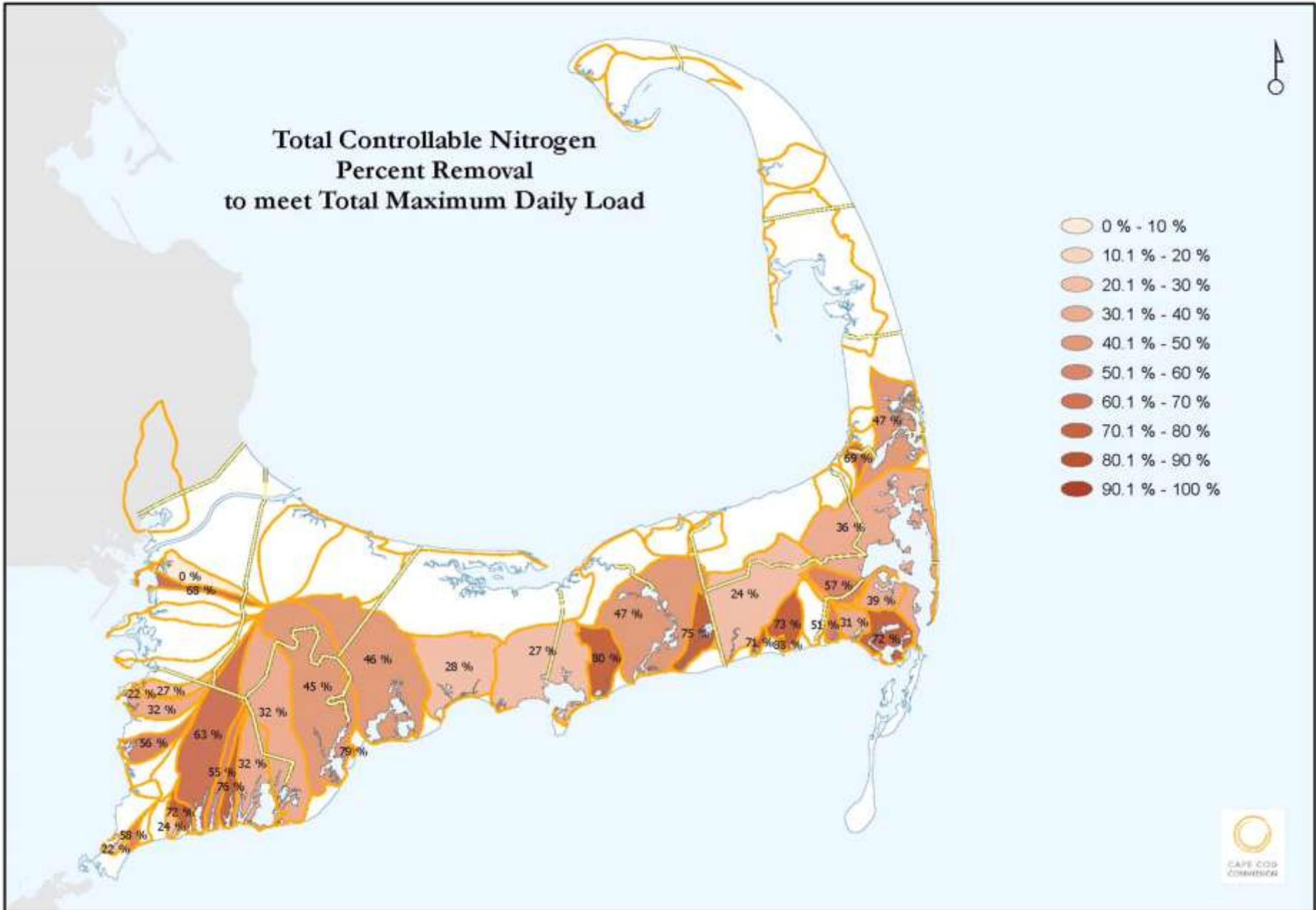
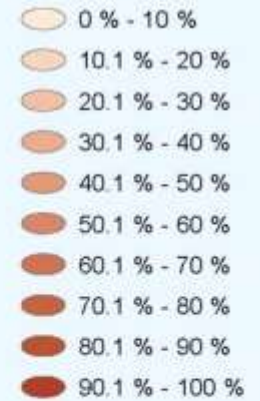


## Supplemental Sewering

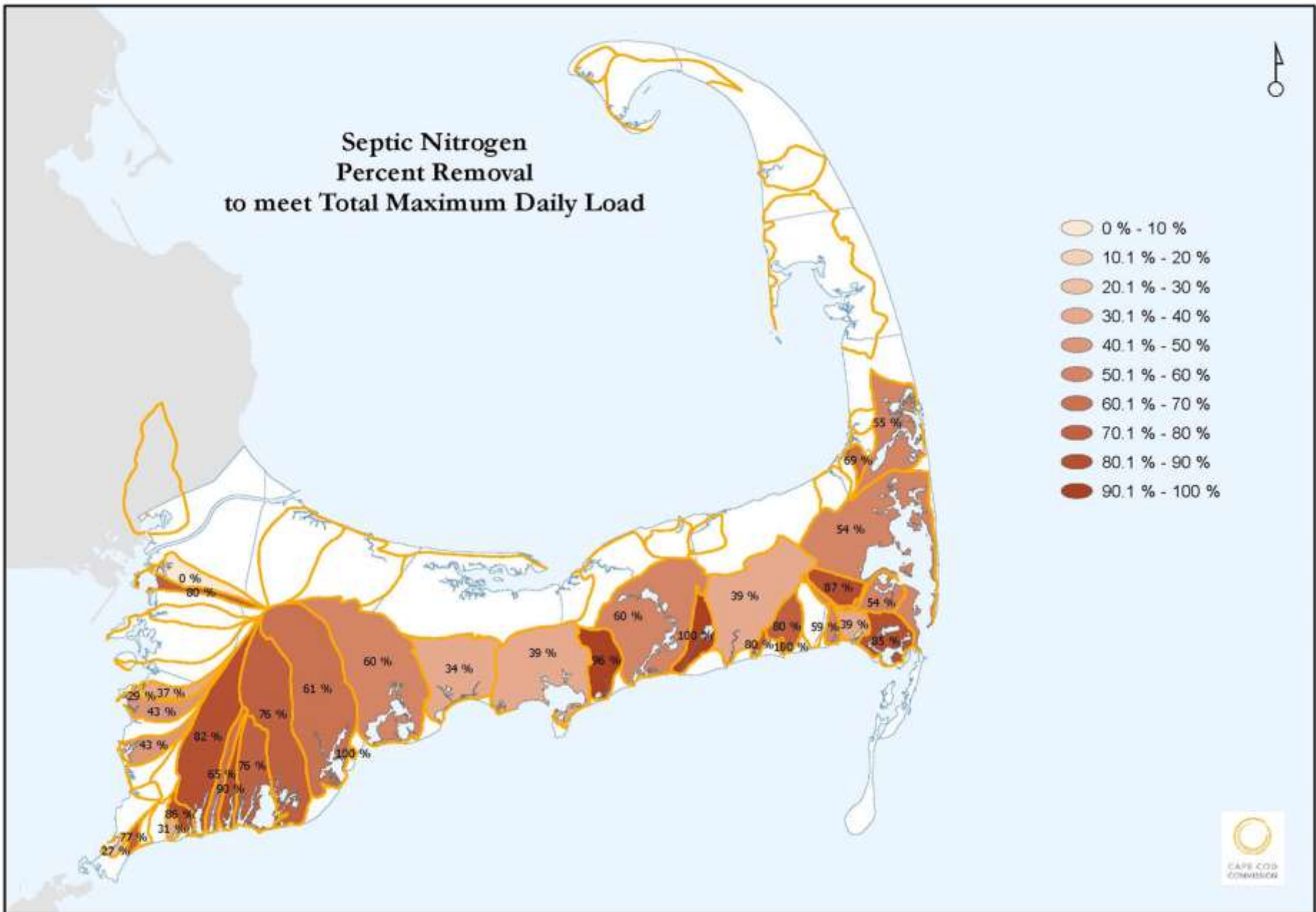
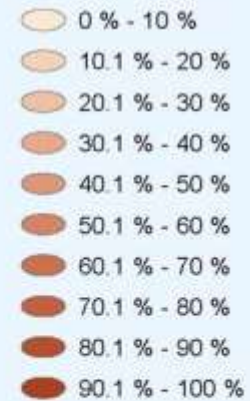


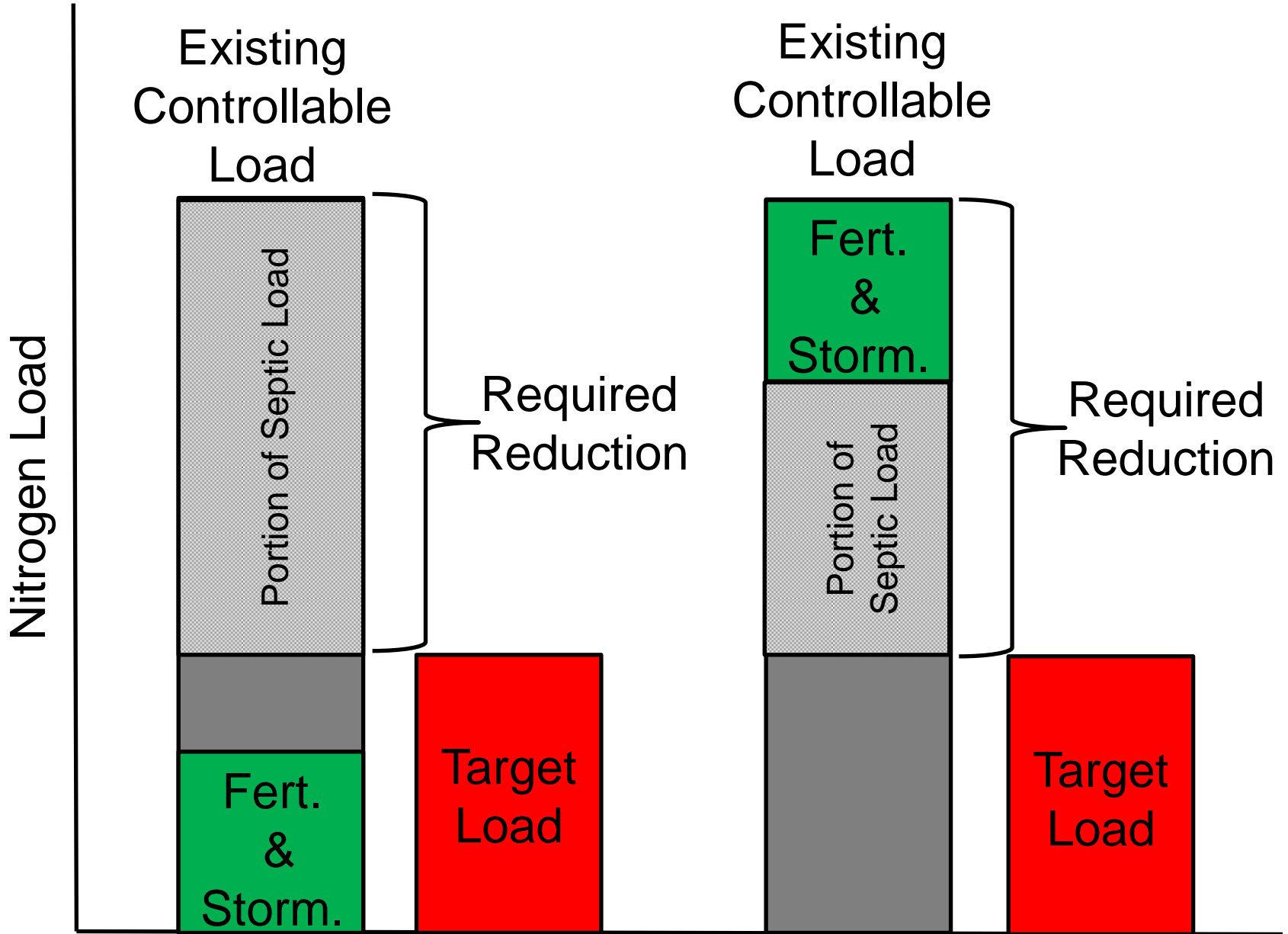


# Total Controllable Nitrogen Percent Removal to meet Total Maximum Daily Load



## Septic Nitrogen Percent Removal to meet Total Maximum Daily Load





# Problem Solving Approach

1  
2  
3  
4  
5  
6  
7

 Wastewater

 Existing Water Bodies

 Regulatory

## Targets/Reduction Goals

**Present Load:** X kg/day **–** **Target:** Y kg/day **=** **Reduction Required:** N kg/day

## Other Wastewater Management Needs

- A. Title 5 Problem Areas
- B. Pond Recharge Areas
- C. Growth Management

## Low Barrier to Implementation

- A. Fertilizer Management
- B. Stormwater Mitigation

## Watershed/Embayment Options

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

## Alternative On-Site Options

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

## Priority Collection/High-Density Areas

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

## Supplemental Sewering



STEP/STEG



# Triple Bottom Line

## Impacts of Technologies and Approaches

Environmental

Economic

Social

# Technology Selection: Process and Principles

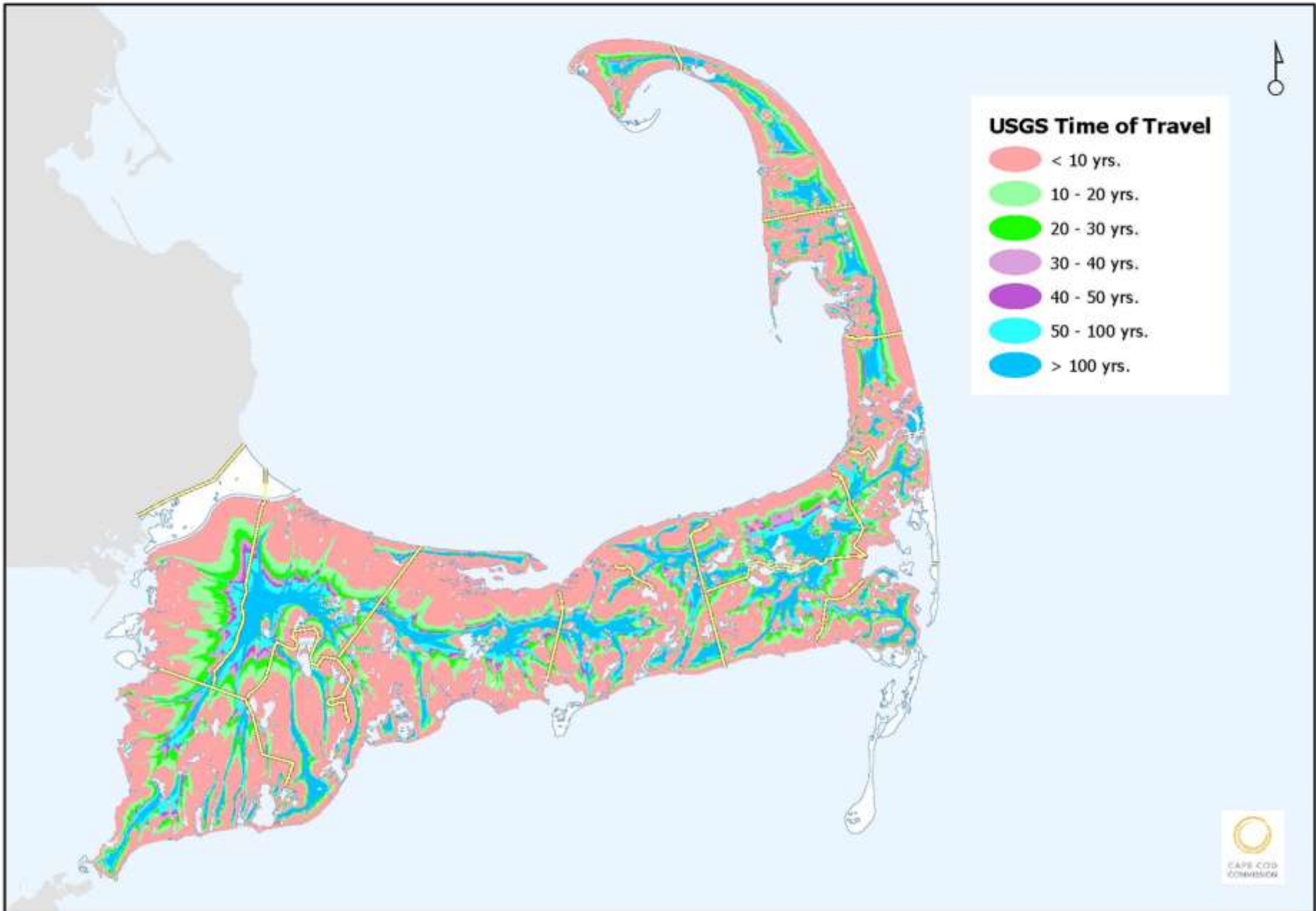
- ❑ 100% septic removal subwatershed
- ❑ Scale: On-Site vs. Collection System vs. Natural System
- ❑ Nutrient intervention and time of travel
- ❑ Permitting Status
- ❑ Land use and Impacts of Growth

DRAFT



**Embayment TMDL Status Map**







# Preparing for Meeting 3 and Beyond

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



*6:00*

*Cape Cod Museum of Art  
Dennis, MA*