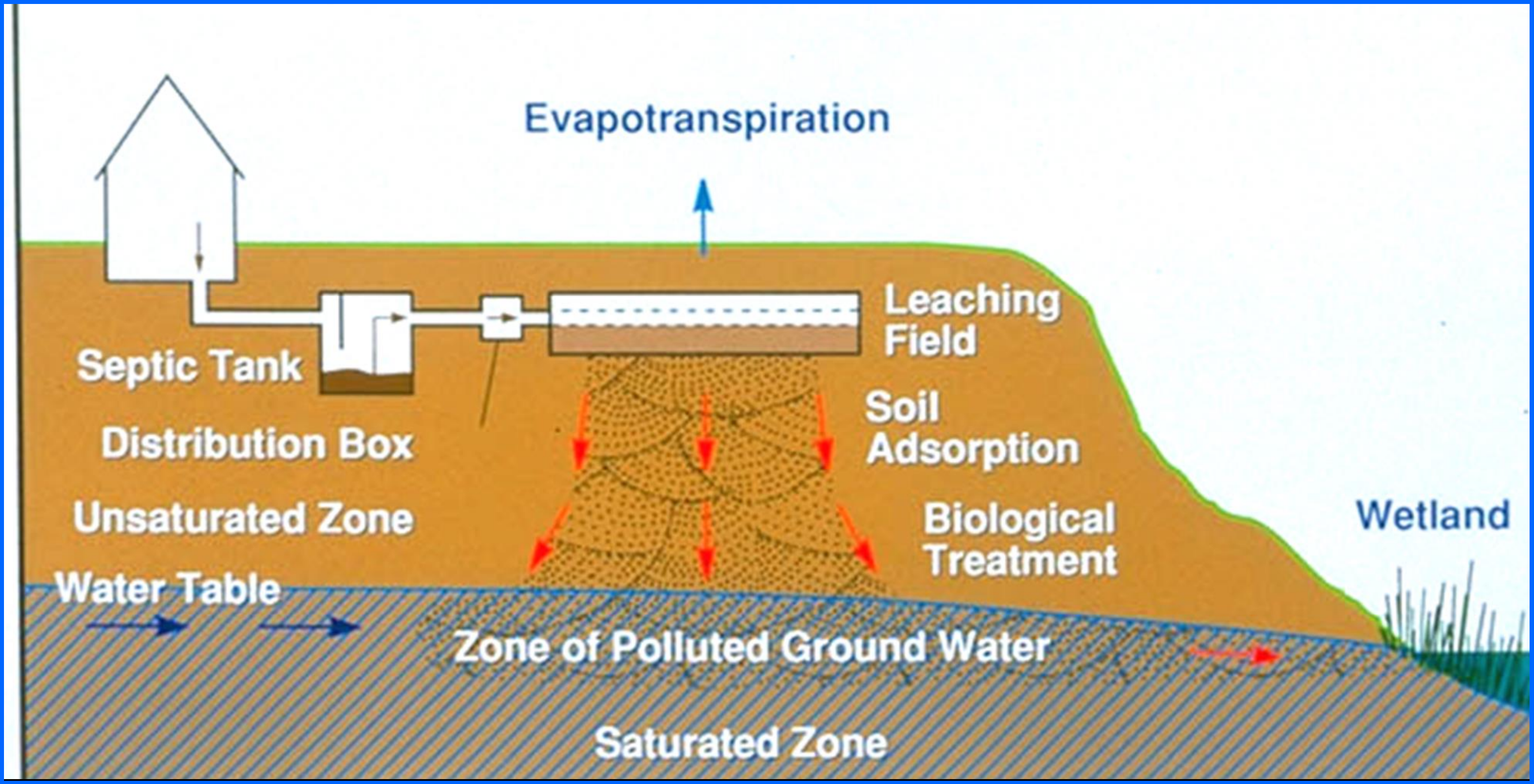
Integrated Water Management & Smart Growth

Scott Horsley

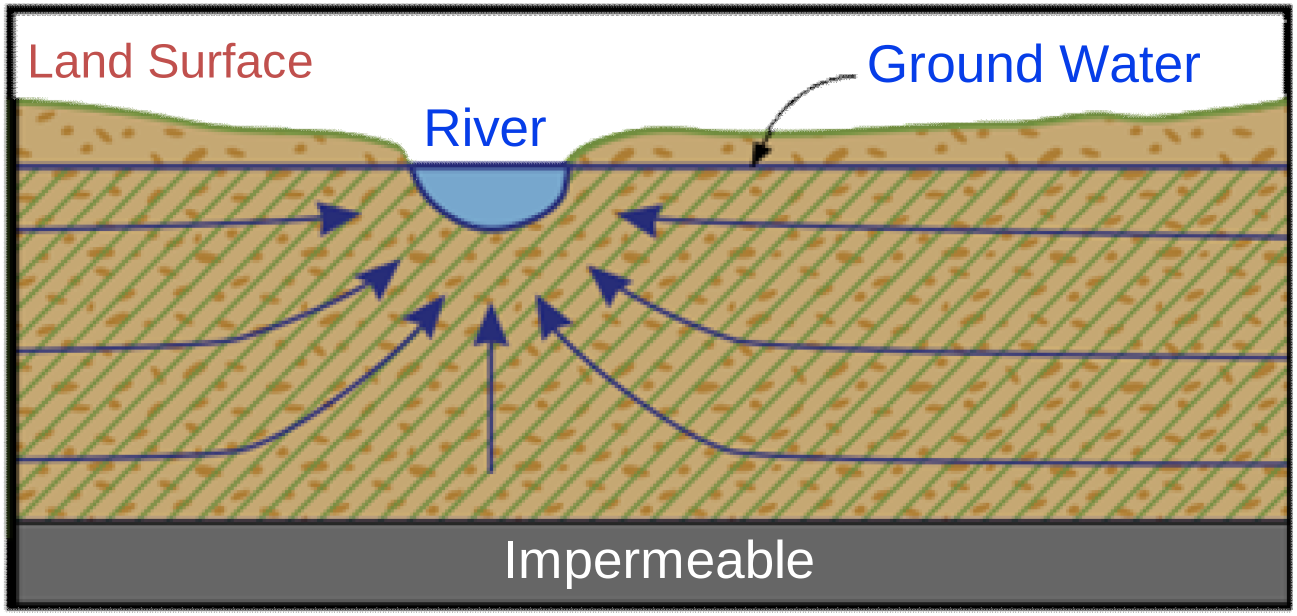
Horsley Witten Group, Inc.

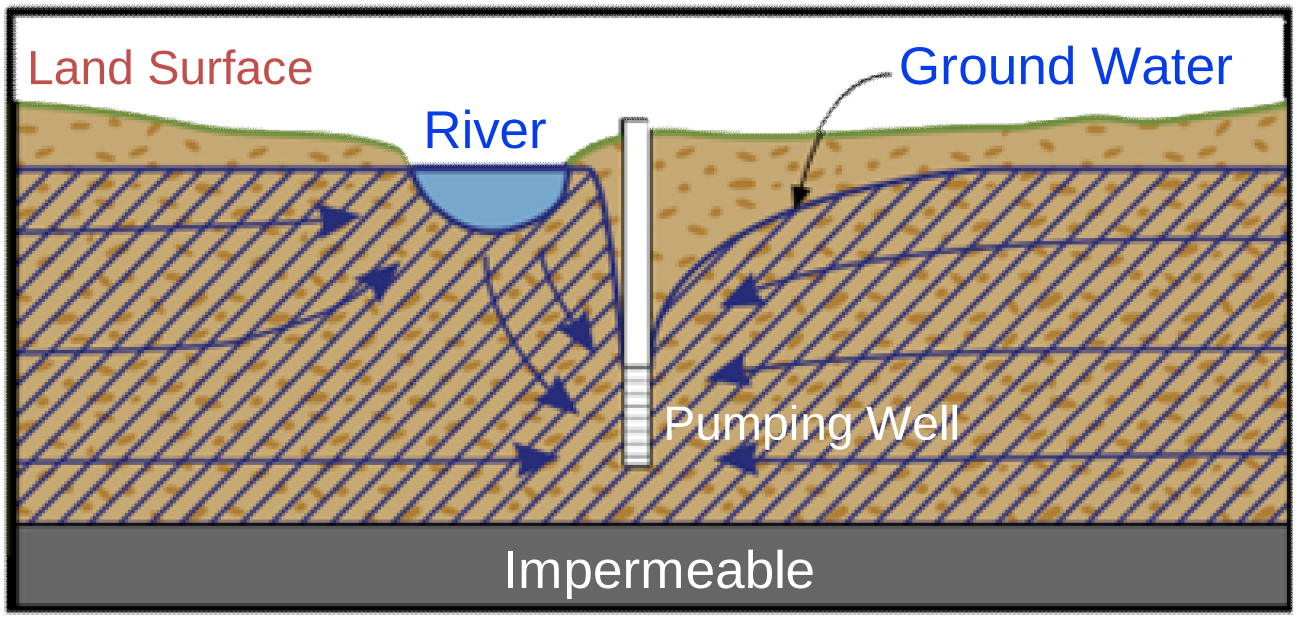
Sandwich *Boston* *Providence* *Newburyport*

On-Site Septic System

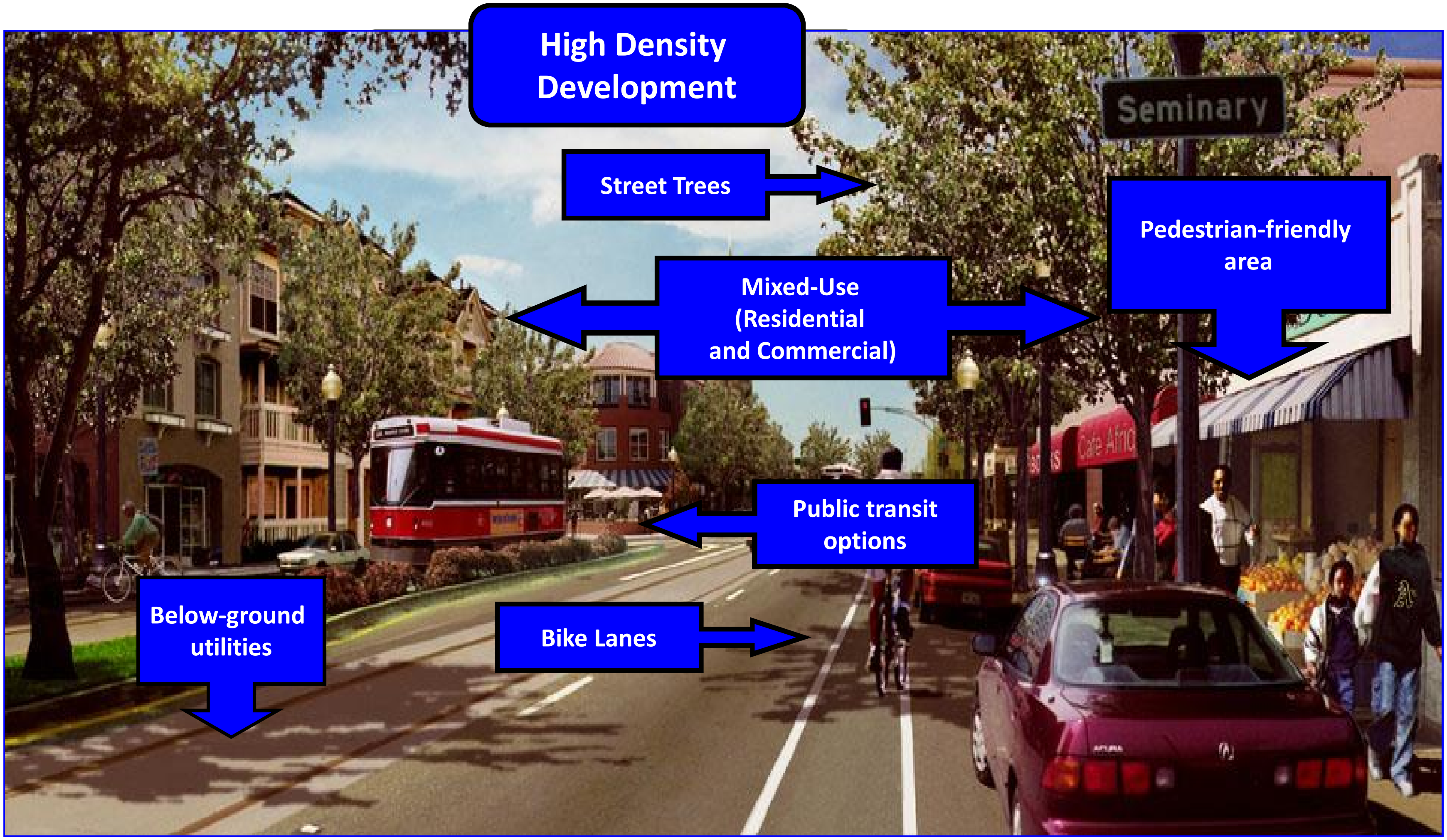


Septic Systems **Do Not** Treat Wastewater


Land Surface
Ground Water
River
Impermeable


Land Surface
Ground Water
River
Pumping Well
Impermeable

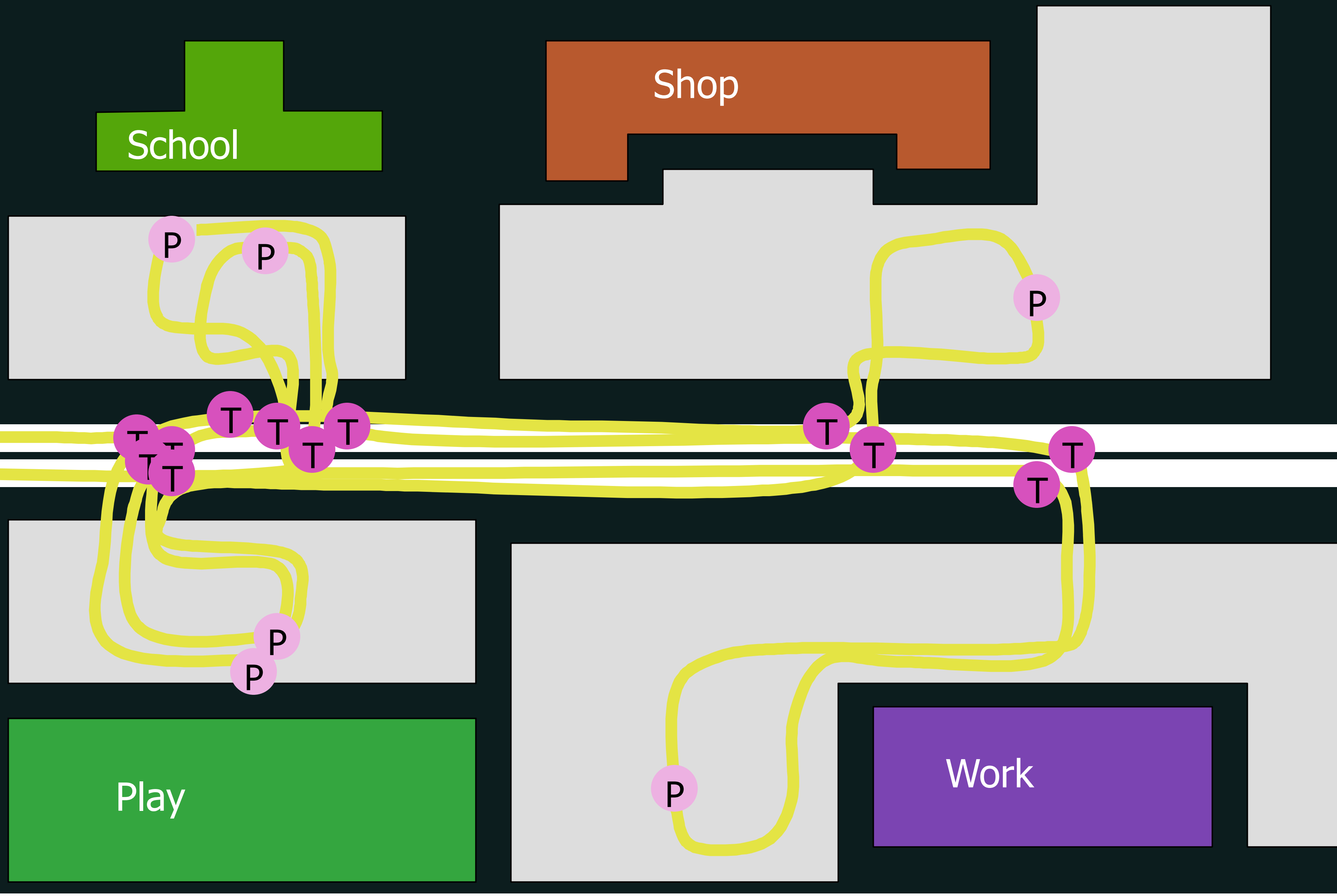
Sprawl Versus Smart Growth Streetscapes



Source: Smart Growth America, Urban Advantage

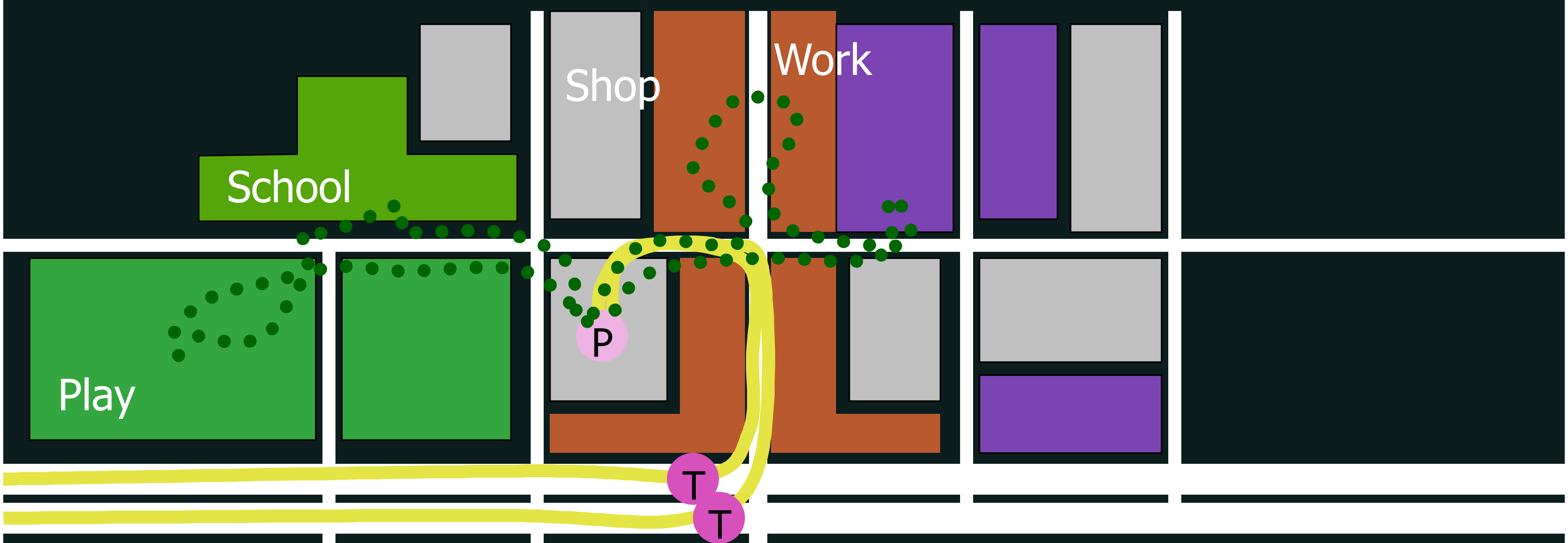
Conventional Development

Source: Jeffery Tumlin, Nelson/Nygaard



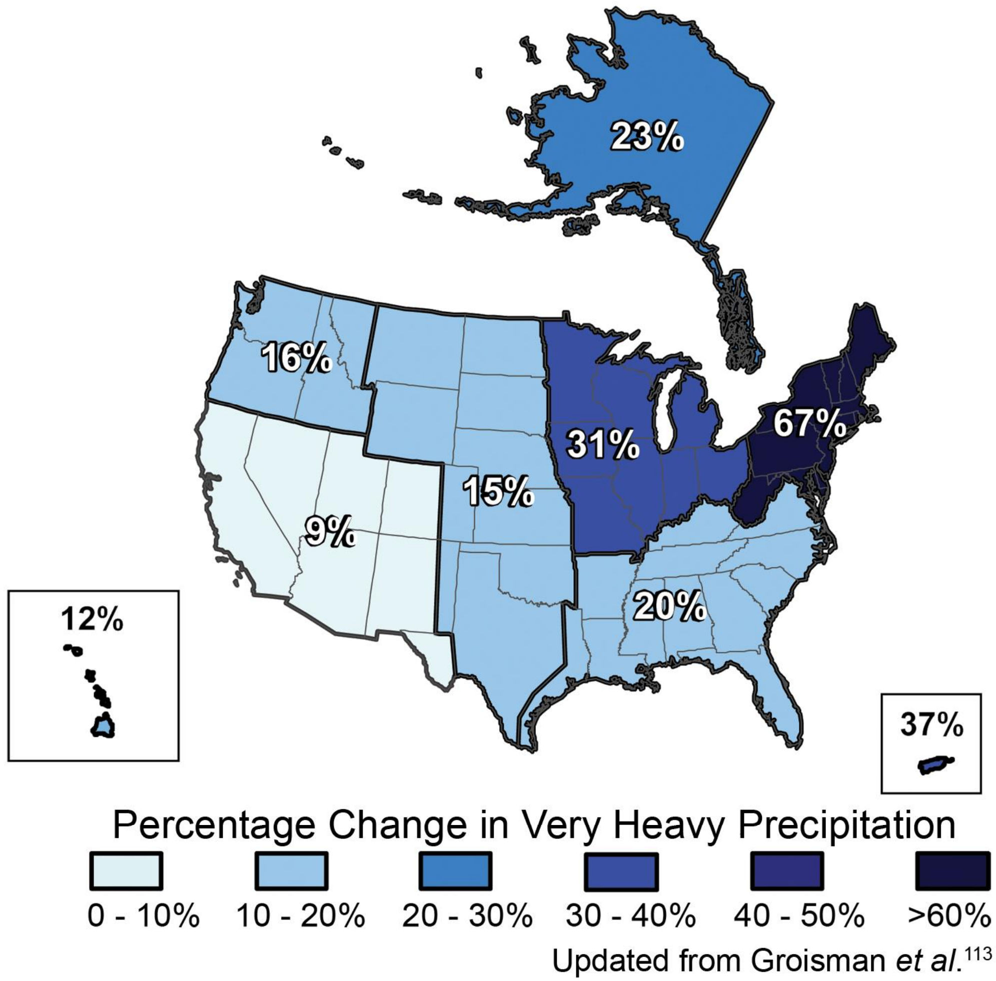
Mixed Use, Park Once District

Source: Jeffery Tumlin, Nelson/Nygaard



Results:

- <½ the parking
- <½ the land area
- ¼ the arterial trips
- 1/6th the arterial turning movements
- <¼ the vehicle miles traveled



The map shows the percentage increases in very heavy precipitation (defined as the heaviest 1 percent of all events) from 1958 to 2007 for each region. There are clear trends toward more very heavy precipitation for the nation as a whole, and particularly in the Northeast and Midwest.

Image credit: U.S. Global Change Research Program (www.globalchange.gov).

Future Design Storms?

Å Kirshen et al. (2008) project sea-level rise onto time-series of past surge events in the U.S. Northeast to estimate that the 2005 100-year-event will become the 30-70 year event by 2050.

Å By 2050, Boston could experience the current 100-year riverine flood every two to three years on average and, by 2100, the current 100-year riverine flood is expected to occur every one to two years under both the low- and high-emissions scenarios (MA Climate Change Adaptation Report)

100-Year Design Storms (inches)

	Springfield	Worcester	Boston
TP40 Design Storm (1930 – 1960)	6.5	6.5	6.6
Cornell Design Storm (1936 - 2008)	8.8	8.8	8.8

Hydrology Handbook for Conservation Commissions: Appendix F. Rainfall Data for Massachusetts from *Rainfall Frequency Atlas of the United States (TP-40). Users of this Handbook should note that current MA DEP written guidance (see DEP Waterlines newsletter -- Fall 2000) requires the use of TP-40 Rainfall Data for calculations under the Wetlands Protection Regulations and the Stormwater Management Policy. More stringent design storms may be used under a local bylaw or ordinance.*

Future Design Storms with Continued Climate Change

25-YEAR, 24-HOUR PRECIPITATION (IN.)					TABLE 5-2 Rainfall Design Depths from Climate Change for Oyster River Infrastructure Vulnerability Assessment
	TP-40	1971-2000 (Baseline)	2046-2075 (A1b)	2046-2075 (A1fi)	
+95% c.i.	5.1	7.46	9.53	12.22	
"most likely"		5.37	6.86	8.35	
-95% c.i.		3.85	4.92	5.66	

Source: University of New Hampshire


Landmarks
A. Commonwealth Avenue
B. Newbury Street
C. Old South Church
D. Copley T Station
E. The Esplanade
F. Copley Square
G. Trinity Church
H. John Hancock Tower
I. Hatch Shell
J. Arlington T Station
K. Public Garden and Swan Boats
A
B
C
D
E
F
G
H
I
J
K
Current 100-year flood zone
Projected 100-year flooded area (higher-emissions scenario)

LID Stormwater Management Techniques

Å Rain Barrels and Cisterns / Water Re-use

Å Stormwater Planters, Tree Planting

Å Permeable Paving

Å Open Channels

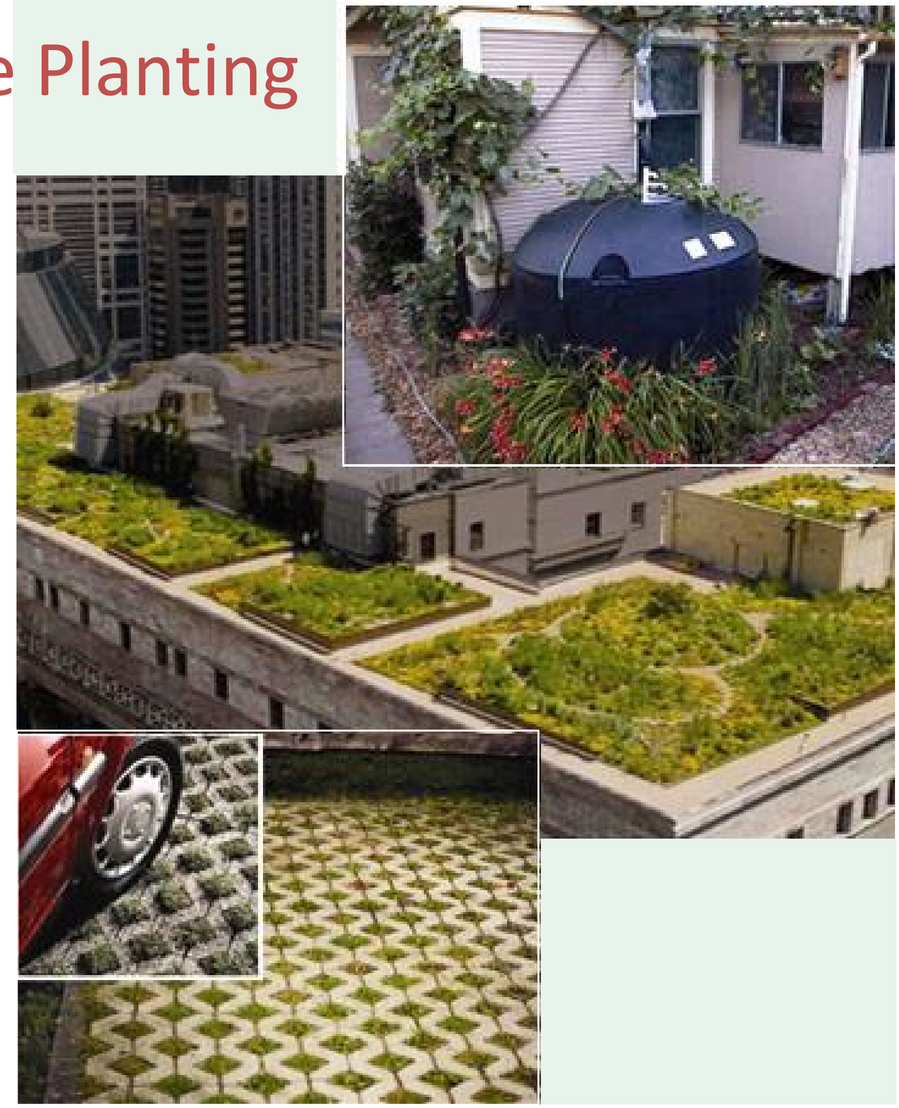
Å Bioretention

Å Stormwater Wetlands

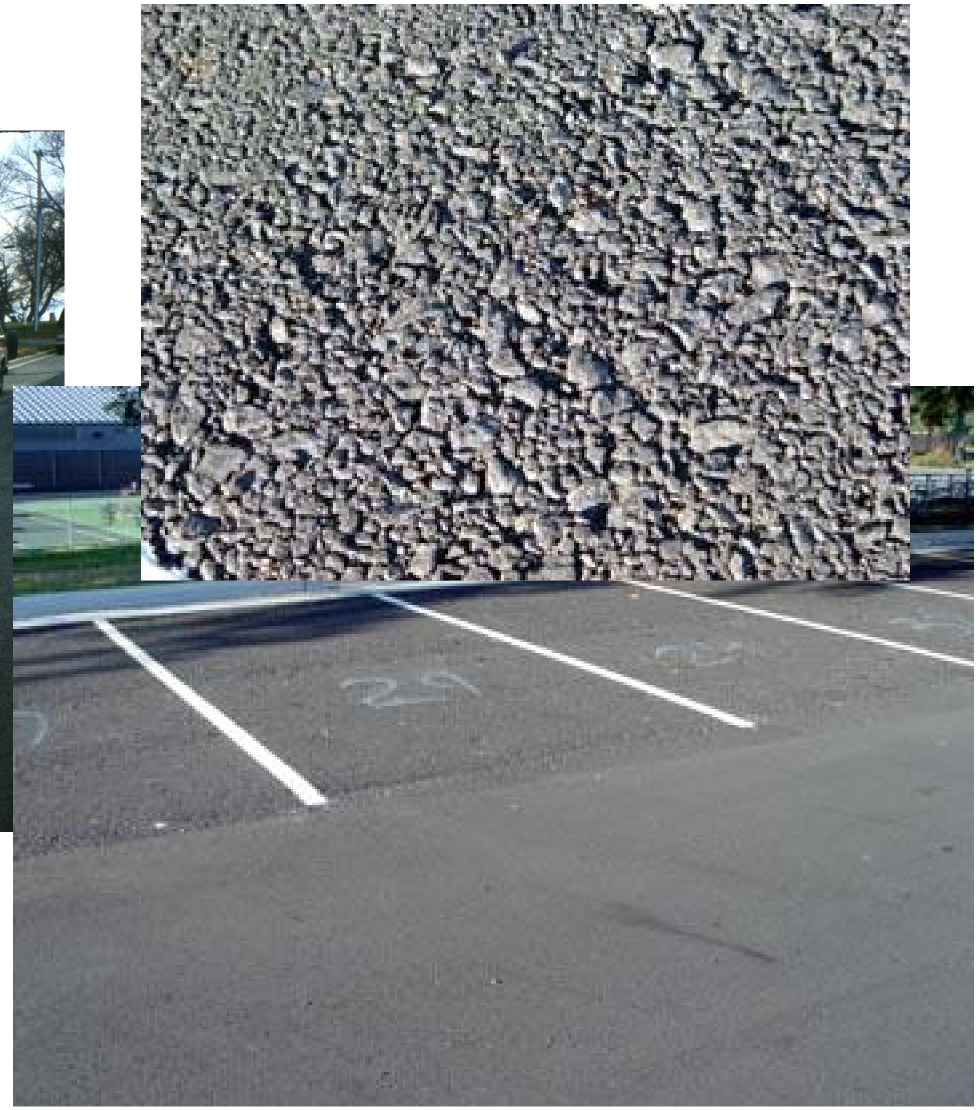
Å Green Rooftop Systems

Å Vegetative Buffers

Å Infiltration



Permeable Pavement



Dry Well Infiltration of Roof Runoff

Disconnection of Rooftop Runoff to Vegetated Swale

Vegetated Swales
Conveyance, Treatment, Infiltration

- Roadside swales ("country drainage") for lower density and small-scale projects
- For small parking lots
- Mild side slopes and flat longitudinal slopes
- Provides area for snow storage & snowmelt treatment

Bioretention Cell
Water Street, Plymouth Center, MA

NYC GI Design Criteria

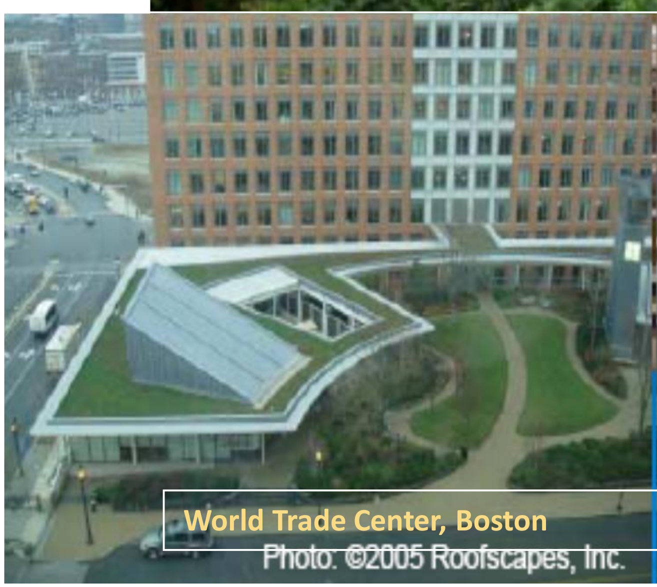
HAZEN AND SAWYER
Environmental Engineers & Scientists

Horsley Witten Group
Sustainable Environmental Solutions

New York City – Bioretention Retrofit

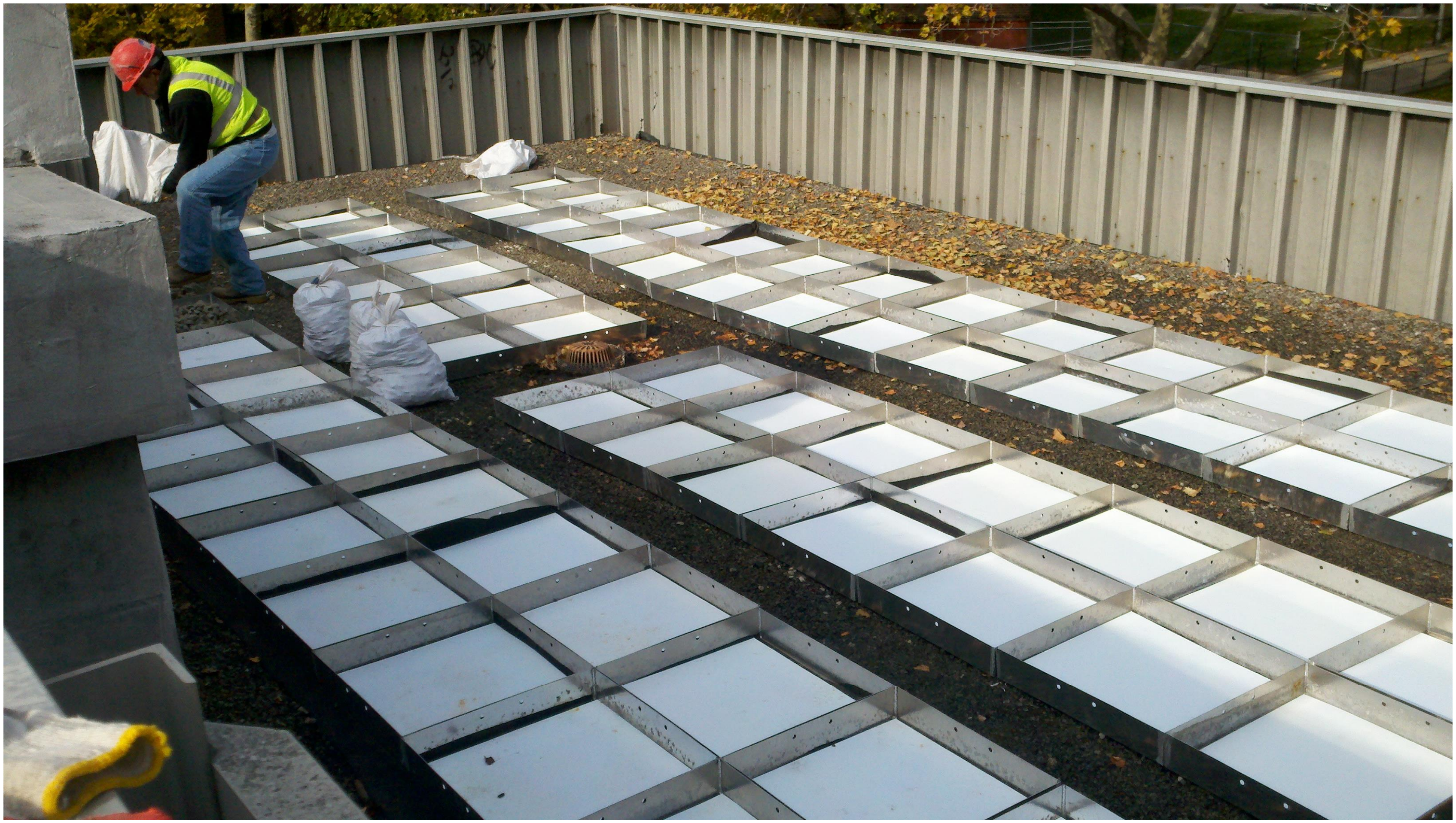
Rain Garden

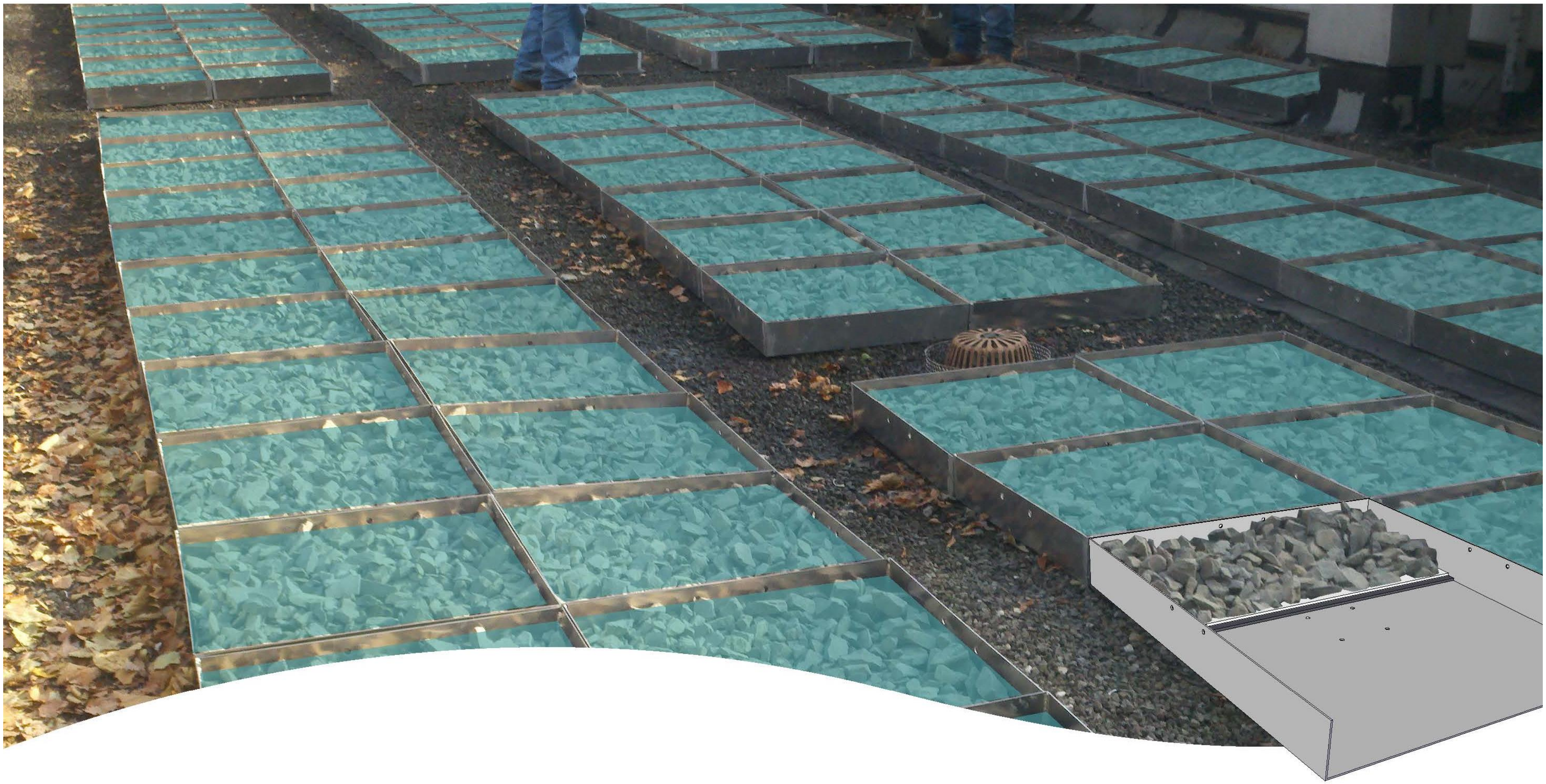
Green Roofs



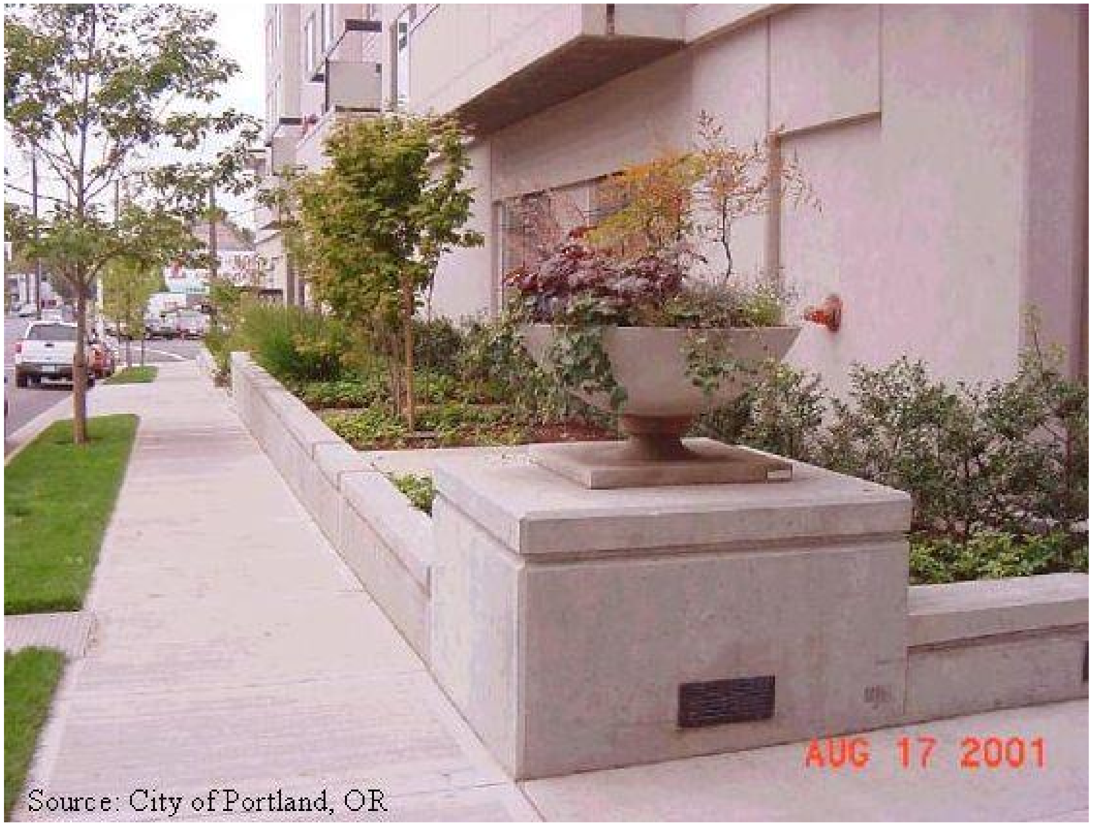
World Trade Center, Boston
Photo: ©2005 Roofscapes, Inc.

- Stormwater Runoff absorption/collection
- Reduced flooding of and damage to urban streets
- Interior heating and cooling benefits of 10 degrees or more
- Air purification
- Recreational amenity
- Improved aesthetics
- Extended roof life, estimated at 40 years





Stormwater Planters

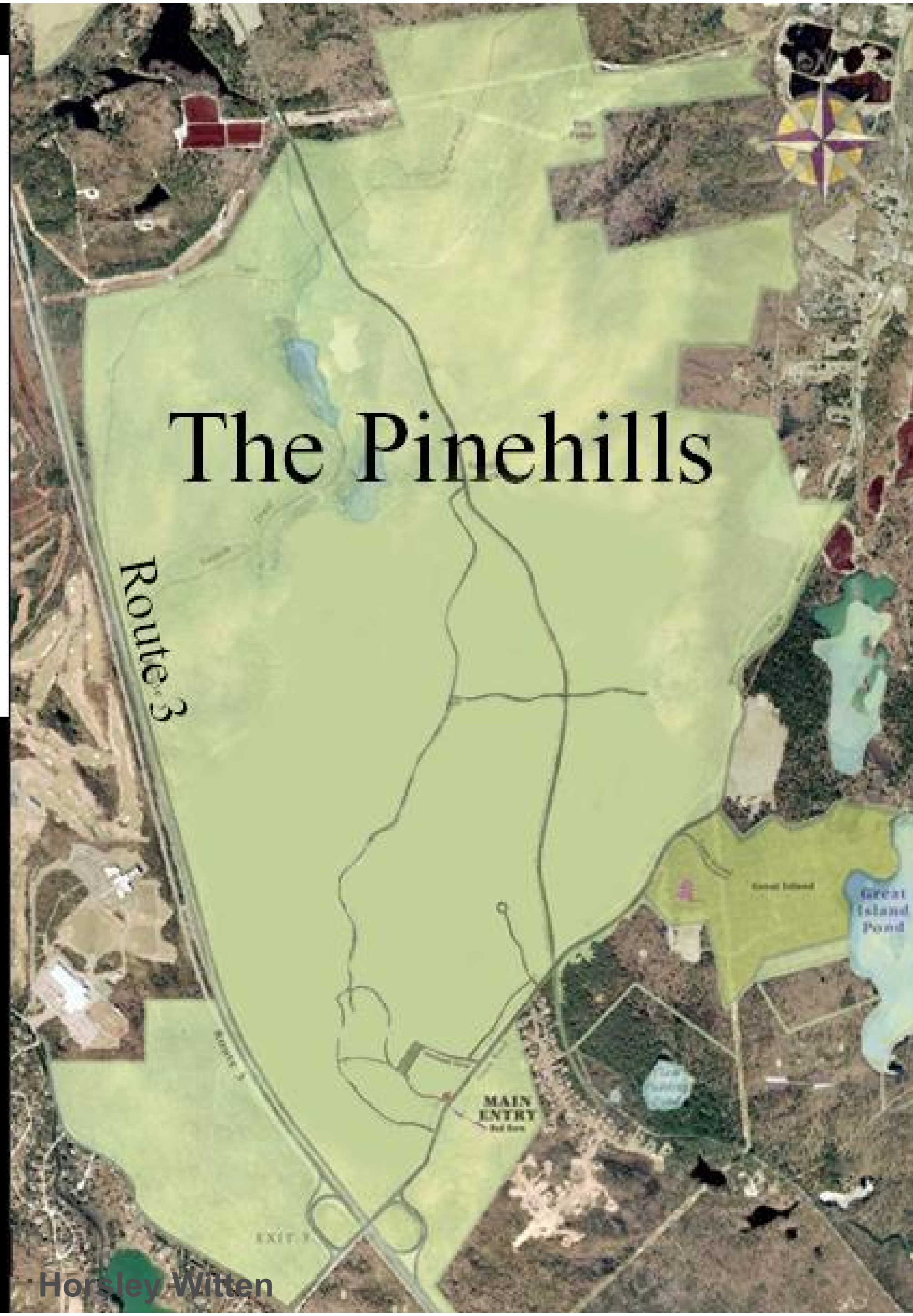


- Vegetative uptake of stormwater pollutants
- Pretreatment for suspended solids before they reach water-treatment facilities
- Aesthetically pleasing
- Reduction of peak discharge rate

Dry Well Infiltration of Roof Runoff

Disconnection of Rooftop Runoff to Vegetated Swale

Source: Horsley Witten Group


The Pinehills
Route 3
Great Island Pond
MAIN ENTRY
Horsley Witten

LID Principles at The Pinehills

Å Open Space Residential Design

Å Reduce Impervious Areas

Å Alternative Landscaping

Å Stormwater Management

Å Wastewater Re-use

Å Nutrient Management

Preserved Historic Sandwich Road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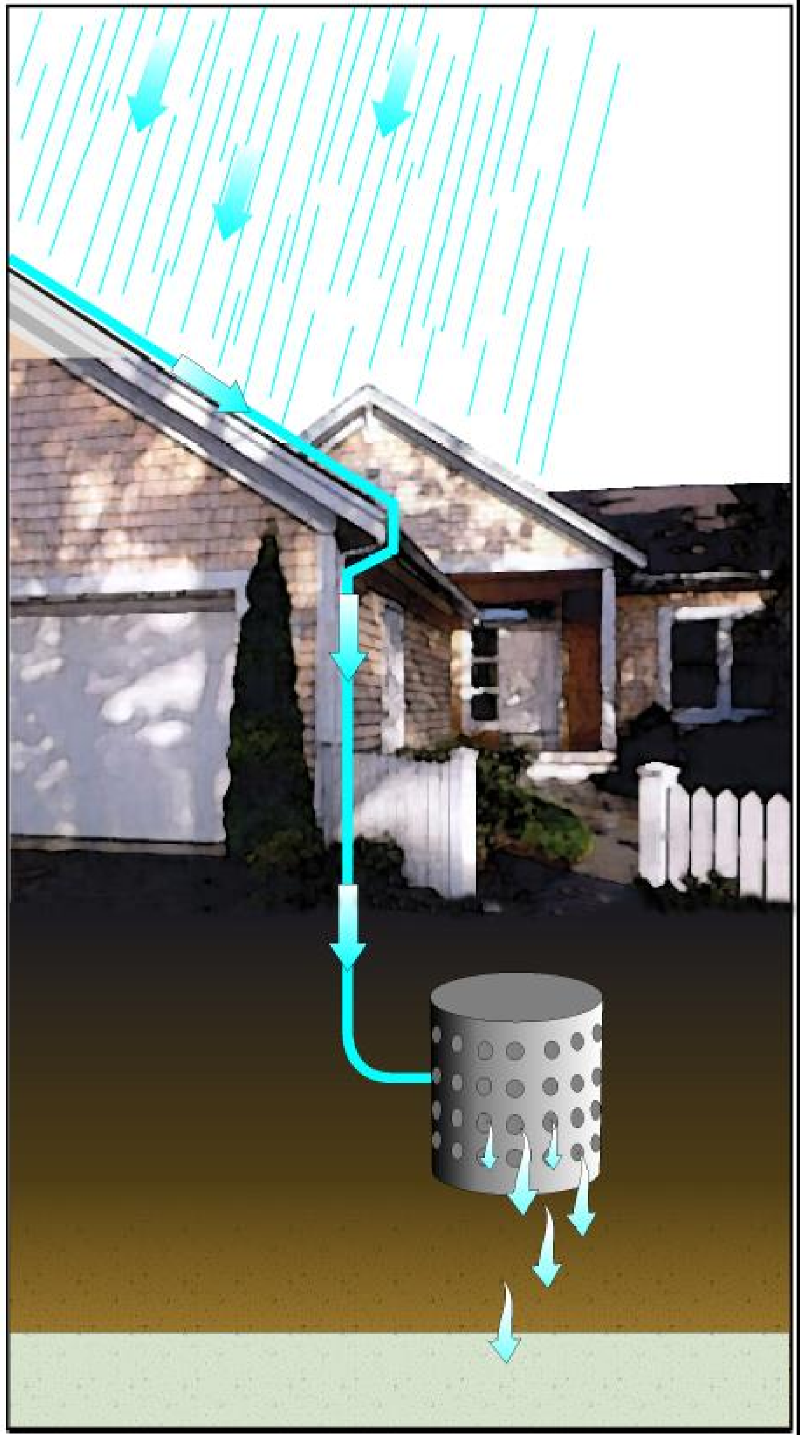
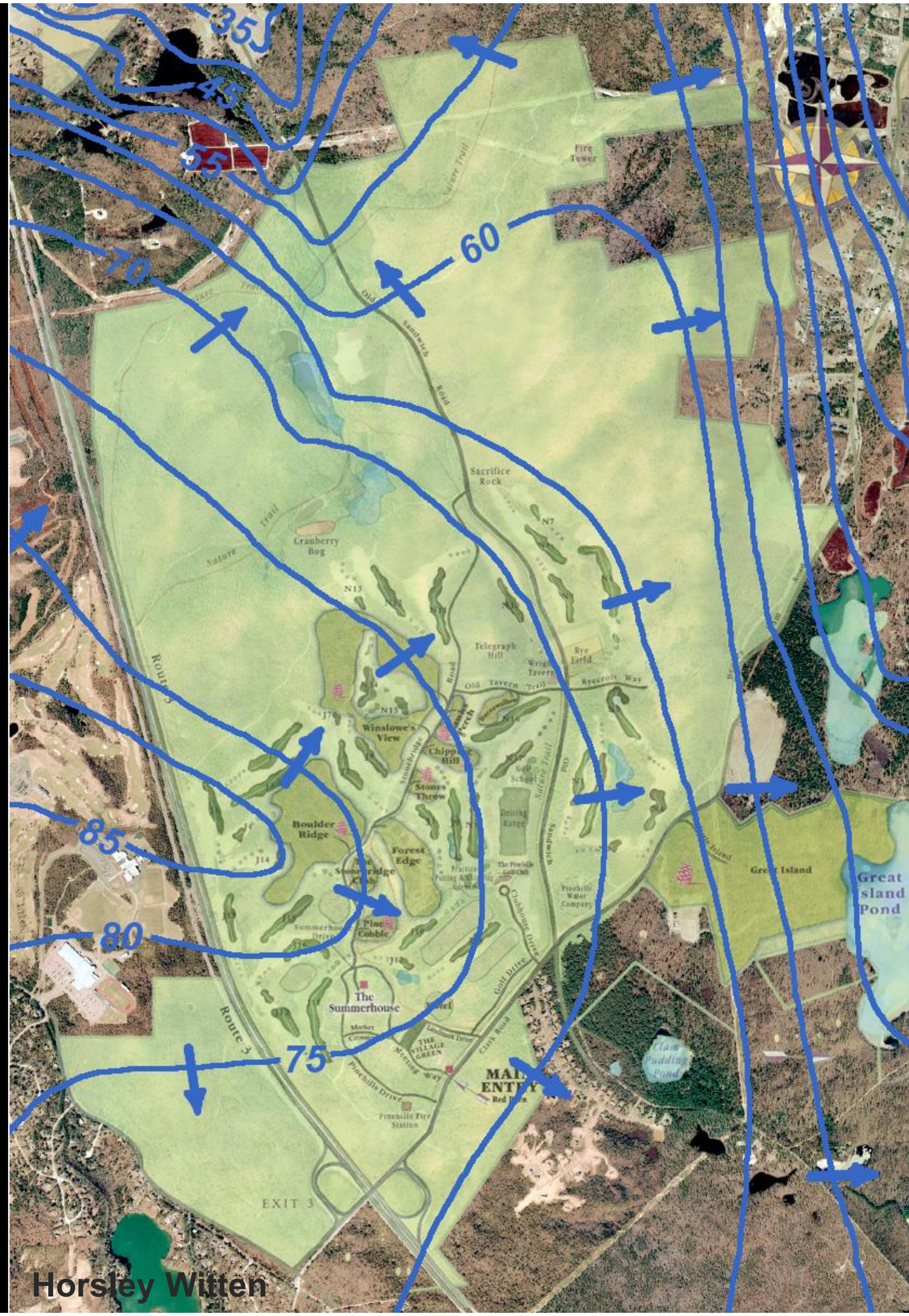
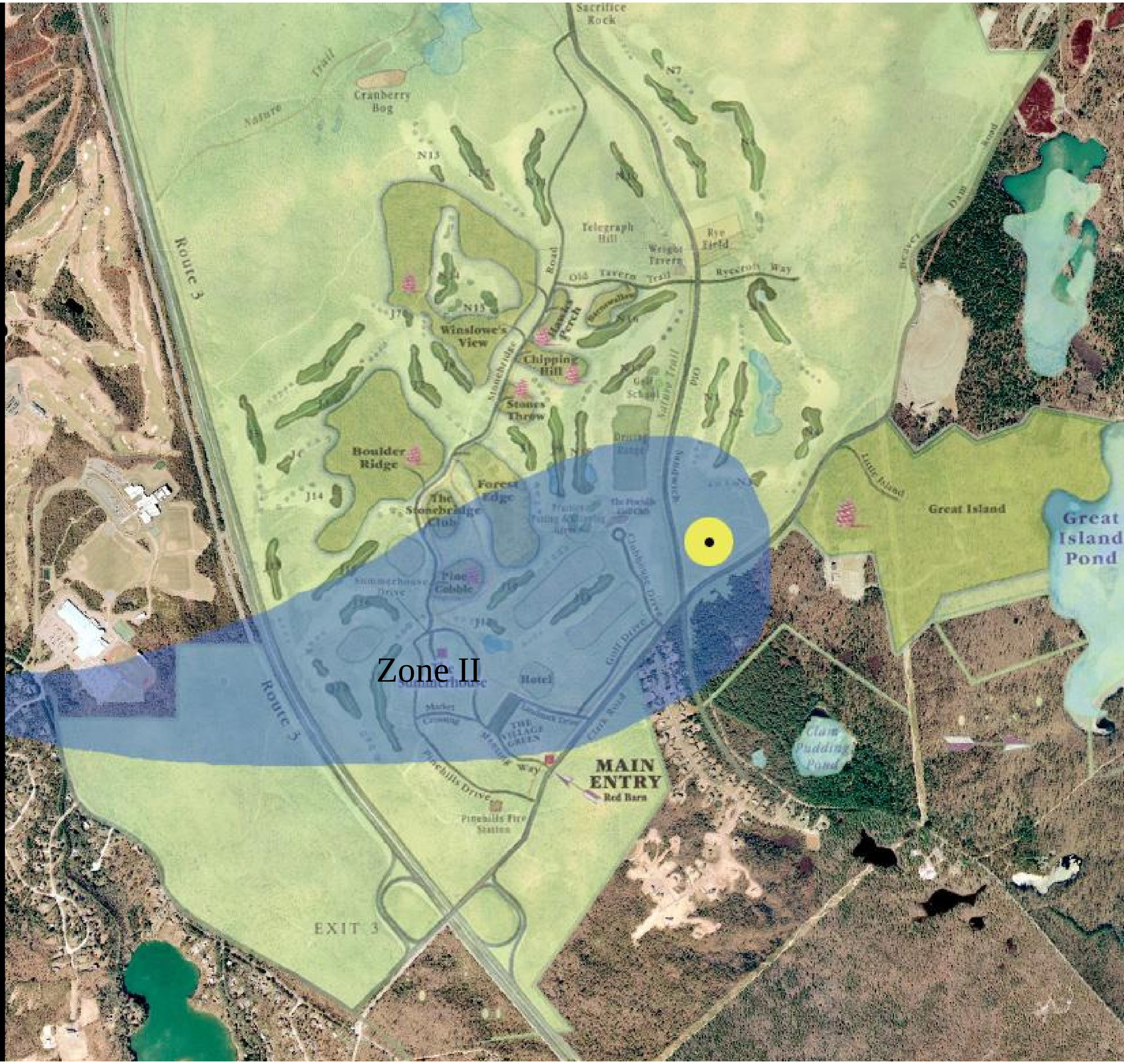
Stormwater Management

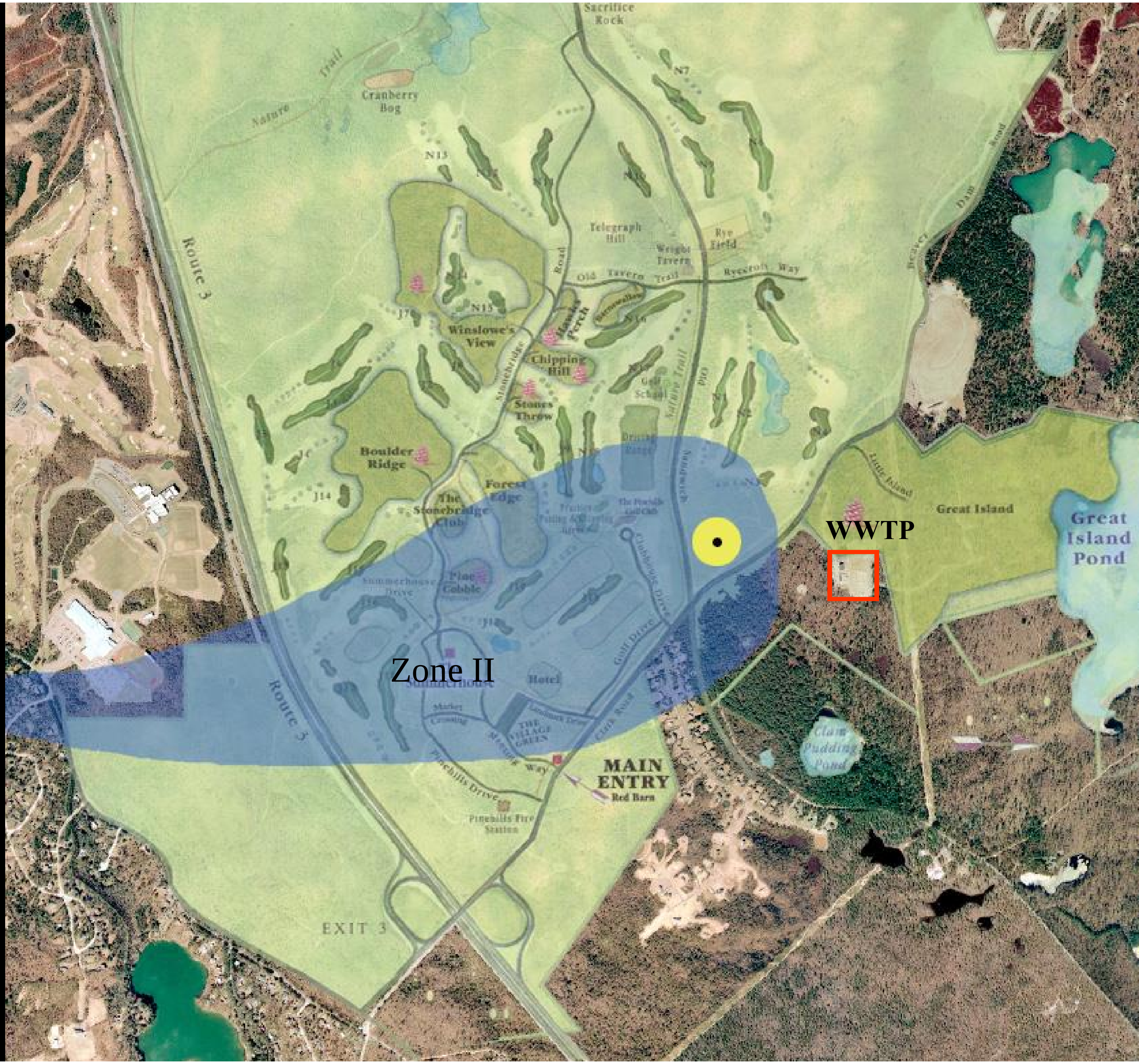


Integrated Water Management

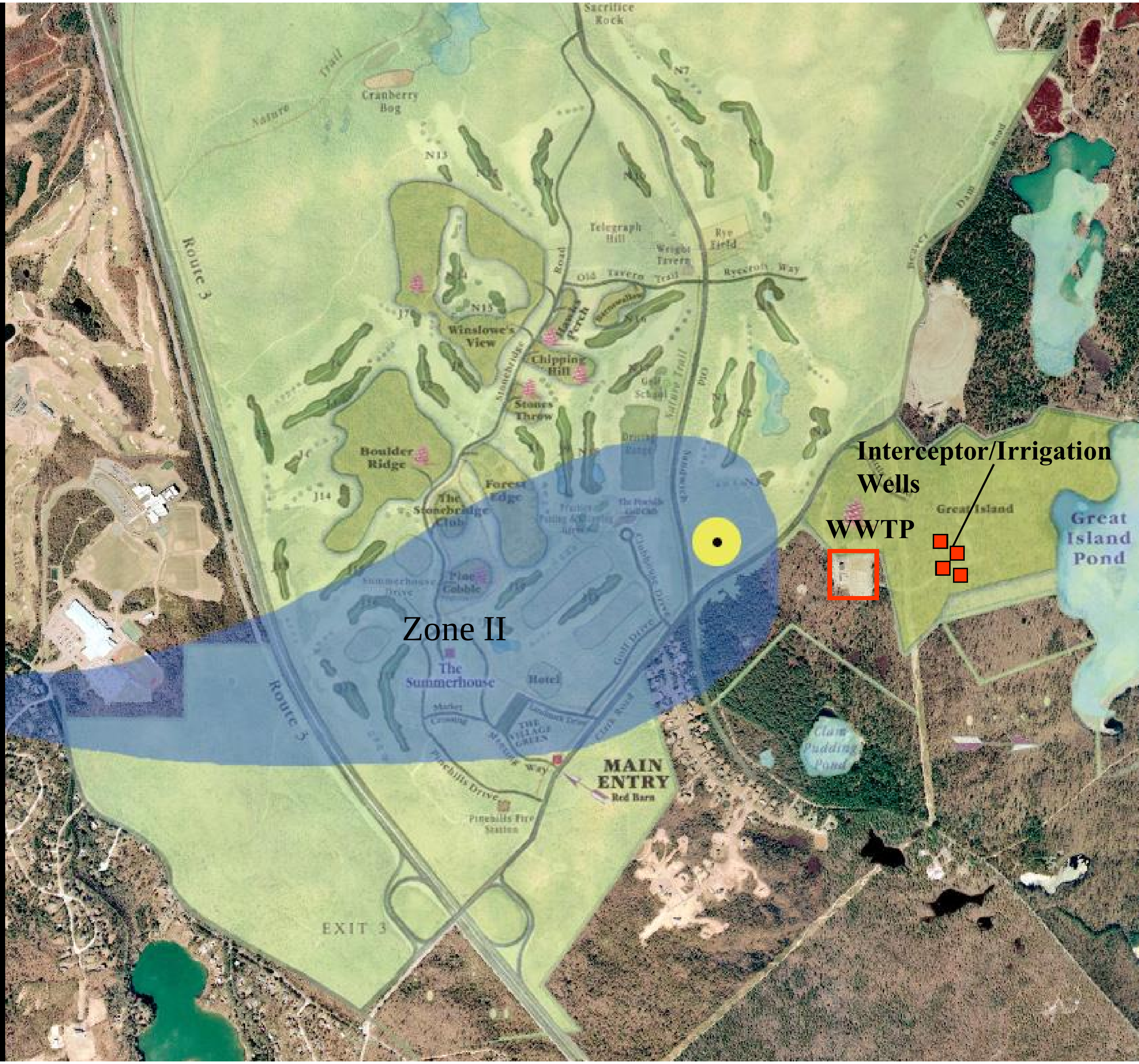

35
45
55
60
70
85
80
75
Fire Tower
Sacrifice Rock
Cranberry Bog
Telegraph Hill
Winslowe's View
Stones Throw
Boulder Ridge
Forest Edge
Pine Cobble
The Summerhouse
MAIN ENTRY
Great Island
Great Island Pond
Route 3
EXIT 3
Horsley Witten



Sacrifice Rock
Cranberry Bog
Nature Trail
Route 3
Telegraph Hill
Rye Field
Old Tavern Trail
Ryecroft Way
Winslowe's View
Chipping Hill
Stones Throw
Boulder Ridge
Forest Edge
The Stonebridge Club
Great Island
Great Island Pond
Zone II
Hotel
THE VILLAGE GREEN
MAIN ENTRY
Red Barn
Pinehills Fire Station
Pinehills Drive
Golf Drive
Club Road
Route 3
EXIT 3
Clam Pudding Pond



WWTP
Zone II
Great Island Pond
MAIN ENTRY
Route 3
EXIT 3


Interceptor/Irrigation Wells
WWTP
Zone II
Great Island Pond
Great Island
Route 3
MAIN ENTRY
Red Barn
The Summerhouse
Hotel
Boulder Ridge
Winslowe's View
Chipping Hill
Stones Throw
Telegraph Hill
Cranberry Bog
Sacrifice Rock
Nature Trail
Clam Pudding Pond
EXIT 3
Pinehills Fire Station
Pinehills Drive
Old Tavern Trail
Rye Field

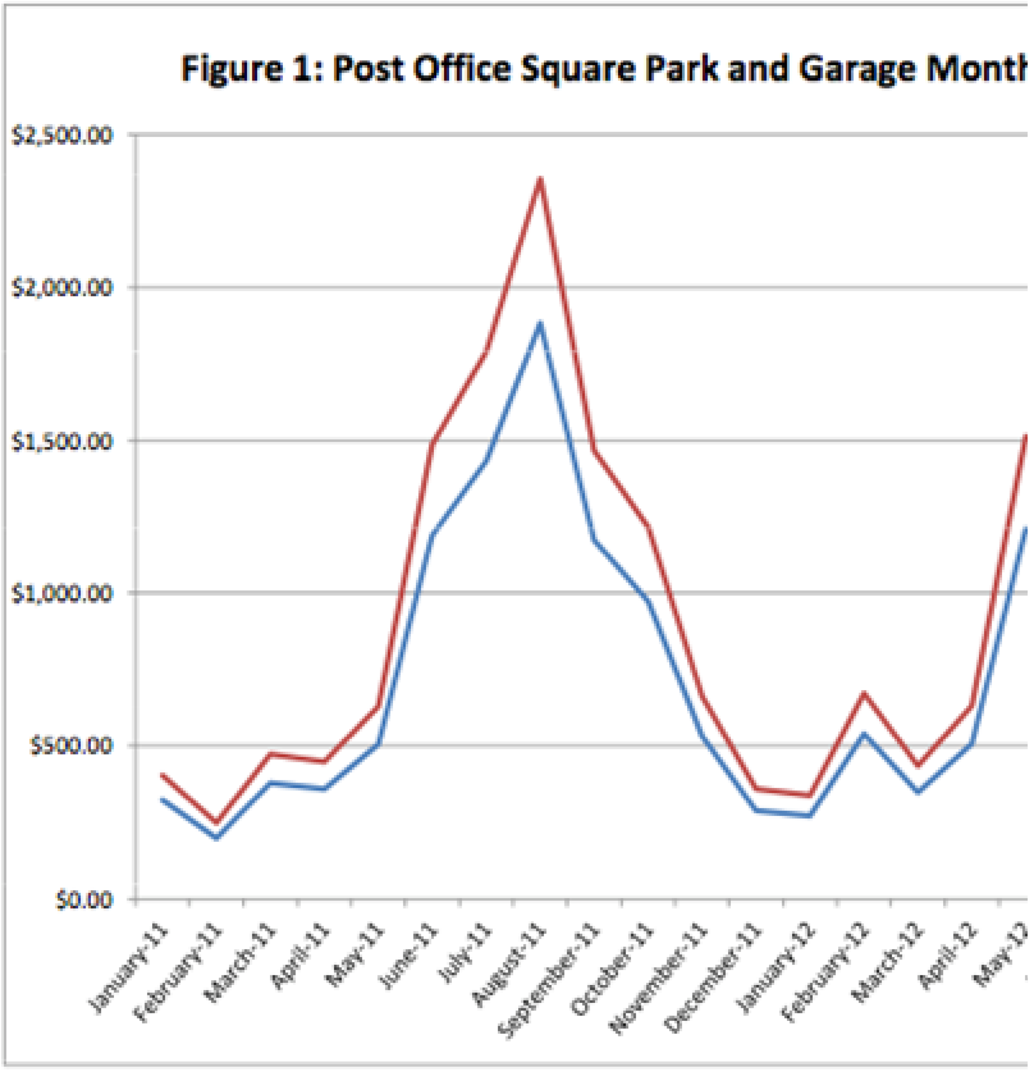
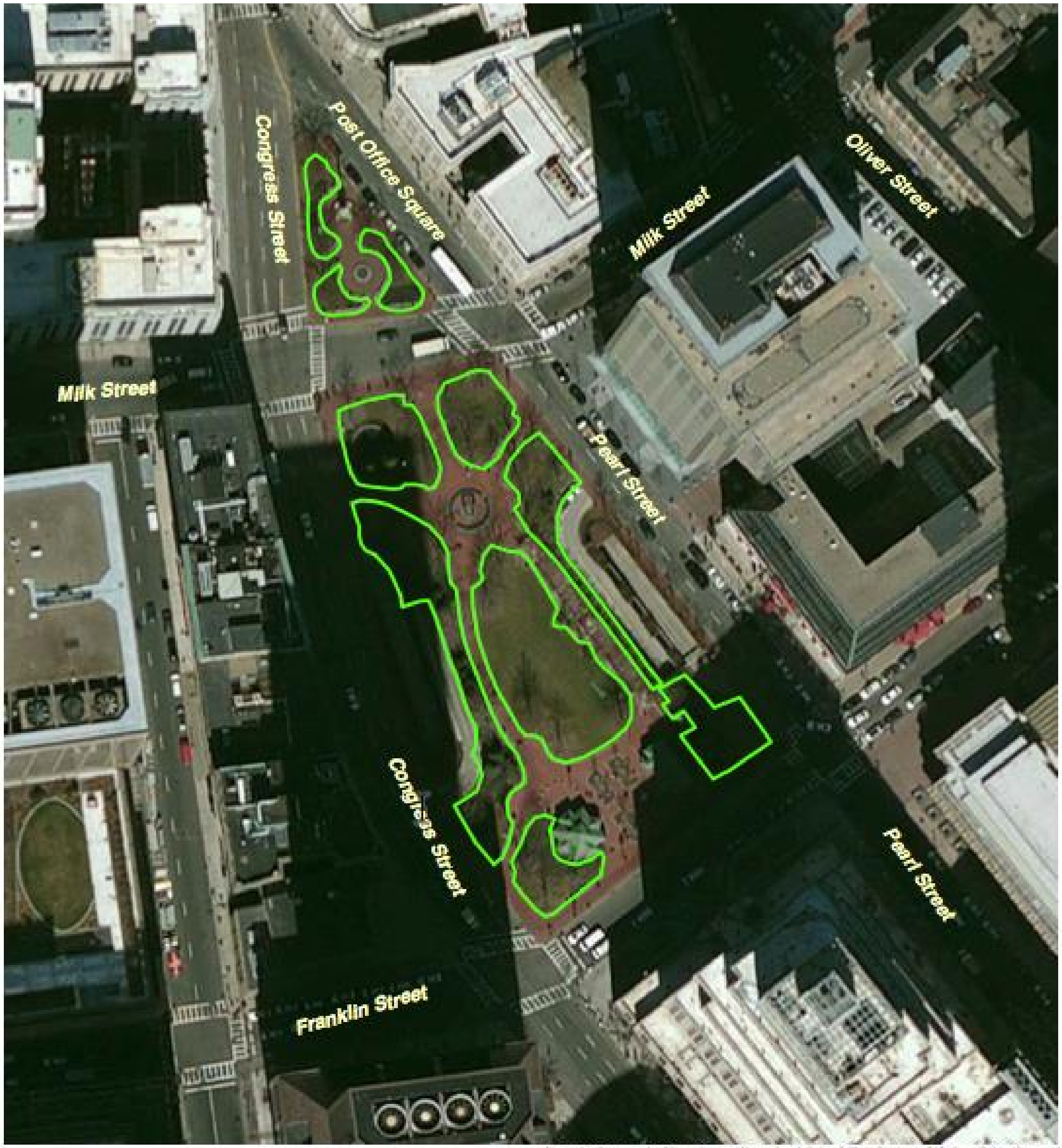


Figure 1: Post Office Square Park and Garage Montl
$2,500.00
$2,000.00
$1,500.00
$1,000.00
$500.00
$0.00
January-11
February-11
March-11
April-11
May-11
June-11
July-11
August-11
September-11
October-11
November-11
December-11
January-12
February-12
March-12
April-12
May-12



Path: H:\Proposals\Client Name\Friends of Post Office Square\GIS\PostOfficeSq.mxd

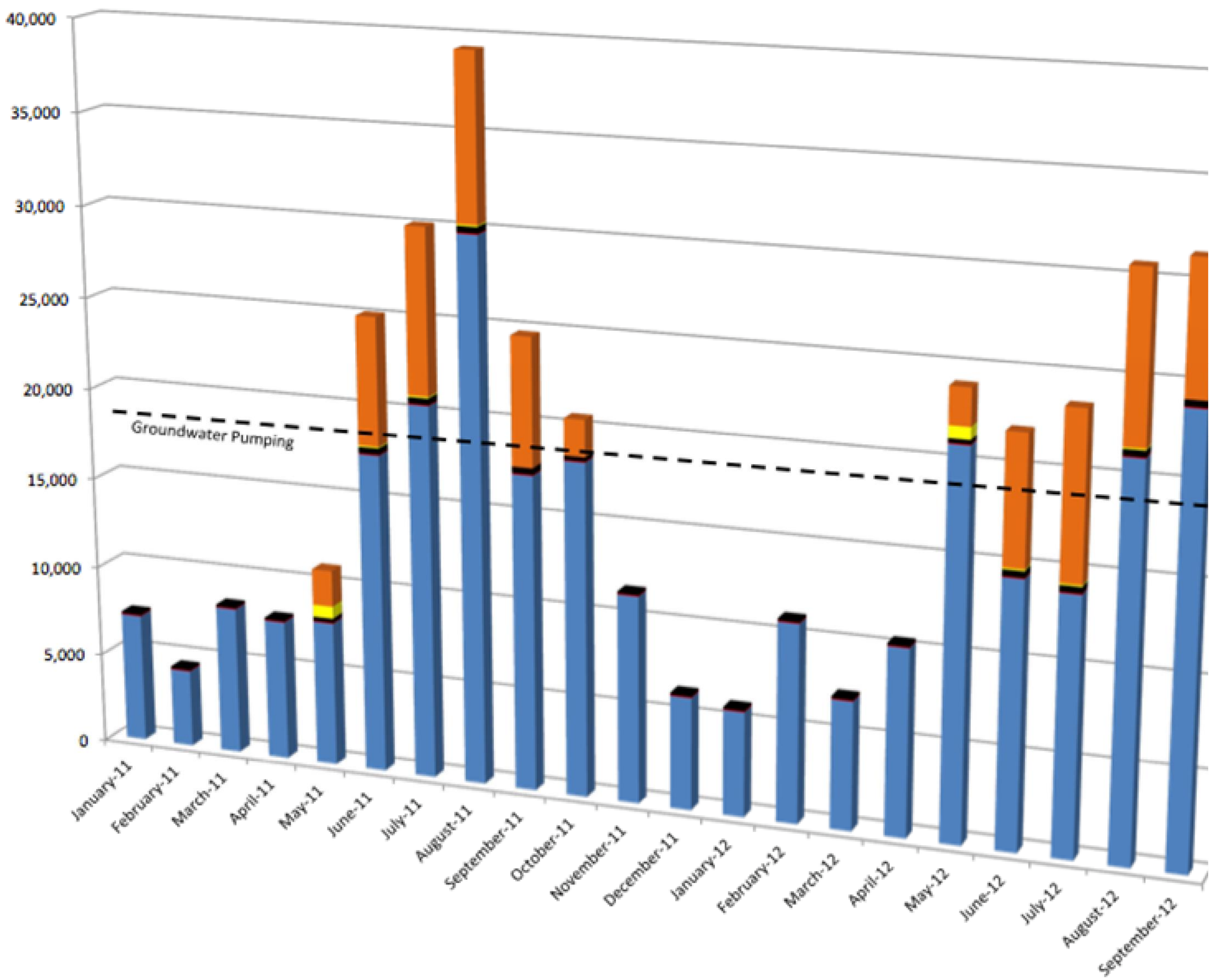
Legend

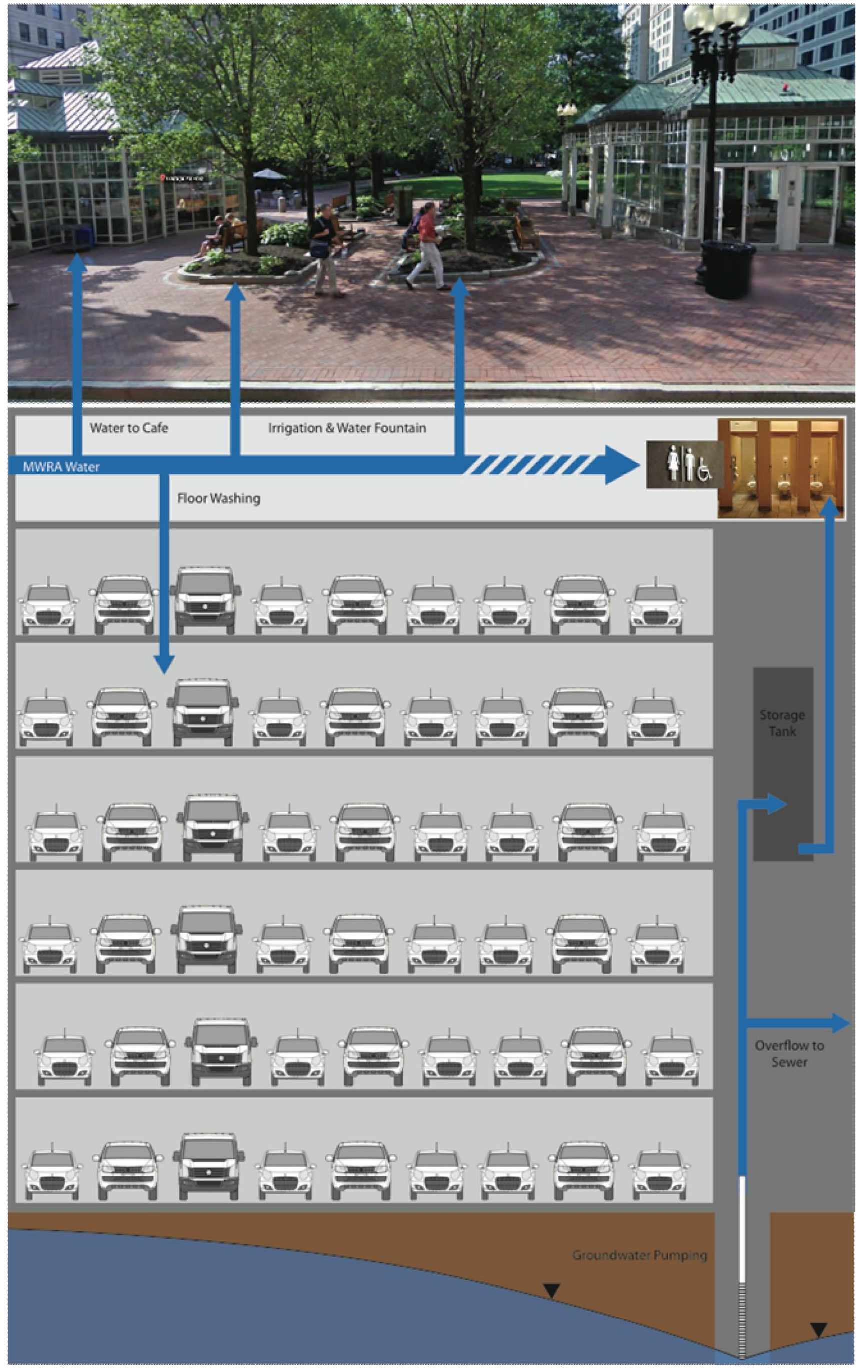
*Bing Imagery, ESRI 2010

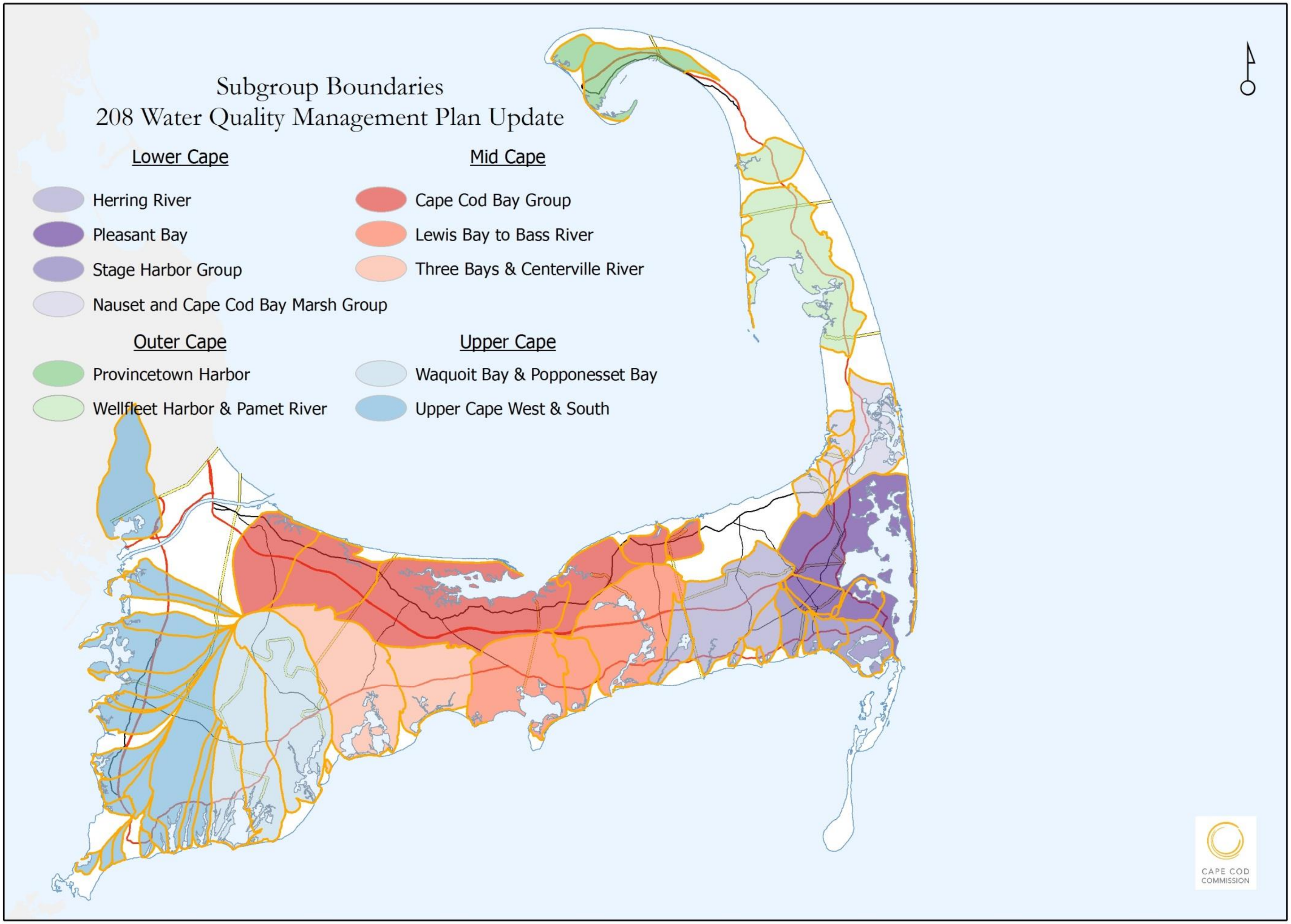
Horsley Witten Group

Pages

Figure 3: Summary of Water Usage at Post Office Square (Cubic Feet/



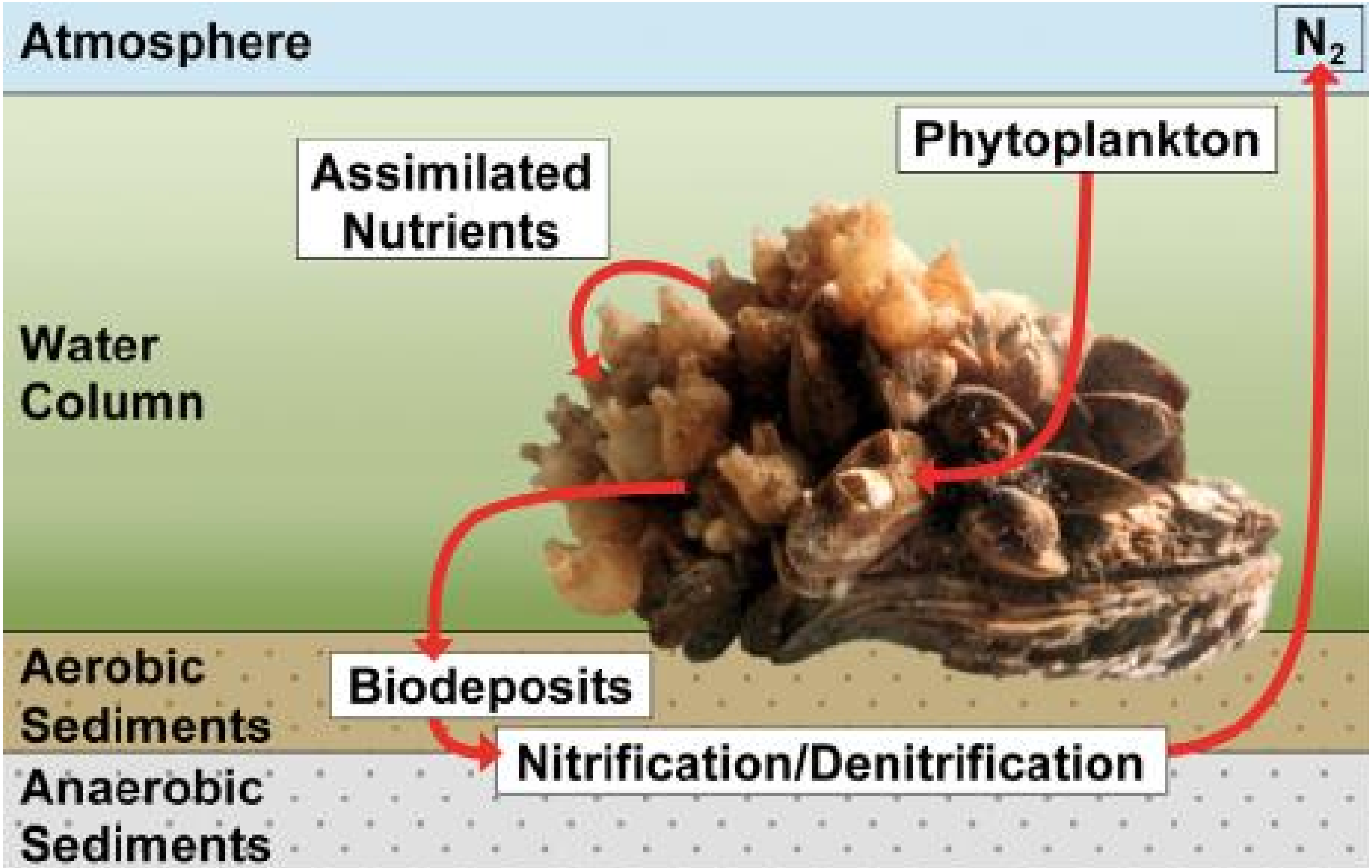

Water to Cafe
Irrigation & Water Fountain
MWRA Water
Floor Washing
Storage Tank
Overflow to Sewer
Groundwater Pumping



Subgroup Boundaries
208 Water Quality Management Plan Update
Lower Cape
Herring River
Pleasant Bay
Stage Harbor Group
Nauset and Cape Cod Bay Marsh Group
Mid Cape
Cape Cod Bay Group
Lewis Bay to Bass River
Three Bays & Centerville River
Outer Cape
Provincetown Harbor
Wellfleet Harbor & Pamet River
Upper Cape
Waquoit Bay & Popponesset Bay
Upper Cape West & South
CAPE COD COMMISSION


Alternatives: Screening Method
Wastewater
Existing Water Bodies
Regulatory
1
Targets/ Goals
Present Load:
X kg/day
Target:
Y kg/day
Reduction Required:
N kg/day
2
Composite Target Areas
A. High Nitrogen Reduction Areas
B. Pond Recharge Areas
C. Title 5 Problem Areas
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. Dredging
PRB
5
Alternative On-Site Options
A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems
IA
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

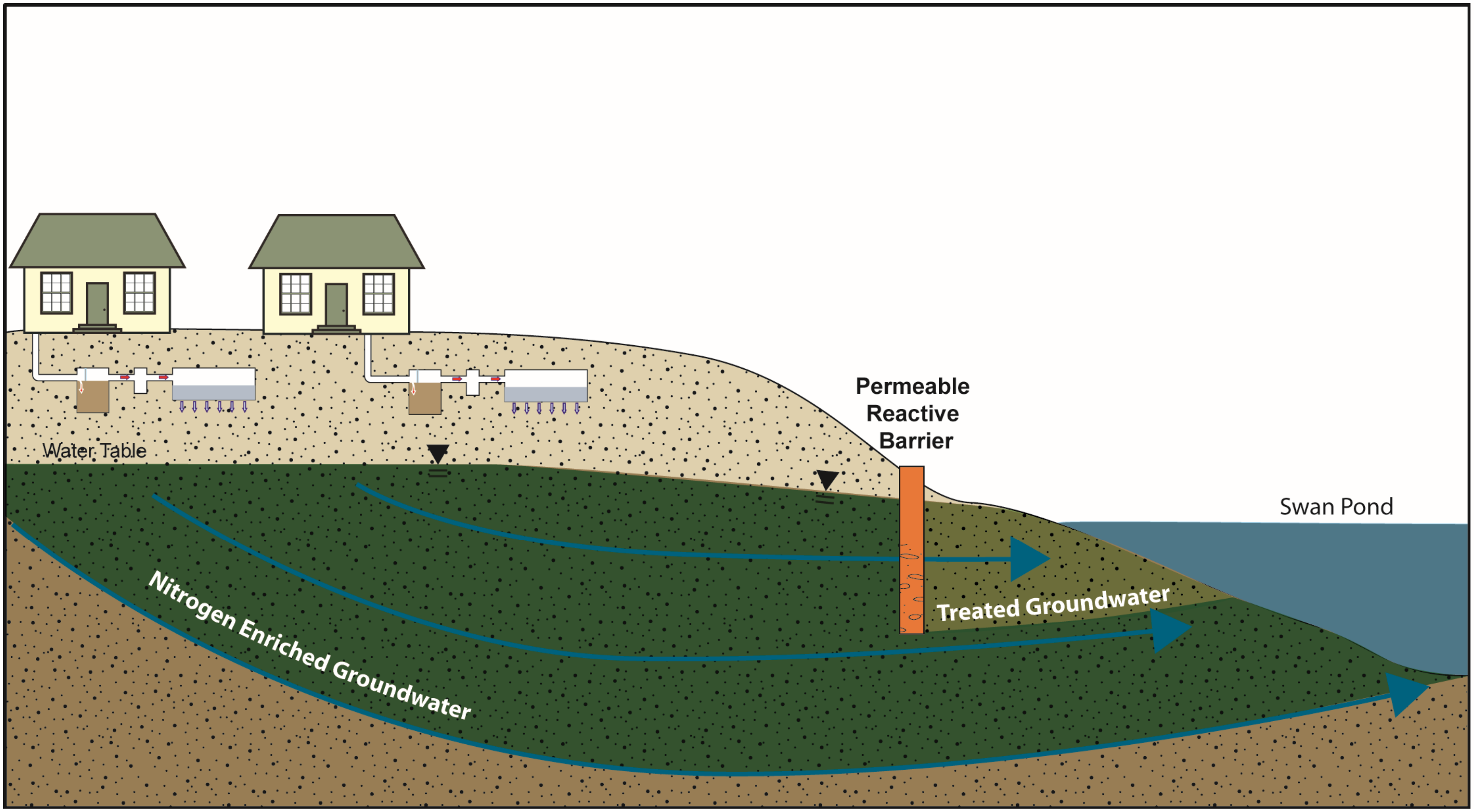
Rain Garden



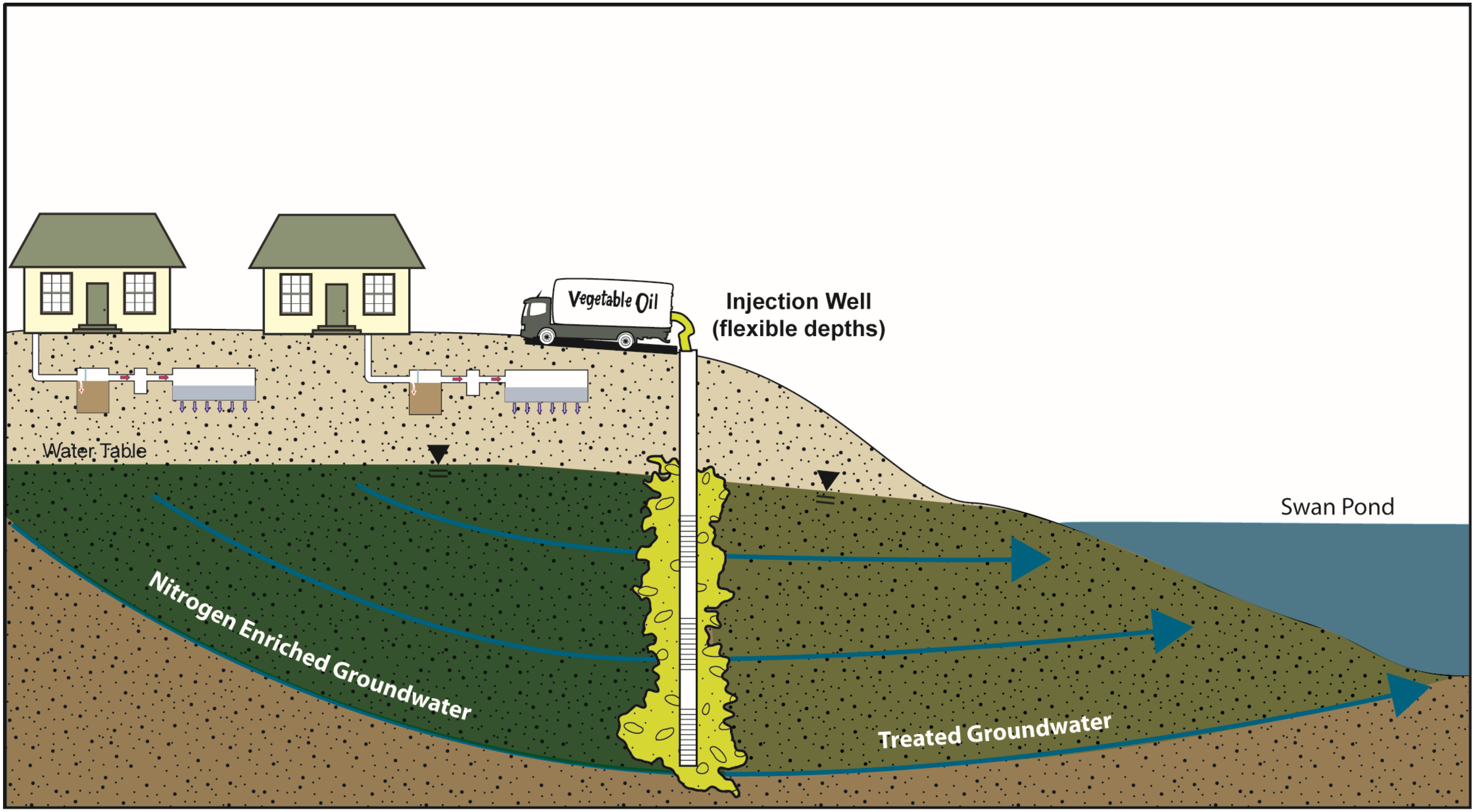
Kellogg et al., Denitrification and nutrient assimilarion on a restored oyster reef

Urine-diverting toilet: 90% of N in wastewater is in the urine!

Permeable Reactive Barriers



Permeable Reactive Barriers



TDR: 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.


THANK YOU!
QUESTIONS?