Introducing Green Infrastructure for Coastal Resilience

National Oceanic and Atmospheric Administration (NOAA)
Office for Coastal Management

What Is “Resilience”?

Introducing Green Infrastructure for Coastal Resilience

OFFICE FOR COASTAL MANAGEMENT
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Course Objectives

Participants:

- Recognize green infrastructure terms and concepts
- Understand ecological, economic, and societal benefits of green infrastructure
- Understand the wide variety of contexts and scales of approaches referred to as “green infrastructure” today
- Understanding of how green infrastructure fits into existing planning processes, tips on engaging stakeholders, and potential funding opportunities
- Identify local green infrastructure activities and experts with additional information and resources

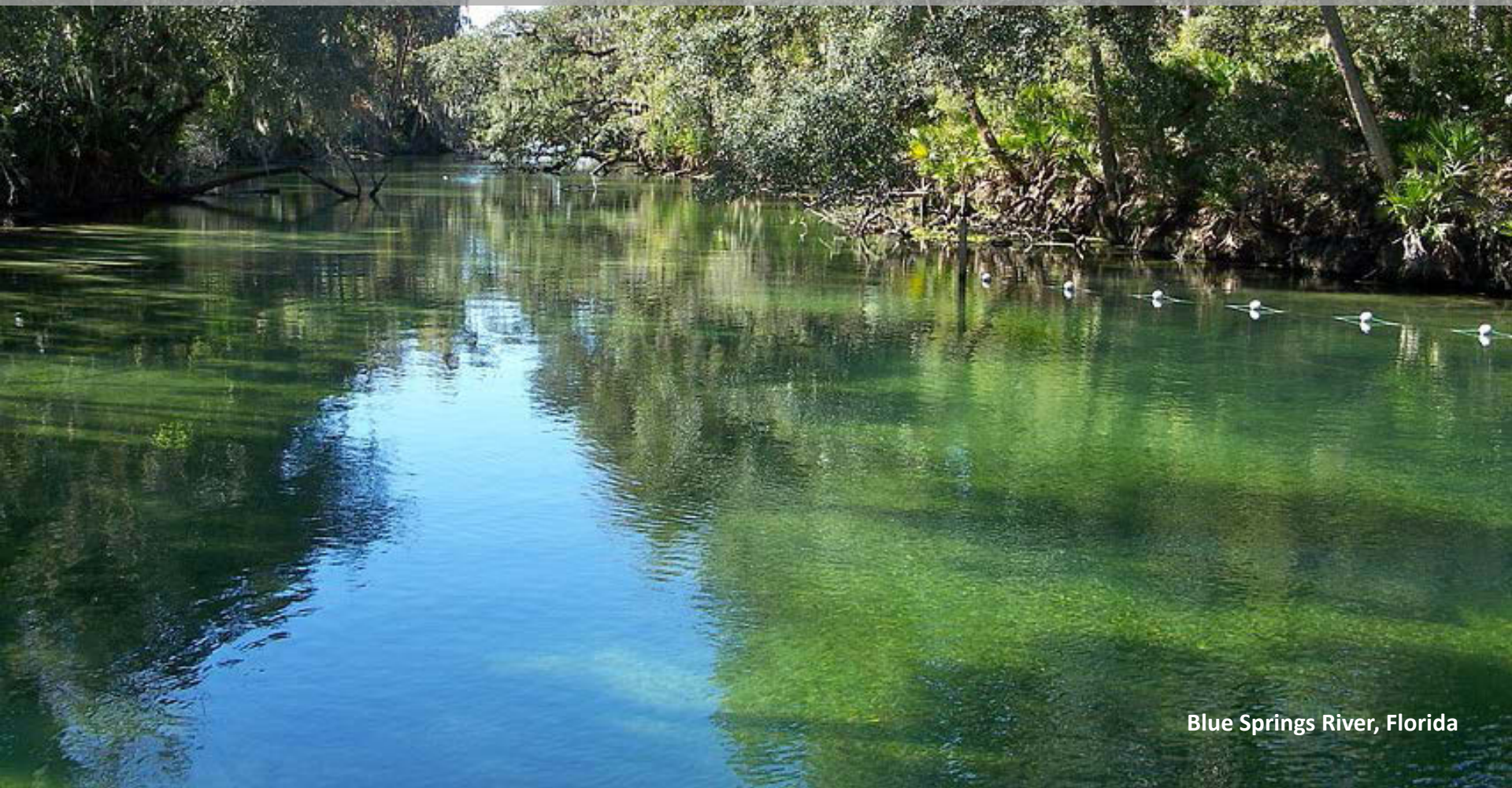
Course Outline

1. Green Infrastructure Concepts and Principles
2. The Practice of Green Infrastructure
3. Implementing Green Infrastructure

A Quick Hello!

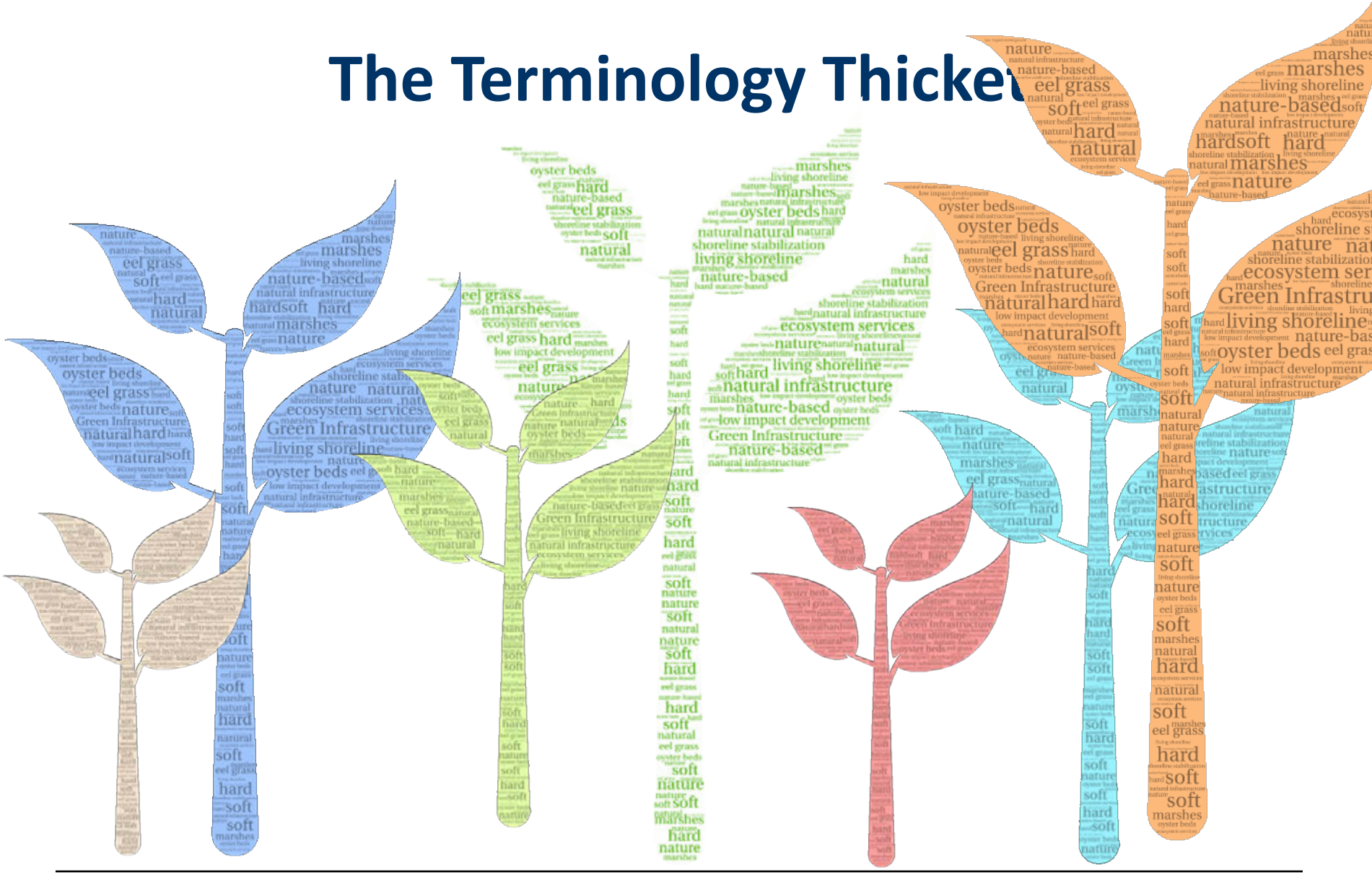
- **Name**
- **Affiliation**
- **One Word** you think of when you hear the term "Green Infrastructure"

Section 1
Green Infrastructure Concepts and Principles



Blue Springs River, Florida

The Terminology Thicket



Foundations of Green Infrastructure

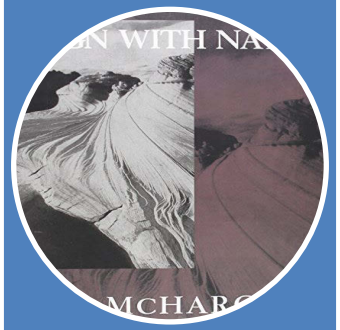
Green Infrastructure Concepts and Principles

Landscape Architecture

1860s

Landscape Ecology

1930s



Design with Nature

1960s

Conservation Biology

1970s

Clean Water Act

1970s

Foundations of Green Infrastructure

Green Infrastructure Concepts and Principles

Landscape approach?

Site-level approach?

Applicability across Scales

Green Infrastructure Concepts and Principles

Landscape and watershed

Community and site

Shore and coastal zone

Importance of Context

Green Infrastructure Concepts and Principles

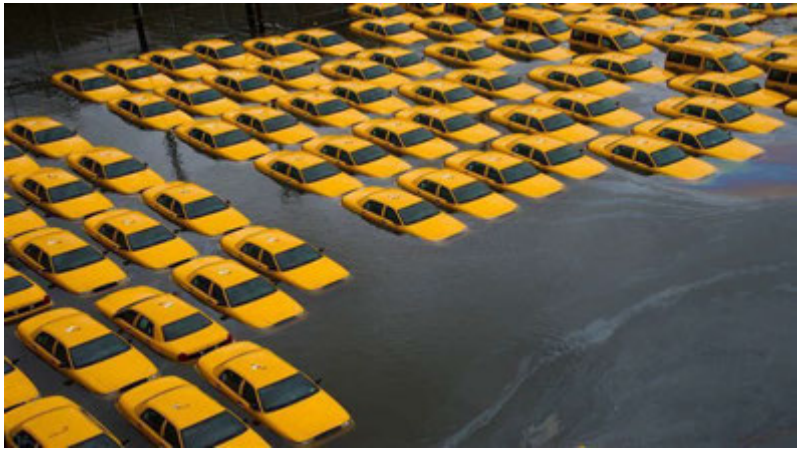
Green infrastructure practices are context sensitive.

Rural → Urban

Coastal ← Upland

Why Green Infrastructure?

Green Infrastructure Concepts and Principles

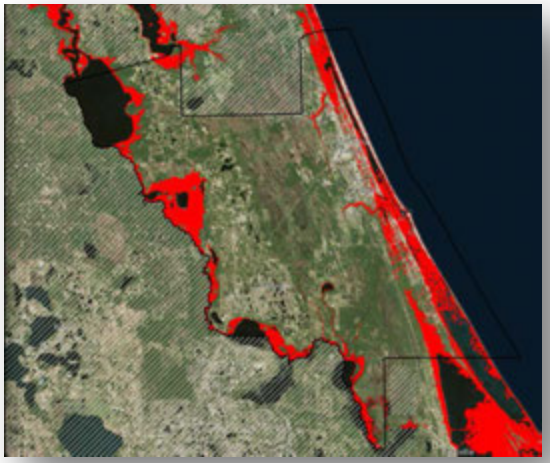


Why Green Infrastructure?

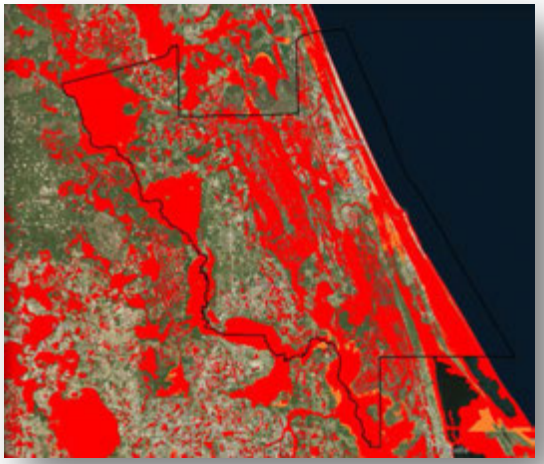
Green Infrastructure Concepts and Principles

Exposure to Coastal Hazards

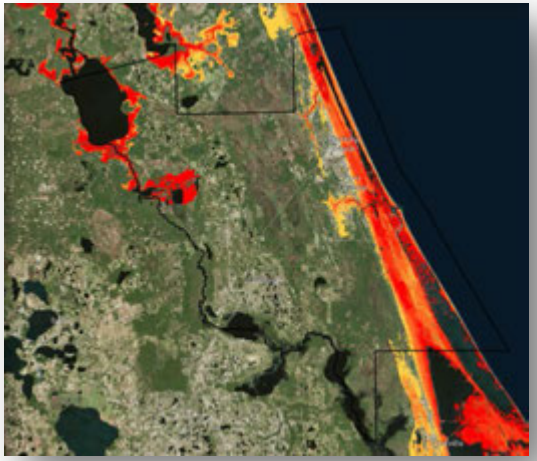
Green Infrastructure Concepts and Principles



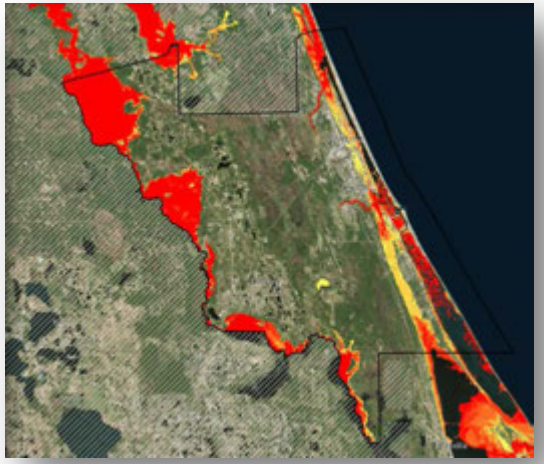
Shallow Coastal Flooding



FEMA Flood Zones



Storm Surge



Sea Level Rise

coast.noaa.gov/digitalcoast/tools/flood-exposure

Ecosystem Services

Green Infrastructure Concepts and Principles

Natural ecosystems provide multiple benefits to people, including food and water production, improved air and water quality, and recreation and spiritual inspiration.

Multiple Benefits

- Environmental
- Societal
- Economic

Who's Benefit

Green Infrastructure Concepts and Principles

A wide variety of stakeholders stand to benefit. Engaging stakeholders is an essential part of understanding the benefits and how they are valued by people.

Table Discussion 1

Green Infrastructure Concepts and Principles

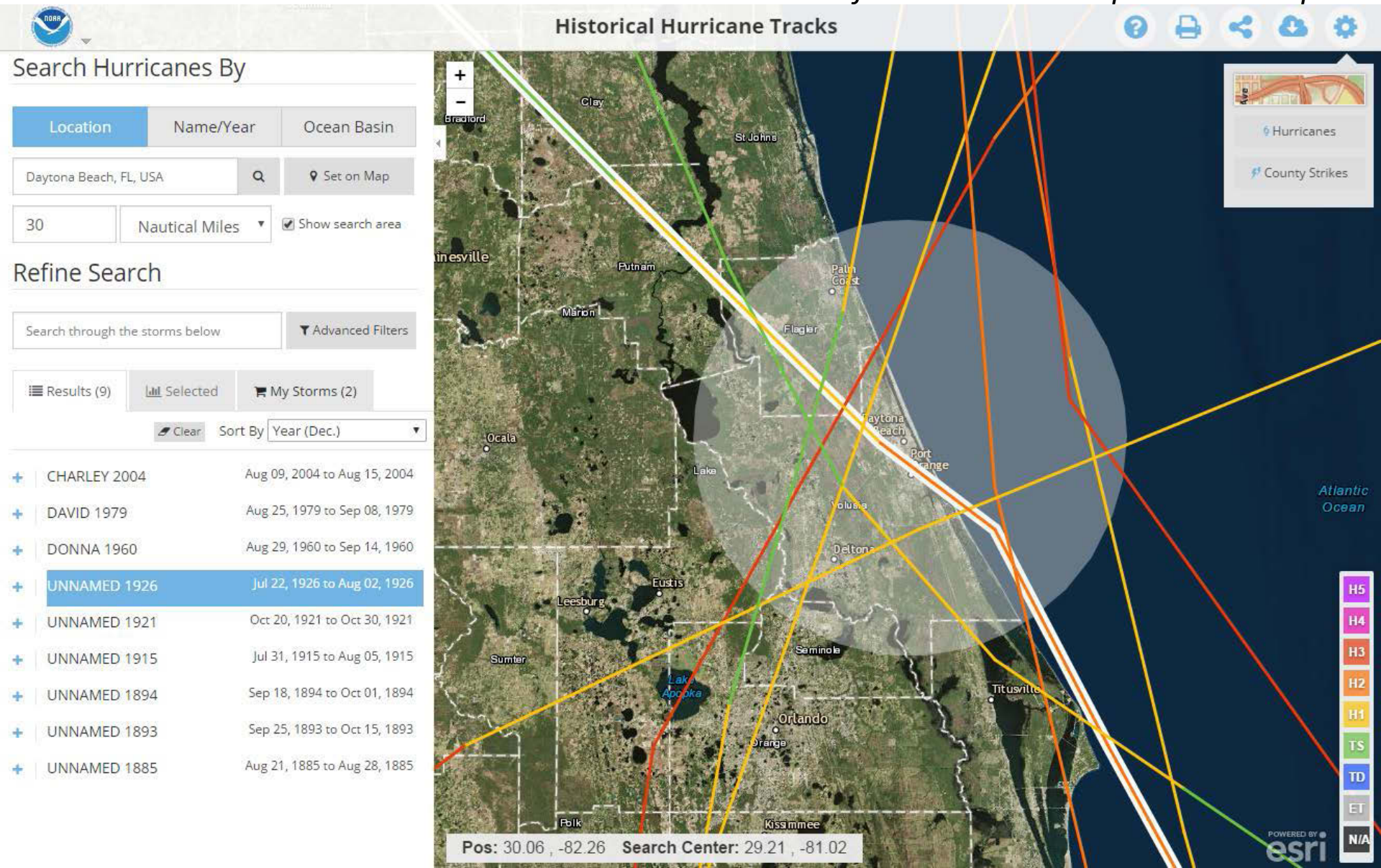


Table Discussion 1

- Between the last big storm and Hurricane Matthew, what has changed on the landscape?
- What has been altered such that areas have become more or less vulnerable?
- Are there Ecosystem Services (natural benefits) that you could preserve or recreate to reduce impacts?

Section 2
The Practice of Green Infrastructure

"Green Street" Jacksonville, FL
Nature by Kevin Songer

Planning Concepts

The Practice of Green Infrastructure

- Approach will depend on the ***scale*** you are addressing
- All practices, regardless of scale, use ***ecosystem services*** to acquire maximum benefits
- Design methods are repeatable and grounded in ***science***
- ***Context*** is important

Design Concepts

The Practice of Green Infrastructure

Successful green infrastructure practices incorporate

- Multi-functionality
- Resilience
- Sense of place
- Return on investment

Green Infrastructure in Practice

The Practice of Green Infrastructure

Landscape and watershed

Community and site

Shore and coastal zone

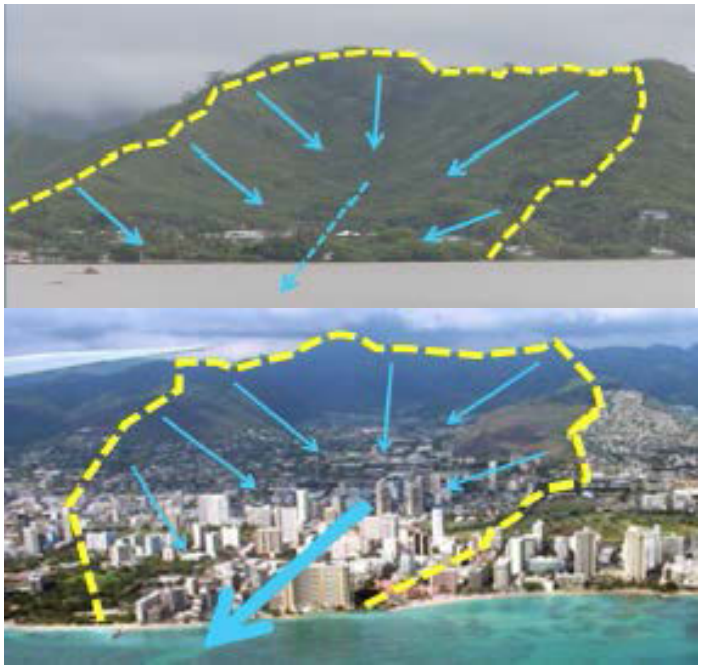
Landscape Design Concepts

The Practice of Green Infrastructure

	BETTER	WORSE
Area		
Proximity		
Connectivity		

Watershed Design Concepts

The Practice of Green Infrastructure



Source: Horsley Witten Group; Center for Watershed Protection

- Preserve native vegetation
- Protect steep slopes
- Buffer stream channels
- Reduce connected impervious cover
- Seek multiple benefits

Community and Site Design Concepts

The Practice of Green Infrastructure

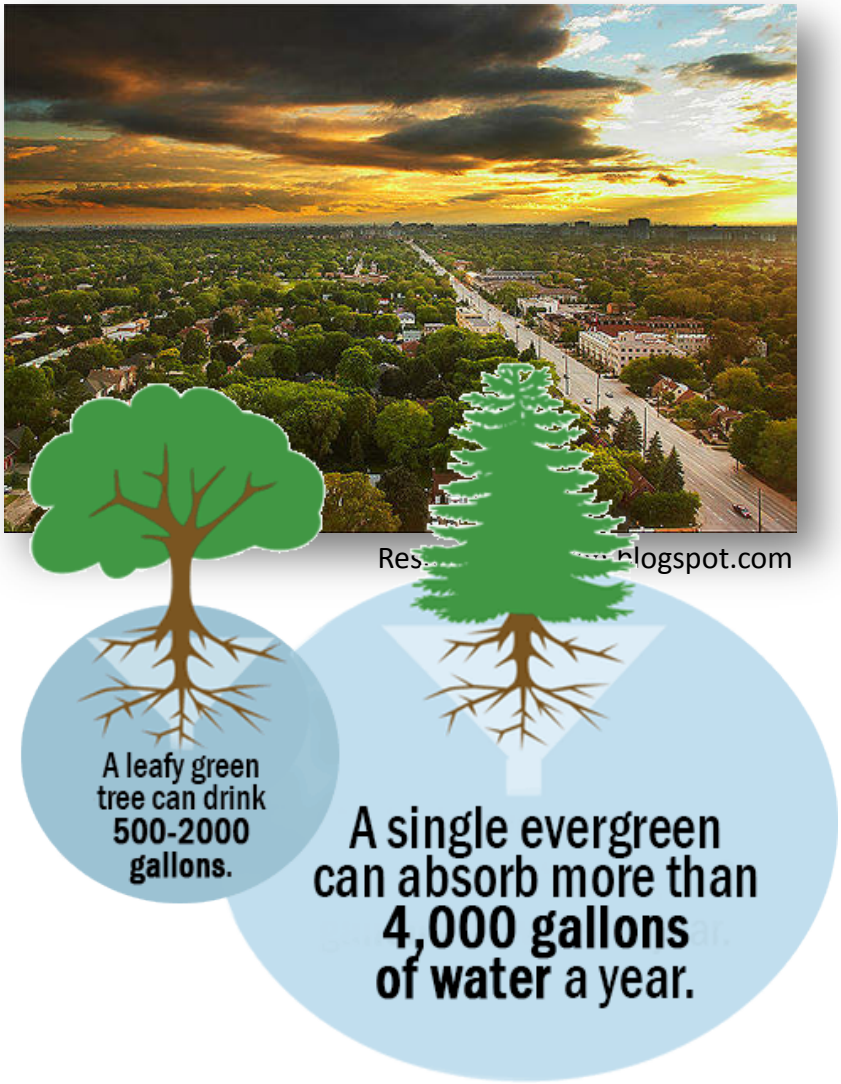
- Natural areas and open spaces should serve multiple functions (e.g., recreation, stormwater storage, filtration)
- Connect people to open areas through greenways and trails
- Preserve or mimic the natural hydrological functions of a site or drainage area
- Use urban streetscapes to provide ecosystem benefits in urban areas

Community and Site Approaches

The Practice of Green Infrastructure

Urban Forestry

- Trees provide enormous environmental, economic, and societal benefits
- Develop a tree planting program designed to maximize benefits
- To the extent possible, protect existing forested areas, particularly large specimen trees



Community and Site Approaches

The Practice of Green Infrastructure

Green Streets

- Key linking component in green infrastructure network
- Design dependent on local conditions but generally include
  - Alternative street widths
  - Swales
  - Bioretention
  - Permeable pavements
- Provides multiple benefits

Philadelphia Water Department

Coos Bay, Oregon

Community and Site Approaches

The Practice of Green Infrastructure

Environmental Site Design

- Place the site in context to greater community
- Preserve and enhance natural features
- Mimic or enhance existing hydrology
- Minimize impervious cover
- Key component of low impact development (LID)

TrockWorks Architectural Services

Community and Site Approaches

The Practice of Green Infrastructure

Low Impact Development Practices

Bioretention (Infiltration and Filtering)

- Rain gardens
- Bioswales
- Stormwater planters

Green Roofs (Storage and Evapotranspiration)

- Blue roofs
- Cisterns

Permeable Pavements (Infiltration)

- Porous asphalt/concrete
- Grass or gravel pavers
- Pavers

Community Practices and Resilience

The Practice of Green Infrastructure

- Many studies on the effectiveness of these practices on heat island effect, water quality, groundwater recharge, societal benefits.
- For LID, flood reduction is a 'co-benefit'
  - Studies and modeling results indicate considerable flood loss reduction with GI practices
  - BUT, there is a need for longer term, empirical studies.

Shoreline Design Concepts

The Practice of Green Infrastructure

- Natural or Nature-Based
  - Dunes and beaches
  - Vegetated features (salt marsh, wetlands, submerged aquatic vegetation)
  - Oyster and coral reefs
  - Barrier islands
  - Maritime forest/shrub communities
- Hybrid
  - Natural and structural features
- Nonstructural
  - Floodplain policy and management
  - Flood proofing

Shoreline Approaches

The Practice of Green Infrastructure

Natural or Nature-based

Dune and Beach Creation

- Break offshore waves
- Attenuate wave energy
- Slow inland water transfer

Salt Marshes, Wetlands, Vegetation, SAV

- Break offshore waves
- Attenuate wave energy
- Slow inland water transfer
- Increase infiltration

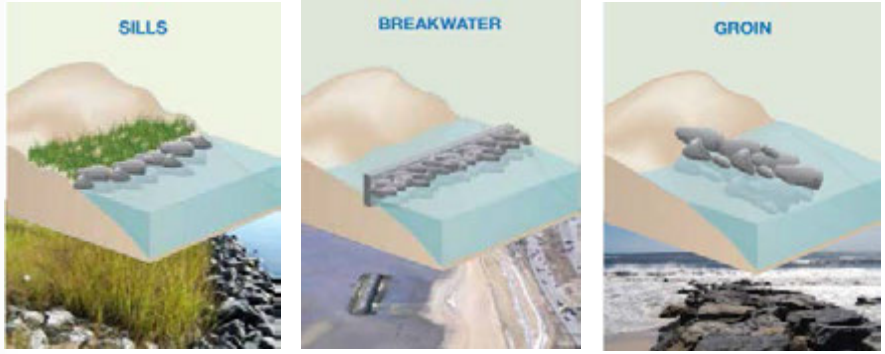
Oyster and Coral Reefs

- Break offshore waves
- Attenuate wave energy
- Slow inland water transfer

Shoreline Approaches

The Practice of Green Infrastructure

Hybrid



http://sagecoast.org/info/information.html

- Blends both nature-based and structural approaches
- Derives benefit of wave energy dissipation from structural practices
- Derives ecosystem service benefits from nature-based practices

Provides NOAA's Guiding Principles:

✓Use to provide, maintain, or improve habitat or ecosystem function

✓Use methodologies that avoid or minimize channel-ward encroachment into subtidal habitat.

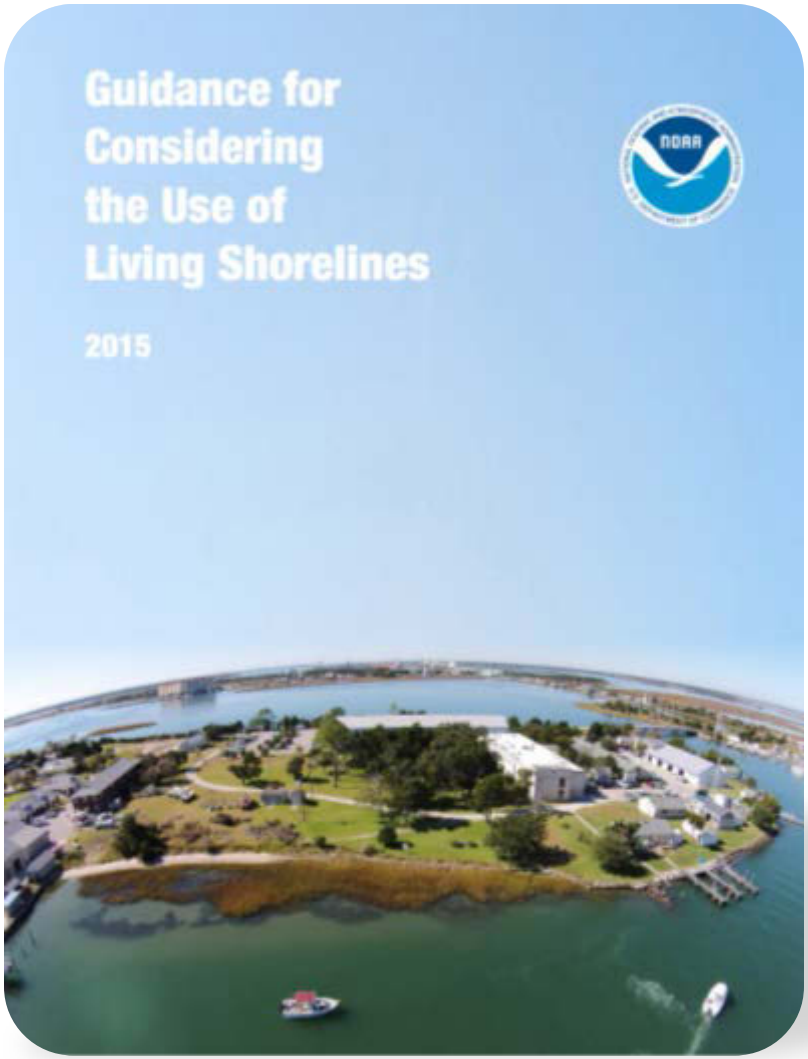
✓Use softest approach feasible, based on site conditions

✓Consider regional and site-specific differences

✓Coordinate across multiple government and non-government entities

✓Incorporate best available regional and local shoreline science and practices

✓Consider ecosystem services provided by the shoreline stabilization approach in project design



Shoreline Practices and Resilience

The Practice of Green Infrastructure

- For Hurricane Sandy, a recent study* showed:
  - Coastal wetlands saved more than $625 million in flood damages
  - Where they exist, coastal wetlands reduced damages by more the 10% on average
  - In Ocean County, NJ salt marsh conservation can reduce average annual losses by more than 20%

*Coastal Wetlands and Flood Damage Reduction: Using Risk Industry-based models to Assess Natural Defenses in the NE USA, 2016.

Table Discussion 2

- What green infrastructure-related projects are you working on now, or hope to, that enhance ecosystem services in your community?

- **Record GI practice being used, location, your contact info.**
- **Use a "P" if this is an existing or planned project, or an "I" if an idea.**

Section 3

Implementing Green Infrastructure

"Green Street" Jacksonville, FL
Nature by Kevin Songer

Barriers to Green Infrastructure

Implementing Green Infrastructure

Technical and Physical

- Lack of understanding
- Lack of data showing benefits, costs, and so on
- Insufficient technical knowledge or experience
- Lack of design standards, codes, and ordinances

Financial

- Not enough data about costs and economic benefits
- Perceived high costs over short and long terms
- Lack of funding for implementation
- Too much risk – not enough incentives

Legal and Regulatory

- Local rules lacking, conflicting, or restrictive
- State policies
- Property rights issues
- Federal rules can be conflicting

Community and Institutional

- Insufficient information and green infrastructure benefits for political leaders, administrators, staff, developers, builders, and landscapers
- Community and institutional values that underappreciate green infrastructure aesthetics and characteristics
- Lack of interagency and community cooperation

Green Infrastructure Can Inform Planning

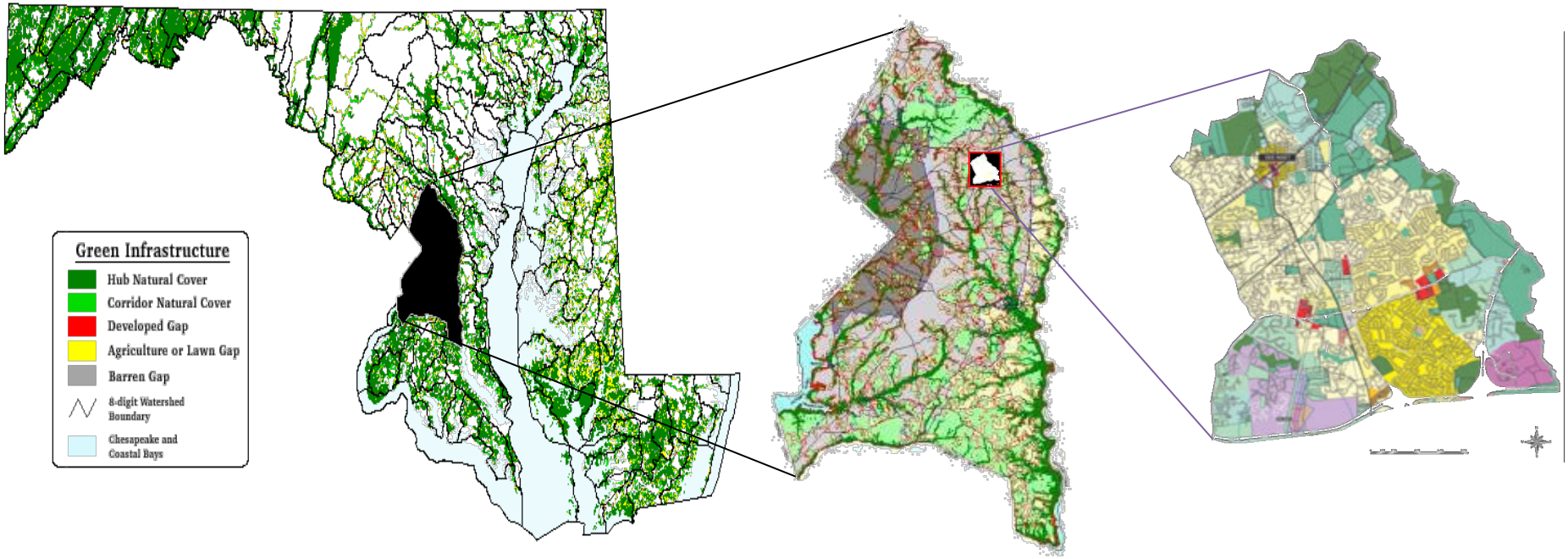
Implementing Green Infrastructure

Incorporate green infrastructure into planning efforts:

- Comprehensive
- Transportation
- Smart growth
- Watershed
- Conservation
- Hazard mitigation
- Stormwater
- Climate change adaptation
- Resilience
- Land use

Green Infrastructure Can Inform Planning

Implementing Green Infrastructure



Maryland State Plan **Prince George's County** **Bowie Planning Area**

Comprehensive Planning

Integrating with Local Plans and Practices

Climate Adaptation Planning

Integrating with Local Plans and Practices

1 ft sea level rise

2 ft sea level rise

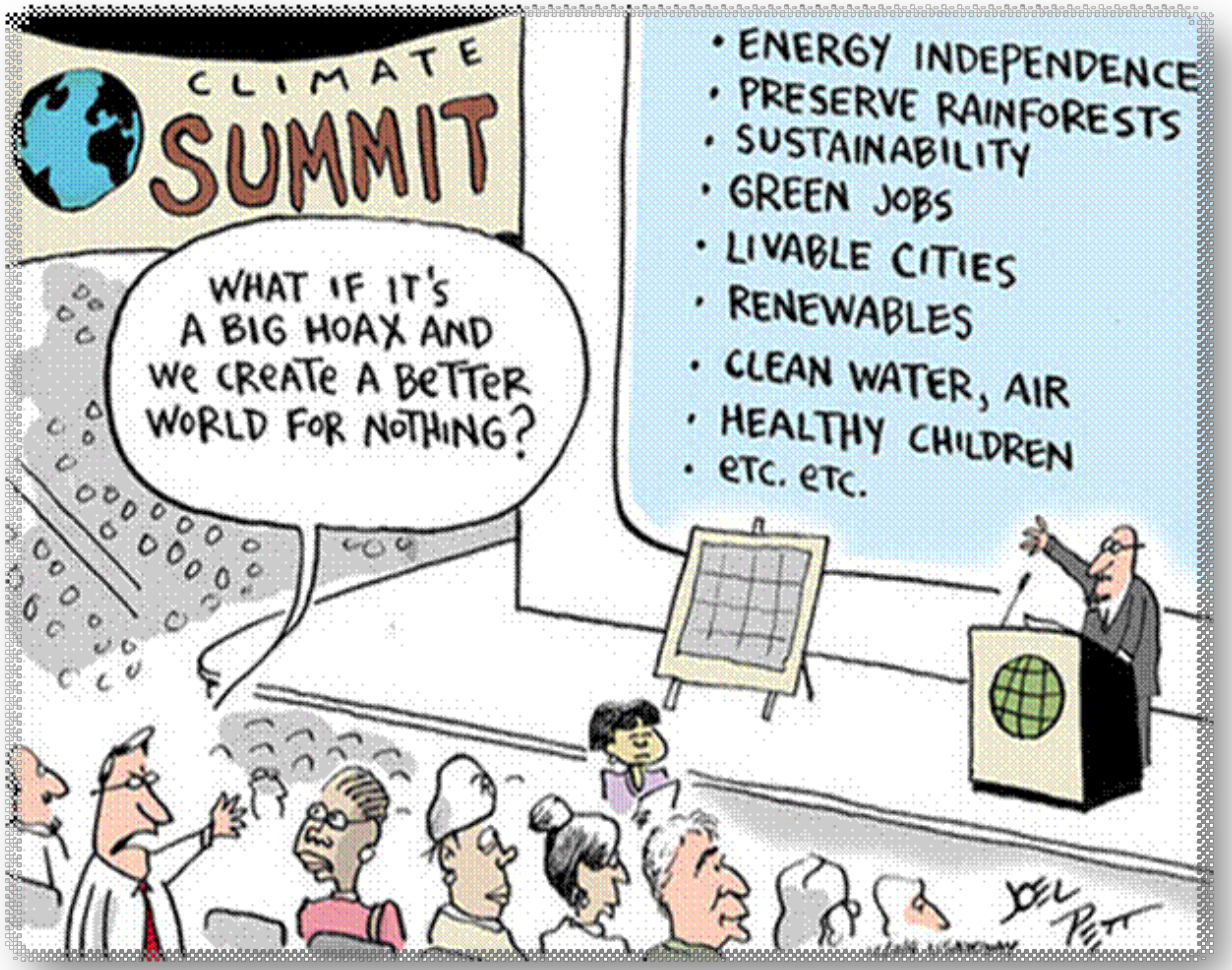
3 ft sea level rise

Map images from ***www.coast.noaa.gov/slr/***

R COASTAL MANAGEMENT
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Multiple Benefits

Implementing Green Infrastructure



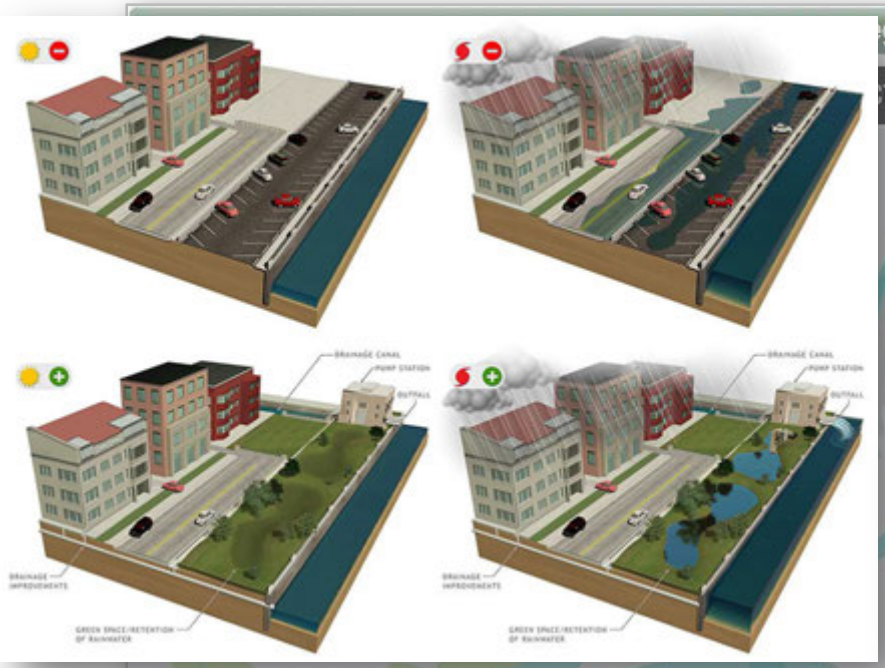
Engaging Stakeholders

Implementing Green Infrastructure

- Have a plan
- Speak to their interests, not yours
- Explain the hazard risk and offer solutions
- Use multiple ways to communicate

Engaging Stakeholders

Implementing Green Infrastructure



Engaging Stakeholders

Implementing Green Infrastructure

coast.noaa.gov/digitalcoast/training/gi-animation

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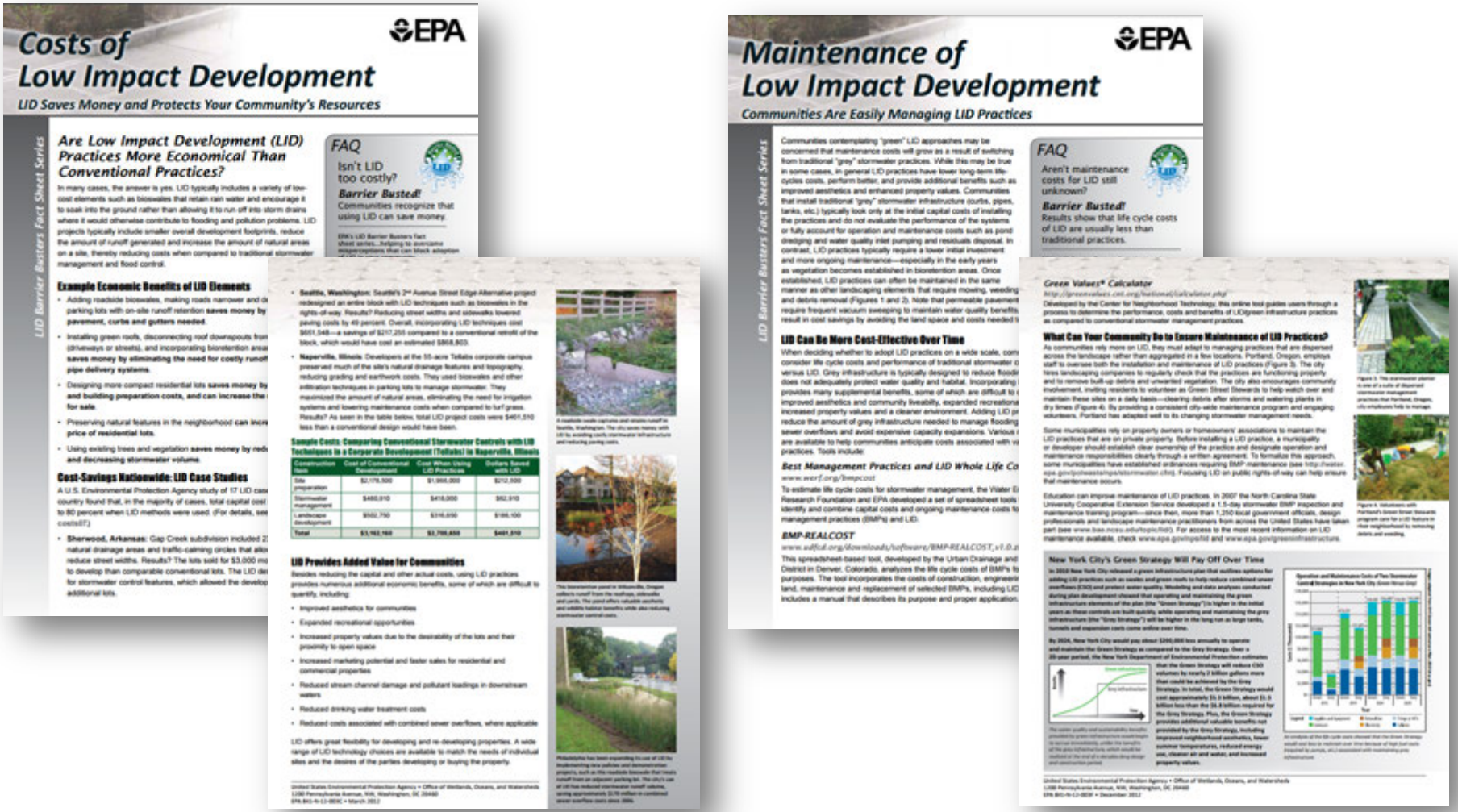
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Engaging Stakeholders

Implementing Green Infrastructure



www.epa.gov/green-infrastructure/overcoming-barriers-green-infrastructure

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Funding for Green Infrastructure

Implementing Green Infrastructure

- US Environmental Protection Agency
- NOAA
- Federal Emergency Management Agency
- National Park Service
- National Endowment for the Arts
- US Department of Transportation

- Economic Development Administration
- National Recreation and Parks Association
- Funders Network for Smart Growth and Livable Communities
- Qualified Energy Conservation Bonds

Table Discussion 3

Implementing Green Infrastructure

- Part 1: What barriers have you run into around implementing green infrastructure? Have you had challenges incorporating green infrastructure into local planning, engaging stakeholders, obtaining funding?

- Part 2: How can you overcome these barriers? Does anyone in your group have solutions to these? What plans or regulations does your green infrastructure work fit into? Are there educational and public engagement opportunities? How can green infrastructure practices become the “new normal”?

Solutions or next steps?

Courtesy Chesapeake Bay Program

One Last Thing . . .

***Please* fill out the Evaluation!**

http://tinyurl.com/VolusiaEval2016

Thank You!

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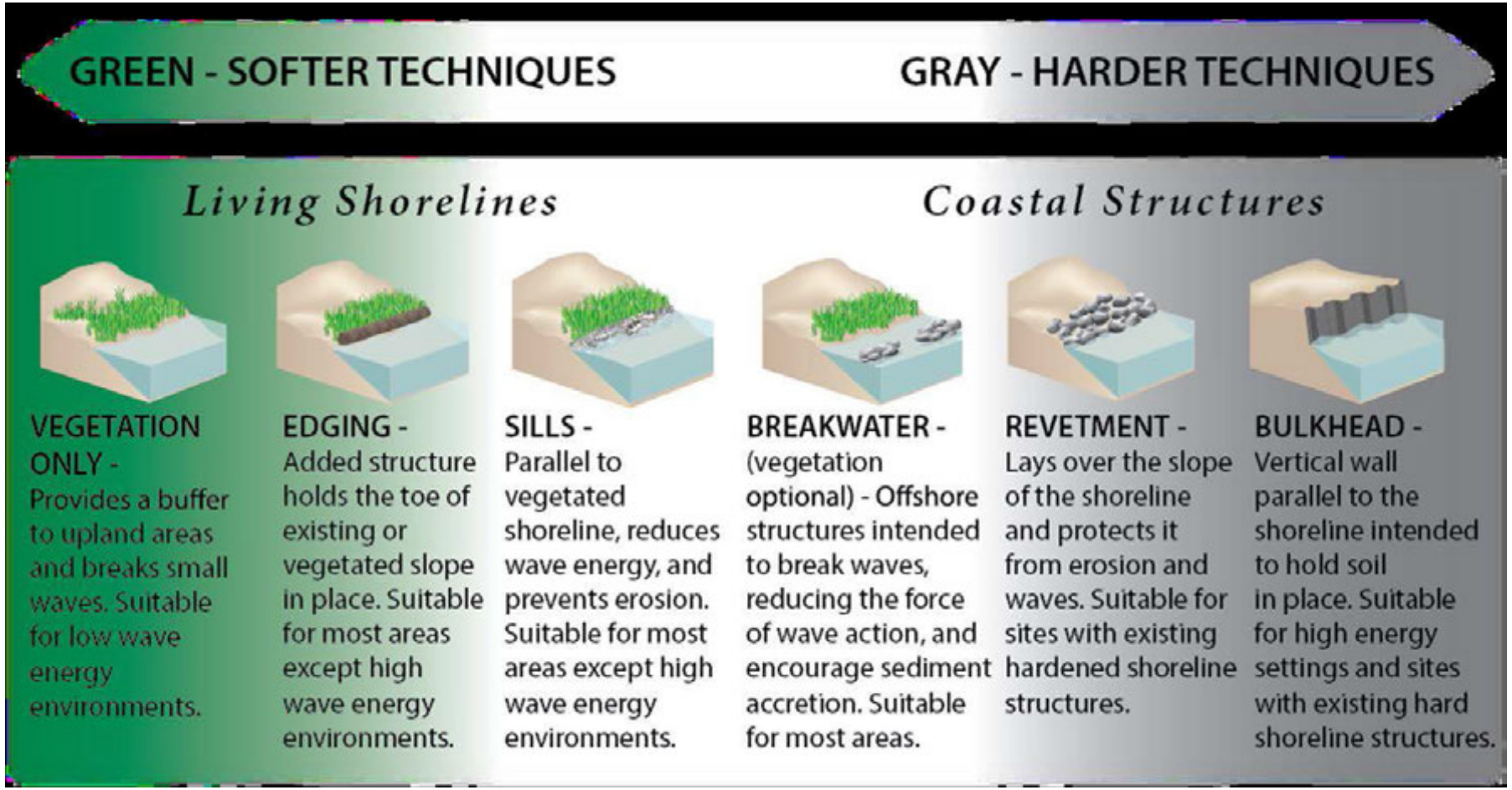
It’s Natural!

Building Coastal Resiliency through *Living Shorelines*

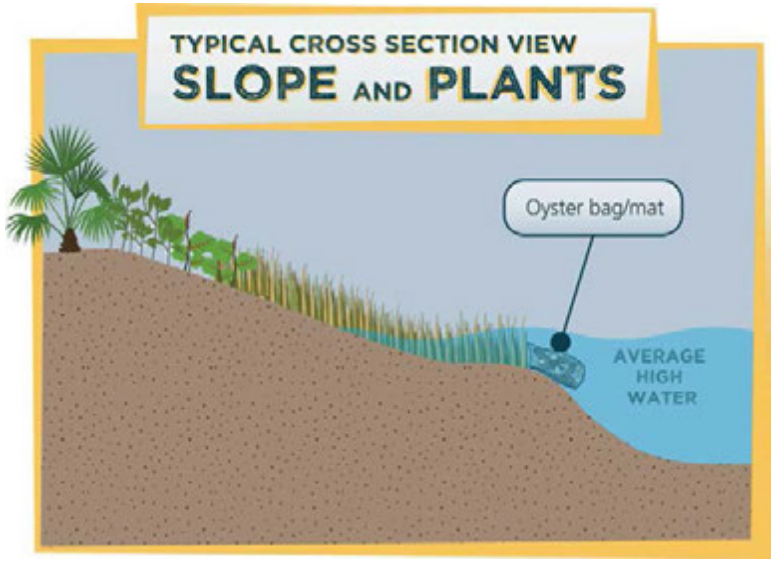
ANNIE RODDENBERRY
AQUATIC HABITAT CONSERVATION AND RESTORATION
FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
ANNIE.RODDENBERRY@MYFWC.COM

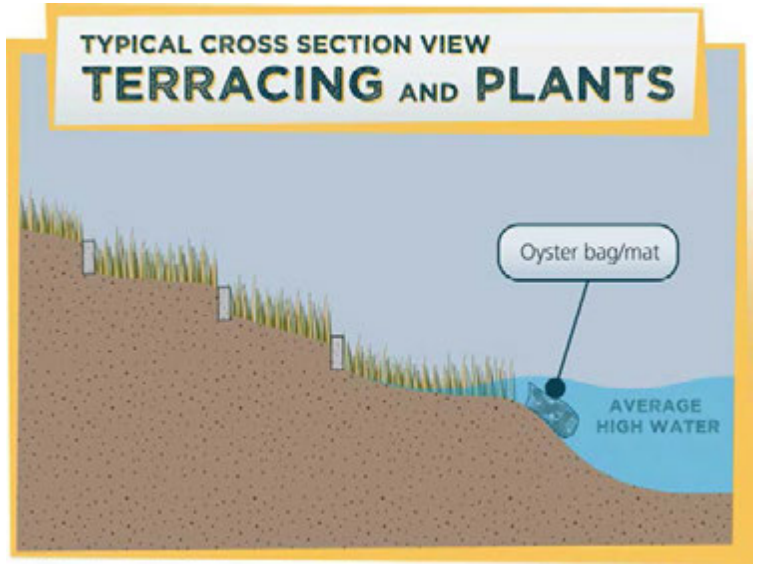
What is a *Living Shoreline*?

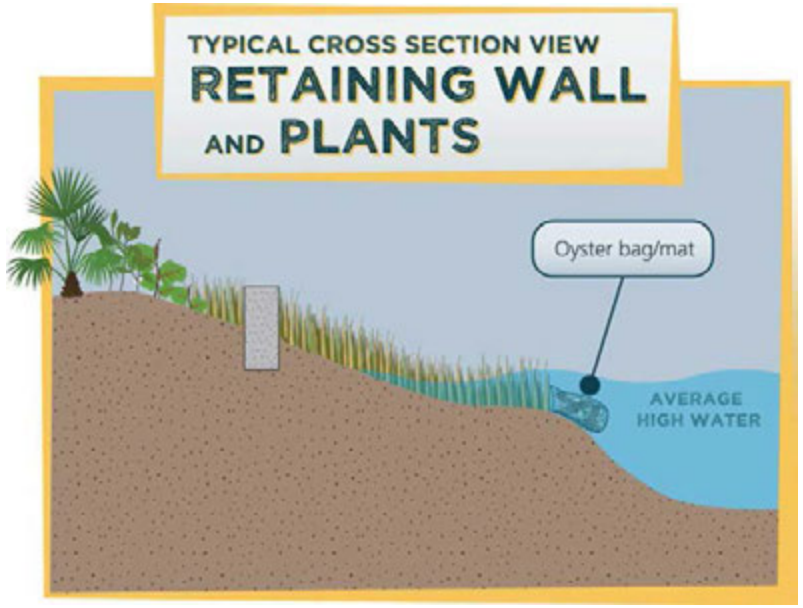


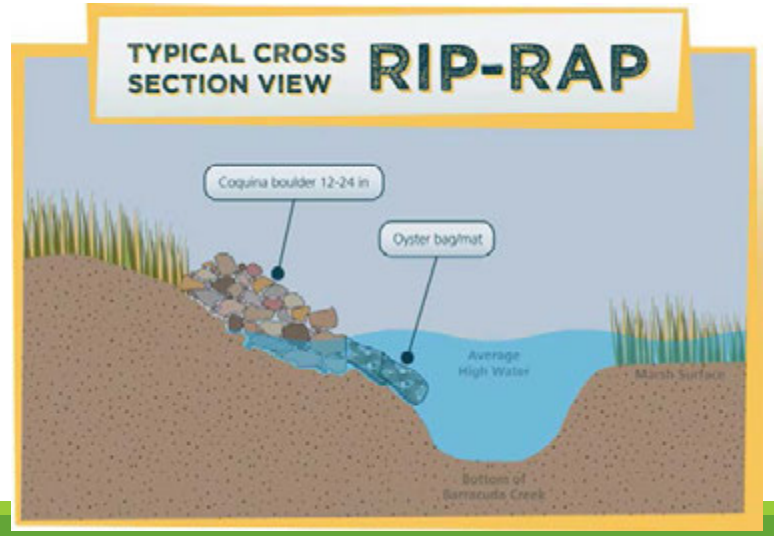
NOAA Guidance for Considering the Use of Living Shorelines, 2015

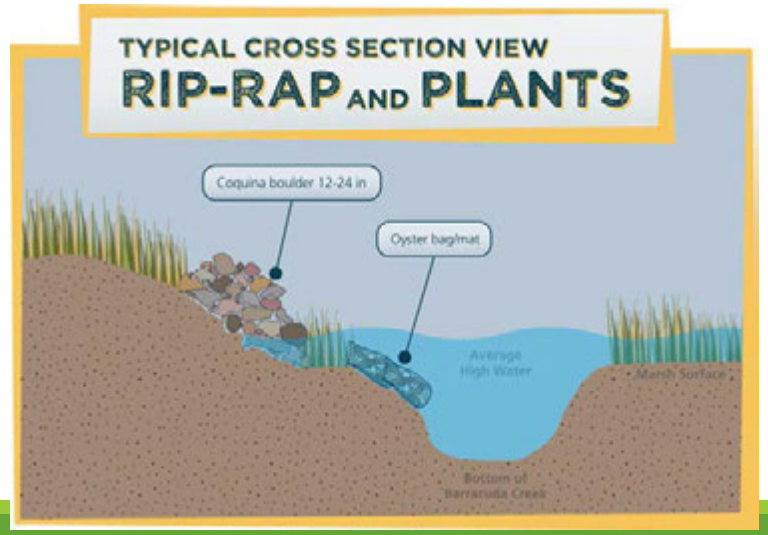
Many shades of ‘green’

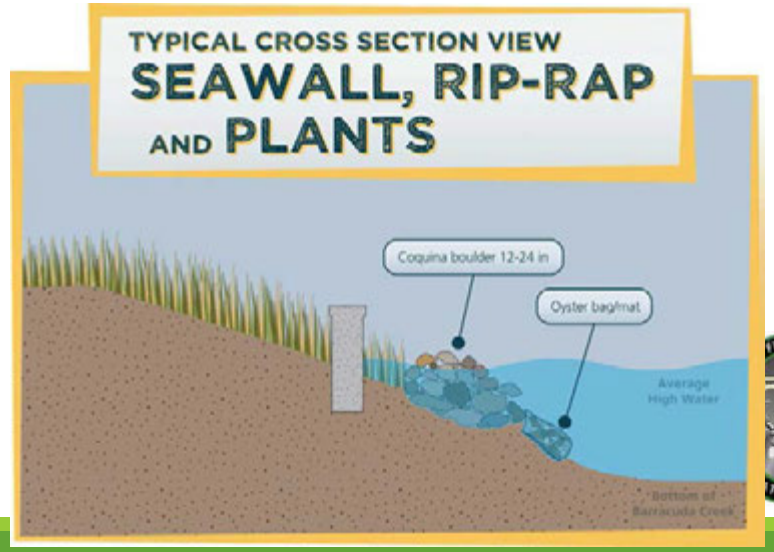


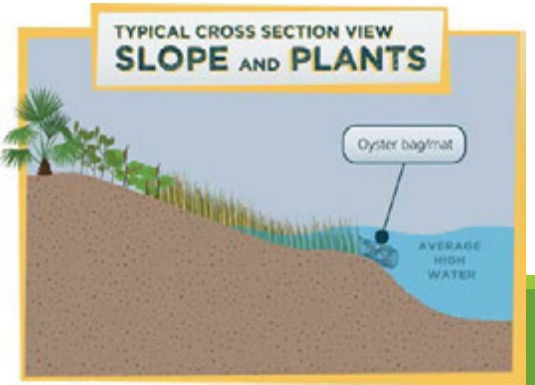


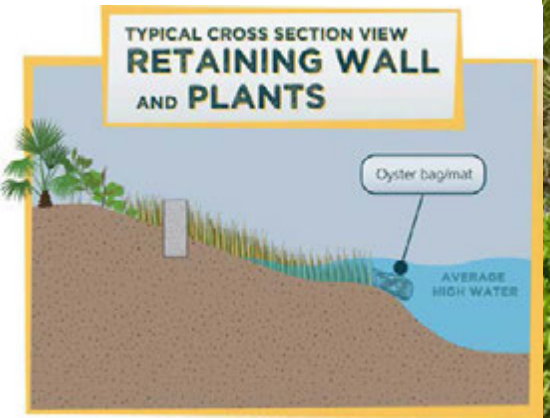


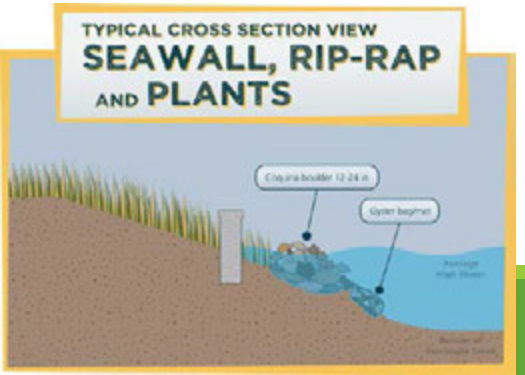




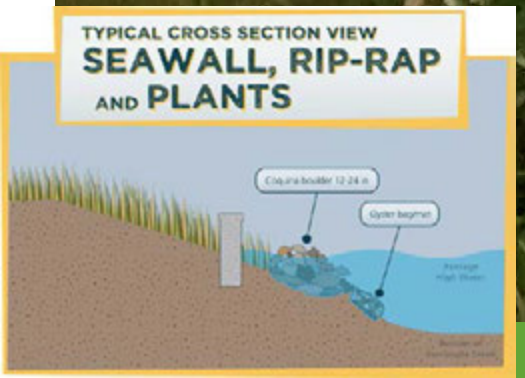



TYPICAL CROSS SECTION VIEW
SLOPE AND PLANTS
Oyster bag/mat
AVERAGE
HIGH
WATER


TYPICAL CROSS SECTION VIEW
RETAINING WALL
AND PLANTS
Oyster bag/mat
AVERAGE
HIGH WATER



Courtesy J. Beal, FWC


TYPICAL CROSS SECTION VIEW
SEAWALL, RIP-RAP
AND PLANTS
Oyster bagmat

TYPICAL CROSS SECTION VIEW
RIP-RAP AND PLANTS
Cocuina boulder 12-24 in
Oyster bagmat

What can *Living Shorelines* do for you?

Bank stabilization & erosion control (property loss)

Habitat enhancement

Maintains coastal processes

Reduce storm water flow into receiving waters

Beautify shorelines

Improve water quality

But wait, there’s more!

1 mile of salt marsh stores C = 76,000 gallons of gas/yr

Naturally adapt to climate change

- Marshes and oyster reefs have been shown to grow faster than SLR
- Provide buffer from storm surge

Recreational opportunities

Increase biodiversity

Reduce wave energy along the shoreline - 15’ can absorb 50% of incoming wave energy

Online Resources:

Florida Living Shorelines

www.FloridaLivingShorelines.com

Print resources, permitting info,
regional contacts, example projects, diagrams

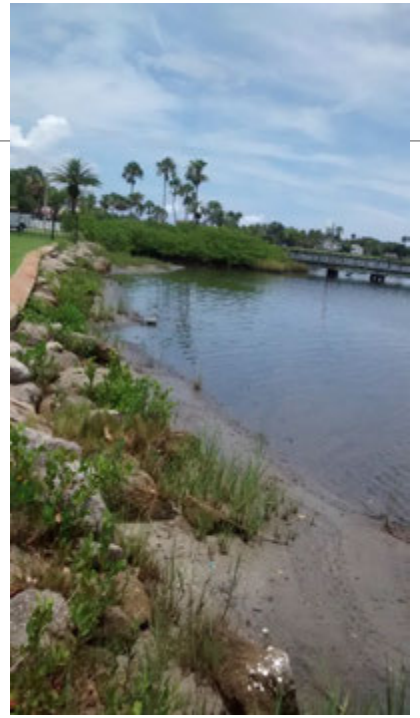
Living Shorelines Academy

www.LivingShorelinesAcademy.org

Modules, training, and certification for
property owners and professionals

Are there some good examples in Volusia County?

Along Riverside Dr., NSB



Manatee Island Park,
Daytona Beach

Seminole Rest, Oak Hill

Sleepy Hollow, NSB

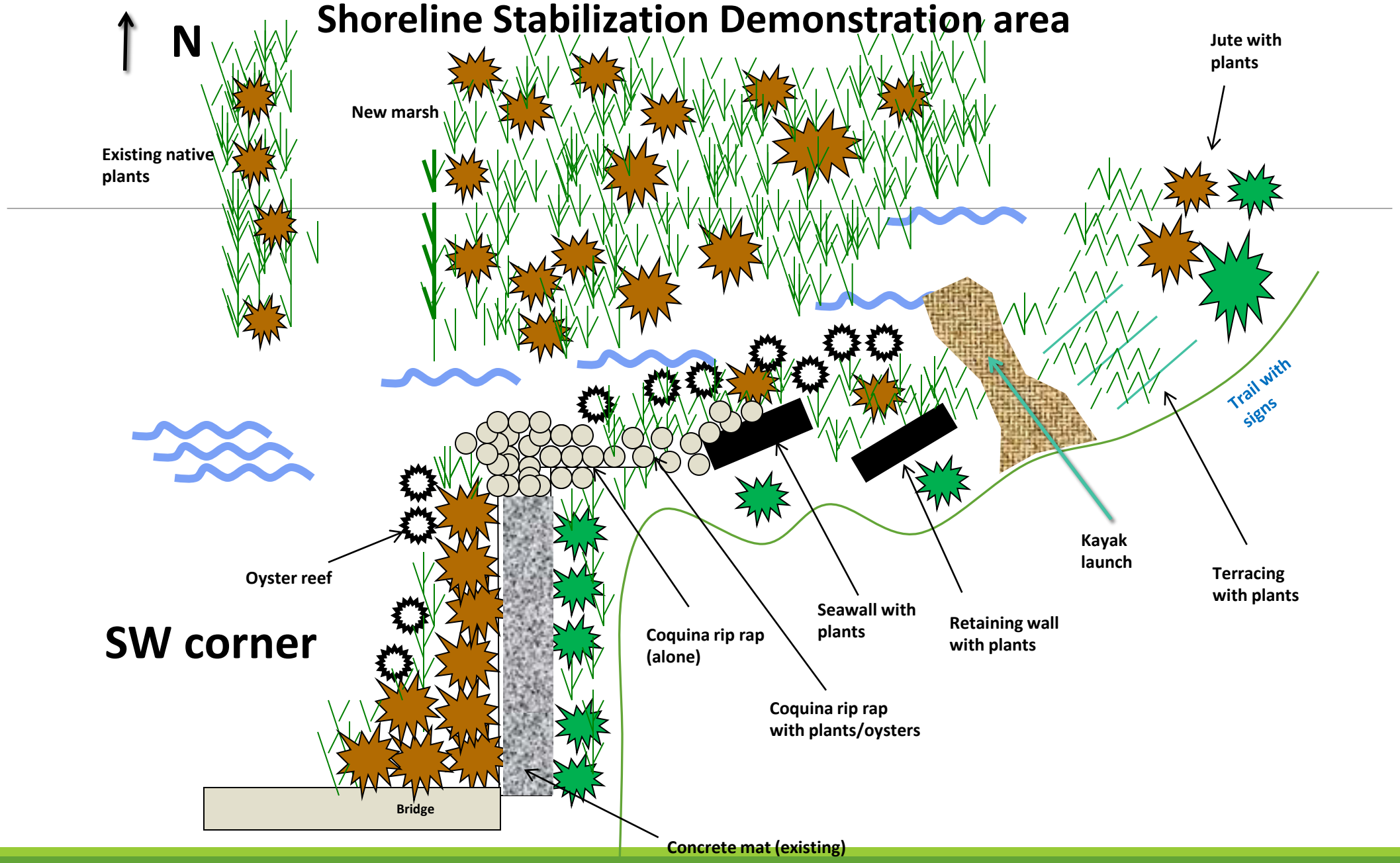
Florida's Marine Fisheries Enhancement Initiative:

Mosquito Lagoon Marine Enhancement Center

Marine Discovery Center, 520 Barracuda Blvd., New Smyrna Beach

Photo: J. Kahn, Presslaunch

Shoreline Stabilization Demonstration area



Courtesy J. Beal, FWC

What can I do?

Develop shoreline management plans that involve *Living Shorelines*

(We can help!!)

Install *Living Shorelines* on public lands

(We can help!!)

Support *Living Shorelines* projects in the region

(Help us!! – ideas, funding, and materials)

Support *Living Shorelines* workshops and help publicize

(Help us!! – fill in gaps for builders and private citizens)

Thank you!

Annie Roddenberry
Aquatic Habitat Conservation and Restoration
Florida Fish and Wildlife Conservation Commission
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386.428.4828

Stormwater Management as a Community Asset

James L. Sipes

"...this isn't rocket science. The idea is to slow down water and direct it where it causes the least amount of damage and where it can be

used in the most beneficial way."

Jim Sipes

Sustainable Solutions for Water Resources (2010)

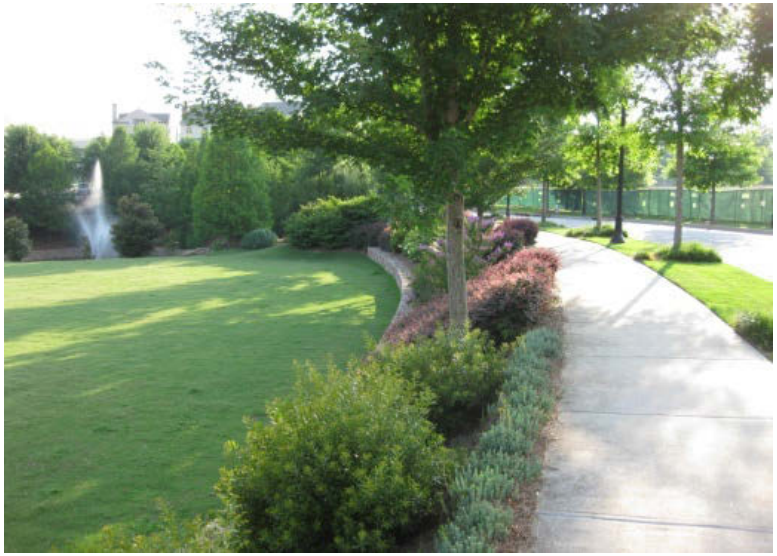
LA River

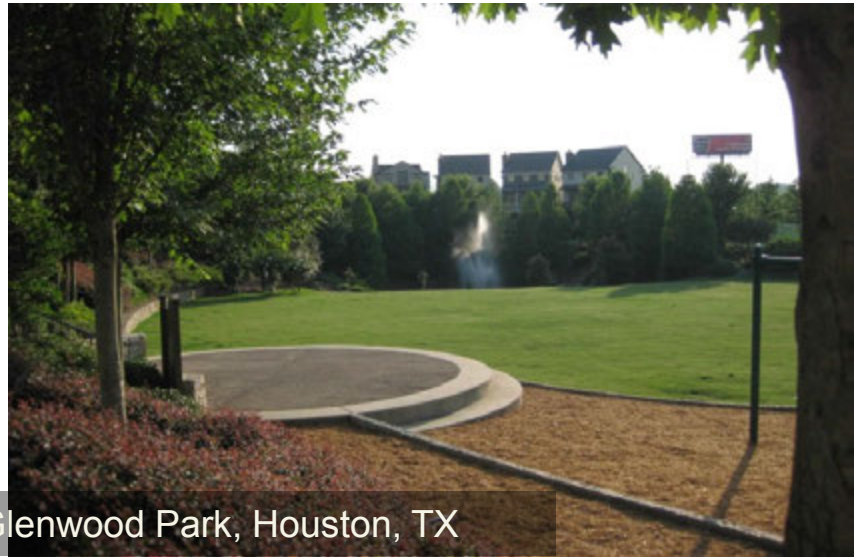
LA River

Detention Basins

Detention Basins

Detention Basins



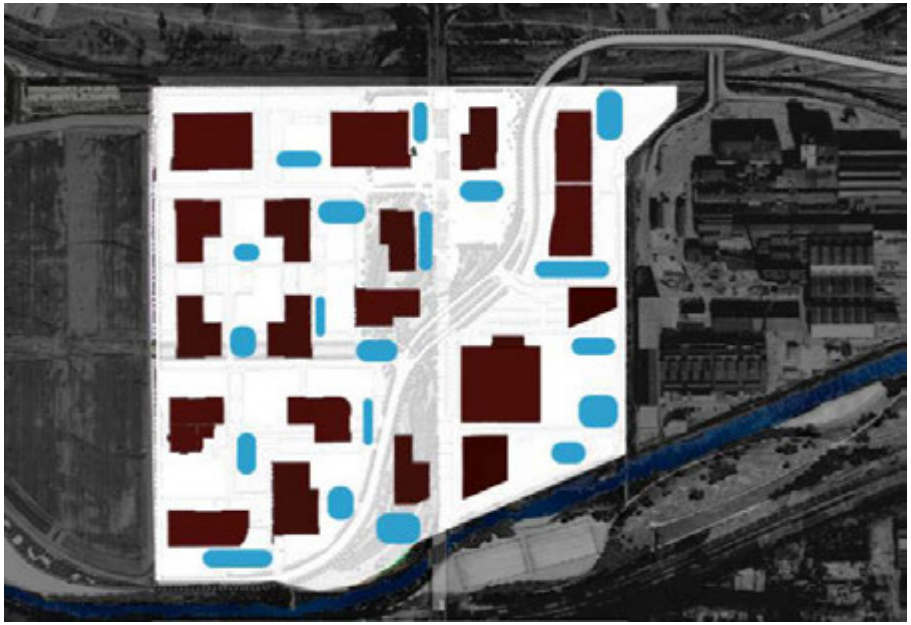


Glenwood Park, Houston, TX

Manassas Park Elementary School Outdoor Classroom

Royal Park Wetland, Melbourne, Australia

Royal Park Wetland, Melbourne, Australia



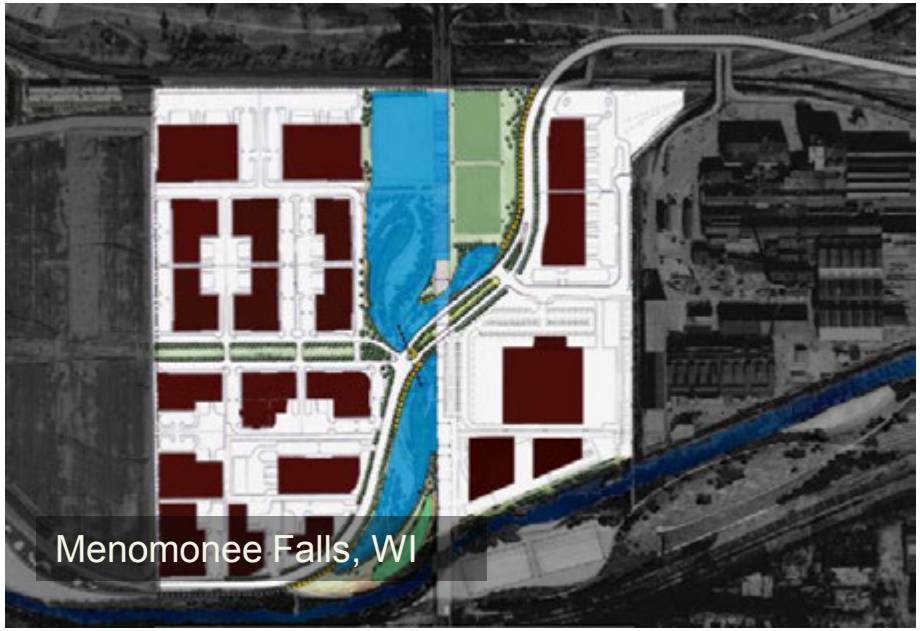
A TRADITIONAL RESPONSE

Piped System = Higher Infrastructure Costs

Individually Planned Sites = Unorganized and Auto-Oriented

Traditional Ponds and Storm BMP's =
Lower Development Yield and "unusable spaces

No park or open space amenity



STORMWATER PARK-
A MULTIFUNCTIONAL APPROACH

Surface System = Limited Subsurface Pipe

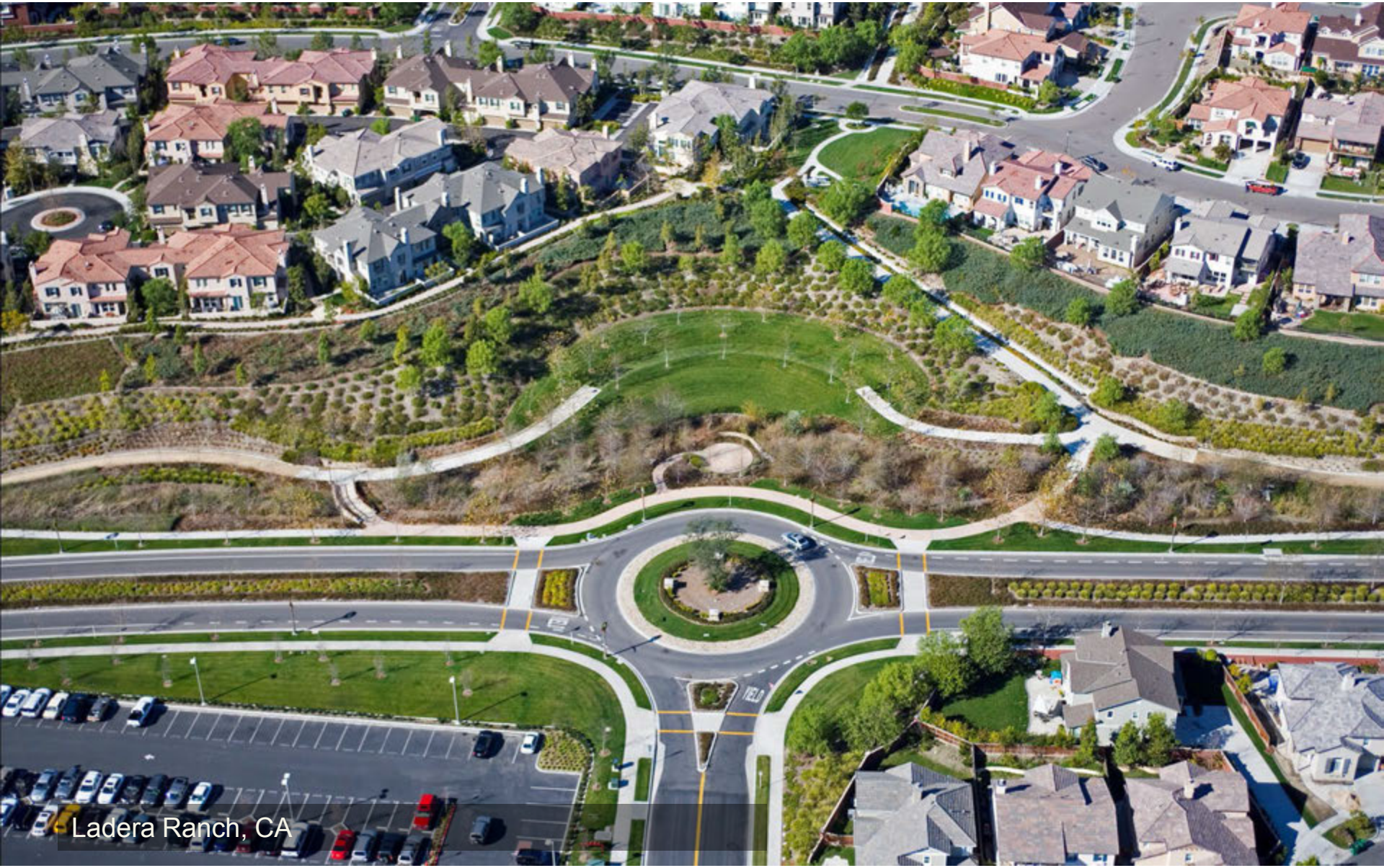
Denser Developments= Walkable Environment

No "wasted" space for Stormwater Management=
Higher Development Yield for Property Owners

Park creates an attractive amenity for neighborhood

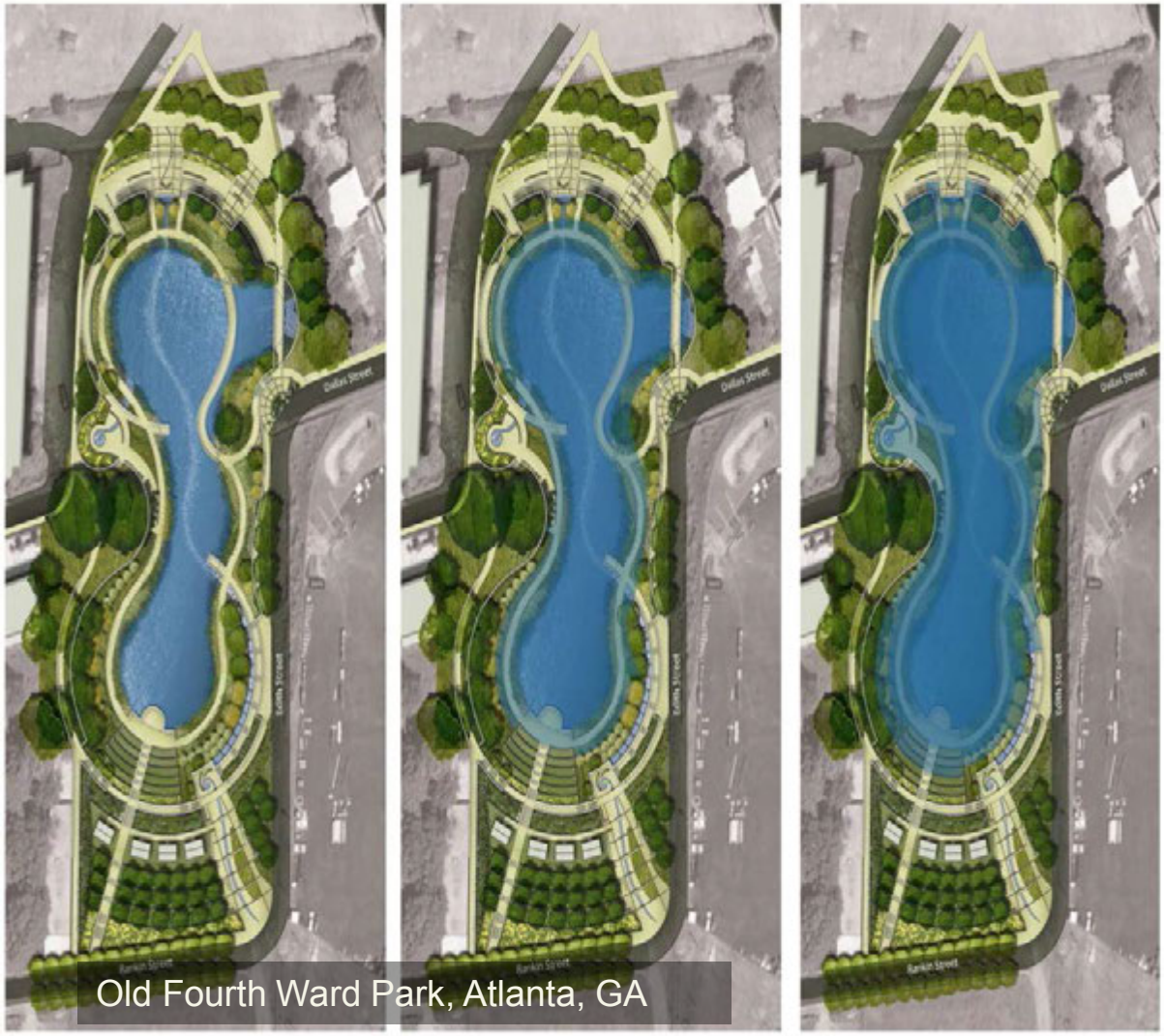
Menomonee Falls, WI

Menomonee Falls, WI

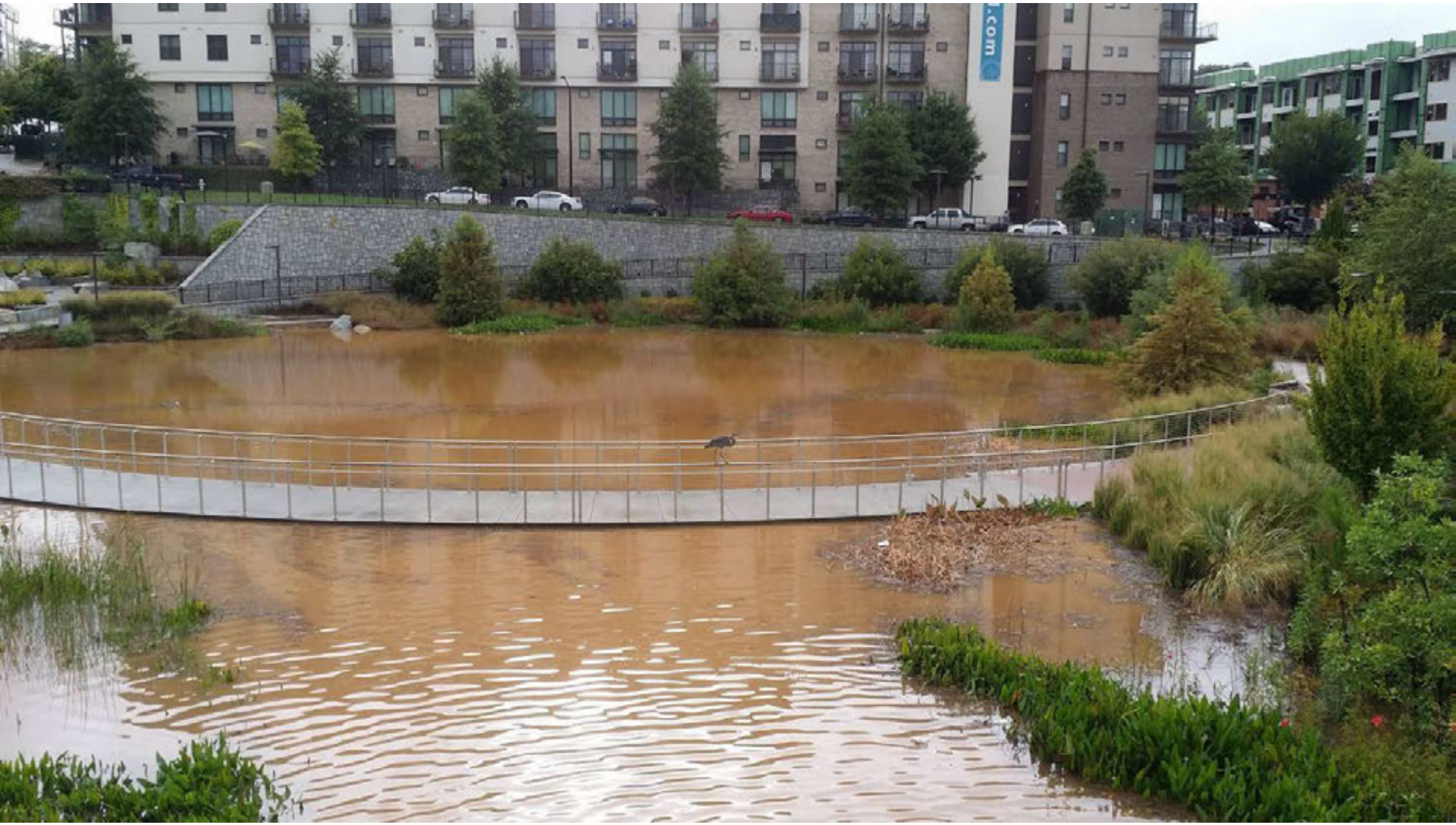

Ladera Ranch, CA

Old Fourth Ward Park, Atlanta, GA

NORTH AVENUE
MORGAN STREET
DALTON STREET
BOWEN STREET
DREW STREET
DALTON ROAD
DREW STREET EXTENSION
SOUTHERN RAILWAY
BUILDING
PARKING
BUILDING
bioswale
entry court
bouldering area
sunken garden
picnic area
flexible play lawn
playground
splash pad
sculpted hills
garden rooms
artifact plaza
event lawn
grand entry
overlook
main pathway
open meadow
amphitheater
rain garden
overlook
open lawn
multi-use field
skatepark



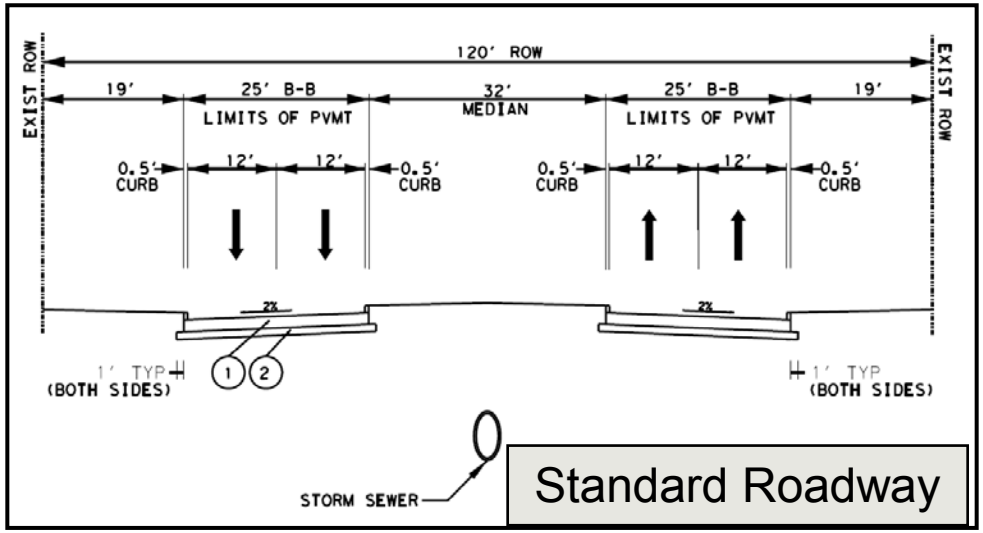
Old Fourth Ward Park, Atlanta, GA



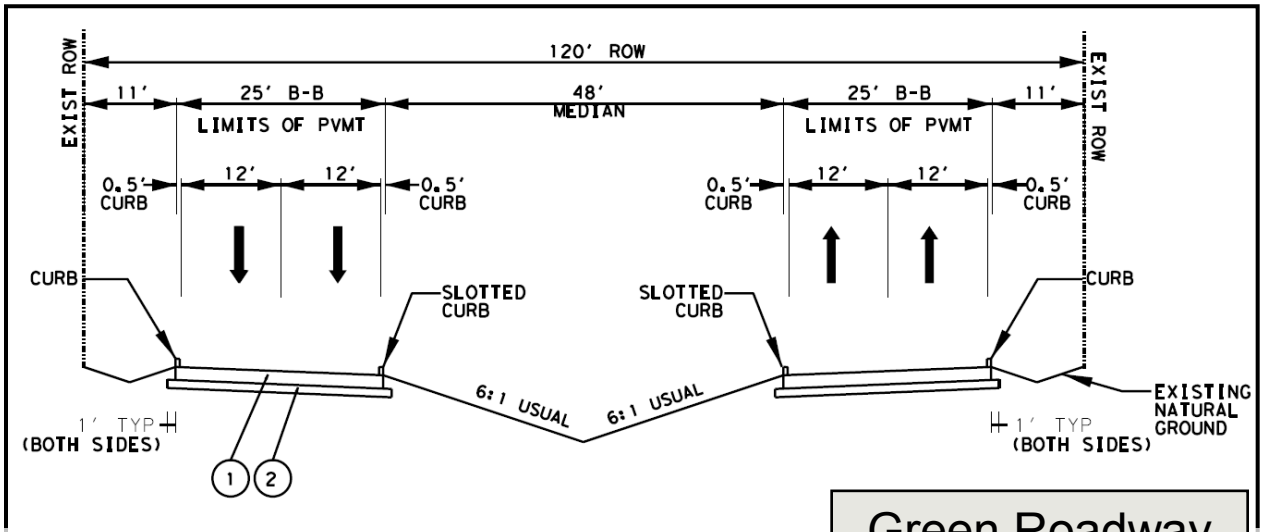
Old Fourth Ward Park, Atlanta, GA

Old Fourth Ward Park, Atlanta, GA

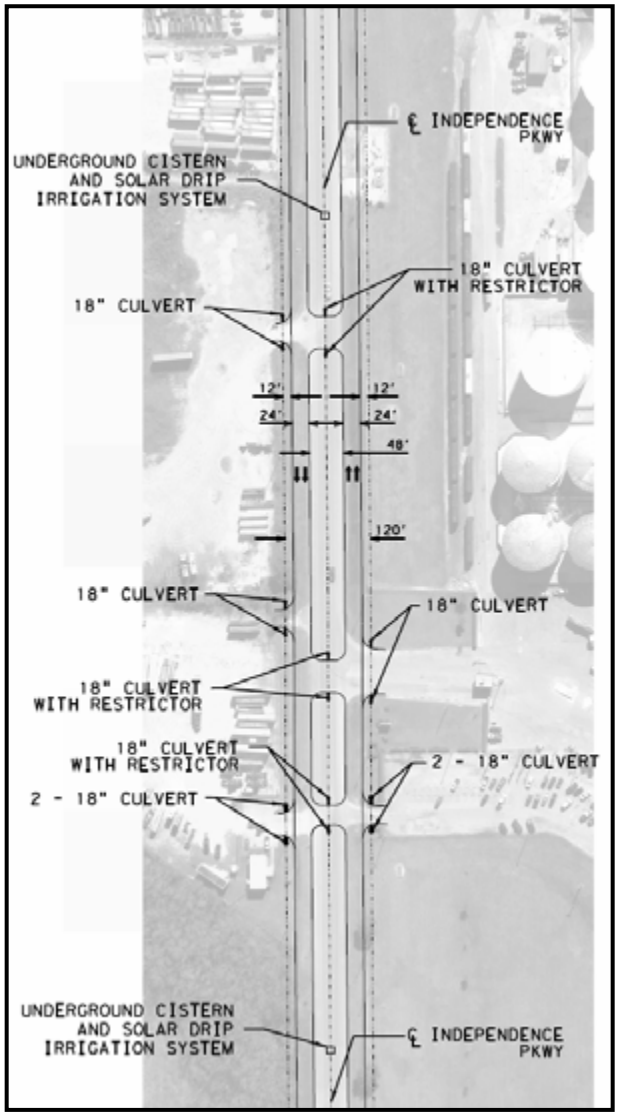
Houston LID Green Road Competition

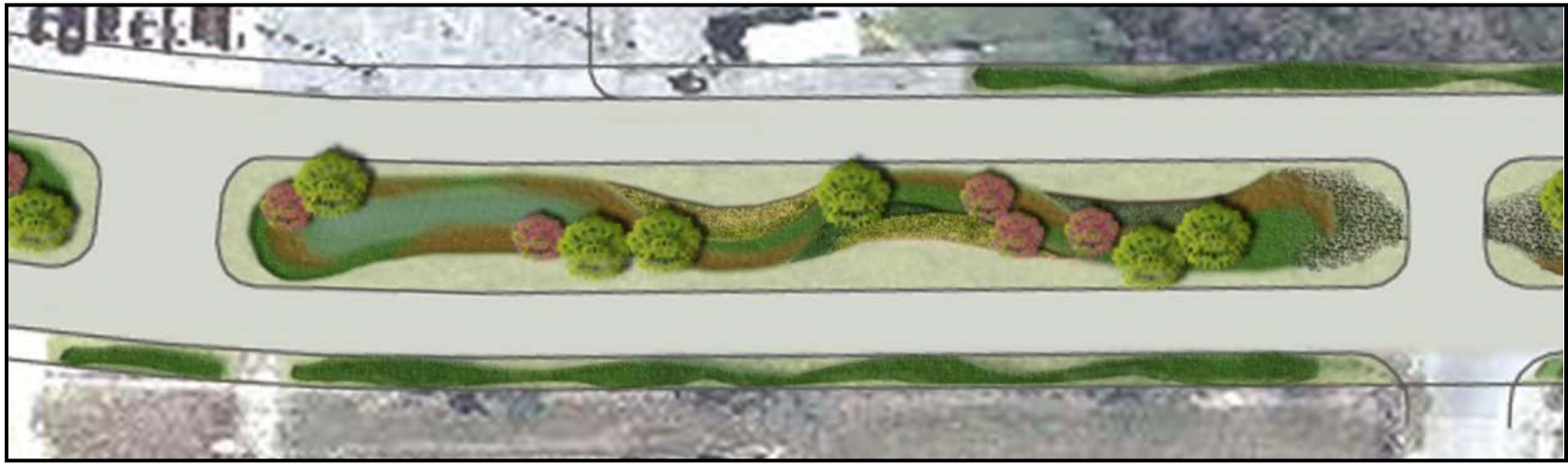


Standard Roadway



Green Roadway





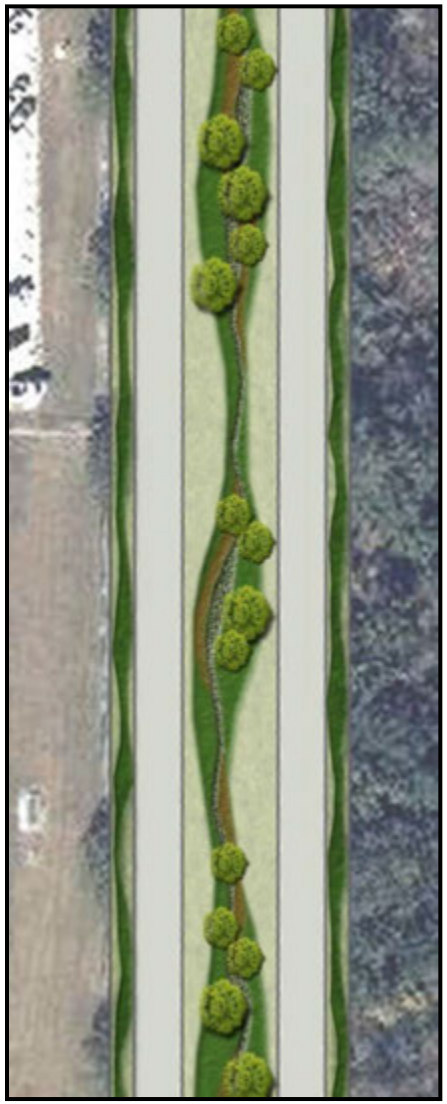
BIOSWALE SHOULDER
PAVED ROAD
BIOSWALE WITH RAIN HARVESTING GARDEN
PAVED ROAD
BIOSWALE SHOULDER
BIOMASS HARVESTING AREA

Shows significant reductions in highway runoff pollutants

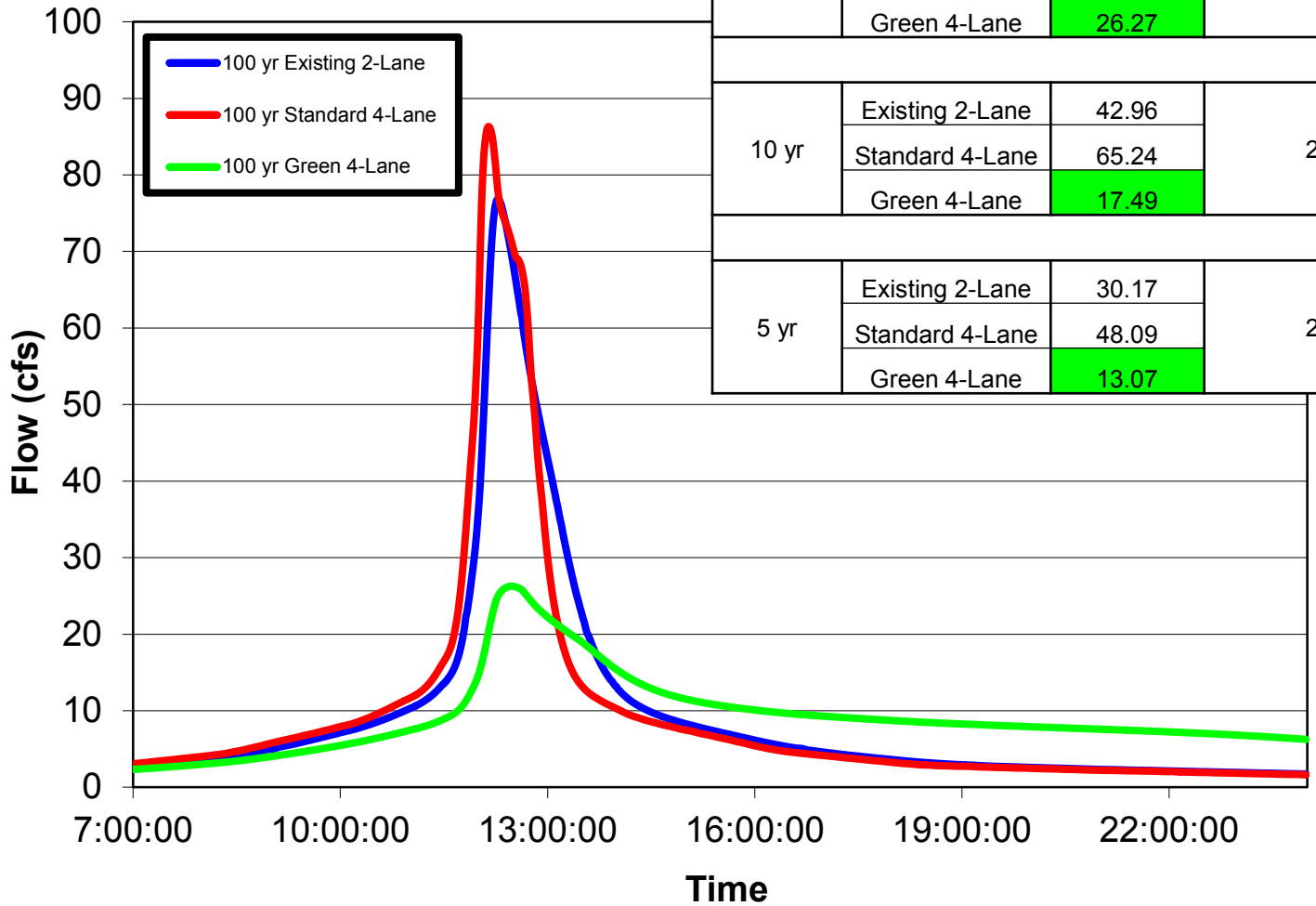
- Predicted 84% TSS removal
- Predicted 68% metals removal
- Predicted 30% pathogen removal

FIRST FLUSH

Ability to treat first 1" of storm water runoff

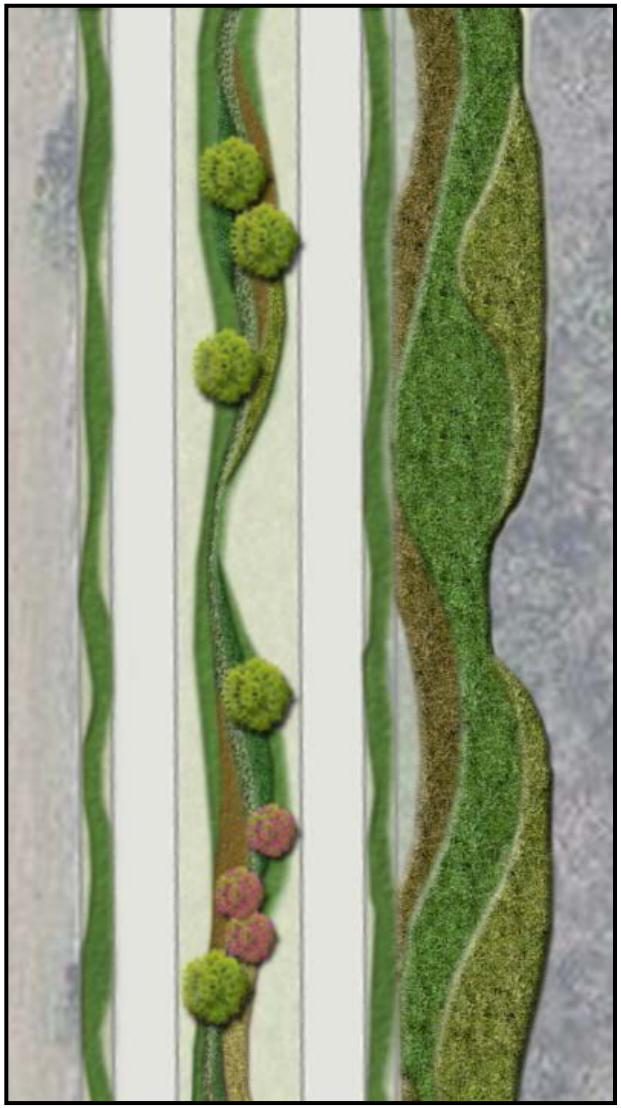


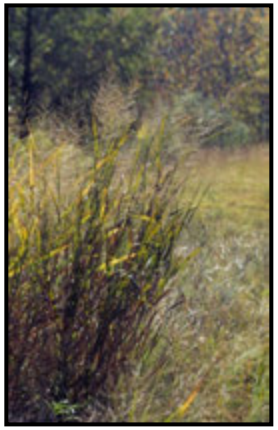
Design Event	Scenario	Peak Discharge	Green vs. Standard Percentage of Peak	Green vs. Existing Percentage of Peak
100 yr	Existing 2-Lane	76.87	30.4%	34.2%
	Standard 4-Lane	86.32		
	Green 4-Lane	26.27		
10 yr	Existing 2-Lane	42.96	26.8%	40.7%
	Standard 4-Lane	65.24		
	Green 4-Lane	17.49		
5 yr	Existing 2-Lane	30.17	27.2%	43.3%
	Standard 4-Lane	48.09		
	Green 4-Lane	13.07		

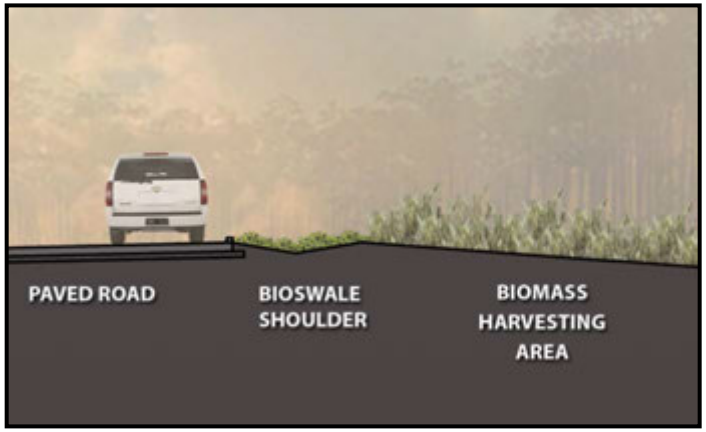


100 Yr. flood is contained inside the median with no roadway flooding

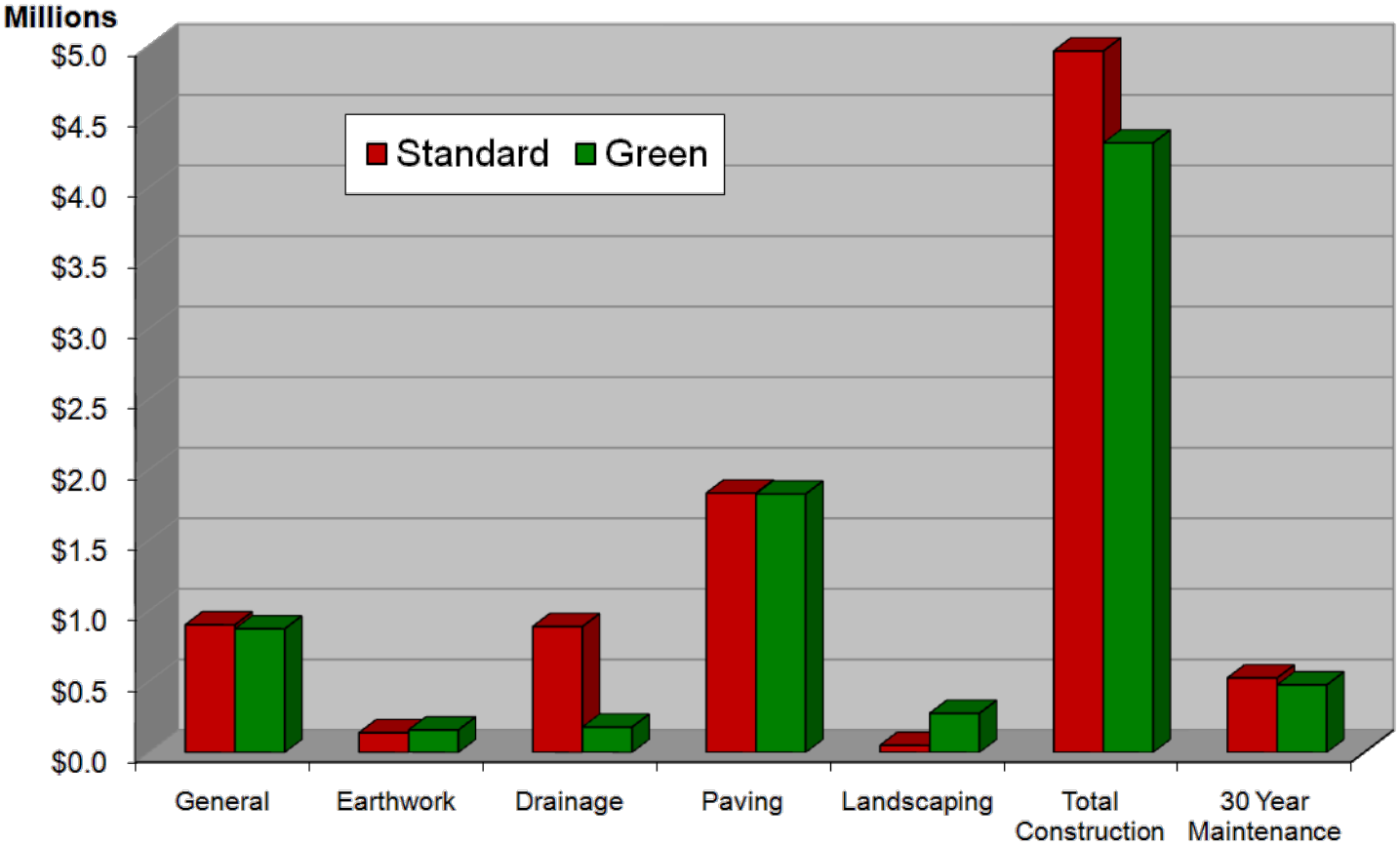
BIO-HARVESTING IN THE ROW







COST OVERVIEW



13% Reduction in Construction Cost

Standard / Mile: $4.97 Million

Green / Mile: $4.32 Million

9% Reduction in Maintenance Cost

Cost estimates prepared for both scenarios, with identical unit costs, to facilitate honest cost comparison

Lasalle (FL) Bioswale

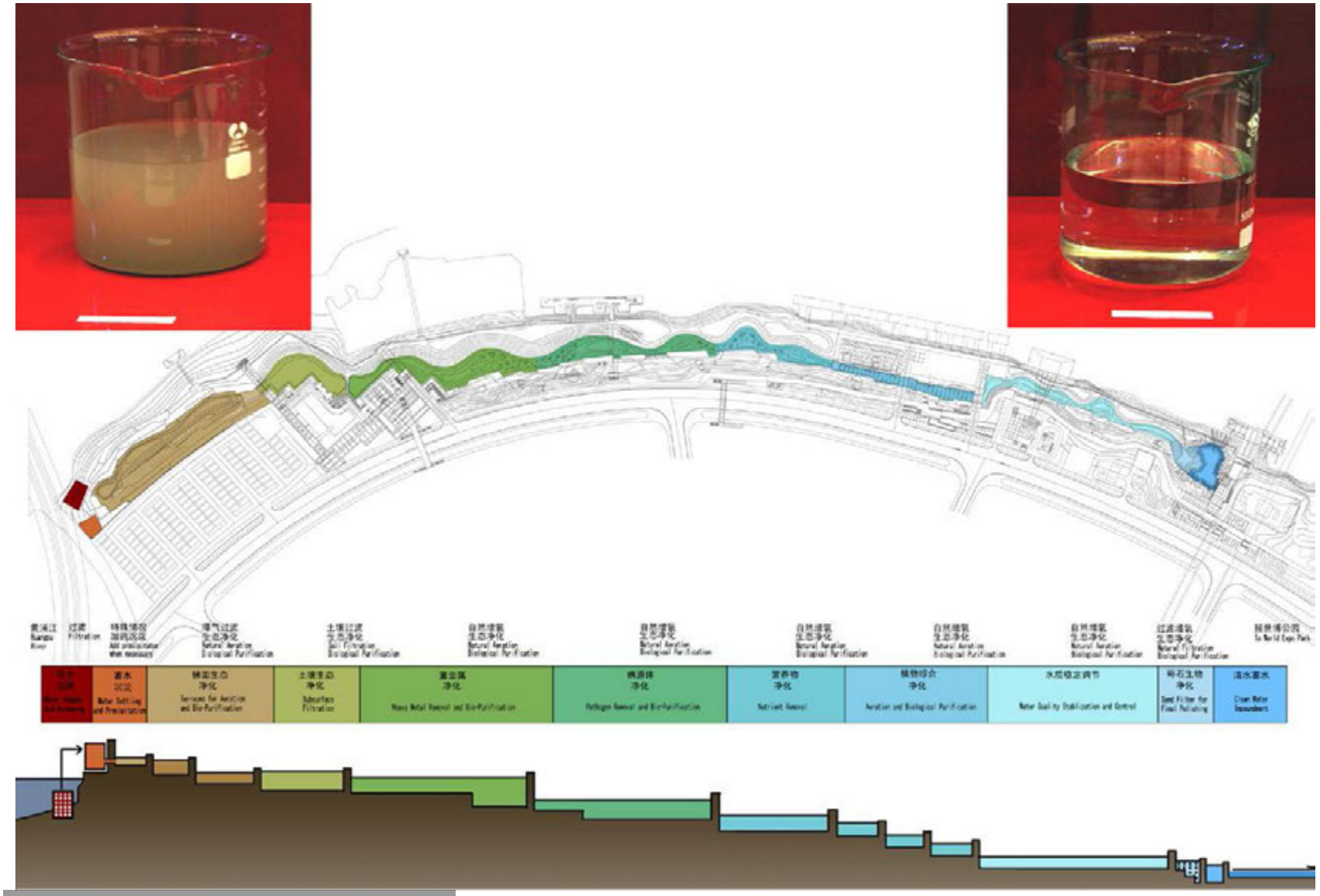
1. When it rains, stormwater runs off roofs, sidewalks, and roads.
2. Stormwater washes pollutants like oil, fertilizers, and pesticides into gutters and storm drains.
3. Instead of going directly into storm drains, stormwater is diverted into the bioswale.
4. Storm drains often carry untreated stormwater straight to the river.
5. The use of native plants and trees in the bioswale helps slow down the stormwater, start the filtration process, and reduces the need for irrigation, fertilizer, and pesticides.
6. Plant and tree roots and soil microbes help clean the water.
7. Detained water also filters through the soil, helping to recharge the groundwater.
8. Water table

The use of native plants and trees also creates important habitat for wildlife.

The Oregon Garden, Silverton, OR

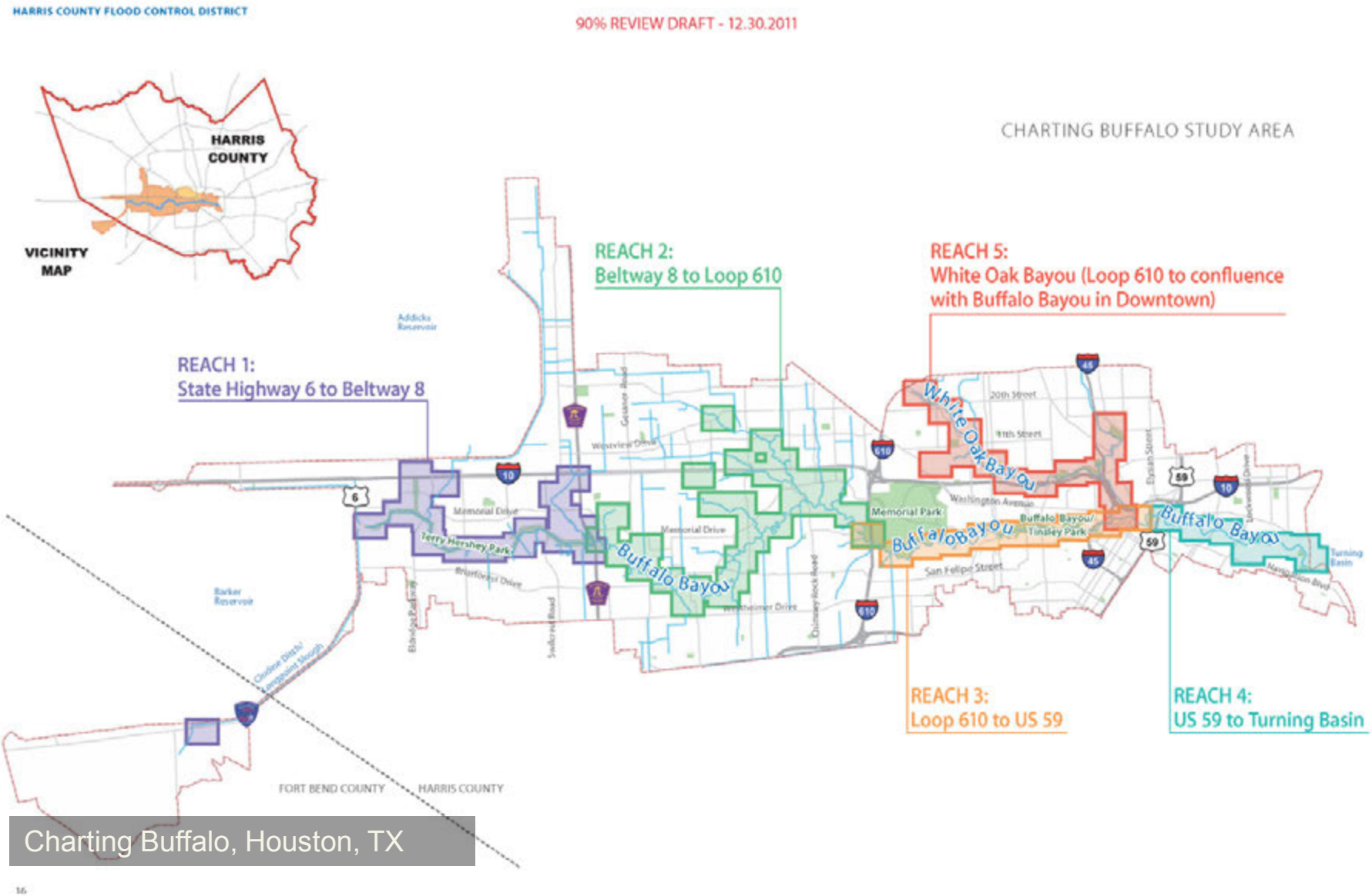
The Oregon Garden, Silverton, OR

Hounan Park, Shanghai, China



Hounan Park, Shanghai, China

Charting Buffalo, Houston, TX



Charting Buffalo, Houston, TX

HARRIS COUNTY FLOOD CONTROL DISTRICT

DRAFT - JANUARY 2012

Flood Damage Reduction Options Map

BUFFALO BAYOU

Description of Potential Options: A potential stormwater detention site on Turkey Creek, and on City of Houston property, is depicted as options in lieu of constructing basins in the HCFCD right-of-way. This option may take priority if environmental surveys limit the ability to use the HCFCD property or if community values suggest an alternative configuration. Langham Creek is the outfall channel for Addicks Reservoir.

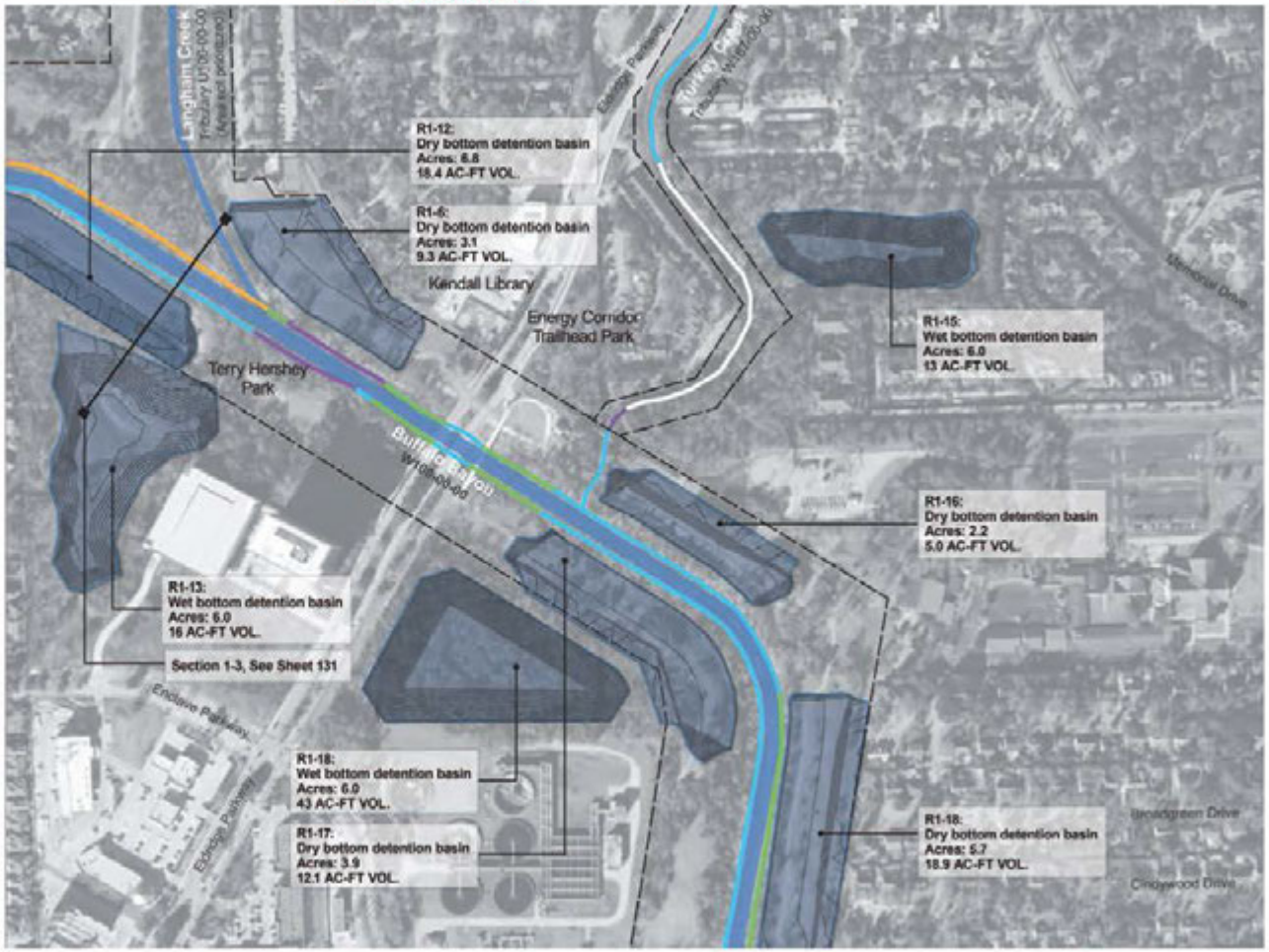
Erosion rates are generally moderate to high, with very few areas of extreme erosion. There is good construction access, good visibility, and potential habitat improvement and cultural resource protection in selected areas, thus the prioritization categories are primarily Medium and High, with some areas of Low and Very High.

Benefits of Potential Options: The total storage volume of basins located in HCFCD right-of-way between State Highway 6 and Eldridge could be 68 acre-feet, with an average 1% WSEL reduction up to 2.7 feet. As many as three structures on W167-00-00 could benefit from a flood damage reduction project in this tributary.

STATE HIGHWAY 6 *to* BELTWAY 8

3a *of* 74

AERIAL DATE: 2010



EXISTING

STREAMBANK PRIORITIZATION CATEGORIES

Prioritization Level

- Extreme
- Very High
- High
- Medium
- Low
- Very Low

RIGHT-OF-WAY (ROW)

- Approximate HCFCD ROW

POTENTIAL

FLOOD DAMAGE REDUCTION OPTIONS

- Detention Basin

Charting Buffalo, Houston, TX

DRAFT - JANUARY 2012

Charting Buffalo, Houston, TX

Community Enhancement Opportunities Map

BUFFALO BAYOU

There are existing trails within Terry Hershey Park on both sides of the bayou. The existing boat launch on Langham Creek could be expanded into a major trailhead. A potential trail could link to a minor trailhead along Enclave Parkway and potential trails along Turkey Creek could improve access. Undeveloped land to the east of Turkey Creek could be developed into a nature park. The areas marked for revegetation could involve selective reforestation based upon the quality and health of existing species. Removal of invasive species and landscaping with native plants in selected areas along both sides of the bayou could improve the visual quality of the park and help create a more ecologically sustainable environment.

Detention basins along both sides of the bayou are intended to be integrated into the existing park in such a way as to consider existing natural resources and enhance visual quality. An existing detention basin between the bayou and Enclave Parkway could be expanded as part of a public/private partnership. Potential detention basins at Eldridge Parkway and along Turkey Creek could also increase flood storage volume. A bioretention area is suggested along the south bank where Eldridge Parkway crosses the bayou.

STATE HIGHWAY 6 to BELTWAY 8

3b of 74

AERIAL DATE: 2010

0 100 300

SCALE: 1" = 300'

N

103

Charting Buffalo, Houston, TX

Charting Buffalo, Houston, TX

GOAL

"...this isn't rocket science. The idea is to slow down water and direct it where it causes the least amount of damage and where it can be **used in the most beneficial way. This is how we create community assets.**"

Jim Sipes

Sustainable Solutions for Water Resources (2010)

Ecosystem Services & Heritage Green

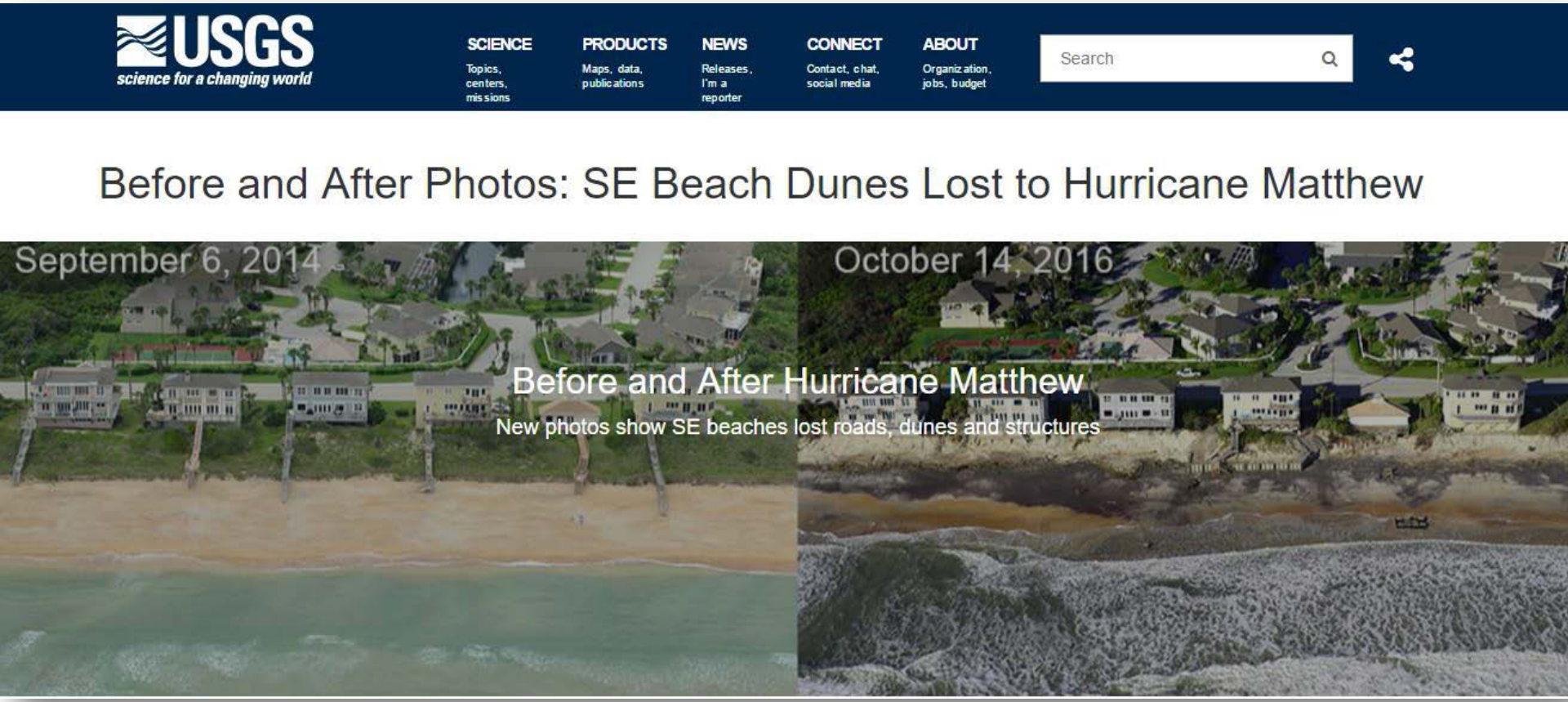
Jennison Kipp Searcy & Lynn Jarrett

NOAA Green Infrastructure for Coastal Resilience Training

November 9, 2016 | Volusia County, FL

UF | IFAS Extension
UNIVERSITY of FLORIDA

Coastal Ecosystem Vulnerability



Vilano Beach, FL

Credit: USGS https://www.usgs.gov/news/and-after-photos-se-beach-dunes-lost-hurricane-matthew

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Water Quality Impairment

DEP News Florida's Environmental News Now

DEP 101 | HOT TOPICS | ARTICLES | DEP RESOURCES | CONTACTS | DEP HOMEPAGE

Springs Restoration Continues with $31.3 Million Investment in Central Florida

OCTOBER 7, 2015 BY FDEPNEWS COMMENTS OFF

Oct. 5, 2015

The Florida Department of Environmental Protection and St. Johns River Florida Water Management District have approved eight springs restoration projects in Marion, Orange, Seminole and Volusia counties. These projects will receive more than $6.9 million in state funding from Governor Rick Scott's 2015-16 "Keep Florida Working" budget. This funding is expected to leverage nearly $24.4 million in matching funds.

These eight selected projects will benefit Silver Springs, Volusia Blue Springs and the springs of the Wekiva River system.

"I would like to thank Governor Scott and the Florida Legislature for providing record funding

Contact DEP Press Office

Depnews@dep.state.fl.us

850.245.2112

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FLDEP News

- It's National #STEMSTEAMday! DEP is committed to educating students about Florida's water, land & air: goo.gl/3A04RI

depnewsroom.wordpress.com/2015/10/07/springs-restoration-continues-with-31-3-million-investment-in-central-florida

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Springs Restoration

A story map

Springs Funding Projects 2015-16

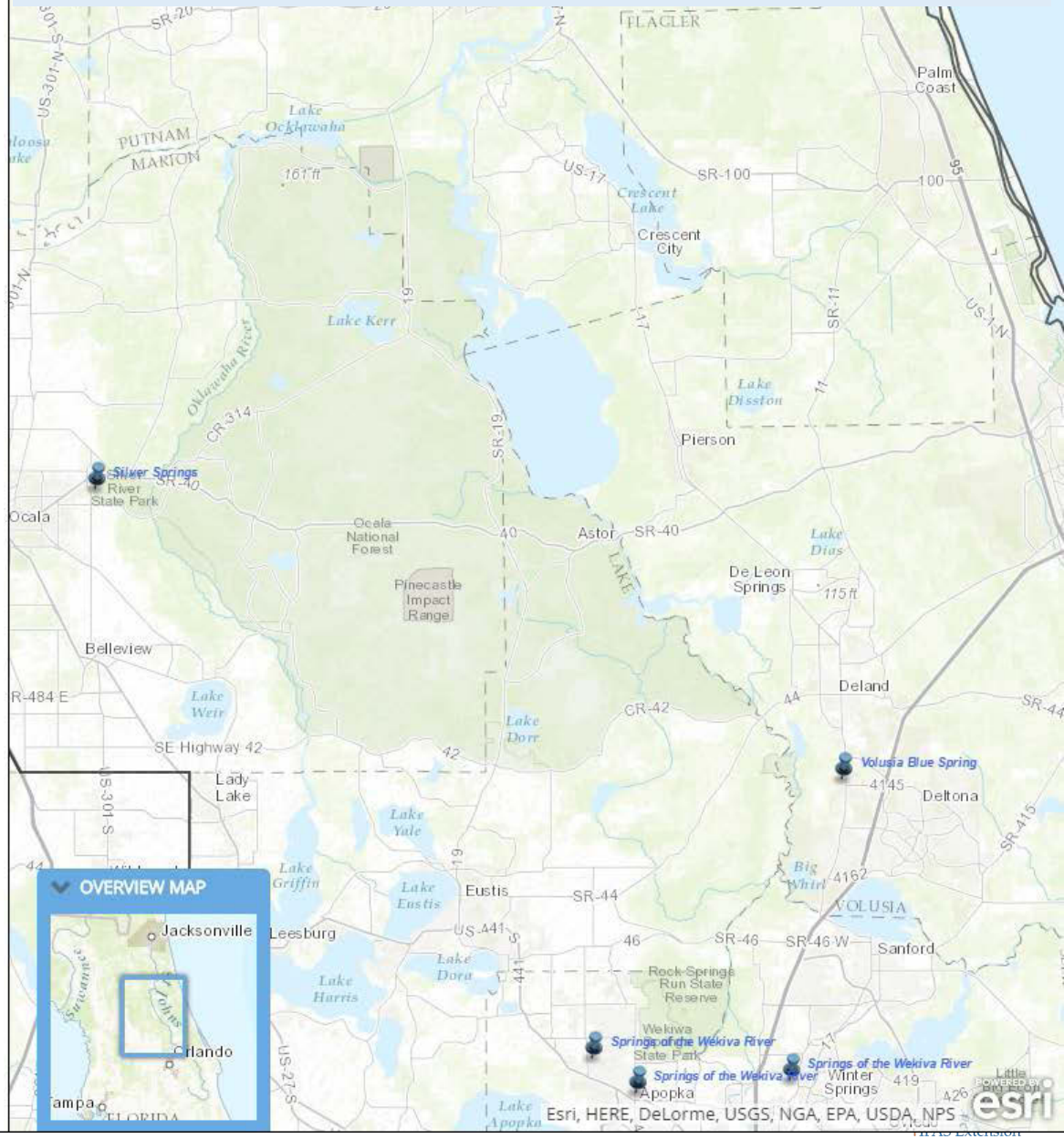
St. Johns River Water Management District: Volusia Blue Spring and Silver Springs

Volusia Blue Spring

Volusia County Advanced Wastewater Treatment

This project will decommission the Four Towns wastewater treatment plant and direct wastewater to the county Southwest Regional Water Reclamation Facility, improving the level of treatment and producing 222,000 gallons per day of reuse. The project also allows for the future removal of 5,200 septic systems, which will result in the reduction of 27,000 lbs/year of total nitrogen and 14,000 lbs/year of total phosphorus in the Blue Spring springshed. The project supports the state's TMDL and BMAP work for Blue Spring as well as the District-approved Volusia MFL Prevention and Recovery Strategy, which will help meet future water demand and improve the ecological health of the Volusia Blue Spring system.

Silver Springs



Windows to Our Water Supply

Photo Credit: John Moran, Springs Eternal Project

I. Ecosystem Services

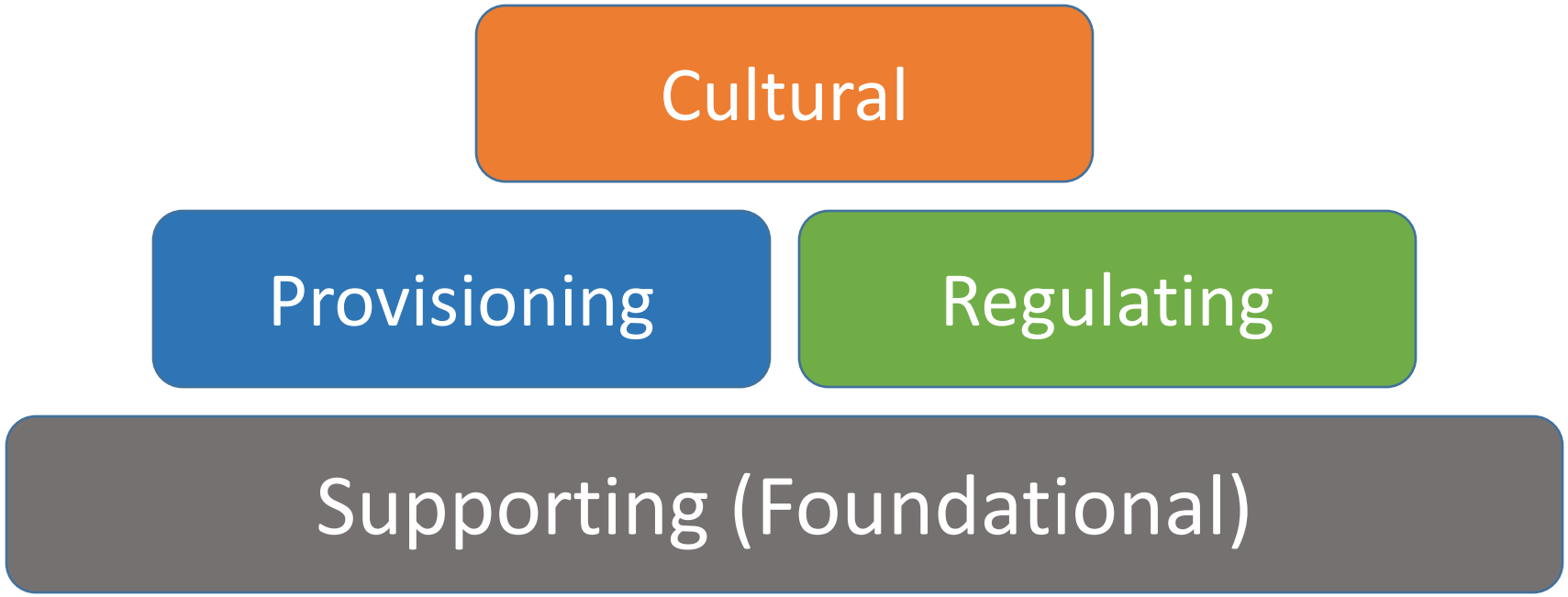
Florida's Natural Capital

What are Ecosystem Services?

"The benefits that <u>people</u> obtain from ecosystems"

(Millenium Ecosystem Assessment, 2005)

- ECOSYSTEM: *"Everything that exists in a particular environment"* (Mirriam Webster Online Dictionary)
- SERVICES: *Consumptive and non-consumptive; direct & indirect*



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Florida's Coastal Ecosystem Services

Services:

- Fisheries production
- Carbon sequestration
- Coastal erosion mitigation & shoreline stabilization
- Tourism & recreation
- Water quality treatment
- Landscape diversity

Natural Communities (Ecosystems):

- Oyster Reefs
- Beach Dunes
- Mangrove Forests
- Seagrass Beds
- Salt Marshes

Source: UF/IFAS EDIS TP-204

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Florida's Changing Coastal Ecosystems

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Florida's Changing Coastal Ecosystems

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Florida's Changing Springs Systems

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Florida's Changing Springs Systems

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Florida's Diverse Wildlife Habitat

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II. Heritage Green

Florida Conservation Subdivision Case Study

Heritage Green Proposed Single-Family Development

- 210 Acres in central Florida
- Rural Transition zone, expected to be annexed to City of Mt Dora
- Currently is undeveloped with wooded and open habitats
- Very well drained sandy soil
- Surrounded by 1 to 5 acre lot residential developments
- Large ‘employment center’ development planned nearby

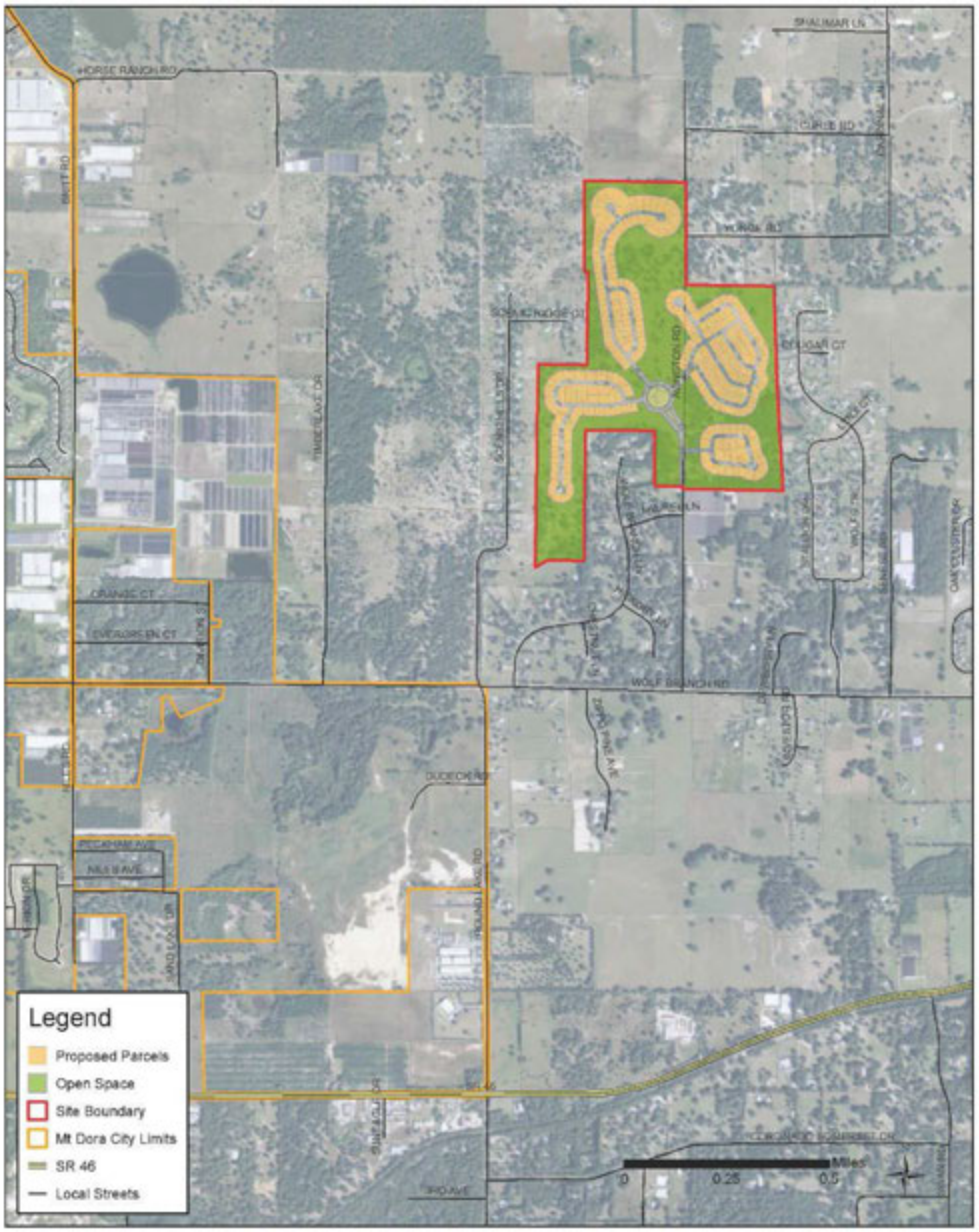

FIGURE 1. HERITAGE GREEN LOCATION MAP

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Rural Transition Development Options

- The County's Comprehensive Land Use Plan allowed residential development under one of three options:
  1. One dwelling unit per five acres, with no requirement for set-aside open space.
  2. One dwelling unit per 3 acres, with a minimum of 35% open space reserved.
  3. One dwelling unit per acre, with a minimum of 50% open space reserved.
- The Heritage Green developer proposed a 4th option:
  4. Two dwelling units per acre, with a minimum of 50% open space reserved.
- PREC was asked to compare the impacts of the proposed plan with Options 1 and 3 (1 DU : 5 ac and 1 DU : 1 ac).

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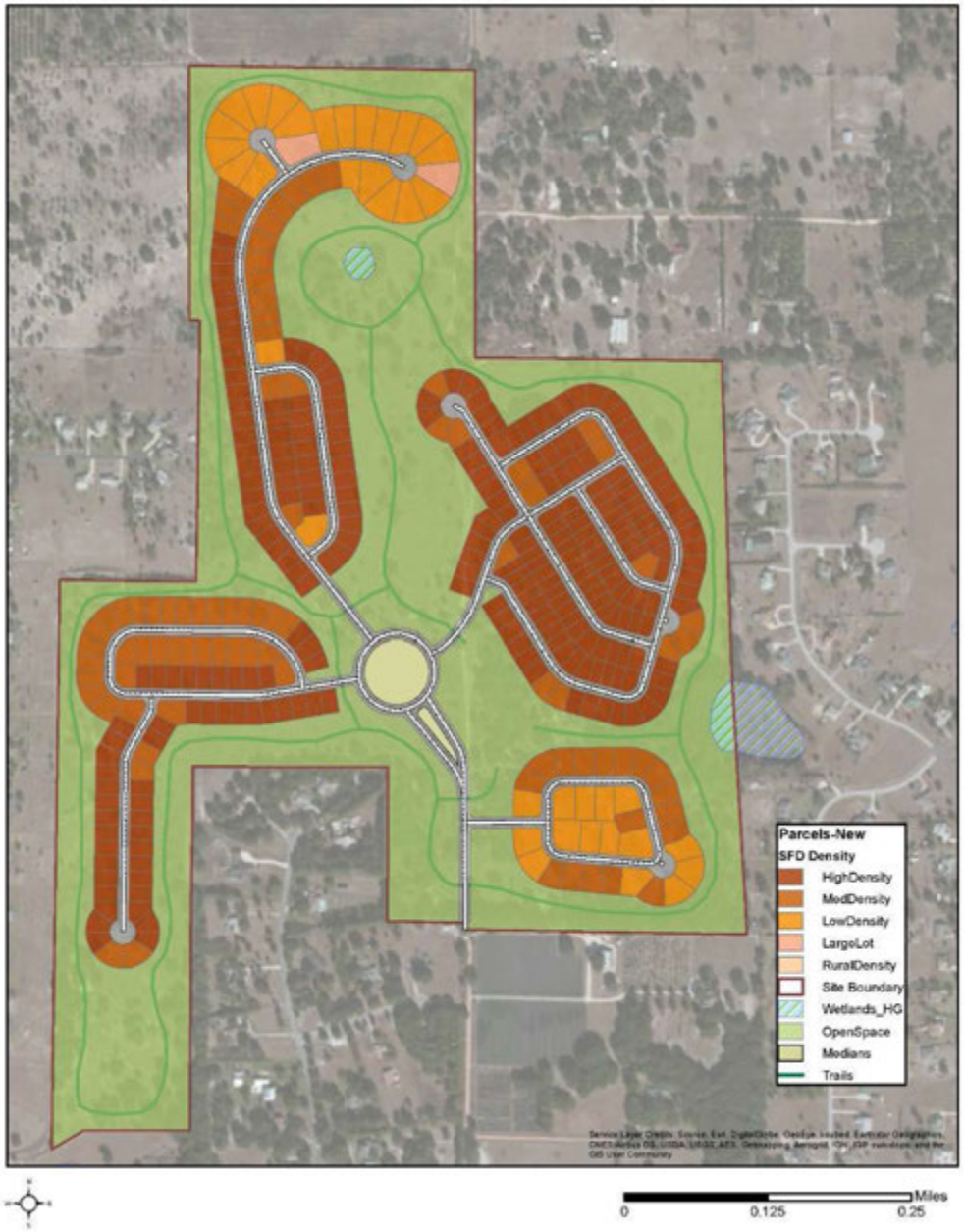
Community-Scale

Heritage Green Conservation Subdivision

Proposed Plan-Scenario A

- 2 DU per acre gross density
- 375 homes
- 50% open space
- Central water & sewer
- LID Stormwater:
  - Rain gardens
  - Roadside vegetated swales
  - No curb & gutter
  - Pervious driveways in most dense areas
- Community amenities:
  - Walking track in natural area
  - Community garden
  - Community pool



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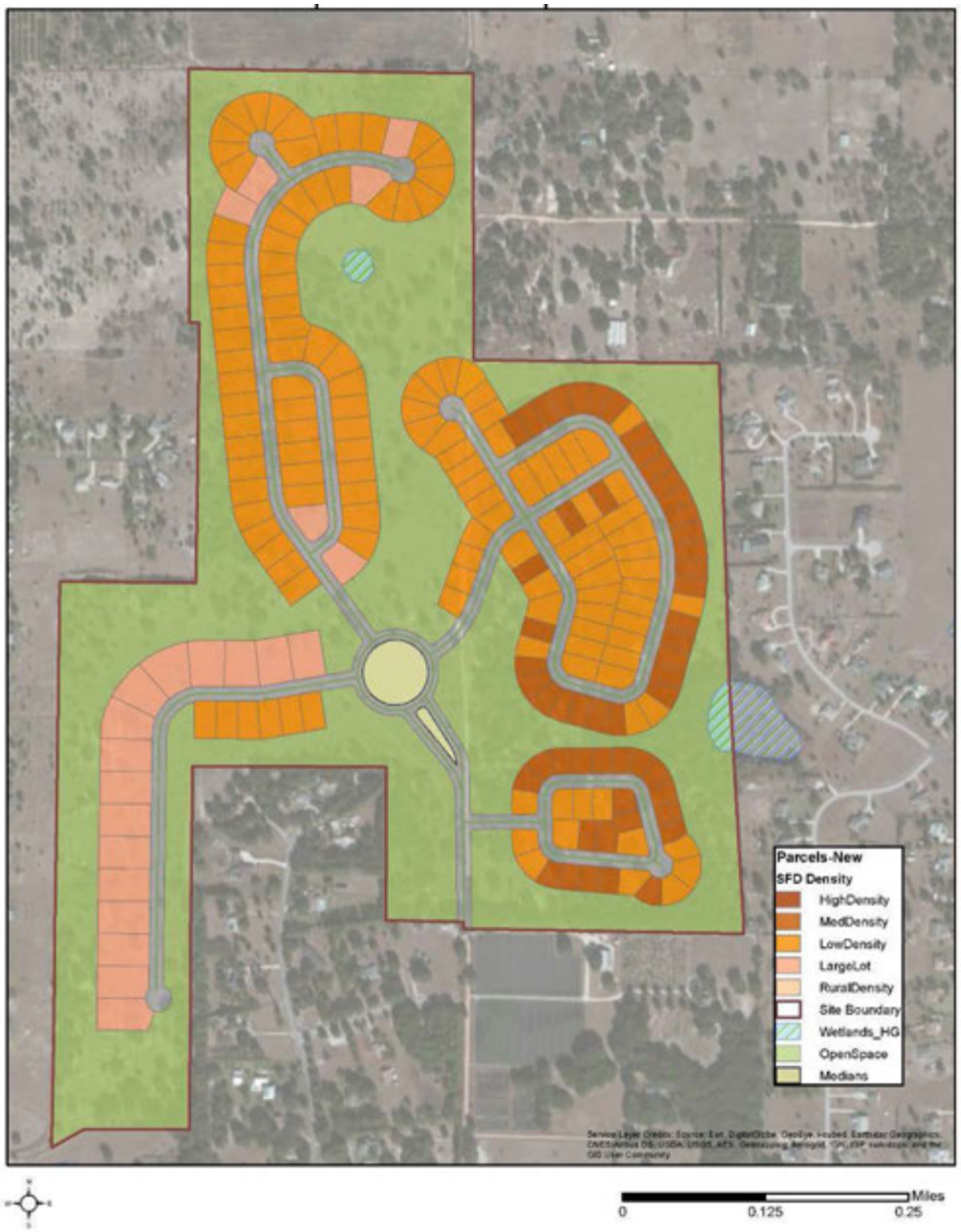
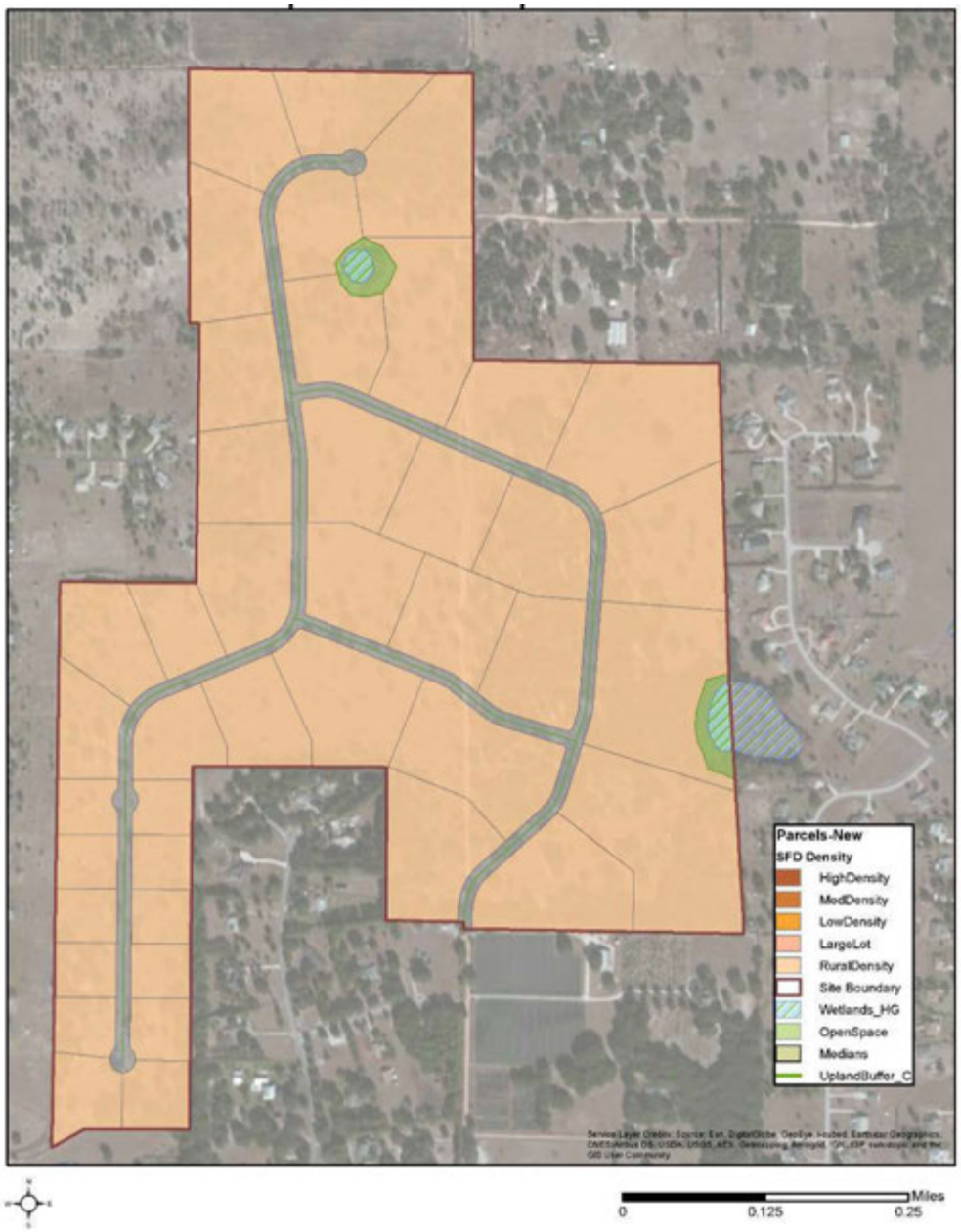
Comparison Plan-Scenario B

- 1 DU per acre gross density
- 207 homes
- 50% open space
- Central water & septic system
- Stormwater:
  - Roadside vegetated swales
  - No curb & gutter
  - Conventional pond SW treatment
- No Community amenities



Comparison Plan-Scenario C

- 1 DU per 5 acre gross density
- 42 homes
- No designated open space (except wetlands)
- Well water & septic system
- LID Stormwater:
  - Roadside vegetated swales
  - No curb & gutter
  - Conventional pond SW treatment
- No Community amenities



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Site-Scale

Heritage Green Conservation Subdivision

Scenario A

Smaller lot sizes
Build vertically
Reduce turf areas
Native landscapes
Shared recreation spaces
Retain natural areas
Minimize impervious areas

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Scenario B

Typical low density suburb; average lot size is 0.5 acre

Single story homes

Large turf areas

Resource intensive landscaping

Retains 50% natural area

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Scenario C

Very low density suburb
Average lot size is 4.7 acres
Mostly single story homes
Large turf areas
Resource intensive landscaping
No designated natural areas

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Key Metrics for Comparison

- Total Water per Household
  - Indoor Water Use
  - Outdoor Water Use
- Impervious area
- Stormwater volume – Annual total
- Nutrient loads from stormwater runoff (fertilizers) and on-site wastewater disposal
  - Nitrogen
  - Phosphorous
- Road and utility lengths
- Cost of infrastructure
  - Roads, water, wastewater, stormwater, and electric and communication services

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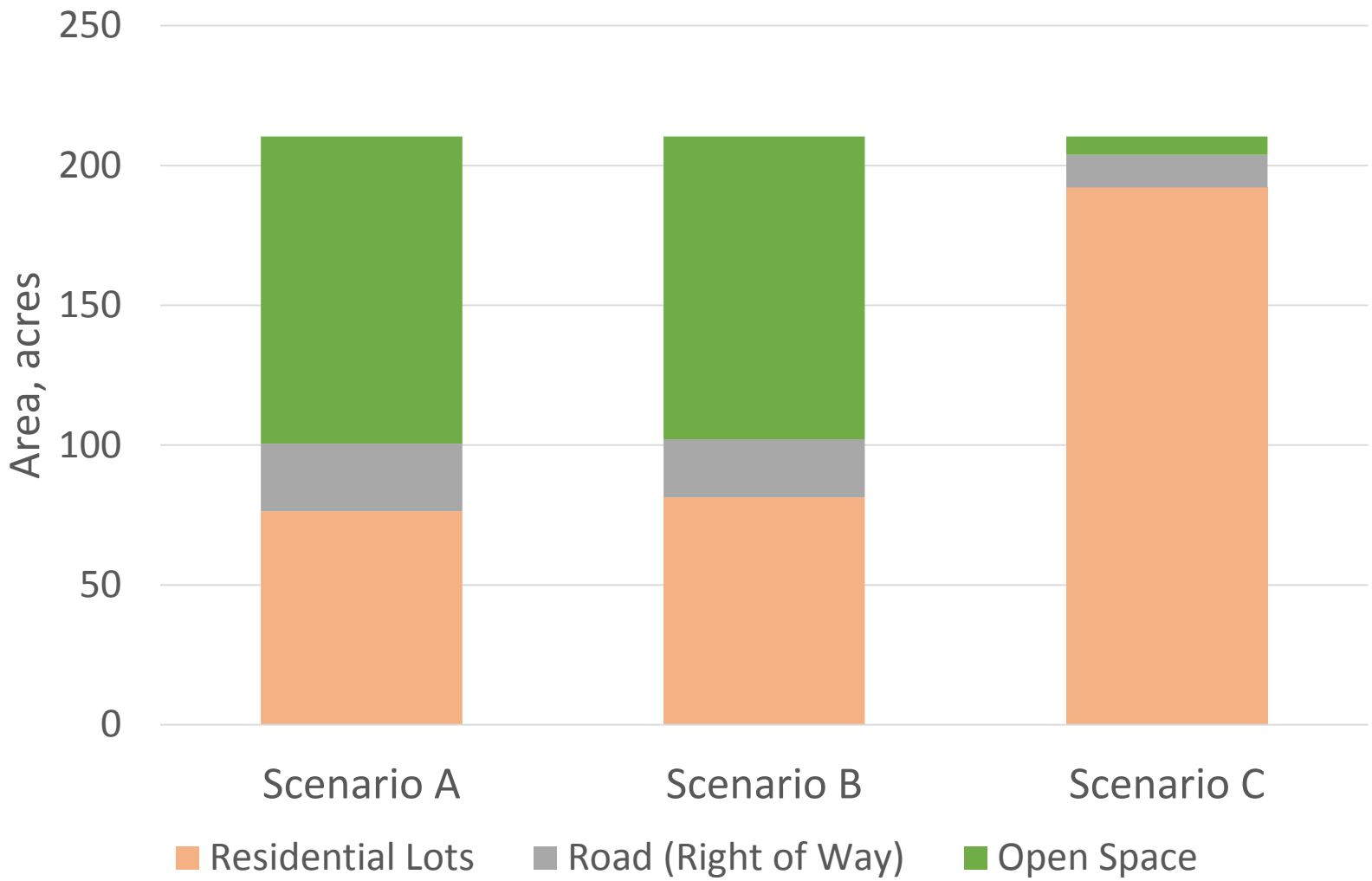
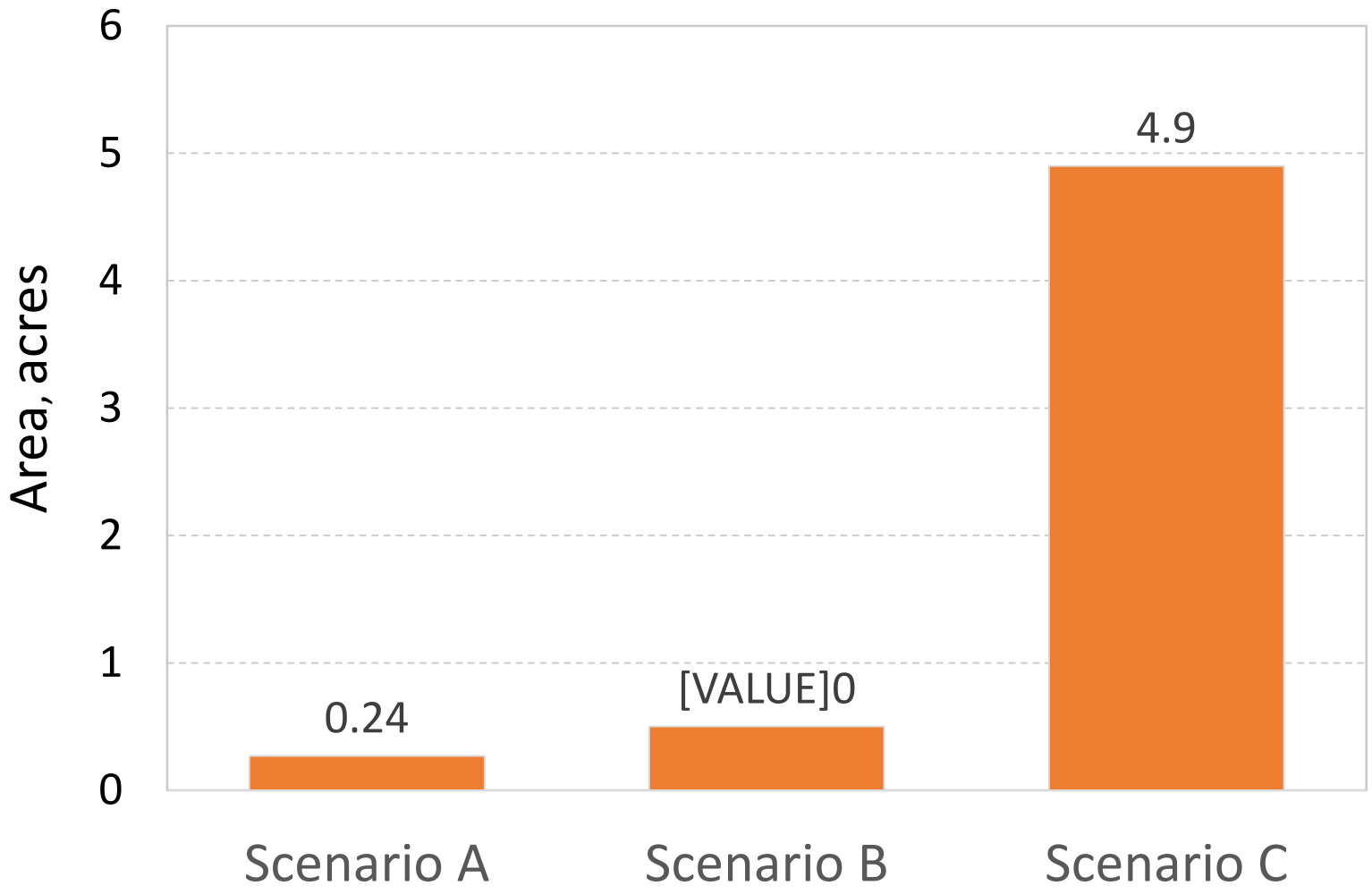
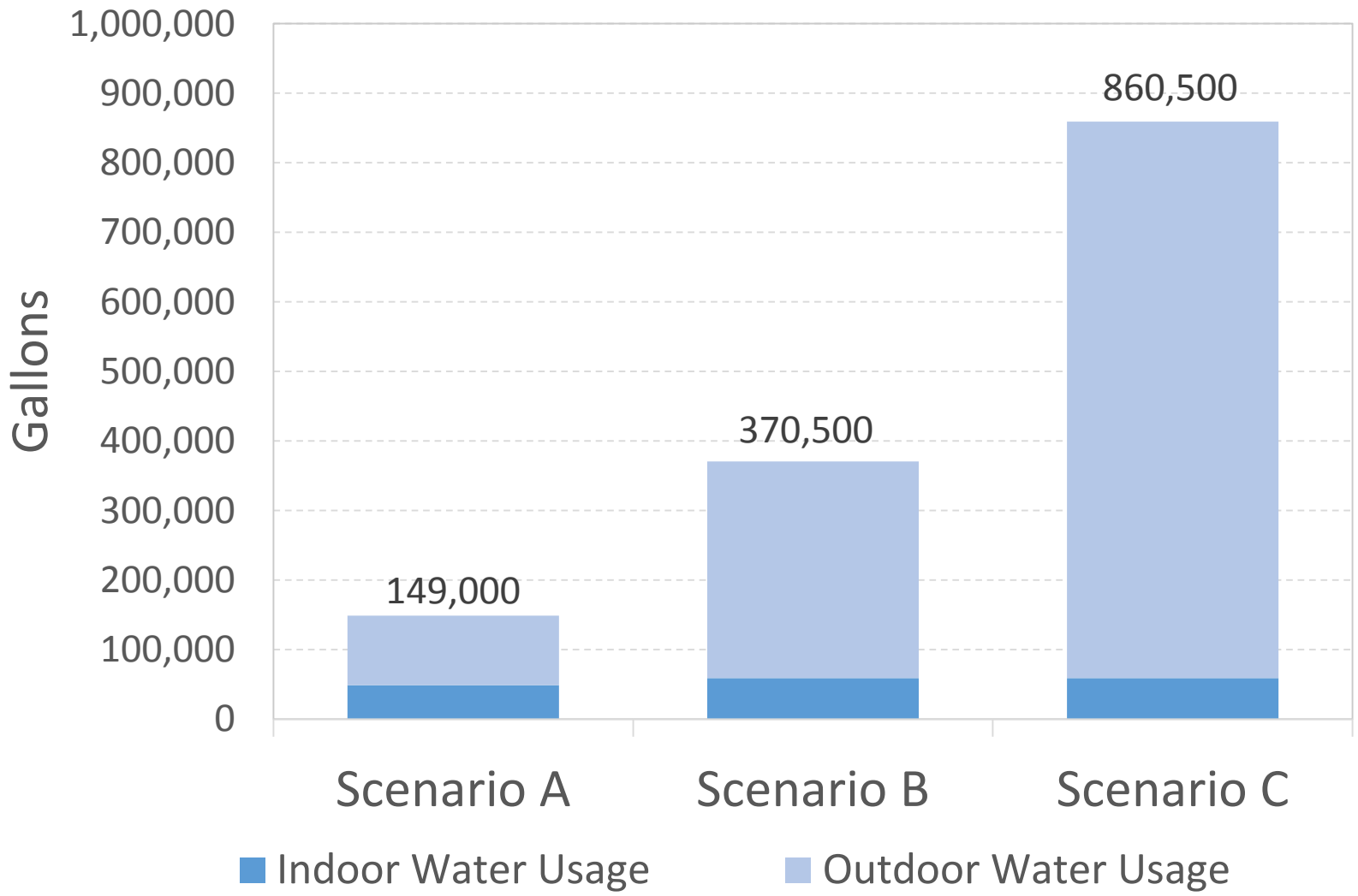
Land Use Distributions



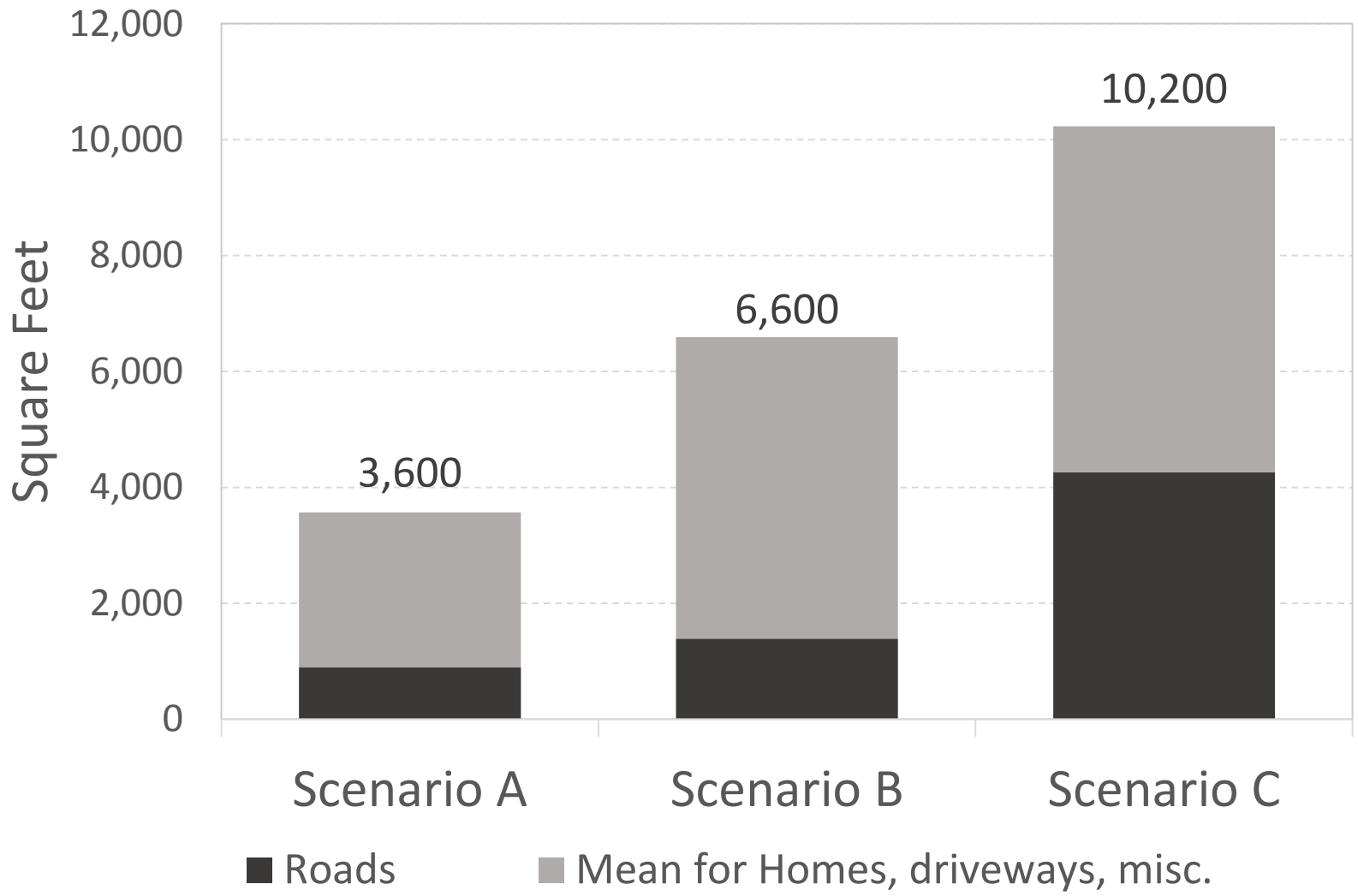
Developed Area per Household



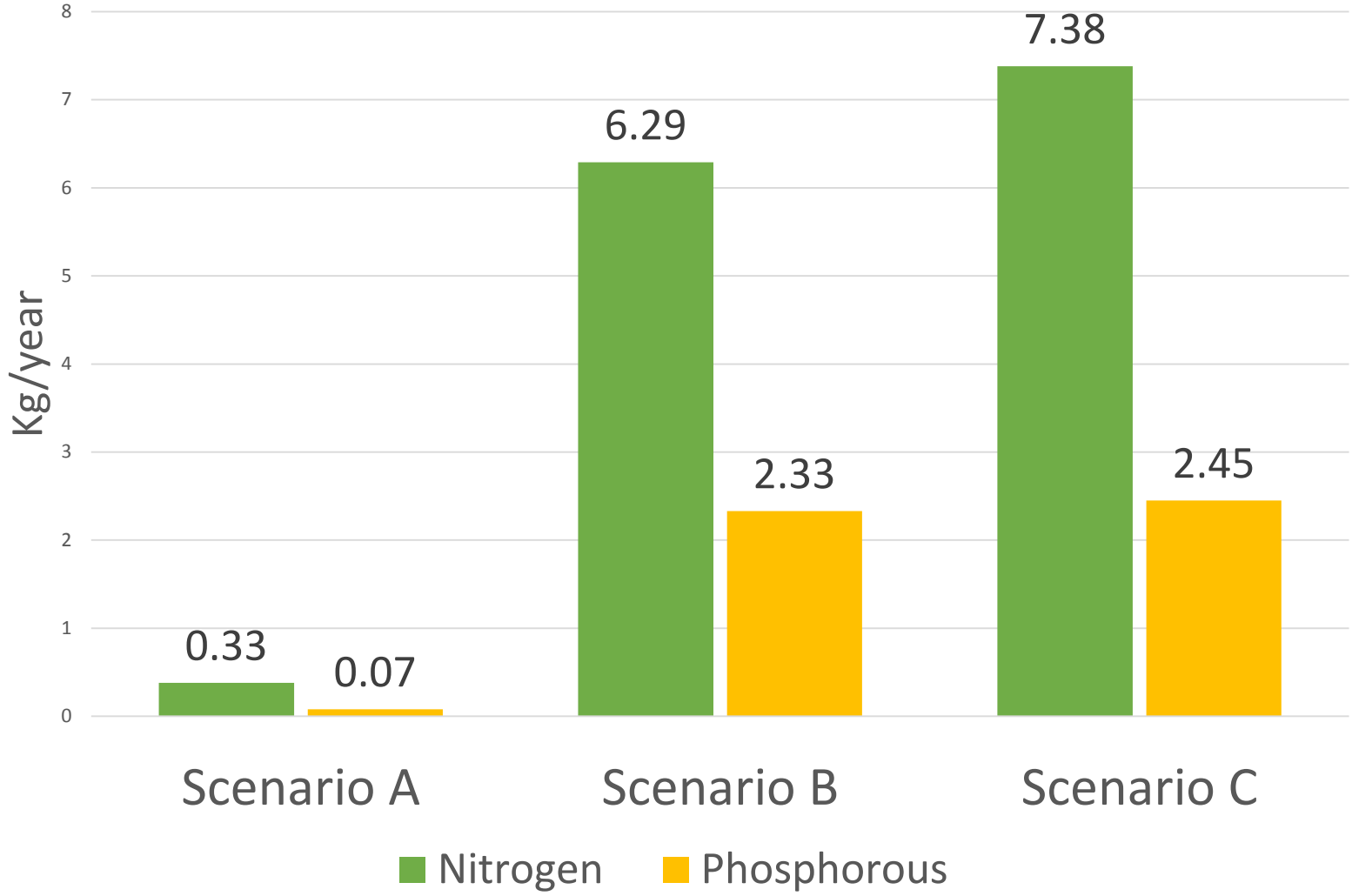
Annual Water Use per Household



Impervious Area per Household



Nutrient Load per Household



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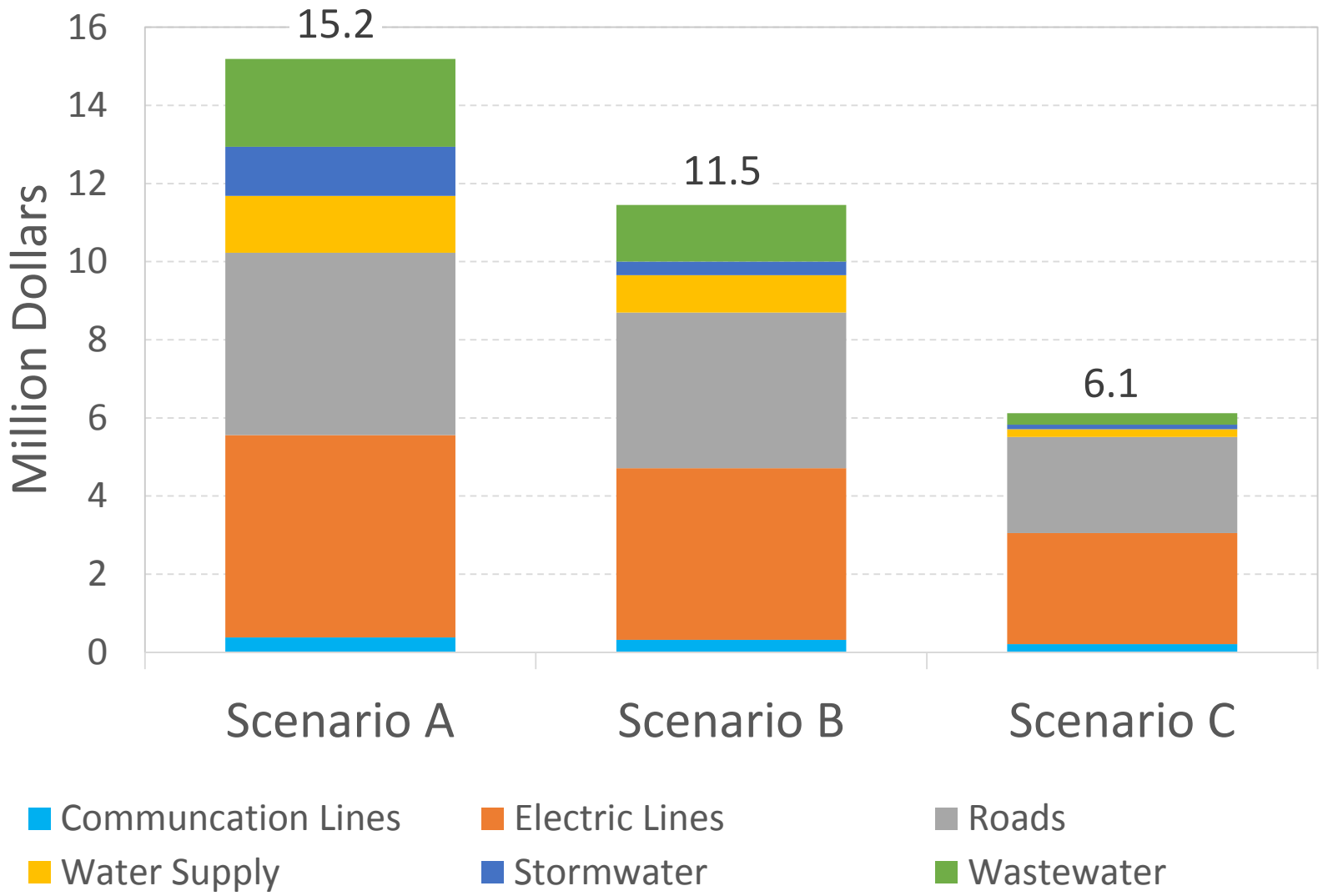
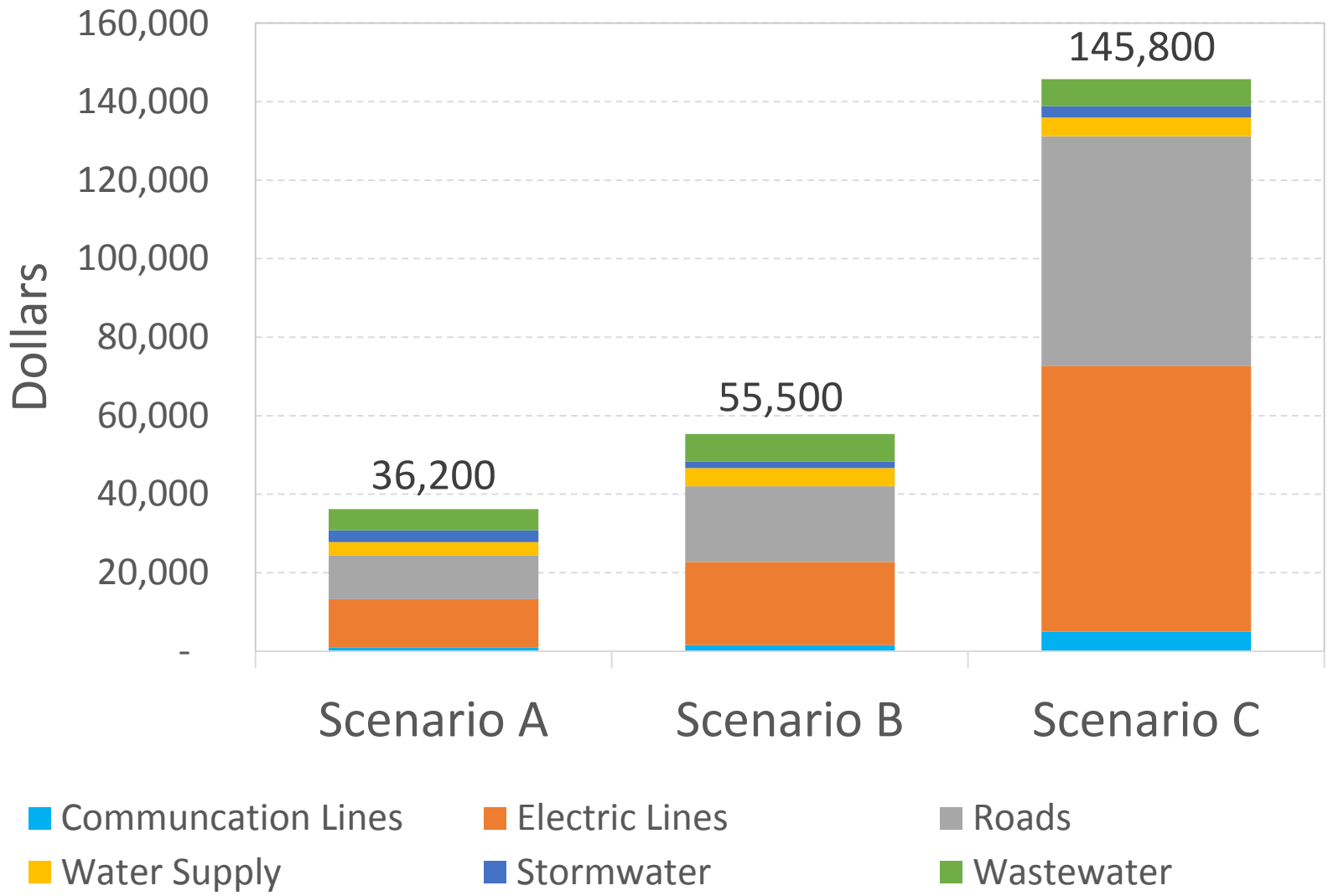
Total Infrastructure Cost

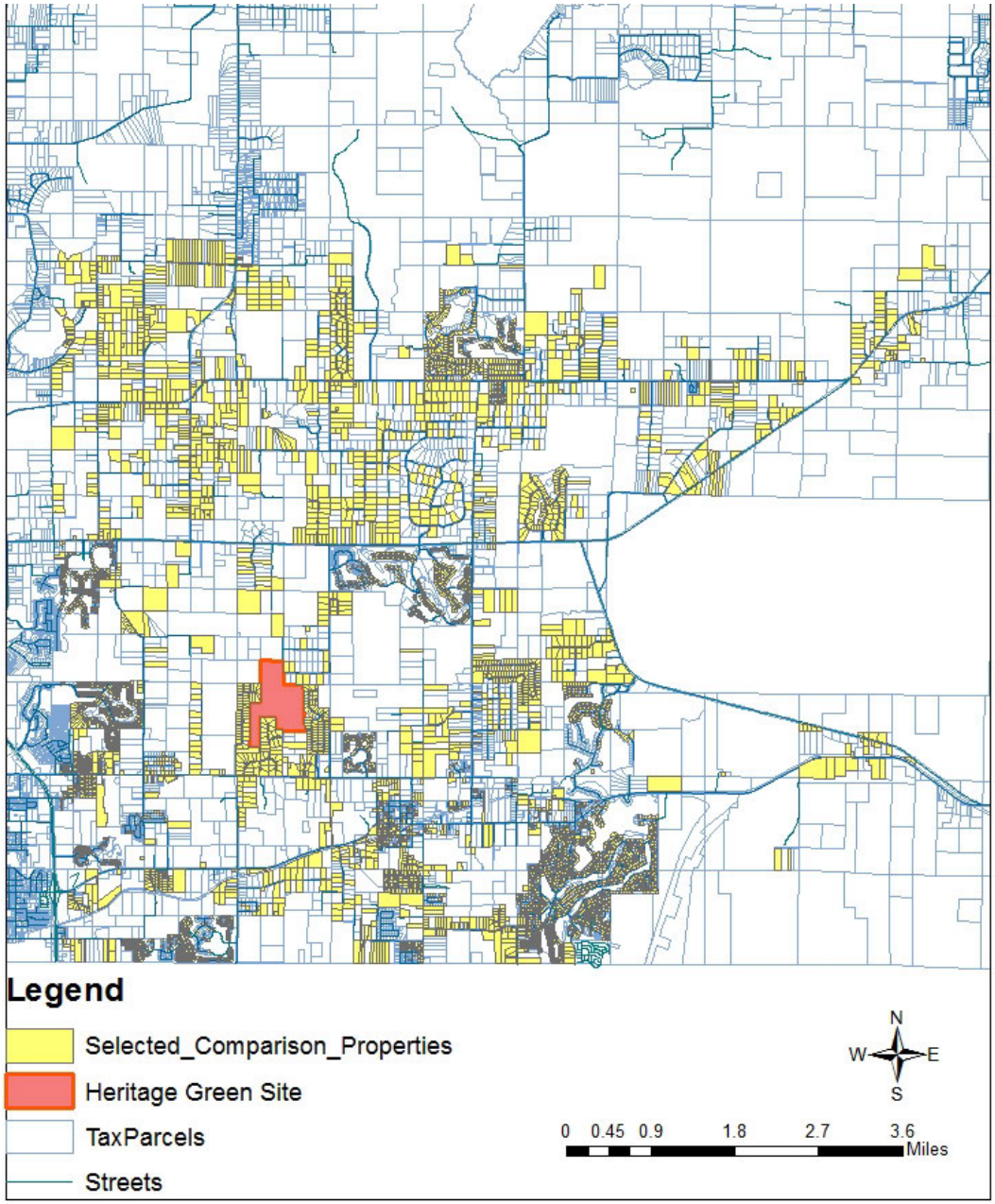


Infrastructure Cost per Household



Residential Properties for County Revenue Comparison

- A total of 4,356 homes were selected.
- All were constructed after 1990 and had an assessed value > $100,000 in 2014.



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Property Tax Revenue Comparison

- Revenue from existing homes projected to Heritage Green

	Comparison Properties			Equivalent Tax Revenue		
Housing density	No. of Homes	Mean Assessed Value	Tax Revenue per Home	Scenario A	Scenario B	Scenario C
SFHigh	1,205	$141,140	$1,373	$344,696	-	-
SFMed	1,006	$191,680	$1,865	$177,179	$149,204	-
SFLow	1,142	$216,630	$2,108	$61,126	$267,692	-
SFVery Low	1,003	$227,640	$2,215	-	-	$93,027
HG Total				$583,002	$416,896	$93,027
% Loss vs. Scenario A				-	(23%)	(83%)

- Note: Actual Tax revenues from Heritage Green would depend on the value of homes constructed and are likely to be greater than the averages presented, but a similar relationship between housing density and values would be expected.

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Summary: Heritage Green

	Scenario A	Scenario B	Scenario C
Urban Land Use per HH *(acres)*	0.27	0.50	4.85
Designated Open Space *(acres)*	109.9	103.6	0
Road Length per HH *(feet)*	50	78	237
Infrastructure Costs per HH *($)*	41,000	56,000	146,000
Water Demand per HH *(gallons/year)*	198,000	370,000	860,000
Impervious Area per HH *(square feet)*	3,600	6,600	10,200
Total Volume Stormwater *(acre-feet)*	59	62	41
Nitrogen Load *(kg/year)*	0.4	6.3	7.4
Phosphorous Load *(kg/year)*	0.1	2.3	2.4
% County Revenue Loss vs. Scenario A		(28%)	(83%)

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Thank You
Questions?

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