Green Infrastructure

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Green Infrastructure

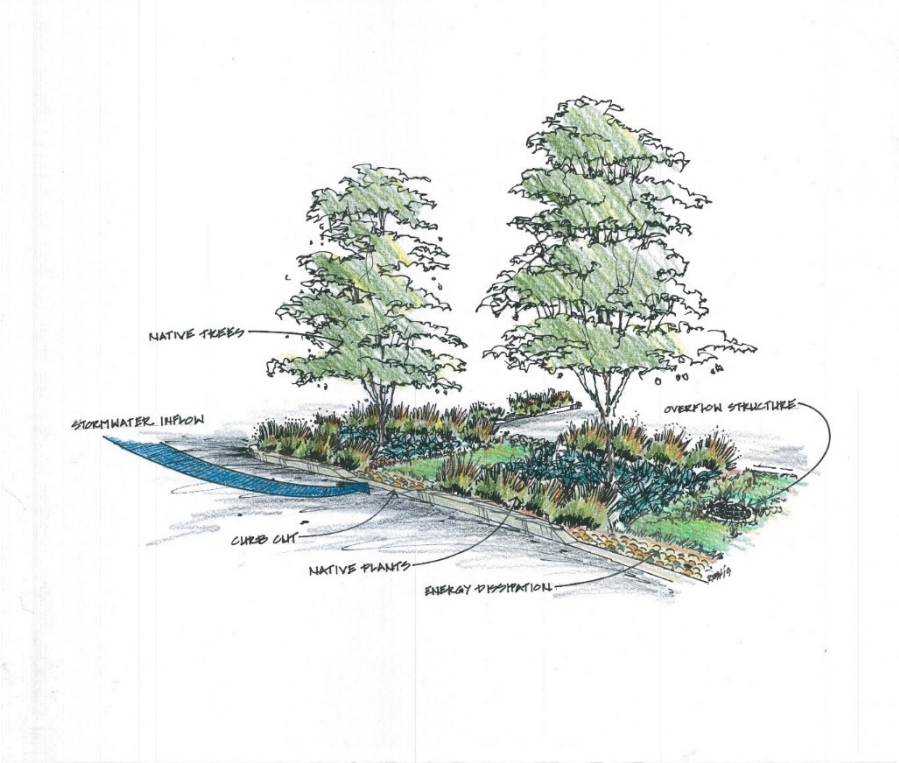
- Definition
- Examples
- Benefits
- Case Studies
- Opportunities


Metro Water Services Offices Nashville, TN

What is Green Infrastructure?

EPA defines green infrastructure as:

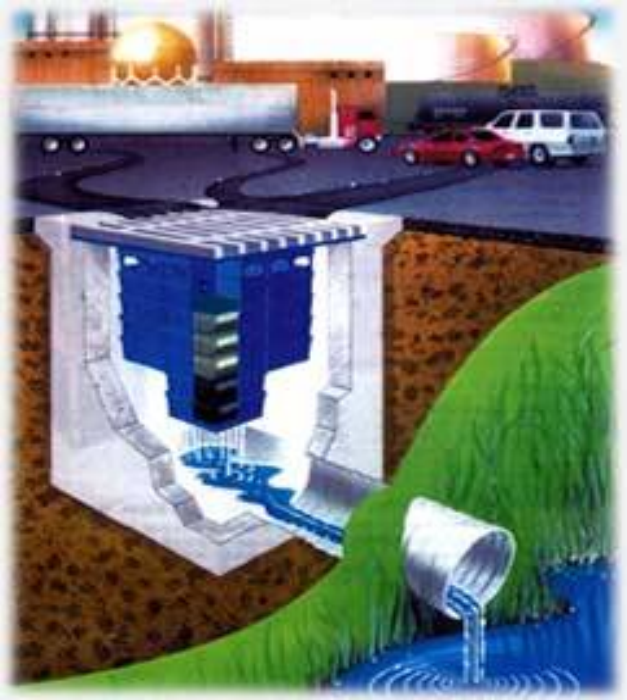
*"a **cost-effective, resilient** approach to managing wet weather impacts that provides **many community benefits.**"*



Shifting Paradigms. . . The GI Way of Thinking

Gray infrastructure:

- Use **basins, pipes & ditches** to **remove** pollutants from **stormwater** where it collects



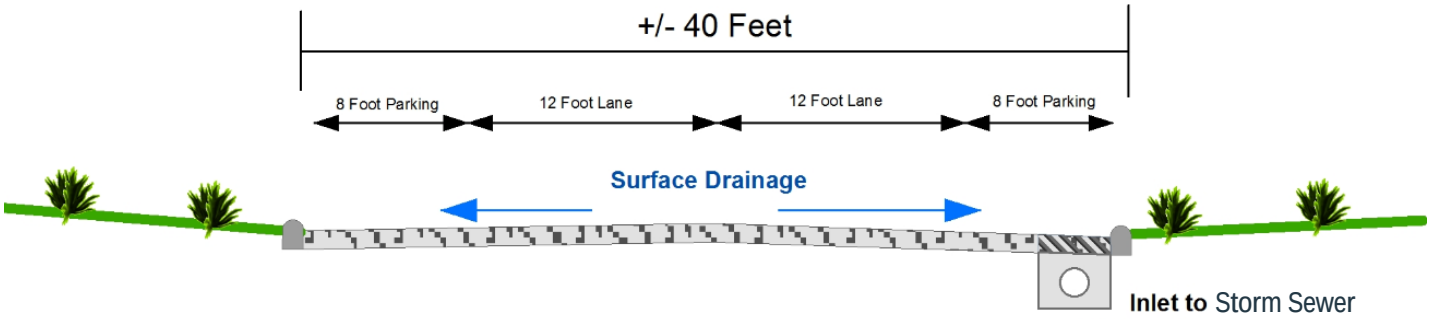
Green infrastructure:

- Use **soil** and **vegetation** to manage **rainwater** close to where it falls

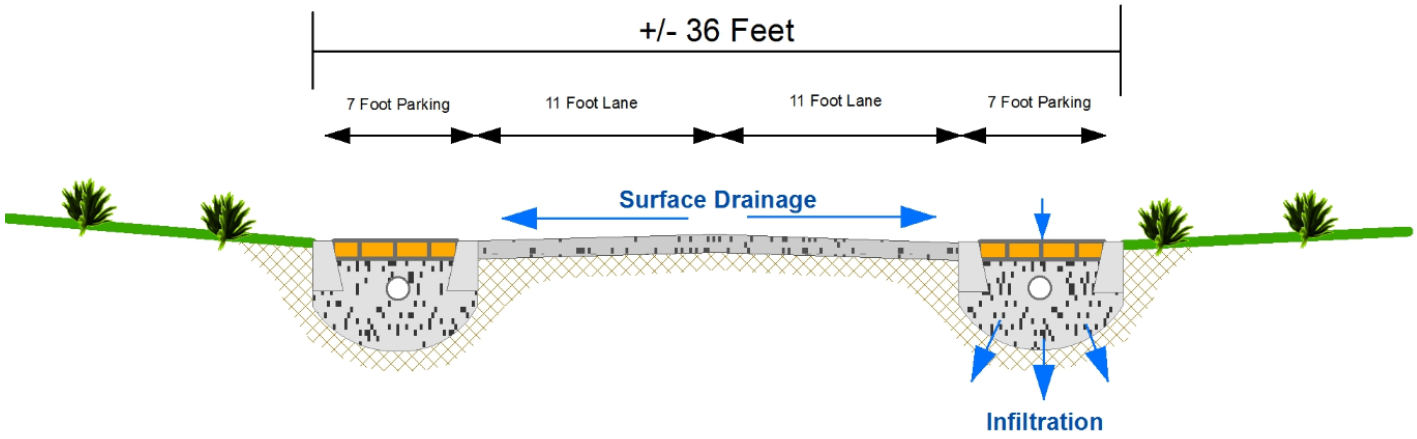
Source: Tompkins County NY (Bioswale)

Shifting Paradigms. . . The GI Way of Thinking

Gray infrastructure:

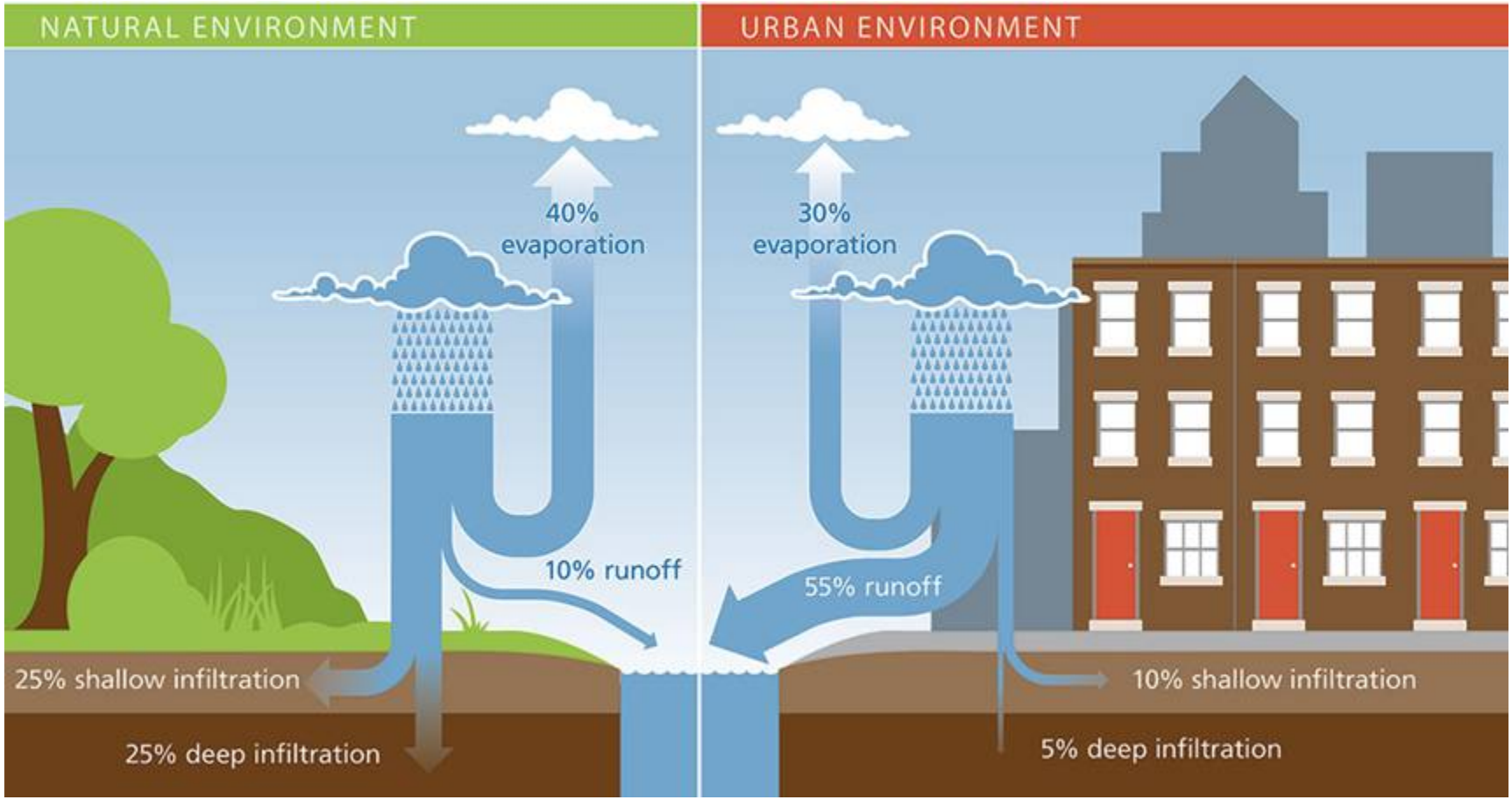


Green infrastructure:



Shifting Paradigms. . . The GI Way of Thinking

Why should we use green infrastructure?



Examples of Green Infrastructure

- **Rainwater Harvesting**
- Rain Gardens
- Planter Boxes
- Bioswales
- Permeable Pavements
- Green Streets and Alleys
- Green Parking
- Green Roofs
- Urban Tree Canopy
- Land Conservation

Rain Barrels

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Rain Garden at Palm Coast City Hall

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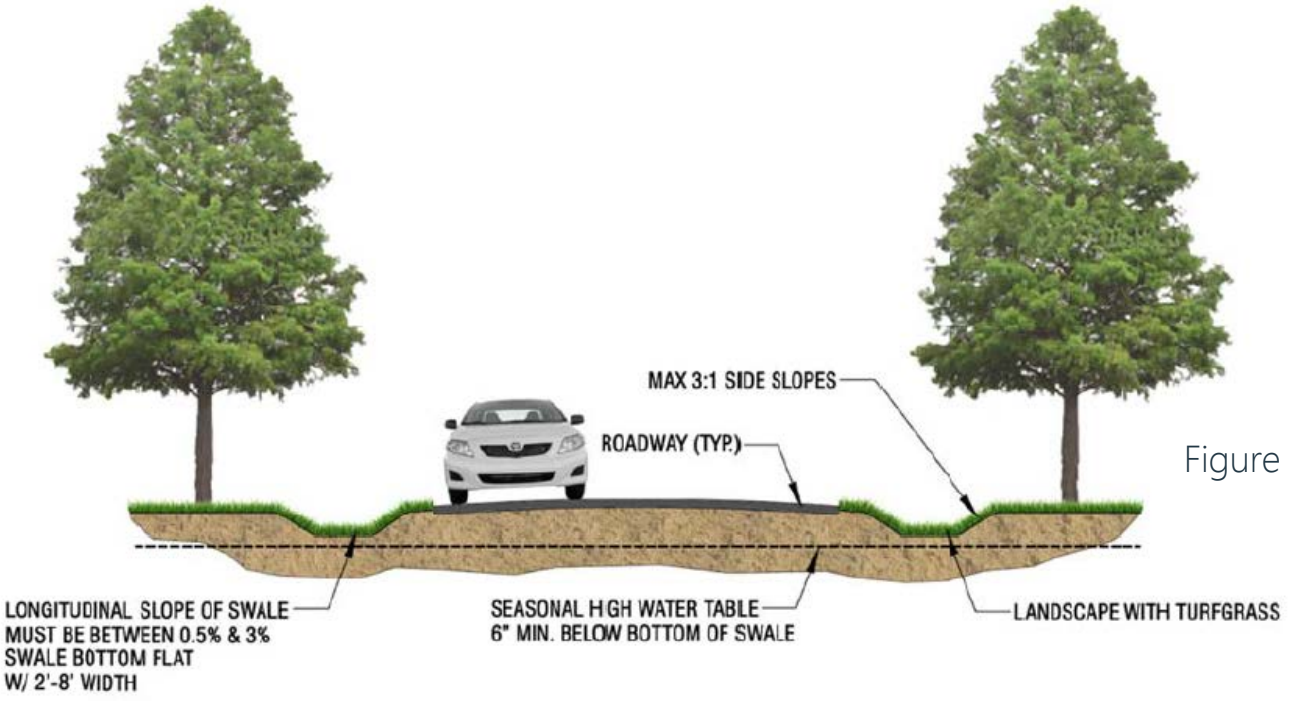

Figure from Duval County LID Manual

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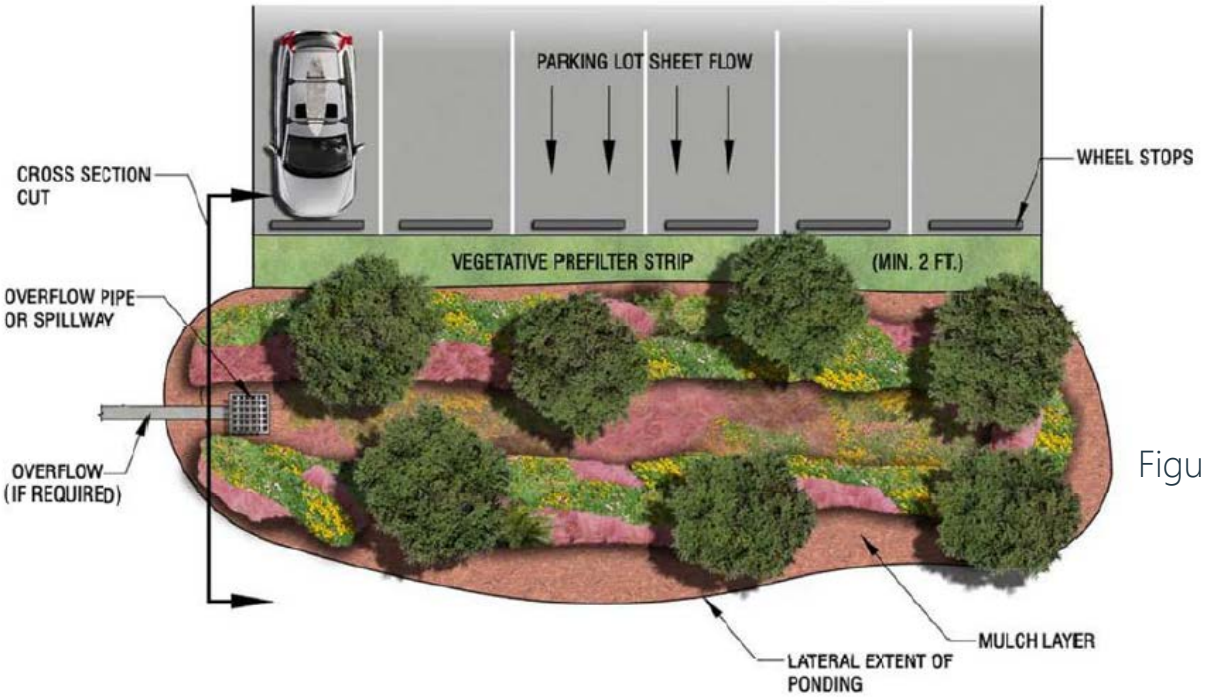


Figure from Duval County LID Manual

Benefits of Green Infrastructure

- Water Quality and Quantity
- Air Quality
- Habitat and Wildlife
- Communities
- Climate Resiliency

Green Infrastructure and Climate Resiliency

- Green infrastructure practices can help communities prepare for and manage the effects of climate change:
  - Manage flooding
  - Prepare for drought
  - Reduce urban heat island
  - Lower building energy demands
  - Spend less energy managing water
  - Protect coastal areas

Green Infrastructure Case Study

Benefits of Green Infrastructure

- Improved aesthetics of asphalted commercial area
- Pollutant removal prior to discharge to underground treatment units
- Reduced flood volumes and flow rates to receiving floodplain system
- Groundwater table recharge
- Reduced flooding of lowest-lying businesses


Ridge Lakes Stormwater Retrofits

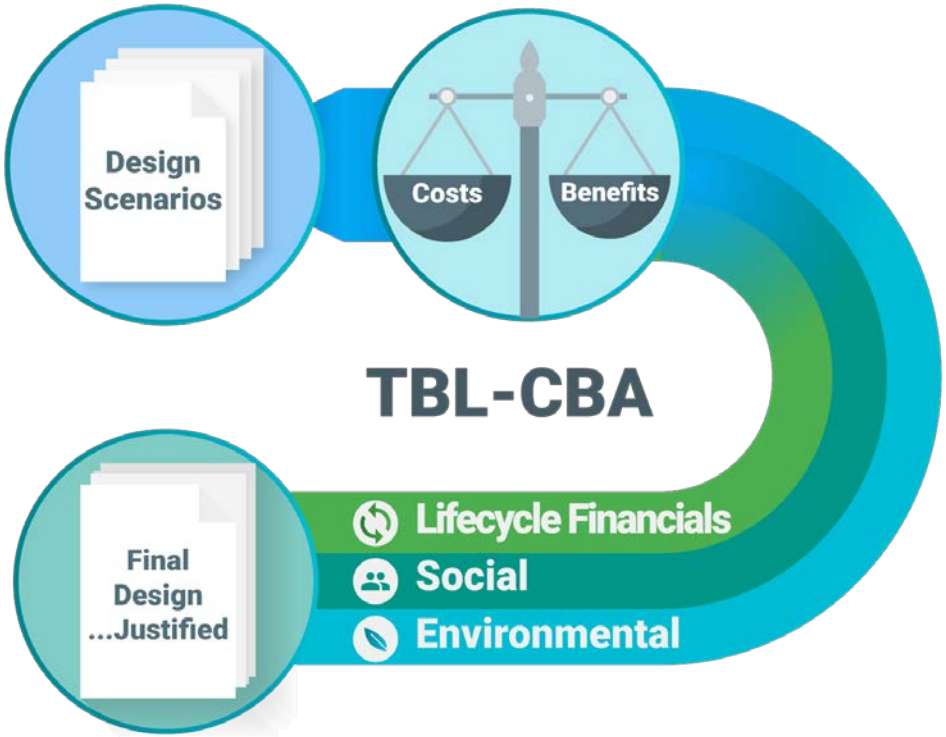
Avoiding perception of higher costs

- Recognize avoided costs
- Recognize that all infrastructure requires maintenance
- Recognize multiple benefits

Green infrastructure provides environmental, social, & public health benefits

Cost Benefit Analysis

Triple Bottom Line – Cost Benefit Analysis



Cost Benefit Analysis
+
Life Cycle Cost Analysis
+
Resilience Analysis
+
Triple Bottom Line

Autocase

Triple Bottom Line - Cost Benefit Analysis

Financial Costs/Benefits:

- Capital Expenditures
- Operations and Maintenance Costs
- Replacement Costs
- Residual Value of Assets
- Decommissioning Costs
- Regulatory Penalties
- Other Costs
- Revenues
- One-time Subsidies
- Recurring Subsidies

Co-Benefits:

- Additional Detention
- Additional Piping
- Air Pollution
- Carbon Emissions
- Flood Risk
- Heat Mortality
- Property Value
- Recreational Value
- Social Value of Water
- Water Quality
- Wetlands Value

Green Infrastructure Case Study

100RC National GI Challenge - NOLA

Challenge:

Demonstrate how ecosystem goods and services value can be added to a Triple Bottom Line Analysis in the design to transform a 25-acre empty site into a recreational and educational urban amenity.

Green Infrastructure Case Study

100RC National GI Challenge - NOLA

Design Objectives:

- Divert and temporarily store up to 10 million gallons of water to reduce flooding
- Infiltrate water to allow organic soils to stabilize and limit subsidence
- Clean the water of pollutants through a series of constructed filtration wetlands
- Educate by demonstrating how natural processes can be utilized for more sustainable water management and local ecology

Green Infrastructure Case Study

100RC National GI Challenge - NOLA

Features:

- Storage systems (Cistern)
- Impervious surfaces (Driveways; Concrete sidewalks; Concrete)
- Retention/Detention (Bioretention Cells; Rain garden; Dry detention pond)
- Water Conveyance (Vegetated swales; Piping Underdrain; Piping Stormwater Discharge; Piping beneath Cartier)
- Roofing Systems (Grey roof)
- Infiltration Practices (Interlocking Porous Concrete Paver; Flexible Porous Paving; Stone Paving; Concrete Step Pads)
- Landscaping Practices: Additional Trees; Additional Shrubs; Managed Turf; Unmanaged Turf)

Impacts:

- **Financial**
  - Capital Expenditures
  - Operations and Maintenance Costs
  - Replacement Costs
  - Residual Value of Assets
  - Decommissioning Costs
- **Environmental**
  - Air Pollution
  - Carbon Emissions
  - Water Quality
- **Social**
  - Heat Mortality
  - Property Value Uplift/Aesthetic benefits
  - Recreational Value
  - Avoided Flood Damage
  - Avoided Subsidence Damage
  - Science and Education
  - Public Health (exercise)

Green Infrastructure Case Study

100RC National GI Challenge - NOLA

Solution:

To see how the design met the objectives, the cost-benefit analysis valued the water quality and avoided flood risk as well as the avoided subsidence and the educational benefits of the project.

Impact Type	Cost/Benefit	Median Value	95% Confidence Interval		
Financial	Capital Expenditures	**-$12,141,029**	-$12,576,950	to	-$11,739,432
Financial	Operations and Maintenance	**-$2,622,715**	-$3,290,368	to	-$2,139,443
Financial	Replacement Costs	**-$2,774,896**	-$6,437,983	to	-$1,443,802
Financial	Residual Value of Assets	**$827,631**	$147,289	to	$1,993,376
Social	Heat Island Effect	**$79,612**	$111,616	to	$30,748
Social	Recreational Value	**$1,309,576**	$1,014,965	to	$1,602,333
Social	Flood Risk	**$90,250,751**	$23,588,468	to	$278,011,070
Social	Subsidence Risk	**$232,436**	$116,722	to	$368,578
Social	Education	**$480,097**	$318,422	to	$651,232
Social	Public Health	**$742,323**	$324,566	to	$1,304,393
Social	Property Value Uplift	**$2,604,632**	$1,531,101	to	$3,998, 568
Environmental	Water Quality	**$31,599**	$31,599	to	$31,599
Environmental	Carbon Emissions from Concrete	**-$144,877**	-$257,507	to	-$63,189
Environmental	Air Pollution Reduced by Vegetation	**$90,082**	$53,622	to	$133,687
Environmental	Carbon Reduction by Vegetation	**$12,579**	$5,498	to	$21,598
Triple Bottom Line Net Present Value		**$79.1 M**	$4.6 M	to	$269 M

Opportunities for Green Infrastructure

Channelized Stream

McCoys Creek – Present Day

Natural Channel Design

Edwards Bottomlands – Year 0

GROUNDWORK JACKSONVILLE

Opportunities for Green Infrastructure

Channelized Stream

McCoys Creek – Present Day

Natural Channel Design

Maron Run – Year 10

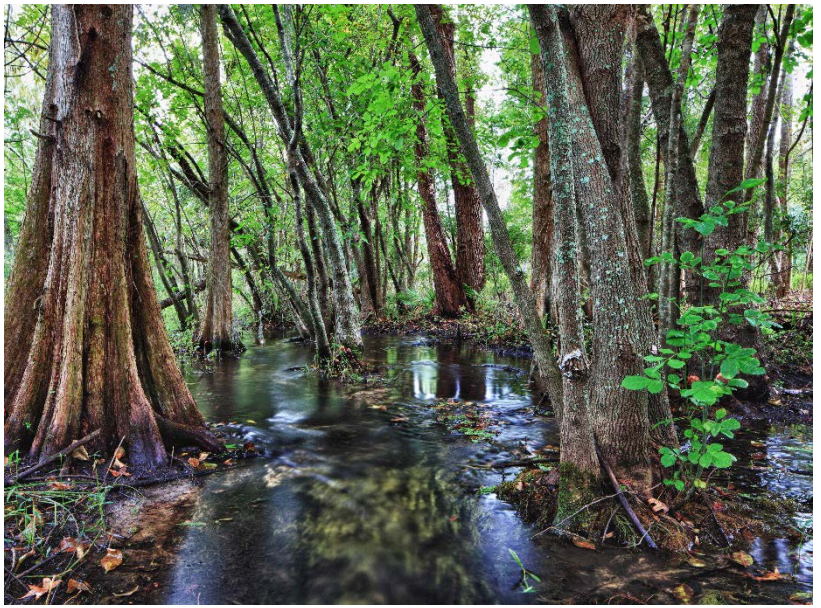
GROUNDWORK JACKSONVILLE

Opportunities for Green Infrastructure

Channelized Stream

McCoys Creek – Present Day

Natural Channel Design

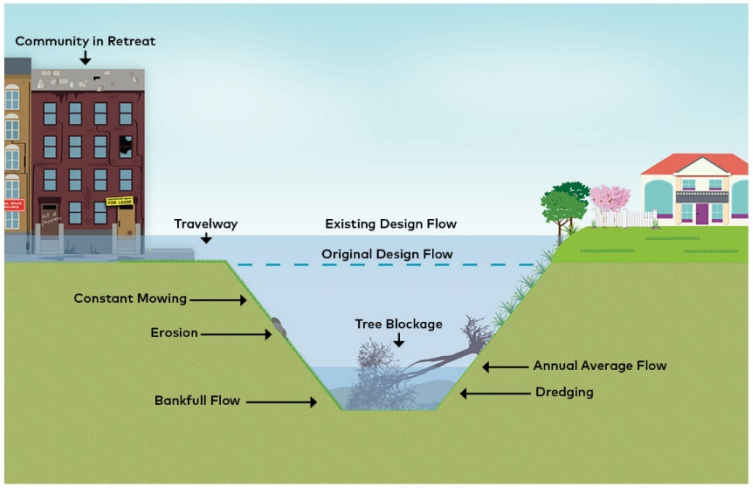


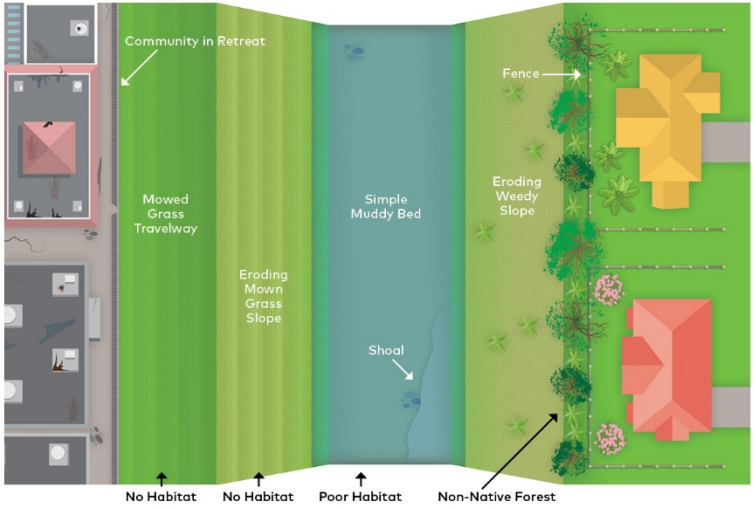
Hickey Branch – Year 20

GROUNDWORK JACKSONVILLE

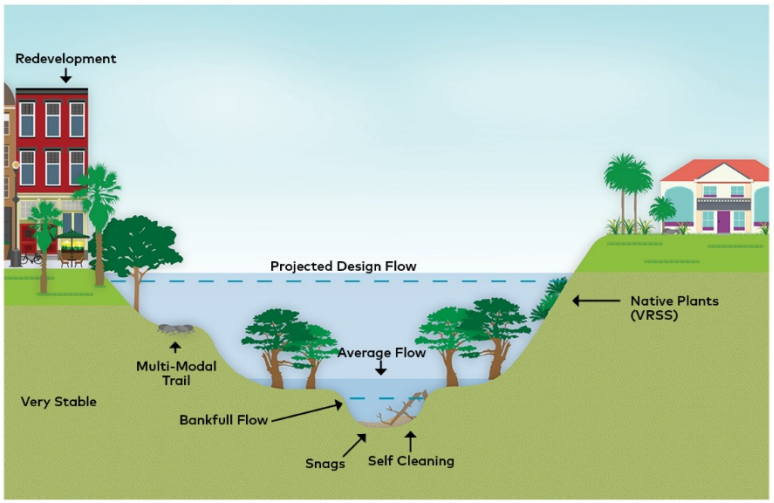
Urban Stream Restoration

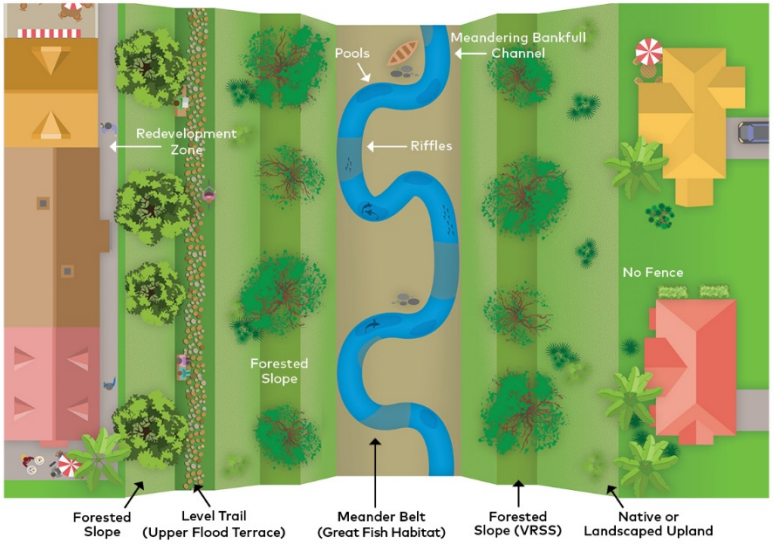
Channelized Stream





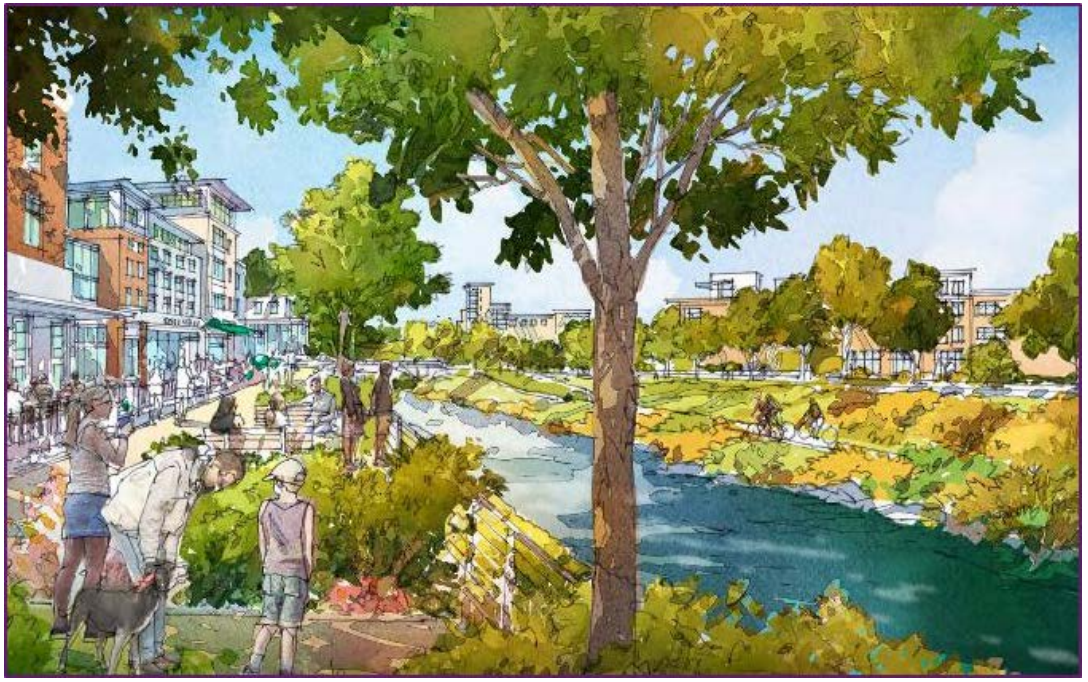
Natural Channel Design





General Benefits of Stream Restoration

- Sustainable and resilient riparian habitat
  - Fish
  - Birds
- Decreased erosion
- Flood mitigation
- Increased wetlands
- Nutrient reduction
- Increased property values
- Blueways and greenways
- Rejuvenate communities



Thank you!

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