Green Infrastructure for Texas: Managing Stormwater with Site-scale practices

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agrilife.org/GIFT

TEXAS A&M AGRILIFE EXTENSION

DISASTER ASSESSMENT AND RECOVERY

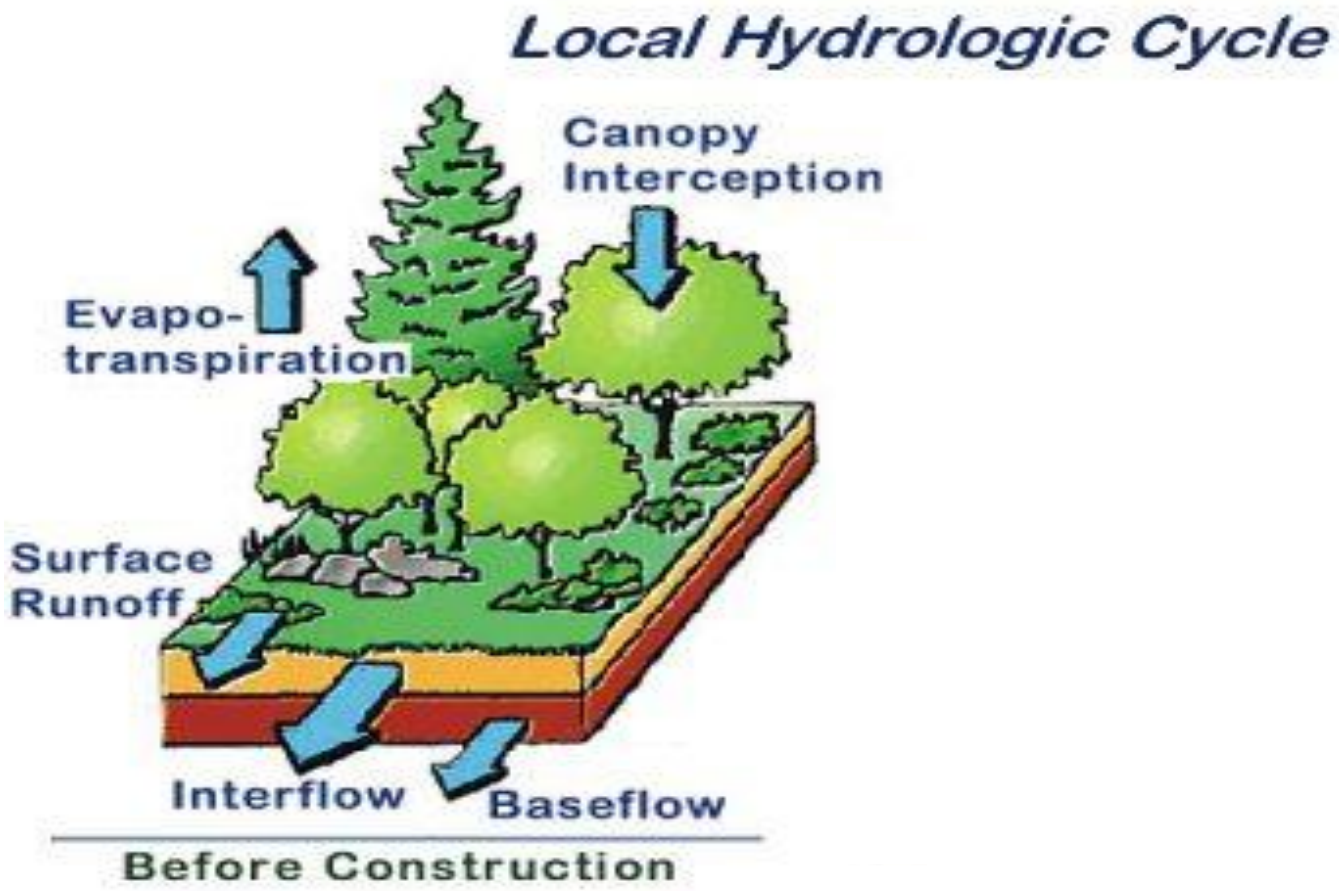
TEXAS COASTAL MANAGEMENT PROGRAM

TEXAS GENERAL LAND OFFICE

Overview

- Stormwater runoff
- Stormwater runoff pollution
- Green stormwater infrastructure (GSI)
- GSI Solutions

Stormwater Runoff



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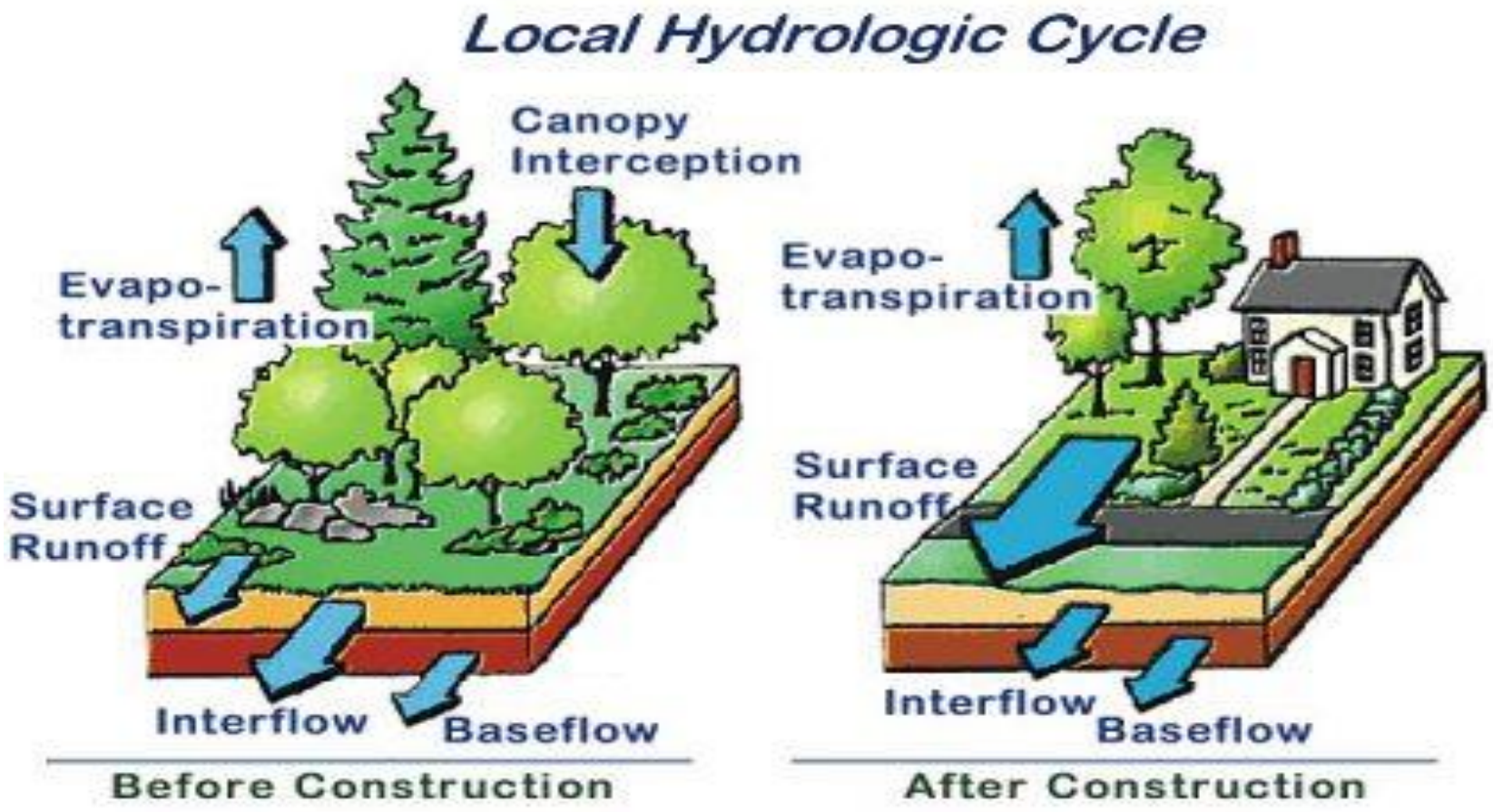
Stormwater Runoff



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Overview

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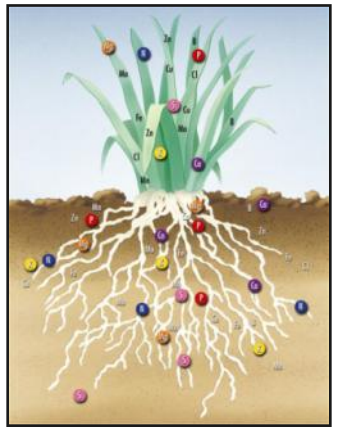
Common Types of Runoff Pollution

- Pathogens/bacteria
- Nutrients
- Sediments
- Debris



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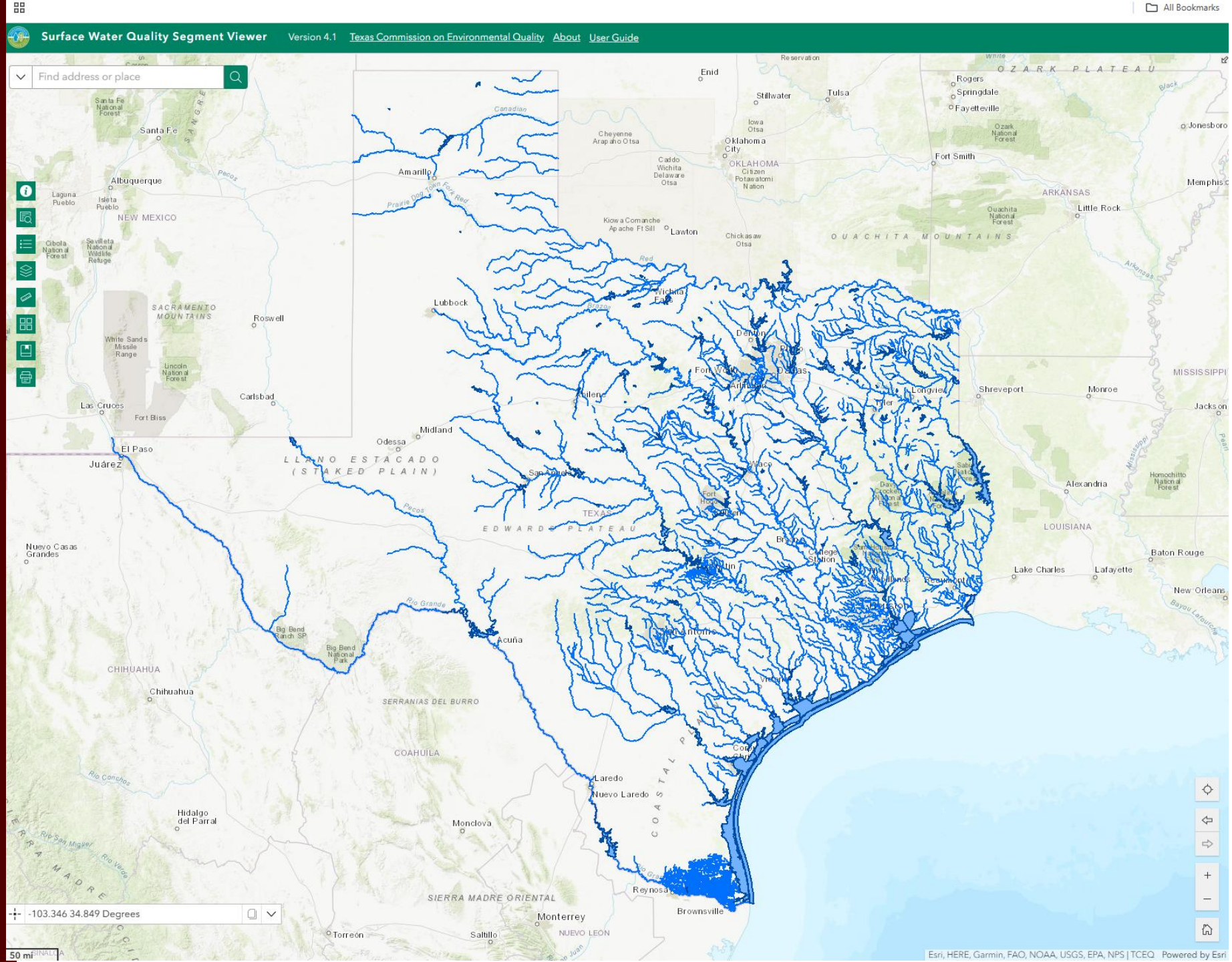

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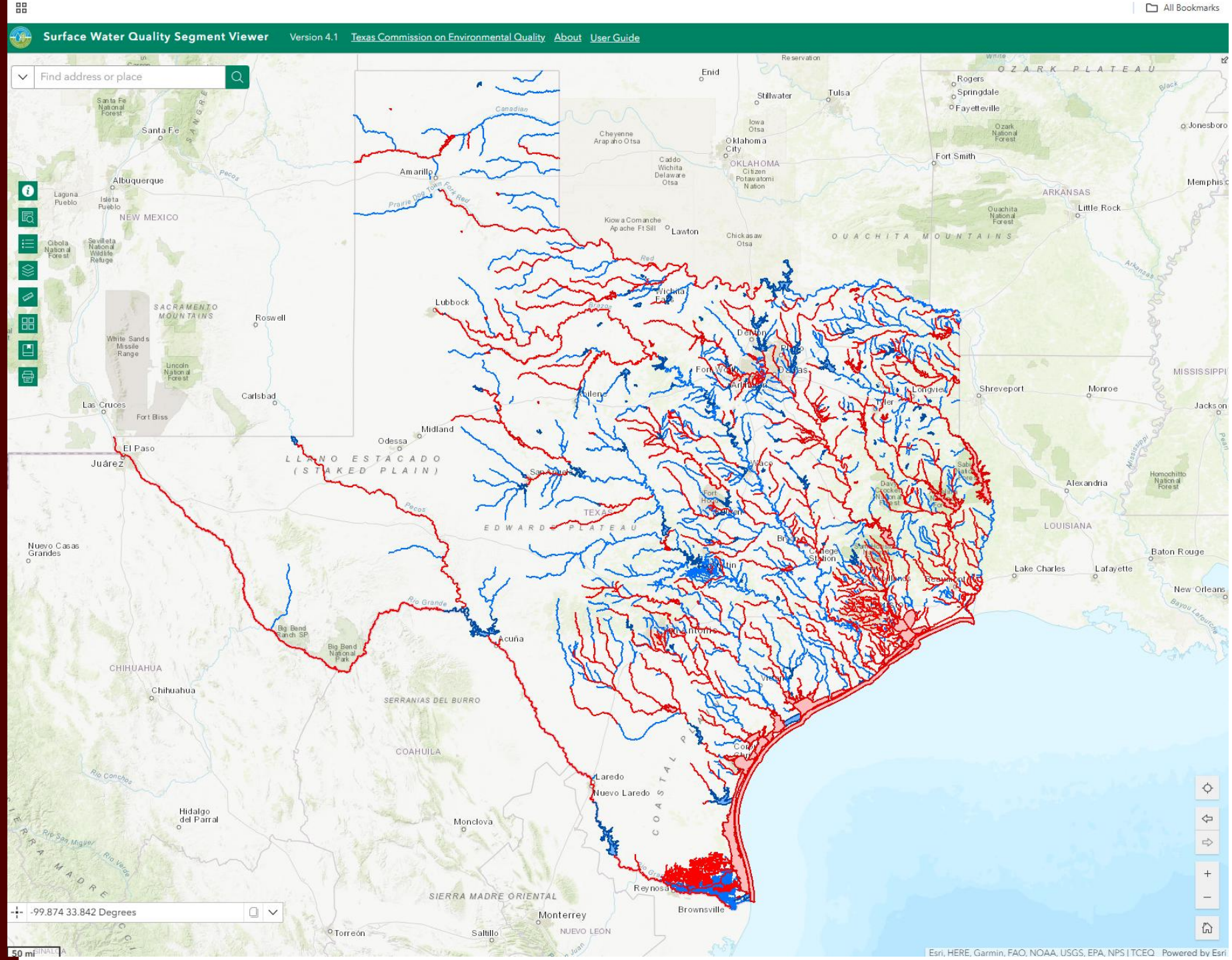

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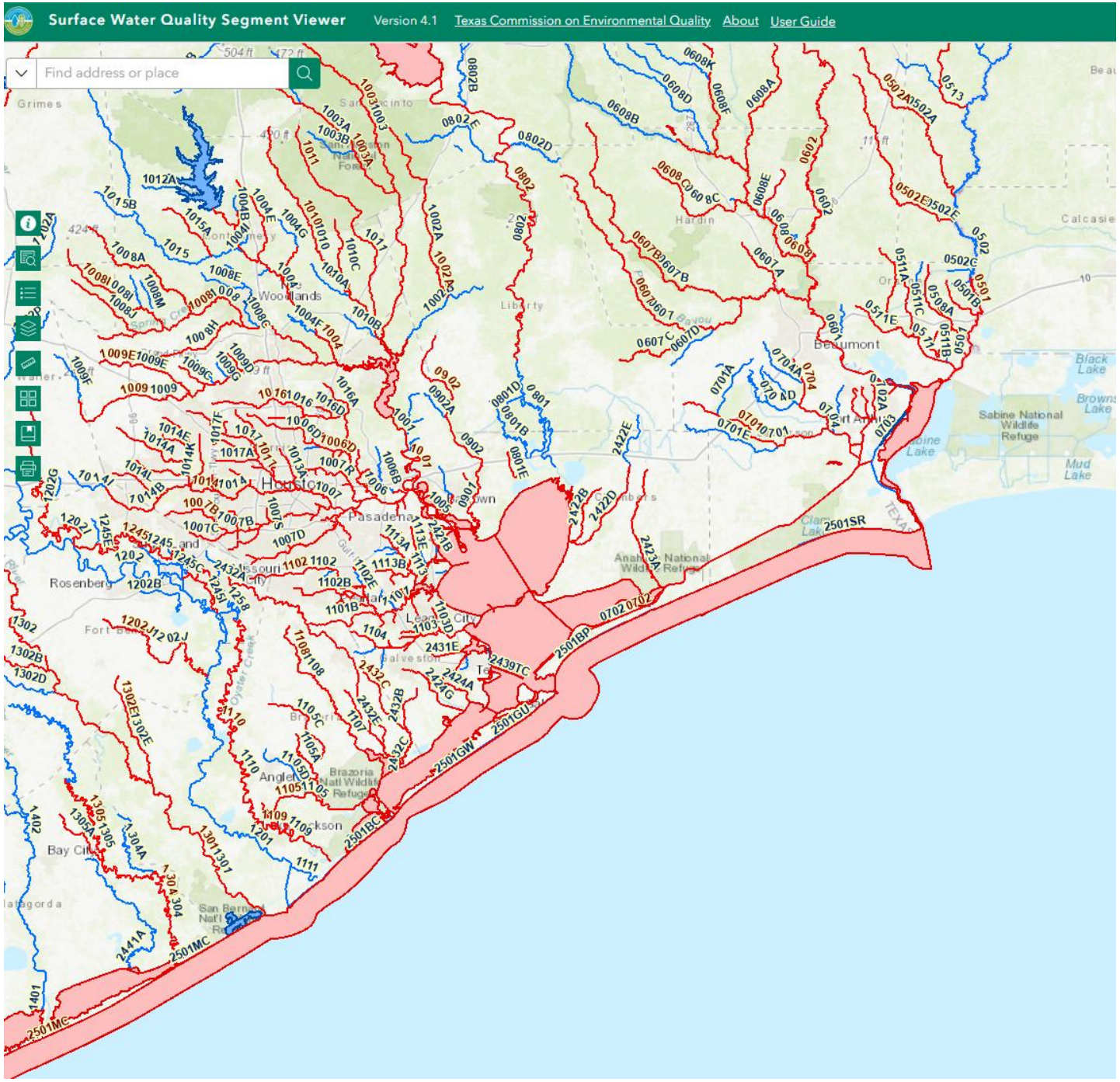

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Sources of Runoff Pollution

Our everyday actions

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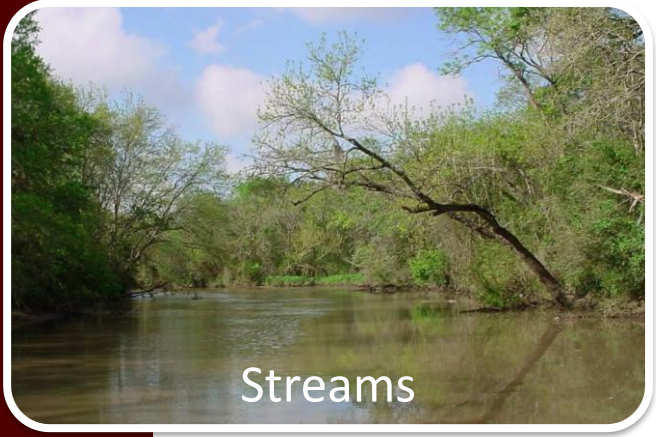
The Path of Runoff Pollution



Overview

- Stormwater runoff
- Stormwater runoff pollution
- **Green stormwater infrastructure (GSI)**
- **GSI Solutions**

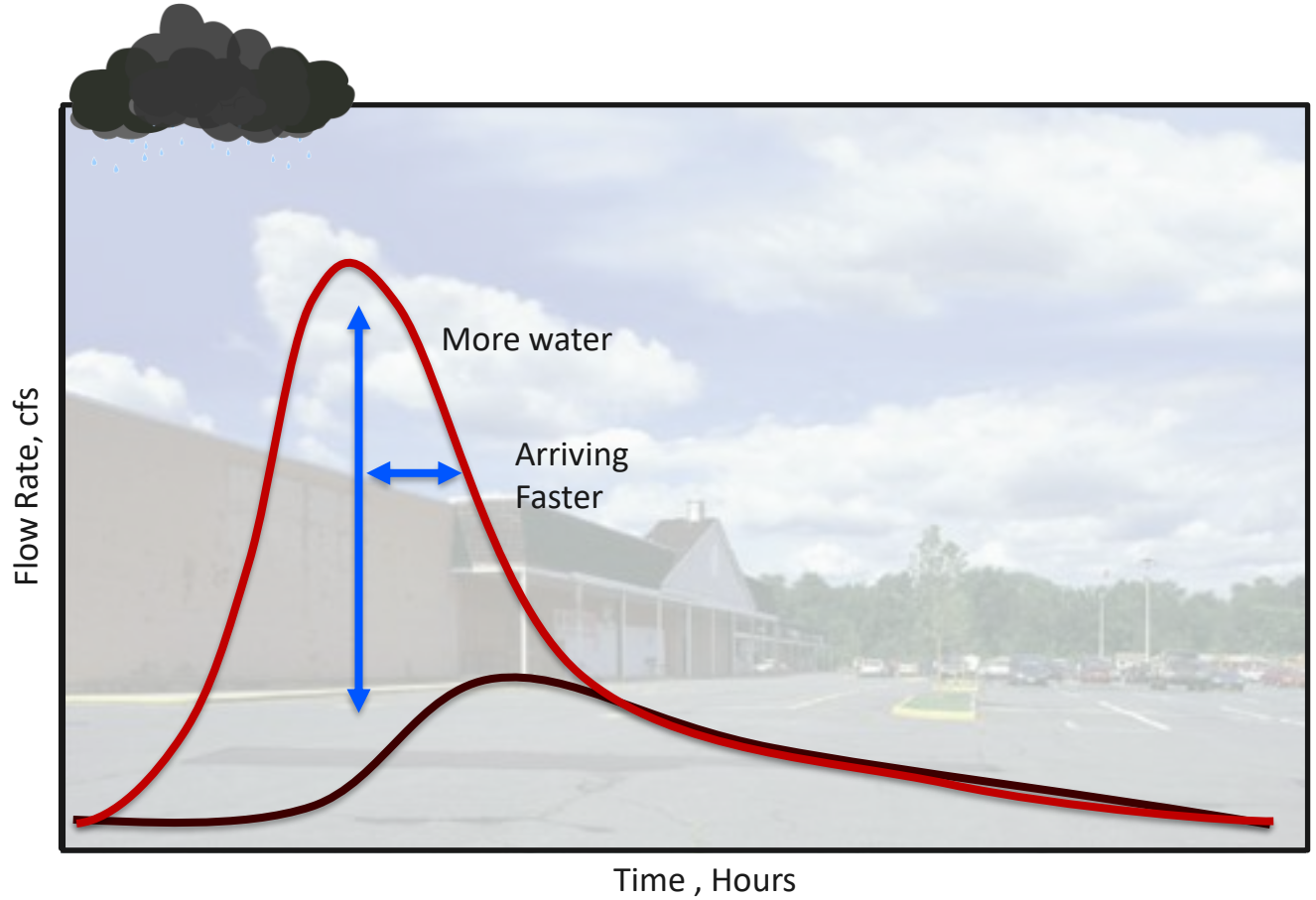
Armand Bayou Nature Center, Pasadena, TX

Green Stormwater Infrastructure

An approach to land development or re-development that **works with nature** to manage stormwater as **close to its source** as possible

- Low Impact Development (LID)
- Nature-based solutions
- Stormwater BMPs
- Blue-green infrastructure
- Stormwater retrofits

Treat Stormwater Where it Falls



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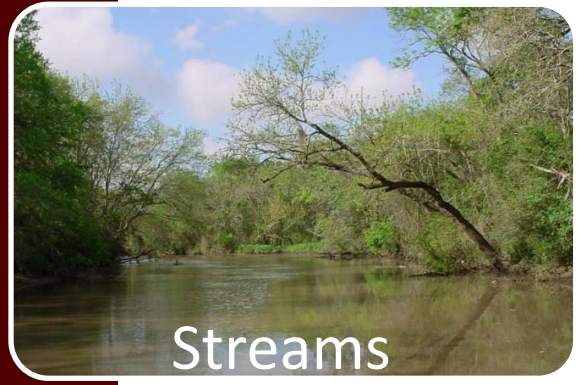
Slow it down
Spread it out
Soak it in

The Path of Runoff Pollution



Why consider green infrastructure solutions?

- Create multi-use areas
- Mitigate flooding
- Improve water quality
- Meet MS4 requirements
- Increase Habitat
- Provide recreation areas


Houston Botanic Garden, Houston, TX

Overview

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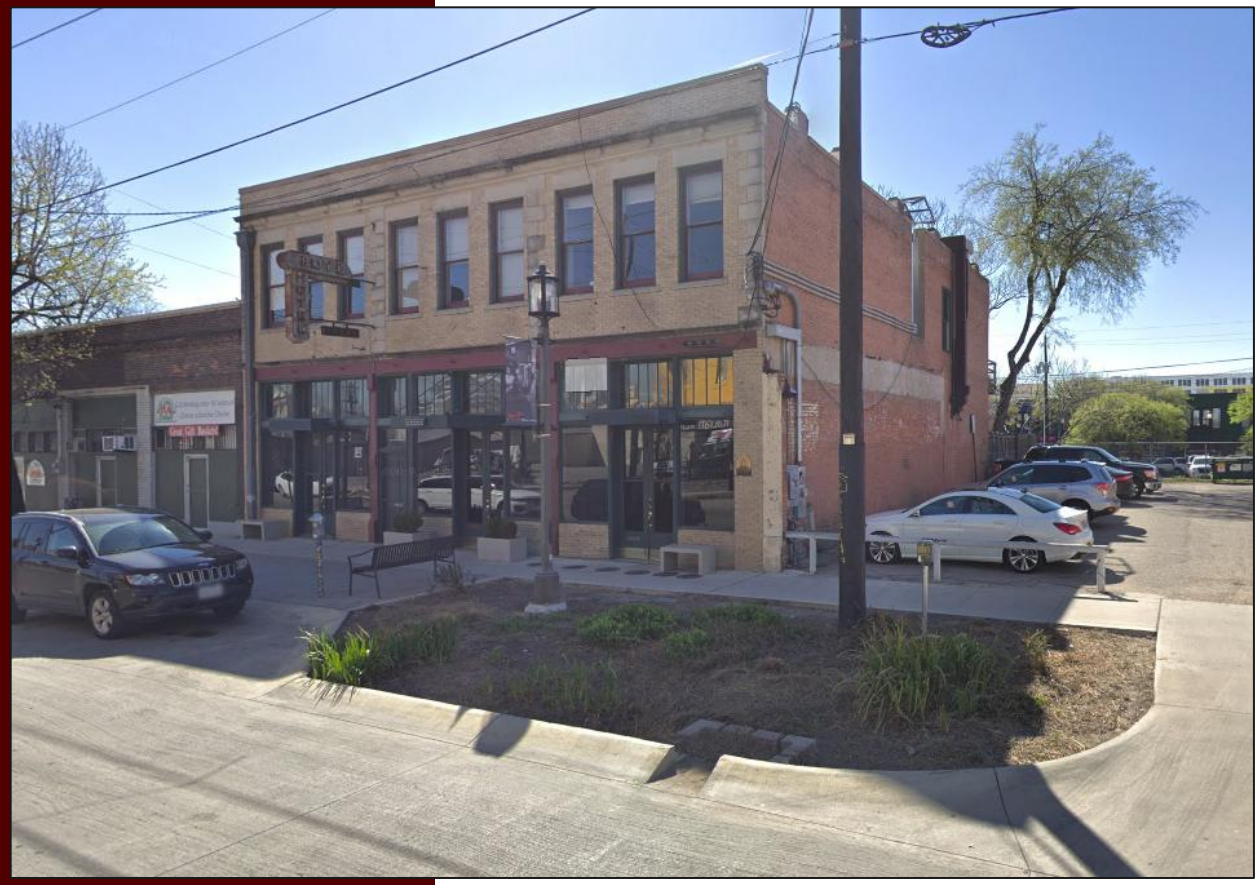
- **GSI Solutions**

Rain Gardens/Bioretention

A shallow depression planted with native and adapted plants that collects rainwater from roofs, parking lots, and other surfaces.



Dallas, TX

Photo from: lowimpactdevelopment.org

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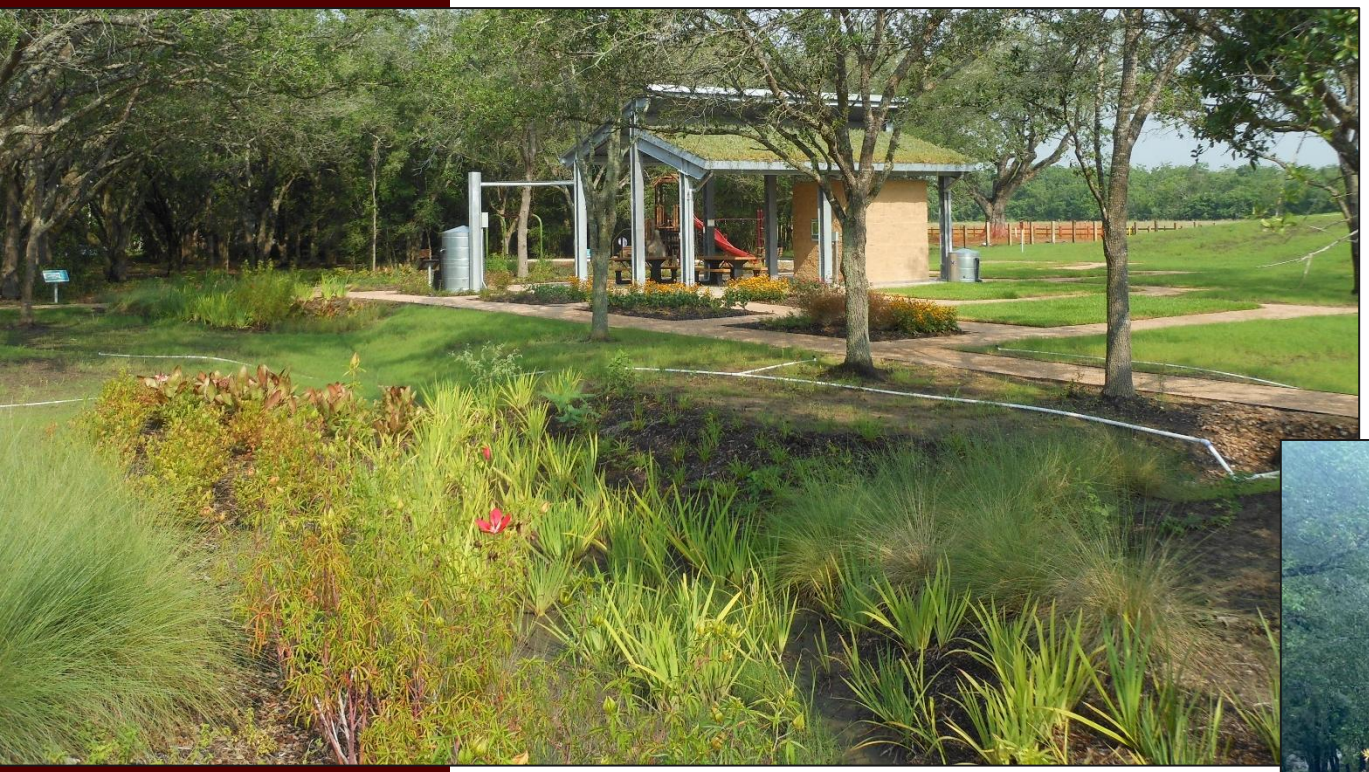
Swales

Drainage course with gently sloping slides, typically vegetated but can have rock

Texas A&M AgriLife



League City, TX

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Rainwater Harvesting

Collecting and storing runoff from an impervious surface for later non-potable usage

Victoria, TX

Galveston, TX

College Station, TX

Rainwater Harvesting - Underground

Photo from sargwatersolutions.com

Photo from tritonsws.com

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Pervious Pavement

- An alternative to asphalt or concrete
- Allows stormwater to drain through the porous surface into a reservoir underneath for temporary storage

Photo from hellerconcreteinc.com

Photo from deeproot.com

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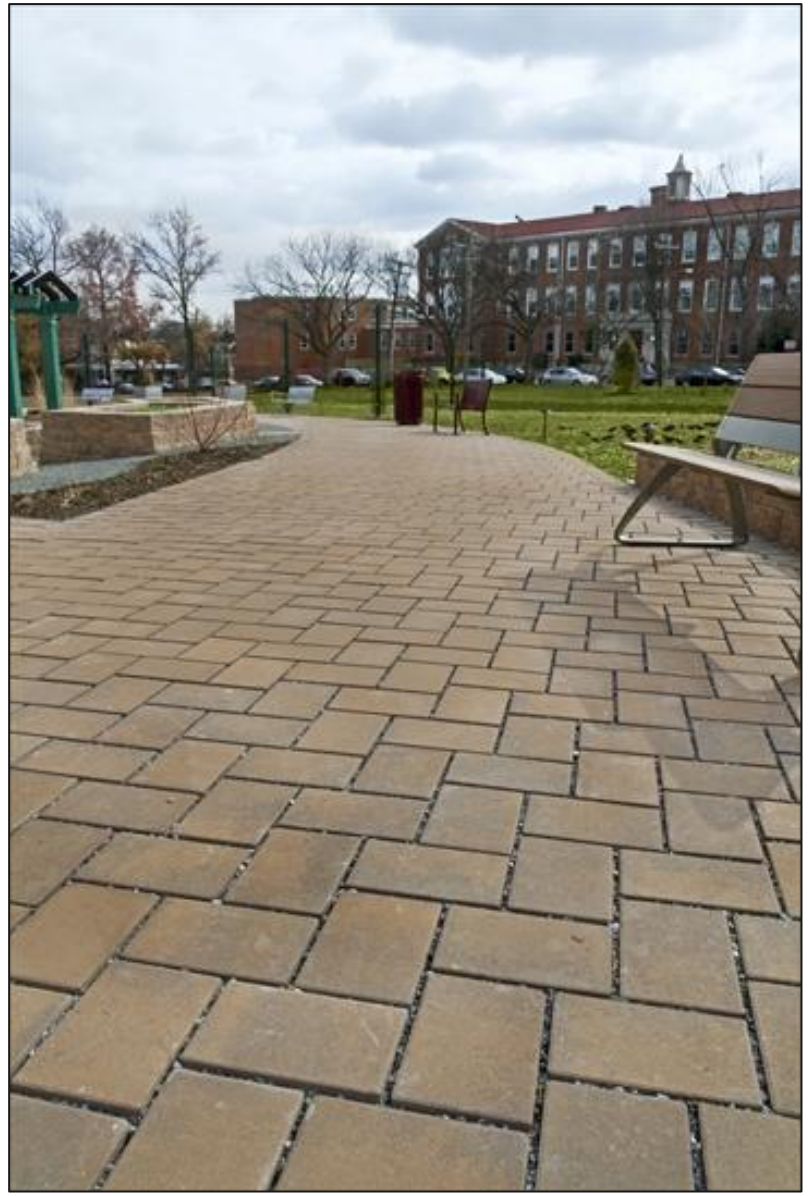
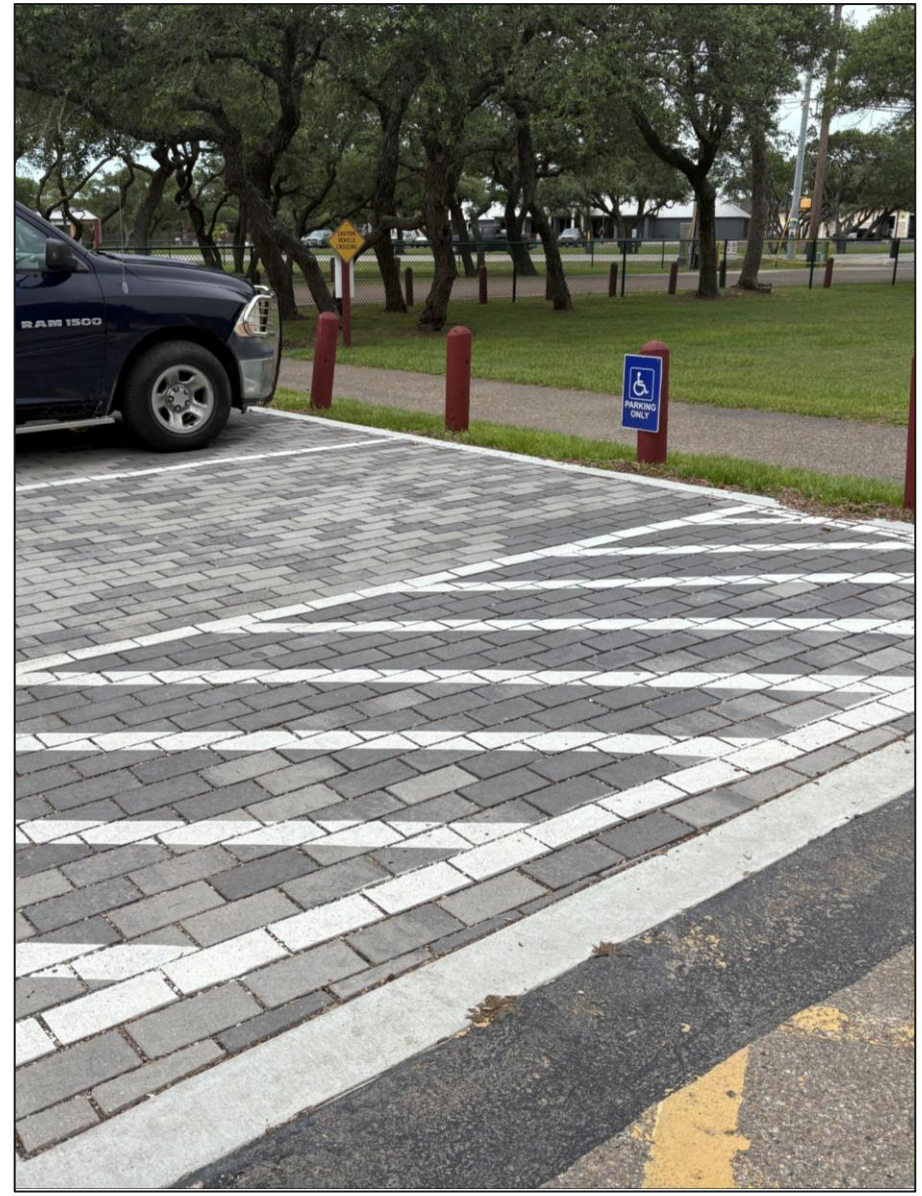


Photo from ephenry.com



Rockport, TX

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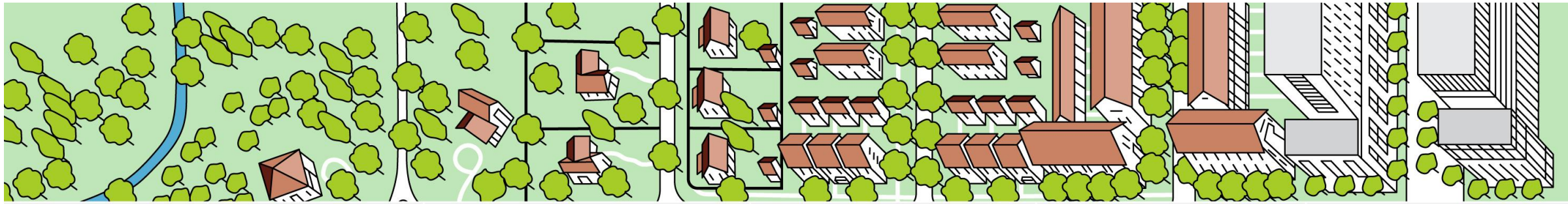
Green Roofs

An extension of a roof which adds water proofing, a drainage system, a lightweight growing medium and plants

Webster, TX

League City, TX

Houston, TX



1. Natural Reserve	2. Natural Preserve	3. Suburban	4. Neighborhood Center	5. Urban Center	6. Urban Core
Good Housekeeping					
Rainwater Harvesting					
WaterSmart Landscaping					
Pervious Pavement					
Rain Gardens/Swales/Bioretention					
Tree-boxes/Sand Filters					
Green Roofs					
Water Quality Inlet Separators					
Green Streets					
Stormwater Wetlands Detention/Retention Ponds				Basins Located Outside Immediate Urban Area	
Conservation Subdivisions/Cluster Development					
Land Preservation Conservation and Restoration					

Selected green infrastructure practices categorized by appropriateness of usage by development type.

The darkest boxes in the diagram indicate the most appropriate location for each type of practice.

Lighter colors indicate potential but less important applications.

Maintenance

- Gray vs Green
- Involve everyone from the beginning
- Houston-Galveston Area Council
- San Antonio River Authority

APPENDIX G:
Operations & Maintenance

Vegetated Swales and Vegetated Filter Strips
Table G-8

Task	Frequency	Indicator maintenance is needed	Maintenance notes
Inlet inspection	Twice annually or after storm event	Ponding occurring at inlet	Check for sediment accumulation and/or uneven flow spreader.
Outlet inspection	Twice annually or after storm event	Ponding occurring in feature	Check for debris or trash accumulation and/or erosion at outlet.
Mowing	2-12 times a year	Overgrown vegetation	Frequency depends on location, desired aesthetic appearance, and type of vegetation. 4" minimum grass height preferred.
Weeding	Monthly as needed	Appearance of undesirable or invasive plant material	Control weeds using Integrated Pest Management strategies. Avoid treatment with herbicides preferred. Some features will be naturally more prone to infestations due to location and the surrounding environment.
Remove and replace dead plants	As needed	Bare space, exposed soil	Plant die-off tends to be highest during the first year. Maintaining complete plantings helps to reduce weed encroachment and is necessary to prevent erosion.
Temporary irrigation	Once every 2-3 days for the first 1-2 months then less frequently, depending on plant material and environmental conditions, until established	Dull leaf color and plant wilting	Watering after plant establishment during periods of drought or for aesthetics may be required.
Inspect check dams	Once before the wet season(s) and monthly during the wet season(s)		Check for sediment accumulation and erosion around or underneath the dam materials.
Miscellaneous	Monthly	Trash collection and erosion and/or rut repairs	

www.sariverauthority.org/services/sustainability/low-impact-development/

Inspection and Maintenance Checklist

RAIN GARDEN

Property Address _____
Property Owner _____
Treatment Measure No. _____ Inspection Date _____
Inspector(s) _____
Type of Inspection:
☐ Monthly ☐ Pre-wet season ☐ Post-wet season ____ ☐ After heavy runoff
☐ Other: _____

Defect	Conditions when maintenance is needed	Maintenance needed?	Comments[a]	Results expected when maintenance is performed
1. Standing water	Water stands in the bioretention area between storms and does not drain within 24 hours after rainfall.			There should be no areas of standing water once inflow has ceased. Any of the following could apply: sediment or trash blockages removed, grade from head to foot of bioretention area improved, media surface scarified, underdrains flushed.
2. Trash and debris	Trash and debris accumulated in the bioretention area and around the inlet and outlet.			Trash and debris removed from the bioretention area and disposed of properly.
3. Sediment	Evidence of accumulated sediment in the bioretention area.			Material removed so that there is no clogging or blockage. Material is disposed of properly.
4. Erosion	Channels have formed around inlets, there are areas of bare soil, or there is other evidence of erosion.			Obstructions and sediment removed so that water flows freely and disperses over a wide area. Obstructions and sediment are disposed of properly.
5. Vegetation	Vegetation is dead, diseased or overgrown.			Vegetation is healthy and attractive. Grass is maintained at least 3 inches in height.
6. Mulch	Mulch is missing or patchy. Areas of bare earth are exposed or mulch layer is less than 3 inches deep.			All bare earth is covered, except mulch is kept 6 inches away from trunks of trees and shrubs. Mulch is even at a depth of 3 inches.
7. Inlet/outlet	Sediment accumulations.			Inlet/outlet is clear of sediment and debris and allows water to flow freely.
8. Miscellaneous	Any condition not covered above that needs attention for the bioretention area to function as designed.			The design specifications are met.

a Describe the maintenance completed; if the needed maintenance was not conducted, note when it will be done.

Prepared by Randle Law Office 2018 www.jgradyrandlepc.com

www.h-gac.com/low-impact-development

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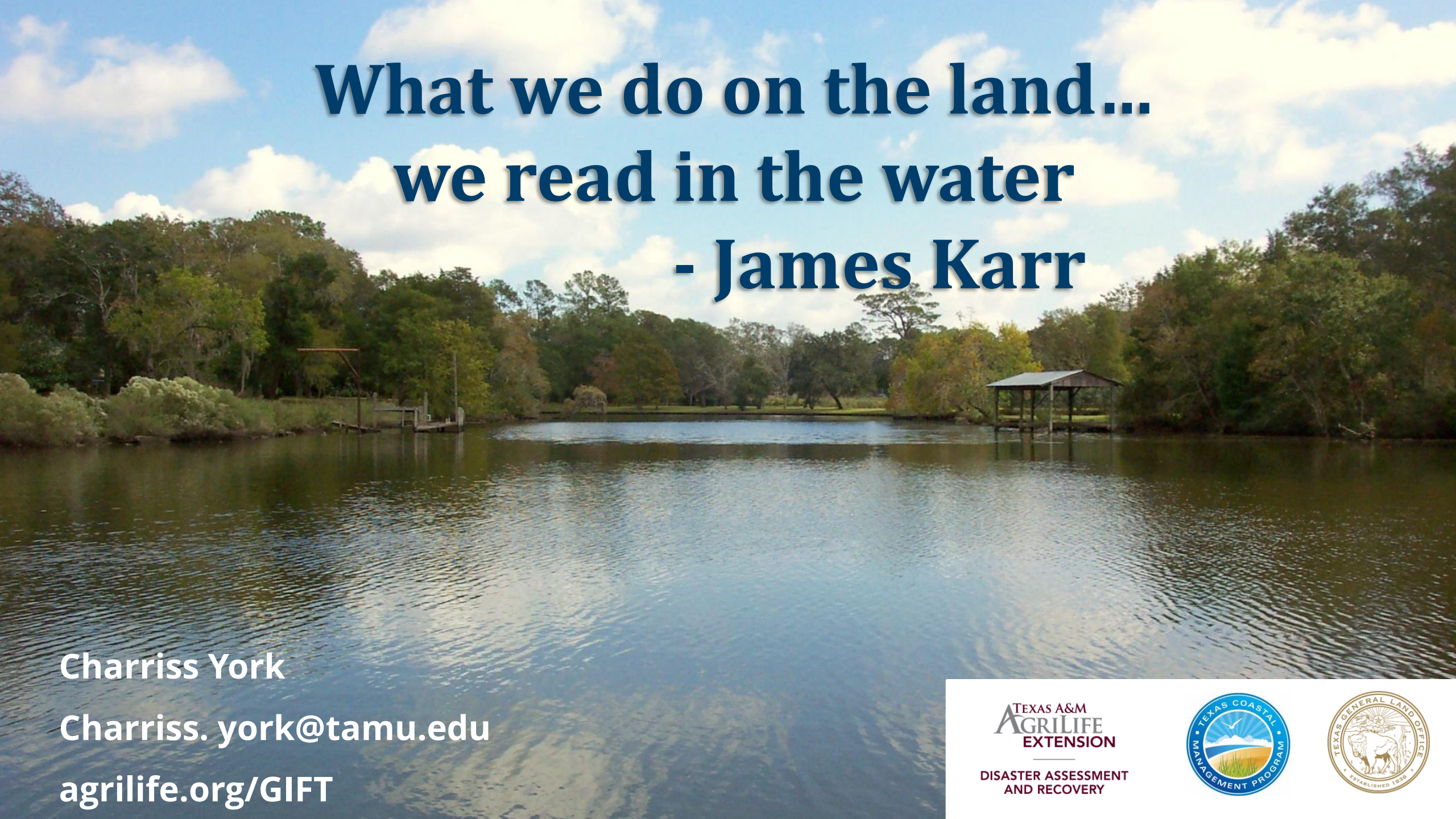
Funding Green Infrastructure

Grants: EPA, TECQ,TSSWCB, foundations, local businesses

- Pilot Projects
- New initiatives
- Innovative uses
- Educational aspects

Locally derived sources: taxes, bonds, CIP

- Maintenance
- Long term funding



What we do on the land… we read in the water - James Karr

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Disaster Assessment and Recovery

Texas Coastal Management Program

Texas General Land Office