

#### Acknowledgments

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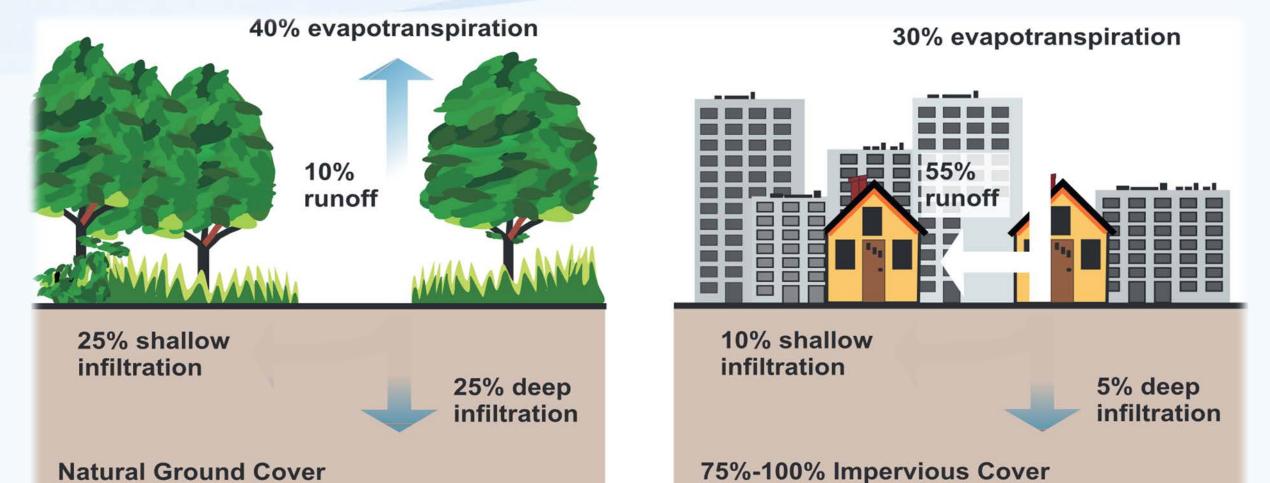
#### The problem

Negative impacts to water quality caused by the polluted stormwater runoff generated in urbanized or urbanizing landscapes



(Texas State University EHSRM 2014)

#### The problem



(US EPA 2003)

### The Solution: Best Management Practices

#### US EPA's Minimum Control Measures:

- 1. Public Education
- 2. Public Involvement
- 3. Illicit Discharge Detection and Elimination
- 4. During Construction
- 5. Post-Construction
- 6. Pollution Prevention













(US EPA 2014)

### Best Management Practice?















#### The Good News!

#### From Traditional/Conventional... To Integrated

Drainage Systems

Reactive Approach

Engineer-Driven

Protection of Property

Piping and Conveyance

Limited Consultation

Local Government Ownership

Focus on Extreme Storm Events

Peak Flow Thinking

→ Ecosystems

→ Proactive Approach

→ Interdisciplinary Team-Driven

→ Protection of Property AND Habitat

→ Mimic Natural Processes

→ Extensive Consultation

→ Partnerships with Others

→ Rainwater Integrated Land Use

→ Volume Based Thinking



### Green Infrastructure and Low-Impact Development

- Downspout Disconnect
- > Rainwater Harvesting
- Raingardens
- ➤ Bio-swales
- > Permeable Pavement
- ➤ Green Streets and Alleys













(US EPA 2014)

### Green Infrastructure and Low-Impact Development

- ➤ Green Parking
- Planter Boxes
- Urban Tree Canopy
- > Green Roofs
- Cluster Development
- Riparian Buffers



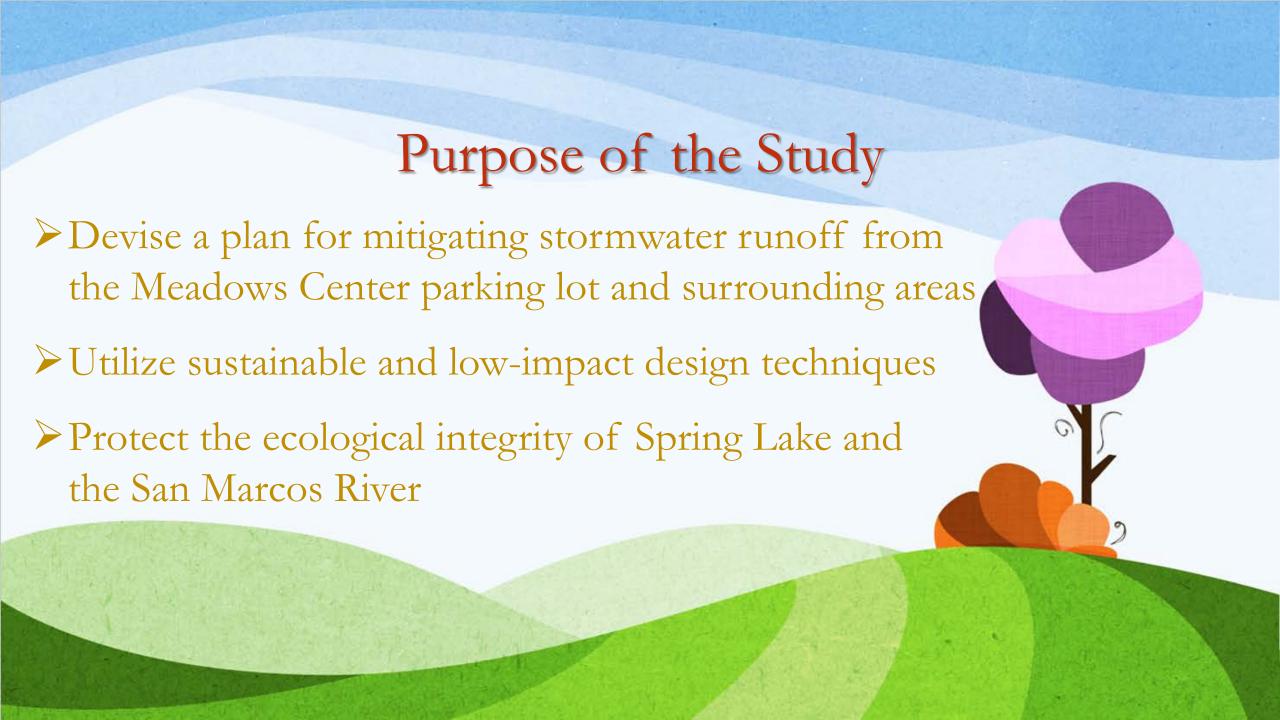












### The Importance of Managing Stormwater

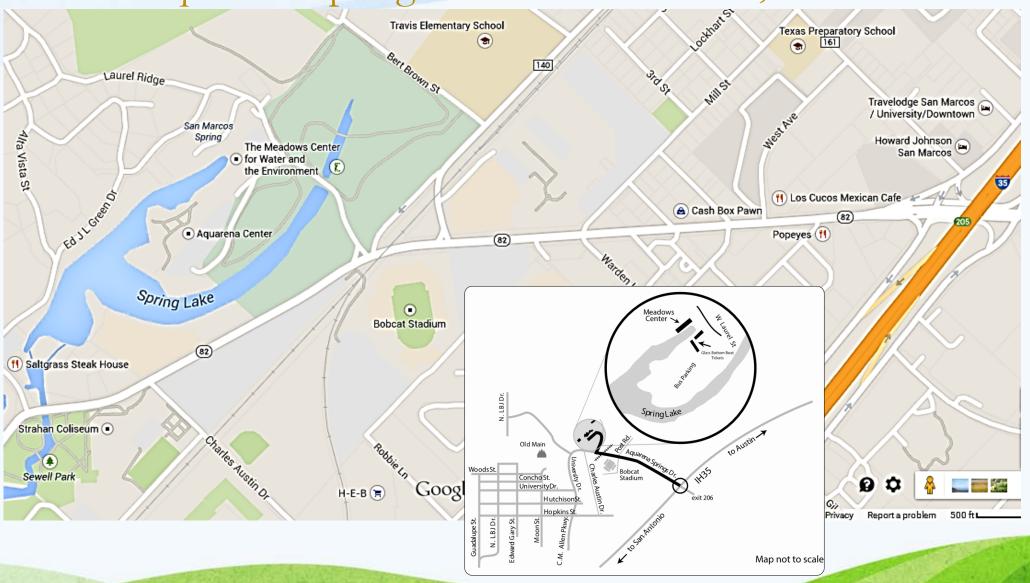
- Downstream flooding
- Stream back erosion
- ➤ Increased turbidity
- ► Habitat destruction
- >Stream flow
- Combined sewer overflow
- ➤ Infrastructure damage
- Contaminated stream, rivers, and coastal waters



(US EPA 2014)



#### Study Site: The Meadows Center for Water and the Environment 951 Aquarena Springs Drive San Marcos, TX 78666







## Site Map



## Stormwater and Sunlight Flow



#### Rainfall Rates & Volume

#### Depth & Infiltration

10-year, 24-hour Storm Event = 6.5 inches

Parking Lot (~1.3 acres/~56,000 ft²) 
$$\rightarrow$$
 Grassy Strips (~17,000 ft²)  $Q_{\text{peak}} = ~8 \text{ ft}^3/\text{sec}$  (~3,600 gal/min)  $V = ~38,000 \text{ ft}^3$  (~285,000 gal)  $V = ~29,000 \text{ ft}^3$  (~220,000 gal)  $V = ~29,000 \text{ ft}^3$  (~220,000 gal)

Main Buildings (~8,000 ft²) 
$$\rightarrow$$
 Large Grassy Area (~ 22,000 ft²)  $Q_{peak} \equiv \sim 1.1 \text{ ft}^3/\text{sec } (\sim 480 \text{ gal/min})$   $V = \sim 16,000 \text{ ft.}^3 (\sim 120,000 \text{ gal})$   $V = \sim 4,100 \text{ ft}^3 (\sim 30,500 \text{ gal})$   $V = \sim 30 \text{ hours } (f = 0.3 \text{ in/hr})$ 

## Critical Drainage Areas





## Overview of Conceptual Design



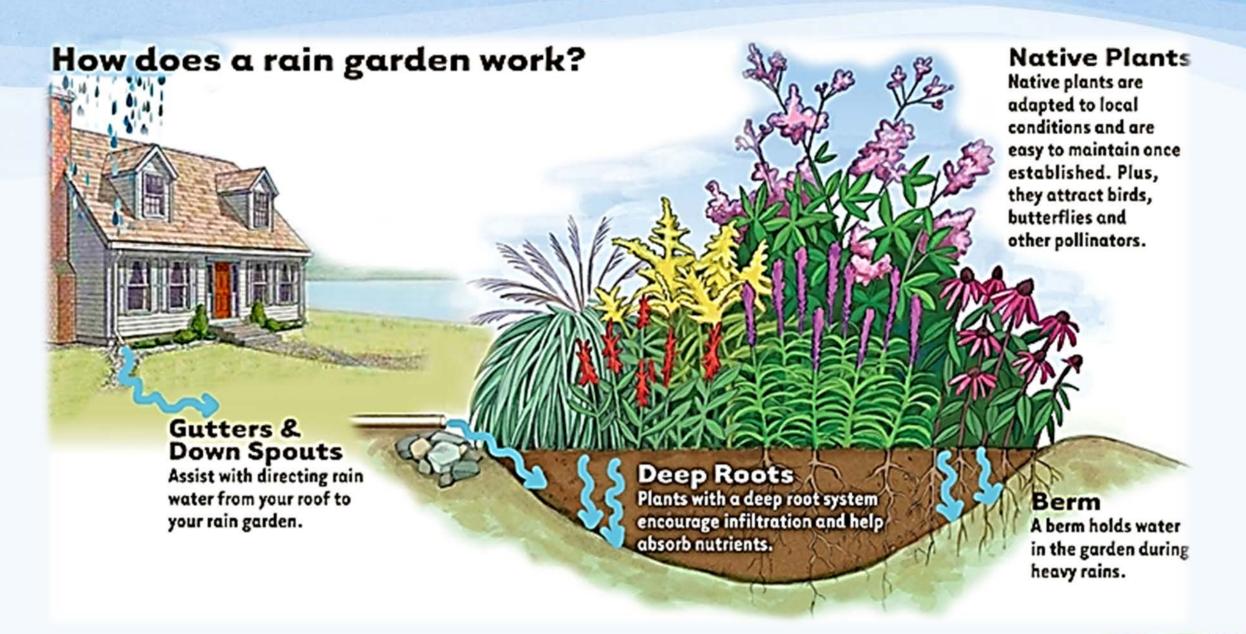














## Target Area #2

















## Target Area #5



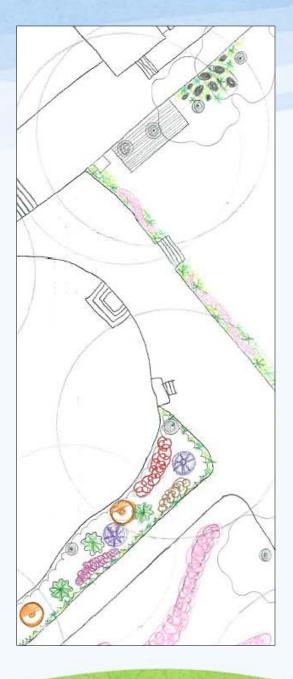










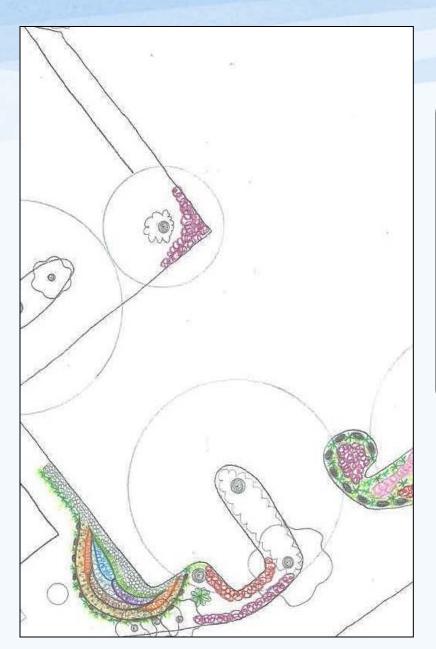
















#### Suggested Plants List and Maintenance Guidelines

Common Name Genus species	Characteristics	Form/Function	Bloom Time and Propagation	Maintenance
Meadow Sedge Carex perdentata  (Grow Green)	Perennial Grass Evergreen Height= 1-1.5 ft. Spread=1.5 ft. FAC(wet or dry) Sun/Part Shade	Ornamental Clumping Deep roots Water retention Heat tolerant Deer resistant Poor drainage ok	Spring Bloom  Fall seed harvest  Propagate by seed or root division	Can be mowed if too tall; however, 1 foot is ideal for water retention.
Texas Sedge Carex texensis  (LBJWC)	Perennial Grass Evergreen Height=1 ft. Spread=1 ft. FAC(wet or dry) Sun/Part Shade	Groundcover Buffer Deep roots Water retention Heat tolerant Deer resistant Poor drainage ok	Fall seed harvest  Propagate by seed or root division	Can be mowed if too tall; however, 1 foot is ideal for water retention.

#### Itemized List of Materials, Cost, and Source

Estimated cost: \$ 3,700 - 6,200 (labor not included)

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Meadow Sedge Carex perdentata	4"/ 20-count flats (wholesale)	\$21/ flat (x8) ~ \$ 168.00	Native Texas Nursery
At least 150 plants	4"/ 18-count flats (wholesale) 1 gallon pots (wholesale)	\$27/ flat (x8) ~ \$ 216.00 \$3.75/pot (x75) ~ \$ 281.25	Far South Nursery
Texas Sedge  Carex texensis (Difficult to find)  Alternative: Cherokee Sedge  Carex cherokeensis  At least 150 plants	4"/ 18-count flats  1 gallon pots (wholesale)	\$27/ flat (x8) ~ \$ 216.00 \$3.75/pot (x75) ~ \$ 281.25	Far South Nursery
River Fern	1 gallon pots (wholesale)	\$3.65/pot (x10) ~ \$ 36.50	Native Texas Nursery
Thelypteris kunthii  About 20 plants	1 gallon pots (wholesale) 1 gallon pots	\$3.75/pot (x10) $\sim$ \$ 37.50 \$3.50/pot (x10)	Far South Nursery Wrights Nursery
	(wholesale)	~\$35.00	
Coralberry/ Indian Currant Symphoricarpos	1 gallon pots (wholesale)	\$4.00/pot(x50) ~ \$ 200.00	Native Texas Nursery
orbiculatus  At least 100 plants	1 gallon pots (whole sale)	3.75/pot(x50) $\sim $187.50$	Far South Nursery
At Rast 100 plants	1 gallon pots (wholesale)	\$3.50/pot(x50) ~ \$ 175.00	Wrights Nursery

## Overview of Conceptual Design



# Thank You!

Questions?

Comments?

Concerns?

Contact: alexatosa@gmail.com