SAN ANTONIO CLIMATE READY

"Water Sponge/Carbon Sink" City

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Topics to be covered

- Background
- Current knowledge.
- What are the economic justifications?
- What is San Antonio’s potential?
- What are possible incentive programs?
- How do we use this information and going forward?

Background

1. Greater Edwards Aquifer Alliance Task Force's Stormwater management recommendations with an emphasis on green infrastructure.

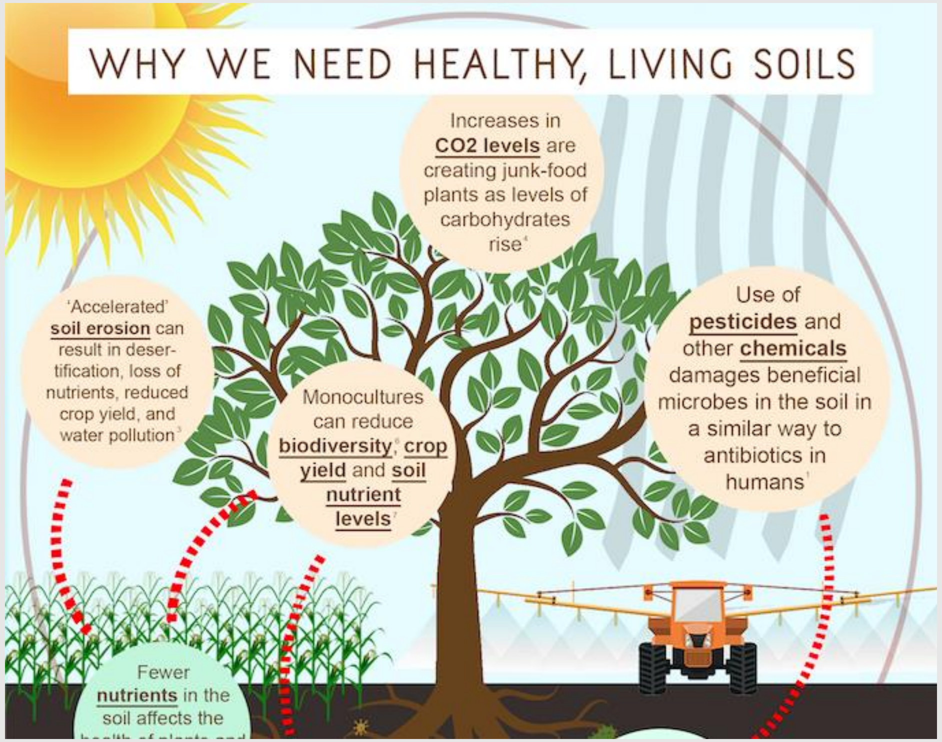
2. City of San Antonio Climate Action and Adaptation Plan (CAAP) with emphasis on emission reduction and mitigation strategies.

- A favorite mitigation strategy was to maximize carbon sequestration of public green spaces.
- Mechanisms to implement include policies, ordinances, incentives and lots and lots of education (perceptions of aesthetics).

3. The same practices that will improve carbon sequestration are ones that will also improve stormwater management; all through the use of green infrastructure.

Current Knowledge: Water Storage & Carbon Sequestration

1. Lots of new research emerging, but there is little local data.
2. Therefore data collected globally and nationally can only be used as guidance.
3. Research has been focused on agriculture lands but is increasing for other ecosystems:
    - Turf
    - Prairie
    - Forest
    - Wetland
    - Riparian/floodplain



4. From this research we can create recommendations to increase potential for water storage and carbon sequestration and understand what types of ecosystems provide the greatest benefits.

Ecosystems Potentials	Stormwater Run-off Reductions	Sediment Removal Depending on size	Net Carbon sequestration (Mg* C ha-1yr-1)
Turf/lawns Minimal inputs BMPs used	10-57%	24-73%	0.7 1.3
Prairie	37-98%	Up to 95%	0.7
Forest/trees	65%	70-90%	0.84
Active Riparian/ Floodplain Forest	9-100%	92-96% Mix vegetation w trees	3.4 68-158**
Wetland	NA	NA	1.6-4.7, 10**
Prairie Pothole Wetlands	NA	Effective, but wetland is lost	50-70**
LID Feature	First 1.5 " of event	80%	??

* Mg = Ton , ** Not given as net so unable to compare directly

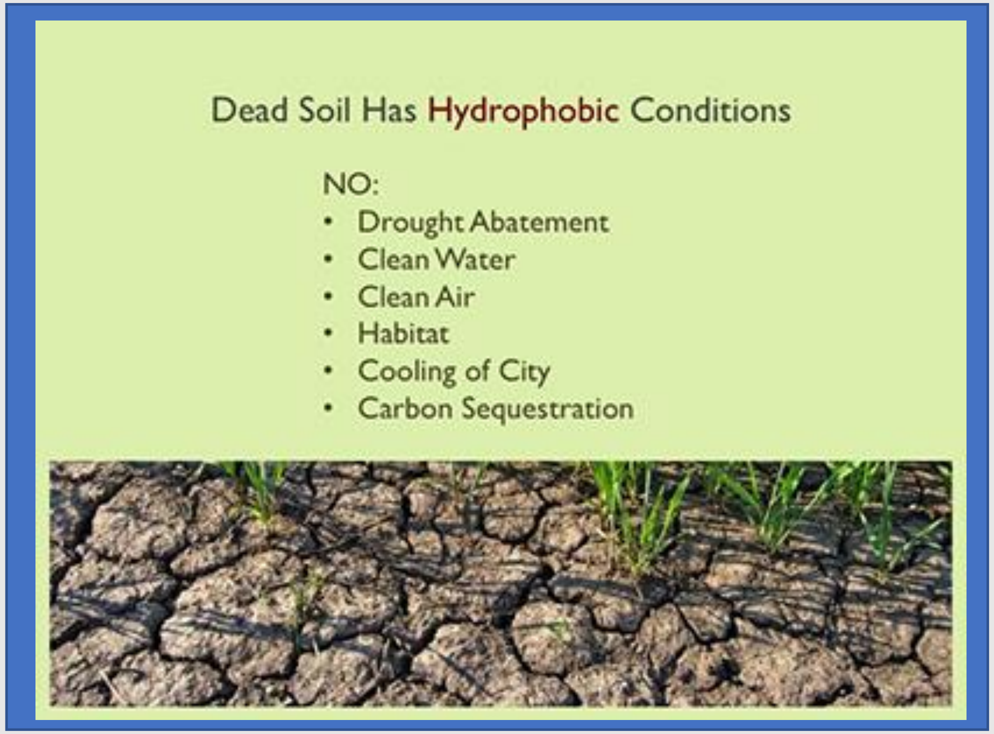
How do we use this information?

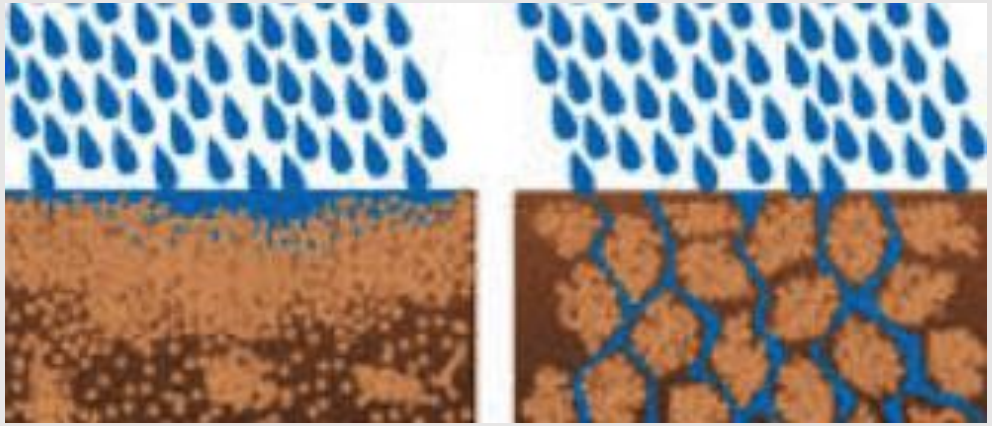
These dead and compacted soils no longer provide ecosystem services.

Using Information: starting with the low hanging fruit

Modifying soil and vegetation practices have minimum costs and could save money.

- Goals
    1. Increase soil infiltration and water storage
- Results
    1. Reduce stormwater runoff and peak flows
    2. Improve water quality
    3. Reduce need for irrigation
    4. Build healthier soils, encourage more vibrant landscapes and create resilience
    5. Sequester more carbon dioxide while reducing summer temperatures
- Barriers
    1. Lack of education
    2. Public perceptions and habits

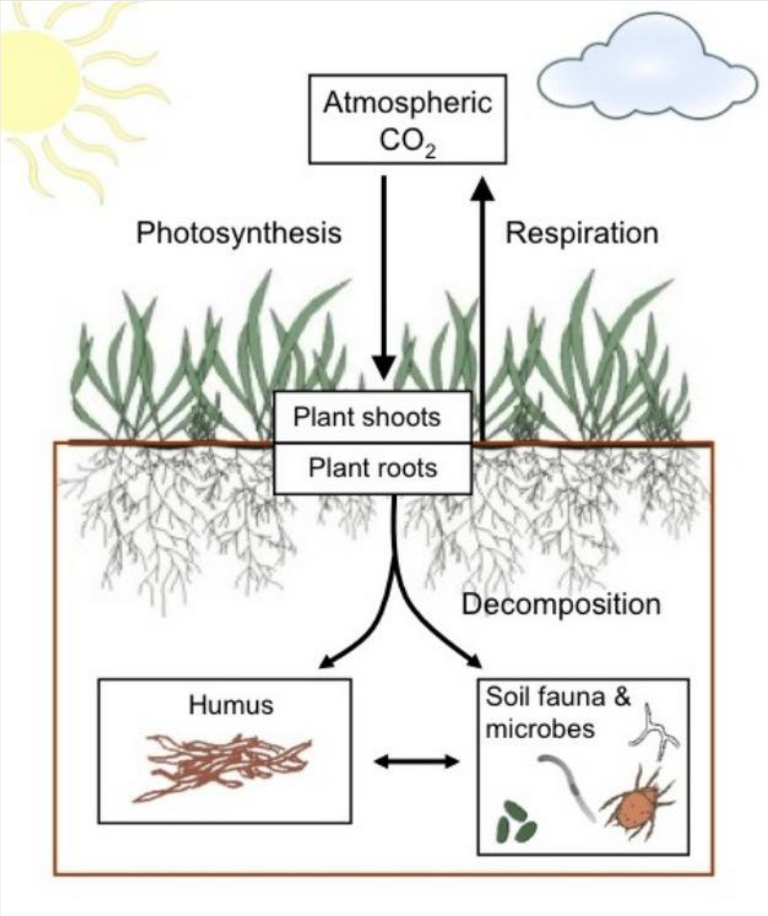




Modifying soil and vegetation practices

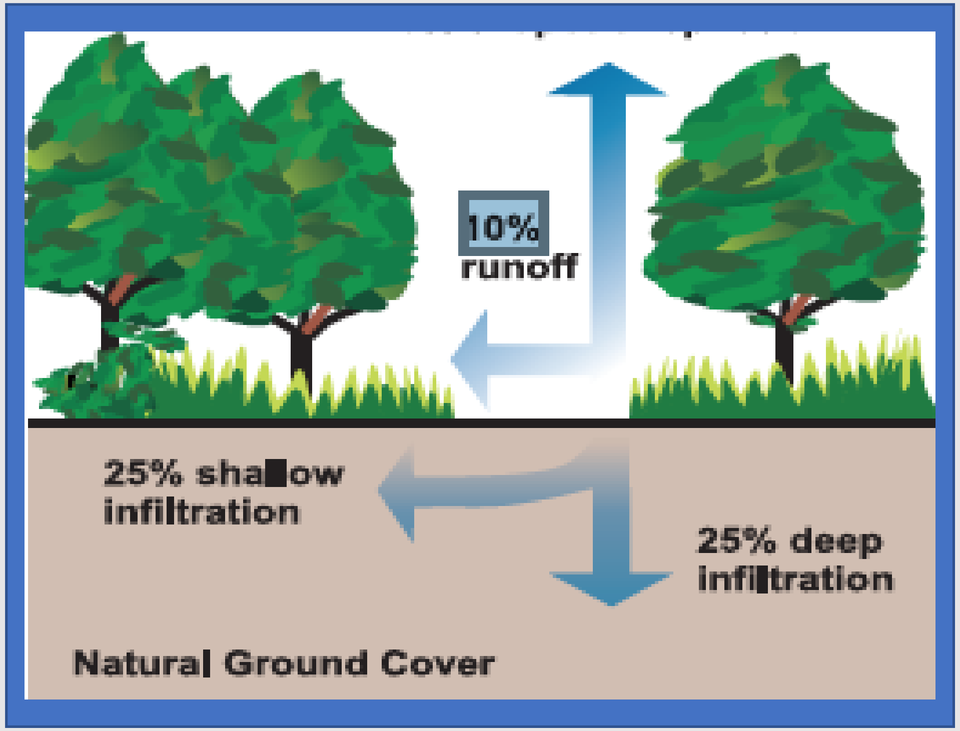
Increasing infiltration and water storage capacity:

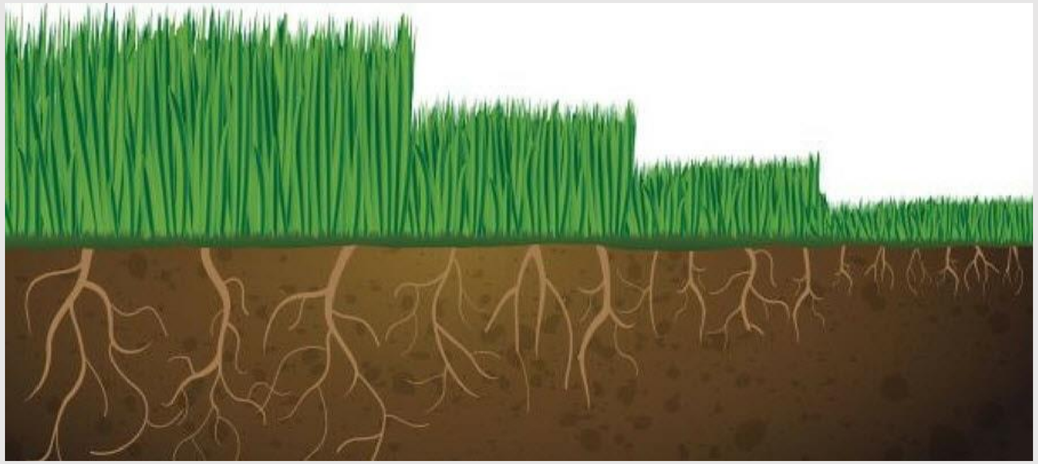
- Increasing soil organic matter (SOM) by 1% can store an additional 20,000 gal water/acre.
- SOM is the basis of soil carbon. Increase the SOM and the amount of stored soil carbon will increase.
- Soil can sequester ~ 3x more carbon than above ground vegetation.
- There is a hypothesis that a 2% increase in SOM of the world's soils can soak up the excess CO^2 within a decade.



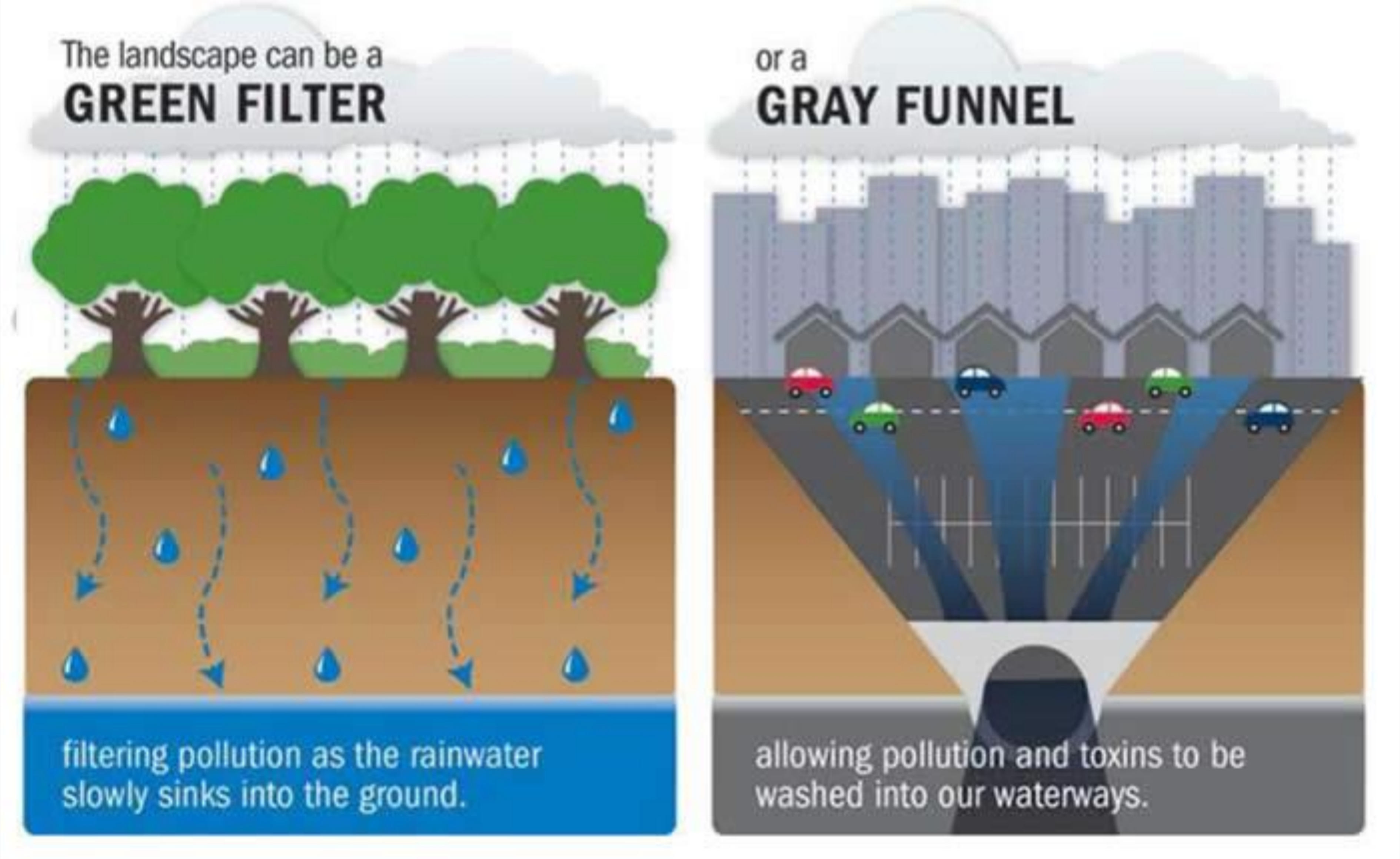
Increasing infiltration and water storage capacity:

- Undisturbed soils with a continuous living perennial cover is the best strategy for improving water infiltration.
- Mowing practices that allow turf to grow 4-5” can increase infiltration so that a 1”/hr rain event will be absorbed. This will practice will reduce:
  - **Soil water evaporation,**
  - **Soil temperatures that increases CO^2 release from the soil,**
  - **Soil erosion (sediment is the #1 pollutant in the US).**
- Adding compost increases the SOM while providing co-benefits.

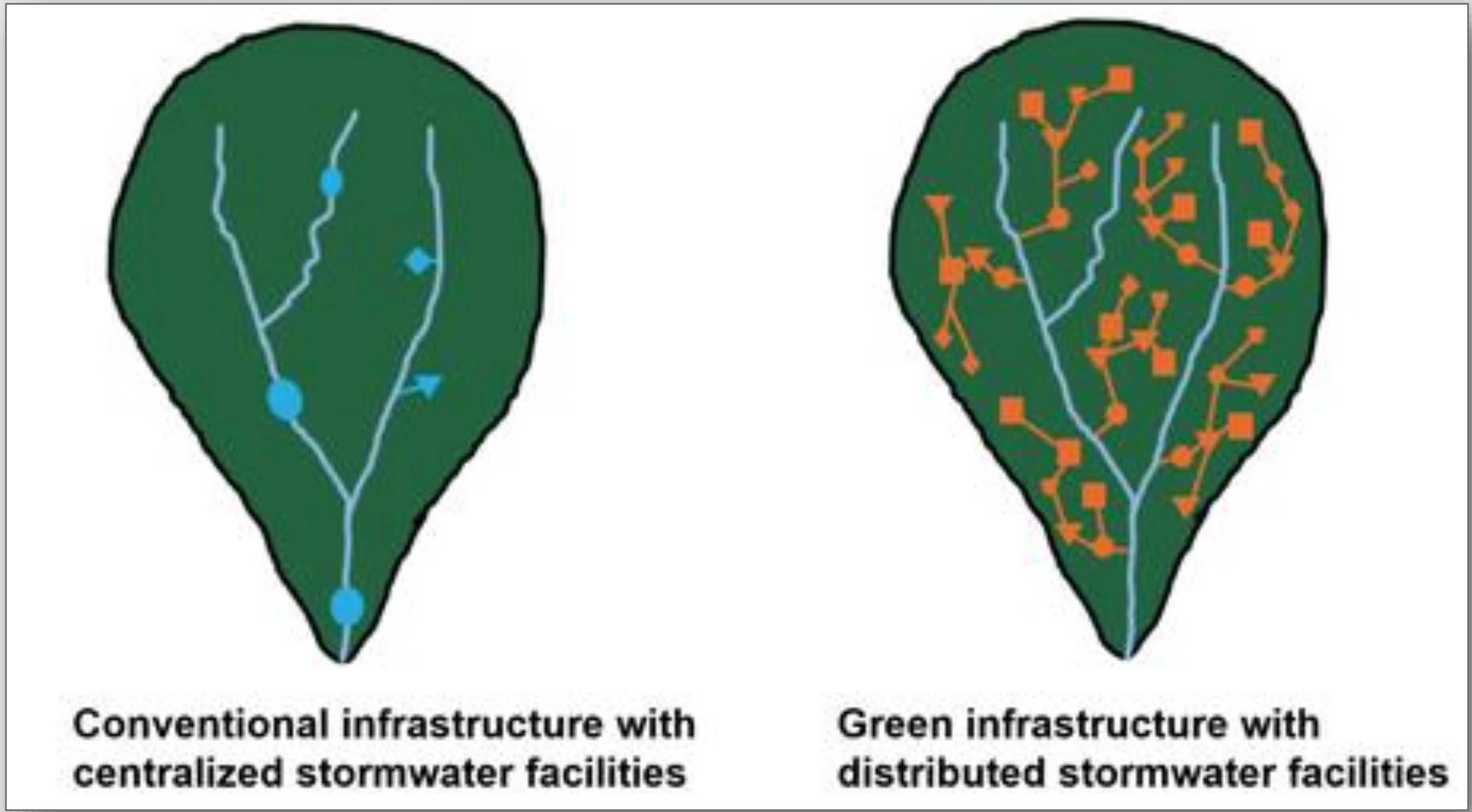




Use information: not a low hanging fruit, but a paradigm shift beginning with stormwater management



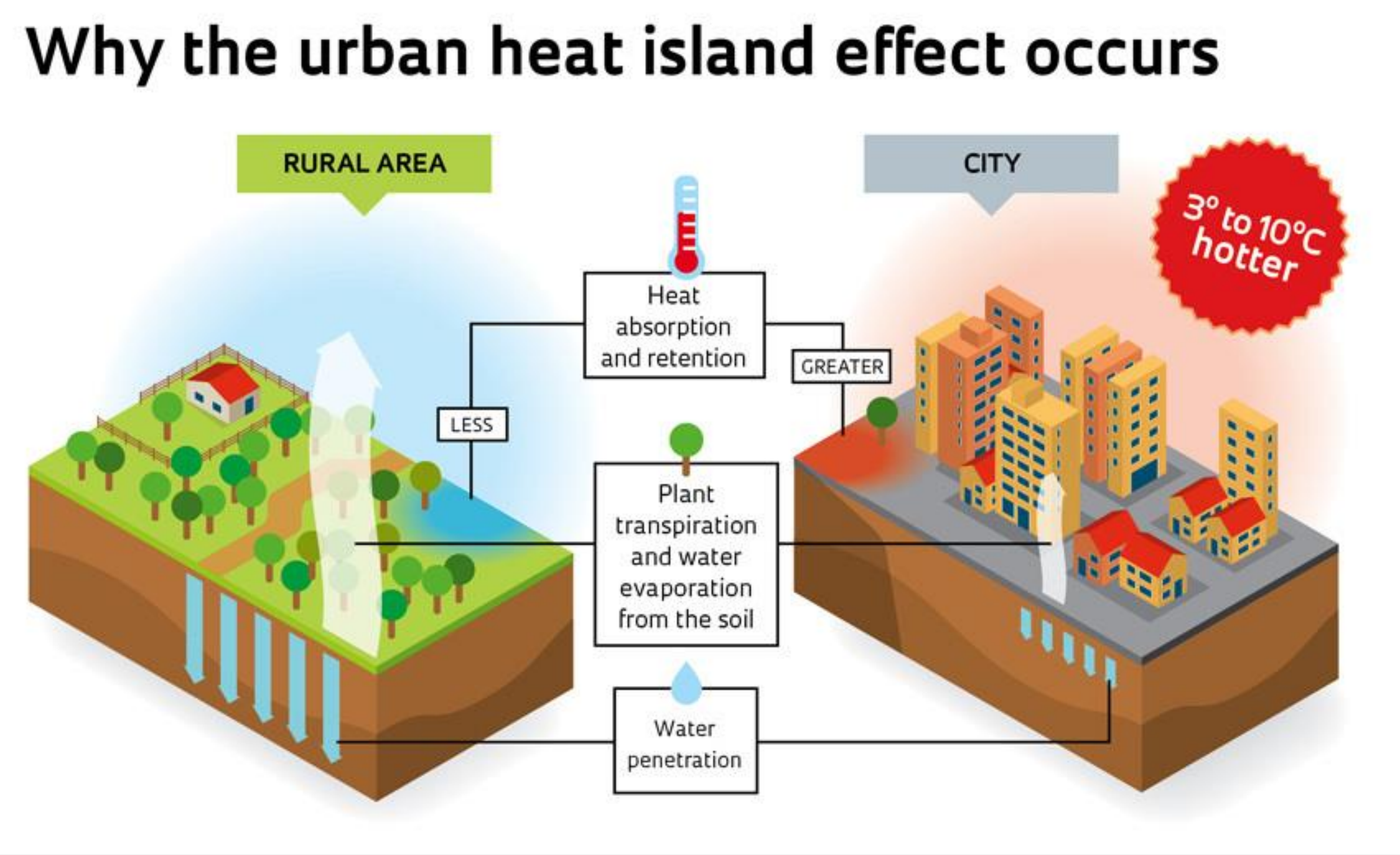
Currently flood control projects focus on specific areas of flooding vs utilizing a watershed approach



The watershed approach allows neighborhoods to be retrofitted with appropriately scaled green infrastructure, enhancing quality of life within communities; cooling temperatures and storing more soil water and carbon.

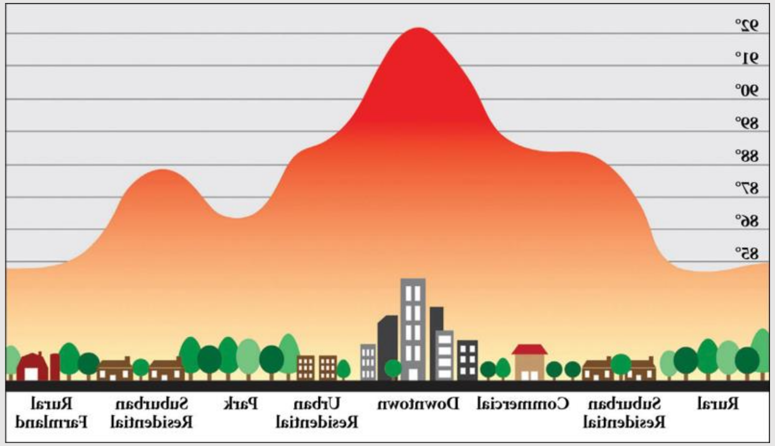
Other factors to consider

- Policies for climate mitigation on land rarely acknowledge biophysical factors, such as:
  - Reflectivity,
  - Evaporation,
  - Surface roughness.
- Yet such factors can often alter temperatures more than carbon sequestration does.



Urban Heat Island: San Antonio

- From 1997 to 2010, data recorded that San Antonio's Urban Heat Island (UHI) is increasing at a rate of 0.8°C per decade (33.44 F).
- A study to measure heat retention of concrete in urban areas found that a summer day with a peak temperature of 90°F, asphalt had an average temperature of 195°F and concrete had an average temperature of 155°F.
- This data illustrates the concern for increasing the use of concrete especially as it relates to gray infrastructure.



Concrete Emissions

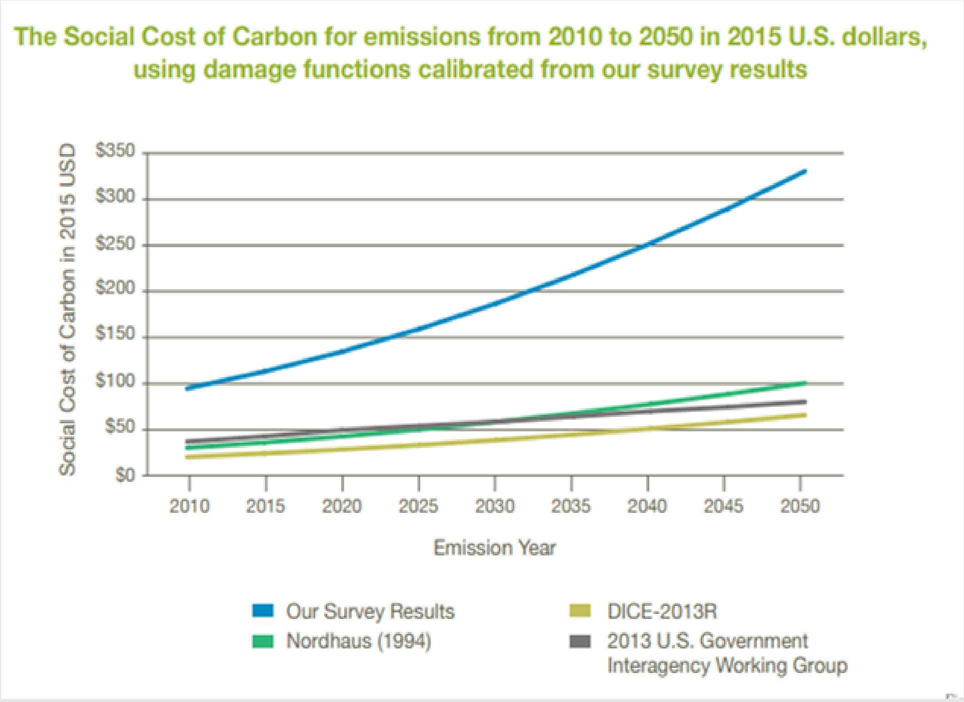
- 100-300 kg of CO2 stored per cubic meter of concrete (170 to 500 lb per yd3)

- A survey by Portland Cement Assoc. states: 2,044 lb of CO2 is emitted per 2,205 lb of manufactured portland cement.

- Study in 2005 states: US cement industry produced roughly 105.7 million tons.

- Societal costs of 1 ton of carbon equates to roughly $40 US.

- Nationally this carbon emission value is $3,932,040,000.



Economic Justifications

1. Utilizing GI/LID for a storm sewer in Lake Como, MN:

- Reduced spending by $500k compared to proposed gray infrastructure system.
- Addition savings were realized due to environmental services provided through GI/LID

2. A cost assessment n Lancaster, PA:

- Total saved was $120 million by utilizing green infrastructure vs gray infrastructure.
- In addition, plan realized $5 million in annual benefits over 25 year period.

Total Calculated Benefits (at Long-Term 25-Year Implementation)	
Estimated Value from Water Benefits Reduced CSS Gray Infrastructure Capital Costs (one-time) Reduced Pumping and Treatment Costs (per year)	 $120,000,000 $661,000
Estimated Value from Energy Benefits (per year)	$2,368,000
Estimated Value from Air Quality Benefits (per year)	$1,023,000
Estimated Value from Climate Change Benefits (per year)	$786,000
Estimated Value from other Qualitative Benefits	Not calculated
TOTAL **Avoided Capital Costs** **Annual Benefits**	 **$120,000,000** **$4,838,000**

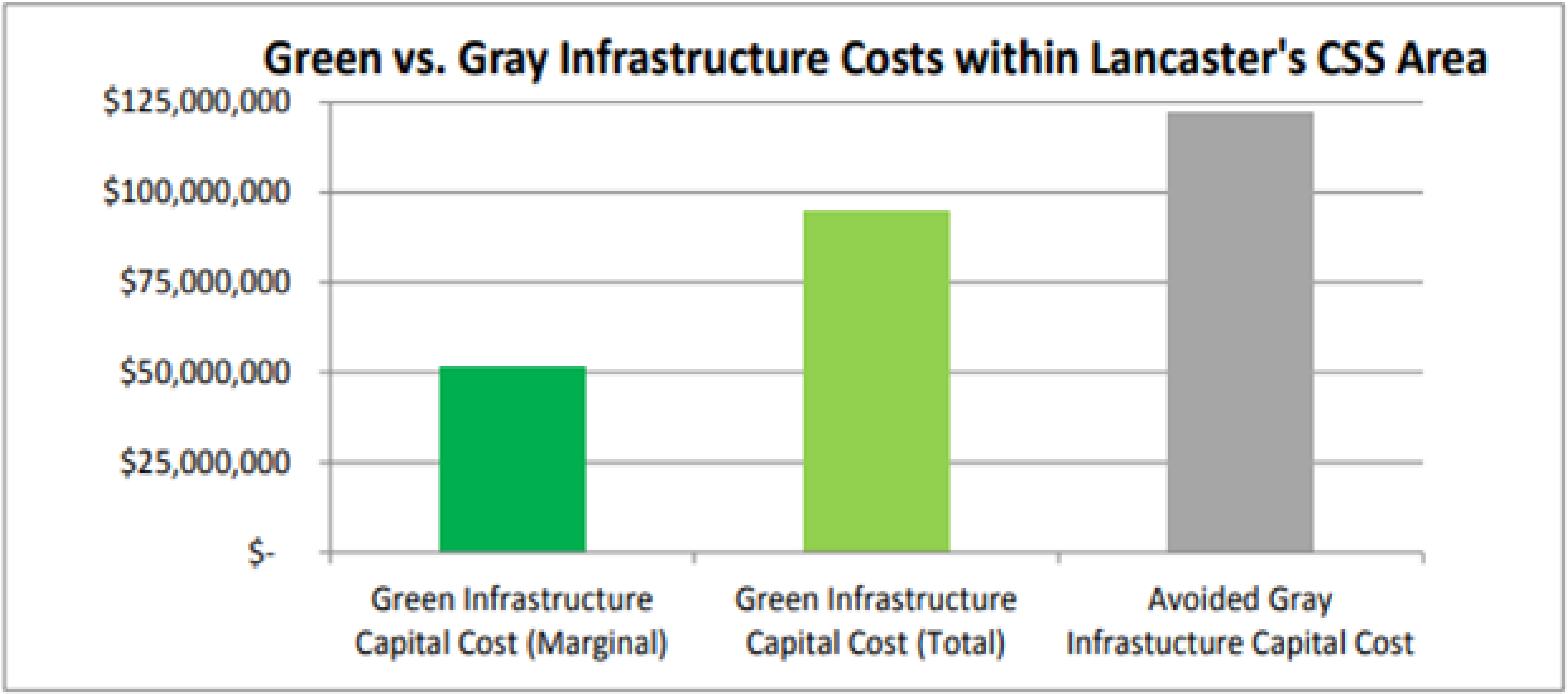


Figure 1: Comparison of avoided gray infrastructure costs to green infrastructure costs within Lancaster's CSS area.

Sponge City Program Case Study

G.I. Case Study: China

- In 2010, 35 major cities implemented G.I. practices to combat stormwater pollutants and to raise air quality
- Survey found 18.7 million tons of carbon sequestered with a density of 21.34t/ha. Equal to $74 million US.

SPC Case study: China

- 16 major cities receive $400 million in funding for
- GI/LID with the requirement to retain 70% of polluted stormwater
- Stormwater volume reduced: 31% / Flow reduced: 53%

Ecosystem Analysis: San Antonio

From a 2007 study, San Antonio’s 113,011 acres of tree canopy citywide:

- Manages 974 million cubic feet of stormwater
  - Economic value: $624 million
- Manages 12.7 million lbs of air pollutants
  - Economic value $30.2 million per year
- Carbon Storage & Sequestration
  - Storage: 4.9 million tons of Carbon
  - Sequestration: 38,000 tons annually
  - Economic Value: $1,520,000

Table 4. San Antonio Ecosystem Services with 2007 High Resolution Imagery by Land Use

	Area	2007 Tree Canopy	2007 Tree Canopy	Air Pollution Removal	Air Pollution Removal Value	Carbon Stored	Carbon Sequestered	Stormwater Value	Stormwater Value @ $.64 per cu. ft
	acres	acres	percent	lbs./ yr	dollar value	tons	tons	cu. ft.	dollar value
Urban Res	107,484	34,576	32	3,883,518	$9,249,691	1,487,866	11,583	327,368,176	$209,515,632
Suburban Res	259,311	85,434	33	9,595,751	$22,854,981	3,676,355	28,621	702,596,006	$449,661,444
CBD	1,066	131	12	14,763	$35,162	5,656	44	1,824,932	$1,167,956
Commercial	67,796	8,915	13	1,001,331	$2,384,951	383,633	2,987	83,795,961	$53,629,415

Note that the sum of the land uses stormwater values doesn't total to the citywide value. This is because each land use has a specified soil type, whereas citywide, soil type must be generalized for the entire area. Stormwater calculations listed here are based on a 2-year, 24 hour storm event. Calculations from a 5-year, 24 hour storm event are included in the Map Book as part of this project.

Urban Ecosystem Carbon Management:
What "Public" Lands Could We Use?

City Parks and Botanical Gardens	**15,337.6 ac with more than 150 miles of trails.**
Howard W. Peak Greenway Trails System	69 miles of greenway trails across the city, spanning 1,500 acres funded by Prop 1 local Sales Tax
Hemisfair	96.2 Acres with 19.2 Acres "park"
The San Antonio Riverwalk	15-mile urban waterway
Riparian/floodplain Areas;	~1,300 miles of waterways in Bexar County
San Antonio Natural Areas, funded by Prop 1: Edwards Aquifer Protection.	Crownridge Canyon NA, Eisenhower Pk, Friedrich Wilderness Pk, Hardberger Pk, Medina River NA, Walker Ranch Pk (77.4?) = 2,008.4 ACRES
CPS Energy Facilities and ROW	Acreage ???

Urban Ecosystem Carbon Management
What "Private" Lands Could We Use?

Mitchell Lake Wildlife Refuge	10750 Pleasanton Rd	600 ac and 600 ac wetlands
Land Heritage Institute	1349 Neal Rd. 78264	1,200 ac
Oblate School of Theology	285 Oblate Dr. at Blanco	41 ac
San Fernando Cemetery III	1735 Cupples Road	130 ac
BSA McGimsey Scout Park	NW Military Drive	140 ac
Valero Energy Corporation	1 Valero Way 78249	200 ac
School Districts Northside ISD	northwest San Antonio	>1000 ac

Potential of COSA Public Lands with a 1% increase in soil organic matter

Type of property	Acreage	Additional gallons of stormwater stored	Additional tons of carbon stored per year
Aquifer Protection	**156,475** acres	31,295,000,000	148,651
City Parks	**20,962** acres	419,240,000	19,914
Total for COSA's public lands	**177,437 acres**	**31,471,240,000**	**168,565**

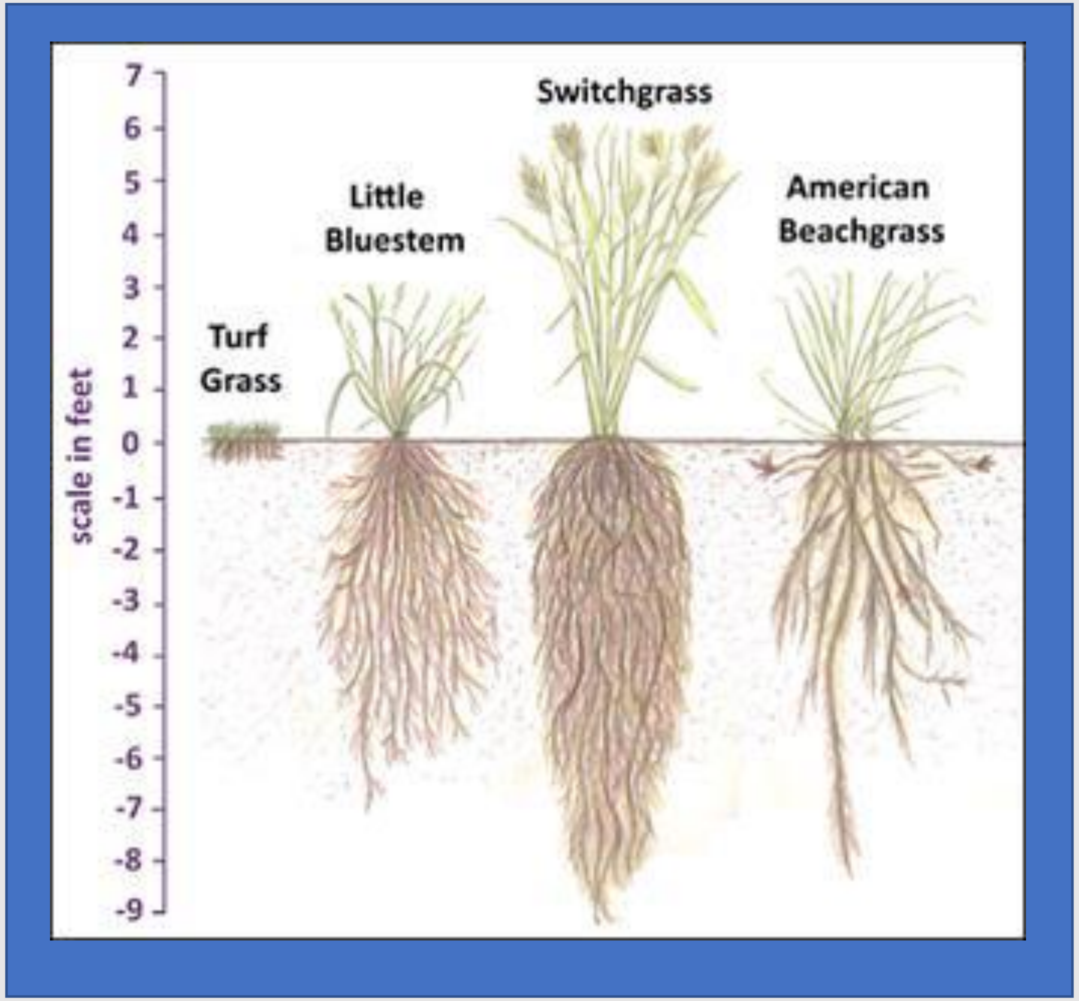
Incentives for private property owners

- Carbon Offsets paid by City
- Stormwater Fee reduction
- Technical Assistance
- Private Carbon+ Registry
- Municipal Bond and Property
- Insurance Risk Reduction
- Rating and Rewarding
- Recognition - Awards

Conclusions: Effective systems

Planting systems that provide the greatest benefits with the least amount of inputs (reduced carbon footprint):

1. A complex vegetative cover such as trees with plants growing underneath.
2. Adding a grass filter strip above the treed area, will increase effectiveness of sediment and pollution removal.
3. Prairies with a mix of native grasses and wildflowers - mowed 2x/yr.
4. Turf/Yards mowed no less than 3-4” high and organic matter (leaves, compost, mulch, etc.) is added every year.



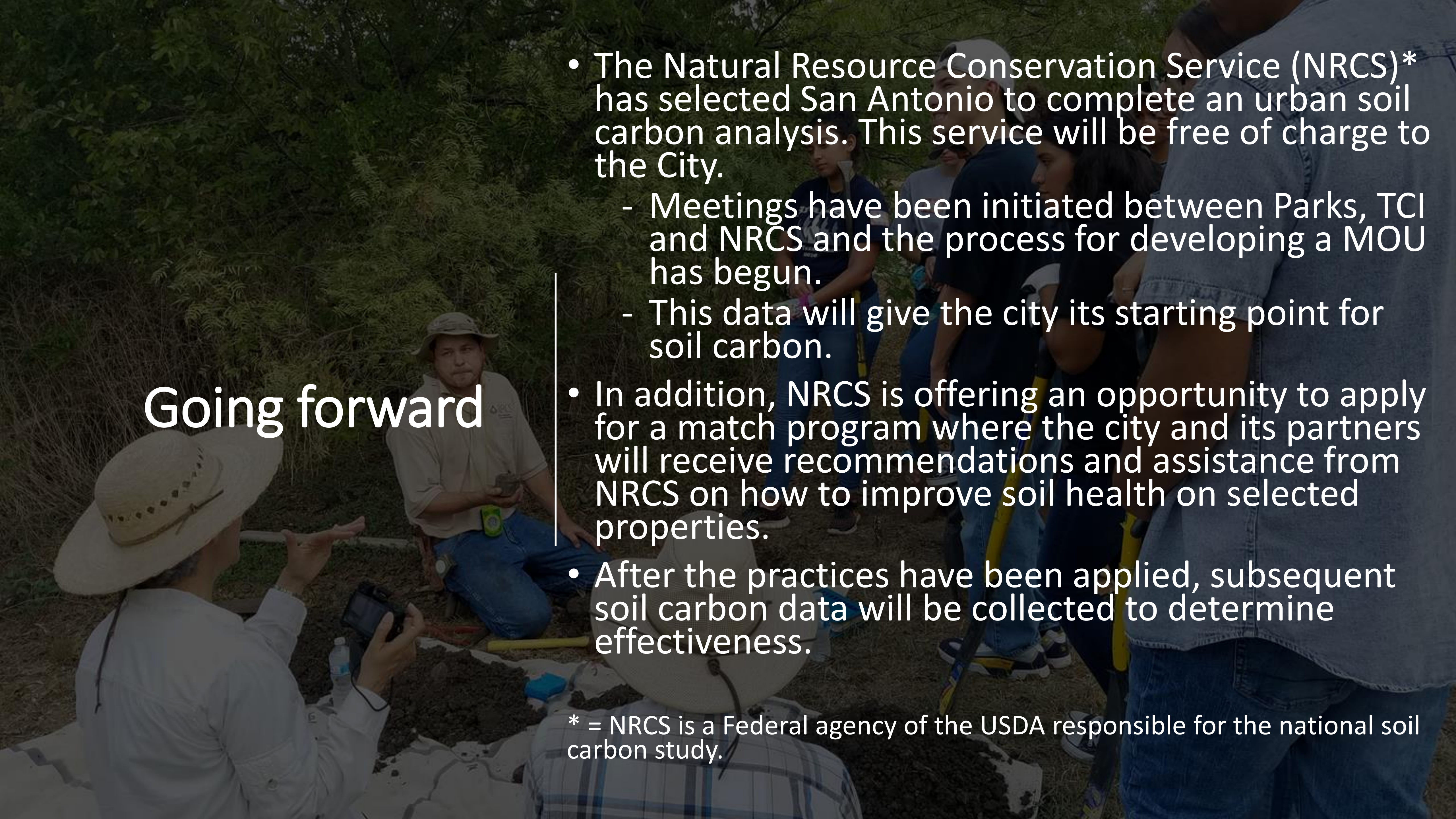
Native grasses and wildflowers naturally have deeper roots. Mowing reduces root systems.

Conclusions: Barriers to adoption

- Current commercial / residential stormwater and vegetation management practices.
- Public perception, aesthetics and the desire to minimize costs.
- Fear of higher vegetation for safety concerns.
- Lack of education especially within landscape maintenance personnel.

Conclusions: going forward

- Our parks system is an important part of the city's green infrastructure.
- Future directions:
    1. **Increase public education.**
    2. **Use 2020 UDC update process to increase park lands and support LID and Green Infrastructure.**
    3. **Support Parks and TCI to modify management practices and increase restoration efforts.**
    4. **Incentivize effectively the use of LID, natural channel design and nature based green infrastructure for stormwater.**



Going forward

- The Natural Resource Conservation Service (NRCS)* has selected San Antonio to complete an urban soil carbon analysis. This service will be free of charge to the City.
  - Meetings have been initiated between Parks, TCI and NRCS and the process for developing a MOU has begun.
  - This data will give the city its starting point for soil carbon.
- In addition, NRCS is offering an opportunity to apply for a match program where the city and its partners will receive recommendations and assistance from NRCS on how to improve soil health on selected properties.
- After the practices have been applied, subsequent soil carbon data will be collected to determine effectiveness.

* = NRCS is a Federal agency of the USDA responsible for the national soil carbon study.

Conclusions and Summary

Water Sponge:

- Increasing our soil's capacity to store water will lead us towards reducing peak flows that cause flooding, improving water quality in our streams and rivers, promoting water conservation, increasing aesthetics with healthier landscapes while providing a slew of co-benefits.

Carbon sequestration/soil carbon storage:

- Soil Carbon can be an active part of the solution to create climate resilience.

Thank you for your attention. Any questions?

WATER QUALITY

AIR QUALITY

WATER CONSERVATION

TERRESTRIAL AQUATIC HABITAT

BIODIVERSITY

CLIMATE CHANGE AND FLOOD RESILIENCY

AESTHETICS AND COMMUNITY HEALTH

RECREATIONAL ACTIVITIES