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Using Land Conservation to Create a More Resilient Future

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To be discussed

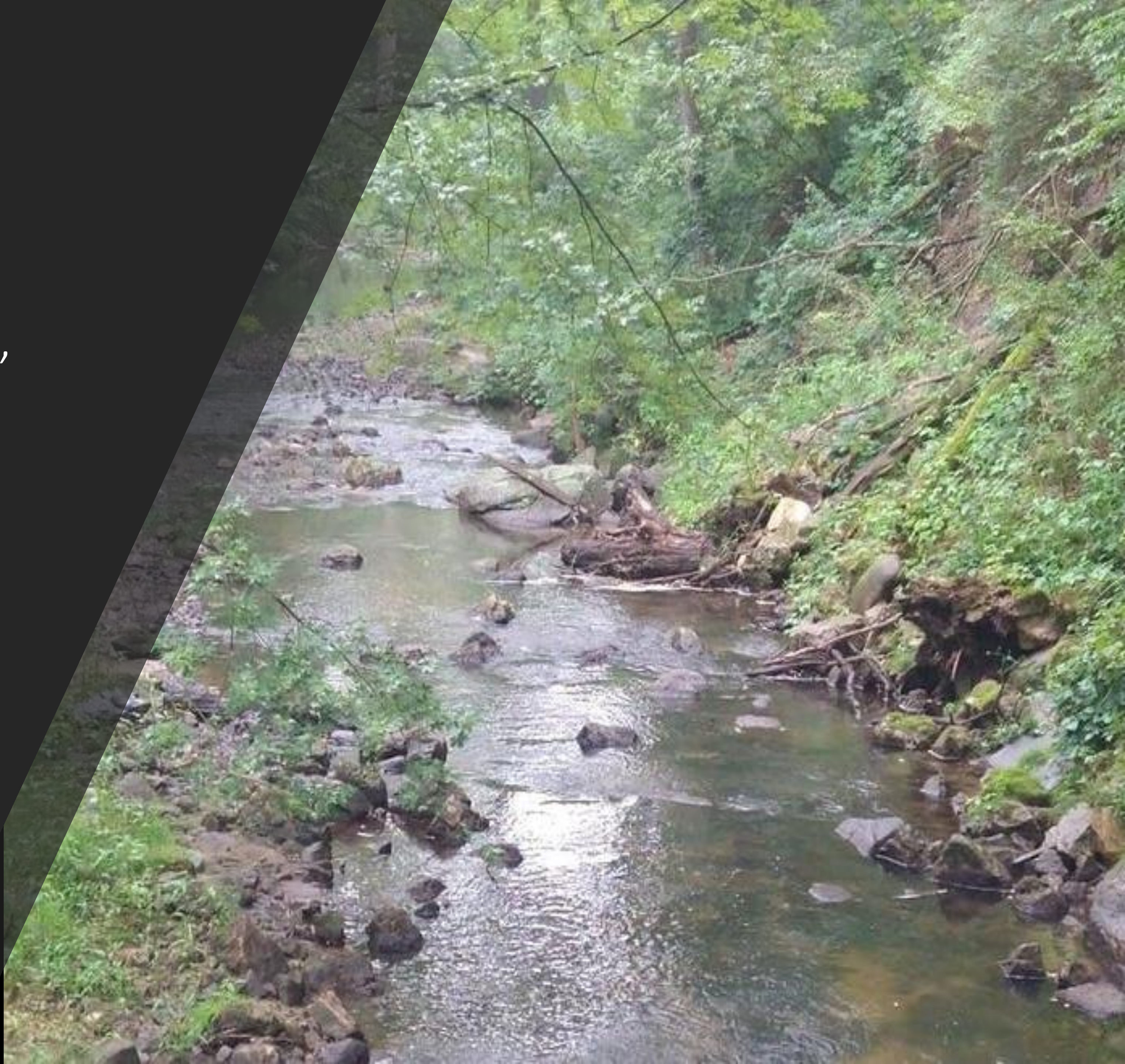
- Ecosystem services provided by conserved land/open space.
- Sources of those services and how they can be measured and assigned value.
- How they can be enhanced or lost.
- Does the cost of economic gain consider the true value of the loss of these services?
- Who pays?
- Can we do a better job and if so – how?

The ecosystem services/benefits provided by the natural world creates create resiliency.

* Services regulated by local, state and federal laws which function as economic drivers.

- Water quantity*
- Water quality*
- Air quality*
- Recreational activities
- Biodiversity
- Terrestrial and aquatic wildlife habitat
- Aesthetics and community health
- Climate and flood resiliency*

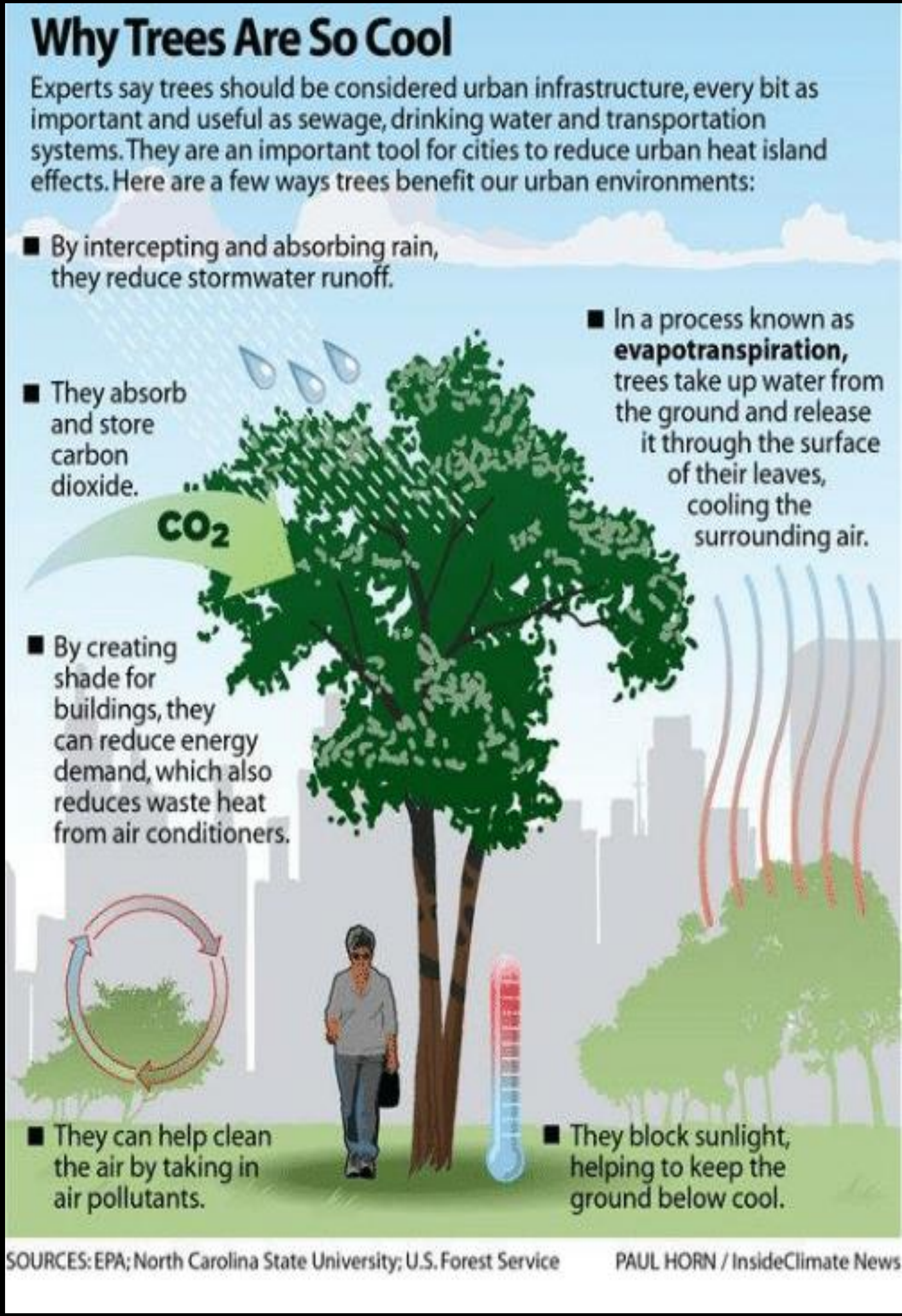
- Some services can easily be measured by their quantity and market value.
- While it is understood market value does not reflect total value, considering other criteria increases complexities:
    1. Avoided costs when land is preserved.
    2. Replacement cost to compensate for ecosystem services lost.
    3. Recreational enjoyment.
    4. Value of biodiversity.
- Further complexities occur when considering land "health".



- And since this can become so complex and this presentation is not on economic valuation of ecosystem services…
- Our focus will be on identifying the sources of services and maximizing their benefits.
- For more information on ecosystem valuation see the Conservation Strategy's Fund's "Valuation of ecosystem services" YouTube series.

The sources of services

- It has been well documented that trees and vegetation provide ecosystem services.
- In fact, the recently released SA Urban Forest Inventory and Analysis states that each year, our urban forest (137.8 million trees):
  1. Removes more than 6,500 tons of air pollution, saving $63 million in health costs.
  2. Reduces stormwater runoff by over 380 million cubic feet and
  3. Saves residents $22 million ($13.89/person) in energy costs each year.



What is less known is the strategy of using soils to provide ecosystem services

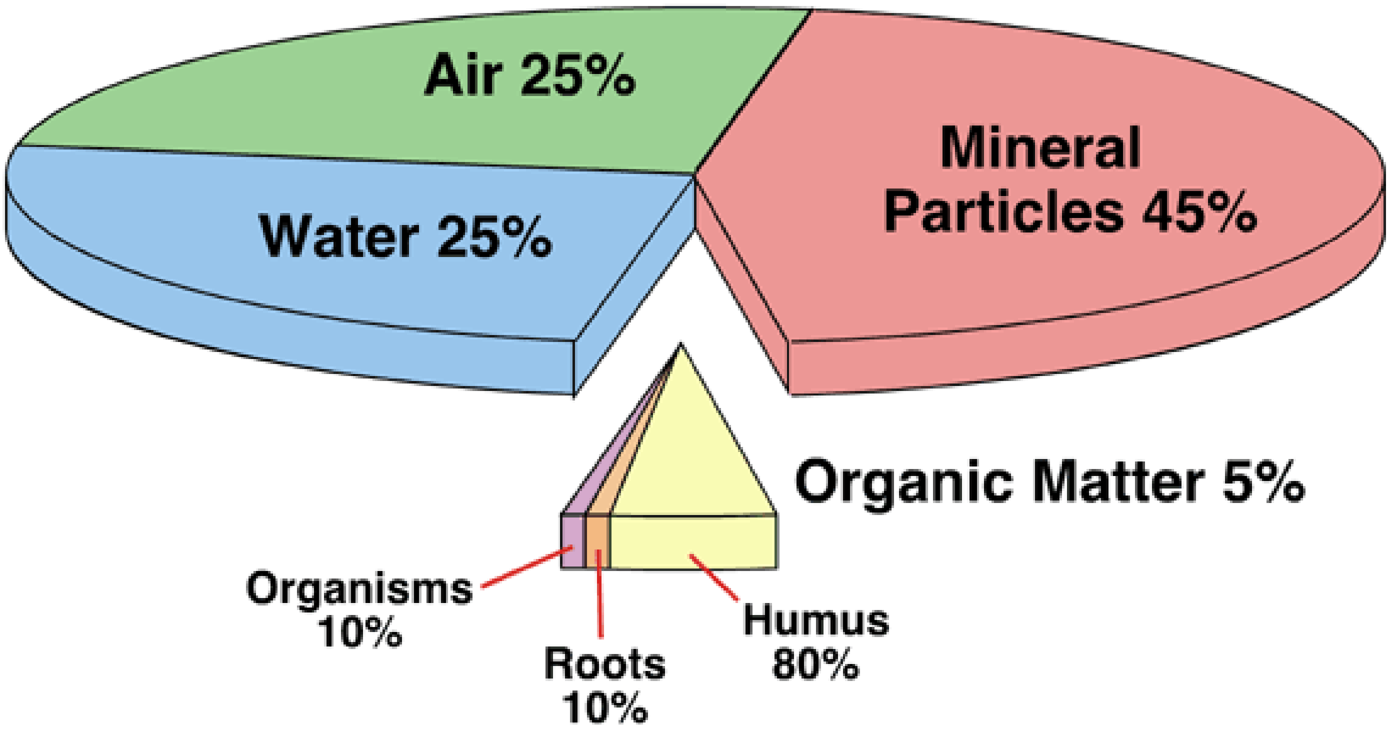
Healthy Soils Support Ecosystem Function

- Water Storage + Filtration
- Carbon Capture + Storage
- Biological Function + Diversity
- Productive Capacity

Using soils as a strategy for resiliency

- Soils are made up of mineral particles such as clay, silt, sand and gravel and organic matter with some air and water.

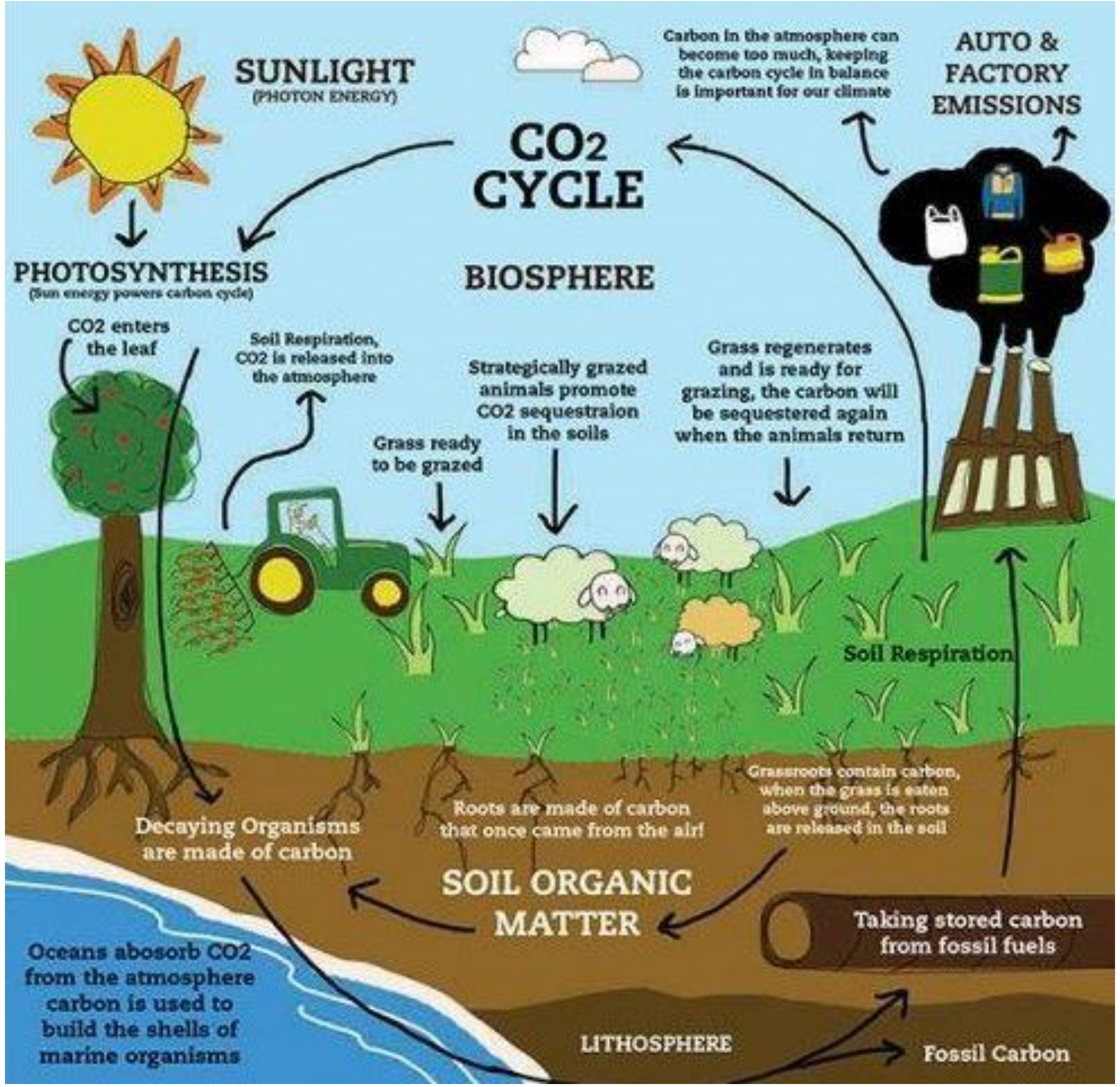
- While all these components are important, the **soil organic matter** (**SOM**) is the basis of a soil's ecosystem service potential.



Soil carbon storage is a vital ecosystem service.

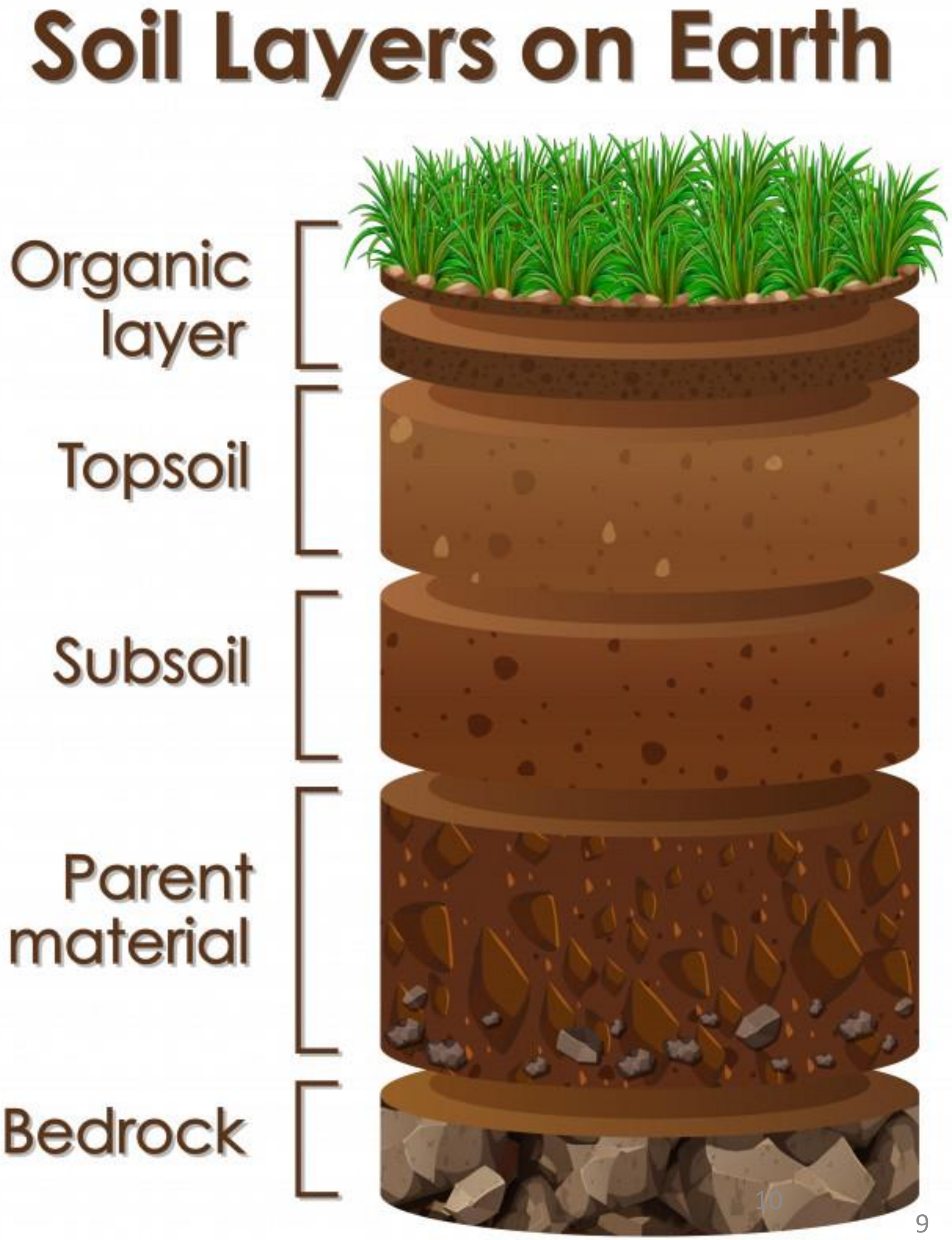
Air quality

- Soils naturally absorb CO2 from the atmosphere where it can be available or stored.
- Human activities and climate can affect this process; re-release CO2 back to the atmosphere or stored which leads to greater mitigation potential.
- A "healthy" soil *can* typically sequester more carbon than above ground vegetation.
- A degraded soil actually releases CO2 back into the atmosphere.



1 ton of stored soil carbon = 3.67 tons of carbon dioxide removed.

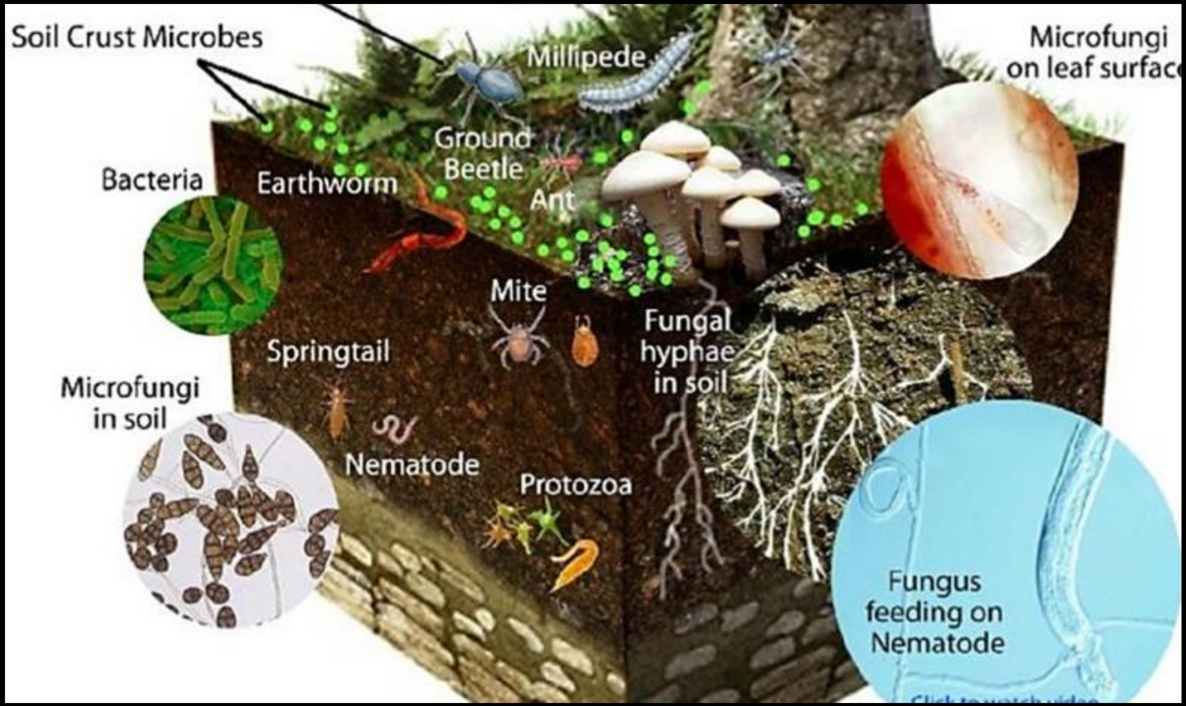
The type of organic matter *matters*	Turn over time
Soluble root exudates and decomposition by-products makes up less than 5% of total soil organic matter.	Minutes to days
Fresh or decomposing plant and animal matter with identifiable cell structure. Makes up 2–25% of total SOM.	2 – 50 years
Older, decayed organic compounds that have resisted decomposition can make up more than 50% of total SOM.	Decades to centuries
Resistant organic matter found at deeper levels is an important long-term **carbon** sink.	Centuries - thousands of years



Stormwater storage and filtration are 2 more services

Water quantity and quality

- SOM plays a crucial role as it fuels the life of the soil.
- This life creates a "healthy" soil with:
  a) Plenty of air pockets allowing stormwater to enter and percolate.
  b) Sponge-like qualities that absorbs water. "***A 1% increase in SOM can absorb an additional 20,000 gallons of stormwater per acre.***"
  c) Ability to remove pollutants while slowly re-filling creeks and rivers with clean water.

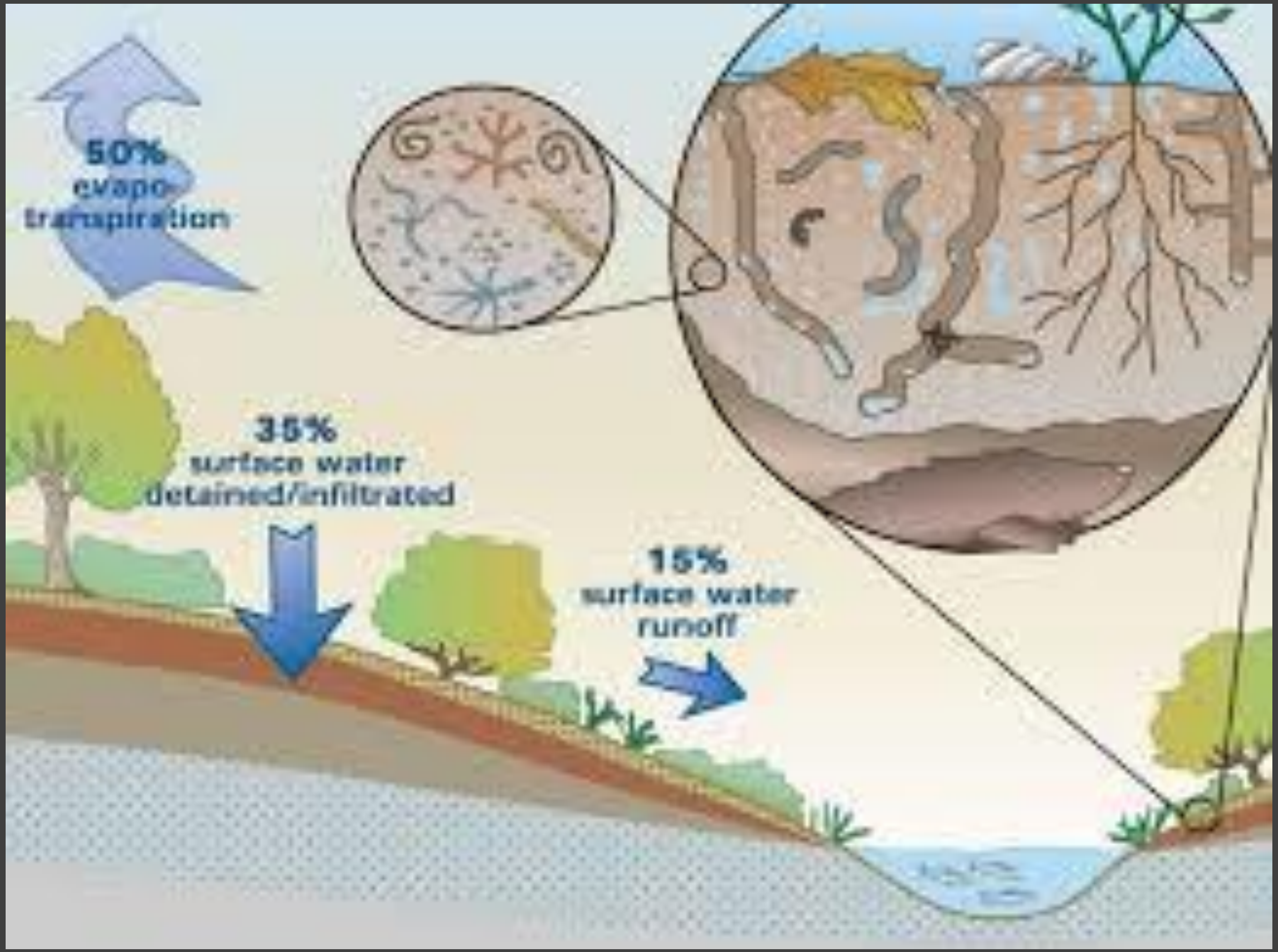


Two soil samples from the same property located in the Blackland Prairies of San Antonio’s Near Northeast area.

While both are basically clay, which one has more organic matter/stored soil carbon? air pockets?

Land Conservation as a flood mitigation strategy providing a service

- Current flood control focuses on floodplains.
- Projects within the floodplain are given priority especially when they remove structures from risk.
- This approach is being driven by FEMA and use of current hydrological modeling platforms.
- Lacking is evaluations with:
  1. Watershed approach to determine where land conservation is needed for prevention.
  2. Software to evaluate plant/soil water budgets and interaction with surface and ground water.



Using the information

Where are we globally?

The bad and the good news is….

1. Globally 25% of our land is degraded which gives us a lot of potential.
2. Approximately 30% of the CO_2 in the atmosphere is attributed to soil degradation.
3. Research shows that world soils still sequester approximately 25% of emissions even today.
4. Theory - a 2% SOM increase worldwide may remove excess CO_2 within 10 years.

For the Hill County, land use changes and practices have been drivers for decreased soil carbon

- There is plenty of research for soil carbon changes on agricultural lands.
- Not so much for urban areas.

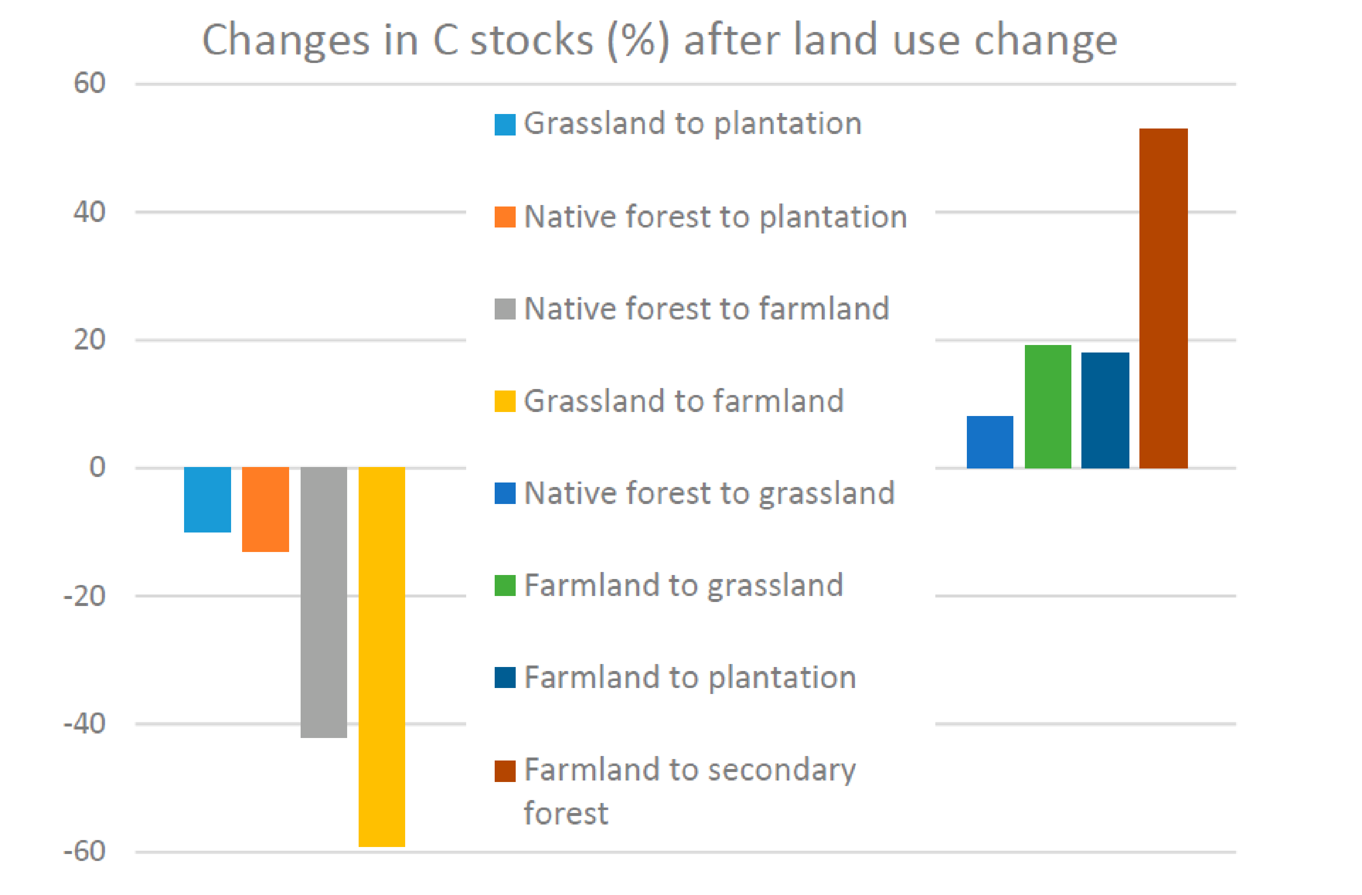


Figure 2. Changes in carbon stocks due to land use change based on Guo and Gifford (2002)

Assumptions for urban soils in the Hill Country

- Initially new development soils would have very little soil carbon remaining.
- Eventually for residential properties, the soil carbon increases depending on maintenance practices.
- For most commercial properties, the soil will remain low in soil carbon, due to design and maintenance practices.

Evaluating how to make the most of land conservation

1. What are the most important lands to conserve?
2. How should they be managed?
3. What are some new mechanisms to promote land conservation and enhancements to increase the services they provide.

Different ecosystems have different potentials

Ecosystems Potentials	Stormwater Run-off Reductions	Sediment Removal Depending on size	Net Carbon sequestration *Soils only* - (Mg* C ha-1yr-1)
Turf/lawns Minimal inputs Soil improved	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**	**3.4**
Wetland	NA	NA	**1.6-4.7**
LID Feature	First 1.5 " of event	80%	??
* Mg approximately equals a ton			

As we expected….

- Riparian areas and wetlands have the most potential for providing ecosystem services.
- But as we scramble to make the most of what is available, all open space becomes valuable.

Potential from *soil only* within CoSA's public Green Space with a 1% increase in soil organic matter

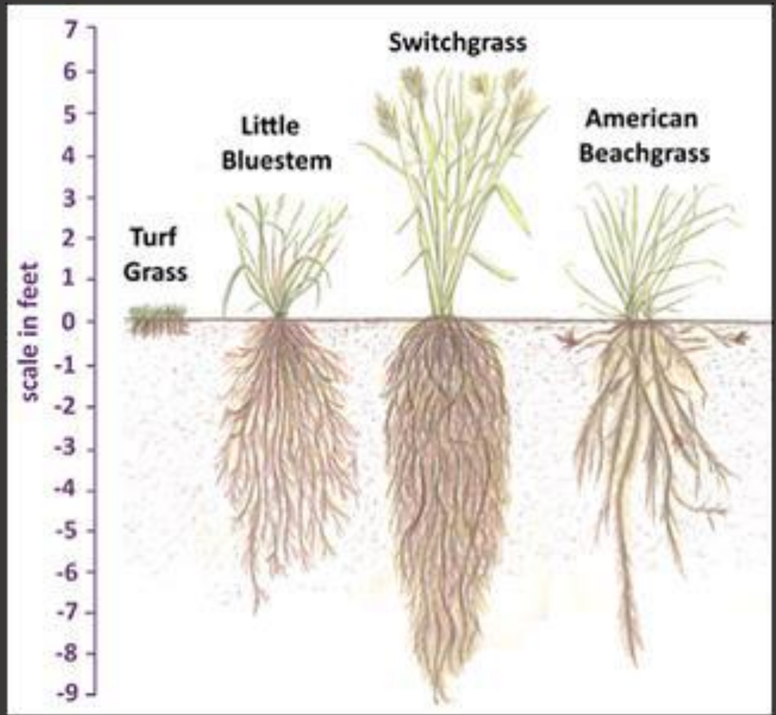
Type of property	Acreage	Additional gallons of stormwater stored per event	Additional tons of carbon stored per year
Aquifer Protection lands	**156,475** acres	31,295,000,000	148,651
City Parks	**20,962** acres	419,240,000	19,914
Totals	**177,437 acres**	**31,471,240,000**	**168,565 C or 618,634 CO_2**

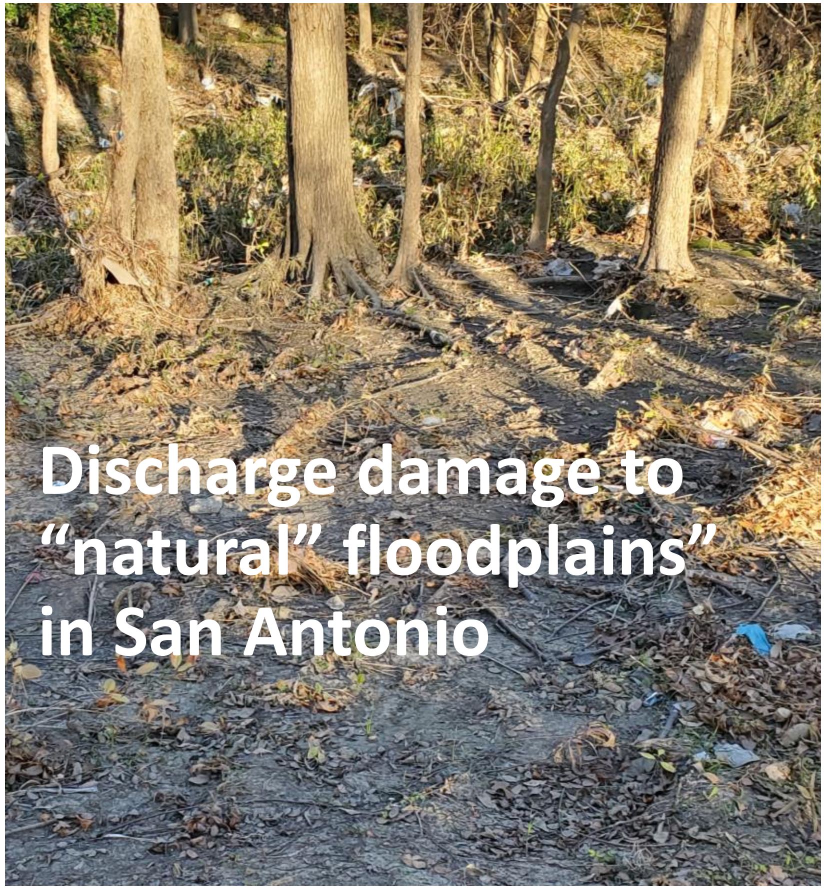
It is felt by only modifying management practices …

Brackenridge park and Olmos baseball field

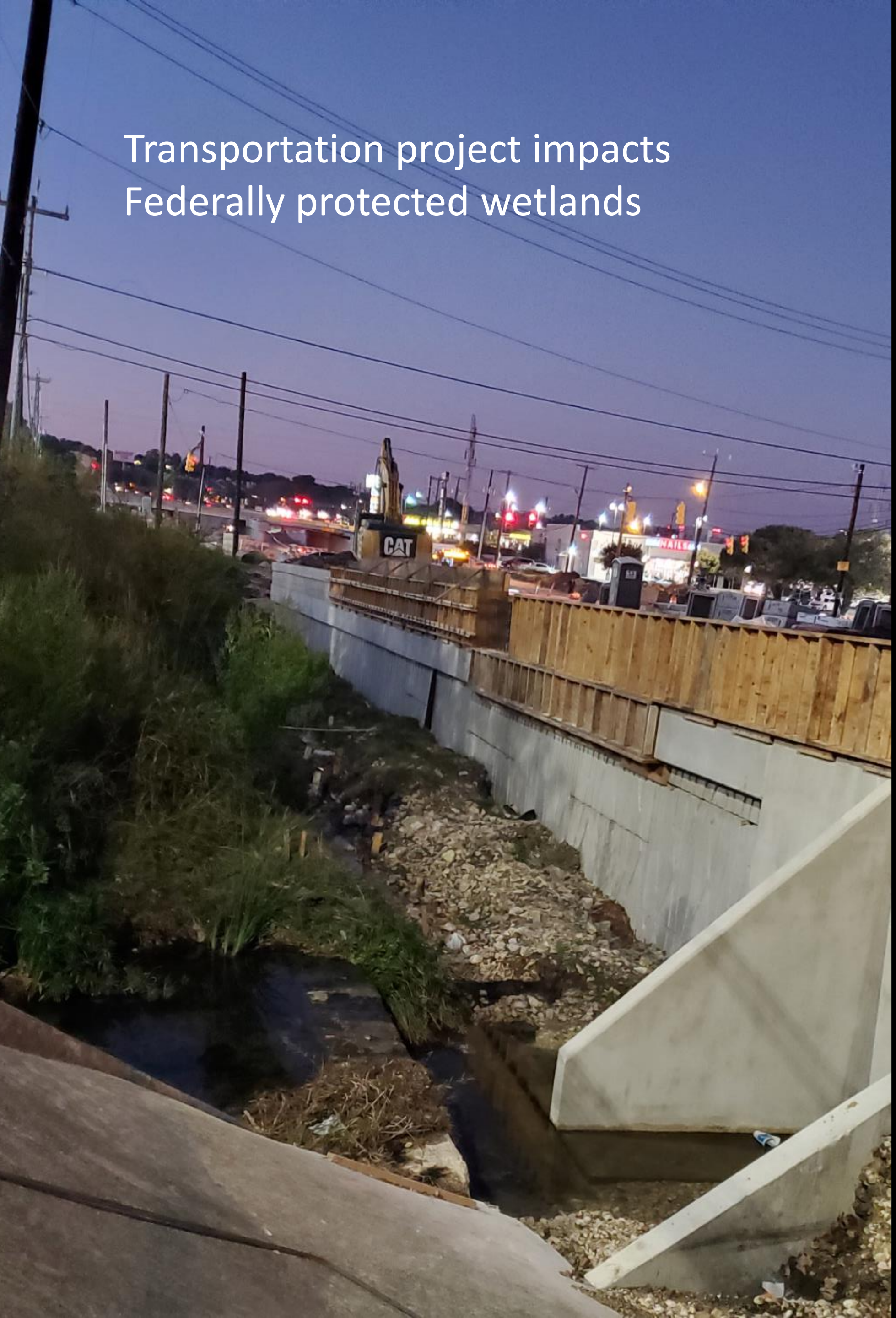
Maintenance practices requested by citizens exacerbate issues.

Parks will be able to increase the SOM, enhancing services received from our public lands which will assist in meeting the city’s climate action goals.





Of course, some areas will need more inputs such as these creek areas that will require restoration and then protection.



What are strategies to make this information work for us?

- Collect the data for our area:
  1. Baseline soil carbon and stormwater runoff data on a variety of lands that represent uses, ecoregions and ecosystems.
  2. Improve valuation of plant/soil/water interaction software in watershed modeling.
- Promote the integration of system thinking in public policies, regulations, incentives and project selection.
- Increase awareness of development impact on ecosystem services that are a public good.
- Ensure what rules in place, *are enforced especially* for riparian and wetland protection.
- Increase regulation and incentive programs as needed to realize public goals as reflected in planning documents.

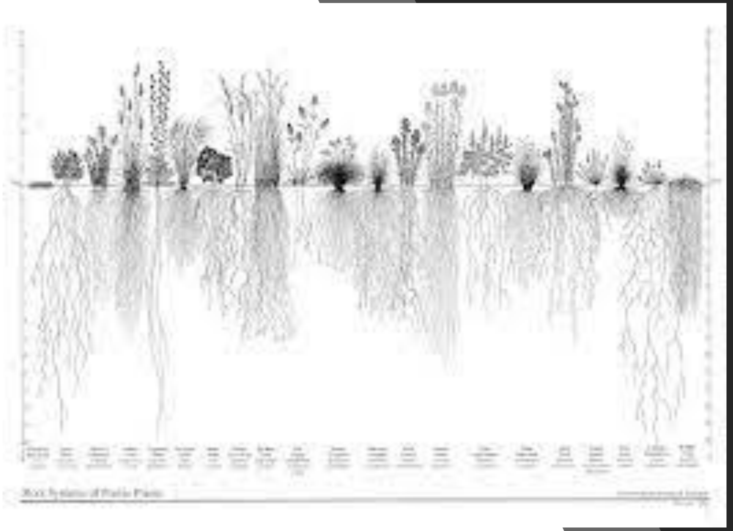
A typical policy has been to allow streams and floodplains to be reduced allowing for more land to be developed to increase tax base

Analysis by Mile High Flood District calculated that for many projects where floodplain reduction was allowed, the city would never realize an economic gain as it will require years of tax collection to replace such systems, and this does not even include the loss of ecosystem services.

How do we pay for it?

- Under today's legal system, taxpayers will need to fund the loss of economic gain that a property owner may experience, regulations can only go so far.
- Currently ecosystem services and even benefits to human health have not been enough to change court decisions especially at the supreme court level.
- In San Antonio, residents support land conservation (along with its trees, vegetation and soils):
  1. Planning documents and development codes.
  2. Voters' taxation approval for aquifer protection and creek trailways.
- Other possible funding sources:
  1. City's MS4 requirements for water quality in stormwater discharges.
  2. County's flood control $s collected with property taxes.
  3. State agencies such as Texas Water Development Board.
  4. Federal agencies such as USACE, NRCS and EPA.

Once it is protected, what are enhancement strategies?



- Properties managed with *few inputs* have the smallest carbon footprint.
- Ecosystem types used together can provide a greater benefit:
    1. A grassy filter strip before a forested area will increase reduction of sediment.
    2. A complex vegetative cover such as trees with understory plants reduces runoff better than trees alone and increases water storage and carbon sequestration while enhancing albedo more effectively.
- The deeper a wetland the more effective it is.
- Prairies designed with plants that better utilize above ground and below ground space can increase services.
- Minimum inputs such as mowing less and leaving vegetation higher while keeping the ground covered increases potential.

Strategies that can increase functionality and resilience with inputs

1. Conservation of environmentally sensitive areas.
2. Basic restoration of streams, rivers and uplands.
3. Increase of water capture with:
   - Bioswales and terracing on the contour,
   - Creation of Infiltration sites.
4. For riparian areas creating and enhancing “overbanking” areas as infiltration sites to reduce runoff and increase filtration while slowly recharging streams.

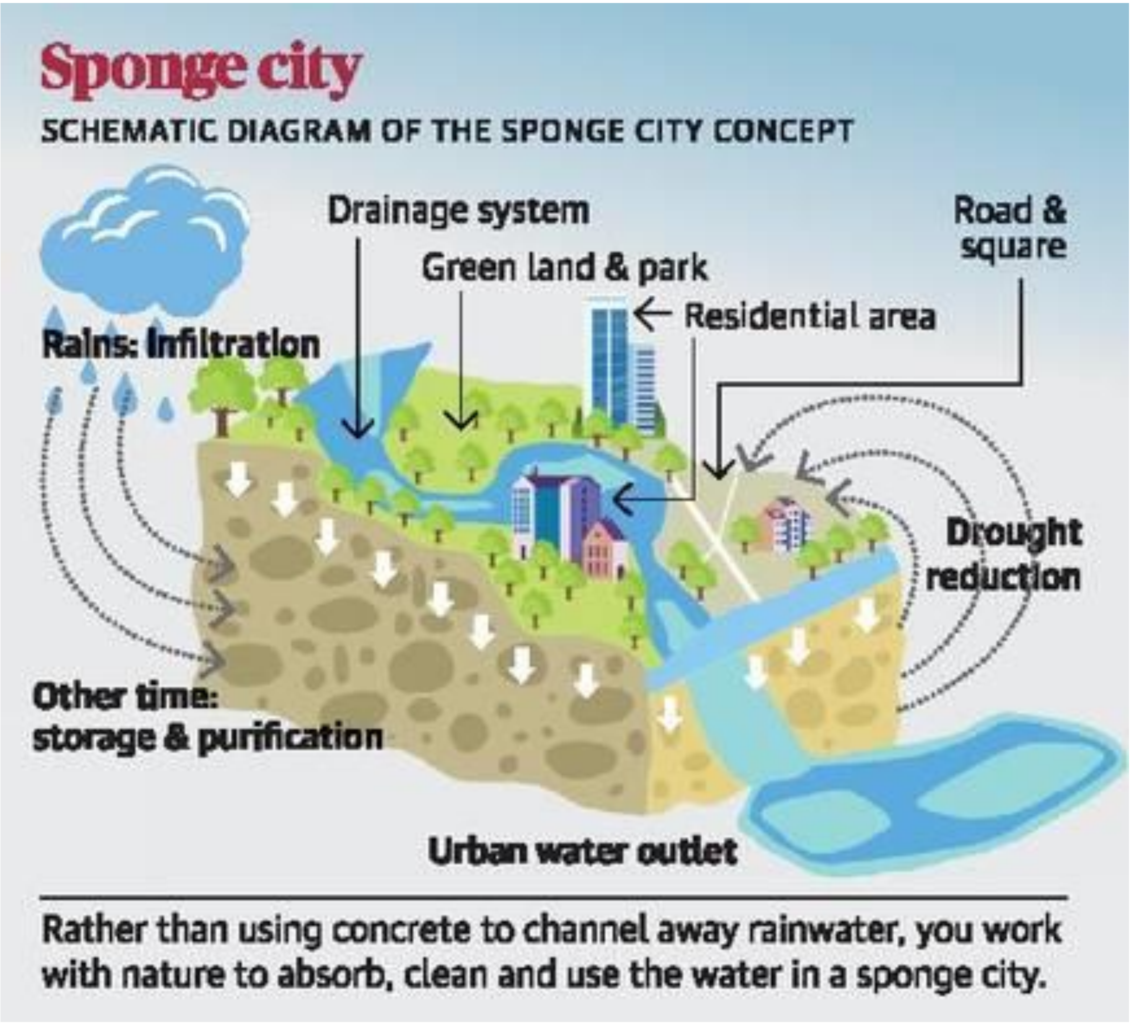
Integrating flood control projects with land conservation and restoration

- It is important to note enhancements will need to be protected from current and future upstream flows.
- So while flood control projects tend to be placed in the floodplain at the bottom of the watershed, land conservation locations and riparian restoration may be best located at the top of the watershed.
- Bottom line it is difficult to do this without a master plan that includes hydrological modeling.

In summary land conservation provides the ecosystem services which:

- Reduces floods and need for flood control projects,
- Recharges aquifers and groundwater,
- Maintains stream and rivers flows along with their biodiversity,
- Reduces irrigation needs,
- Reduces heat stress,
- Improves public health,
- Provides climate resilience, recreational opportunities and community cohesiveness.

The key is to encourage water to enter the soil and to slowly percolate.



References that will excite you!

Books:

- The Soil Will Save Us by Kristin Ohlson. 2014.
- Grass, Soil, Hope: A Journey Through Carbon Country by Courtney White. 2014

- Greater Edwards Aquifer Alliance website:

1. https://aquiferalliance.org/using-our-green-spaces-to-improve-water-quality-and-create-resilient-communities/