

**SOUTH SAN HEAT
RESILIENCE PROJECT**
A Workforce Training

Building Healthy Landscapes to Cool Communities

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Topics

- ▶ The facts of life, our basic needs.
- ▶ How healthy landscapes can cool communities and reduce the heat island effect.
 - ⌚ Terms and their definitions,
 - ⌚ Water cycle and water sources,
 - ⌚ Capturing and using water, and
 - ⌚ The roles of trees and soils.
- ▶ Landscape practices.
- ▶ Constructing water capturing systems.
- ▶ Using alternative water sources.

The facts of life...

Our basic physical needs:

- ▶ Air
- ▶ Water
- ▶ Food
- ▶ Shelter

Are provided by the



A glass globe with a map of the world inside, resting on a mossy rock in a sunlit forest. The globe is transparent, showing the continents and oceans. It is placed on a dark, moss-covered rock. The background is a lush green forest with sunlight filtering through the trees, creating a soft, glowing effect. The overall scene is peaceful and natural.

The Natural World



Definitions



What do all landscapes need to be healthy?

1. Landscape - the physical environment and includes specific areas such as a forest, a park or a back yard.
2. Green spaces - refer to urban open spaces such as parks, public green spaces and have great potential for cooling communities.
3. Yards - private greenspaces that can be managed to cool the immediate area including the house.

Using Landscapes to Cool Communities ...



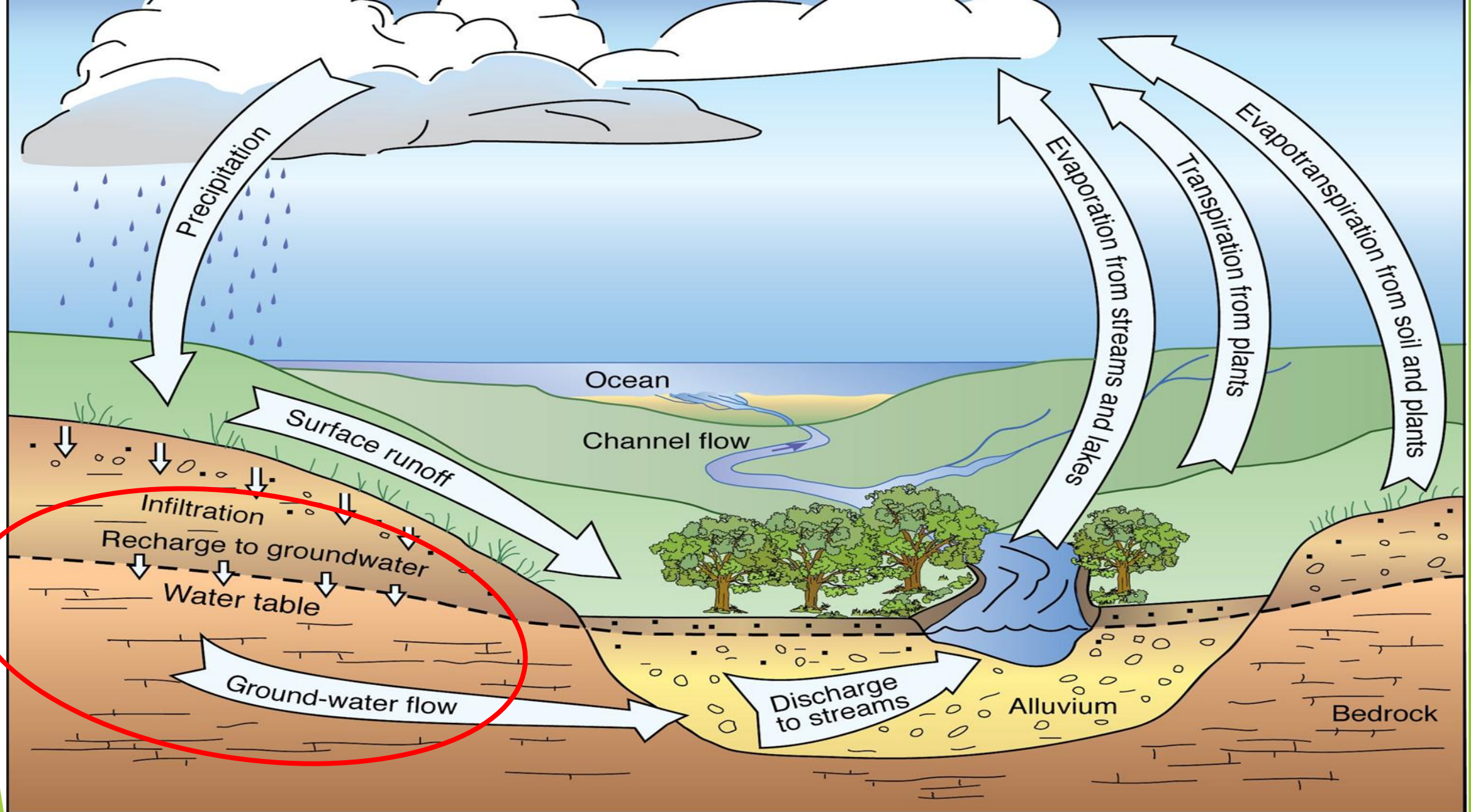
- ▶ Is an effective mitigation strategy, to meet many urban challenges including heat islands, but...
- ▶ Landscapes need water to cool communities!
- ▶ When you turn on the hose in San Antonio, where does the water come from?

Sources of Water



The Edwards Aquifer Zones;
Contributing, Recharge and Artesian

- While San Antonio has several water sources, about half is provided by the Edwards Aquifer.
- This water is treated for household uses which includes potable or drinking water.
- The original source of our water is rain.



THE HYDROLOGIC CYCLE

Capturing and using water

- ▶ Therefore, our goal is to capture more rain and better utilize our water by:
 - Improving the maintenance of our **green spaces**.
 - Adding rain or water capture systems.
 - Using permeable materials.



Adjusting mowing heights



Planting landscape areas



Rain garden



Green roof



Permeable pavement



Infiltration trench



Landscape water body



Grassed swale

How Healthy Landscapes Cool Communities



Green spaces are landscapes that include trees, plants and soils which create cooler, healthier and safer communities by:

1. Cooling the surrounding air,
2. Remove water and air pollution,
3. Reduce stormwater runoff and flooding,
4. Reduce crime, and
5. Improve public health.

How Healthy Landscapes Cool Communities - Trees

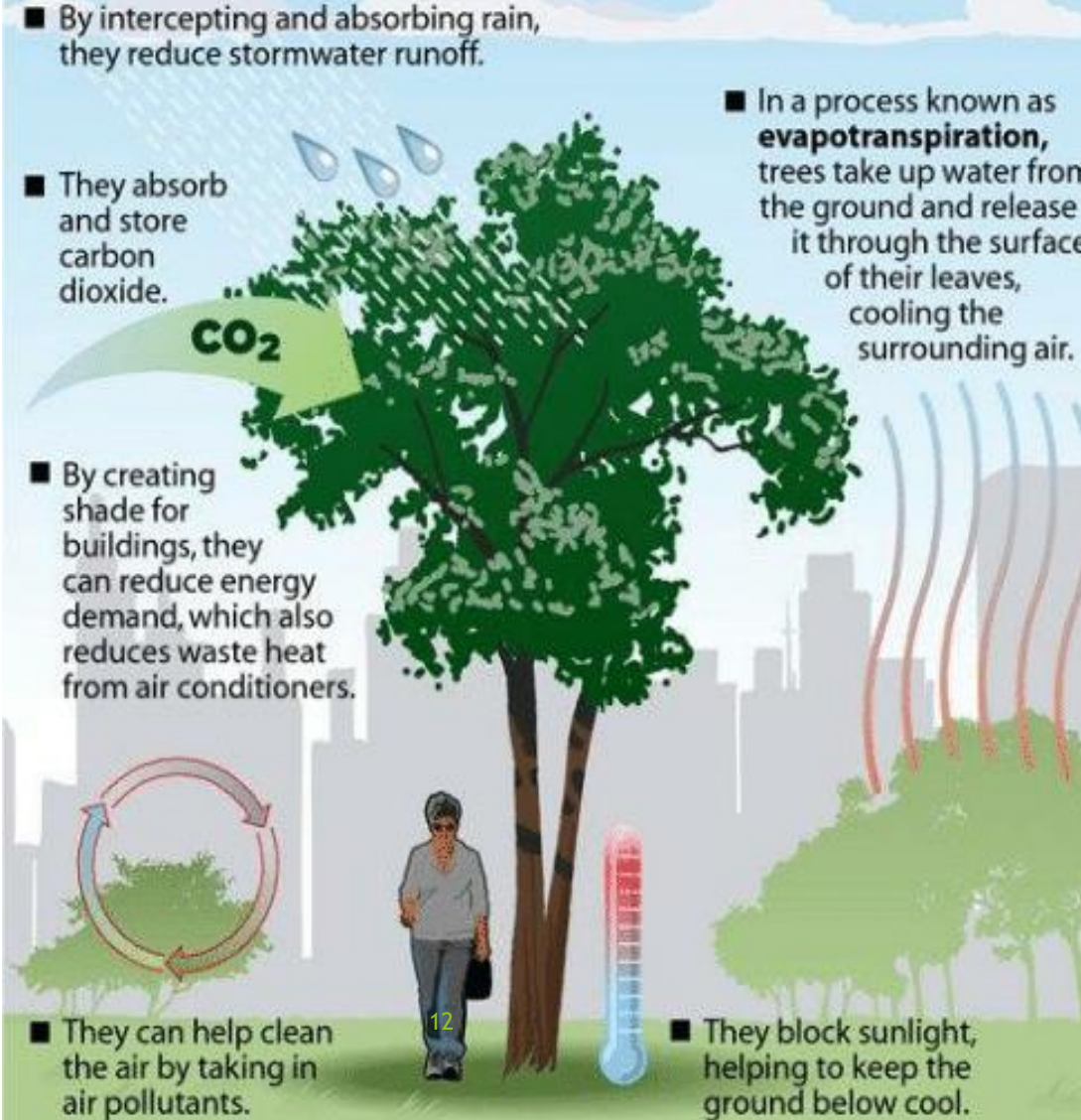
In San Antonio, the benefits of trees has been documented.

Our SA Urban Forest Inventory and Analysis states that each year, our urban forest (~138 million trees):

- Removes more than 6,500 tons of air pollution, saving \$63 million in health costs.
- Reduces stormwater runoff by over 380 million cubic feet and
- Saves residents \$22 million (\$13.89/person) in energy costs each year.

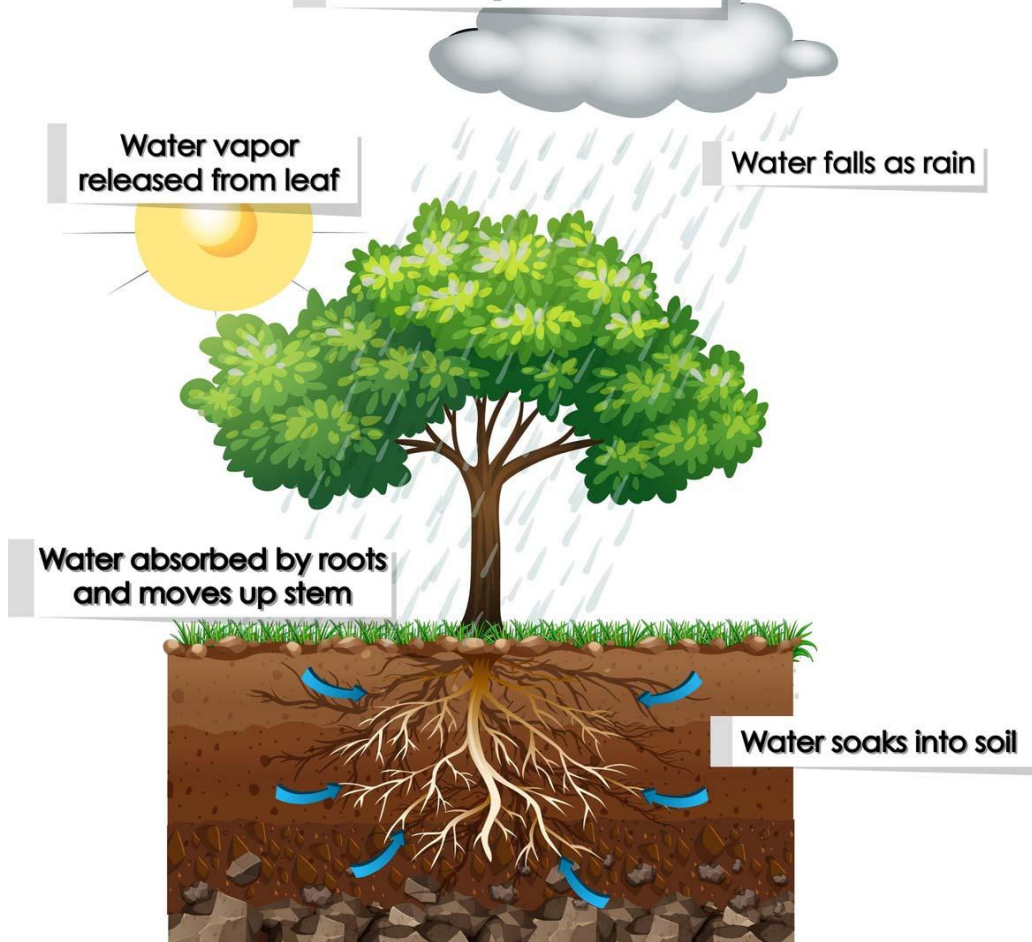
Why Trees Are So Cool

Experts say trees should be considered urban infrastructure, every bit as important and useful as sewage, drinking water and transportation systems. They are an important tool for cities to reduce urban heat island effects. Here are a few ways trees benefit our urban environments:

- 
- The infographic features a central illustration of a large green tree in an urban environment with a city skyline in the background. A person is walking near the tree, and a thermometer is placed on the ground next to it. Various arrows and labels point to different parts of the tree and its surroundings, illustrating its benefits:
- By intercepting and absorbing rain, they reduce stormwater runoff.
 - They absorb and store carbon dioxide. (CO₂ is shown being absorbed by the leaves)
 - In a process known as **evapotranspiration**, trees take up water from the ground and release it through the surface of their leaves, cooling the surrounding air.
 - By creating shade for buildings, they can reduce energy demand, which also reduces waste heat from air conditioners.
 - They can help clean the air by taking in air pollutants.
 - They block sunlight, helping to keep the ground below cool.

How Healthy Landscapes Cool Communities - Trees

Transpiration



- ▶ Trees help cool communities by providing shade and by releasing moisture through transpiration.
- ▶ Transpiration is when a tree pulls liquid water from the soil and releases it as a vapor, cooling the surrounding air.
- ▶ Therefore, trees can provide greater cooling than shade structures when they have water.

Cool... but how does it work?

**The other major component of landscapes
is the soil which can also cool communities**

Healthy Soils Support Ecosystem Function

**Water
Storage +
Filtration**

**Carbon
Capture +
Storage**

**Biological
Function +
Diversity**

**Productive
Capacity**

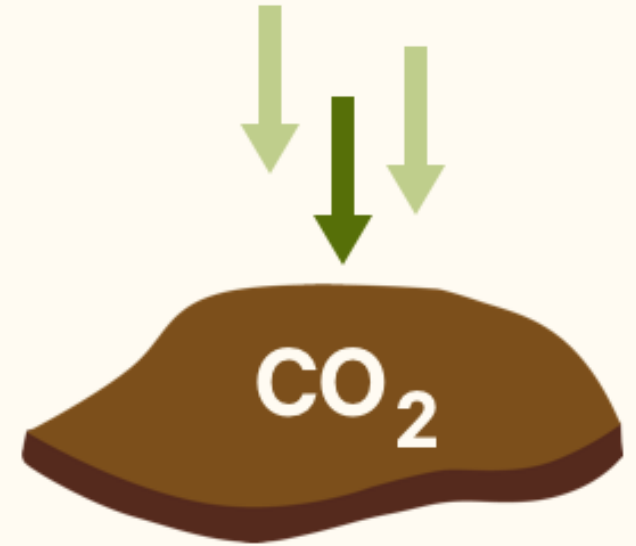
facts about soil



Globally, about **95%**
of our food comes
from soils



Soils store and filter
water, improving food
security and our
resilience to floods
and droughts



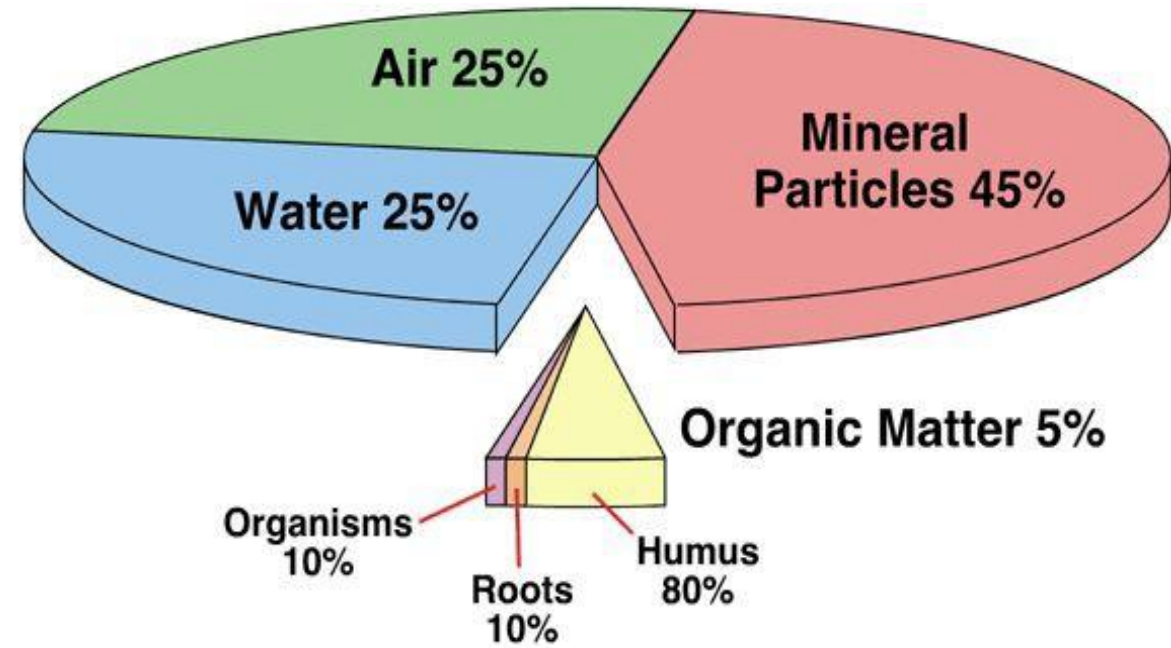
Soils store more carbon
than the atmosphere and
terrestrial vegetation
combined



Soils host **25%** of the earth's biodiversity

How Healthy Landscapes Cool Communities - Soils

- ▶ Healthy soils cool communities.
- ▶ Soil is a mixture of:
 - Mineral particles
 - Organic matter
 - Air and water
- ▶ While all of these are important, it is the soil organic matter (SOM) that creates healthy soil and landscapes.
- ▶ The goal is to increase the amount of SOM and protect it from ***erosion, high temperatures, compaction, etc.***



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.

2 – 50 years

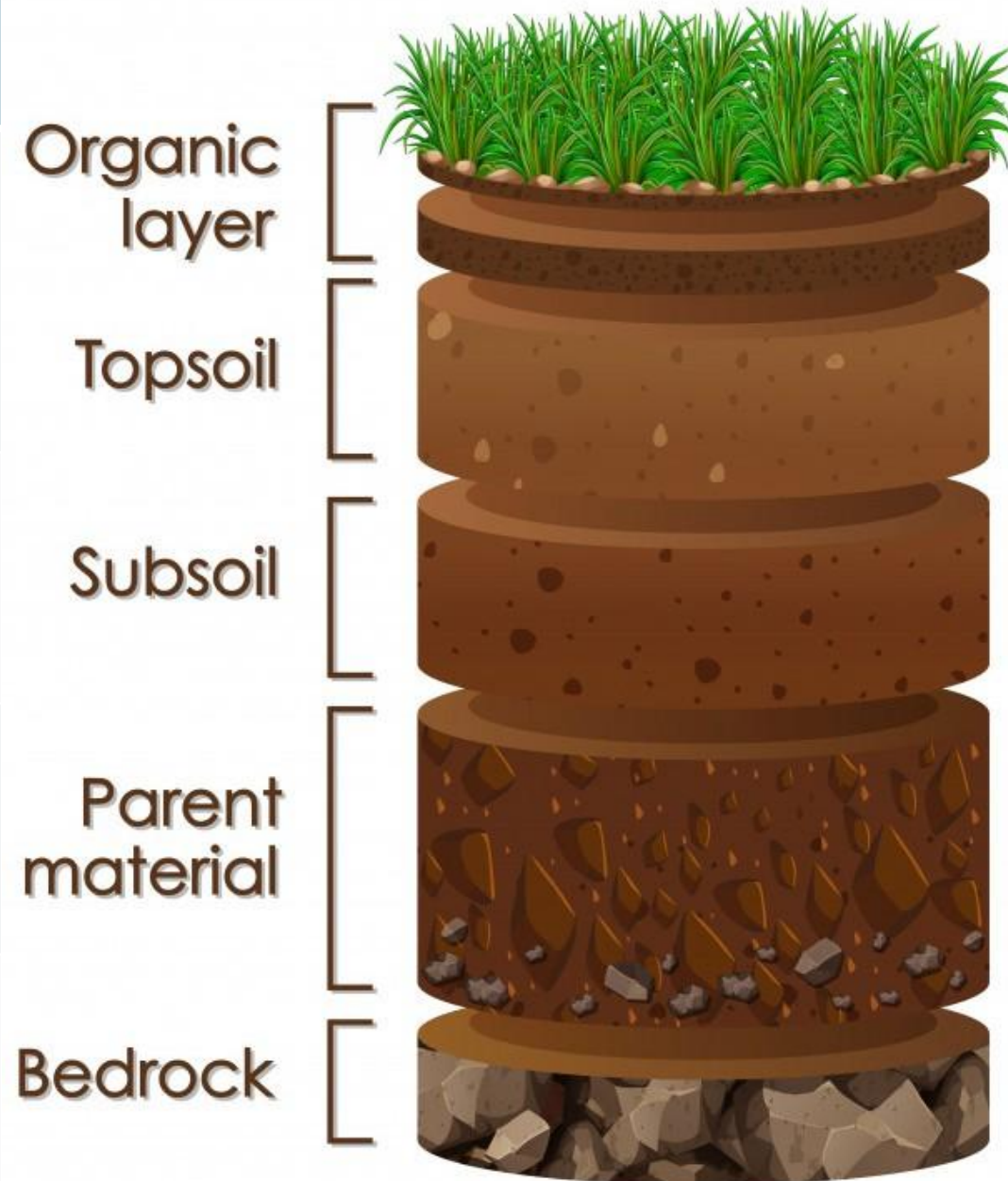
Older, decayed organic compounds that have resisted decomposition. Can make up more than 50% of total.

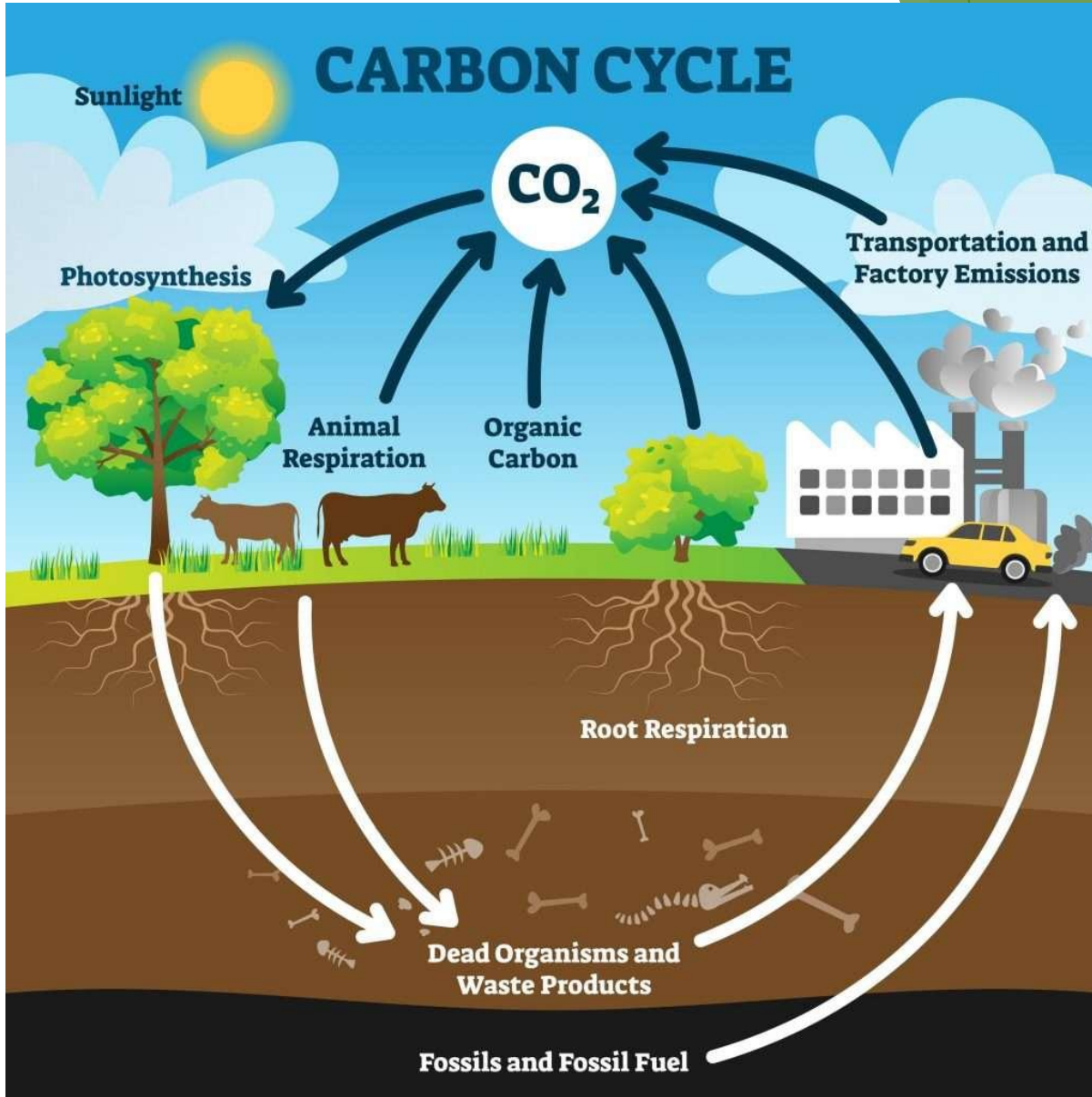
Decades to centuries

Resistant organic matter found at deeper levels is an important long-term **carbon** sink.

Centuries - thousands of years

Soil Layers on Earth



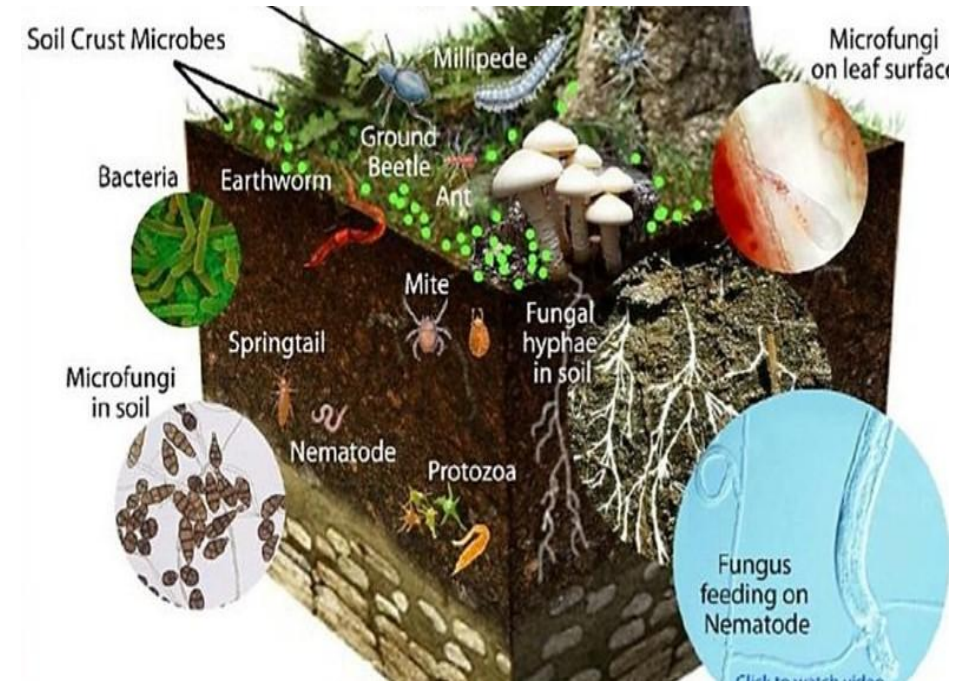


How Healthy Landscapes Cool Communities - Soils

- ▶ Soils have a greater capacity than above ground vegetation including trees to:
 1. Remove and store greenhouse gases such as carbon dioxide (CO_2) which will clean the air and reduce temperatures.
 2. Reduce flooding due to the sponge-like characteristics of SOM.
 3. Filter out pollutants in stormwater runoff and laundry water.
- ▶ Soils can only perform these services when it is “healthy”.

How Healthy Landscapes Cool Communities - Soils

- ▶ A healthy soil is full of life (1 billion organisms /teaspoon)
- ▶ This life is fueled by SOM, the food of the soil, a soil that has:
 1. Air pockets allowing rain and gases to enter and be used or stored.
 2. Sponge-like characteristics that hold the water in the soil for plants and soil organisms to use.
 3. The ability to filter and *break down* pollutants.

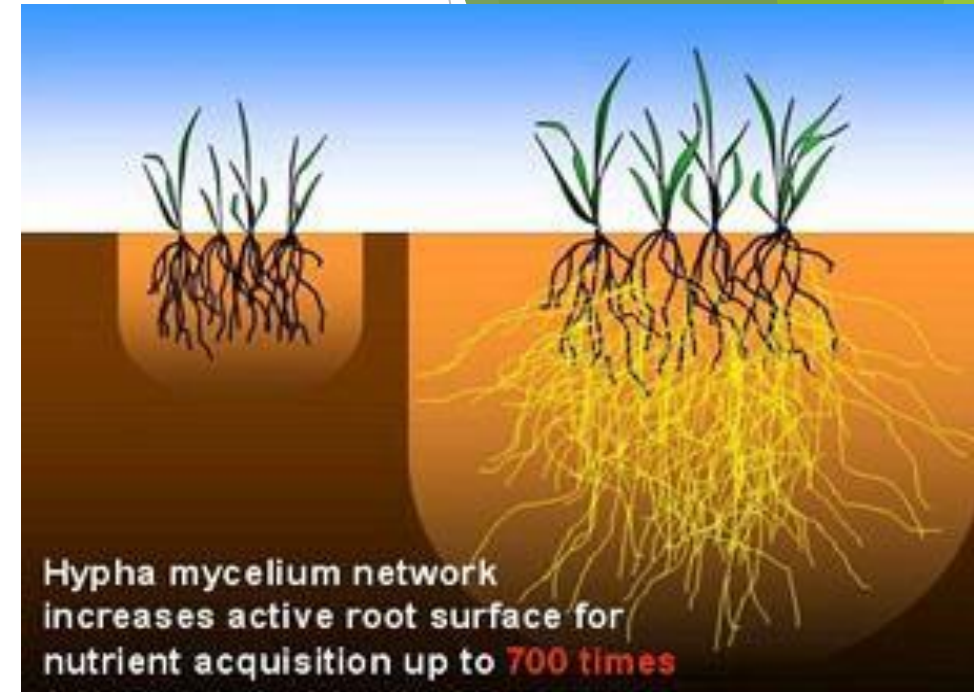


A 1% increase in SOM can store an additional 20,000 gal of water per acre per rain event or about 1,500 gal per yard !!

Healthy Soils Support Healthy Plants and Landscapes

A healthy soil also contains a variety of bacteria, fungi and other organisms that assist plants to access the water and nutrients they need for growth:

1. Turn minerals into a form of nutrients that plants can use, just like gut bacteria do for us in our stomachs.
2. Promote **mycorrhizae**, which live in association with plant roots to increase the volume of soil that roots can utilize up to 700 times.
3. They are vital for tree survival in San Antonio.



Soil biodiversity assists plants to develop drought tolerance.



Landscape Practices to Cool Communities

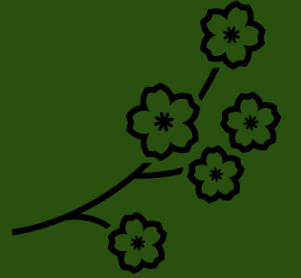


Two soil samples from
the same property
located in the Blackland
Prairie region within San
Antonio's Near
Northeast area.

While both are basically
clay, which one has
more soil carbon? More
air pockets? Which will
hold more water?



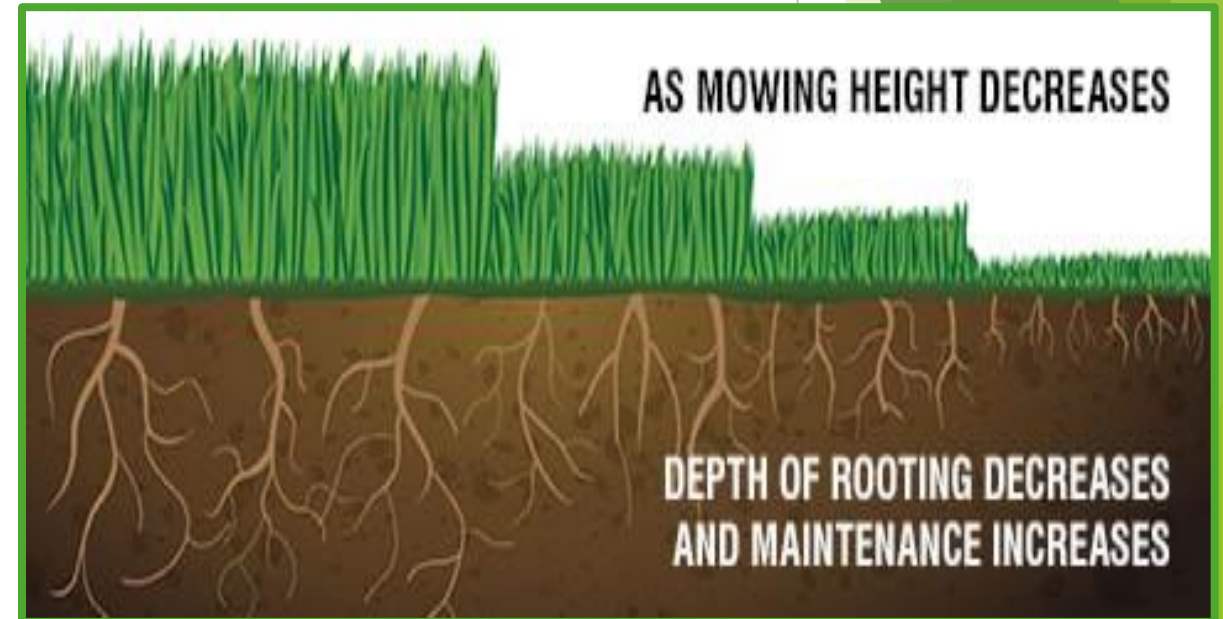
Keys and Practices to Soil Health



- **Maximize soil cover and allow vegetation to grow taller.**
- **Maximize the presence of living roots in the soil.**
- **Minimize soil and vegetation disturbance, especially soil compaction.**
- **Maximize biodiversity of plants and soil organisms.**
- **Modify mowing practices to accomplish the above.**

Mowing Non-Irrigated Turf Areas

- ▶ Set mowers at 3.5-4" high.
- ▶ Let the mowers set the height for line trimmers.
- ▶ Do not cut more than 30% of the vegetation.
- ▶ Reduce or stop mowing during droughts and allow taller vegetation of 5"-6".
- ▶ Avoid "scalping".
- ▶ Avoid mowing when the soil is wet and saturated to prevent compaction.



Higher vegetation protects the soil and plant roots from erosion, extreme temperatures while maintaining soil moisture and reducing weeds.

Possible Issues

1. If the turf is not just one species, it can be difficult to maintain at a uniform height.
2. When the turf is allowed to grow, the roots will be more vigorous making the vegetation grow faster.
3. Strict mowing schedules may not work.
4. Public acceptance.



How this strategy Cools Communities

- Plants depend on their roots to survive, especially in dry weather.
- Therefore, the more robust the root system, the more drought tolerant the plant.
- Taller plants with their more robust root systems are a constant source of SOM which continually feeds the soil microbes.
- Taller vegetation is better able to:
 1. Slow stormwater so that it will soak into the ground.
 2. Remove pollution from the air and water.
 3. Prevent soil erosion and weeds.
 4. Assist in maintaining soil health.



Line Trimming

- ▶ It is often the only way to manage difficult areas such as slopes where the vegetation height is best maintained at a **minimum of 5"-6"**.
- ▶ Line trimmers can be used to quickly remove the tops of plants for a uniform height across a turf area.
 1. Better to use than a mower during droughts, and
 2. When the soil is wet to prevent soil compaction caused by mowers.



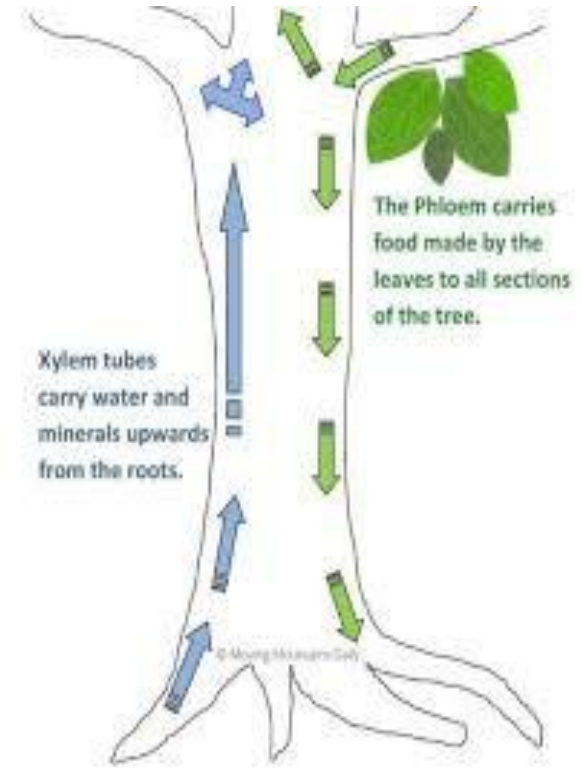
Vegetation cut too short increasing soil erosion and weeds.



Vegetation height protects soil and reduces maintenance.

More on Line Trimming

- ▶ Line trimming around trees is especially challenging.
- ▶ Hold equipment at a slant with the head down away from the bottom of the tree trunk.
- ▶ Using tree guards should be required on all sites for trees less than 3-4 years old and longer on tree species with thin bark such as Crepe myrtles and Texas persimmon.
- ▶ If more than 30% of the outer bark is removed on a tree, then the tree should be replaced.



This young tree died due trunk damage.



Tree guards with ventilation holes protect trees from equipment damage.

Mulching

- ▶ Organic mulches are preferred as they protect the soil *and* add to the SOM when they break down.
- ▶ Mulching around newly planted trees is typical, but even larger trees can benefit from a 2"-3" application.
- ▶ Gathering leaves around trees and then covering with a bark mulch provides additional benefits.
- ▶ Avoid fresh sawdust (it will rob nutrients) and mounding mulch against a tree trunk which causes girdling roots and rots the trunk.



Avoid mulch against tree trunks; promotes trunk rot and girdling roots.



Proper mulching around trees will promote stronger and deeper root

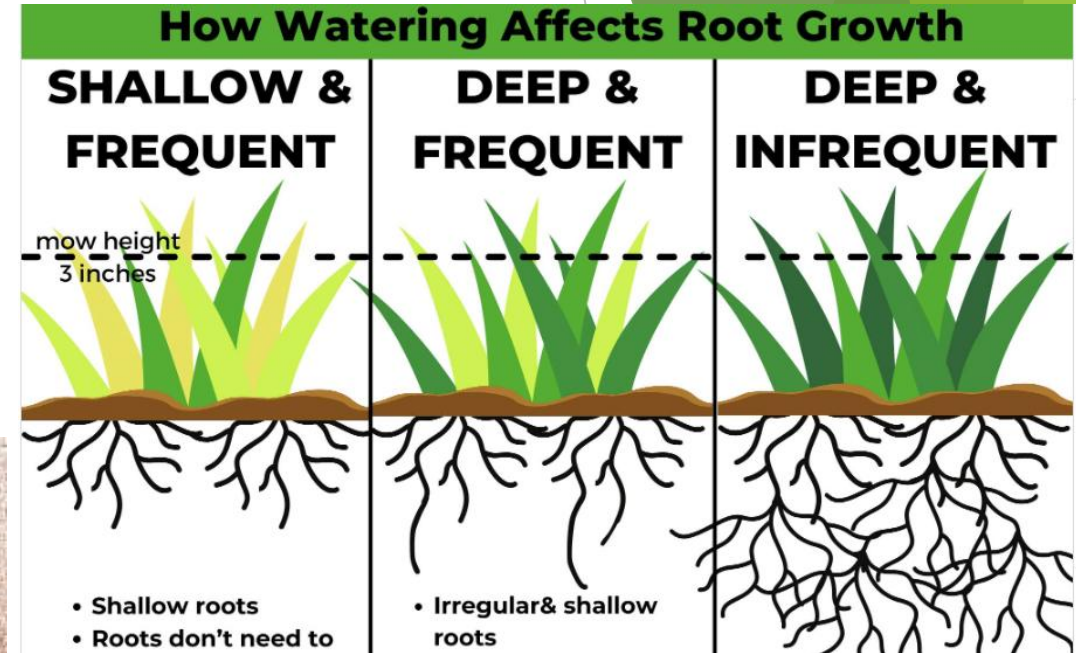
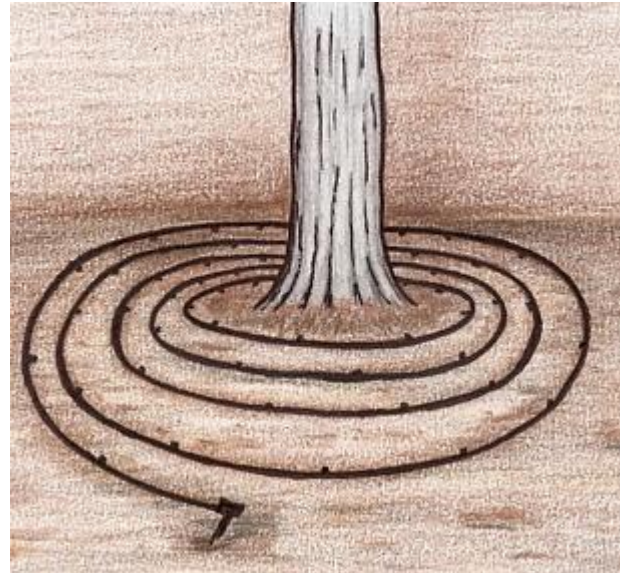
Soil Amendments

- ▶ A soil amendment like compost, can be mixed into the soil or applied to the surface.
- ▶ It can be a *quick start* to creating a healthy soil.
- ▶ Compost is partially decomposed organic matter, can be applied any time of the year and should be:
 1. No more than 3% nitrogen
 2. Weed free, and
 3. Well aged.



Water: slowly, deeply and infrequently

- ▶ As tempting as it is to water by hand....it may not be effective.
- ▶ Turf and trees require slow deep watering to ensure that the entire area under the canopy is moistened to at least a foot deep.



If trees are watered like flowering plants, their roots come to the surface, and they lose their drought tolerance.

The Problem with Compaction and Hardpans

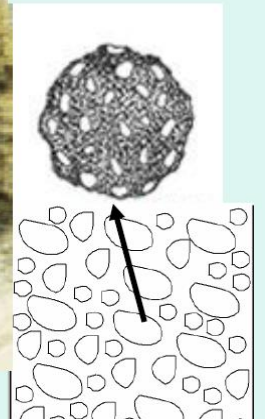
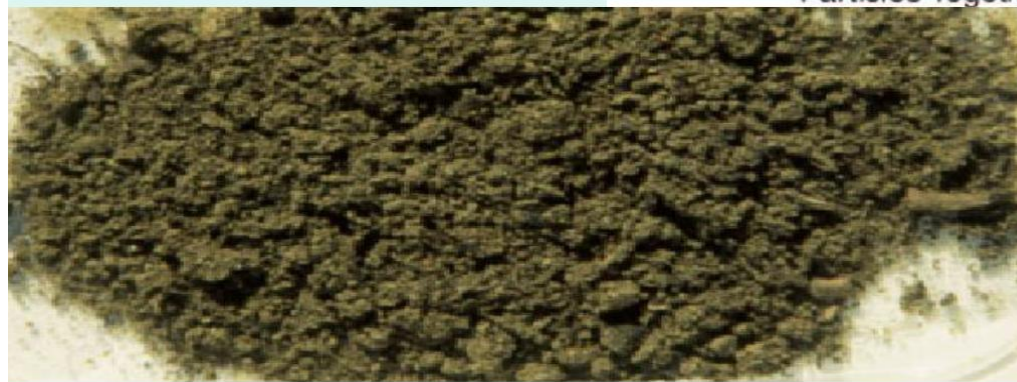


Hard pans are created when the soil is not protected from vehicles, rain or irrigation

1. A vehicle will compact the soil eliminating pore space causing trees and plants to die.
2. A single rain drop has the power to move soil particles clogging up pores and preventing air and water from entering the soil.
3. This effect can be reversed by adding a soil amendment such as compost and or mulch.



Agregar composta o materia orgánica para aumentar la infiltración la lluvia y crear un suelo con "agregados de pegamentos" y más espacio entre de las partículas del suelo



Specialized landscapes

Maintenance in Low Impact Maintenance Areas

- Low Impact Maintenance Areas (LIMAs) are areas with reduced mowing where the vegetation is allowed to grow taller.
- LIMAs can play a big role in addressing urban challenges:
 1. Reduce emissions and labor costs from mowing.
 2. Quickly build SOM.
 3. Slow stormwater promoting infiltration.
 4. Remove pollutants from stormwater.
 5. Sequester and store more soil carbon.
 6. Increase biodiversity and cool communities.
- The locations of a LIMAs can direct the level of maintenance required.



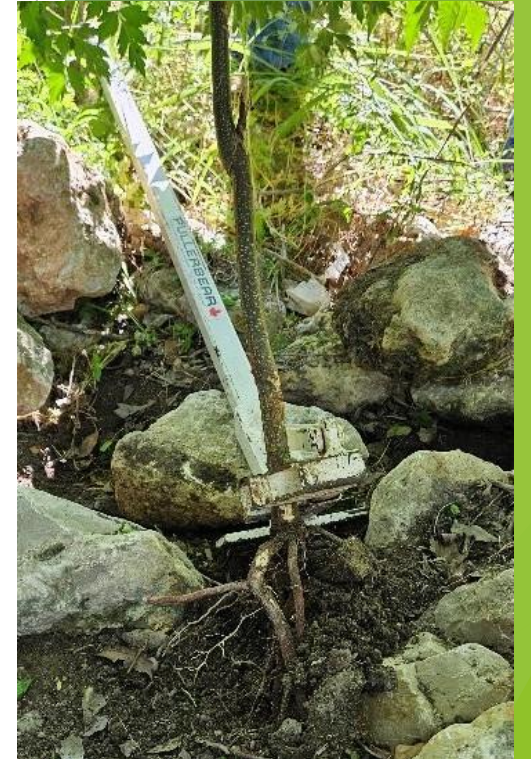
This pocket prairie site in the Houston medical center requires high maintenance.



This pocket prairie requires less maintenance.

Maintenance in Low Impact Maintenance Areas

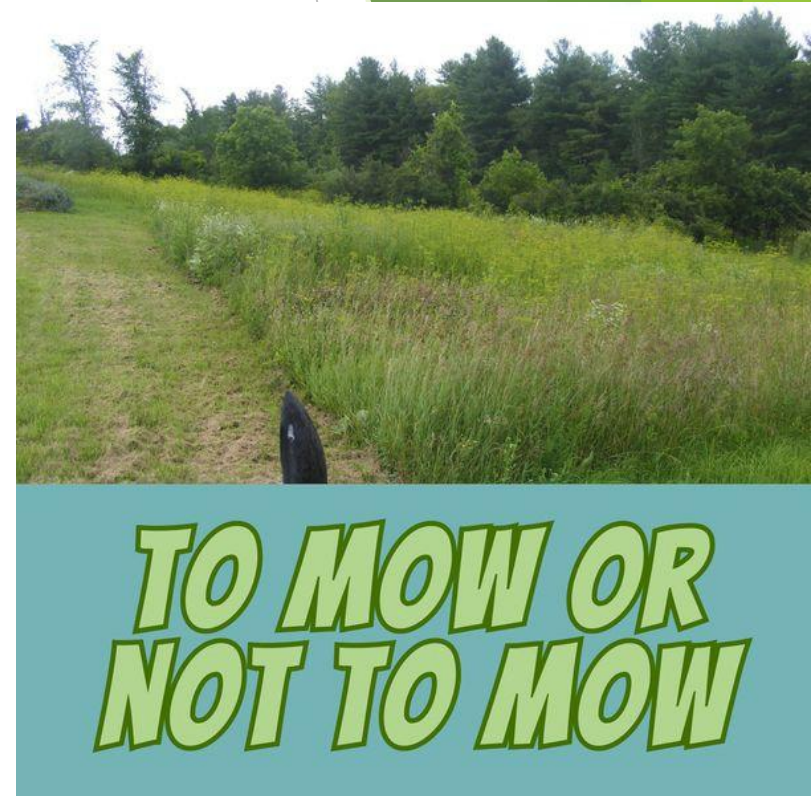
- These areas can require some hands-on maintenance with the ability to distinguish between desirable and non-desirable plants.
- LIMAs should be inspected 1-2x/yr for invasive woody or non-native plants to be removed, reduced or cut to remove flowerheads to prevent seeds.
- Reasons to mow include:
 1. Assist in managing brush and weeds.
 2. Public acceptance and safety.



A good plant cover will reduce invasion by trees and weeds, but some hand control may be necessary. Needle nose pliers and a weed wrench are useful tools.

To Mow or Not to Mow: *If Mow, When and How?*

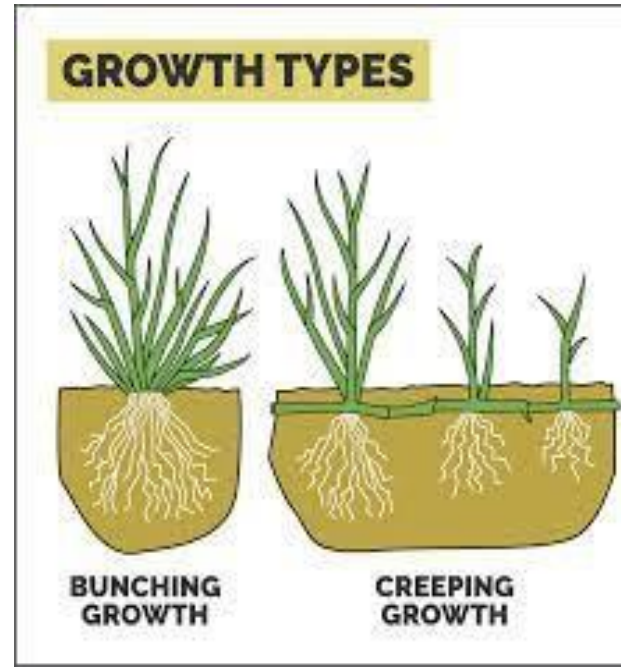
- Reasons to not mow or reduce mowing include:
 - a. Build SOM.
 - b. Provide wildlife food sources and cover for ground nesting birds such as Killdeer, Nighthawks, Ducks and more.
- Pocket prairies or LIMAs:
 - a. Extensive mowing can reduce perennial wildflowers while promoting annual wildflowers and weeds leading to reduced soil health.
 - b. A compromise is: mow patches regularly for annual wildflowers while leaving most of the area unmowed.
- If mowing is needed:
 - a. Avoid between mid-February to early July for nesting and migratory birds.
 - b. Maintain a minimum height of 5"-6".
 - c. Avoid mowing when soil is wet.



Why Maintain a Minimum Height of 5"- 6"



Vegetation height reduction to 5"-6" allows bunch grasses and biennial and perennial wildflowers to survive in this LIMA or Pocket prairie.



Most native grasses are bunch type and have their growing points 3"- 4" above ground level.



The exceptions, Buffalo grass and Vine mesquite are creeping or stoloniferous grasses which can be mowed at lower heights, but they also benefit being mowed at a minimum of 5"-6". This height will reduce weeds because of greater ground coverage and protect SOM.

Maintenance Along Rivers, Creeks and Lakes

- The land along a river, creek or lake plays an even greater role in improving air and water quality than uplands.
- This area whether it is a river, creek or lake is the riparian zone.
- Maintenance of this area directly impacts water levels, flood control, and the quality of recreational activities such as swimming, fishing and birding.

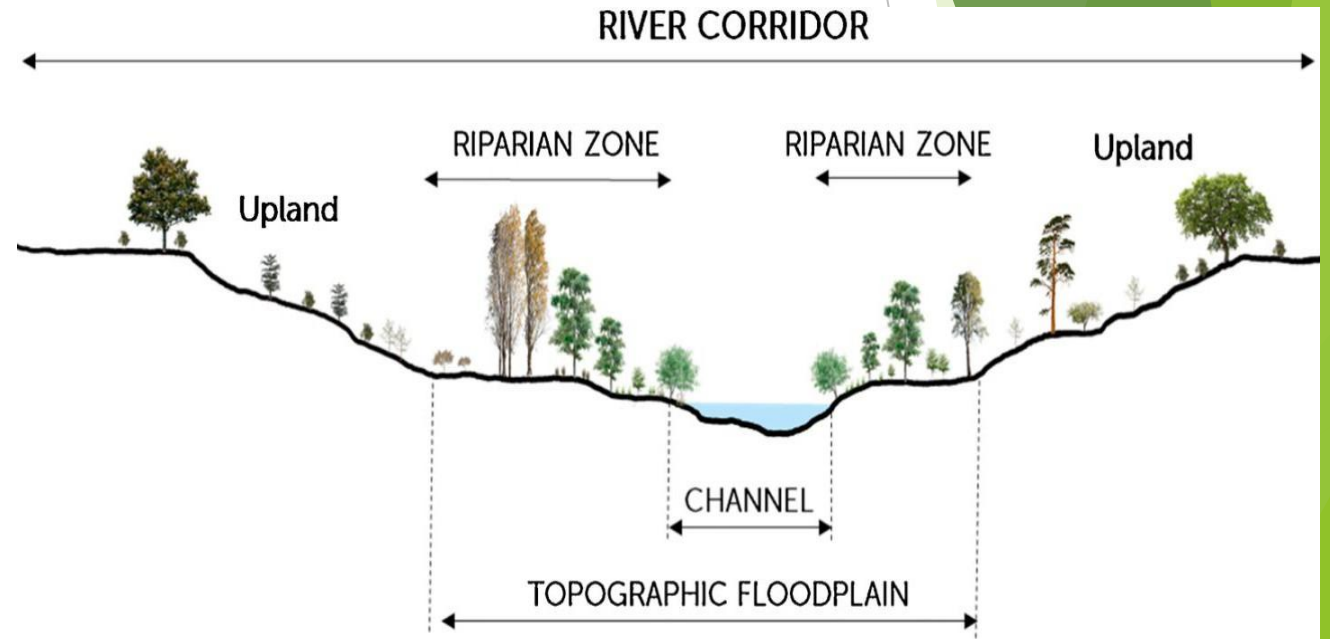


Fig. 7. Cross section of a symmetric natural corridor.

Maintenance Along Rivers, Creeks and Lakes

- It is crucial to leave a LIMA buffer of at least 10'-15' from the water's edge.
- The buffer width should be wider for steeper slopes.
- Trees provide additional bank stabilization while cooling the water with shade.
- Vegetative buffers also filter pollutants from stormwater and create habitat for fish and other aquatic wildlife.
- Maintenance of these areas follows the previous section on LIMAs except avoid using *mowing equipment in a riparian buffer*.



Mowing to the water's edge causes the bank to erode.

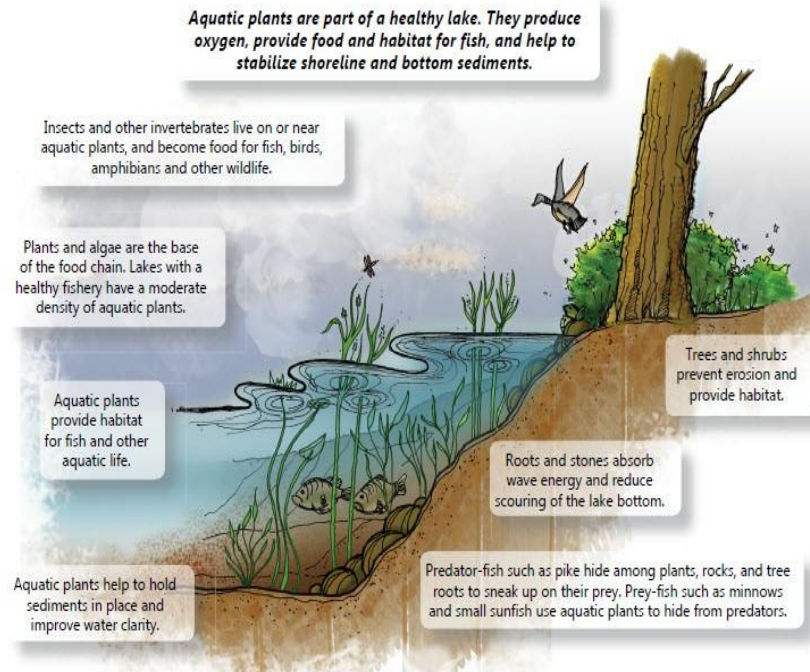
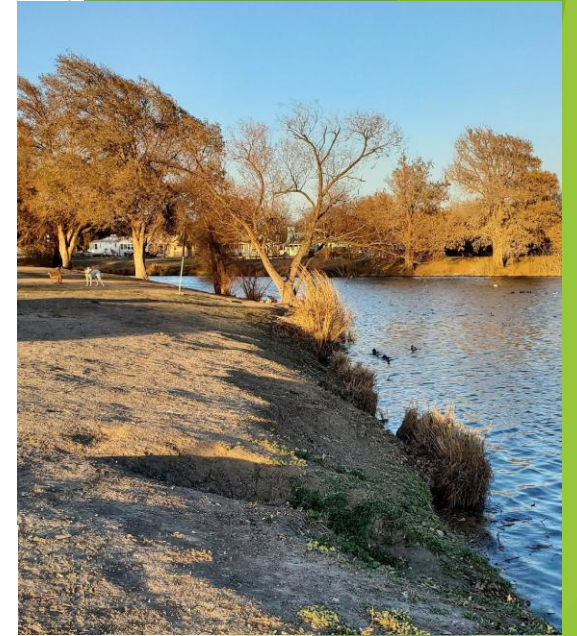


Vegetation protects the bank.

Maintenance Along Rivers, Creeks and Lakes

- Uncontrolled access to the water's edge leads to soil degradation and water pollution.
- Access can be managed with vegetation:
 1. Stop mowing a minimum of 10' from top of bank.
 2. Establish physical barriers with natural materials and allow vegetation to grow and or install new riparian plants.

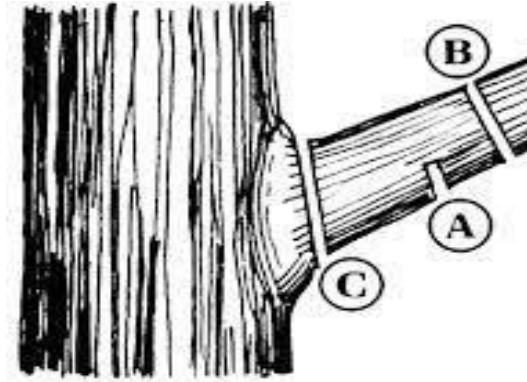
The lack of vegetation on this bank allows soil to wash into the lake causing the lake to fill with sediment and impairing water quality.



Creating a living lake leads to more recreational and educational activities while improving water quality.

Trees: Pruning Basics

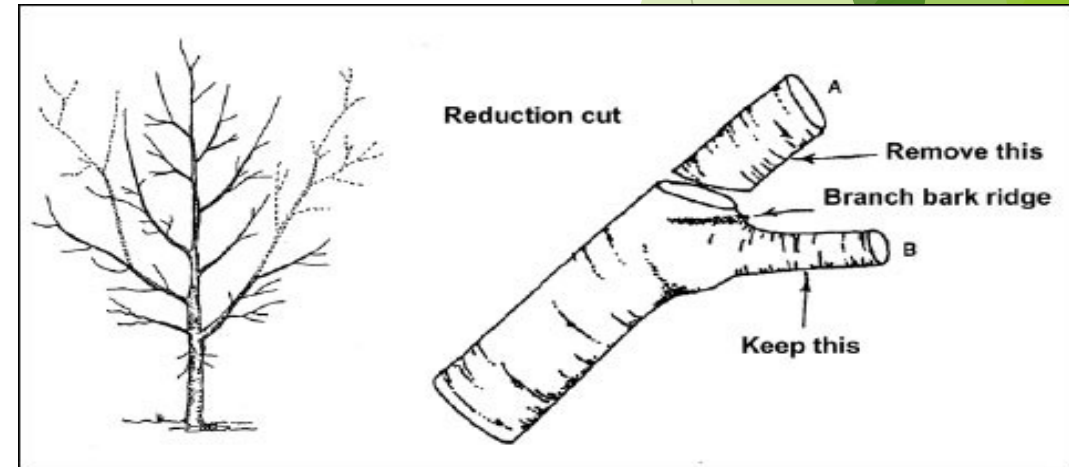
- Proper pruning is required for a tree's health.
- Pruning in the winter will invigorate a tree, summer pruning results in reduced vigor.
- It is best to prune oak trees in very cold or very hot weather to prevent oak wilt.
- Even so, painting within 20 minutes is required on wounds 1" or greater in diameter.
- Avoid removing more than 25% of the foliage at one time to maintain food production capacity.
- Follow proper pruning methods as shown and do not leave stubs and avoid topping and/or lion-tailing.



For larger branches, use the three-step process to avoid ripping the bark.



A proper cut forms callus protecting the tree from insect and diseases.



Tree Abuse Prevention



Lion tailing/over-pruned oak tree:

- Stresses tree due to loss of too much foliage at one time.
- Tree compensates by producing hundreds of small twigs along the main branches.
- Also puts all the weight at the branch tip. Duh!



Topping produces wounds that are impossible for a tree to heal, and new branches are weakly attached and easily broken.



These stubs will never heal properly, and any foliage produced will be inferior. Cut back to the trunk.



Compacted soil stresses a tree; limits water, oxygen and nutrients.

Equipment

- Using the right equipment and keeping the equipment in good working condition is needed to create and maintain a healthy landscape.
- Maintenance checklist (based on use):
 - ✓ Clean and lubricate including the decks of riding mowers,
 - ✓ Check oil and fuel levels and change when needed,
 - ✓ Clean or replace air filters,
 - ✓ Check spark plugs or batteries,
 - ✓ Sharpen or replace worn blades, and
 - ✓ Check tires for recommended pressures.



Mowing Tips to Avoid Ruts, Compaction and Scalping

- Use a lighter mower, such as a Reel or self-propelled hand mower, in soggy or wet areas.
- Stagger the tracks, 6" to the left, or right.
- If a rut begins, leave a space of about ½ the deck width and mow with a lighter mower or line trimmer.
- There are different opinions, but wider tires may help.
- Correctly inflated tires and sharp blades will allow you to move more quickly reducing ruts.
- Use a lighter weight person on the riding mower.
- In rough terrain, use a stabilized or floating deck or a pull behind mower.

Note: Scalping may not be as big of a problem where the vegetation is 4" or higher or in LIMA areas. ?



A full floating deck prevents scalping and will move better over uneven ground without gouging or tearing up turf.



Equipment

- If mowing is required within a riparian buffer...
- Avoid rolling a mower and soil compaction with these options.



Light weight mowing
by remote control.



Equipment

Mowing in a LIMA or Pocket prairie at a minimum 6”:

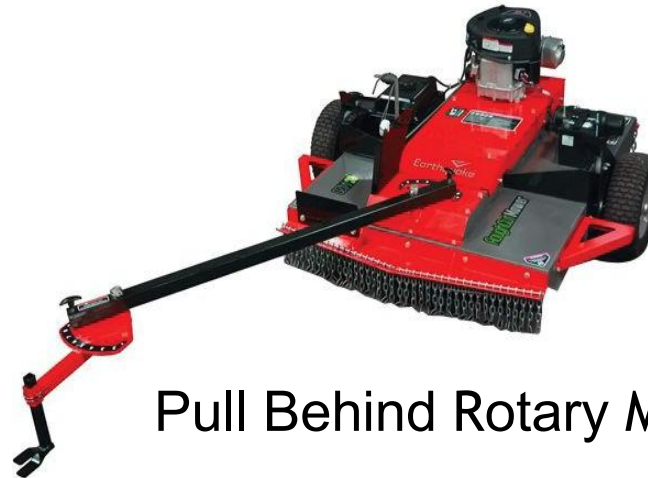
- Mow every 2-3 years to promote the continuation of a diverse native plant community.
- Mow patches at a lower height to maintain annual wildflowers.
- A rotary mower is preferable to a sickle-type mower to prevent burying young prairie seedlings.
- Mow frequently enough that the invasive weeds do not grow too large.



Dual Action Sickle Mower



Sickle Mower



Pull Behind Rotary Mower



Pull Behind ATV
Flail Mower

The goal is to control weeds and not cover the growing grasses and wildflowers/forbs with a lot of concentrated plant material.

Typical Hand Tools Needed



Sharpshooter or trenching shovel



Garden rake



Round shovels



Pullerbear or Weed wrench



Loppers, hedgers and hand pruners



Hand cultivator or hoe



Pick axe or Pick mattock



Garden trowel



Hula hoe

The handout on rules, regulations and information...

- A 1-page handout on rules, regulations and information has been included in the packet.
- Big takeaways are:
 - It is illegal to allow leaves, grass and or debris from landscape operations to be discharged into a street.
 - In San Antonio, any business or person removing or pruning a tree requires a tree maintenance license.



Rules, Regulations and Information for San Antonio

- Environmental Protection Agency (EPA) has given the Texas Commission on Environmental Quality (TCEQ) the responsibility for implementing the Clean Water Act in the state.
 - Requires cities to prevent (as much as reasonable) water pollution from entering creeks and rivers.
 - Large cities must develop and implement a stormwater plan that includes treatment and monitoring.
 - a) Manage the runoff from construction sites,
 - b) Prevent illegal discharges into stormwater water management system which includes streets,
 - c) Implement strategies practices such as street sweeping, public education and trash pick-up events.
- **BLOWING TRASH, GRASS CLIPPINGS, LEAVES OR ANY OTHER MATERIAL INTO THE STREET IS A VIOLATION TO THE CITY'S PERMIT AND IS SUBJECT TO PENALTIES: The San Antonio Water System.**

Rules, Regulations and Information for San Antonio

- American National Standards Institute (ANSI) A300 Part 1 outline the best practices for tree maintenance and pruning.
- City of San Antonio's ordinance to prevent and control the spread of Oak Wilt.
 - The provisions of this section apply to any person, firm, corporation, business entity, city department, public or private utility to the extent permitted by law.
 - All wounds to the trunk, limbs and root system of oak trees in the city that expose sapwood shall be painted within thirty minutes of the wound with asphaltic or exterior oil or latex based paint.
 - Firewood from oak wilt infected trees shall not be brought into the city at anytime.
 - It shall be unlawful for any person or firm to engage in the business or occupation of pruning, treating, or removing trees without a valid tree maintenance license by the city



References that will excite you!

What We Do:

- Our organization is made up of 62 member organizations including Fuerza Unida.
- Our goal is to protect the Edwards and Trinity aquifers and their watersheds.
- Implementation of this training will assist in conserving water and protecting these aquifers.

- ▶ Texas Native Plant Landscape Certification Program
<https://www.npsot.org/our-work/class-schedule/>
- ▶ 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:
<https://aquiferalliance.org/using-our-green-spaces-to-improve-water-quality-and-create-resilient-communities/>

Thanks so much for your
interest and attention!