ACLP II
ADVANCED
ARIZONA CERTIFIED
LANDSCAPE PROFESSIONAL

Tree Health Care

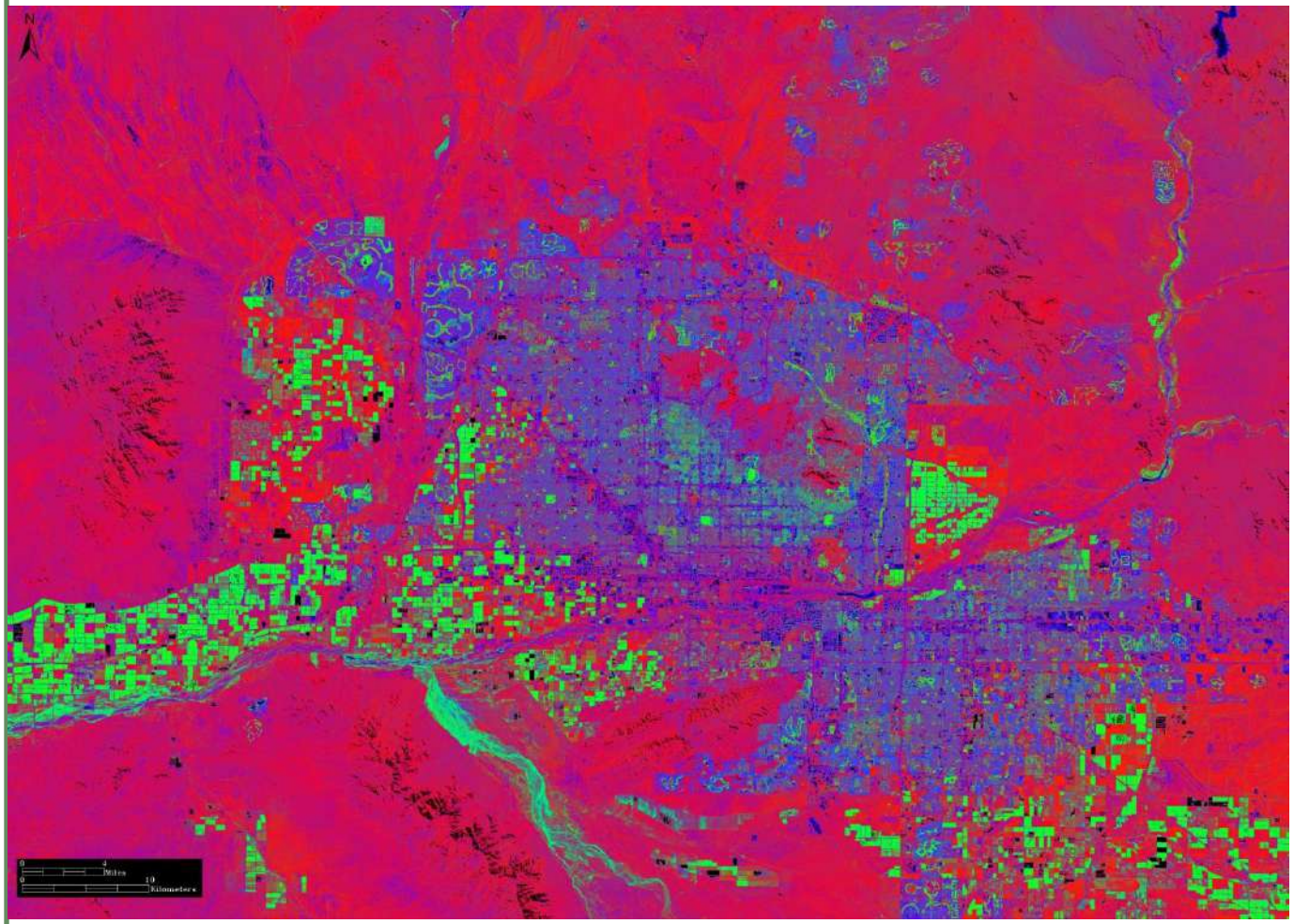
What you will learn

- How trees impact the environment
- Tree anatomy & physiology
- Top tree killers
- Soil issues
- Nutrition and irrigation
- Growth regulators
- Pruning
- Health assessment checklist

Benefit of Trees

- Reduce air pollution
- Conserve water and reduce soil erosion
- Save energy
- Modify local climate
- Increase economic stability
- Reduce noise pollution
- Create wildlife and plant diversity
- Increase property values
- Add beauty and improve personal health

Benefits of Trees



Phoenix metro area showing the Urban Heat Island effect (UHI) as of 2000.

Red- soil/pervious surface
Green- vegetation
Blue- impervious surfaces

Nasa.gov

The Urban Forest

Increasing tree canopy cover from the current level of about 10% to 25% could reduce temperatures by 4.3°F.

For a bare neighborhood with no vegetation, adding 25 percent canopy could lead to a **7.9 degree cooling effect**.

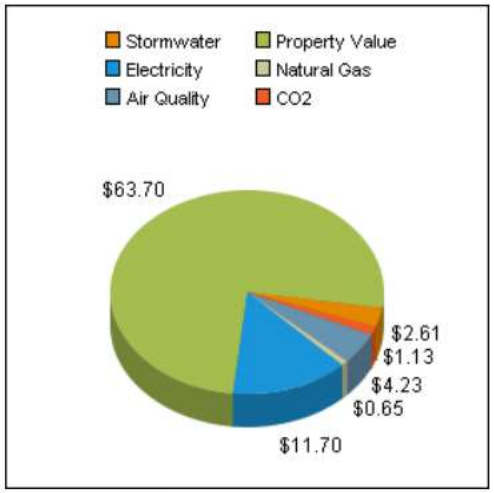
How much does this tree save me?

Home Calculate another tree

National Tree Benefit Calculator

Beta

Overal Benefits | Storm Water | Property Value | Energy | Air Quality | CO2 | About the Model



Breakdown of your tree's benefits
Click on one of the tabs above for more detail

This **8 inch Honey mesquite** provides overall benefits of: $84 every year.

While some functional benefits of trees are well documented, others are difficult to quantify (e.g., human social and communal health). Trees' specific geography, climate, and interactions with humans and infrastructure is highly variable and makes precise calculations that much more difficult. Given these complexities, the results presented here should be considered initial approximations—a general accounting of the benefits produced by urban street-side plantings.

Benefits of trees do not account for the costs associated with trees' long-term care and maintenance.

If this tree is cared for and grows to 13 inches, it will provide $127 in annual benefits.

Honey mesquite
Prosopis glandulosa

Casey Trees WASHINGTON DC

The National Tree Benefit Calculator was conceived and developed by Casey Trees and Davey Tree Expert Co.

DAVEY

http://www.treebenefits.com/calculator/

The Value of a Tree

Tree (installed) = $285
(equal to 24” box)

Total Value = $285

Tree = $720

Removal/Stump
Grind = $290

Total Value = $1,010

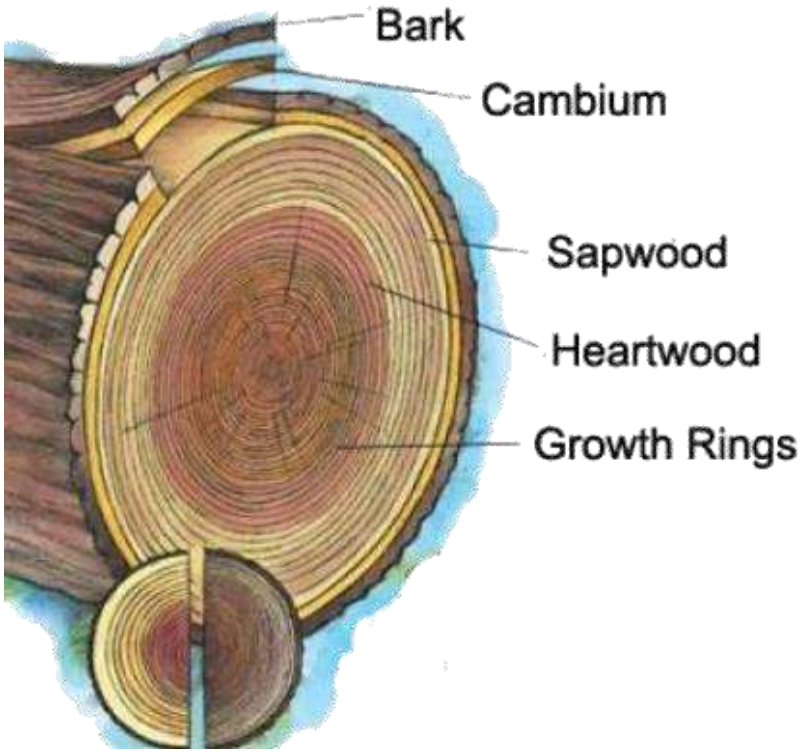
Tree = $3,285.00 (equal to 60” box)

Delivery = $1,000

Install = $1,600

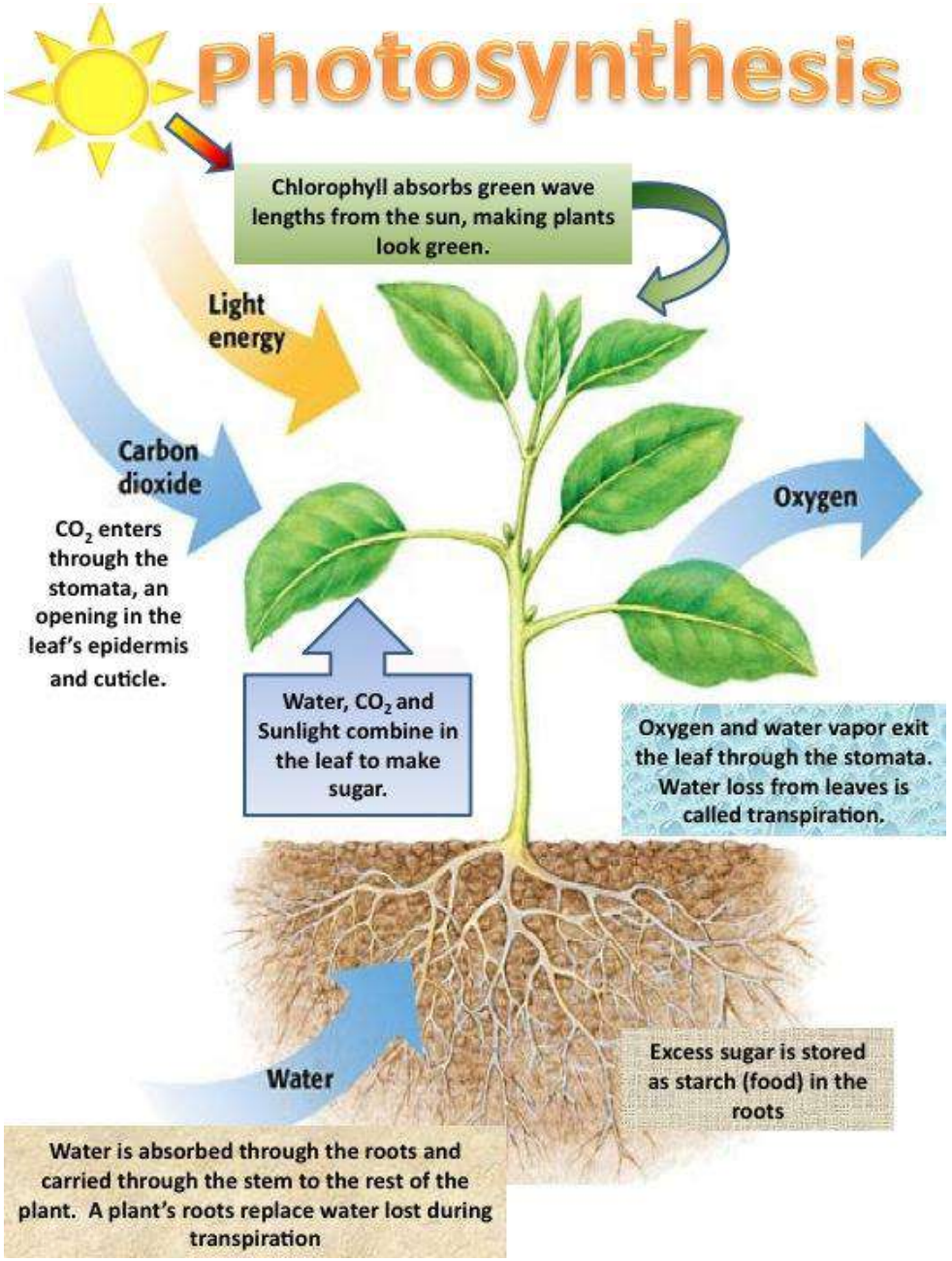
Total Value = $5,885

Total X 500 trees on your
property…PRICELESS!!!!



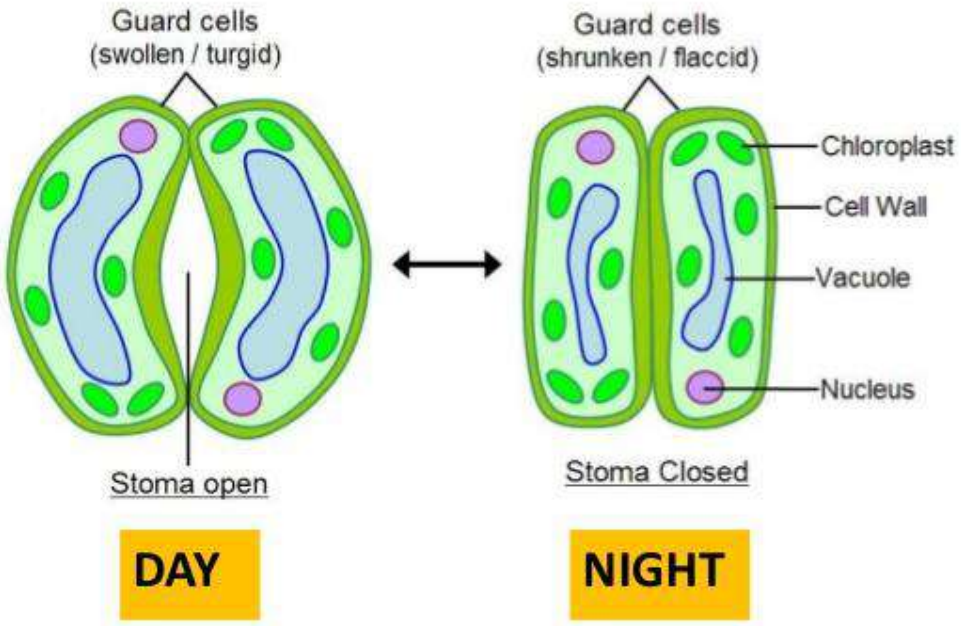
TREE ANATOMY AND PHYSIOLOGY

Photosynthesis



Stomata

Tiny openings on the leaf surface, usually the underside, which allows for gas exchange. This is also where **transpiration,** or the loss of water vapor occurs from the plant.



Fun Fact: *Some desert plants have adapted to capture light energy but keep stomata closed during the day, helping to reduce water loss.* ***CAM*** *plant stomata open at night, capturing* CO_2 *which can then complete photosynthesis with stored energy from the daytime.*

Sometimes **lenticels** are formed from the periderm, which are pores allowing gas exchange on the stems, similar to a stomata's function.

Conducting Tissues

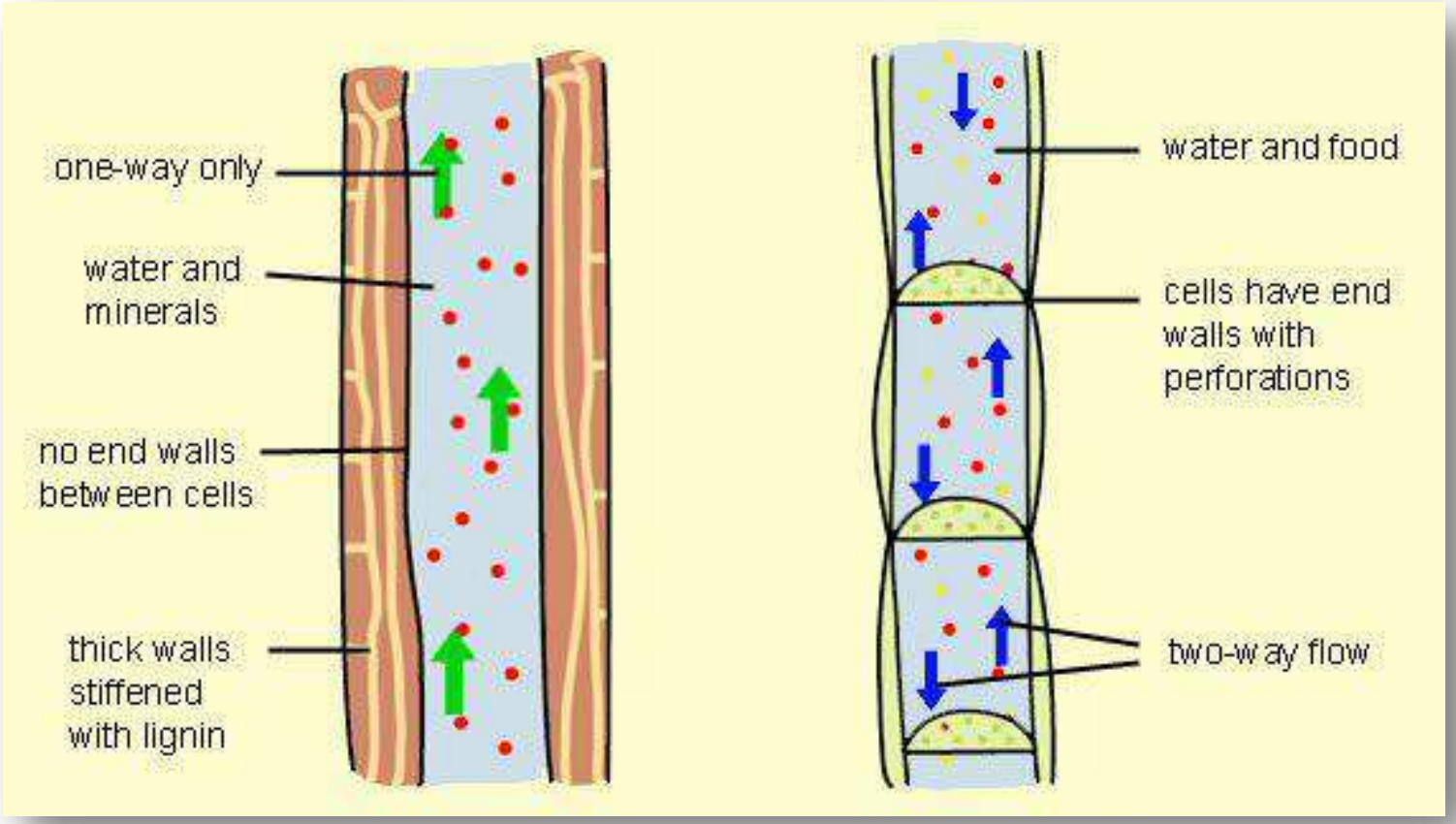
Xylem

- Transports water & minerals from the roots **up** to the aerial parts of plant
  - ‘Dead’ cells, passive transport, moved based on water potential (**up**)
  - Wood is primarily xylem tissue
  - Inside of vascular bundle

Phloem

- Transports food and nutrients such as sugars & amino acids from leaves to storage organs & growing parts of plant
  - Active, under plant’s control where sugars are moved **(up or down)**
  - Outside of vascular bundle

Conducting Tissues



Xylem **Phloem**

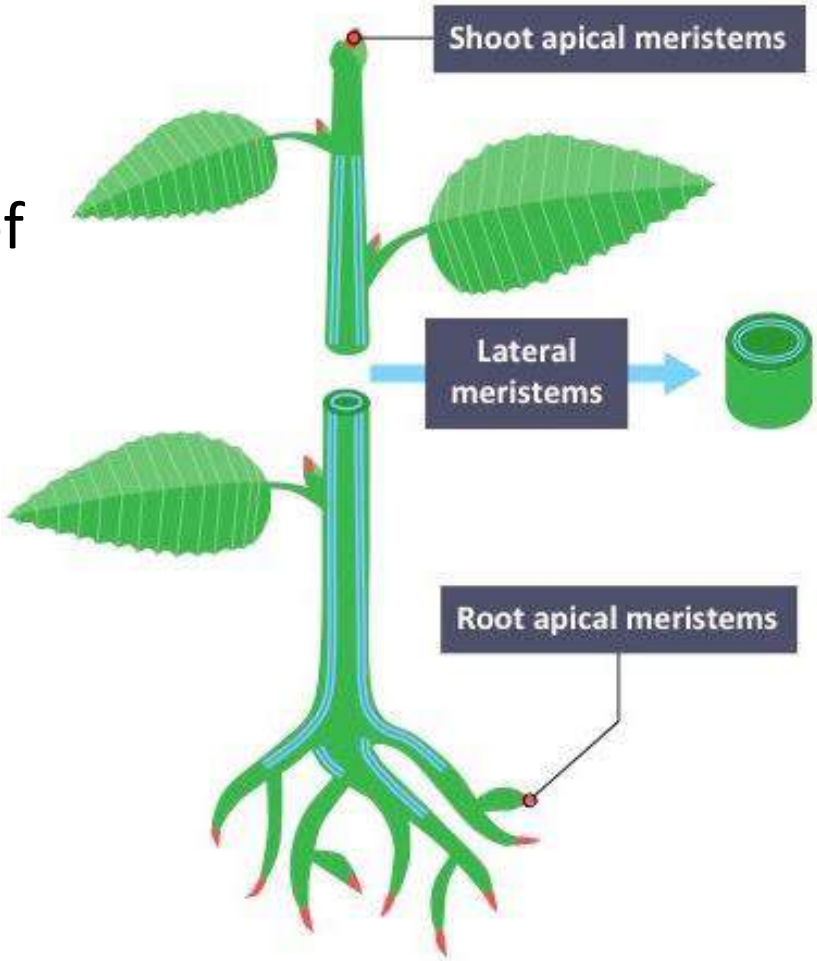
Meristems

Primary Growth

- Apical meristems
  - Increases in length at tips of shoots and roots
  - Produces new leaves, flowers/fruit

Secondary Growth

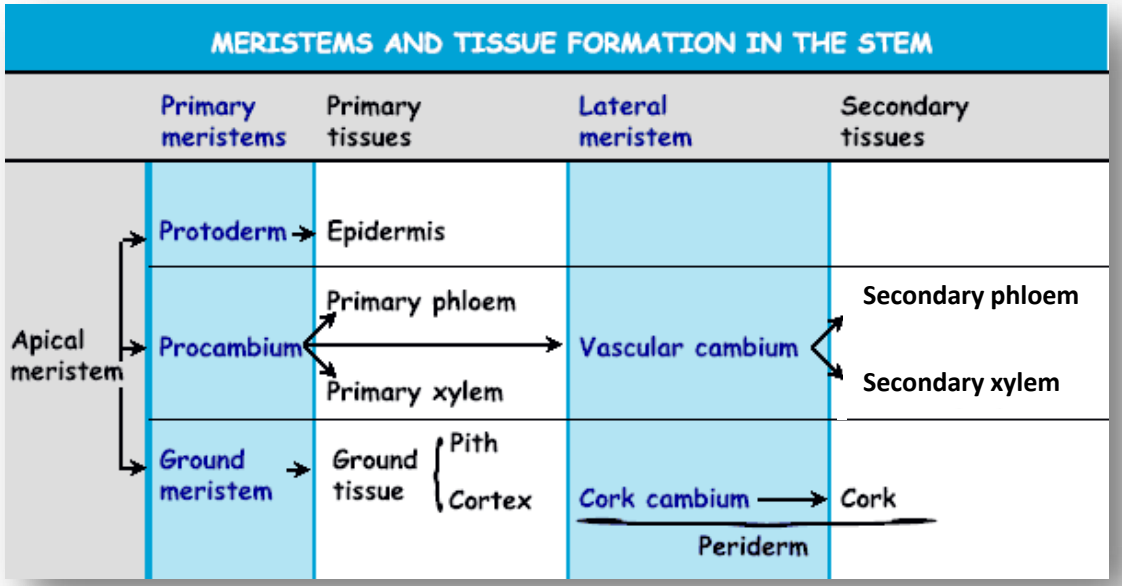
- Lateral meristems
  - Increases in stem and root diameter (girth)
  - Produces bark on trees

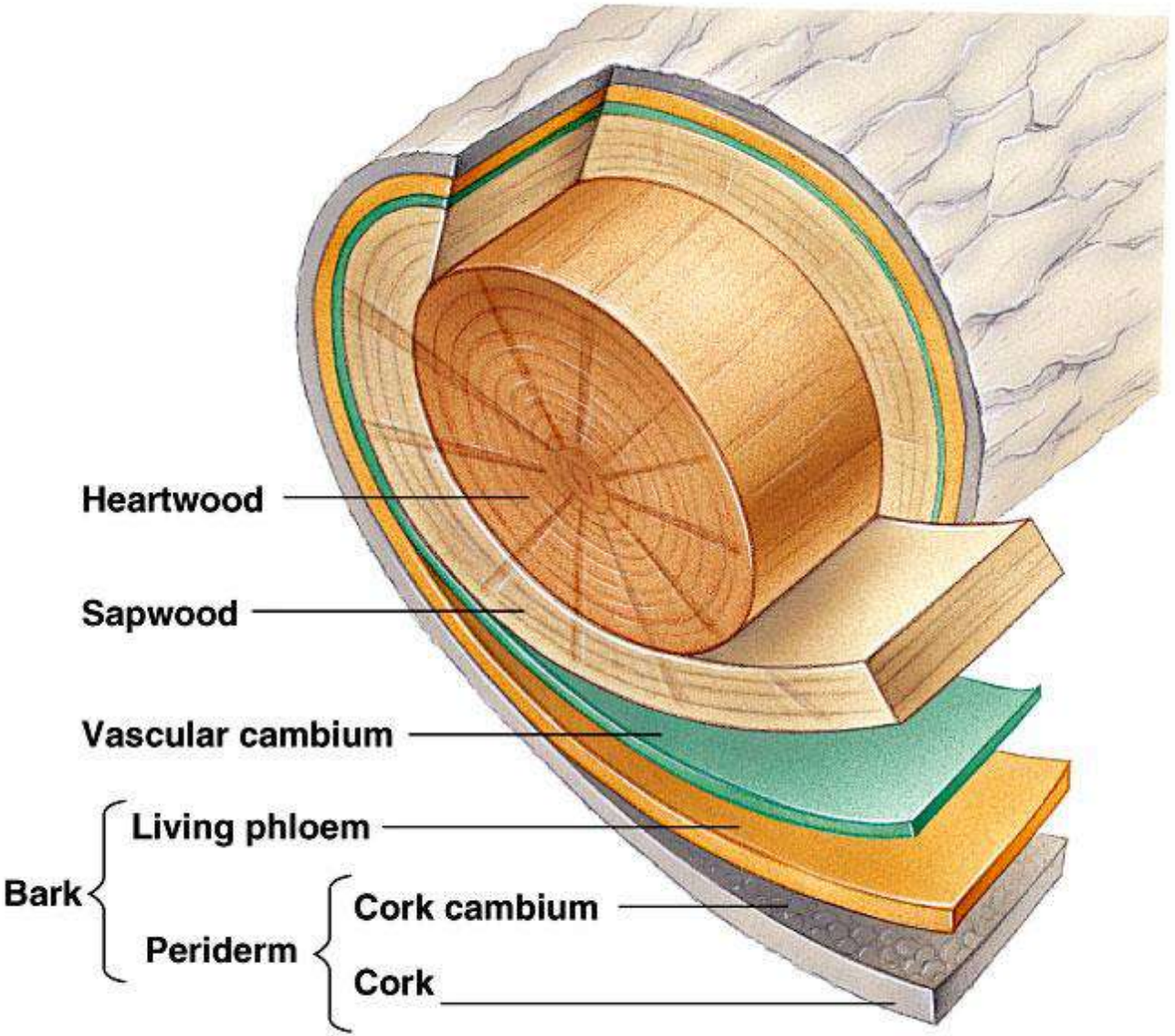


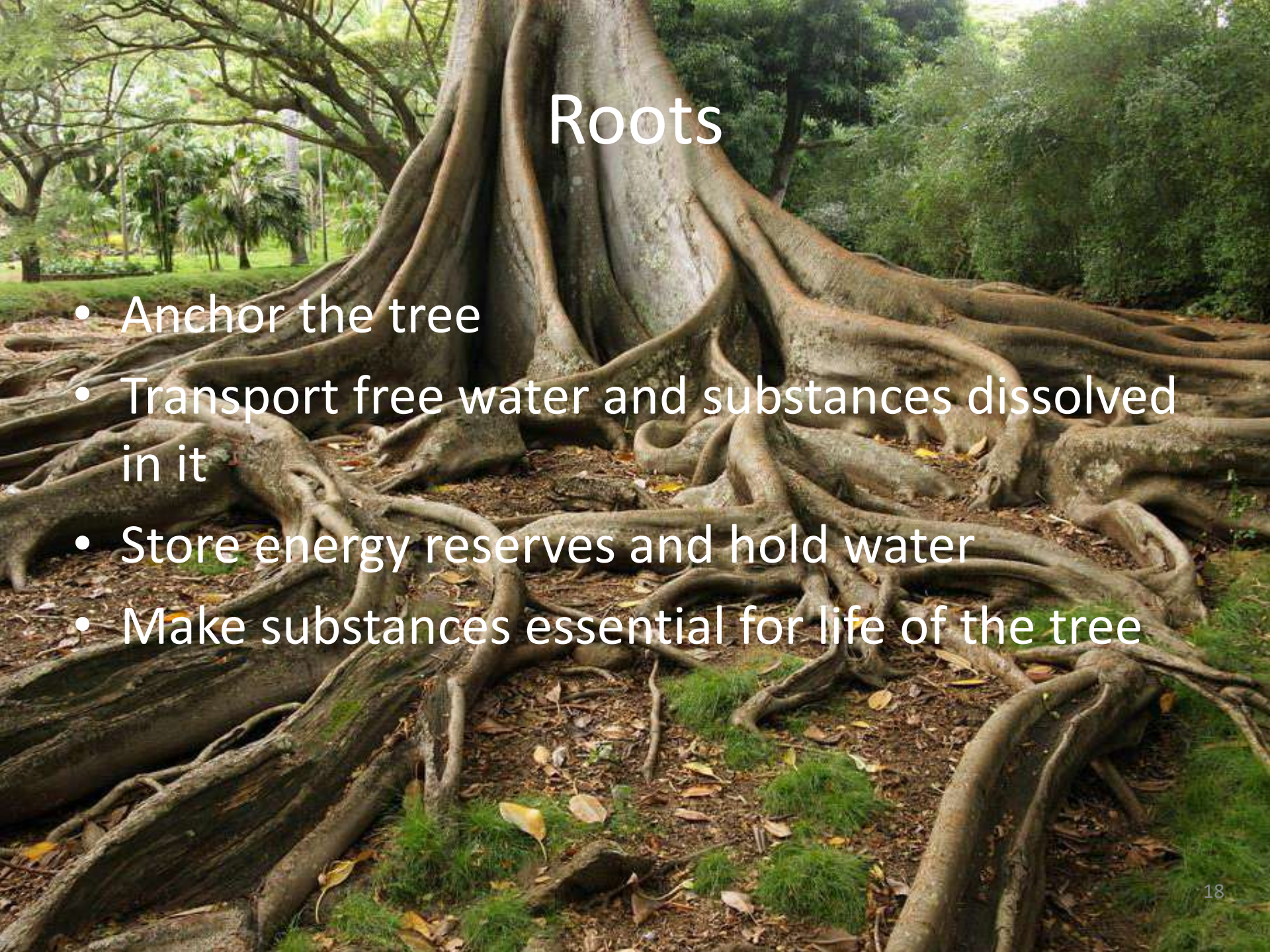
Meristems

Lateral meristems add thickness to woody plants (secondary growth)

- **Vascular cambium** adds layers of vascular tissue called secondary xylem (wood) and phloem
- **Cork cambium-** thick, waxy protective outer layer (periderm)



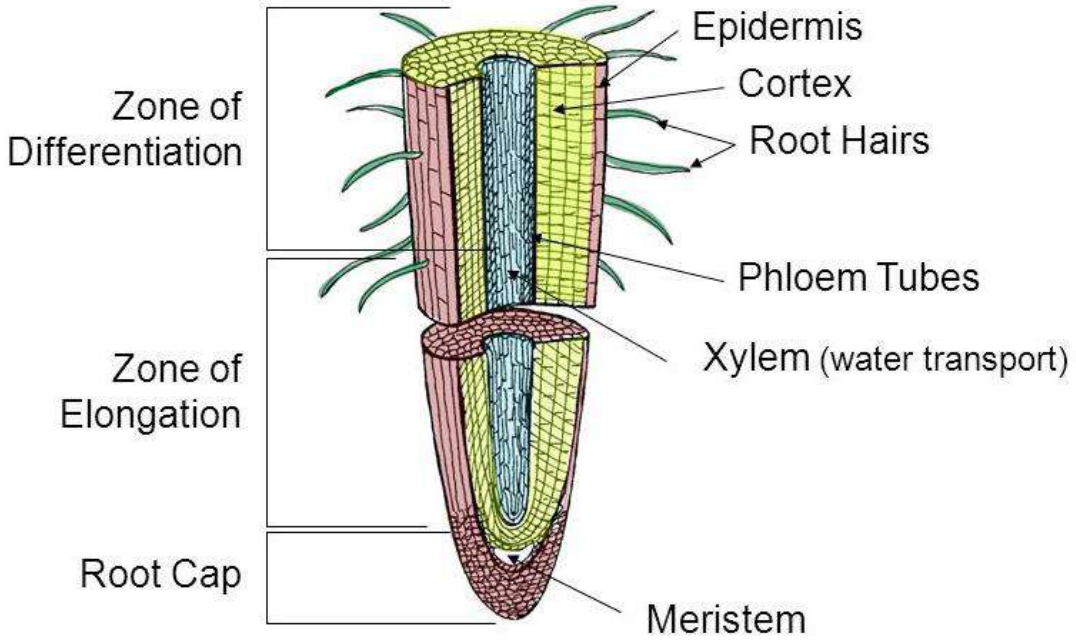




Roots

- Anchor the tree
- Transport free water and substances dissolved in it
- Store energy reserves and hold water
- Make substances essential for life of the tree

Roots



- Root hairs absorb water and minerals from soil
- Phloem brings food from the leaves which is used to make new cells at root tip
- Root cap protects the root tip as it grows through the soil
- Cortex stores food as starch
- Xylem carries water and minerals up to stems
- Root tip grows as cells divide

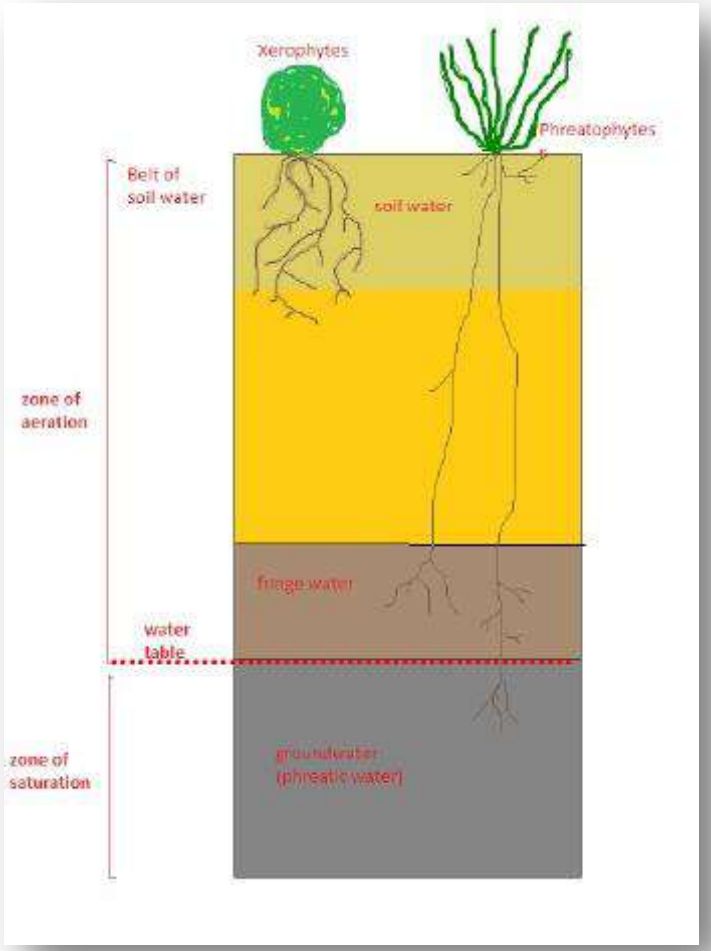
Plant Adaptation

Xerophytes

- Plants adapted to arid environments by storing as much of the little water made available and reducing evaporation rates
  Example: cactus

Phreatophytes

- Plants that have adapted to arid environments by growing extremely long roots, allowing them to acquire moisture at or near the water table
  Example: ocotillo

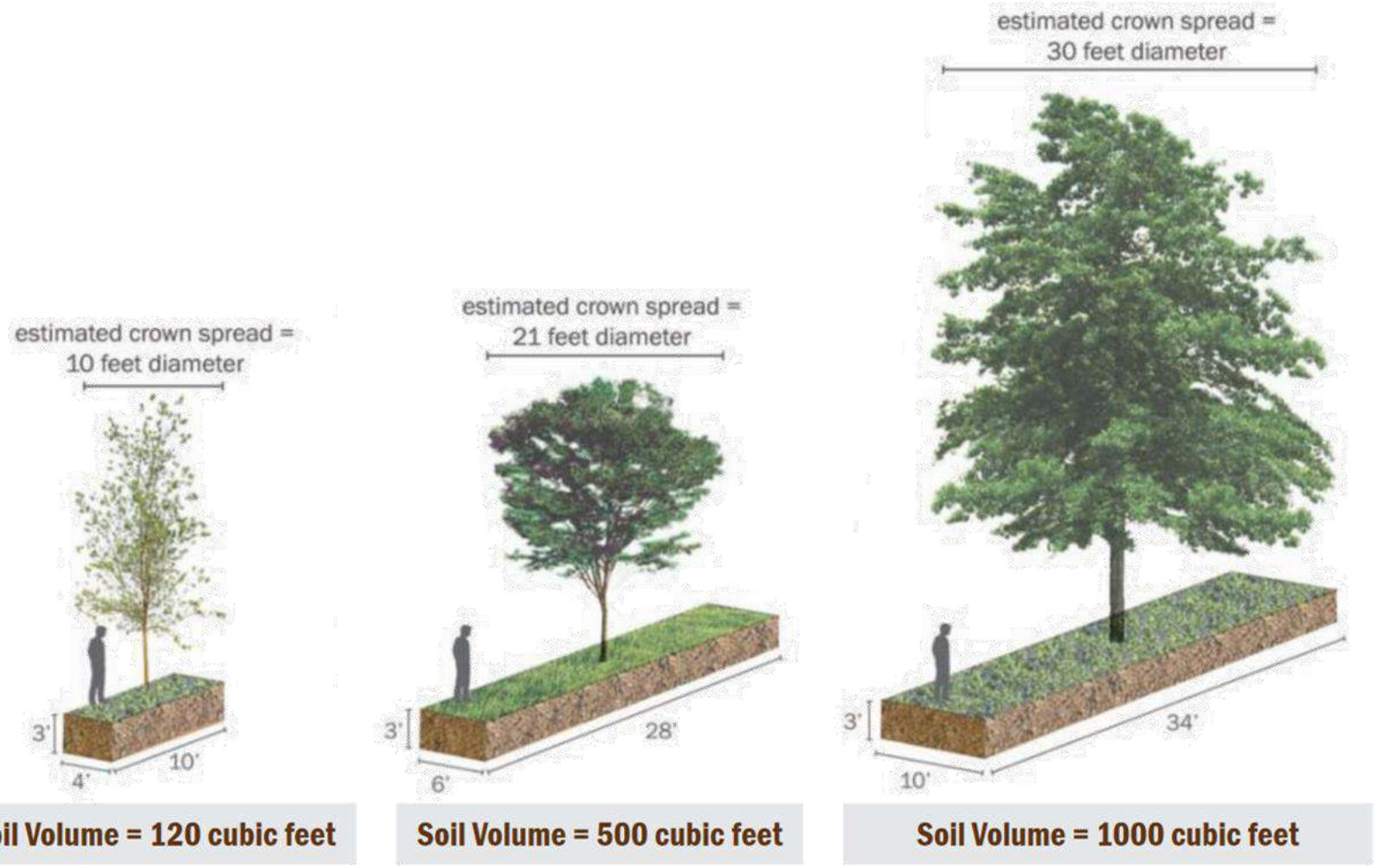


Other Plant Adaptions

- Reduction of leaves, often into spines for protection (animals)
- Development of the stems as major photosynthetic structures, like shoestring acacia, which has **phyllodes**
- Water storage in the stem
- Waxy cuticle coating on plant to reduce water loss
- Pubescent foliage or dense hairs to reduce air movement over surface, creating a microlayer
- **Allelopathy**, or root chemicals which help prevent competition from neighboring plants

How Trees Grow in Urban Spaces

Space to Grow



Casey Trees, Washington DC

Planting a Liability or Growing an Asset

150 cubic feet of soil
Estimated lifespan: 7-10 yrs

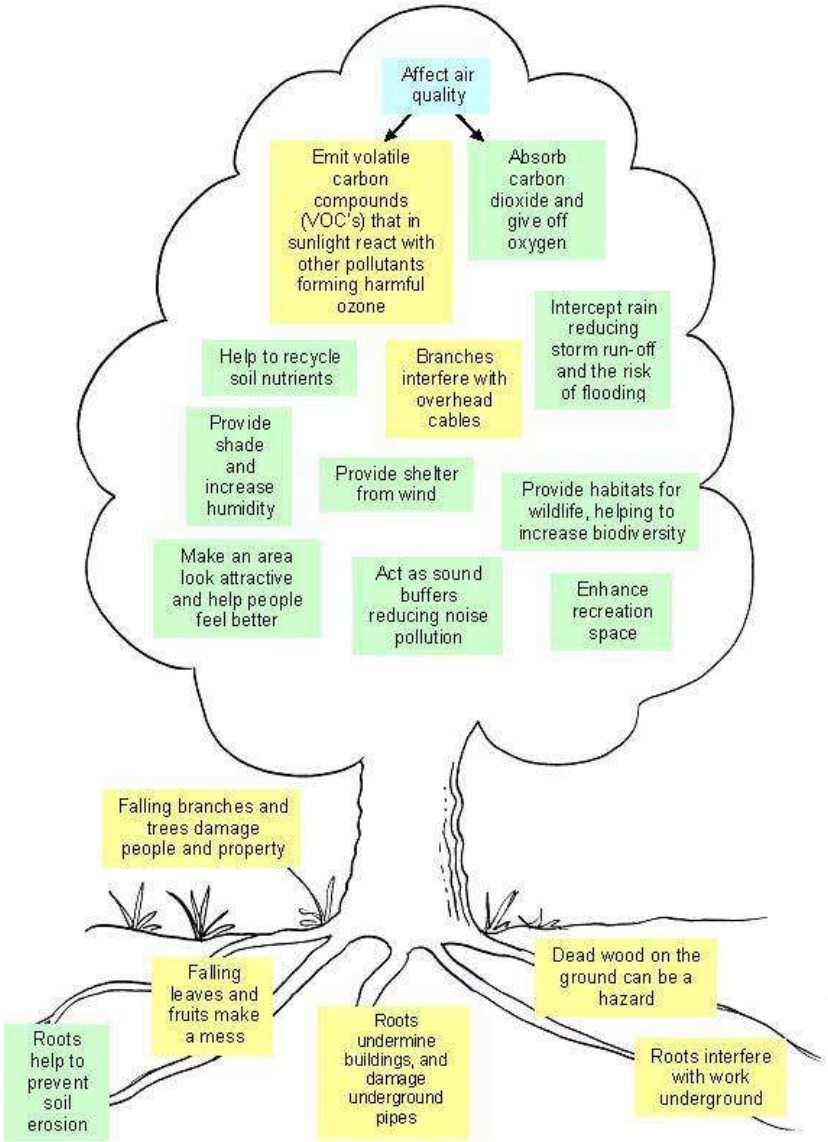
1,000 cubic feet of soil*
Estimated lifespan: 50+ yrs
*This design utilities Silva Cells

Installation Costs	$5,000 (replanted 5 times)	Installation Costs	$14,000
Maintenance Costs	$1,211.99	Maintenance Costs	$2,241.75
Total Benefits	$2,717.66	Total Benefits	$41,769
Net Lifecycle Costs	**$3,493.33**	**Net Lifecycle Costs**	**-$25,427.25**

Provided by the City of Phoenix

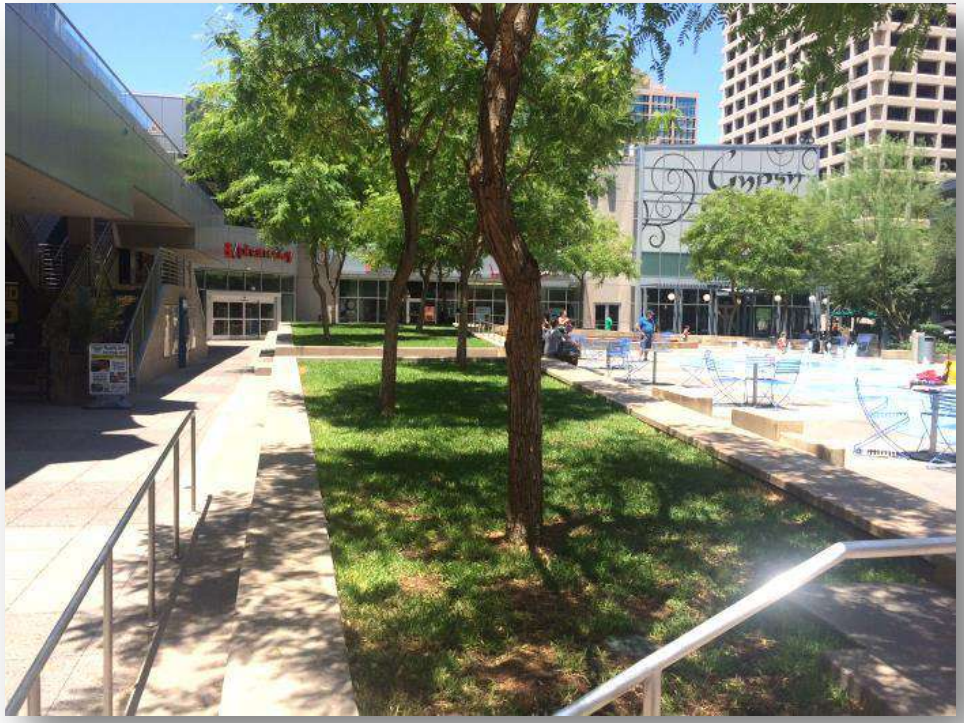
The Urban Tree

The Good,
The Bad and
The Ugly



Overall more benefits than negatives

The Urban Tree

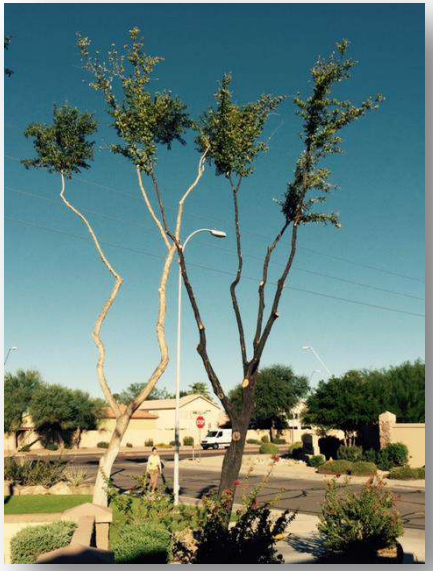


Raised planters = extreme temperatures limiting root growth

Run-off contaminants & lack of maintenance shortens a street tree's life span

The Urban Tree

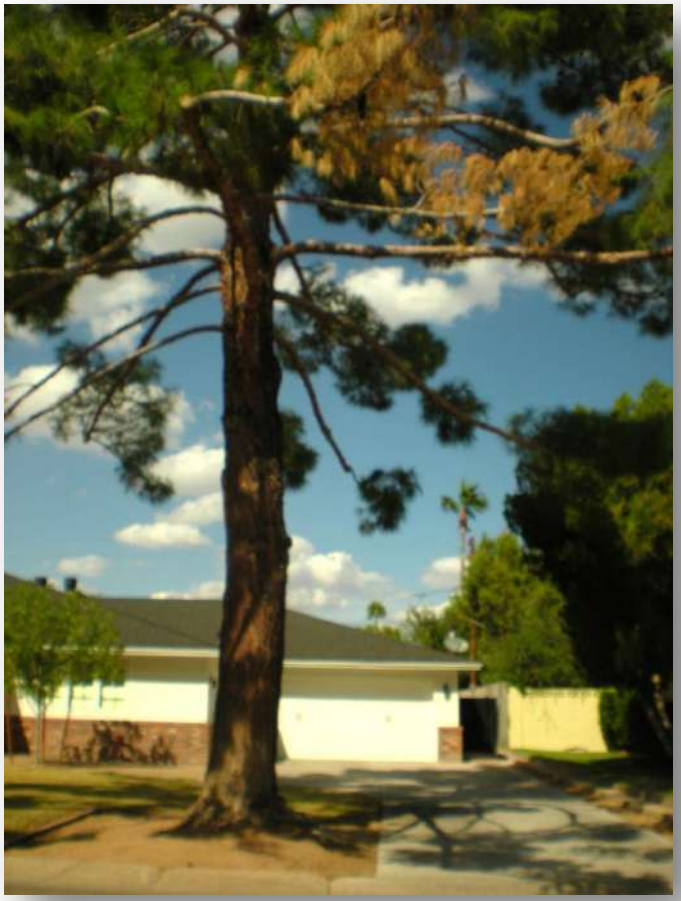
Parking lot islands- how many stresses can you count?



Soil contaminants and the lack of water and air due to compaction are common stresses.

Trees can also be destructive to infrastructure….

…which can lead to damage to tree roots by improper root removal




TOP 10 TREE KILLERS

Top 10 Tree Killers

1. Construction
2. Inappropriate grade
3. Improper pruning
4. Vandalism
5. Wrong tree for the site
6. Poor quality nursery stock
7. Soil issues
8. Inappropriate watering
9. Bark damage
10. Herbicides

Construction

Construction

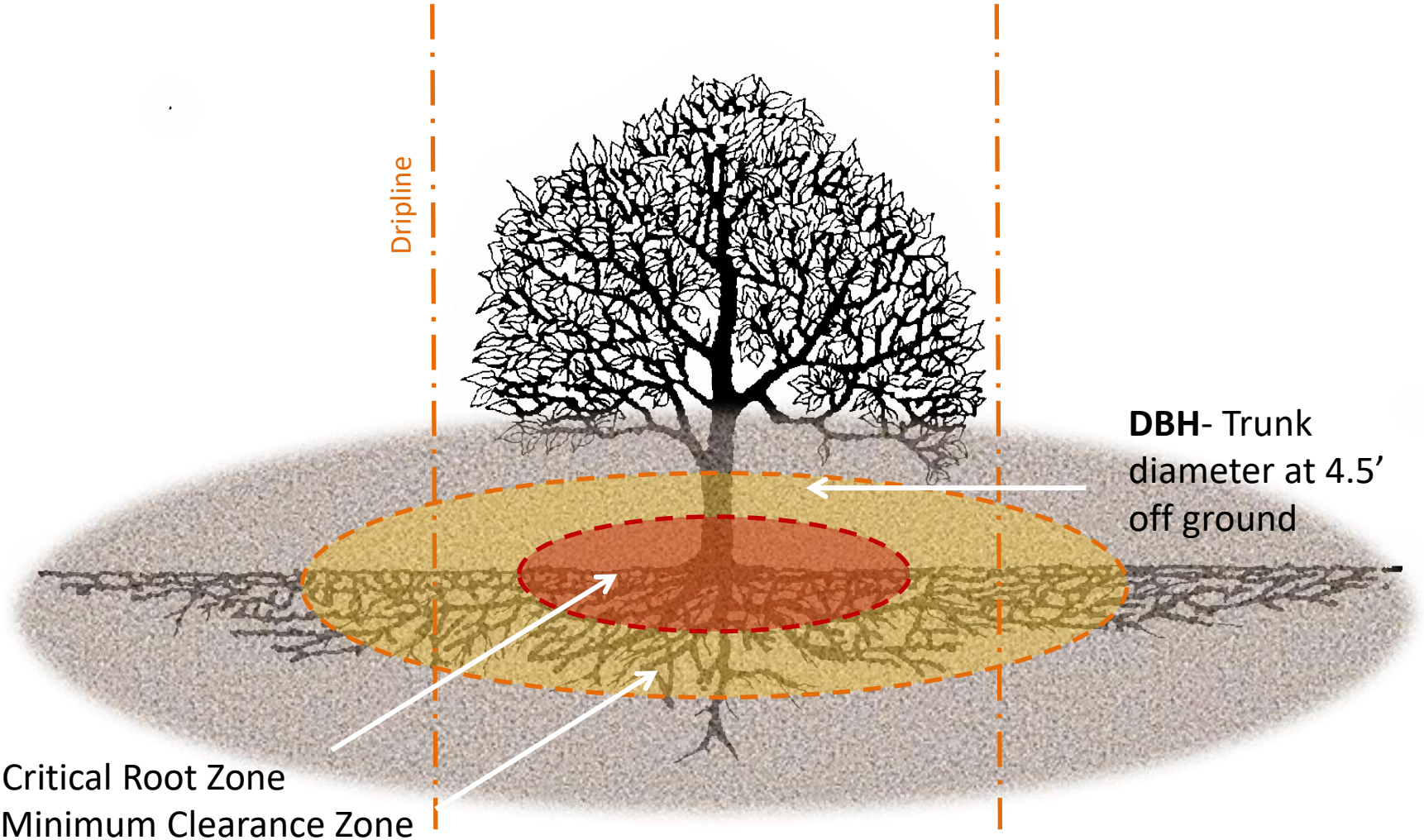
Critical Root Zone (CRZ)

- Severing even one major root can cause the loss of 15-25% of the root system.
- Roots greater than 4” in diameter are likely structural, cutting or damaging these roots may impact structural stability of the tree, creating a liability if it fails.
- The farther away from the trunk the cut, the less likely you are to cut a large root that will have a profound impact on the entire root system.

Critical Root Zone (CRZ)

1’ for every inch of DBH

1.5’ for every inch of DBH on sensitive tree varieties



DBH- Diameter at breast height

Construction

- Root damage does not repair quickly
- On average, it takes a tree one year for every inch in trunk diameter to recover from torn roots
- If you must trim roots radically to accommodate landscape construction, consider root pruning well in advance of construction to lessen the impact

Conserve and Protect Existing Trees

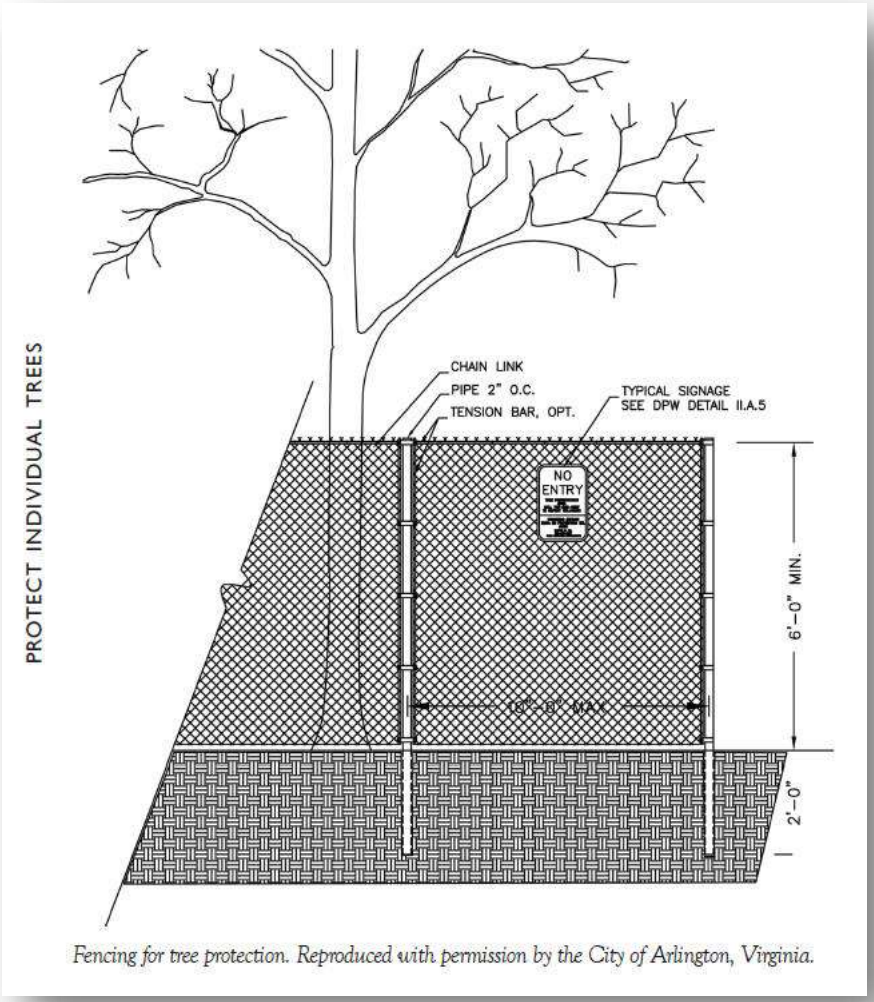
Do not store equipment or place debris near existing trees. A barrier should be established around this oak tree during construction.

Protection Plan

- Budget for tree protection and preservation
- Initiate plan one year prior to construction
- Hire a Certified Arborist to develop plan and monitor tree during the project
- Ensure adequate water is being delivered as irrigation system may not being functioning
- Trees that can not be protected or are growing within 10’ of existing or future structures should be removed
- Establish penalties for tree damage by any company or workers on the project

Construction Protection

- Establish a tree protection program prior to construction
- Install barrier fencing around the CRZ, which should be in place until the project is completed
- Signage to help inform other workers why barrier is in place
- Do not cut roots larger than 4” in diameter
- Make all cuts with sharp tools to encourage wound closure



Fencing for tree protection. Reproduced with permission by the City of Arlington, Virginia.

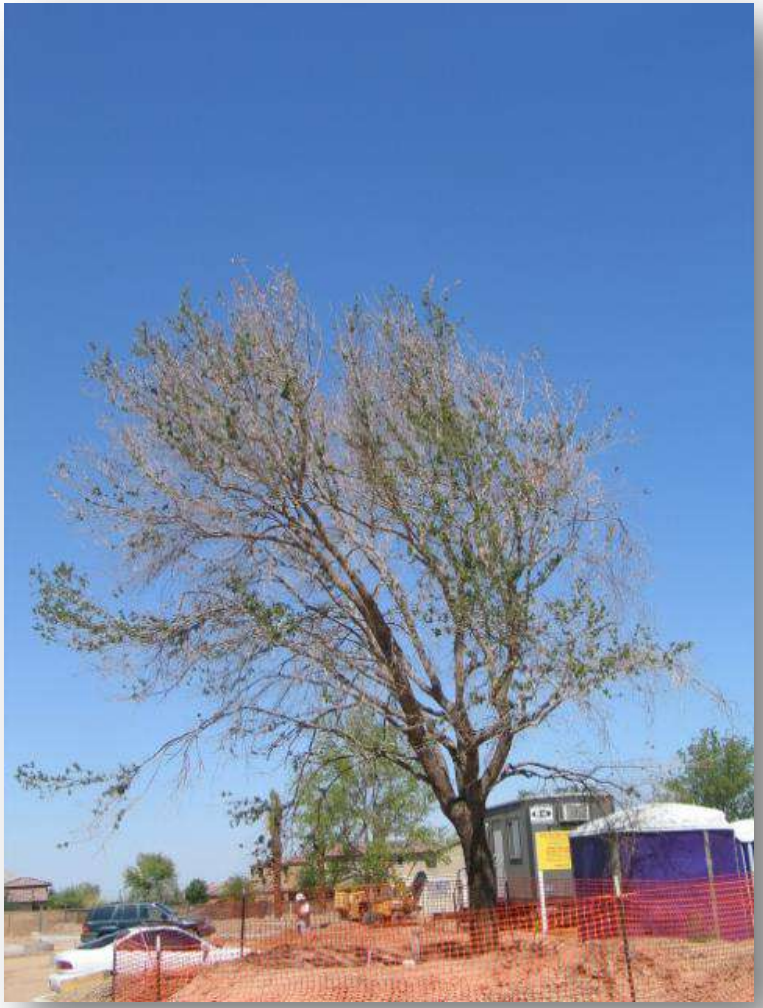
NOT a protection plan

What is wrong here?

Construction Protection

While trees are within barrier **DO NOT**:

- Store equipment or debris
- Park vehicles or equipment
- Pile soil or mulch
- Trench for utilities or irrigation
- Change grade (decrease or increase)
- Damage roots by grading, tearing or filling
- Compact soil with vehicles, equipment or foot traffic
- Attach anything to tree limbs or trunk



Why do some trees tolerate root damage?

While some species are very sensitive to root disruption, this live oak tolerated this pool excavation surprisingly well.

- Some species are more sensitive to root damage than others
- Age and existing health contribute to tree's tolerance
- Soil conditions and moisture levels
- Weather conditions during disruption also impacts tree's ability to overcome stress

During re-grading of the adjacent driveway, this pine tree had large roots removed to allow for a lower grade.

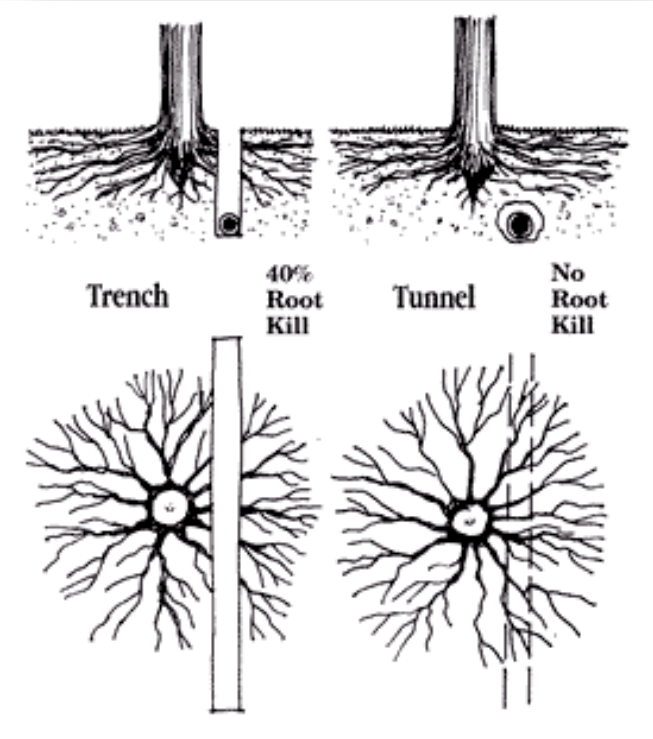
Flagging in the pine's canopy developed in the months following. Significant limbs were lost on this tree.

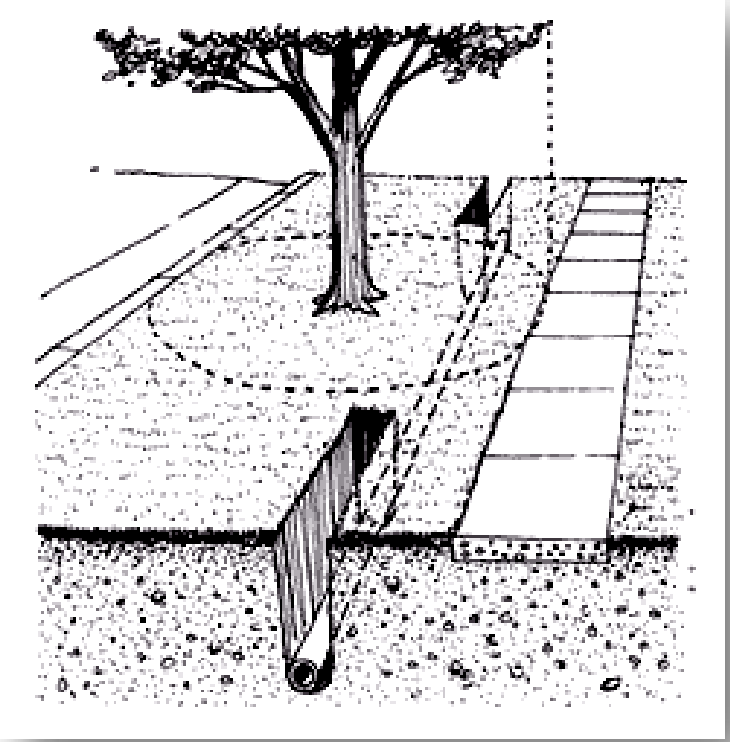
Is there a better option for trenching in this area?

Air Trenching

https://www.youtube.com/watch?v=Aspu-FnGYss

If you must dig….





Tunneling is best

This carob is losing the battle from a recent renovation.

Established in turf for the past 40 years, the tree sustained **compaction**, **drought** conditions and **root damage** during renovation, plus the **removal of turf** surrounding the tree.

Will it make it?

Group Activity

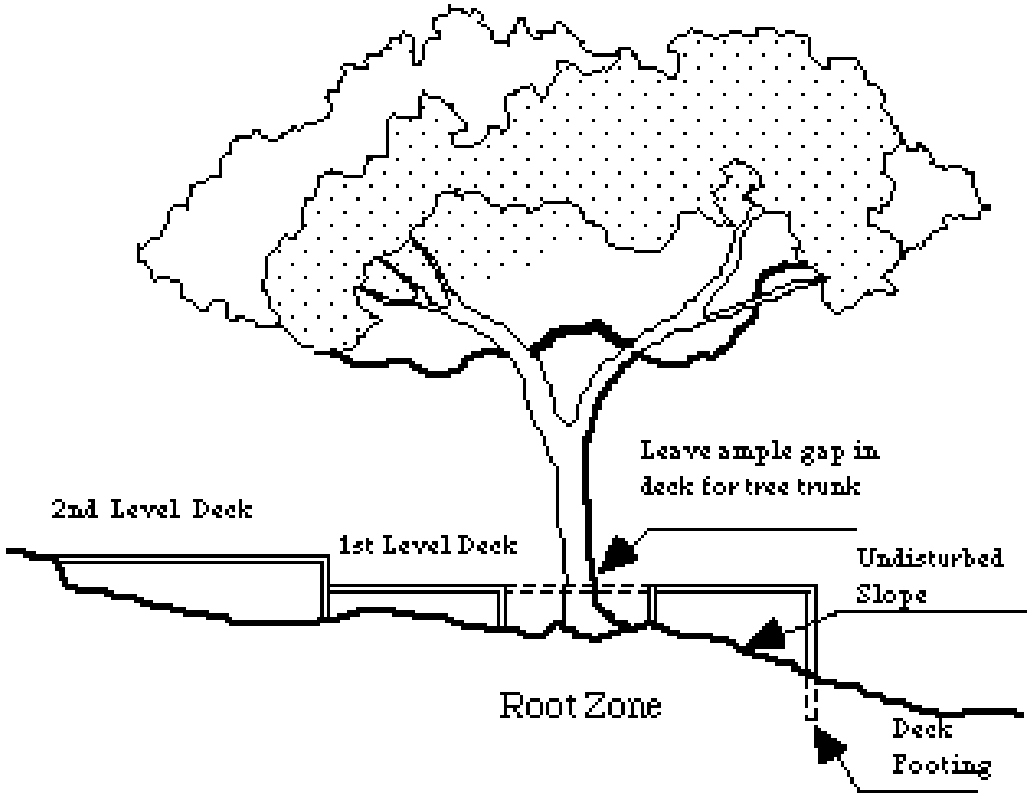


Figure #3 Terraced Deck on Slope with Tree

Chinese evergreen elm, *Ulmus parvifolia*
24” DBH
Soil silty loam with some large rocks, pH 8.1

This *Ulmus parvifolia* has been in the ground for at least 25 years. The new property owner would like to build a terraced deck around it. You have been hired to develop a protection plan to preserve the health of the tree. Please work in groups to create an action plan to help protect the tree during construction.

Who was here first?

Post-Construction Care

- Communicate with property owner/ manager what they may see in future months or years if damage was done to the tree
  - Branch dieback
  - Yellowing, dwarfed foliage if soil was compacted
  - Slowed growth or late leaf-out in spring
  - Other symptoms of stress
- Continue monitoring the tree for the following year, making adjustments to irrigation schedule as needed
- Make any fertilizer or pest control applications required to maintain health

Top 10 Tree Killers

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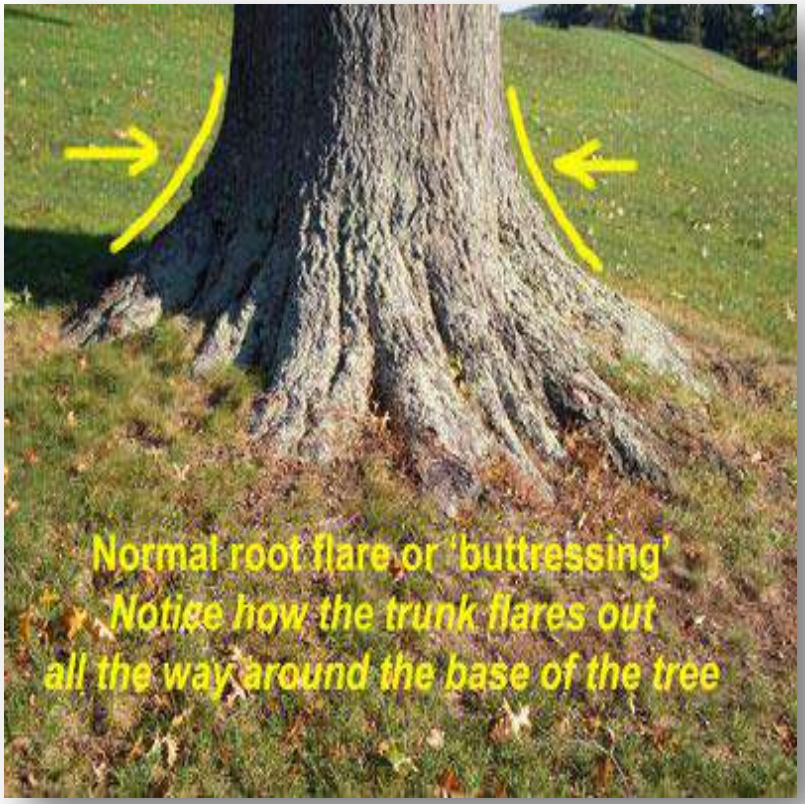
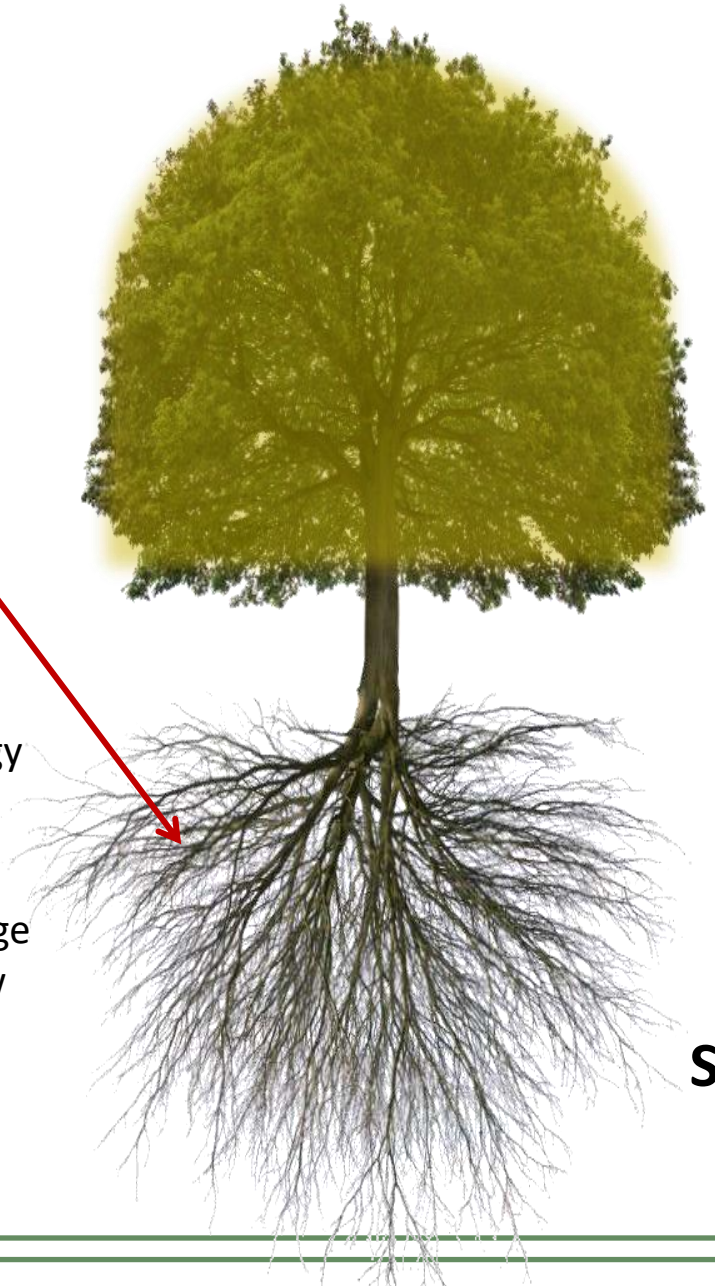
Inappropriate Soil Grade

Root Flare


Normal root flare or 'buttressing'
Notice how the trunk flares out
all the way around the base of the tree


No flare, likely planted too
deep and is at risk of failing

What happens when a tree is planted too deeply?



1. Roots lack O_2

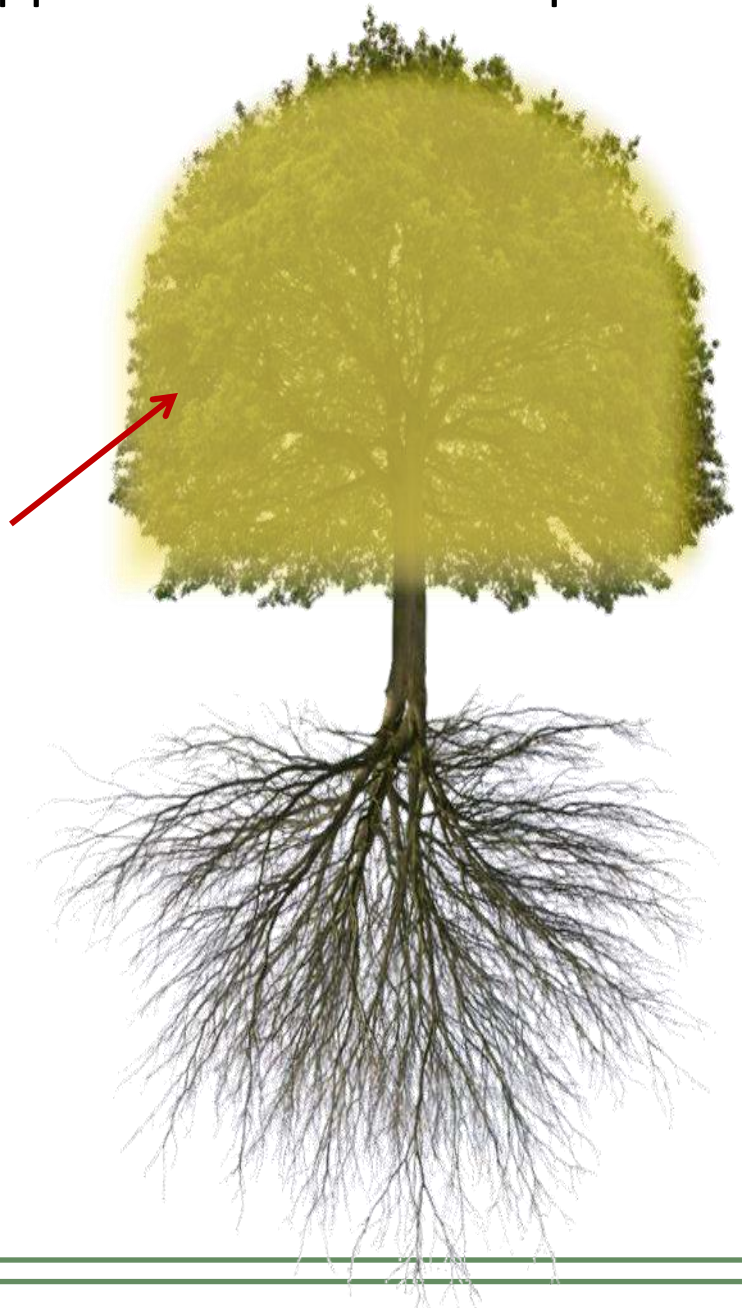
- O_2 required for aerobic respiration, releases energy for root growth & mineral uptake
- O_2 changes electrical charge in water & nutrients, allow roots to extract with less energy

- Reduces permeability of roots to water
- Accumulation of toxins
- Water & minerals can't be absorbed
- **Process is accelerated in clay soils**

Symptom #1: Wilting

What happens when a tree is planted too deeply?

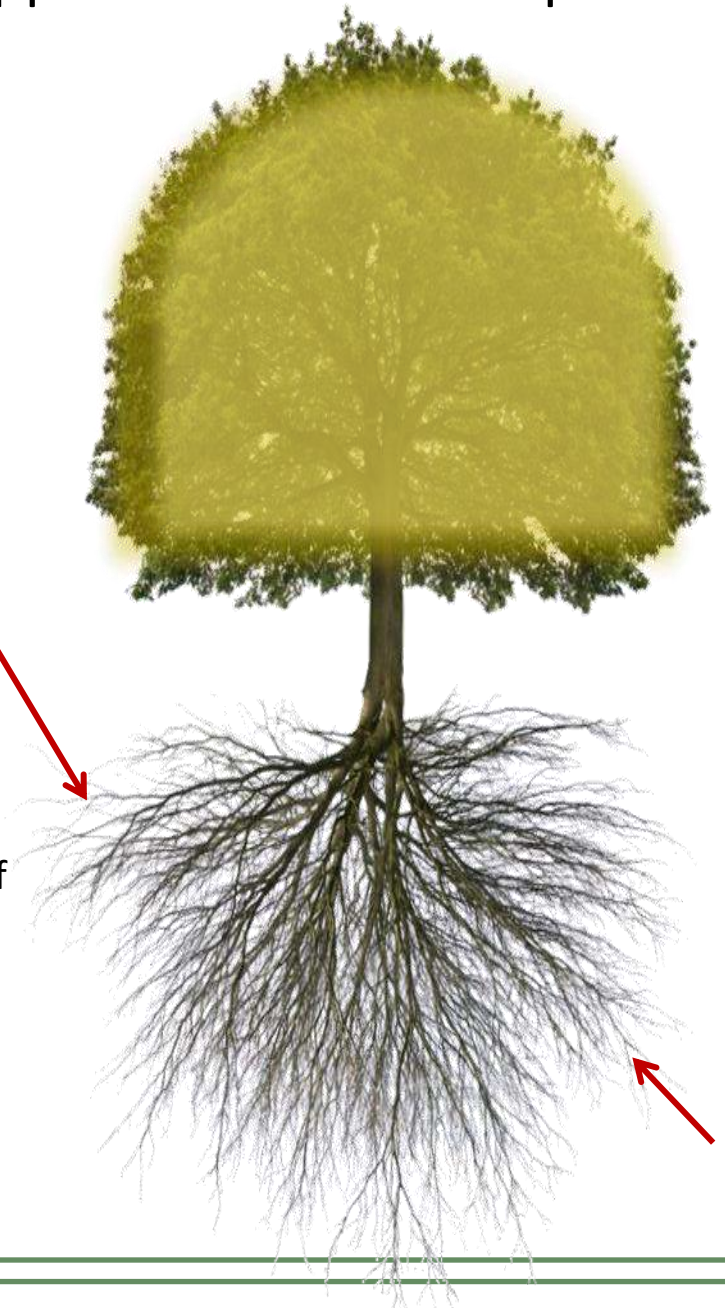
2. Slowed rate of photosynthesis



- Mineral deficiencies will develop
- Plant organs do not function properly

Symptom #2: Slowed growth & yellowing

What happens when a tree is planted too deeply?

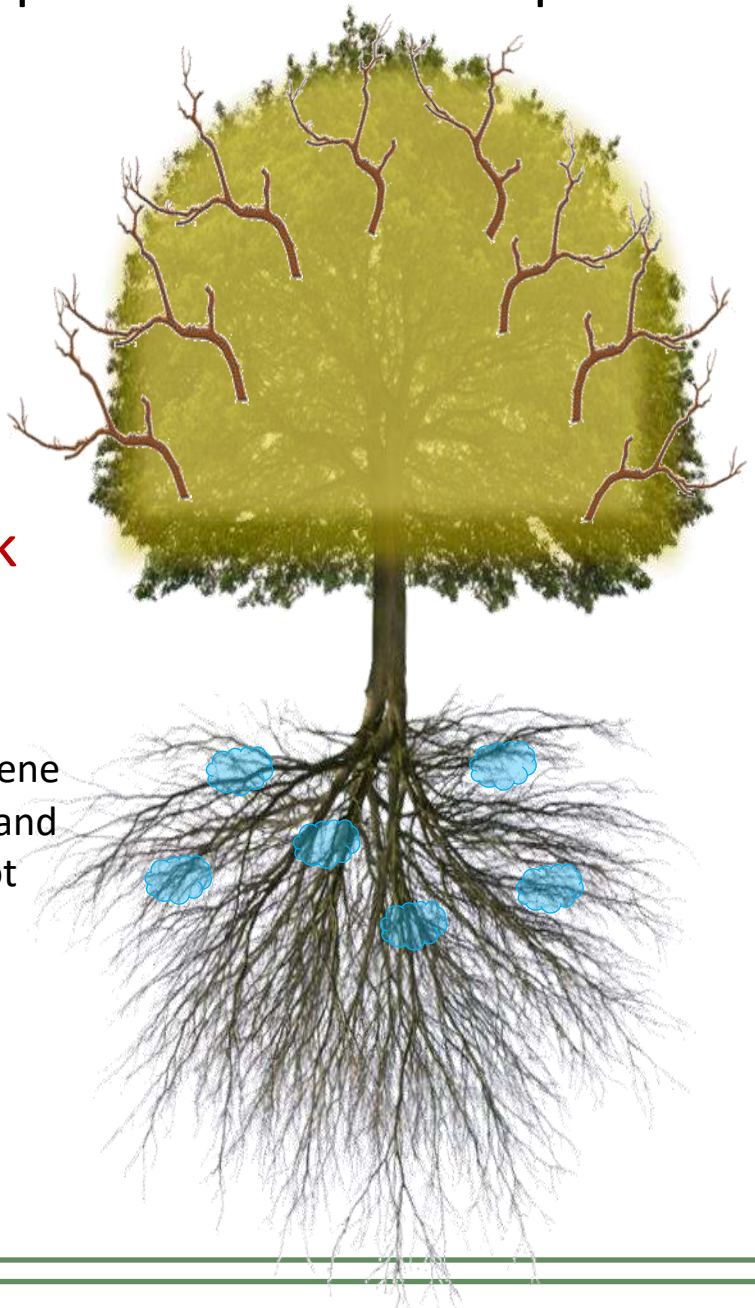


3. Root dieback

- Fewer functioning roots to do their job of absorbing and anchoring

Symptom #3: Stunted plant

What happens when a tree is planted too deeply?

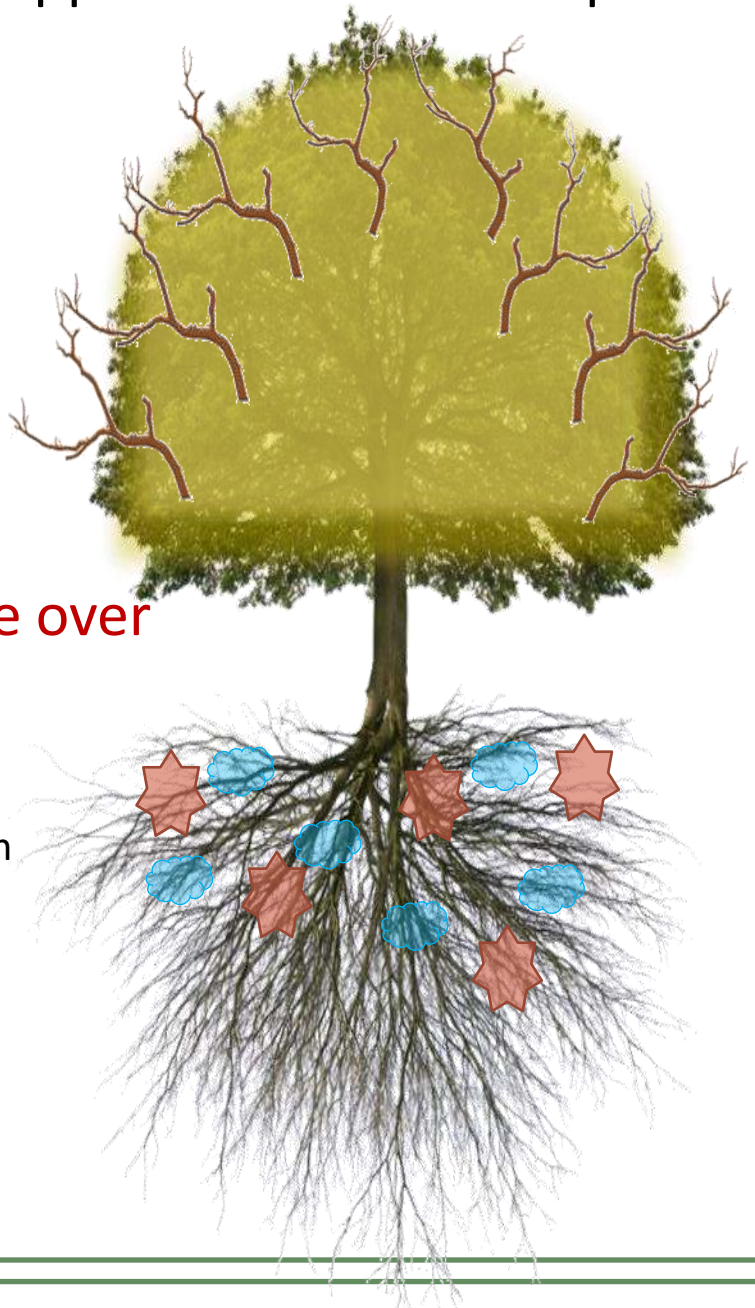


4. Branch dieback

- Stress hormone ethylene accumulates in roots and causes collapse of root cells

Symptom # 4: Continued decline of tree

What happens when a tree is planted too deeply?



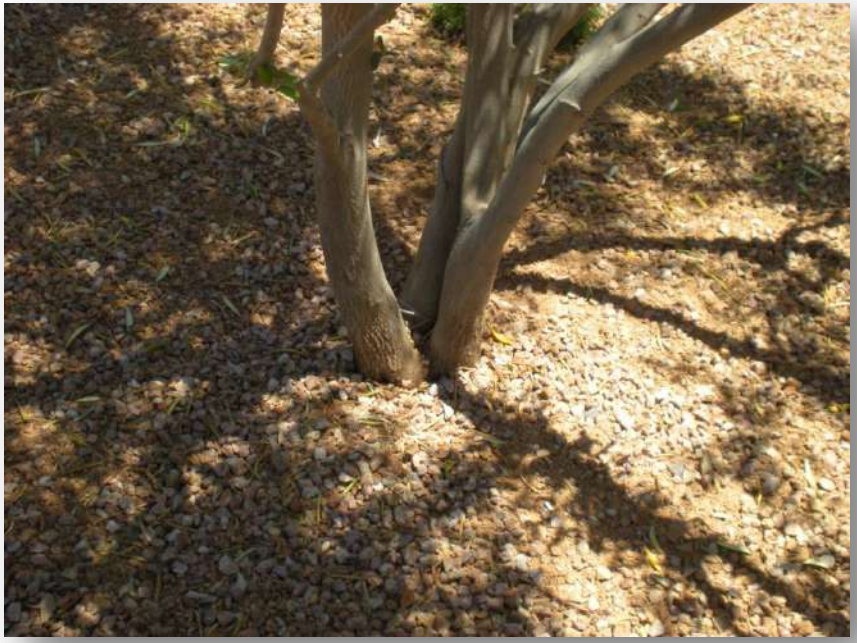
5. Pathogens take over

- Opportune fungus like *Pythium* and *Phytophthora* begin clogging vascular system

Symptom #5: Wilting and eventually death

Inappropriate Soil Grade

Planted Too Deep



Larger trees are often planted prior to final grade, soil gets moved around, often creating a ‘too deeply’ planted situation. Borer damage and limb dieback are the first symptoms seen.

Inappropriate Soil Grade

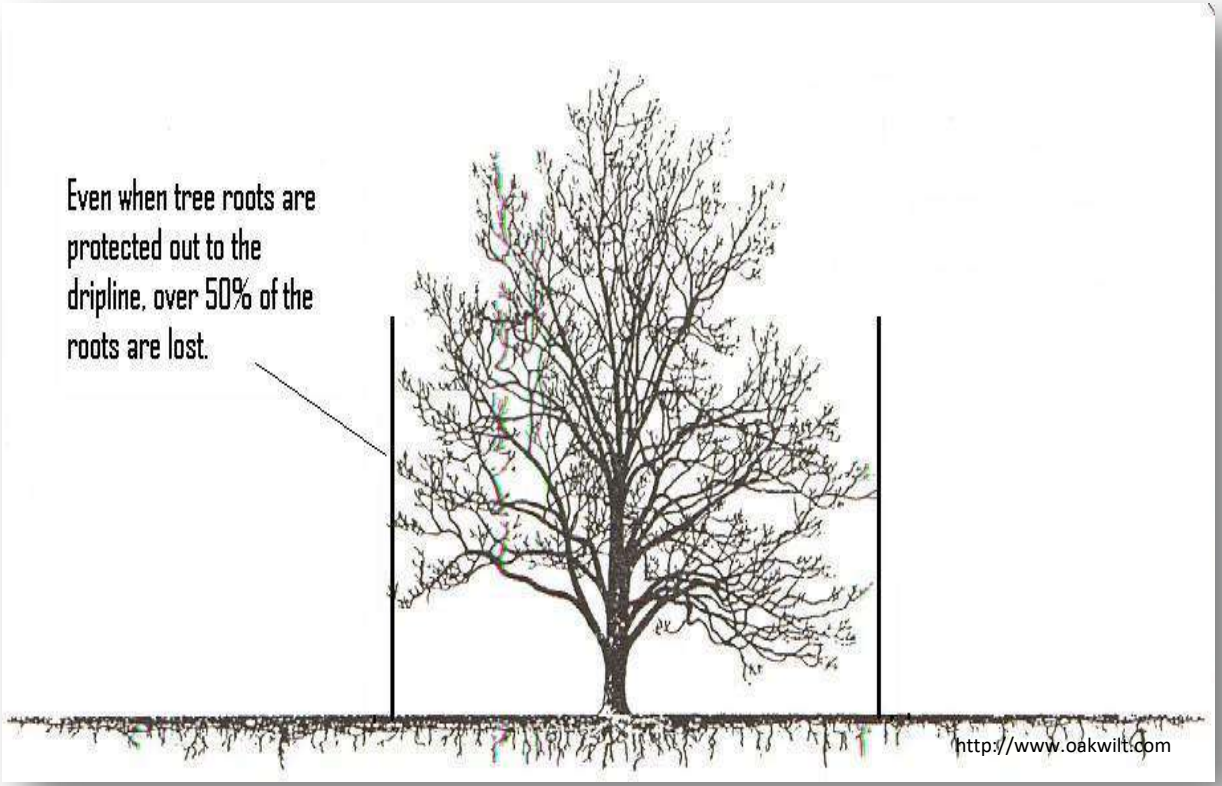
What else happens to a tree when it has been planted too deeply?

- *Girdling roots (stem, SGR and root-girdling roots, RGR) develop*
  - *Reducing vascular flow*
- *Trunk exposed to excess moisture, leading to decay*

Inappropriate Soil Grade

More causes

- Grade increased, decreased during re-landscape
- Street tree planted with grate, overtime, soil and debris gets added to space, covering root mass



Incorrect Soil Grade

Treatment for deeply planted trees

- If in the ground for a short time, carefully remove and replant at appropriate level
- If the tree is established, perform a root collar excavation to remove excess soil

Root Crown Excavation

Is this an option?

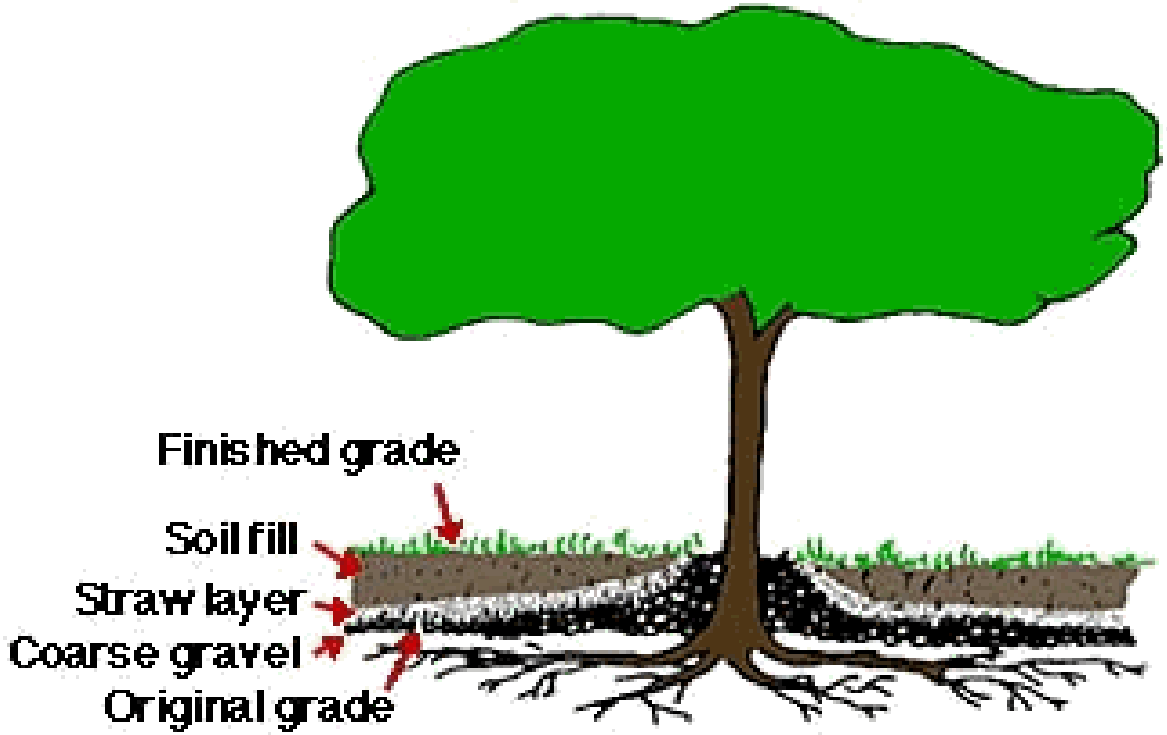


Fig 3. Coarse gravel placed over the original grade will provide aeration for tree roots beneath shallow soil fill.

Discuss pros and cons for this resolution.

Is this a practical solution?

Inappropriate Soil Grade

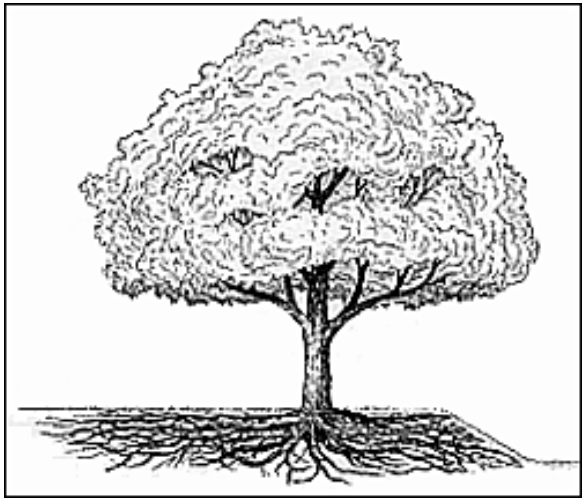
<u>Increasing</u> soil grade can be detrimental….

- Reduces oxygen to feeder roots (we know what a lack of O_2 does to plants now, right?)
- Adding varying soil textures in layers can cause a soil **texture interface**
- Causes drainage issues
- Temperature and air exchange differences which leads to root problems

Inappropriate Soil Grade

<u>Decreasing</u> soil grade can also wreak havoc on established trees

- Loss of vital feeder roots, often located in upper 6” of soil
- Exposure of feeder roots to higher or lower temperatures, leading to root death
- Severed or weakened roots can not function to anchor or transport water and minerals



Activity

http://www.isa-arbor.com/education/onlineresources/CDDemos/gradeChange.swf

Activity:
Excavating trees along Bell Rd
Grab a shovel!

Top 10 Tree Killers

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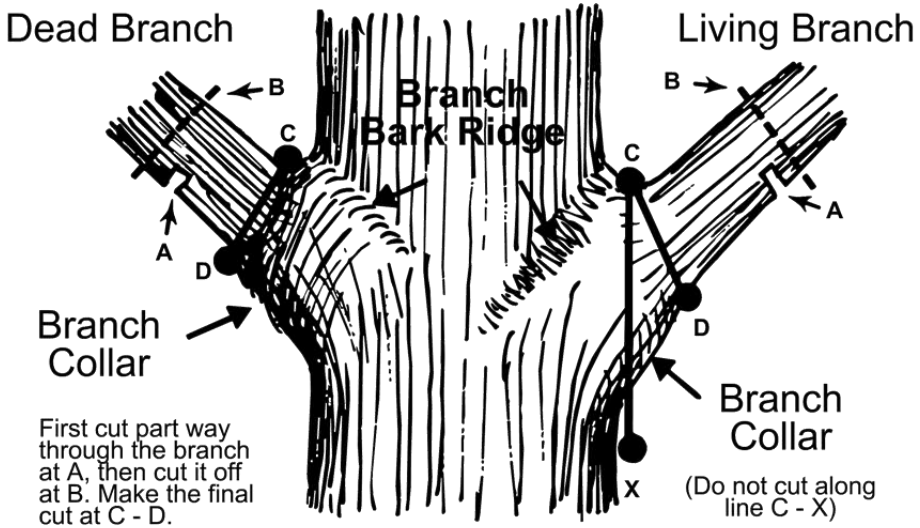
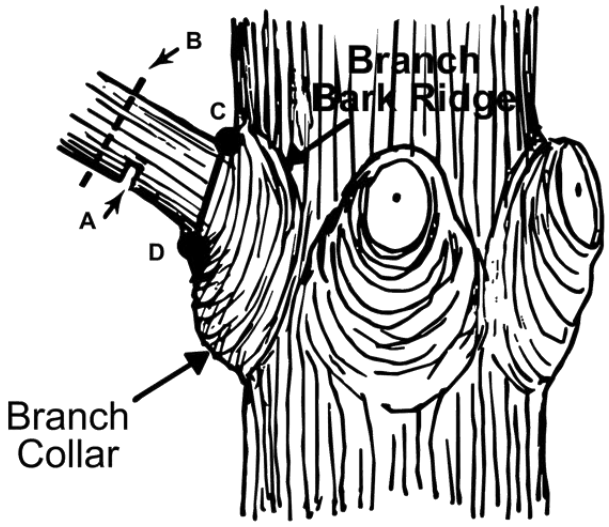
4. Vandalism
5. Wrong tree for the site
6. Poor quality nursery stock
7. Soil issues
8. Inappropriate watering
9. Bark damage
10. Herbicides


Think Twice, Cut Once

Proper Pruning Principles



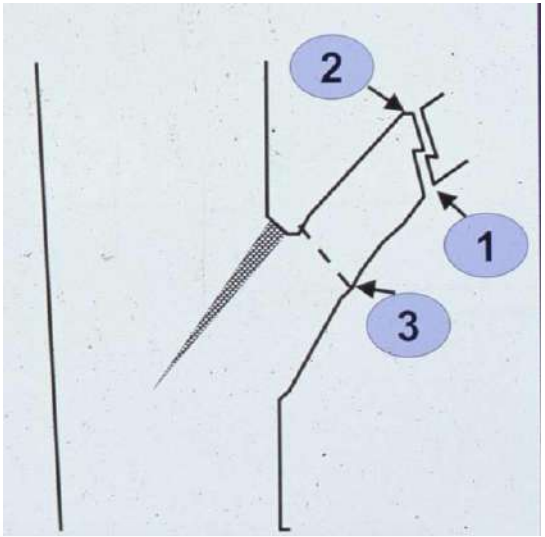
Hardwoods



Conifers

3-Point Cut

- Recommended method
- Helps prevent tearing bark and damaging cambium
- Branch falls clear of stub
- Clean cut to remove stub

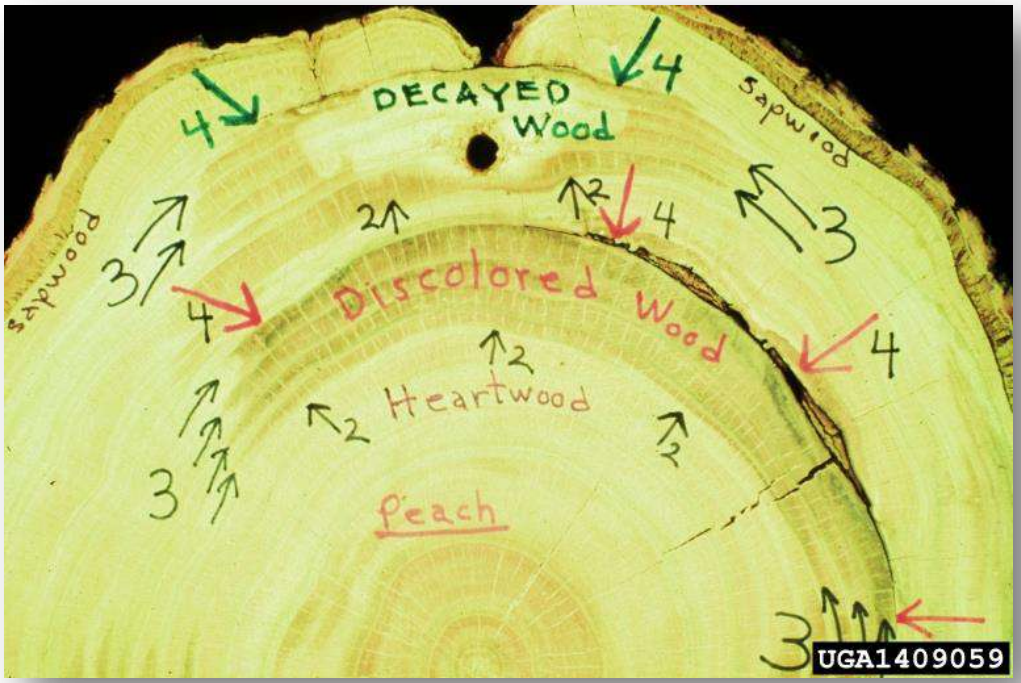


Tree Wounds

- Trees don't *heal*, they *seal*
- **C**ompartmentalization **o**f **d**ecay **i**n **t**rees, **C.O.D.I.T.**
- Tree's reaction to a wound, either from pruning, sunburn or mechanical damage
- C.O.D.I.T. occurs in 4 levels, or 4 walls

C.O.D.I.T.

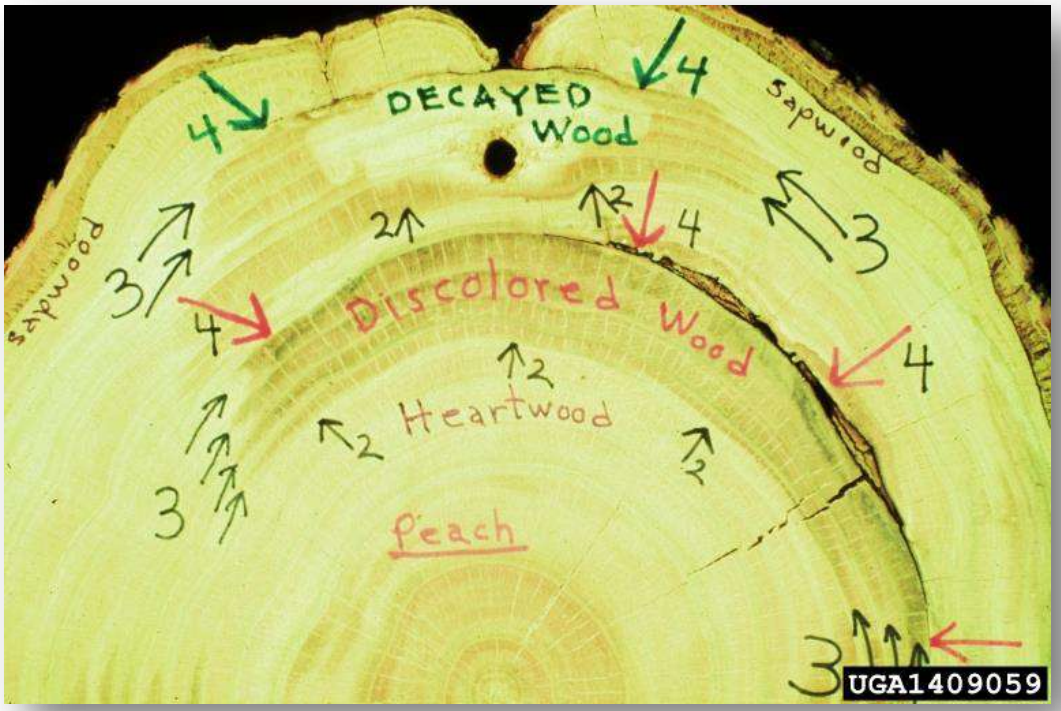
- **Wall 1:** Xylem vessels plug above and below injury with chemicals. This wall is considered weak.
- **Wall 2:** Growth rings; decay has trouble moving across rings, but this darkened region stops decays advancement inward towards pith.



USDA Forest Service

C.O.D.I.T.

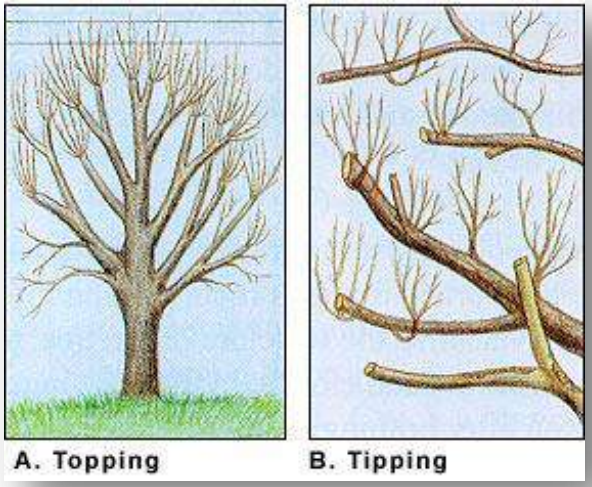
- **Wall 3:** Rays, which are rich in starch; decay has harder time moving across this area than wall 1 or 2.
- **Wall 4:** Reaction zone in the cambium along outer-most growth ring. It can take several years for wall 4 to reach other side of trunk.



USDA Forest Service

Ask yourself “why am I removing this limb” before making the cut.

Topped Trees

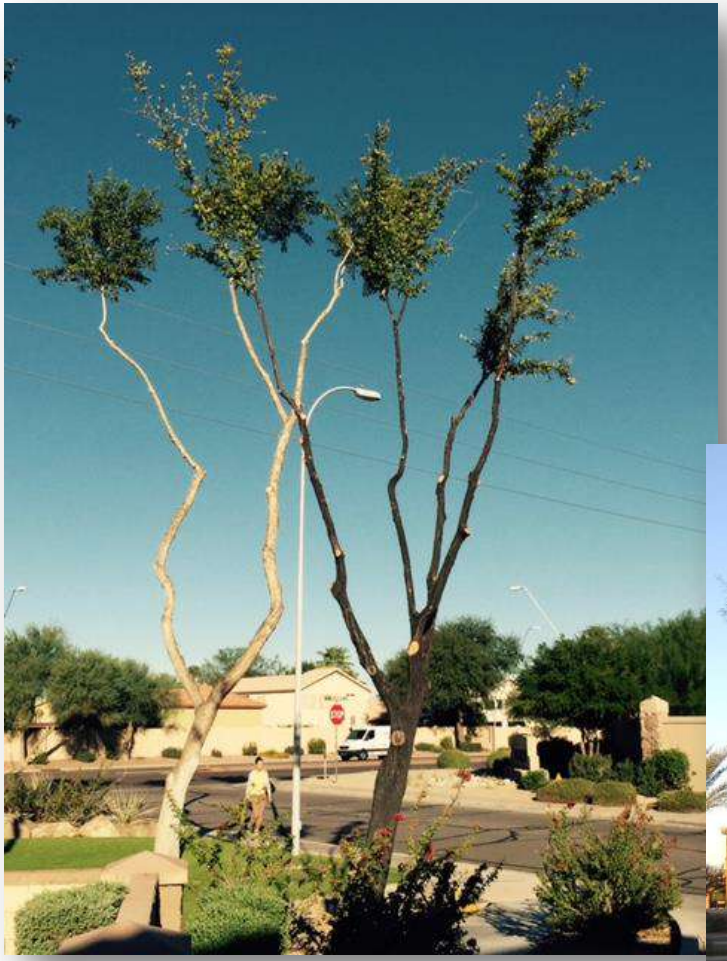


Topped elm trees after a few months of regrowth.
Branches are weakened due to poor attachment to limb.

Tree Defects

Defects should be removed when the tree is a juvenile

We’ve seen it all before



Timing is Critical

This shoestring acacia was pruned in the heat of the summer, removing more than 30% of the living tissue. The tree stressed, turned brown and died within a week of pruning.

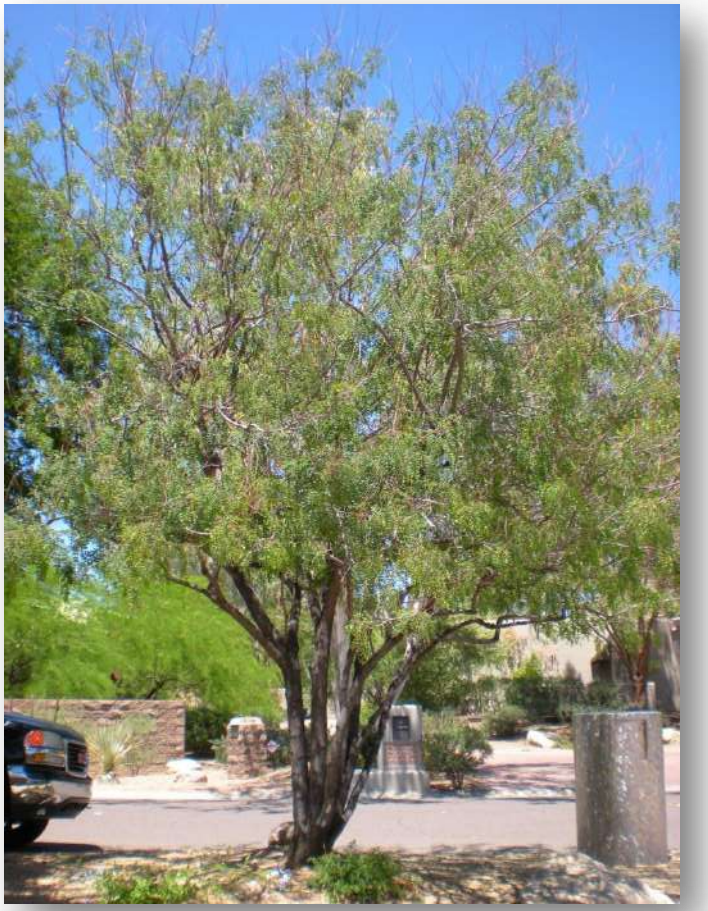
Shoestring acacia overpruned in June, causing tree to fail

Over-elevated canopy exposed trunk, leading to sunburn damage

Pruning at the wrong time of the year can also impact the health of a tree.

Proper Pruning Practices

Maintain canopy as low as possible for site

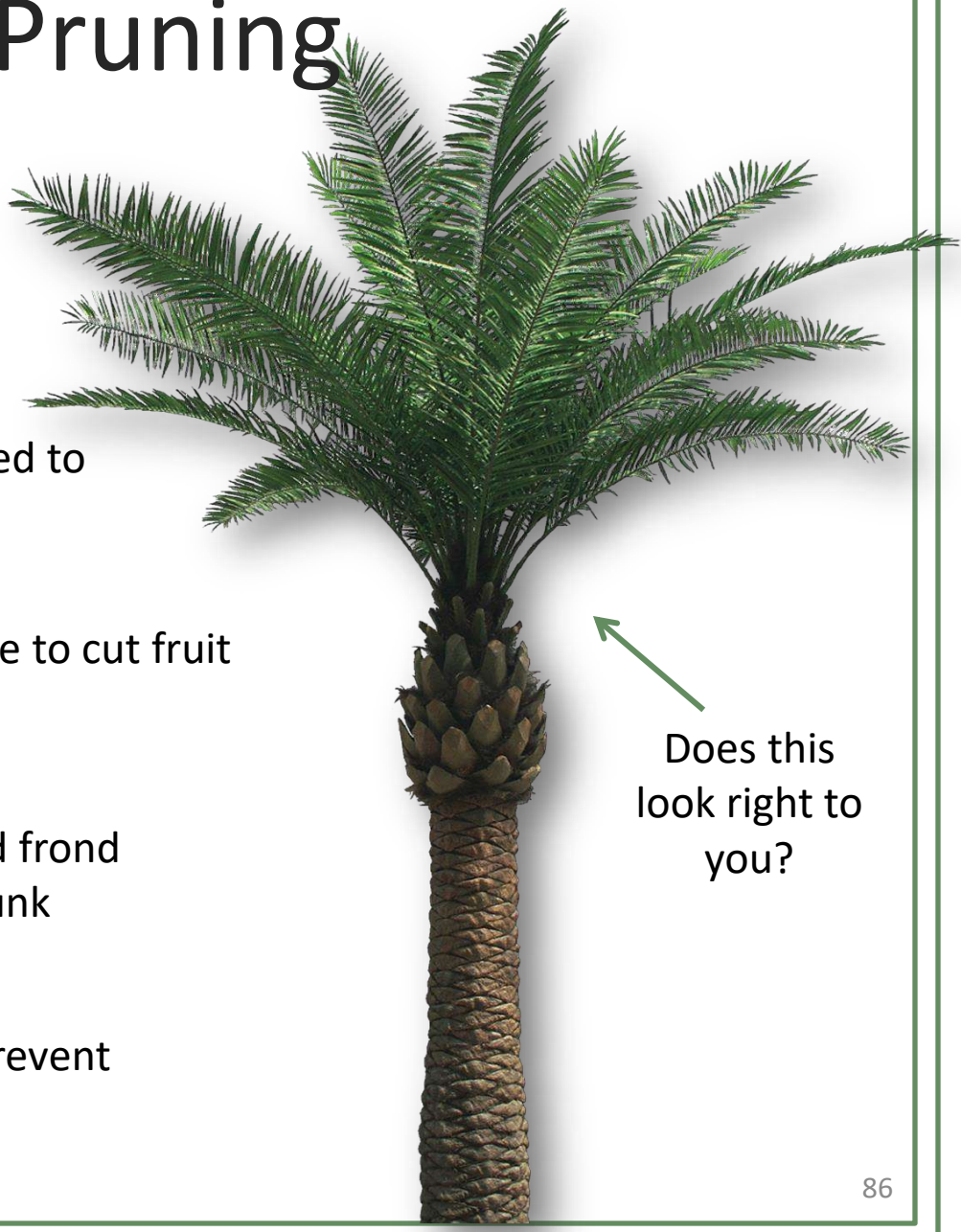


Only elevate canopy as high as necessary for safety and clearance

Remember to ask yourself "who is required to maintain the tree?"

Palm Pruning

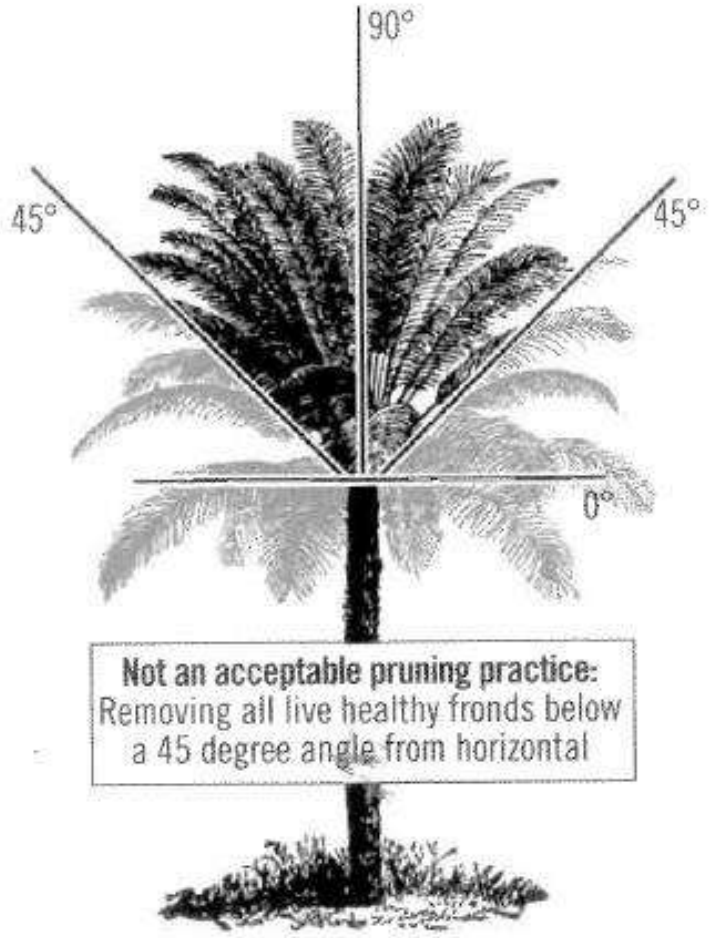
- Remove fruit stalks
- Remove dead fronds to an approximate 90 degree angle
- Use mechanical lifts (if able) as opposed to climbing spikes
- Use saws and/or a sharp linoleum knife to cut fruit stalks and dead/damaged fronds
- Palm peeling consist of removing dead frond bases at the point they contact the trunk
- Pruning tools should be sanitized to prevent spread of disease



Does this look right to you?

Palm Pruning

ANSI A300 (Part 1) 2008 Standard Practices (Pruning)



Once again, Think Twice, Cut Once

Vandalism/ Vehicular Damage

Top 10 Tree Killers

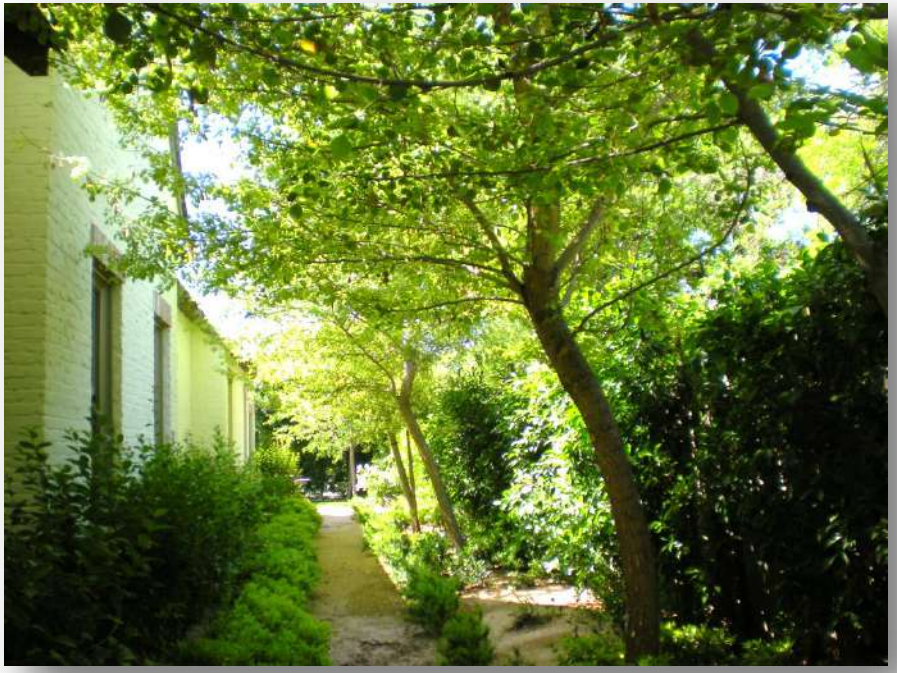
1. Construction
2. Inappropriate grade
3. Improper pruning
4. Vandalism
5. Wrong tree for the site
6. Poor quality nursery stock
7. Soil issues
8. Inappropriate watering
9. Bark damage
10. Herbicides

Right Tree, Right Place

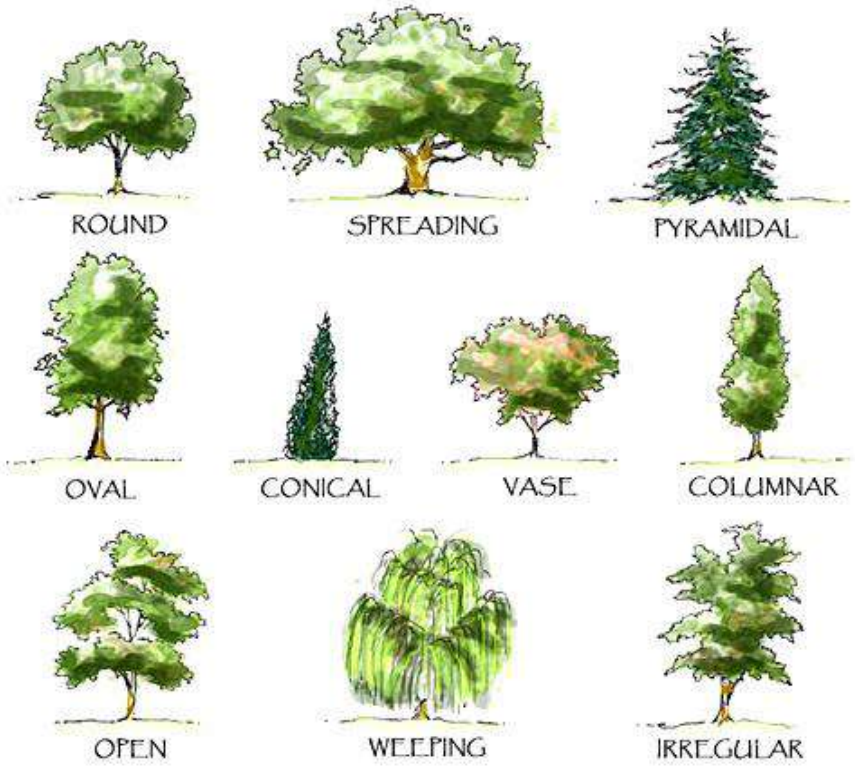
- Asset or a liability?
- Does it ‘fit’ in the space or does the space fit the tree?
- Is there sufficient root space for the tree?
- Does the tree serve a purpose?
- Is the tree species best suited for the microclimate?

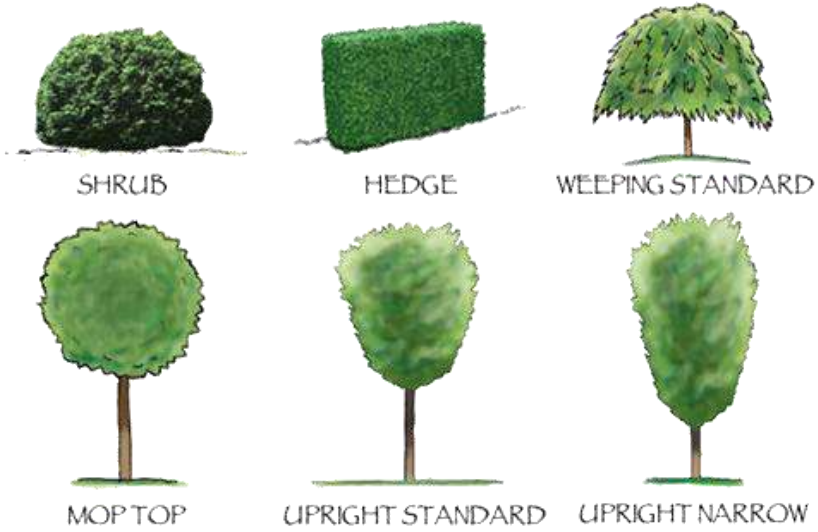
Wrong Tree for the Site

How will the wrong site potentially impact the tree's health?



Tree Forms



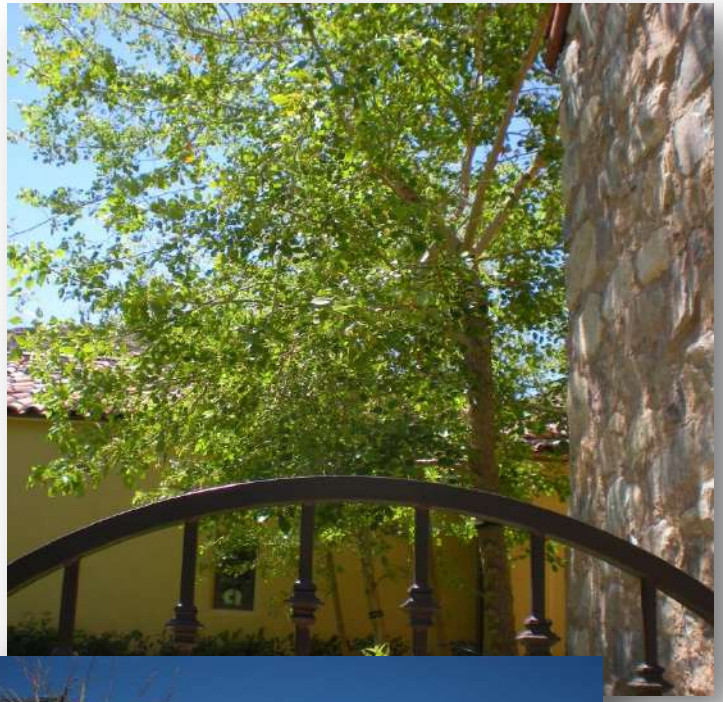


Activity:

Match the tree form to the growing space available for the tree.

Good examples of
Right Tree, Right Place

Wrong Tree for the Site



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Girdling Roots

Stem girdling roots (SGR)
Root girdling roots (RGR)

- Both can both restrict water and nutrient transport
- Cause leaning and failure

Can be caused by

- Root bound at planting
- Planted too deeply
- Compacted soils

Girdling Roots

Symptoms of girdling roots

- No visible root flare at soil surface
- Trunk looks like a telephone pole going into the soil
- Trunk appears pinched at soil surface
- Trunk is flattened on one or more sides
- Sun scald or frost cracks visible on the trunk
- Tree canopy is thin or sparse
- Die-back in upper tree canopy
- Leaves are wilting, scorched, or smaller than normal
- Leaves may be off-colored (yellow)
- Trees exhibit early fall color and leaf drop

First symptom was limb dieback

Girdling Root Removal

Girdling Root Removal

- Removal is necessary to prevent tree failure
- Steps
  - Excavate area carefully to expose entire root
  - Cleanly cut root 6-12” from trunk
  - Final cut should be made where root attaches to trunk, as long it is accessible
  - Do not damage adjacent roots to trunk tissue during the removal

Good Quality Nursery Stock

What to look for in the can:

- Tree taper
  - Stabilizes trunk to hold crown and withstand wind
  - Leaving lower temporary lateral branches on trunk and allowing the trunk to move in the wind promotes caliper and taper
- Vigorous and healthy root system
- Avoid root bound plants
- Root ball should hold firmly together
- Root ball should be moist
- Container should be full of media and not partially full

ANA Tree Standards

TREE LISTING BY BOTANICAL NAME

BOTANICAL NAME	BOX SIZE	HEIGHT (in feet)	WIDTH (in feet)	CALIPER (in inches)
Acacia aneura	15	4.0-5.0	1.0-2.0	0.5-0.75
Acacia aneura	24	5.0-7.0	2.0-3.0	0.75-1.25
Acacia aneura	36	7.0-9.0	4.0-6.0	1.5-2.0
Acacia pendula	15	4.0-5.0	1.5-2.5	0.5-1.0

- Standards established for container grown trees in Arizona
- Helps determine if a tree is too big or too small for container size
- Caliper determination- measured at 6” above soil line

Quality Tree + Proper Planting & Maintenance= Longer Living Tree

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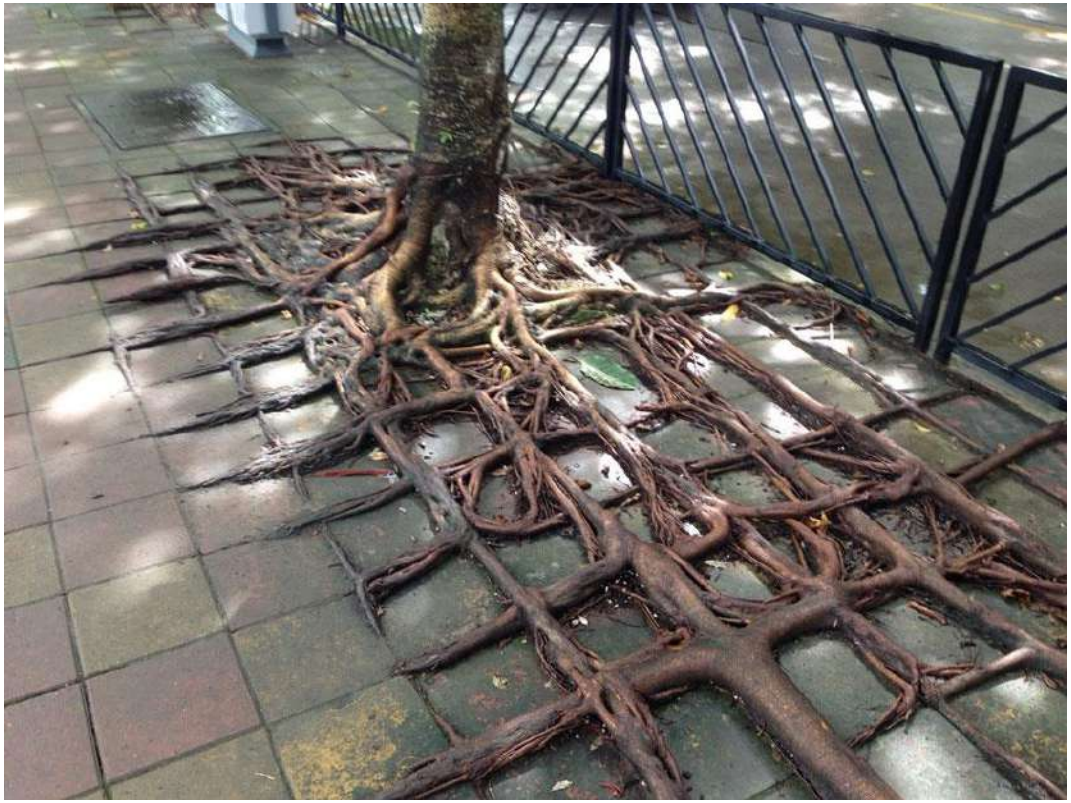
Trees in Urban Soils

High quality soil is important for tree health and function, affecting…

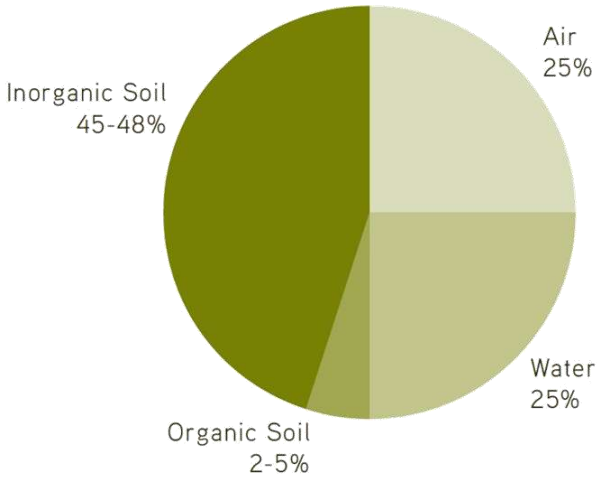
- ✓ Structural stability
- ✓ Water uptake
- ✓ Root growth
- ✓ Drainage and aeration
- ✓ Nutrient availability
- ✓ Filtering of toxins



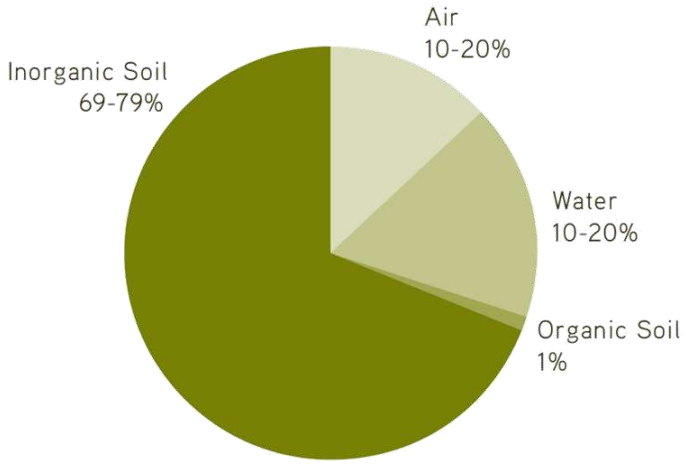
Urban Soils

Soil quality directly impacts tree

- ✓ Establishment
- ✓ Growth
- ✓ Health
- ✓ Longevity



FOREST SOILS



URBAN SOILS

*Remember desert soil has less than 5% organic matter… why is that?

Urban Soils

- Urban soils are highly modified and degraded
- Physical, chemical or biological impairments
  - Chemical contaminants
  - Pollutants such as heavy metals and salts
  - Poor quality irrigation water leads to salinization
  - Soil degradation from compaction from heavy equipment during construction
- Leads to limited root growth and tree stress
- Contributes to premature mortality

What is the average lifespan of an urban tree?

An urban soil profile showing that a fill was added near the surface of this soil. Credit: Natural Resources Conservation Service

How do urban soils become this way?

- Poorly timed irrigation systems can cause soil moisture problems
- Removal of organic matter influences soil fertility and moisture
- Excessive herbicide or fertilizers contaminate the soil
- Foot traffic from pedestrians and road vibrations compact the soil
- Backyard chemical spills, such as gasoline and oil, contaminate the soil

Progression of Soil Compaction in an Urban Environment

Compaction limits and damages tree health

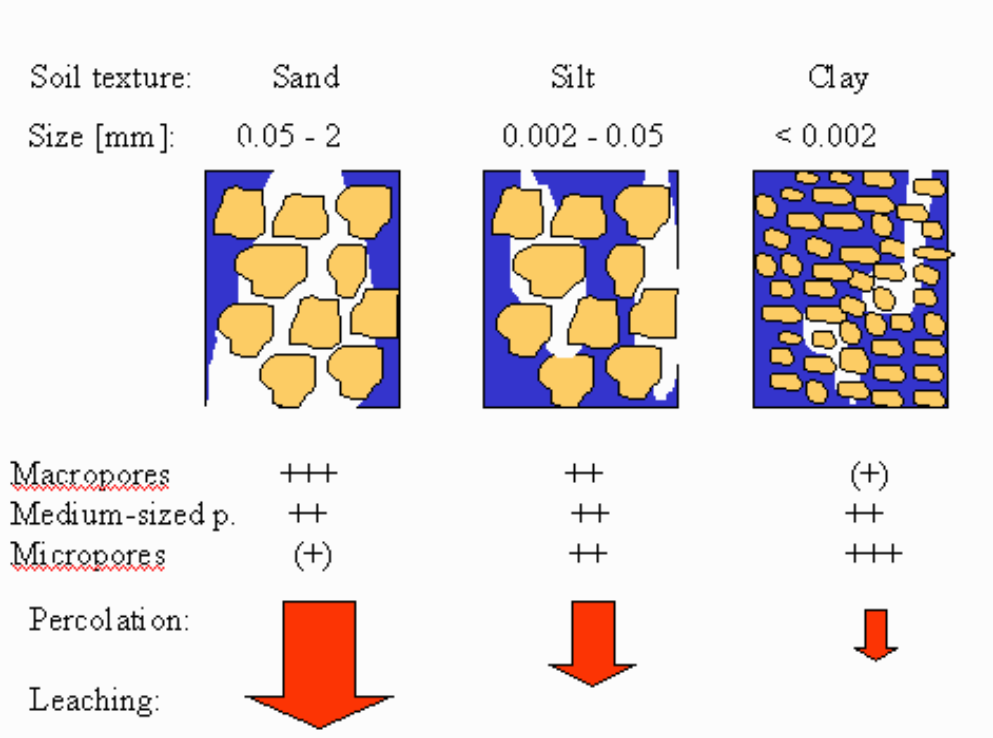
1. ***Compression***- loss of soil volume, leads to loss of total pore space and aeration pore space.
2. ***Compaction***- destruction of soil aggregates and collapse of aeration pores. Compaction is truly compaction; sand, silt and clay particles are affected. Facilitated by high moisture contents.
3. ***Consolidation***- deformation of the soil destroying any pore space and structure. Moisture is squeezed from the soil matrix. Leads to internal bonding, pore space is eliminated.

Compaction process does not have to occur in this order or to the same soil.

Compaction

Which soil texture is more prone to compaction issues? Why?

Pore space, water and gas contents & electron exchange are always changing



What can be done to help compacted areas?

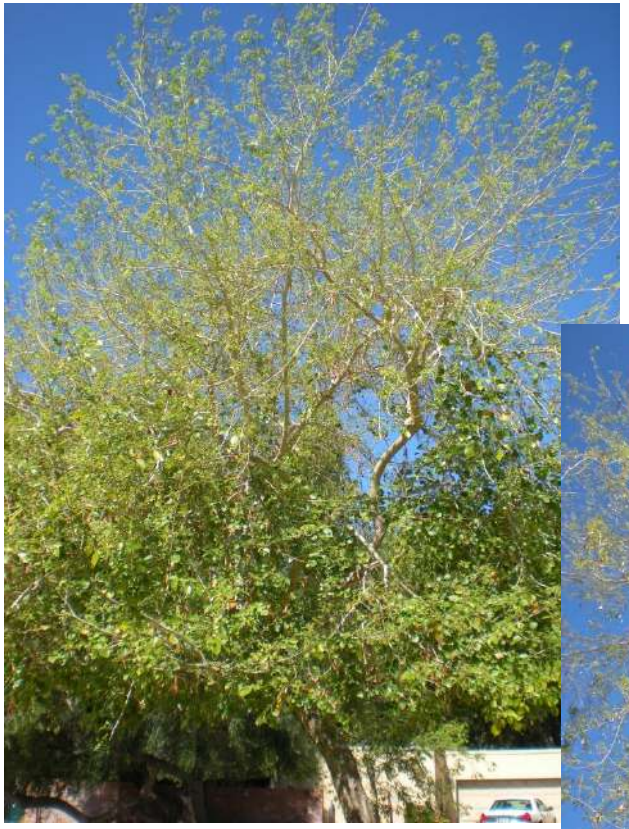
- Mechanically loosening of soil before planting
- Soil aeration by injecting pressurized air into ground
- Periodic aeration around areas with high foot traffic
- Vertical mulching (numerous auger holes filled with sand)
- Install subsurface drainage with perforated pipes connected to vertical pipes
- Addition of organic materials to provide sufficient aggregation agents, creating a stronger structure
- Introduction of earthworms, or other soil organisms to increase macropores
- Select species with inherent capacity to grow in compacted soils

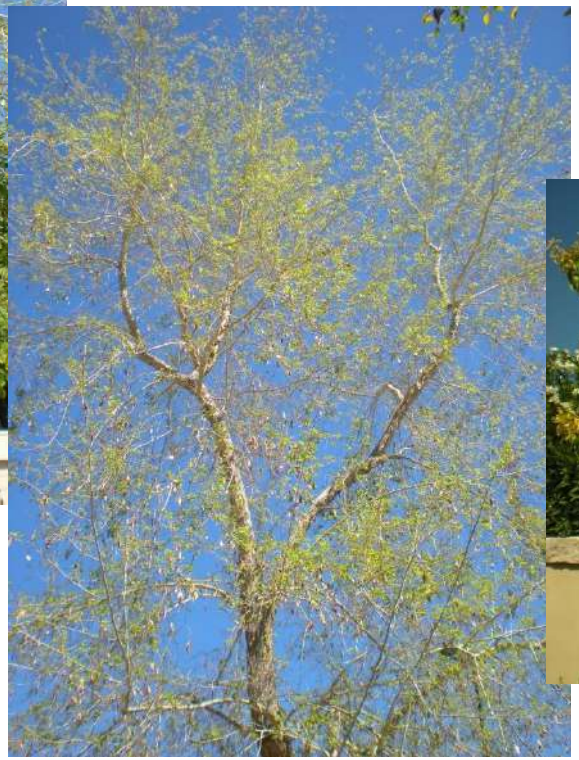
What are some other options?

If you can't find a solution to soil compaction…..

Keep digging!

Poor soil conditions can lead to nutritional issues





Common deficiencies in our area

Palm Nutrient Deficiencies

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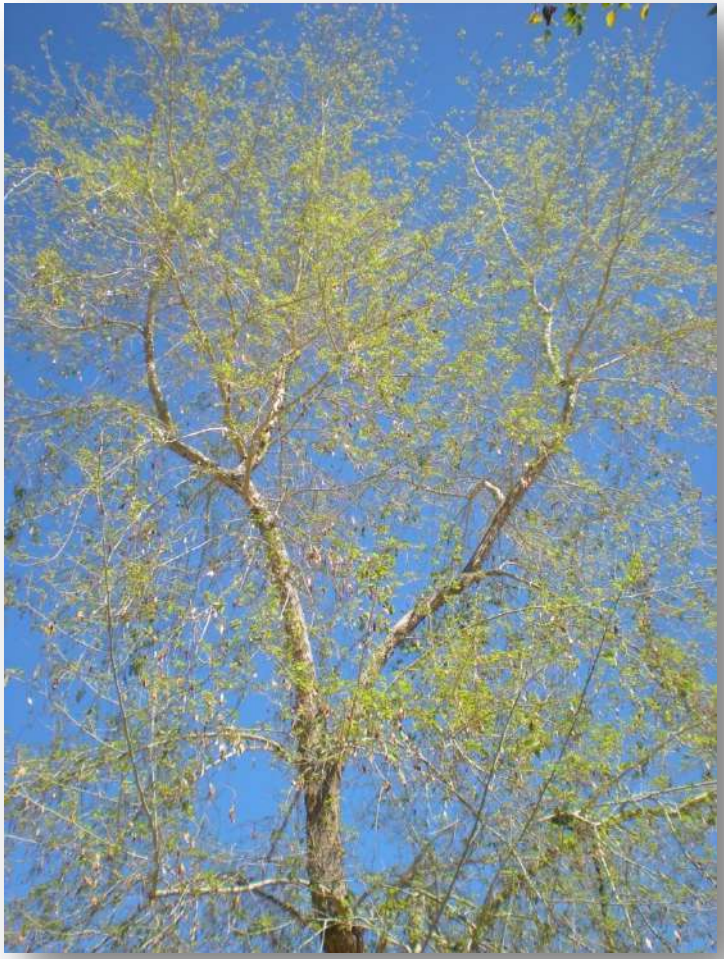
How much water?

Underwatering

vs.



Overwatering

Tree Irrigation

- Monitor soil moisture levels monthly and make appropriate adjustments
- Adjust irrigation volumes during periods of extreme temperature and drought
- Runtimes should be based off of evapotranspiration, (ET/ weather conditions) not past practices
- Perform quarterly leaching cycles to help leach accumulated salts from soil profile
- Smart controllers may achieve the most sustainable irrigation method

****
* *
* AZMET STATE WEATHER SUMMARY *
* *
* APR 19 2017 *
* *
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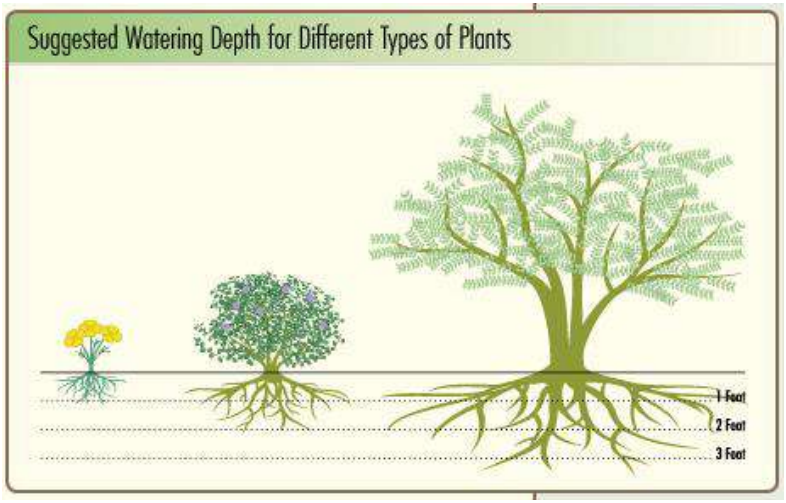
LOCATION	TX	TN	TM	RHX	RHN	RHM	TD	SR	PPT	ST1	ST2	WS	WD	ET	HU
Aguila	86	55	72	57	7	24	29	655	0.00	79	68	4.9	267	0.30	15.5
Bonita	82	52	67	52	10	28	30	681	0.00	76	71	6.5	299	0.31	12.4
Bowie	86	52	72	65	9	24	31	675	0.00	79	74	6.3	276	0.33	14.2
Buckeye	91	61	76	55	8	26	35	659	0.00	84	74	5.4	251	0.32	20.2
Coolidge	89	56	76	64	12	28	38	674	0.00	84	83	5.1	248	0.31	17.3
Desert Ridge	86	59	74	62	10	28	37	667	0.00	69	66	3.4	233	0.29	17.3
Harquahala	88	57	74	59	8	28	35	671	0.00	82	76	5.6	294	0.31	16.9
Maricopa	91	65	79	40	9	22	35	671	0.00	79	73	6.0	256	0.33	22.3
Mesa	90	70	81	33	10	19	33	658	0.00	86	80	3.4	283	0.30	24.3
Mohave	92	53	73	83	12	45	48	654	0.00	80	74	4.0	347	0.27	16.6
Mohave-2	91	54	75	72	12	35	42	622	0.00	##	##	5.4	316	0.29	16.7
Paloma	91	59	73	73	11	41	45	667	0.00	80	75	4.7	224	0.28	19.1
Parker-2	87	58	74	73	17	41	47	646	0.00	83	79	5.6	258	0.28	17.5
Payson	74	44	61	70	15	36	32	676	0.00	65	61	2.9	233	0.25	6.8
Phx.Encanto	89	63	78	75	9	24	36	630	0.00	70	67	3.8	258	0.29	20.3
Phx.Greenway	89	64	77	46	9	24	35	652	0.00	73	69	2.9	207	0.28	20.7
Queen Creek	89	58	75	49	10	26	36	657	0.00	82	75	3.8	268	0.29	18.2
Roll	91	60	76	78	8	35	42	667	0.00	79	74	7.2	276	0.33	19.6
Safford	89	60	75	50	9	21	31	658	0.00	78	72	7.8	315	0.35	19.3
Sahuarita	92	54	73	41	10	24	33	656	0.00	85	78	3.8	283	0.29	16.7
San Simon	87	46	68	81	8	28	29	674	0.00	76	71	4.7	294	0.31	13.5
Tucson	89	53	74	52	11	24	33	682	0.00	68	66	4.9	285	0.32	15.8
WillcoxBench	85	49	68	47	10	24	27	675	0.00	77	73	5.8	280	0.31	12.8
Yuma N. Gila	91	60	76	80	11	40	46	661	0.00	81	76	4.7	300	0.29	19.8
Yuma Valley	89	66	77	61	11	37	46	655	0.00	80	67	6.9	287	0.30	22.0

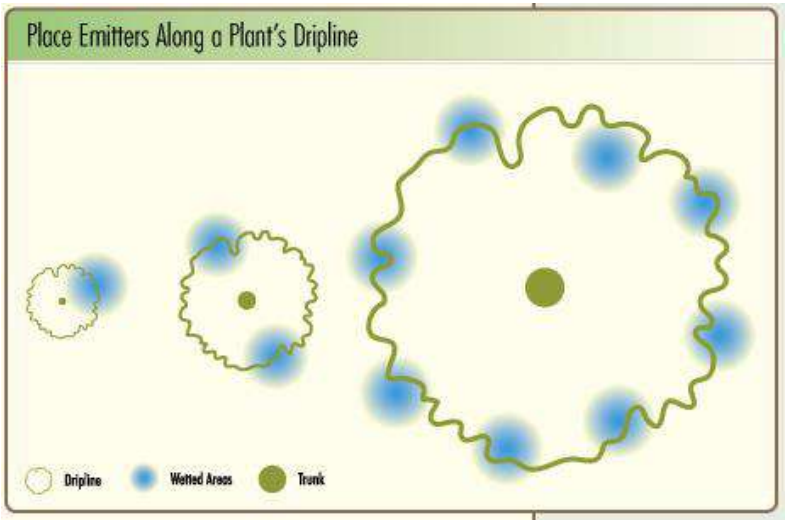
AZMET
cals.arizona.edu/azmet/

Tree Irrigation

- Many mature native or desert trees may not need regular irrigation once established
- To help prevent excessive growth, reduce or limit water to rapid growing trees, such as mesquite and palo verde
- Ideally, trees should be watered to the soil depth of 3-4’ at each irrigation (or series of irrigation cycles)
- Supplemental water may be delivered during periods of extreme drought

Tree Irrigation





- Move emitters out towards dripline as tree matures
- Look for alternate water sources tree may be accessing

Water Delivery

Placement of irrigation lines can influence the rooting and anchoring of trees into the ground.

Ensure you have good distribution of water around the tree, including on palms, which have a fibrous root system immediately surrounding the trunk.

Chronically moist conditions on the bark can head to decay and damage to the vascular system.

Discussion:

What is the best way to water trees?

Changes in water delivery/ availability

Borers may have killed the tree, but it was the removal of turfgrass that caused the stress. Some trees do not respond well to change in irrigation. Roots had depended on water from the sprinklers, but died with the ***change in water availability.***

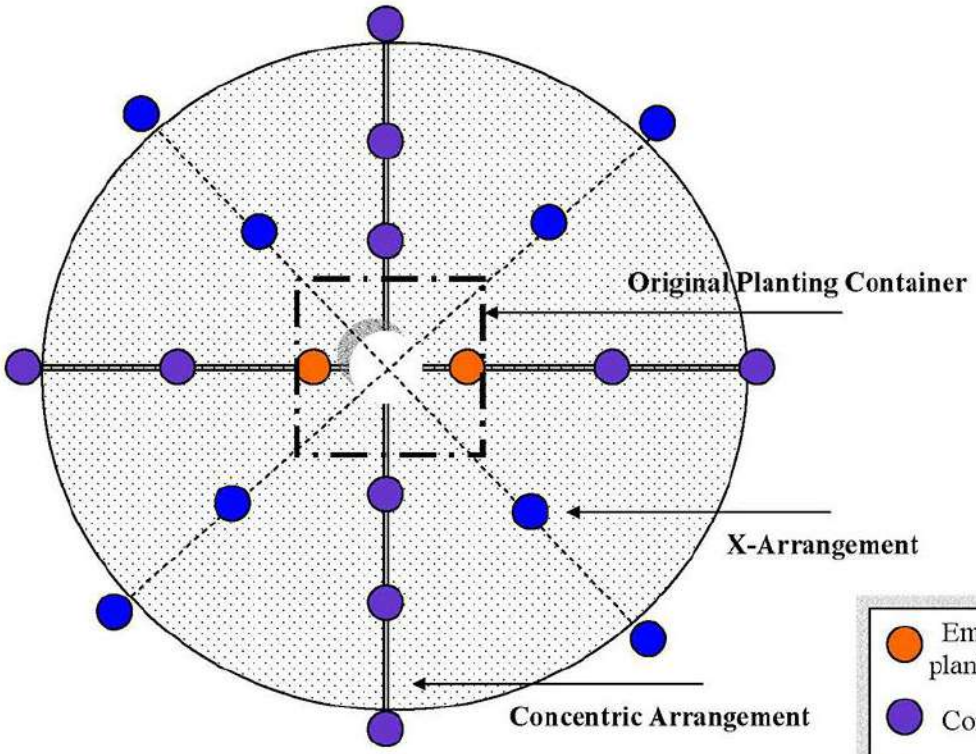
Inappropriate Irrigation Practices

Changes to existing irrigation practices or to the landscape can also impact the tree's health

- Conversions from turf to d.g.
- Flood to drip irrigation conversions
- Temporary outages during construction
- New property management altering irrigation to 'standard' program

*This newly planted olive tree began showing tip dieback after 6 months in the ground. It was receiving **too much water**, especially in the heavy clay soil. Soil conditions were chronically wet, leading to tree failure due to overwatering/ lack of drainage.*

How to Water Trees



Irrigation Emitter Arrangement Options

Many desert trees may be capped after a few seasons in the ground, helping to reduce excessive growth.

- Emitter watering original rootball (plug emitter 30 to 90 days after planting)
- Concentric watering pattern (3 foot spacing)
- X watering pattern with additional emitters for more water demanding trees i.e.: Chilopsis linearis or Acacia smallii
- Trunk of tree

Provided by Arid Zone Trees

Roots and Water

Activity:

- What's in the can? Head outside to look at tree roots
- Flag the placement where emitters should be placed on a mature tree

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9. Bark damage
10. Herbicides

Bark Damage

Stake not maintained, causing girdling and swelling of trunk due to the inability of the tree to 'sink' starches to the roots.

Line trimmer damage is common in trees planted in turf. Maintaining tree rings is recommended to prevent turf damage.

Woodpecker damage

Sprinkler erosion

Any ideas on what this is?

Abandoned swing

Bark Damage

Remedies

- Remove any old staking materials that have become lodged in bark, but do not damage tree in process
- Prune out damaged limbs
- Install protective staking if required
- Maintain vegetation-free area around each tree
- Use protective screens if vandalism occurs
- Avoid using tree spikes when trimming trees (palms)
- Shorten stakes to prevent rubbing on scaffold branches
- For bird control, contact a pest management profession for ID, some birds are protected

Bark Damage

Damage due to over pruning, leading to sunburn

Damage likely from poor pruning cuts, leading to tearing of bark and decay down the length of trunk.


Where do we go from here?

Tree Protection

Is this necessary?

What really is the solution?

You're doing it now!

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Herbicide Injury

- Can be translocated through bark
- Systemic herbicide contact on suckers
- Movement into tree through surface roots
- Spray drift or vapor
- Contaminated soil

Herbicide Injury

Glyphosate Injury

Entry into plant from spray hitting foliage, bark or root tissue

Symptoms:

- Strap-like leaves
- Bushy growth
- Irregularly shaped leaves
- May kill tree if enough chemical is sprayed on tissue

Herbicide Injury

2,4-D or Dicamba Injury

2,4-D is prone to volatilization above 90°F

Dicamba can persist is soil for 3+ months, and can leach in soil

Symptoms:

- Leaf cupping, coiling or bending
- Chlorosis
- Blackened tissues
- Defoliation

Herbicide Injury

How to prevent damage

- Know what product is being used and the potential for off-target exposure.
  - i.e. Lontrel is very active on legume family plants, spraying surface or shallow roots on a legume family trees may be impacted.
- Follow all label restrictions closely to watch for wind and temperature warnings.
- Triple rinse tanks or have separate spray rigs for trees and herbicides.
- Know what's in your soil before planting.
- READ THE LABEL!!!

For more information on herbicide-specific injuries, please look for the link on our website at https://www.azlca.com/study-materials-aclp-ii

Left: Lateral root growth in cotton seedlings is suppressed in the top 6” of trifluralin-treated soil. Lateral roots grow normal in untreated soil below.
Right: Roots in upper 6” growing normal while treated soil on the bottom suppresses lateral root growth.

How would this impact the health of your tree?

Herbicide Injury

Getting to the bottom of it:

- Ask questions, gather history of property and adjacent properties
- What does the plant normally look like this time of year?
- Any other pests that may have look-alike symptoms?
- Look at weeds and shrubs in surrounding area, are other species impacted?
- Look over the fence, is the ground weed-free?
- Tissue and soil samples may confirm chemical presence, but symptoms may be seen long after residual has gone

Herbicide Injury

Remedies

- Leaching contaminated soil with extra irrigation cycles
- Activated charcoal for root-active chemicals (soil incorporation or injection)
- Patience
  - Some trees may recover, but it may take as long as a year or more, depending on the severity of the injury, product persistence and environmental conditions
- Replant only if soil has been tested and confirm herbicide residual is no longer present

Plant Growth Regulators

Options for fruit control

- Olive
- Ash
- Mesquite
- Sycamore

What other trees are causing trouble?

Fruit Management

Product	Timing	Comments	Bark Banding
Maintain	Apply as early as 2-3 months before bloom to right before bloom. Tight bud is the best time.	Maintain is a one-time treatment. Best if sprayed under 85 degrees, be very careful when applying around turf and other herbaceous or flowering plants; remember it is an herbicide! Low rates are recommended; high rates can cause severe stress to tree. The use of a surfactant like Nu Film P, Pro Spreader or CMR Silicone Surfactant will aid in sticking to foliage surface.	x
Florel	At the flower bud to full bloom stage: if fruit has set, there is no effect	Florel can be regarded as a one-time treatment. Thorough coverage is essential. No surfactant is needed. Flowers should drop from tree. Temporary yellowing of leaves is possible. Leaf drop may also be experienced, mostly old growth, which will be replaced. Trees should be in good health and not under moisture stress. Florel is very acidic; do NOT leave in sprayer overnight. Try to use within 4 hours of mixing.	
Embark 2S	Tight bud stage to 5% bloom	Total coverage is essential. Two treatments are recommended to cover all buds (about a two-week interval.) If the tree is sprayed properly, flowering will not occur. If a surfactant is used, use at ½ rate using only non-ionic surfactants. Tarping is important, as Embark will act as a plant growth regulator on turf and shrubs. Treat only healthy trees not under stress.	
Olive Stop	At full bloom prior to fruit set; start first sprays between half and three fourths bloom, second treatment 7-14 days later.	User must observe Personal Protective Equipment labeling. Do not apply when temperatures exceed 85 degrees and avoid spraying during the heat of the day. Cover any ornamentals that come in contact with the spray. Coverage is essential. Use a non-ionic wetting agent @ 1 ¼ to 2 ½ teaspoons per 10 gallons of spray mix. Flower drop should occur. Use only on healthy trees not under stress.	
Atrimmec	Treat anytime from pre-bloom period after rachis has elongated about ½ inch through early bloom. Best results are obtained in early spring during tight bud stage of the pre-bloom period.	Coverage is absolutely essential. Do not mix with other products. No wetting agent is needed. Some yellowing may be observed several weeks after treatment. Tarping is recommended as Atrimmec will retard growth of hedges and shrubs and may cause bloom drop on annual flowers. Check worker protection standards on the label. Use only on healthy trees.	x

For more precise timing of these applications, contact your chemical supplier or the manufacturer representative.

Bark Banding Application

https://www.youtube.com/watch?v=1LifyEaL5ek

PGRs as a Tool for Managing Plant Stress

- *Paclobutrizol* has been used for growth control in annual and perennial flower production for years
- Newer formations used for managing tree growth under utility lines
- Now being used for other benefits besides growth regulation

Shortstop®

Profile* 2SC
Tree Growth Regulator

Cambistat®

Paclobutrazol Use on Trees

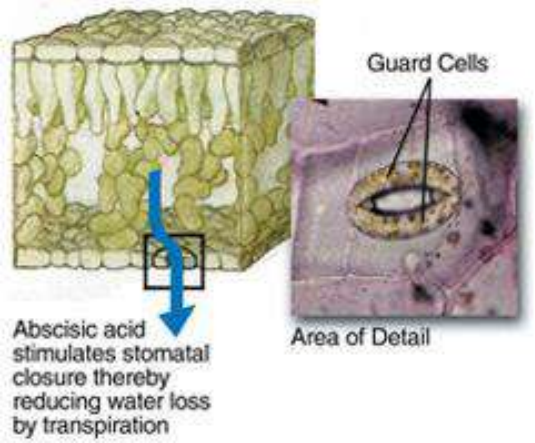
Benefits

- Trees are more tolerant of drought conditions
  - Increased root-to-shoot ratio= greater water uptake capacity
- Increase in leaf thickness and masses of hairs, protecting from disease infections
- Less sensitive to air pollutants
- Usually darker in color, chlorophyll is more concentrated
- Smaller, denser canopies, great option if the tree is too large for the space
- Reduction of water loss through leaves
  - stomata will close

Paclobutrazol Use on Trees

How it works

- Blocks gibberellins, hormones responsible for cell elongation
  - Same number of cells are produced, but they do not elongate
- Increased production of abscisic acid, hormone responsible for fighting stress, which helps close stomata
- Result is trees treated have a greater tolerance to environmental stresses and resistance to fungal & bacterial diseases



Paclobutrazol Use on Trees

How it is applied

- Basal drench
  - Dig a trench around base of tree
  - Pour solution evenly around tree
  - Replace soil at appropriate grade

  https://www.youtube.com/watch?v=j6vO8bBIiYk

- Soil injection
- Trunk injection (Shortstop)

Paclobutrozol Rates

Profile* 2SC
Tree Growth Regulator

MSRP is $425/ gallon

Example for trees in our area

- Mesquite tree
  - 4 grams (6.76 oz) / inch of DBH (concentrated product)
  - If tree is **18" DBH**, use 121.7 oz of solution (diluted mix)
  - Cost per application is **$22.45 per tree**
  - Symptoms of regulation may not be seen for up to 18 months
  - Follow-up applications can be made after 3 years

1989 This tree, at the Morton Arboretum, had been declining over a period of a few years at the time of application.

1998 Same tree, now the tree canopy if fuller and greener than before.

2001 Same tree, the deadwood has been removed and the tree experienced much improved health. No additional applications were made since initial application in 1989.

Treated

Second Treatment

1989

1994

2001

2011

2014

Updates courtesy of Rainbow Treecare

Is this an option on any of your properties?

Health Assessment

Assessments can be made in 3 levels

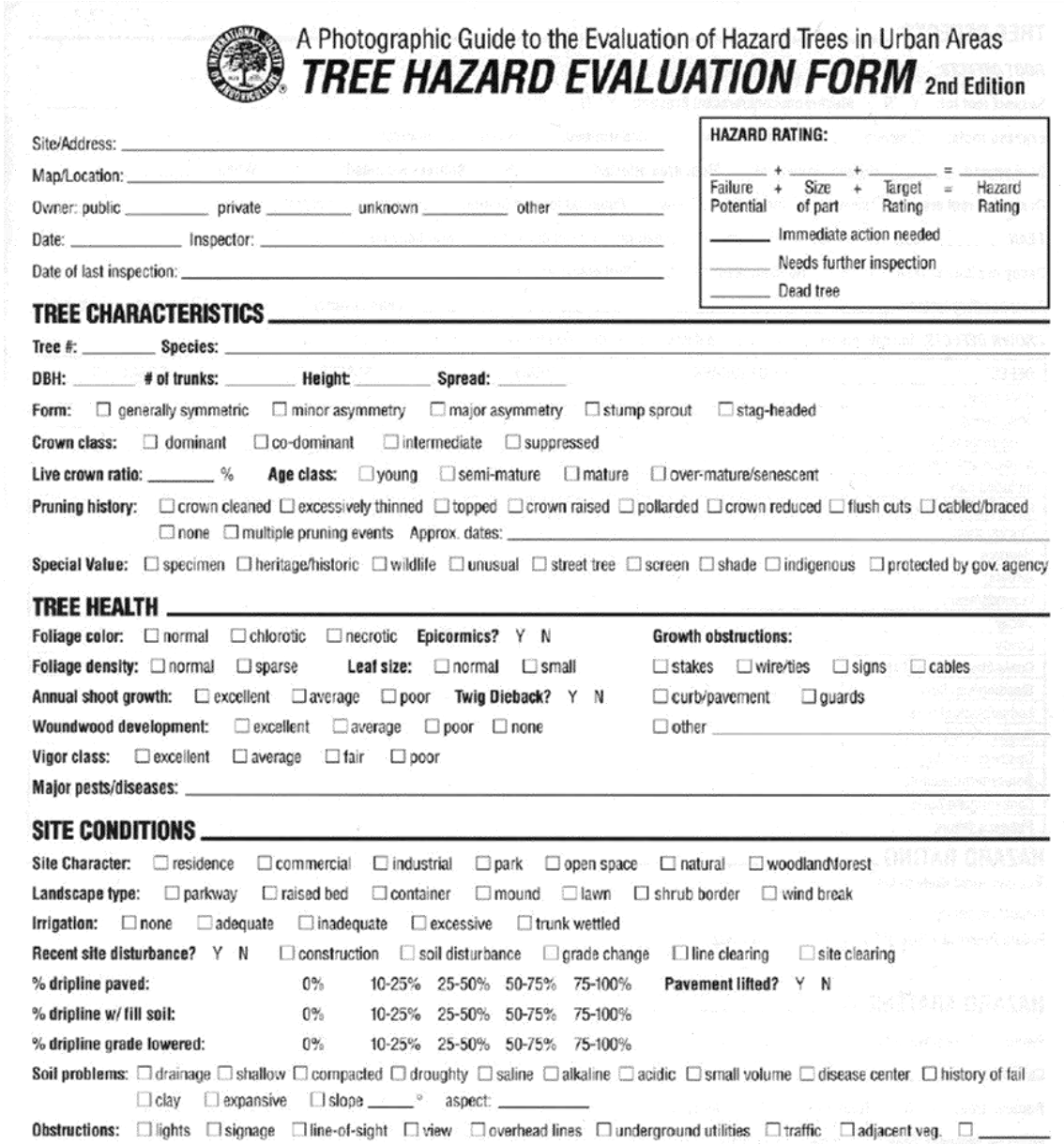
- **Level I**
  - Limited visual inspection at ground level
  - Site observations
  - Site history
- **Level II**
  - Basic visual: evaluation of tree
  - Obtaining tree measurements, history and site changes
  - Photo documentation
  - Fact gathering if not readily available on site
  - The use of some tools such as binoculars, mallet for sounding and soil probe or excavating tools
- **Level III**
  - Advanced assessment: aerial survey of tree
  - Decay detection, health evaluation, wind load assessment and static load assessment
  - Generally reserved for high-valued or heritage trees

Tree Risk Assessment

- Should be performed by an ISA Certified Arborist who has been trained in risk assessment

Group Activity

- Split into 3 groups
- Head outside to tagged trees
- Assess tree's health using provided form



A Photographic Guide to the Evaluation of Hazard Trees in Urban Areas

TREE HAZARD EVALUATION FORM 2nd Edition

Site/Address: _____

Map/Location: _____

Owner: public _____ private _____ unknown _____ other _____

Date: _____ Inspector: _____

Date of last inspection: _____

HAZARD RATING:

_____ + _____ + _____ = _____

Failure Potential + Size of part + Target Rating = Hazard Rating

_____ Immediate action needed

_____ Needs further inspection

_____ Dead tree

TREE CHARACTERISTICS

Tree #: _____ **Species:** _____

DBH: _____ **# of trunks:** _____ **Height:** _____ **Spread:** _____

Form: ☐ generally symmetric ☐ minor asymmetry ☐ major asymmetry ☐ stump sprout ☐ stag-headed

Crown class: ☐ dominant ☐ co-dominant ☐ intermediate ☐ suppressed

Live crown ratio: _____ % **Age class:** ☐ young ☐ semi-mature ☐ mature ☐ over-mature/senescent

Pruning history: ☐ crown cleaned ☐ excessively thinned ☐ topped ☐ crown raised ☐ pollarded ☐ crown reduced ☐ flush cuts ☐ cabled/braced ☐ none ☐ multiple pruning events Approx. dates: _____

Special Value: ☐ specimen ☐ heritage/historic ☐ wildlife ☐ unusual ☐ street tree ☐ screen ☐ shade ☐ indigenous ☐ protected by gov. agency

TREE HEALTH

Foliage color: ☐ normal ☐ chlorotic ☐ necrotic **Epicormics?** Y N

Foliage density: ☐ normal ☐ sparse **Leaf size:** ☐ normal ☐ small

Annual shoot growth: ☐ excellent ☐ average ☐ poor **Twig Dieback?** Y N

Woundwood development: ☐ excellent ☐ average ☐ poor ☐ none

Vigor class: ☐ excellent ☐ average ☐ fair ☐ poor

Major pests/diseases: _____

Growth obstructions:

☐ stakes ☐ wire/ties ☐ signs ☐ cables

☐ curb/pavement ☐ guards

☐ other _____

SITE CONDITIONS

Site Character: ☐ residence ☐ commercial ☐ industrial ☐ park ☐ open space ☐ natural ☐ woodland/forest

Landscape type: ☐ parkway ☐ raised bed ☐ container ☐ mound ☐ lawn ☐ shrub border ☐ wind break

Irrigation: ☐ none ☐ adequate ☐ inadequate ☐ excessive ☐ trunk wettled

Recent site disturbance? Y N ☐ construction ☐ soil disturbance ☐ grade change ☐ line clearing ☐ site clearing

% dripline paved: 0% 10-25% 25-50% 50-75% 75-100% **Pavement lifted?** Y N

% dripline w/ fill soil: 0% 10-25% 25-50% 50-75% 75-100%

% dripline grade lowered: 0% 10-25% 25-50% 50-75% 75-100%

Soil problems: ☐ drainage ☐ shallow ☐ compacted ☐ droughty ☐ saline ☐ alkaline ☐ acidic ☐ small volume ☐ disease center ☐ history of fail ☐ clay ☐ expansive ☐ slope _____° aspect: _____

Obstructions: ☐ lights ☐ signage ☐ line-of-sight ☐ view ☐ overhead lines ☐ underground utilities ☐ traffic ☐ adjacent veg. ☐ _____


Tree #1


Tree #2


Tree #3

Who Should Work on Trees?

Tree Certifications

ISA International Society of Arboriculture

- **Certified Arborist**
  - 3+ years of practical experience *OR*
  - Degree in horticulture or agriculture
- **Certified Arborist Utility Specialist**
  - Minimum of 2000 hours experience over 2 years *OR*
  - Served as a consultant to a utility with 4000 hours over 10 years
- **Certified Arborist Municipal Specialist**
  - Current ISA Certified Arborist
  - 3 additional years work experience
- **Certified Tree Worker Climber Specialist**
  - Skills and endurance to climb
  - Tested in both classroom and in field
- **Certified Tree Worker Aerial Lift Specialist**
  - Competent aerial lift operator
  - Safety, CPR and first aid knowledge required
- **Board Certified Master Arborist**
  - Highest level certification
  - Extensive scenario-based exam
  - Fewer than 2% of all ISA Certified Arborists hold this certification

Benefits of Trees

- Air filtration
- Water purification & conservation
- Erosion prevention
- Lower heating/ cooling bills
- Climate control
- Increases property values
- Improve social interactions

A Special Thanks to…

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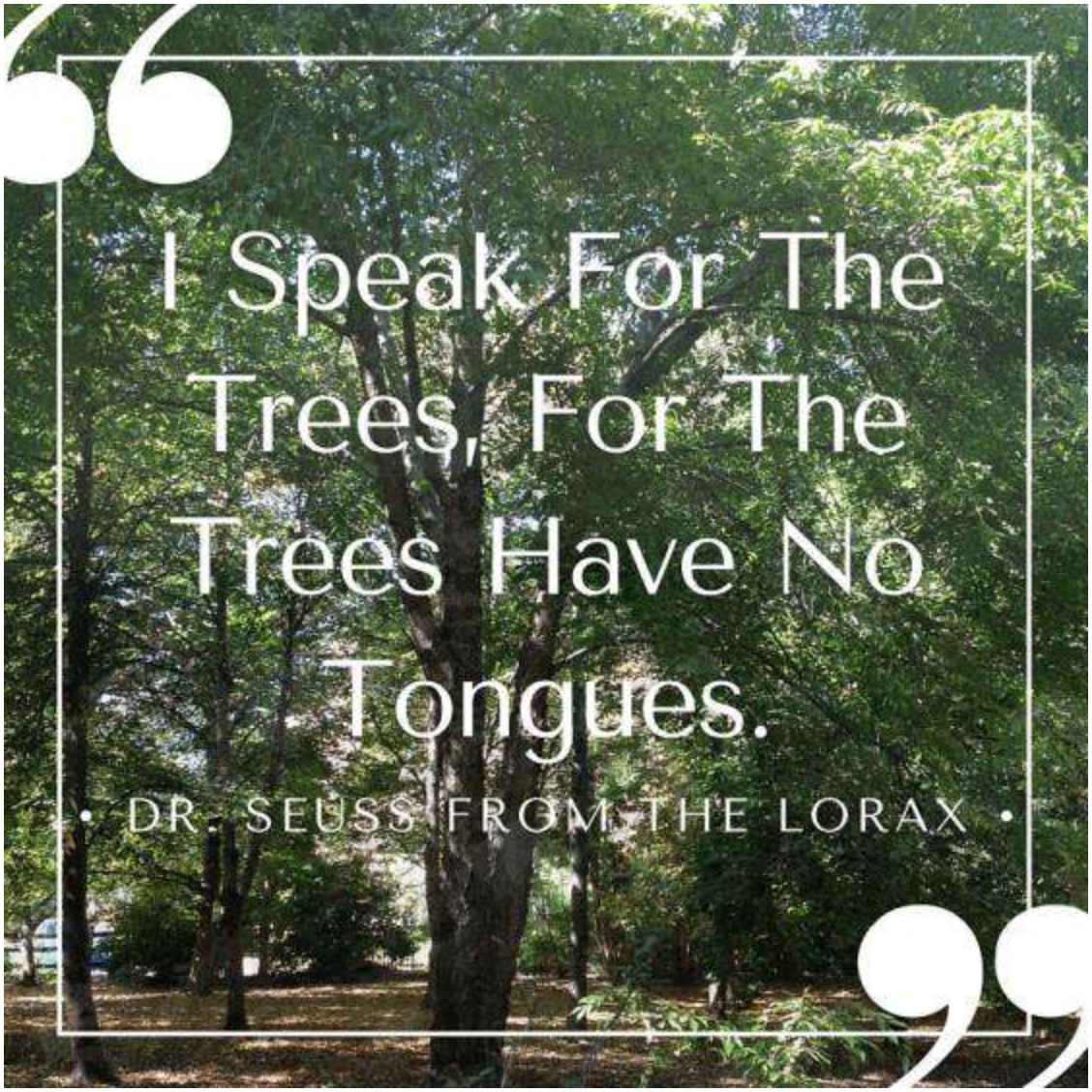
Rick Robinson, President at Stillwater Landscape Management

Claud Cluff, Grounds Supervisor at the City of Chandler Parks & Recreation

Bryan Steinhour, Operations Manager at Integrity Tree Service


I Speak For The Trees, For The Trees Have No Tongues.
• DR. SEUSS FROM THE LORAX •