TREES

FOR THE 21ST CENTURY

Eight steps to cultivating a thriving, resilient urban tree canopy that benefits our communities for decades to come.

CALIFORNIA ReLeaf

Introduction

EIGHT STEPS TO A 21ST CENTURY CANOPY

California faces many challenges in the 21st century. Extreme weather events pose a serious threat to public health, infrastructure, agriculture, and water and energy resources. Heatwaves have significantly intensified over the past two decades and expose densely populated regions to the risks of extreme heat, wildfire, and pollution, with California experiencing record-breaking heatwaves in September 2020. The high temperatures are coupled with lower precipitation levels and repeated droughts. Furthermore, existing greenhouse gas (GHG) levels in the atmosphere are very high. Many communities are feeling hotter, less inviting, and vulnerable.

Trees are part of the solution. A thriving urban canopy helps make our communities become more resilient by adapting and mitigating the effects of climate change. No existing technology can significantly remove GHGs from the air except trees. Healthy urban trees not only sequester carbon, but also lower temperatures, reduce flash flooding, and provide many human health benefits. But in order to produce all these benefits, tree survival is paramount. That part is on us!

While native species can be an interesting component of a project, limiting your choices to native plants will probably not be possible. Urban sites, with their compacted soils, hotter temperatures, lower water availability, and higher pollution levels, are often not a good match for native trees. **Tree success depends on good choices and actions, from planting to young and mature tree care, as well as community engagement.** These eight steps are designed to help you plan, plant, and promote a resilient urban canopy that can survive and thrive throughout the 21st century.

SPEAK TREE

ARBORIST: a certified specialist in the care and cultivation of trees and shrubs.

CANOPY: the above-ground portion of forest, which includes the leaves, branches, and collective crowns of one or several trees. A full, healthy mature canopy is the goal.

CARBON SEQUESTRATION: the process of capturing and storing atmospheric carbon dioxide in a tree's trunk, slowing or reversing CO_2 polution in the air.

DIVERSITY: a wide variety and number of tree species that live in a particular location. It is the opposite of monoculture, which is where only one species is prevalent. More diversity is associated with increased vigor and resiliency.

GHG: Greenhouse gas - any atmospheric gas which creates heat, such as carbon dioxide.

MULCH: A layer of material applied to the surface of soil. For tree health, plant-based organic mulch is preferred (rather than synthetic mulch or rocks).

NURSERY STOCK: Tree and plants grown or propagated for sale or distribution. For urban trees, usually referred to by the container size: bareroot, #5 or 5-gallon, #15 or 15-gallon, 24" box, etc.

RESILIENT: adapting well in the face of adversity or significant stress.

SEEDLING/SAPLING: A tree's lifecycle is seed, seedling, sapling, mature, decline. Seedling and sapling are the ages at which trees are usually planted in an urban forest project. The younger the tree, the quicker it acclimates.

SELECTREE Tree Selection Guide: An interactive website designed to help select appropriate trees. It refines searches for species based on compatible characteristics such as water use, height, soils type, and climate.

URBAN FOREST: The private and public greenspaces such as parks, street trees, or residential yards that coexist with human communities. Urban forestry is the care/management of them.

WHY URBAN TREES?

Urban forests are critical to a holistic approach of addressing climate change. Compared to trees in wildlands, they often require more resources and funding to plant and maintain. The co-benefits make them well worth the investment, however, and make them vital infrastructure for cities and residents.

Across California many disadvantaged communities are dramatically under-canopied compared to affluent neighborhoods. Prioritizing plantings in these neighborhoods expands access to the benefits trees provide and helps make all of California more equitable and resilient by starting with our most vulnerable neighbors.

GHG REDUCTIONS

While many climate iniatives focus on reducing further GHG emissions, this is only part of the solution. Existing GHG levels in the atmosphere are very high and no existing tool removes GHGs from the air as effectively as trees!

AIR QUALITY

Trees and plants filter the air and reduce pollution, ozone and smog levels. This improves the quality of the air we breathe and reduces symptoms of asthma.

ENERGY & COOLING

Through carbon sequestration, evapotranspiration, and providing shade, urban trees lower city temperatures and reduce the costs and demand for energy.

ACTIVE TRANSPORTATION

The shade, safety and beauty of trees encourage active transportation like biking and walking. Trees also promote public transportation, as every transit ride begins and ends with a walk.

SAFETY

Trees reduce crime, slow cars on the road, and provide a physical guard between cars and the sidewalk, making roads safer for drivers and pedestrians.

HUMAN HEALTH

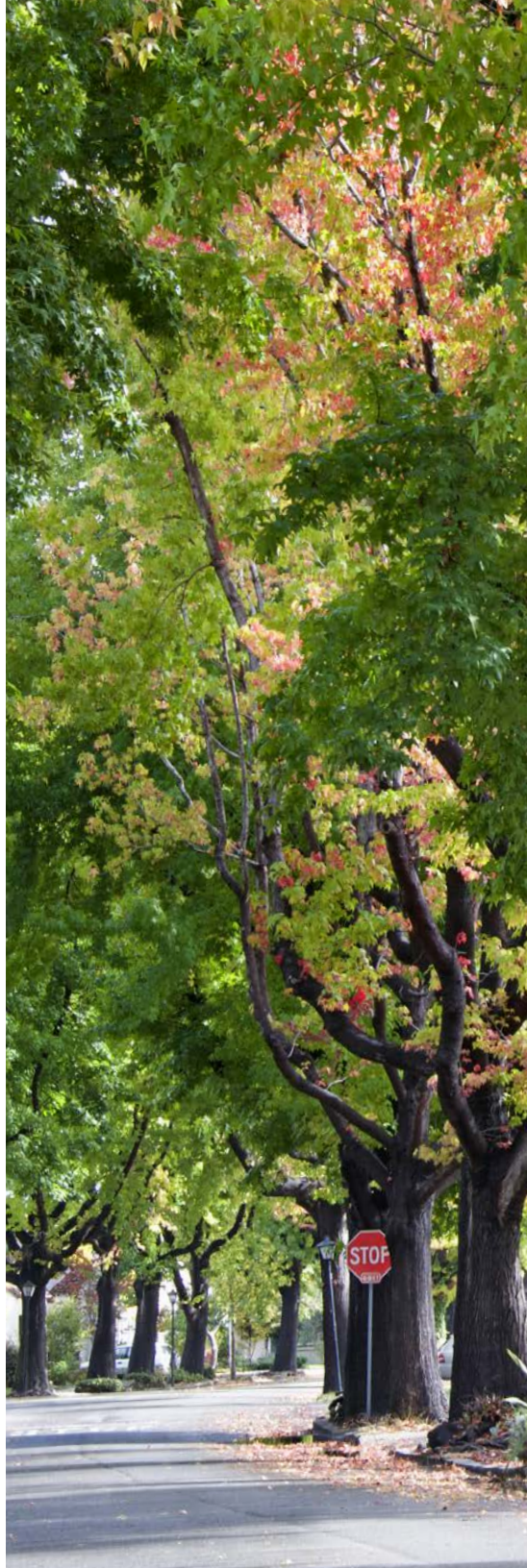
Beyond improving air and water quality, and increasing physical activity, trees are also proven to have a positive effect on mental health including depression and stress.

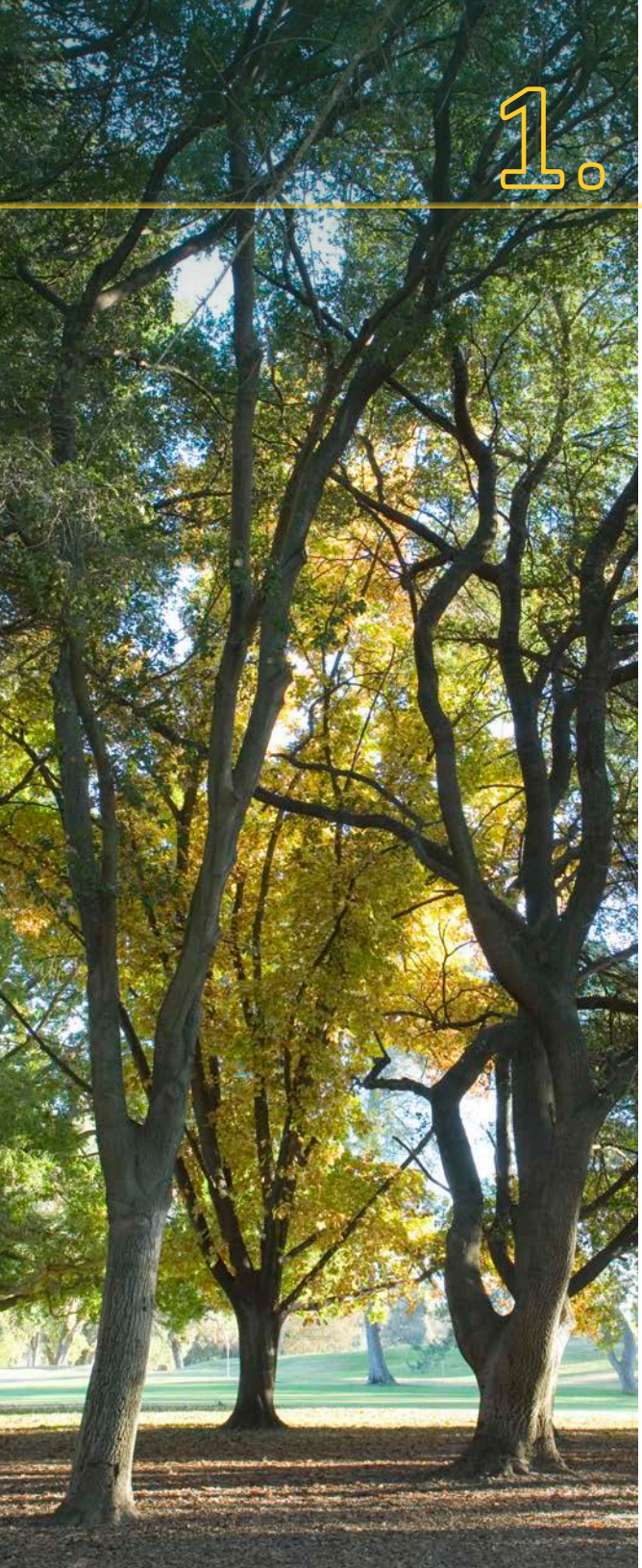
PLACEMAKING

Trees and green space create public spaces where people can come together to enjoy the neighborhood and can grow a sense of community pride. Honoring existing communities and meaningfully involving residents in decision-making encourages innovation, cultural relevance, and stewardship.

WATER QUALITY

Trees help keep our waterways clean by reducing stormwater run-off and soil erosion, and by filtering chemicals and other pollutants from water and soil. Trees also intercept rainfall, which protects against flash flooding and recharges groundwater.





1. Think Big

Bigger trees mean more benefits. Larger trunks capture more GHGs. Broader canopies collect more pollutants, provide more shade, and intercept more stormwater. This adds up to cleaner air, cooler buildings, and clearer waterways for our communities, just by selecting a tree that grows bigger. Whenever possible, plant the largest species a space can handle.

One mature oak tree (60 ft) provides the same environmental benefits as 10-20 mature crape myrtles (25 feet).

Large trees are usually the best choice for parks, schoolyards, and many street tree situations. However, not every site can support a big tree. Sites near power lines may call for a shorter species. Perhaps your project focus involves food forests or understory reforestation and not large trees. In these cases, it is still worth considering whether some large trees can be incorporated in the design to boost the benefits and create a more robust and multi-faceted project.

– GHG SEQUESTRATION POWER +

Not so good:

- Fruit trees, in general
- Most small ornamental flowering trees
- Species that are described as "small tree or shrub"

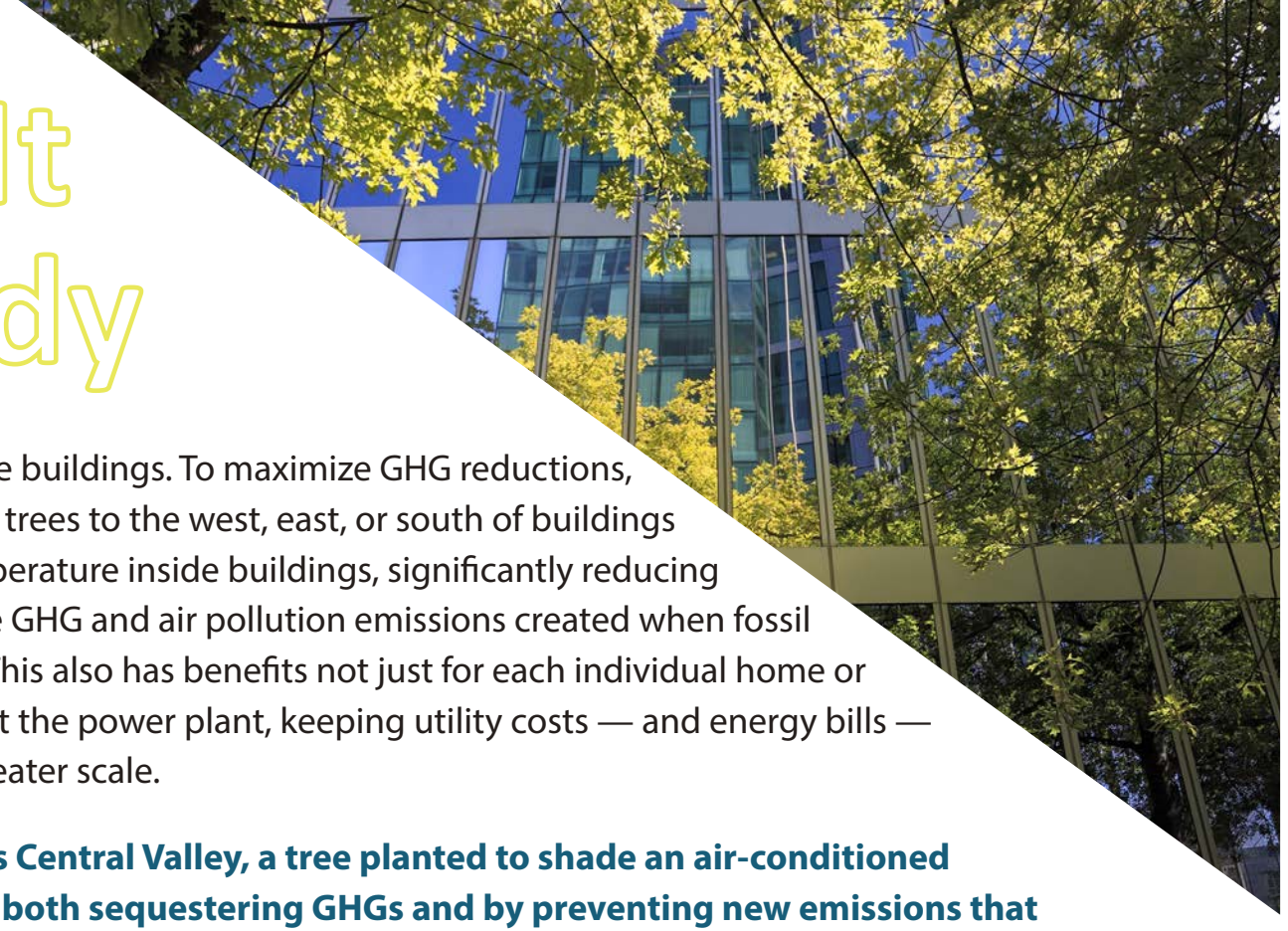
Moderate:

- Trees with mature heights of 20-40 ft
- Trees with mature trunk diameters of ~12-18 inches
- Trees with delicate trunks and branches

Best:

- Trees with mature heights of 60+ ft
- Trees with mature trunk diameters of 24+ inches
- Trees with a lot of wood in the trunk and/or branches
- Trees traditionally used for lumber

2. Keep It Shady



Whenever possible, use trees to shade buildings. To maximize GHG reductions, air quality, and energy benefits, plant trees to the west, east, or south of buildings within 60 feet. Shade lowers the temperature inside buildings, significantly reducing energy use, which in turn reduces the GHG and air pollution emissions created when fossil fuels are burned to make electricity. This also has benefits not just for each individual home or business but also reduces demands at the power plant, keeping utility costs — and energy bills — lower and conserving energy on a greater scale.

In a hot, dry climate like California's Central Valley, a tree planted to shade an air-conditioned building can double its benefits by both sequestering GHGs and by preventing new emissions that would be created to cool the building. The new emissions prevented by a shade tree can be as much as, or more than, those sequestered.

RESOURCES

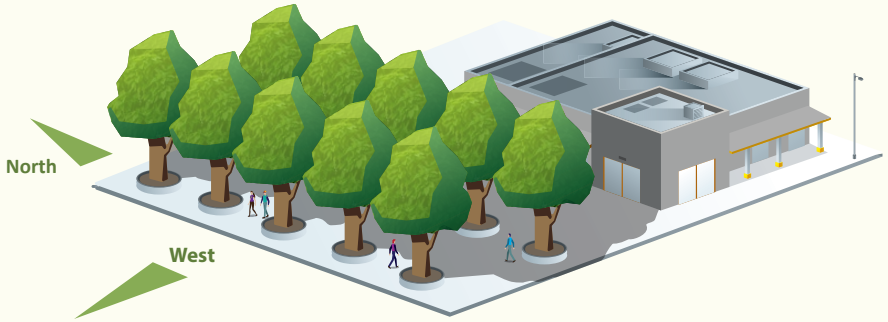
- SelecTree allows you to search for a tree species that meets your needs, with filters for size, climate zone, and many other characteristics.
- See the figures on the following page for details on the impact of tree size, distance, and direction from building.

In neighborhoods where air conditioning is not common, trees can provide needed cooling on increasingly hot days, by reducing the interior temperatures by up to 10 degrees. This cooling power can save lives by preventing heat-related illness and mortality.

Deciduous trees provide shade in the hotter months and, after losing their leaves, allow sunshine and warmth to come through in the cooler months. This makes deciduous trees preferable to evergreens for use the south sides of buildings.

GETTING THE MOST OUT OF YOUR TREES

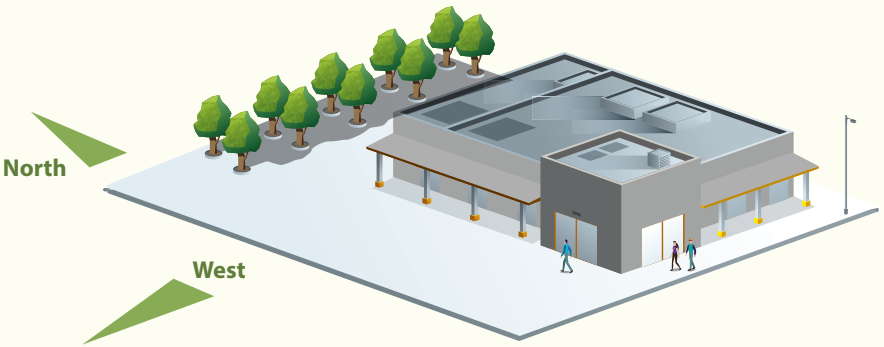
How Orientation Affects Outcome



High Impact Design at 40 years

10 large trees planted 20-40 feet west of building.

- Greenhouse Gases reduced ..... 52 tons
- Stormwater captured ..... 158,100 gallons
- Electricity saved ..... 149,000 kWh
- Air Pollutants reduced ..... 590 lbs



Low Impact Design at 40 years

10 small trees planted 40 feet north of building.

- Greenhouse Gases reduced ..... 2 tons
- Stormwater captured ..... 19,100 gallons
- Electricity saved ..... 0 kWh
- Air Pollutants reduced ..... 62 lbs

– GHG REDUCTIONS FROM ENERGY CONSERVATION +

Little to negative energy conservation value:

- Any trees planted more than 60 ft from buildings
- Medium trees planted more than 40 feet from buildings
- Small trees
- Trees planted to shade buildings in regions with moderate climate
- Evergreen trees planted to the south of buildings

Moderate conservation value:

- Medium trees planted to the west and east within 40 feet of buildings
- Large and medium deciduous trees planted to the south of buildings

Best conservation value:

- Large trees planted to the east and west of buildings
- Trees planted within 60 feet of buildings in the Central Valley and Inland Empire

3. Diversify

A natural forest system contains an extensive diversity of species, with each having a role to play in the forest's survival. In urban forests, we have to consciously create that diversity ourselves.

Diversity of tree species in an urban forest improves canopy vigor and resilience. The greater the variety in the selection of trees in an urban forest, the better it can withstand stresses caused by environmental factors, such as drought and climate change, and the more resistant it is to the risks associated with pests and diseases. A mix of species also provides added interest and appeal to the surroundings: just by adding a few conifers, flowering trees, or fruit trees to a planting plan, you increase resilience and natural beauty.

Increase diversity by choosing a variety of species for your project and by considering species that are less common in your community.

When selecting trees, consider the adjacent and existing trees in the area you are planting. Taking into account all the trees (existing and to be planted), a good diversification goal is to strive to avoid any one species making up more than 10-25% of the total trees.

For example, if supplementing trees at a park that has all maples, diversify by adding different species to the park, rather than more maples. And for a project with 100 trees at one location, limit yourself to 25 of any one species, or to 10 for an even more resilient project.

RESOURCES

- Regional arborist websites and SelecTree can lead you to ideas and inspiration for choosing new species in your region.

4. Be Water Wise

There is no one-size-fits-all solution when it comes to trees and water. Water needs for a tree depend on the species, climate, and weather, as well as the specific site. **While some trees will always need regular rain and/or supplemental watering, others can go months without rain once they've established themselves.** Even in non-drought years, Californians can't afford to waste water.

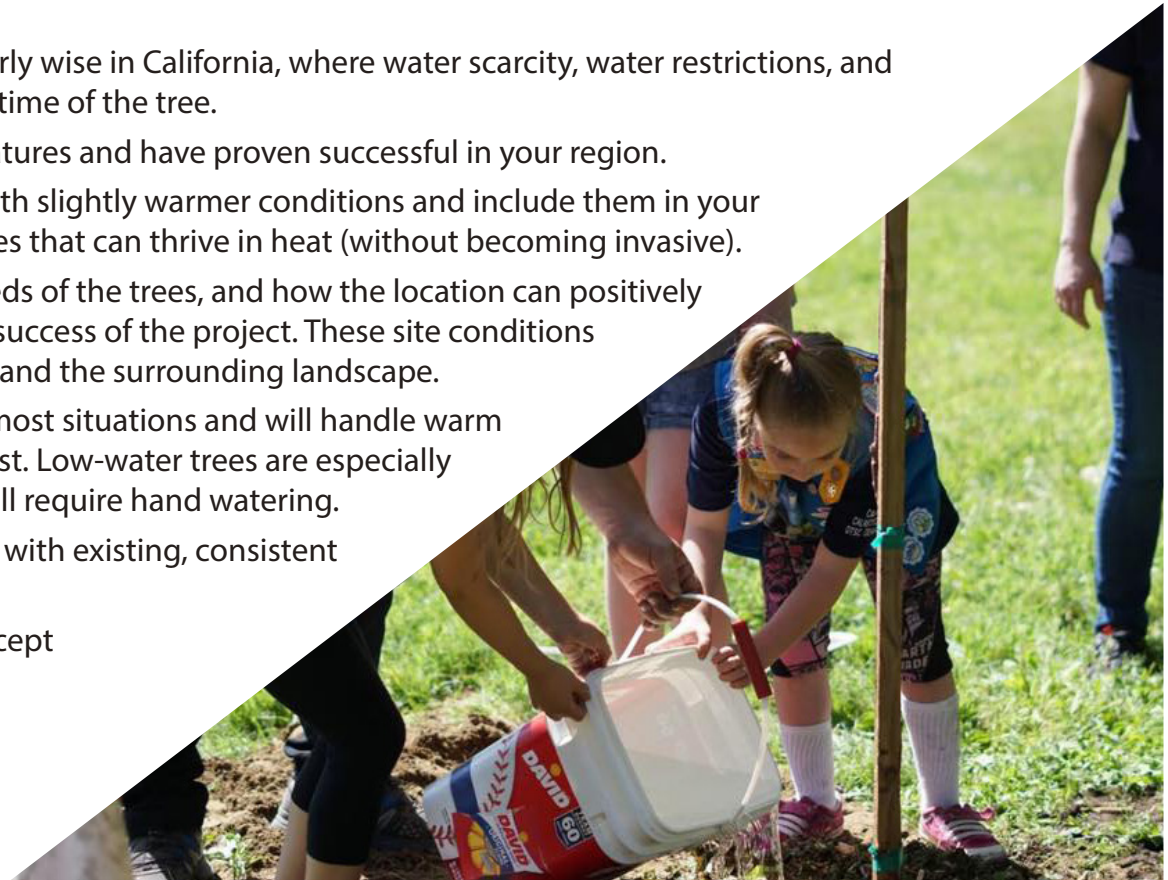
It is important to understand that different tree species have vastly different water needs. If a tree doesn't receive the amount of moisture it needs to thrive, its health is jeopardized, and the tree could fail.

Here are some tips to consider:

- Select water-efficient trees. This is particularly wise in California, where water scarcity, water restrictions, and increased water rates are likely over the lifetime of the tree.
- Choose trees that can handle high temperatures and have proven successful in your region.
- Research trees that have thrived in areas with slightly warmer conditions and include them in your design. Remember, this includes non-natives that can thrive in heat (without becoming invasive).
- Consider from the get-go the irrigation needs of the trees, and how the location can positively impact the survival of the trees — and the success of the project. These site conditions include water availability, soil, topography, and the surrounding landscape.
- Overall, lower water-use trees will work in most situations and will handle warm temperature and weather variations the best. Low-water trees are especially good for most street trees and trees that will require hand watering.
- Moderate water-use trees do better in sites with existing, consistent irrigation (i.e., schools and parks).
- High water-use trees should be avoided except in very specific circumstances.

RESOURCES

- Water Use Classification of Landscape Species (WUCOLS) Plant List is great for finding trees that are appropriate for your planting site.
- Use the soil moisture filter in SelecTree to refine your search by water need.



5. Avoid Trouble

Nobody wants to plant a tree that will bring potential problems. A little bit of research can go a long way in avoiding bad situations.

Pests

Environmental and human stressors make some trees vulnerable to pest invasions. Often by the time the pest or disease is detectable to us, the tree has undergone too much damage to thrive.

Two devastatingly notorious pests are the Invasive Shot-hole Borer in Southern California and Sudden Oak Death in Northern California. These aggressive tree killers spread readily and attack a wide swath of species. Other common pests include mistletoe, Dutch elm disease, aphids, and anthracnose.

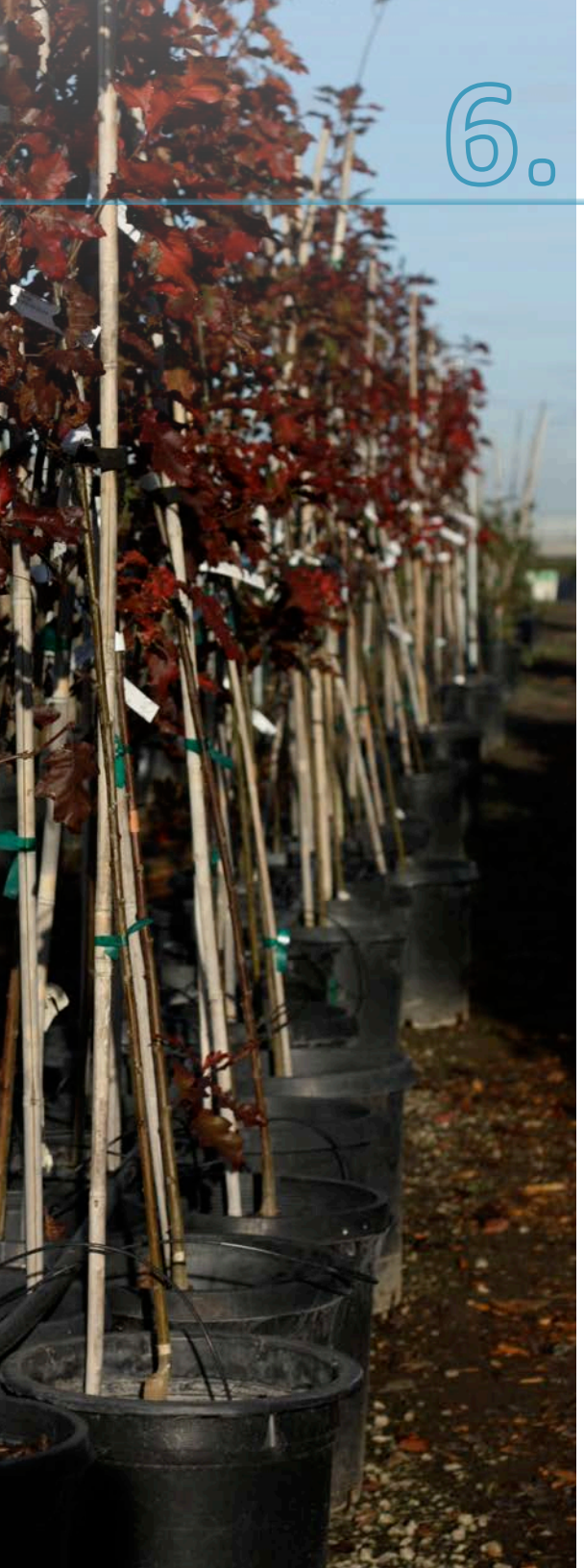
Imagine spending time and money on a project that gets completely attacked by unwanted pests in just a few years! Selecting species that are less susceptible to these problems and working to keep trees free from stress will help.

RESOURCES

- Check with regional experts to select trees that show resilience to pests and diseases.
- SelecTree can indicate the pest and disease vulnerability of your choices.
- The California Invasive Plant Council (Cal-IPC) maintains an inventory of invasive plant species. Use this as your "do not plant" list to make tree selection easy!

Invasives

Some plants and trees are listed as invasive species and have been documented to spread quickly and threaten natural habitats and the surrounding landscape. These species can spread through aggressive root growth or with heavy seeding. Most publicly funded projects do not allow invasive species for this reason, and they should be avoided in all projects.



6. Start Strong

Success starts with the young tree, before it is in the ground. Selecting and installing healthy, structurally sound trees is very important. **The younger and healthier a tree is when planted, the better the success rate.**

When deciding on the container size for a project, go with the youngest tree feasible for the site and the funding source. Most funding for public trees use the #15 container size as the most practical — it is large enough to avoid damage and vandalism, while young enough to ease planting and promote vigor.

Here are some pointers for selecting trees at the nursery:

- Examine the entire selection of your desired species. Avoid selecting the largest or smallest tree.
- Avoid a tree in a container that is bulging, misshapen, or light to pick up. These are clear indicators that the tree has been in the container too long.
- Inspect the rooting, trunk, and branching of each tree:
- Look for white, fibrous roots that are exploring the soil around the base of the trunk. Avoid trees that are rootbound or that have woody roots resembling branches.
- Identify trees with single trunks that taper from the base towards the top.
- Make sure any branches are evenly distributed along the trunk, with no branches as thick as the trunk of the tree or growing up, parallel to the tree's trunk. Some young trees may not yet have lateral branches.

RESOURCES

- This Nursery Cue Card goes into more details about the trunk and root characteristics to look for (and provides visuals).
- If a contractor or other party is selecting and providing the trees for the project, please be sure they have reviewed the current American Standard for Nursery Stock, Z-60.1.

7. Plant Like a Pro

All the benefits of planting the right trees for your community can only occur if proper tree planting and maintenance techniques are followed. Engaging the local community in this process also builds their sense of ownership of the trees — and their knowledge about how to care for them — which helps ensure the long-term survival.

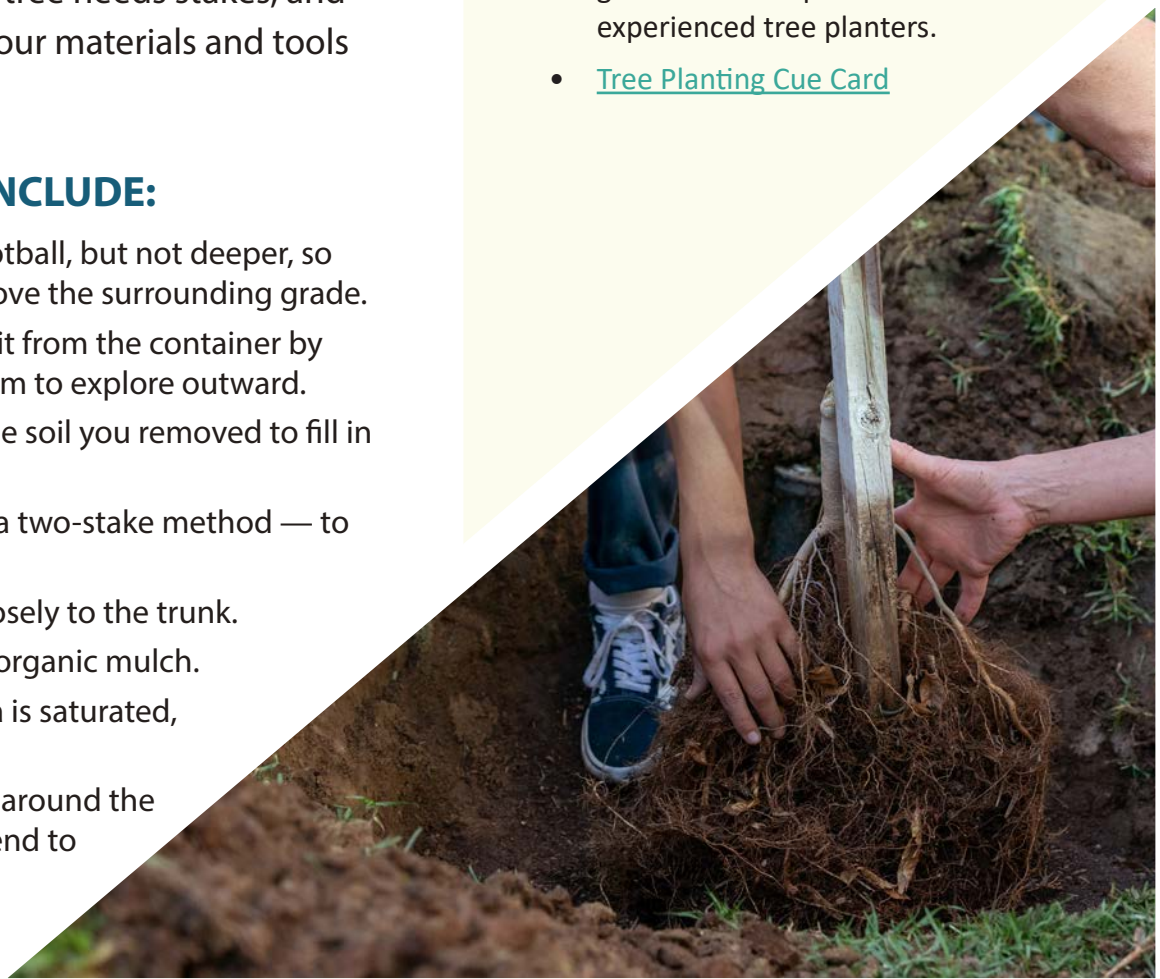
Take time before installing the trees to learn how to handle the rootball, what size hole to dig, whether the tree needs stakes, and what tools you'll need. Be sure to have all your materials and tools before you dig.

BASIC STEPS FOR TREE PLANTING INCLUDE:

- Dig a hole that is 2-4 times wider than the rootball, but not deeper, so that the top of the rootball is at or slightly above the surrounding grade.
- Prepare the roots for planting as you remove it from the container by loosening any circling roots to encourage them to explore outward.
- After placing the tree in the hole, use the same soil you removed to fill in around the rootball.
- Stake the trees as needed — generally using a two-stake method — to allow movement in the wind.
- Remove the nursery stakes that are bound closely to the trunk.
- Cover the planting areas with a thick layer of organic mulch.
- Water the tree so that the entire planting area is saturated, including the mulch.
- In the first few weeks, keep an eye on the soil around the rootball (that was in the container) as it will tend to dry out more quickly.

RESOURCES

- "How to properly Plant a Tree" video from Sacramento Tree Foundation.
- CAL FIRE's Nursery Standards and Technical Specifications offer a great reference point for new and experienced tree planters.
- Tree Planting Cue Card



8. Help Them Grow

Unlike a tree that grows in a natural forest on its own, a tree in the urban forest needs our help. **Access to moisture is the biggest obstacle tree roots confront.** Having an irrigation plan beforehand makes this easy to address.

Generally, a young tree needs a deep watering 2-3 times per week, particularly in its first warm seasons. During summer months, it is important to make sure the tree's irrigation system is functioning. You may also need to supplement the routine, especially during hot spells.

Regularly reapplying the mulch layer around the trees provides multiple benefits to the young tree. This layer buffers the roots from extreme temperatures and conserves moisture in the soil. It also reduces competition from weeds and plants, and protects it from lawn equipment that may unintentionally harm the tree. And, as the mulch breaks down, it adds nutrients to the soil and invites healthy microorganisms into the area!

Research young tree care. Stake adjustment/removal and young tree pruning are important and easy steps. Remember that **small, well-informed actions when a tree is young can promote good tree structure, healthy canopy, and all the great desired benefits for decades to come.**

RESOURCES

- California Urban Forests Council has great resources and vidoes about tree care.
- UC Cooperative Extension also has resources for tree care and management.
- International Society for Arboriculture (ISA) has details and drawings explaining tree planting and tree care.

Resources

Tree Selection

- Water Use Classification of Landscape Series (WUCOLS) provides the irrigation water needs plant and trees used in California landscapes.
- California Invasive Plant Council (Cal-IPC) provides an inventory of species that threaten California's natural areas, including invasives.
- SelecTree: A Tree Selection Guide. An interactive website designed to help select appropriate trees. Browse thousands of species, narrow your search to your needs, and find trees at a nursery near you.
- American Standards for Nursery Stock (ANSI Z60): If using a contractor, make sure that they are familiar with these standards before selecting your trees.

Tree Planting & Care

- California ReLeaf lists extensive resources for selecting, planting, and caring for trees.
- International Society for Arboriculture (ISA) has a collection of details and drawings for many scenarios of tree planting and tree care.
- CAL FIRE Standards and Specifications for Purchasing, Planting, and Maintaining Trees offers a great reference for new and experienced tree planters alike.
- California Urban Forests Council has great resources and vidoes about tree care.
- UC Cooperative Extension also has resources for tree care and management.

Experts

- Find An Arborist is a searchable directory of certified arborists, as qualified through the International Society of Arboriculture.
- UC Cooperative Extension has academic advisors and volunteer program specialists (like Master Gardeners) who can provide advice about science-based solutions as well as share pertinent research.
- CAL FIRE Urban and Community Forestry Program works to expand and improve the management of trees and related vegetation in communities throughout California. Find the Regional Urban Foresters near you.
- California ReLeaf Network Member organizations. Check for local resources with a community urban forestry nonprofit organization near you.

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Photo contributed by to California ReLeaf grantees and Network members: Balboa Park Conservancy (p1), Sustainable Claremont (p1), Tree Davis (p8), Forest Resiliency Program (p11), Canopy (p12), and People and Trees (p13).

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Empowering grassroots efforts and building strategic partnerships that preserve, protect, and enhance California's urban and community forests.

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