

Climate-Ready Trees



Tree Species Selection Guidelines for the Albuquerque Metro Area



Photo Credit: Jennie Trinkaus

LAND ACKNOWLEDGMENT

The Nature Conservancy is committed to creating, promoting, and perpetuating a narrative and future in which nature and people can thrive and coexist. Our mission must encompass inclusion, collaboration and support of the ancestral and current stewards of our natural systems.

We take this opportunity to acknowledge the ancestral homelands of the Indigenous peoples of the US Southwest that now comprise the 19 Pueblo communities, Fort Sill Apache, Jicarilla Apache, Mescalero Apache, Navajo Peoples in New Mexico and Ute Mountain Tribe in New Mexico.

We pay our respect to these traditional stewards, past, present and emerging, who have been the custodians of these lands and waters since time immemorial.

ACKNOWLEDGMENTS

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Thank you to the Indian Pueblo Cultural Center for their support in developing The Nature Conservancy's land acknowledgment in New Mexico.

HOW TO USE THIS DOCUMENT

The information in this document is intended to help practitioners make informed decisions for tree species selection.

CHAPTER 1 — INTRODUCTION

This chapter outlines the context for Albuquerque's trees and the purpose of this project.

CHAPTER 2 — METHODOLOGY

Chapter 2 details the projected climate models for mid- and end-of-century temperature and precipitation, including how the hardiness zone and frost-free days change over that time frame. It also includes a deep dive into the criteria used to score a master list of species evaluated.

CHAPTER 3 — SPECIES LISTS

This chapter provides a short description of the tree characteristics, site characteristics and appropriate trees for each of seven example site conditions.

APPENDIX A — MASTER LIST

Appendix A provides a more detailed look at how each tree was scored on the master list of species evaluated. Additional information about each tree and our experts' local knowledge is captured in the full spreadsheet.

APPENDIX B — DETAILED SITE DESCRIPTIONS

This appendix provides a more detailed description of six of the site locations and serves as a companion piece to the lists.

"Our urban centers can be viewed as bellwethers of our global environmental fate. Our success at meeting the challenges of protecting biological diversity in urban areas is a good measure of our commitment to protect functioning ecosystems worldwide. If we cannot act as responsible stewards in our own backyards, the long-term prospects for biological diversity in the rest of this planet are grim indeed."

-D.D. Murphy, 1988

CHAPTER 1 - INTRODUCTION

Albuquerque is facing increasingly extreme climatic events, compounded by the city's urban heat island (UHI) effect. As a large metropolis in an already arid environment, Albuquerque urgently needs creative strategies to mitigate and adapt to climate change.

Urban trees are a cost-effective, nature-based solution to mitigating climate change and improving the livability in cities and towns. Albuquerque's estimated 1.5 million urban trees are quietly benefitting human and wildlife inhabitants, providing air and water pollution removal, carbon sequestration, carbon storage, building energy savings, heat mitigation, reduction of stormwater runoff, and improving physical and physiological health and well-being for residents.

Yet, the tree canopy in Albuquerque is rapidly declining. Poor tree species and planting site selection, limited capacity for proper tree care, weak policies to protect mature trees, and tree canopy age are major factors in the decline. Climate change is amplifying the UHI effects with increasing temperatures and altered precipitation patterns, which will greatly affect Albuquerque's urban trees. Tree species that practitioners have been planting for years are no longer viable options. Sun scorch, drought stress, new pests, disease and other tree health problems are increasingly prevalent.

The last major tree planting campaign in New Mexico took place nearly a century ago. Many of the largest shade trees in Albuquerque today are the Siberian elms (*Ulmus pumila*, now considered an invasive species) planted during that campaign that alone account for 25% of Albuquerque's canopy cover.¹ Roughly 60% of Albuquerque's trees are younger or smaller stature trees with a trunk diameter of six inches or less that contribute limited shade. Albuquerque faces a crisis where a majority of the shade-producing tree canopy could be lost over the next decade.

The Nature Conservancy is part of a concerted effort in Albuquerque to reverse the tree canopy decline by supporting thoughtful tree plantings

resilient for the century to come. An alliance of public agencies and non-profit organizations is addressing the tree stewardship and climate challenges. Each organization brings a unique area of expertise and influence that is necessary for a holistic and robust approach to meeting the needs of both the community and the community forest. The alliance's efforts have built a strong foundation that has empowered the City of Albuquerque's Mayor Keller to adopt a goal to plant 100,000 trees by 2030, one tree for every child in Albuquerque. The Nature Conservancy's role in this effort has been to convene stakeholders and find science-based solutions that use data and analysis to inform projects and ensure long-term success.

Tree species selection is a critical piece of preparing for what is to come. Climate-ready tree species are those well-adapted to face both present and future climatic challenges such as heat, drought, extreme weather events, and pests and pathogens.² Best practices in urban and community forest management provide minimum recommended levels of species and genera diversity to limit pest and disease outbreaks and to ensure greater resiliency.² Historically, resiliency is defined as an ecosystem's ability to resist damage and/or quickly recover from a disturbance event such as extreme heat, flooding, or invasive pests. For the purposes of this project, we are expanding that concept of resilience to also include climate change.

PURPOSE

The purpose of the Climate-Ready Trees for Albuquerque project was to develop a list of urban adapted tree species that can survive both current conditions and the climatic challenges over the next century. While several research studies have examined the role of anthropogenic sources of change, like development, or more specifically impervious surface area^{3,4} as the cause for tree canopy decline, very little information exists on the role climate change may play in impacting the viability and density of our community forests.



Photo Credit: Roberto Rosales

This report is intended to serve as a guideline to increase the tree species diversity and resiliency of Albuquerque's community forest. Outcomes of this project and report:

- Provide the first step in making the Albuquerque community forest more resilient to climate change, more specifically increasing temperatures and decreasing precipitation.
 - Provide a resource for use in tree selection and site selection.
 - Highlight the variety of trees available to help diversify our future community forest.
 - Encourage nursery industry partners to start planning for future tree needs of their customers and introduce new species into the propagation pipeline.
- Inspire more people to plant trees and engage in The Nature Conservancy's tree awareness and tree planting campaigns.
 - Continue to foster community stewardship of trees and guide people to plant the right tree in the right place at the right time.

Chapter 2 of this report details the process used to develop the tree species lists found in Chapter 3. These tree species recommendations may be utilized for residential, commercial, and municipal plantings. They are intended as a starting point and should always be used in conjunction with the Master List found in Appendix A of this report, planting site characteristics, local expert knowledge, and applicable local or municipal tree ordinances.

CHAPTER 2 - METHODOLOGY

The Nature Conservancy’s project lead invited local and regional experts from agencies, universities, municipalities, and private industry to serve on the Climate-Ready Trees for Albuquerque project team. The team of experts represented many different backgrounds and interests to capture a wide breadth of tree related knowledge and best communicate Albuquerque’s tree canopy needs. A project process was developed following the framework outlined by Dr. Greg McPherson’s climate-ready trees research project evaluating potential street trees for Southern California.² This valuable foundational work was modified to best fit the team’s capacity and challenges of Albuquerque’s unique high desert ecosystem, and to utilize publicly available data on a wide variety of regionally appropriate tree species.

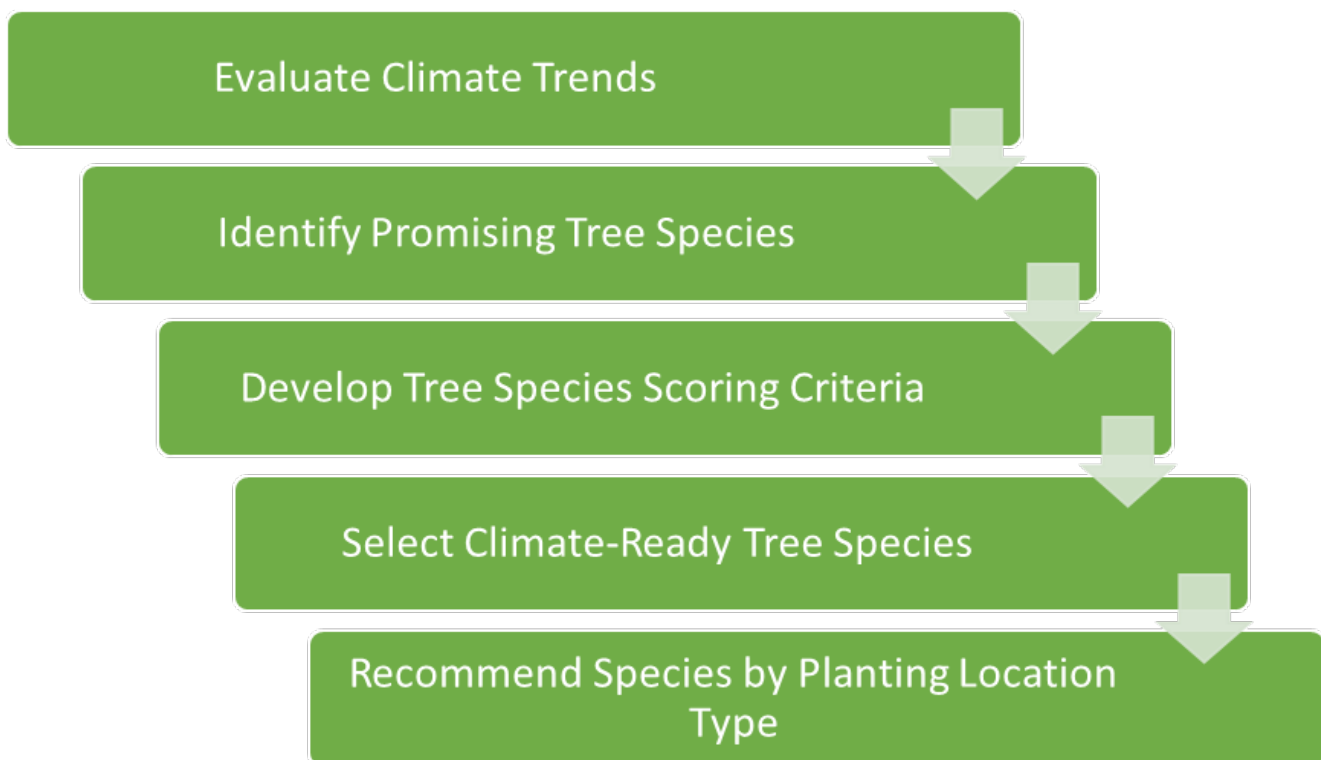
The first step in the analysis was to evaluate climate trends in the greater Albuquerque area. If planted in the right place and well cared for, many tree species can live 50 to 100 years or more and must be able to tolerate changes in temperature and precipitation throughout their lives.

Following the climate trend evaluation, the team compiled a list of tree species anticipated to be well suited to the Albuquerque area. Climate-focused scoring criteria were developed by the team, and the master list of tree species were evaluated on these criteria and either eliminated or recommended for further consideration. Those tree species identified as “climate-ready” were categorized and further recommended based on their suitability for common planting location types in Albuquerque.

EVALUATING CLIMATE TRENDS

Climate-ready tree species are those that can be planted now and survive current cold temperatures while thriving in a warming climate over the next 100 years. To understand those climatic changes, publicly available climate and precipitation projection data were used in this project’s analysis to understand future climate conditions in Albuquerque. Data used were from the Coupled Model Intercomparison Project Phase 5 (CMIP5) from the Lawrence Livermore National Laboratory Program for Climate Model

PROJECT PROCESS



Projected Maximum Temp: Model + UHI

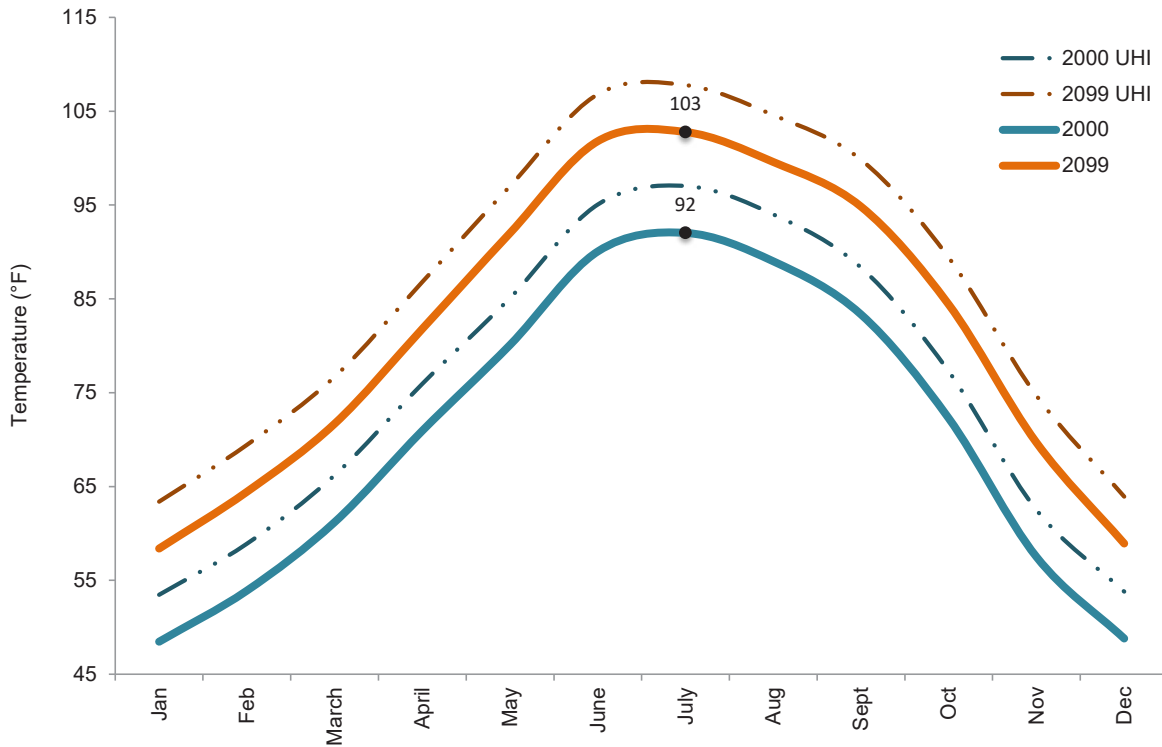


Figure 1. Projected daily average maximum temperatures for each month in 2000 and 2099. By end of century, projections show a 10° F increase in average maximum temperature, and a 15° F increase with currently known urban heat island (UHI) effects.

Projected Average Daily Precipitation

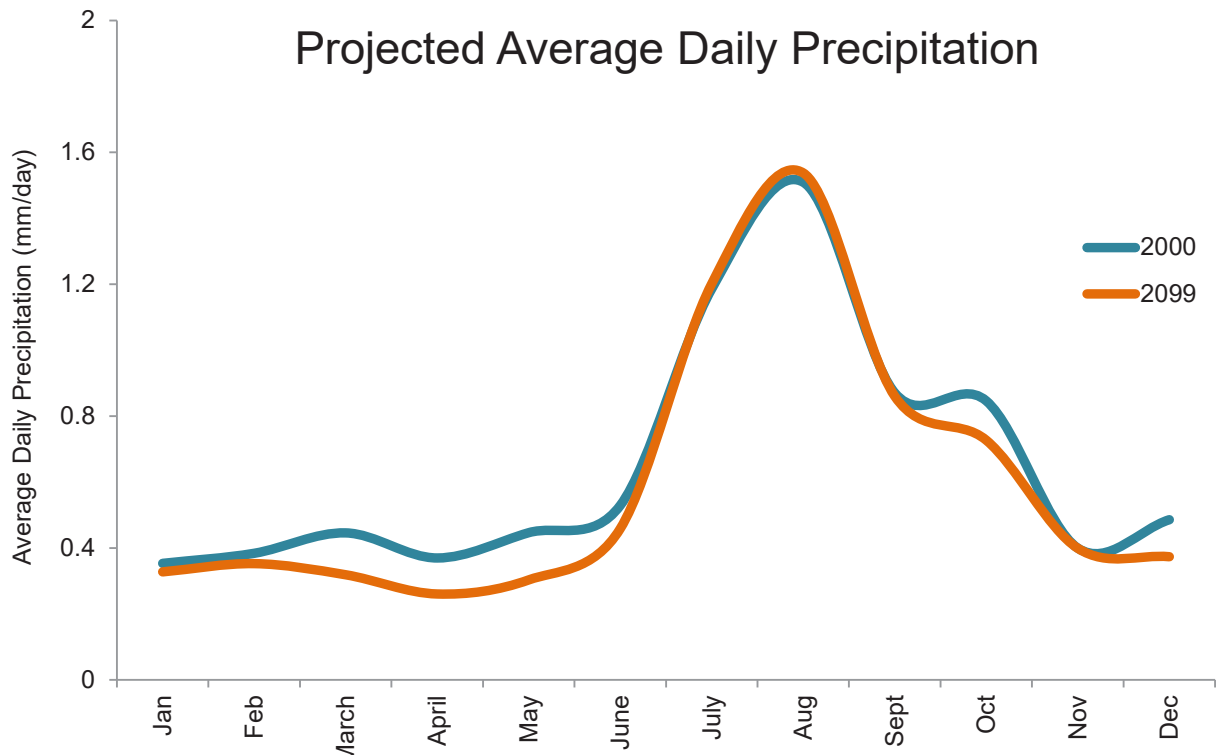


Figure 2. Projected average daily precipitation for each month. Changes in seasonality, with drops in the spring, early fall, and mid-winter are shown, with annual precipitation projected to decline 0.83 inches over the century.

Diagnosis and Intercomparison.⁵ Because Earth's climate system is so complex, there is no computer powerful enough to model climate on a local scale. Statistical analysis, however, can take large-scale data and accurately downscale climates to smaller areas. Bias-Correction Spatial Disaggregation (BCSD)-CMIP5-climate-monthly statistically downscaled model outputs from 39 global climate models were used to obtain the monthly temperature and precipitation data used in this analysis. Climate data used were those projected under the highest greenhouse gas emissions scenario that assumes no major climate action is taken in this century and business continues as usual (Representative Concentration Pathway (RCP) 8.5).⁵

TEMPERATURE & PRECIPITATION

Temperatures from the year 2000 were compared to projected temperatures in the year 2099. In Albuquerque, the UHI effect (a phenomenon that occurs when impervious surfaces such as asphalt, concrete, buildings and other infrastructure absorb solar radiation during the day and re-emit it as infrared radiation throughout the day and night) causes an average increase of 5°F during the day and 8°F overnight.⁶ Some areas of the city are more heavily impacted by the UHI due to green space inequality and near zero tree canopy. By end of century, temperature projections show a 10°F increase in average maximum monthly temperature and a 15°F increase with currently known UHI effects (Figure 1).⁶

Projected precipitation data have more uncertainty than temperature data in Global Climate Models (GCMs) because precipitation patterns are governed by small scale climate processes that require more computing power to analyze than is currently available.⁷ Despite this uncertainty, research has shown that even if precipitation stays the same, risk of Southwestern decadal long droughts is high in the coming century.⁸ CMIP5 data projected a drop of 0.83 inches in annual precipitation by end of century (Figure 2).

PLANT HARDINESS ZONES AND FROST-FREE DAYS

The United States Department of Agriculture (USDA) maintains a Plant Hardiness Zone Map based on the average annual extreme minimum temperature, divided into 5°F zones. Tree species are commonly categorized by plant hardiness zone for marketing and recommendation purposes.

This project analyzed the projected change in Albuquerque plant hardiness zones from a historical range (1986-2005) to 2099. Data were acquired from the State Climate Office of North Carolina Climate Voyager Tool, which uses Multivariate Adaptive Constructed Analogs statistical downscaling of 20 GCMs to project changes in climate and plant hardiness zones from 2020 to 2099.

Zone changes from the Albuquerque coordinates 35.1°N 106.64°W were utilized in the tool. Outputs are provided in 20-year increments (2020-2039, 2040-2059, 2060-2079, 2080-2099) and were compared to historical data. Projected temperatures under the RCP8.5 emissions scenario were utilized for the analyses to complement the temperature and precipitation models.

For both plant hardiness and freezing days, data from the highest likely outcome (97.5th percentile) was captured under the current, high emissions scenario. From 1986 to 2099, the plant hardiness zone is projected to change for the greater Albuquerque area from a zone average of 7a to 9a (Figure 3).

The average number of days per year in which the temperature dips below 32°F in Albuquerque is projected to drop from 121 days to 88 days by 2099 (Figure 4). The average number of days below 15°F is projected to drop from 6.3 days to 1.8 days by 2099.

HARDINESS ZONES

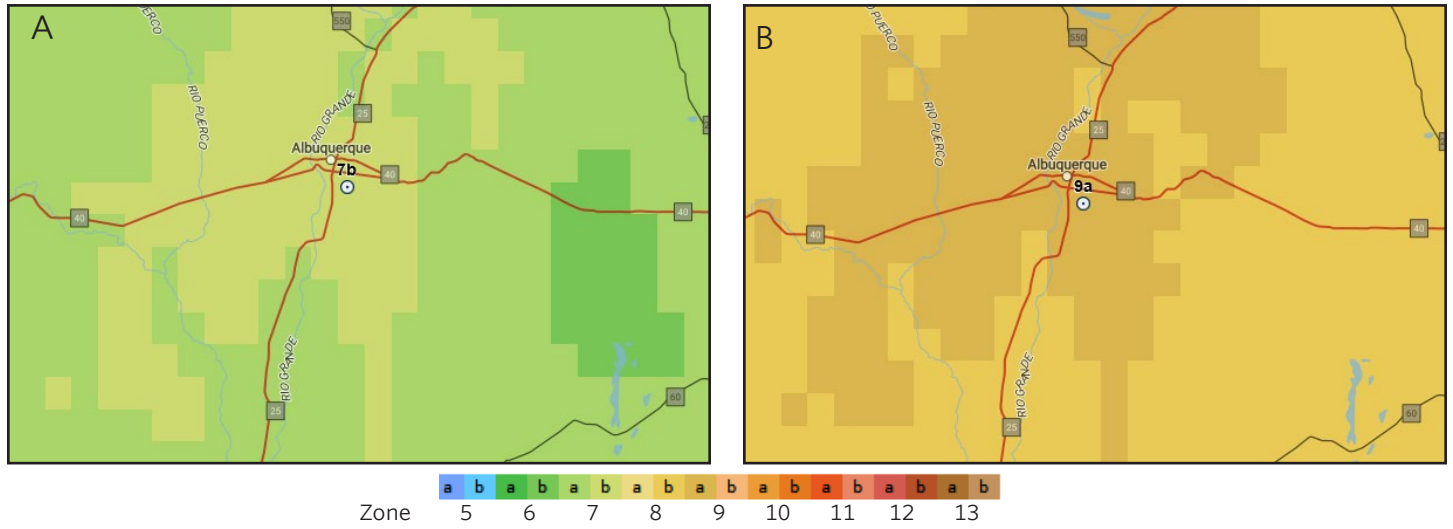


Figure 3. A) Historical USDA Plant Hardiness Zone for Albuquerque (7a). B) Projected USDA Plant Hardiness Zone for Albuquerque in 2099 (9a).

FROST-FREE DAYS

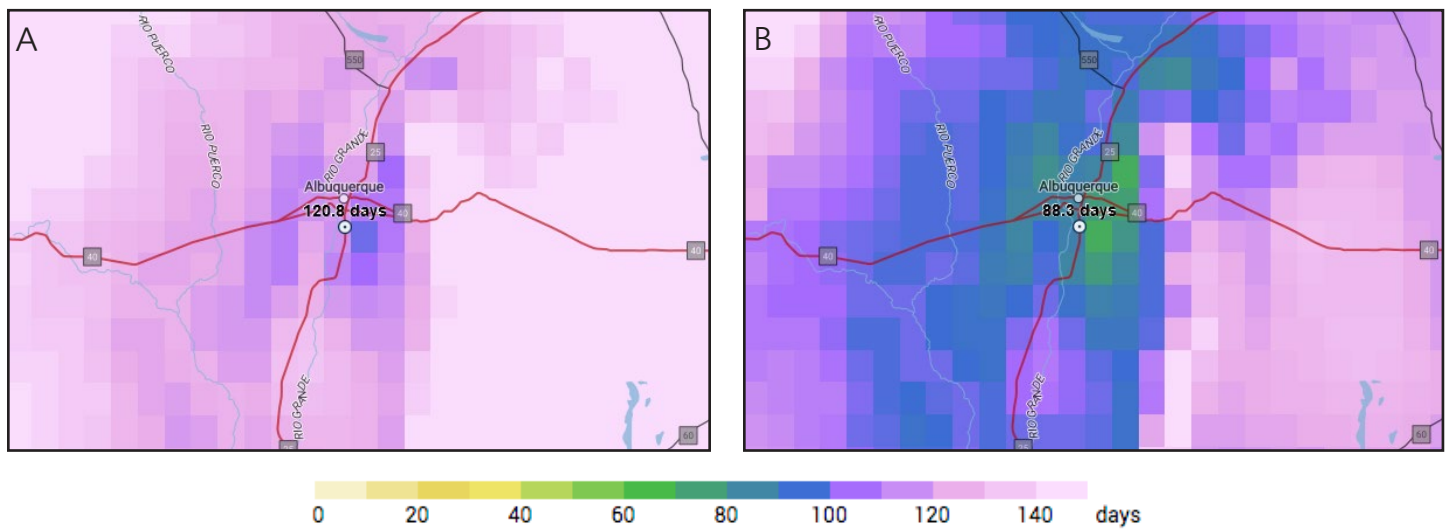


Figure 4. A) Historical average number of days with temperatures reaching below 32°F. B) Projected average number of days below 32°F in 2099.

IDENTIFYING PROMISING TREE SPECIES

The local and regional experts compiled a list of tree species anticipated to be well suited to the Albuquerque area, plus those that are commonly planted that were expected to do poorly. This was used as a check on the scoring process and criteria. When compiling the list of tree species for evaluation, the team extensively discussed whether tree species should be limited to native species (and native to where) or to also include ornamental species and species that originate from other continents. The team concluded that it would be best to evaluate tree species currently growing within the broadest definition of the Southwest, extending from Southern California through the four corners area to western Texas and northern Mexico. If species originated from other continents, they were evaluated for non-invasive reproductive properties or were labeled as potentially invasive.

A total of 136 tree species were included in the master list for evaluation. This list is found in Appendix A.

DEVELOPING TREE SPECIES SCORING CRITERIA

Tree species evaluation criteria were refined through a series of meetings where the team of experts debated the merits and practicality of multiple tree species characteristics. For consistent analysis, it was important to have criterion data available for all tree species evaluated. This reduced the available criteria, as some of the characteristics considered had limited data across tree species.

The final tree species scoring criteria were extreme heat and cold tolerance, soil texture tolerance, and drought tolerance:

- Temperature tolerance is determined by a plants' physiological response to periods of extreme heat or cold. Extreme temperature tolerance analysis was split into two criteria: before and after the year 2060. From 2020-2059, Albuquerque is projected to shift from current USDA plant hardiness zone 7a to zone 8b. Between 2060-2099, Albuquerque is

projected to further shift to zone 9a. Short-lived, fast-growing tree species that are less heat adapted to end of the century climatic conditions can still be planted to help bolster the tree canopy and become established to survive mid-century temperature extremes better. Likewise, a species' need to tolerate cold will shift over century; some species analyzed should not be planted until closer to 2060 due to marginal cold tolerance. The ideal tree species has heat and cold tolerance both now and at end of century.

- Soil texture is the relative fineness or coarseness of the inorganic, mineral soil properties and determines nutrient availability, drainage and water storing ability, and oxygen availability. Albuquerque has a range of sandy to clay soils and some silt soils, with loam being a mixture of all three. The ideal tree species can tolerate all soil textures.
- Drought tolerance is determined by a plant's physiological response to periods with minimal water availability. Ability to survive under local conditions indicates drought tolerance and is different from a species' general water needs. (For example, a tree species tolerant to Missouri drought conditions may not be tolerant to New Mexico drought conditions.) The ideal tree species is highly tolerant of Albuquerque historic drought conditions.

Tree species received a numerical score for each of these criteria. The criteria descriptions and scoring method are shown in Table 1. The data sources for each of the criteria are noted in the master list in Appendix A.

Evaluation Criteria			Value	Score
Extreme Temperature Tolerance: (2020-2059)	Heat Tolerance	≥ Zone 8 or up to 105°F	+1	a
		≤ Zone 7 or less than 105°F	-1	
	Cold Tolerance	≤ Zone 7	+1	b
≥ Zone 8		-1		
Extreme Temperature Tolerance: (2060-2099)	Heat Tolerance	≥ Zone 9 or up to 120°F	+1	c
		≤ Zone 8 or less than 120°F	-1	
	Cold Tolerance	If Zone 8 is included	+1	d
≥ Zone 9		-1		
Soil Texture Tolerance: sand, clay, loam, silt	Three or more types listed		+1	e
	Two types listed		0	
	One type listed		-1	
Drought Tolerance	Yes or high tolerance		+1	f
	Medium or relative		0	
	No to low tolerance		-1	
Total Score			Sum	a+b+c+d+e+f

Table 1. Descriptions and scoring rubric for each criterion used to evaluate the master list of species identified by the expert panel.

SELECTING CLIMATE-READY TREE SPECIES

Following the first round of criteria scoring, the team reviewed the results and made adjustments to scoring based on local knowledge of tree species. Any changes are noted in the master list (Appendix A).

The list was then split into tree species able to thrive in both the current and future projected climate (climate-ready), tree species not climate-ready, and fruit tree species. The maximum score for climate readiness a species could receive was a 6; species with scores at or above 4 were considered climate-ready, if those species satisfied the heat and cold tolerance criterion. Trees that received a score of less than 4 were not recommended. However, because this score is a combination of criterion,

some of these challenges may be overcome with the right siting and care. The full master list with all the scoring is included in Appendix A to allow readers to make informed decisions about tree selection and site characteristics. Fruit trees are presented separately because of their overwhelming interest from residents and the specific care needs that is often different than a shade tree.

This tree species list will continue to evolve as more is learned about each species in Albuquerque's unique high desert ecosystem and what characteristics drive success in an urban setting.

RECOMMENDING SPECIES BY PLANTING LOCATION TYPE

Even tree species identified as climate-ready will suffer in a location that cannot meet its complex physiological and spatial needs. Worse, well-performing trees are often removed because they have undesirable characteristics for the location (e.g., leaf litter that becomes a slip hazard). Appendix A provides additional tree species characteristics not included as scoring criteria that can help further select the “right tree for the right place.” These characteristics and their importance are summarized in Table 2.

To help refine the tree species selection recommendations for the climate-ready tree

species, six common tree planting location types were identified for Albuquerque. The team defined the characteristics of each planting location type and the characteristics the trees need to perform well in that site. Detailed descriptions of these planting location types can be found in Appendix B.

The “Tree Owner’s Manual,” a free resource provided online by the United States Department of Agriculture Forest Service, supplies a simple checklist to help think through tree species selection considerations.

Additional Tree Species Characteristics Evaluated	
Flooding Tolerance	Necessary to determine if the tree can survive short-term water inundation at collection points.
Well-Drained Soil Requirement	Should be considered in conjunction with soil texture tolerance.
Allergens/Toxic Parts	Should be considered in both selection of tree as well as site location of tree.
Urban Compaction Tolerance	Should be considered if tree will be planted in a parking strip or median.
Pest/Disease Susceptibility	Avoid trees with many current pests/diseases as climate change will likely increase these threats.
Management Requirements	Understanding fruit and litter production or pruning needs will determine site location.
Alkaline Soil Tolerance	Important for a tree to persist in Albuquerque. Select only trees with tolerance.
Branch Attachment Strength	Important so as to avoid hazards to objects and people, particularly for municipal use.
Edible Parts	Important to consider for litter potential and for human or wildlife value.
Attractiveness	Important for landscaping decisions and public appeal such as flowering and fragrance.
Supports Wildlife	Important for ensuring urban diversity and health of beneficial insects and animals.

Table 2. Bonus columns of tree species characteristics available in Appendix A that can be used for further selection of the right tree in the right place. These details can assist with narrowing down tree selection through specific desired traits in addition to general site characteristics. Note that not all of this information is available for all of the species evaluated.

CHAPTER 3 - CLIMATE-READY TREES FOR ALBUQUERQUE

How to Use These Lists

The following tree species selection lists should only be used as a starting point when determining the right tree for the right place. They should always be used in conjunction with the Master List found in Appendix A of this report, planting site characteristics, local expert knowledge, and applicable local or municipal tree ordinances.

Finally, it is important that trees be planted correctly and all trees need additional irrigation during an establishment period, usually the first three years after planting. Please consult local resources for proper planting techniques and specific watering guidance.



Photo Credit: Roberto Rosales

LOCATION TYPE 1 - SMALL GREEN STORMWATER INFRASTRUCTURE (GSI) FEATURES

LOCATION TYPE 2 - LARGE GREEN STORMWATER INFRASTRUCTURE (GSI) FEATURES

LOCATION TYPE 3 - XERISCAPED PUBLIC RECREATION, RESIDENTIAL, OR COMMERCIAL PLACES

LOCATION TYPE 4 - PUBLIC RECREATION, RESIDENTIAL, OR COMMERCIAL PLACES

LOCATION TYPE 5 - STREETSCAPES WITH AVERAGE GROWING AREA

LOCATION TYPE 6 - RESTRICTED GROWING AREA

LOCATION TYPE 7 - CLIMATE-READY FRUIT TREES

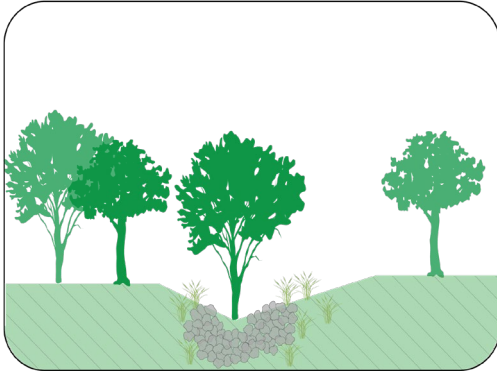


Photo Credit: Roberto Rosales

Climate-Ready Trees for Albuquerque

LOCATION TYPE 1

SMALL GREEN STORMWATER INFRASTRUCTURE (GSI) FEATURES



LOCATION CHARACTERISTICS

Follows “Right Tree in the Right Place”

Low Points Collect Stormwater Runoff

Soil Decompacted to a Depth ≥ 18 ”

May Have Tree Trenches, Curb Cuts, or Scuppers

Similar Restrictions to Location Type 5

Examples: Anthea Building, Southern Sandoval County Arroyo Flood Control Authority Main Office, and South 2nd St.

TREE CHARACTERISTICS

Mature Tree Height: Site Specific

Inundation Compatible up to 96 Hours.

Pollution Tolerant



Photo Credit: MRWM Landscape Architects

RECOMMENDED TREES SPECIES

<i>Celtis reticulata</i>	Netleaf Hackberry
<i>Cercis canadensis</i> var. <i>mexicana</i> *	Mexican Redbud*
<i>Cercis occidentalis</i> *	Western Redbud*
<i>Cercis reniformis</i> *	Oklahoma Redbud*
<i>Cercis canadensis</i> var. <i>texensis</i> *	Texas Redbud*
<i>Crataegus ambigua</i> *	Russian Hawthorn*
<i>Forestiera neomexicana</i>	New Mexico Privet
<i>Fraxinus cuspidata</i> *	Fragrant Ash*
<i>Lagerstroemia indica</i> *	Crape Myrtle*
<i>Pistacia chinensis</i>	Chinese Pistache
<i>Prosopis glandulosa</i> *	Honey Mesquite*
<i>Prosopis pubescens</i> *	Screwbean Mesquite*
<i>Salix gooddingii</i>	Goodding’s Willow
<i>Sapindus saponaria</i> var. <i>drummondii</i> *	Western Soapberry*

* These species have further site specific needs outlined in Appendix A - Master List

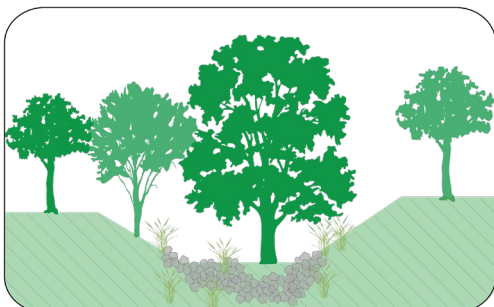
Right Tree, Right Place

Keeping mature size and other species characteristics in mind, consider overhead and underground utilities, proximity to buildings and traffic, the users of the space and maintenance and upkeep.

Climate-Ready Trees for Albuquerque

LOCATION TYPE 2

LARGE GREEN STORMWATER INFRASTRUCTURE (GSI) FEATURES



LOCATION CHARACTERISTICS

Follows "Right Tree in the Right Place"

Low Points Collect Stormwater Runoff

Soil Decompacted to a Depth $\geq 18"$

May Have Basins, Swales, or Infiltration Trenches

Examples: Southern Sandoval County Arroyo Flood Control Authority Main Office landscaping, Pete Domenici Courthouse, and Smith Brasher Hall

TREE CHARACTERISTICS

Mature Tree Height: Site Specific

Inundation Compatible ≤ 96 Hours

Pollution Tolerant



Photo Credit: MRWM Landscape Architects

RECOMMENDED TREES

Celtis reticulata
Cercis canadensis var. *mexicana**
*Cercis occidentalis**
*Cercis reniformis**
Cercis canadensis var. *texensis**
*Crataegus ambigua**
Forestiera neomexicana
Fraxinus cuspidata
*Gymnocladus dioica**
Platanus mexicana
*Lagerstroemia indica**
*Maclura pomifera**
Pistacia chinensis
Populus deltoides
Populus deltoides var. *wislizeni*
*Prosopis glandulosa**
Prosopis pubescens
Quercus arizonica
*Quercus ilex**
Quercus muehlenbergii
*Quercus suber**
*Quercus virginiana**
Salix gooddingii
Sapindus saponaria var. *drummondii**
Ulmus x 'Morton' *Accolade*TM
Ulmus x 'Frontier'
*Ulmus parvifolia**
*Taxodium mucronatum**
Zelkova serrata

Netleaf Hackberry
Mexican Redbud*
Western Redbud*
Oklahoma Redbud*
Texas Redbud*
Russian Hawthorn*
New Mexico Privet
Fragrant Ash
Kentucky Coffeetree*
Mexican Sycamore
Crape Myrtle*
Osage Orange*
Chinese Pistache
Eastern Cottonwood
Rio Grande Cottonwood
Honey Mesquite*
Screwbean Mesquite
Arizona White Oak
Holly Oak*
Chinkapin Oak
Cork Oak*
Southern Live Oak*
Goodding's Willow
Western Soapberry*
Accolade Elm
Frontier Elm
Lacebark Elm*
Montezuma Cypress*
Japanese Zelkova

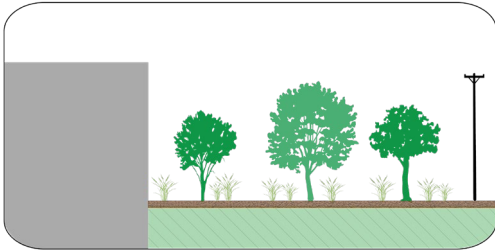
* These species have further site specific needs outlined in Appendix A - Master List

Right Tree, Right Place

Keeping mature size and other species characteristics in mind, consider overhead and underground utilities, proximity to buildings and traffic, the users of the space and maintenance and upkeep.

Climate-Ready Trees for Albuquerque

LOCATION TYPE 3 XERISCAPED AREAS



LOCATION CHARACTERISTICS

- Follows "Right Tree in the Right Place"
- Consider Existing Utilities
- Building Setback: Varies
- Consider Users
- Xeriscaped or Low-Medium Irrigation
- Examples: Plants of the Southwest, Explora, High Desert Neighborhood

TREE CHARACTERISTICS

- Mature Tree Height: Site Specific
- Water Needs: Low to Very Low
- Ornamental and Large Trees
- Wildlife or Pollinator Benefit Desired



Photo Credit: ABCWUA

RECOMMENDED TREES

Arbutus xalapensis
Celtis reticulata
Cercis canadensis var. *mexicana*
Cercis reniformis
Cercis canadensis var. *texensis*
Cercis occidentalis
Cedrus atlantica
Chilopsis linearis
Cotinus obovatus
Forestiera neomexicana
Gymnocladus dioica
*Fraxinus cuspidata**
*Juniperus deppeana**
*Juniperus monosperma**
*Juniperus virginiana**
Lagerstroemia indica
*Leucaena retusa**
Maclura pomifera
*Parkinsonia x Cercidium**
Pinus eldarica
*Pinus pinea**
*Pistacia chinensis**
*Prosopis glandulosa**
*Prosopis velutina**
Quercus arizonica
Quercus fusiformis
Quercus gravesii
Quercus ilex
Quercus muehlenbergii
Quercus oblongifolia
*Quercus suber**
Sapindus saponaria var. *drummondii**
*Sophora secundiflora**
Rhus lanceolata
Ulmus x 'Morton' Accolade™
Ulmus x 'Frontier'
*Ulmus parvifolia**
Vitex agnus-castus

Texas Madrone
 Netleaf Hackberry
 Mexican Redbud
 Oklahoma Redbud
 Texas Redbud
 Western Redbud
 Atlas Cedar
 Desert Willow
 American Smoketree
 New Mexico Privet
 Kentucky Coffeetree
 Fragrant Ash*
 Alligator Juniper*
 One Seed Juniper*
 Eastern Red Cedar*
 Crape Myrtle
 Goldenball Leadtree*
 Osage Orange
 Palo Verde Hybrids*
 Afghan Pine*
 Italian Stone Pine
 Chinese Pistache*
 Honey Mesquite*
 Velvet Mesquite*
 Arizona White Oak
 Escarpment Live Oak
 Chisos Red Oak
 Holly Oak
 Chinquapin Oak
 Blue Oak
 Cork Oak*
 Western Soapberry*
 Texas Mountain Laurel*
 Prairie Flameleaf Sumac
 Accolade Elm
 Frontier Elm
 Lacebark Elm*
 Chaste Tree

* These species have further site specific needs outlined in Appendix A - Master List

Right Tree, Right Place

Keeping mature size and other species characteristics in mind, consider overhead and underground utilities, proximity to buildings and traffic, the users of the space and maintenance and upkeep.

Climate-Ready Trees for Albuquerque

LOCATION TYPE 4 HIGHLY IRRIGATED AREAS



LOCATION CHARACTERISTICS

Follows “Right Tree in the Right Place”

Consider Existing Utilities

Consider Users

Building Setback: >10’

Examples: UNM Golf Course, Mountain View Community Center, Ridgecrest Neighborhood, and Tiguex Park

TREE CHARACTERISTICS

Mature Tree Height: Site Specific

Water Needs: High Irrigation Tolerant

Ornamental and Large Trees

Wildlife or Pollinator Benefit Desired



Photo Credit: ABCWUA

RECOMMENDED TREES

Celtis reticulata
Cercis canadensis var. *mexicana*
Cercis reniformis
Cercis canadensis var. *texensis*
Cercis occidentalis
Cedrus atlantica
Cedrus deodara
*Forestiera neomexicana**
Gymnocladus dioica
*Fraxinus cuspidata**
*Juniperus deppeana**
*Juniperus virginiana**
Lagerstroemia indica
*Maclura pomifera**
Pinus eldarica
Pinus pinea
Pistacia chinensis
Platanus mexicana
Populus deltoides
Populus deltoides var. *wislizeni*
*Prosopis pubescens**
Prunus mexicana
Quercus arizonica
Quercus fusiformis
Quercus gravesii
Quercus ilex
Quercus muehlenbergii
*Quercus suber**
Quercus buckleyi
Quercus virginiana
Sapindus saponaria var. *drummondii**
Sophora secundiflora
Rhus lanceolata
*Taxodium mucronatum**
Ulmus x ‘Morton’ *Accolade*™
Ulmus x ‘Frontier’
Ulmus parvifolia
Vitex agnus-castus
Zelkova serrata

Netleaf Hackberry
 Mexican Redbud
 Oklahoma Redbud
 Texas Redbud
 Western Redbud
 Atlas Cedar
 Deodar Cedar
 New Mexico Privet*
 Kentucky Coffeetree
 Fragrant Ash*
 Alligator Juniper*
 Eastern Red Cedar*
 Crape Myrtle
 Osage Orange*
 Afghan Pine
 Italian Stone Pine
 Chinese Pistache
 Mexican Sycamore
 Eastern Cottonwood
 Rio Grande Cottonwood
 Screwbean Mesquite*
 Mexican Plum
 Arizona White Oak
 Escarpment Live Oak
 Chisos Red Oak
 Holly Oak
 Chinkapin Oak
 Cork Oak*
 Texas Red Oak
 Southern Live Oak
 Western Soapberry*
 Texas Mountain Laurel
 Prairie Flameleaf Sumac
 Montezuma Cypress*
 Accolade Elm
 Frontier Elm
 Lacebark Elm
 Chaste Tree
 Japanese Zelkova

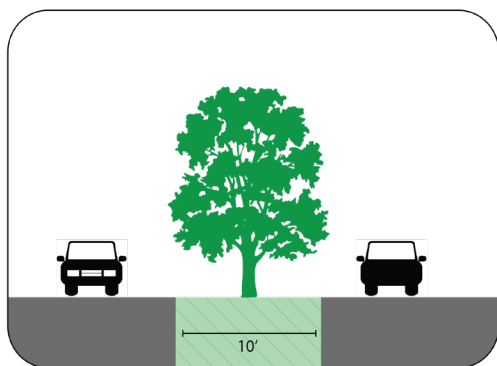
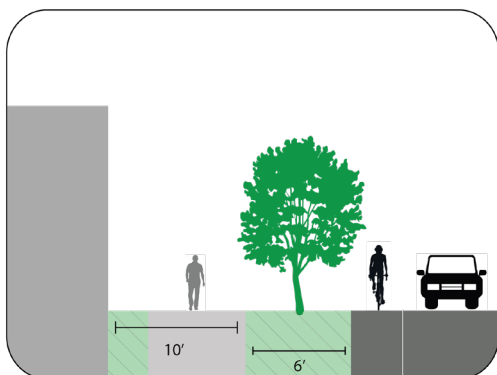
* These species have further site specific needs outlined in Appendix A - Master List

Right Tree, Right Place

Keeping mature size and other species characteristics in mind, consider overhead and underground utilities, proximity to buildings and traffic, the users of the space and maintenance and upkeep.

Climate-Ready Trees for Albuquerque

LOCATION TYPE 5 STREETSCAPES



LOCATION CHARACTERISTICS

- Follows "Right Tree in the Right Place"
- Soil Volume: Sufficient
- No Utility Conflicts
- Building Setback: >10'
- Consider Sidewalks, On-Street Parking, Bike Paths
- Median or Parkway Width: ≥ 6'
- Examples: Menaul Blvd, Big I Medians, 12th and 4th St., Ridgcrest Neighborhood

TREE CHARACTERISTICS

- Mature Tree Height: Any
- Low Litter Potential
- Compacted Soil and Pollution Tolerant
- Will Require Structural Pruning

RECOMMENDED TREES

- | | |
|--|-------------------------|
| <i>Arbutus xalapensis</i> | Texas Madrone |
| <i>Celtis reticulata</i> | Netleaf Hackberry |
| <i>Cercis canadensis</i> var. <i>mexicana</i> | Mexican Redbud |
| <i>Cercis reniformis</i> | Oklahoma Redbud |
| <i>Cercis canadensis</i> var. <i>texensis</i> | Texas Redbud |
| <i>Cercis occidentalis</i> | Western Redbud |
| <i>Cedrus deodara</i> | Deodar Cedar |
| <i>Chilopsis linearis</i> | Desert Willow |
| <i>Cotinus obovatus</i> | American Smoketree |
| <i>Crataegus ambigua</i> | Russian Hawthorn |
| <i>Forestiera neomexicana</i> | New Mexico Privet |
| <i>Gymnocladus dioica</i> | Kentucky Coffeetree |
| <i>Fraxinus cuspidata</i> * | Fragrant Ash* |
| <i>Lagerstroemia indica</i> | Crape Myrtle |
| <i>Leucaena retusa</i> * | Golden-ball Lead-tree* |
| <i>Maclura pomifera</i> | Osage Orange |
| <i>Parkinsonia</i> x 'Desert Museum' * | Palo Verde hybrids* |
| <i>Pistacia chinensis</i> * | Chinese Pistache* |
| <i>Prosopis glandulosa</i> * | Honey Mesquite* |
| <i>Quercus arizonica</i> | Arizona White Oak |
| <i>Quercus fusiformis</i> | Escarpment Live Oak |
| <i>Quercus gravesii</i> | Chisos Red Oak |
| <i>Quercus ilex</i> | Holly Oak |
| <i>Quercus muehlenbergii</i> | Chinkapin Oak |
| <i>Quercus oblongifolia</i> | Blue Oak |
| <i>Quercus suber</i> * | Cork Oak* |
| <i>Quercus buckleyi</i> | Texas Red Oak |
| <i>Sapindus saponaria</i> var. <i>drummondii</i> * | Western Soapberry* |
| <i>Sophora secundiflora</i> * | Texas Mountain Laurel* |
| <i>Rhus lanceolata</i> | Prairie Flameleaf Sumac |
| <i>Ulmus</i> x 'Morton' <i>Accolade</i> ™ | Accolade Elm |
| <i>Ulmus</i> x 'Frontier' | Frontier Elm |
| <i>Ulmus parvifolia</i> * | Lacebark Elm* |
| <i>Vitex agnus-castus</i> | Chaste Tree |
| <i>Zelkova serrata</i> | Japanese Zelkova |

* These species have further site specific needs outlined in Appendix A - Master List

Right Tree, Right Place

Keeping mature size and other species characteristics in mind, consider overhead and underground utilities, proximity to buildings and traffic, the users of the space and maintenance and upkeep.

Climate-Ready Trees for Albuquerque

LOCATION TYPE 6 RESTRICTED GROWING AREA

LOCATION CHARACTERISTICS

Follows "Right Tree in the Right Place"

Soil Volume: Limited

Consider Existing Utilities

Building Setback: <10'

Sidewalks, on-street parking, bike paths

Median or Parkway Width: 4-6'

Examples: Downtown Central Avenue and Silver Street

TREE CHARACTERISTICS

Mature Tree Height: <25'

Low Root Damage Potential

Low Litter Potential

Compacted Soil and Pollution Tolerant

Will Require Structural Pruning



Photo Credit: MRWM Landscape Architects

SUGGESTED TREES

Celtis reticulata
Cercis canadensis var. *mexicana*
Cercis occidentalis
Cercis reniformis
Cercis canadensis var. *texensis*
Fraxinus cuspidata
Lagerstroemia indica
Prosopis glandulosa
Quercus oblongifolia

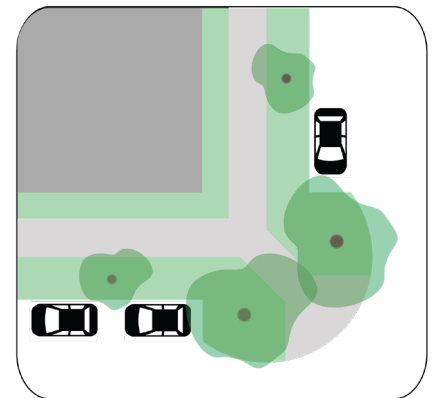
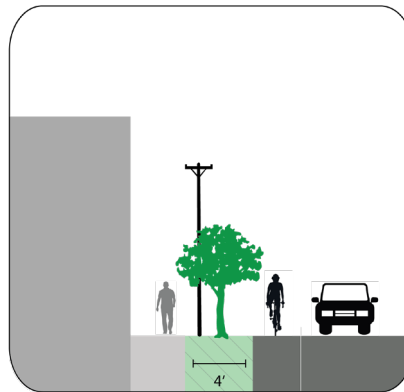
Netleaf Hackberry
Mexican Redbud
Western Redbud
Oklahoma Redbud
Texas Redbud
Fragrant Ash
Crape Myrtle
Honey Mesquite
Blue Oak

RECOMMENDATIONS

The practice of planting trees in medians or parkways should be limited to Location Type 5 for sufficient soil volume to support the full size of a mature tree.

Medians or parkways 4-6' wide can only provide sufficient soil volume to support health trees if there are continuous, uncompacted strips of soil like soil vaults or suspended pavement.

If the width is $\leq 4'$, only plants that are $< 3'$ wide at maturity should be planted.



Right Tree, Right Place

Keeping mature size and other species characteristics in mind, consider overhead and underground utilities, proximity to buildings and traffic, the users of the space and maintenance and upkeep.

Climate-Ready Trees for Albuquerque

LOCATION TYPE 7 FRUIT TREES



LOCATION CHARACTERISTICS

Follows "Right Tree in the Right Place"

Soil Volume: Sufficient

No Utility Conflicts

TREE CHARACTERISTICS

Mature Tree Height: Any

High Litter Potential

Fruit Producing

Requires Irrigation to Ensure Fruit Production



Photo Credit: Dr. Marisa Thompson

RECOMMENDED TREES

Diospyros texana
Ficus carica 'Mission'
*Morus microphylla**
Pistacia vera
Punica granatum
Ziziphus jujuba
Cydonia oblonga
Diospyros kaki
Juglans microcarpa
Carya illinoensis
Prunus armeniaca
*Eriobotrya japonica**

Texas Persimmon
Black Mission Fig
Little Leaf Mulberry*
Pistachio
Pomegranate
Jujube
Quince
Japanese Persimmon
Little Walnut
Pecan
Apricot
Loquat*

* These species have further site specific needs outlined in Appendix A - Master List



Photo Credit: Dr. Marisa Thompson

Right Tree, Right Place

Keeping mature size and other species characteristics in mind, consider overhead and underground utilities, proximity to buildings and traffic, the users of the space and maintenance and upkeep.

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Appendix A

This appendix provides a detailed look at how each tree species evaluated was scored, additional information about each species, and experts' local knowledge on the species.

Climate-Ready Trees for Albuquerque - Appendix A Master List

Common Name	Tree Species	Native Range	USDA Hardiness Zones	Extreme Temp (2020-2059)		Extreme Temp (2060-2099)		TOTAL HEAT SCORE	Soil type	Drought*	TOTAL SCORE	2019 Meeting Notes (Expert Comments)
				a.) Heat	b.) Cold	a.) Heat	b.) Cold					
Afghan Pine	<i>Pinus eldarica</i>	Pakistan/Russia	6,7,8,9	1	1	1	1	4	1	1	6	Winning conifer
Arizona White Oak	<i>Quercus arizonica</i>	Desert Southwest (wildflower.org)	3-9 (Utah State)	1	1	1	1	4	1	1	6	No experience with this species. Looks good on scoring.
Atlas Cedar	<i>Cedrus atlantica</i>	Atlas Mountains of Algeria and Morocco (UFEI)	6-9 (UFEI)	1	1	1	1	4	1	1	6	Never seen invasive nature
Black Mission Fig	<i>Ficus carica</i>	Western Asia and Eastern Mediterranean (UFEI)	6-9 (UFEI)	1	1	1	1	4	1	1	6	Changed to much more drought tolerant. Cold tolerance may be lower than indicated by the hardiness zone.
Cedar Elm	<i>Ulmus crassifolia</i>	north america (USDA)	6-9 (USDA)	1	1	1	1	4	1	1	6	Does very well in Amarillo and Las Cruces but haven't worked here. Not much experience
Chaste Tree	<i>Vitex agnus castus</i>	not native to NA (USDA)	7b-11 (USDA)	1	1	1	1	4	1	1	6	Agree with scoring.
Chinese Pistache	<i>Pistacia chinensis</i>	Central and West China	6b,7,8,9 (USDA)	1	1	1	1	4	1	1	6	In danger of been overplanted. Maybe invasive?
Chinquapin Oak	<i>Quercus muhlenbergii</i>	north america (USDA)	3-9A (USDA)	1	1	1	1	4	1	1	6	Agree with scoring. In Tuscan and Las Cruces
Crape Myrtle	<i>Lagerstroemia indica</i>	not native to north america (USDA)	7-9a (USDA)	1	1	1	1	4	1	1	6	A lot of water to get established, drought tolerant once established. Does well in Las Cruces. Not invasive. Variety dependent issues?
Deodar Cedar	<i>Cedrus deodar</i>	E Afghanistan, N Pakistan, North Central India (UFEI)	7-9 (UFEI)	1	1	1	1	4	1	1	6	Joran loves this tree. Not invasive.
Desert Willow	<i>Chilopsis Linearis</i>	n Mex, s CA-TX	7b,8,9,10,11	1	1	1	1	4	1	1	6	Good.
Eastern Redbud	<i>Cercis canadensis</i>	north america (USDA)	4b-9a (USDA)	1	1	1	1	4	1	1	6	Not good for windy places. Would not plant in place of TX or OK redbud. Protected understory trees. Desert factor not good.
Eastern Redcedar	<i>Juniperus virginiana</i>	north america (USDA)	2-9 (USDA)	1	1	1	1	4	1	1	6	Issues with western cedar bore. Drought tolerance suspect due to all in parks with heavy watering.
Escarpment Live Oak	<i>Quercus fusiformis</i>	Texas, Oklahoma	7,8,9,10	1	1	1	1	4	1	1	6	Agree with scoring. Do not plant in winter.
Gingko	<i>Gingko biloba</i>	not native to north america (USDA)	3-8a (USDA)	1	1	1	1	4	1	1	6	Look into tree, may be more heat tolerant. Not invasive.
Golden-ball Leadtree	<i>Leucaena retusa</i>	TX, Northern Mexico (UFEI)	7-9 (UFEI)	1	1	1	1	4	1	1	6	Going into the future, very good tree. Cold hardy now.
Golden Rain Tree	<i>Koelreuteria paniculata</i>	Asia (UFEI)	6-9 (UFEI)	1	1	1	1	4	1	1	6	Can be invasive (reseeds in yards in mulch). Agree on the drought and heat tolerance though. Attracts bugs, does nothing to the tree.
Honey Mesquite	<i>Prosopis glandulosa</i>	SW US to N Mexico	6b,7,8,9	1	1	1	1	4	1	1	6	Agree with scoring. Questioning whether it is a tree? Does well in Cruces
Italian Stone Pine	<i>Pinus pinea</i>	not native to NA (USDA)	7-11 (USDA)	1	1	1	1	4	1	1	6	Love it! Not invasive!
Jujube	<i>Zizyphus jujuba</i>	not native to NA (USDA)	6-9 (USDA)	1	1	1	1	4	1	1	6	Concerned about invasiveness...it suckers so it needs to be put in the right spot. Thicket forming? Cultivar forming? Otherwise agree with scoring.
Lacebark/Chinese Elm	<i>Ulmus parvifolia</i>	not native to NA (USDA)	5b-10A (USDA)	1	1	1	1	4	1	1	6	Still concerned about invasiveness maybe...not invasive in LA & Tuscan. Maybe not quite a 1 on the drought tolerance.
Little Leaf Mulberry	<i>Morus microphylaa</i>	OK, NM, AZ south through MX (wildflower.org)	5 (TAMU)	1	1	1	1	4	1	1	6	Is the zone wrong? Think so it does well
Mexican Elder	<i>Sambucus mexicana</i>	north america (USDA)	7b-10 (USDA)	1	1	1	1	4	1	1	6	Agree with scoring.
Mexican Redbud	<i>Cercis mexicana</i>	west of the Pecos River in TX into Nuevo Leon in MX (wildflower.org)	6b-8 (USDA)	1	1	1	1	4	1	1	6	Mexican OK and TX redbud are all very similar. Good trees, not sure about specific species differences. Good street trees?
Mexican Sycamore	<i>Platanus mexicana</i>	Eastern US (UFEI)	4-9 (UFEI)	1	1	1	1	4	1	1	6	No experience with this. Seems like a good one?
New Mexico Olive	<i>Forestiera Neomexicana</i>	NM, CO, AZ, CA	5,6,7,8,9	1	1	1	1	4	1	1	6	Yes!!
Oklahoma Redbud	<i>Cercis reniformis</i>	SW US and Eastern US	6b,7,8,9a	1	1	1	1	4	1	1	6	
One-seed Juniper	<i>Juniperus monosperma</i>	west TX to SE CO & AZ (wildflower.org)	6 (TAMU)	1	1	1	1	4	1	1	6	Pollen ordinance. USDA hardiness wrong?

Climate-Ready Trees for Albuquerque - Appendix A Master List

Common Name	Tree Species	Native Range	USDA Hardiness Zones	Extreme Temp (2020-2059)		Extreme Temp (2060-2099)		TOTAL HEAT SCORE	Soil type	Drought*	TOTAL SCORE	2019 Meeting Notes (Expert Comments)
				a.) Heat	b.) Cold	a.) Heat	b.) Cold					
Osage Orange	<i>Maclura pomifera</i>	north america (USDA)	5-9a (USDA)	1	1	1	1	4	1	1	6	Does alright in Bosque and Robinson park. Tree is liked. Does well in Las Cruces
Palo Verde hybrids	<i>Parkinsonia x Cercidium</i>	hybrid of trees found in the sonoran and chihuahuan deserts (UFEI)	6-9 (UFEI)	1	1	1	1	4	1	1	6	<i>Parkinsonia species</i> . Cold tolerant 2040 and on.
Persian Silk Tree/ Mimosa	<i>Albizia julibrissin</i>	not native to north america (USDA)	6b-9b (USDA)	1	1	1	1	4	1	1	6	Does well in parks and courtyards (very messy tree). No known data that it is non-invasive (self seeds in Las Cruces?)
Pistachio	<i>Pistacia vera</i>	not native to north america (UFEI)	7-11 (UFEI)	1	1	1	1	4	1	1	6	Fruiting in Socorro. Protection from cold is necessary. Good one for the city. Drought tolerance may be scored on fruit production.
Pomegranate	<i>Punica granatum</i>	Iran and the Himalayas (UFEI)	8-10 (UFEI)	1	1	1	1	4	1	1	6	Cold tolerant if in protected spots. Not going to be issue in future. Non-invasive
Siberian Elm	<i>Ulmus pumila</i>		5,6,7,8,9	1	1	1	1	4	1	1	6	INVASIVE. NOT RECOMMENDED.
Southern Live Oak	<i>Quercus virginiana</i>	north america (USDA)	7b-10b (USDA)	1	1	1	1	4	1	1	6	Drought tolerance potentially not correct? Needs research. Have been seen in Marfa, TX doing well
Texas Persimmon	<i>Diospyros texana</i>	north america (USDA)	7-9 (USDA)	1	1	1	1	4	1	1	6	Seems good.
Texas Red Oak	<i>Quercus texana</i>	N central and central TX	5b,6,7,8,9a	1	1	1	1	4	1	1	6	More drought tolerant
Texas Redbud	<i>Cercis texicana</i>	southwestern US (USDA)	5-9a (USDA)	1	1	1	1	4	1	1	6	
Tx. Mt. Laurel	<i>Sophora secundiflora</i>	north america (USDA)	7b-10a (USDA)	1	1	1	1	4	1	1	6	Potentially not cold tolerant but very good tree overall. Agree with scoring
Western Soapberry	<i>Sapindus saponaria var. drummondii</i>	north america (USDA)	6-9 (USDA)	1	1	1	1	4	1	1	6	Like the tree and agree with scoring
White Mulberry	<i>Morus alba</i>	not native to north america (USDA)	3b-9 (USDA)	1	1	1	1	4	1	1	6	INVASIVE. Allergy and overplanting issue. Does very well. Toughest tree in the world. Has habitat value.
Yaupon Holly	<i>Ilex vomitoria</i>	north america (USDA)	7-9(USDA)	1	1	1	1	4	1	1	6	Seems to be cold tolerant in current temperature. Agree this is a good tree. Courtyard or south facing area.
American Elm	<i>Ulmus americana</i>	north america (USDA)	2-9 (USDA)	1	1	1	1	4	1	0	5	Dropped drought tolerance. Found in Roswell
American Sweetgum	<i>Liquidambar styraciflua</i>	north america (USDA)	5b-10a (USDA)	1	1	1	1	4	1	0	5	Chlorotic issues. Tends to be in lawns and parks with lots of water. Maybe does not tolerate alkaline soils?
Arizona Cypress	<i>Cupressus arizonica</i>	north america (USDA)	7-9 (USDA)	1	1	1	1	4	0	1	5	Banned for pollen by the city.
Cherry Plum	<i>Prunus cerastifera</i>	Asia (UFEI)	5-8 (UFEI)	1	1	1	1	4	1	0	5	Not recommended though. Survive in Tuscan and over planted. Prone to pests.
Fragrant Ash	<i>Fraxinus cuspidata</i>	W TX to AZ, Mexico (wildflower.org)	7 (TAMU)	1	1	1	1	4	1	0	5	Check on future heat tolerance to be sure. Potentially less prone to pests than other fraxinus.
Frontier Elm	<i>Ulmus frontier</i>	Hybrid created in the US (OSU)	5 (OSU)	1	1	1	1	4	1	0	5	
Green Ash	<i>Fraxinus pennsylvanica</i>	north america (USDA)	3-9a (USDA)	1	1	1	1	4	1	0	5	A lot of pest and disease issues. Overplanting issues. Drought stress.
Holly Oak	<i>Quercus ilex</i>	Western Mediterranean (UFEI)	7-9 (UFEI)	1	1	1	1	4	1	0	5	Drought tolerance score was inaccurate. Potentially not cold tolerant now.
Japanese Persimmon	<i>Diospyros kaki</i>	not native to north america (USDA)	7-9a (USDA)	1	1	1	1	4	1	0	5	Very limited experience. But some anecdotal word that it does well here?
Japanese Zelkova	<i>Zelkova serrata</i>	not native to north america (USDA)	5-8 (USDA)	1	1	1	1	4	1	0	5	Comparable to elm? Could probably take future extreme heat.
Little Walnut	<i>Juglans microcarpa</i>	W OK, KS and TX to SE NM (wildflower.org)	7 (OSU)	1	1	1	1	4	1	0	5	No consensus
Mexican Plum	<i>Prunus mexicana</i>	US (UFEI)	6-8 (UFEI)	1	1	1	1	4	1	0	5	Pest issues. In Tuscan. Wide not tall.
Netleaf Hackberry	<i>Celtis reticulata</i>	California (UFEI)	3-9 (UFEI)	1	1	1	1	4	0	1	5	Wonderful
Ornamental Pear	<i>Pyrus calleryana</i>	non-native; East, South, West US	5,6,7,8,9a	1	1	1	1	4	1	0	5	No Bradford pear. Has water addiction problems. Not good in hot and windy. Could be invasive.

Climate-Ready Trees for Albuquerque - Appendix A Master List

Common Name	Tree Species	Native Range	USDA Hardiness Zones	Extreme Temp (2020-2059)		Extreme Temp (2060-2099)		TOTAL HEAT SCORE	Soil type	Drought*	TOTAL SCORE	2019 Meeting Notes (Expert Comments)
				a.) Heat	b.) Cold	a.) Heat	b.) Cold					
Quince	<i>Cydonia</i>	SW Asia (UFEI)	5-9 (UFEI)	1	1	1	1	4	1	0	5	6 in Los Lunas growing for 10 years with no water (doing great! 15'). Changed drought tolerance (is it really low tolerance)
Screwbean Mesquite	<i>Prosopis pubescens</i>	W TX to S CA, Coahuila to Baja CA (wildflower.org)	7 (TAMU)	1	1	1	1	4	0	1	5	
Shumard Oak	<i>Quercus shumardii</i>	north america (USDA)	5b-9 (USDA)	1	1	1	1	4	1	0	5	Hard time growing here.
Southern Waxmyrtle	<i>Morella cerifera</i>	north america (USDA)	7b-11 (USDA)	1	1	1	1	4	1	0	5	May not be a "tree". Experimental.
Texas Ash	<i>Fraxinus tex.....</i>	north america (USDA)	5-9a (USDA)	1	1	1	1	4	1	0	5	A lot of pest and disease issues. Overplanting issues. Drought stress.
Western Redbud	<i>Cercis occidentalis</i>	CA, AZ, UT (USDA)	6-9 (USDA)	1	1	1	1	4	1	0	5	
White Ash	<i>Fraxinus americana</i>	north america (USDA)	3-9a (USDA)	1	1	1	1	4	1	0	5	A lot of pest and disease issues. Overplanting issues. Drought stress.
Apricot	<i>Prunus armeniaca</i>	Armenia (UFEI)	6-9 (UFEI)	1	1	1	1	4	0	0	4	Agree with scoring
Crabapple tree	<i>Malus</i>	Western Asia (UFEI)	3-9 (UFEI)	1	1	1	1	4	1	-1	4	Unsure about the heat tolerance. Jimmy Z says "bad heat scorch in Las Cruces"
Eastern Cottonwood	<i>Populus deltoides</i>	Canada; US Mid-W, SW, Eastern	2,3,4,5,6,7,8,9	1	1	1	1	4	0	0	4	Agree with scoring on this one.
Giant Sequoia	<i>Sequoiadendron giganteum</i>	california (UFEI)	6-9 (UFEI)	1	1	1	1	4	1	-1	4	Changed drought tolerance to lower
Golden Weeping Willow	<i>Salix trista</i>	not native to north america (UFEI)	3-10 (UFEI)	1	1	1	1	4	1	-1	4	Not invasive. Agree with scoring.
London Plane Tree	<i>Platanus x acerfolia</i>	not native to north america (USDA)	5-9a (USDA)	1	1	1	1	4	1	-1	4	Potentially invasive under high water conditions? Overplanted and disease prone and insect prone. Agree with scoring.
Montezuma Cypress	<i>Taxodium mucronatum</i>	South Coastal TX and MX (UFEI)	6-9 (UFEI)	1	1	1	1	4	1	-1	4	Dropped drought score. Bag worms issue
Pecan	<i>Carya illinoensis</i>	south central north america (UFEI)	5-9 (UFEI)	1	1	1	1	4	0	0	4	Grown in Hatch. Good on temp tolerance. Great landscape trees but will not produce fruit under water stress. A lot of water to establish and grow well?
Red Maple	<i>Acer rubrum</i>	north america (USDA)	4-9 (USDA)	1	1	1	1	4	1	-1	4	Gets chlorotic easily. Needs cool and wet. Does it really get to a 9? Not heat tolerant in desert conditions.
Rio Grande Cottonwood	<i>Populus deltoides var. wislizeni</i>	Southern North America (UFEI)	3-9 (UFEI)	1	1	1	1	4	0	0	4	Agree with heat cold scoring. Changed drought tolerance scoring.
San Joaquin/ Gooding Willow	<i>Salix gooddingii</i>	SW US (UFEI)	6-10 (UFEI)	1	1	1	1	4	1	-1	4	No experience with this species. Good in heat but could suffer from drought tolerance.
Thornless Honey Locust	<i>Gleditsia tricanthos inermis</i>	E TX to E SD, to MS & OH (wildflower.org)	4-9 (UFEI)	1	1	1	1	4	0	0	4	Good on scoring. Pest issues though to be considered.
Accolade Elm	<i>Ulmus acolade</i>	Hybrid created in the US (UMN)	4-9 (UMN)	1	1	1	1	4	-1	0	3	Doing well in parks and planted in Las Cruces.
Southern Magnolia	<i>Magnolia spp.</i>	SE US (UFEI)	7-9 (UFEI)	1	1	1	1	4	0	-1	3	Does well in protected spots from cold. Needs lots of water.
Water Birch	<i>Betula occidentalis</i>	Western US (UFEI)	5-10 (UFEI)	1	1	1	1	4	0	-1	3	Needs to add a desert factor. Usually an understory riparian tree. Potentially too low humidity for it to survive here.
Arizona Sycamore	<i>Platanus wrightii</i>	Arizona (UFEI)	7-11 (ASU)	1	1	1	1	4	-1	-1	2	Don't look good here, hammered by leaf hoppers. Not drought tolerant.
Alligator Juniper	<i>Juniperus deppeana</i>	north america (USDA)	7-9 (USDA)	1	1	-1	1	2	1	1	4	Not heat tolerant for future
Black Locust	<i>Robinia pseudoacacia</i>	north america (USDA)	4-8 (USDA)	1	1	-1	1	2	1	1	4	Not really recommended (big thorns etc) Can sucker/invade and a good bee forage plant. But not heat tolerant in the future. Branches break easily
Burr Oak	<i>Quercus macrocarpa</i>	north america (USDA)	3-8 (USDA)	1	1	-1	1	2	1	1	4	Leaves can burn up because they are big. Huge seedling variability. Cannot take extreme heat in future and not drought tolerant.

Climate-Ready Trees for Albuquerque - Appendix A Master List

Common Name	Tree Species	Native Range	USDA Hardiness Zones	Extreme Temp (2020-2059)		Extreme Temp (2060-2099)		TOTAL HEAT SCORE	Soil type	Drought*	TOTAL SCORE	2019 Meeting Notes (Expert Comments)
				a.) Heat	b.) Cold	a.) Heat	b.) Cold					
Cork Oak	<i>Quercus subur</i>	Western Mediterranean and North Africa (UFEI)	8-10(UFEI)	1	-1	1	1	2	1	1	4	Suffering from cold now. Should be good in the future.
English Oak	<i>Quercus robur</i>	not native to north america ((USDA)	5-8 (USDA)	1	1	-1	1	2	1	1	4	Not invasive. Scoring is correct
Japanese Black Pine	<i>Pinus thunbergiana</i>	not native to north america (USDA)	6-8 (USDA)	1	1	-1	1	2	1	1	4	Not invasive. Not great but not awful either.
Kentucky Coffeetree	<i>Gymnocladus dioicus</i>	Midwest/Upper South NA	3b,4,5,6,7,8	1	1	-1	1	2	1	1	4	Scoring looks good
Mexican Pinyon Pine	<i>Pinus cembroides</i>	north america (USDA)	5b-8 (USDA)	1	1	-1	1	2	1	1	4	Maybe more heat tolerant than ours but need to look into it? Look into recommended Tuscan list?
Modesto Ash	<i>Fraxinus velutina</i>	north america (USDA)	7-8 (USDA)	1	1	-1	1	2	1	1	4	Not a good tree. NOT RECOMMENDED
Northern Catalpa	<i>Catalpa speciosa</i>	Central US (UFEI)	4-8 (UFEI)	1	1	-1	1	2	1	1	4	Severe dieback, it survives but doesn't look good.
Praire Flameleaf Sumac	<i>Rhus lanceolata</i>	north america (USDA)	6b-8 (USDA)	1	1	-1	1	2	1	1	4	Not tolerant of future heat. Also does not grow that tall right now so might not be tree like in the future
Raywood Ash	<i>Fraxinus augustifolia oxycarpa</i>		5,6,7,8	1	1	-1	1	2	1	1	4	Pest and disease prone.
Russian Hawthorn	<i>Crataegus ambigua</i>	SE Russia, Turkey, Iran (UFEI)	4-6 (UFEI)	1	1	-1	1	2	1	1	4	Not invasive. Maybe not good in the future heat but now it is heat tolerant.
Shoestring Acacia	<i>Acacia steophylla</i>	Australia (UFEI)	8 - 11 (UFEI)	1	-1	1	1	2	1	1	4	Not much experience. Good in the future. Could be invasive?
Smoketree	<i>Cotinus coggygria</i>	not native to north america (USDA)	5b-8 (USDA)	1	1	-1	1	2	1	1	4	Seems to be a higher heat tolerance? Not invasive. Maybe look at Cotinus americana as an additional score.
Triumph Elm	<i>Ulmus triumph</i>	Hybrid created in the US (UMN)	4-7 (UMN)	1	1	-1	1	2	1	1	4	
Box Elder	<i>Acer negundo</i>	north america (USDA)	3-8 (USDA)	1	1	-1	1	2	1	0	3	Good heat tolerance now. But not good in the future. Agree with the scoring. Dropped drought tolerance.
Loquat	<i>Eriobotrya japonica</i>	china and japan (USDA)	8a-11 (USDA)	1	-1	1	1	2	1	0	3	Not cold hardy here now but potentially could be very good in the future. Not invasive
Dawn Redwood	<i>Metasequoia glyptostroboides</i>	not native to north america (USDA)	5-8 (USDA)	1	1	-1	1	2	1	0	3	Not invasive. Deciduous. Not good in the future and not drought tolerant
Black Pine	<i>Pinus nigra</i>	Mediterranean Region (UFEI)	5-8 (UFEI)	1	1	-1	1	2	1	0	3	Rated about right. Dropped drought tolerance
Scotch Pine	<i>Pinus sylvestris</i>	not native to north america (USDA)	3-8a (USDA)	1	1	-1	1	2	1	0	3	Dropped drought tolerance
Wild Plum	<i>Prunus spp.</i>	North America (UFEI)	3-8 (UFEI)	1	1	-1	1	2	1	0	3	Maybe not tall enough. Suckers a lot
Black Chokecherry (Western Variety)	<i>Prunus virginiana var melomacarpa</i>	Eurasia (NRCS)	3-8 (UFEI)	1	1	-1	1	2	1	0	3	Change to native with native range. Not a good tree for heat. Does well in Lubbock but not good in extreme future
Gambel Oak	<i>Quercus gambelii</i>	American Southwest (UFEI)	4-7 (UFEI)	1	1	-1	1	2	0	1	3	unsure about future heat tolerance
Japanese Pagoda Tree	<i>Styphnolobium japonicum</i>	not native to NA (USDA)	5-8A (USDA)	1	1	-1	1	2	1	0	3	Pest and disease resistant. Could take extreme heat (? This needs to be looked into) and drop down the drought tolerance. Not invasive
Japanese Elm	<i>Ulmus davidiana</i>	Japan, NE Asia (UFEI)	3a (UFEI)	1	1	-1	1	2	1	0	3	Not invasive.
Bigtooth Maple	<i>Acer grandidentatum</i>	Rocky Mountains (UFEI)	4-8 (UFEI)	1	1	-1	1	2	0	0	2	Potentially handles heat if the right seed source and roots are kept cool
Texas Madrone	<i>Arbutus xalapensis</i>	W Texas and NM (UFEI))	7-8 (UFEI)	1	1	-1	1	2	1	-1	2	Impossible to grow in commercial areas. Does very well with everything but may never get planted.
Arizona Walnut	<i>Juglans major</i>	AZ, NM, Northern Mexico (UFEI)	6-7 (UFEI)	1	1	-1	1	2	0	0	2	No consensus on future heat tolerance
North Japanese Hill Cherry	<i>Prunus sergentii</i>	Japan (UFL)	5a-8a (UFL)	1	1	-1	1	2	1	-1	2	Not Invasive. Dropped drought tolerance.
Corkscrew Willow	<i>Salix matsudana</i>	not native to north america (USDA)	4b-8a (USDA)	1	1	-1	1	2	1	-1	2	Should not be on this list. Pest and water issue. NOT RECOMMENDED

Climate-Ready Trees for Albuquerque - Appendix A Master List

Common Name	Tree Species	Native Range	USDA Hardiness Zones	Extreme Temp (2020-2059)		Extreme Temp (2060-2099)		TOTAL HEAT SCORE	Soil type	Drought*	TOTAL SCORE	2019 Meeting Notes (Expert Comments)
				a.) Heat	b.) Cold	a.) Heat	b.) Cold					
Western Redcedar	<i>Thuja occidentalis</i>	Northern Coastal CA (UFEI)	6-8 (UFEI)	1	1	-1	1	2	1	-1	2	Get this one rescored with update species
Hardy Rubber Tree	<i>Eucommia ulmoides</i>	not native to north america (USDA)	4b-7 (USDA)	-1	1	-1	1	0	1	1	2	Not much known about this tree. Potentially more heat tolerant now
Palo Blanco	<i>Mariosousa willardiana</i>	mexico, sonoran desert (UFEI)	9-11 (UFEI)	1	-1	1	-1	0	1	1	2	Cold tolerance is an issue now, may be an issue in the future with extreme cold events
Pacific Willow	<i>Salix lucida</i>		6?	-1	1	-1	1	0	1	1	2	lack of data
Bosnian Pine	<i>Pinus heldreichii</i>	Southern Europe (Arkansas)	4-8 (Arkansas)	1	1	-1	1	2	-1	0	1	Heat is a big issue. Won't do well in future heat. Not invasive
Blue Oak	<i>Quercus oblongifolia</i>	Extreme SW NM, SE Arizona, N Mexico (wildflower.org)	7 (TAMU)	1	1	-1	1	2	-1	0	1	Hardiness zone is wrong? Should be much more heat tolerant.
Tartarian "Hot Wing" Maple	<i>Acer tartarica</i>	SE Europe and W Asia (UFEI)	3-8 (UFEI)	-1	1	-1	1	0	1	0	1	Handles heat well now but may not do very well in the future.
Pinchot's Juniper	<i>Juniperus pinchotii</i>	C Tx to SE NM and W OK (wildflower.org)	7 (TAMU)	-1	1	-1	1	0	1	0	1	Same as One seed juniper essentially
Rocky Mountain Juniper	<i>Juniperus scopulorum</i>	north america (USDA)	4-9a (USDA)	-1	1	-1	1	0	0	1	1	Heat problems now
Two-Needle Pinyon	<i>Pinus edullis</i>	Western US (UFEI)	4-8 (UFEI)	-1	1	-1	1	0	1	0	1	Not heat or drought tolerant now
Limber Pine	<i>Pinus flexilis</i>	north america (USDA)	4-7a (USDA)	-1	1	-1	1	0	1	0	1	
Southwestern White	<i>Pinus strobiformus</i>	mountains of the trans-Pecos, TX west to AZ, south to central Mexico (wildflower.org)	6 (TAMU)	-1	1	-1	1	0	1	0	1	
Chisos Red Oak	<i>Quercus gravesii</i>	Texas (TAMU)	7 (TAMU)	-1	1	-1	1	0	1	0	1	Don't know much about this tree species
Autumn Blaze Red Maple	<i>Acer fremonii</i>	north america (USDA)	3-8 (UFEI)	-1	1	-1	1	0	1	-1	0	Danger Danger not good now. Desert factor of soil and light intensity and dropped drought.
Ponderosa Pine	<i>Pinus ponderosa</i>		3,4,5,6,7	-1	1	-1	1	0	1	-1	0	
Narrowleaf Cottonwood	<i>Populus angustifolia</i>	West and SW US	3,4,5,6,7	-1	1	-1	1	0	1	-1	0	
Velvet Mesquite	<i>Prosopis velutina</i>	AZ, TX, NM (UFEI)	9-11 (ASU)	1	-1	1	-1	0	-1	1	0	Issue with cold tolerance
Wild Privet	<i>Ligustrum vulgare</i>	Europe and Northern Africa (Uconn)	4 (Uconn)	-1	1	-1	1	0	-1	0	-1	Shrub? Weird hardiness rating.
Bristlecone Pine	<i>Pinus aristada</i>	CO, NM, AZ, NV, CA (wildflower.org)	4 (OSU)	-1	1	-1	1	0	-1	-1	-2	Change the soil type. But can't recommend with heat tolerance
Catclaw Acacia	<i>Acacia syn Senegalia greggii</i>	S & W Texas to SE CA (wildflower.org)	2, 5, 6, 7, 8, 10 (TAMU)									Eliminated because <10'
Single Leaf Ash	<i>Fraxinus anomala</i>											Eliminated because <10'
Rose of Sharon	<i>Hibiscus syriacus</i>											Eliminated because <10'
Lanceleaf Cottonwood	<i>Populus acuminata</i>	high elevation riparian tree (UFEI)							0	-1		No good data source
Mexican White Oak	<i>Quercus polymorphii</i>	West Texas into Mexico (Austin)							-1	1		No good data source

(UFEI) = Urban Forest Ecosystem Institute
(USDA) = USFS Fact Sheet

Appendix A - Additional Tree Species Characteristics

Common Name	Tree Species	Native Range	Flooding tolerant	Urban compaction tolerance	Alkaline Soil Tolerant	Well-drained soil	Pests/disease susceptibility	Allergens/ Toxic parts	Maintenance	Branch attachment strength/ prone to breakage	Edible parts	Fragrance, blooms, color	Supports wildlife
Accolade Elm	<i>Ulmus acolade</i>	Hybrid created in the US (UMN)	occasional flooding (UMN)	bred to be urban tree (UMN)		well-drained soils (UMN)	phloem necrosis, wetwood, wilts, rots, cankers, leaf spots (UMN)		regular pruning and spraying (UMN)			fall foliage (UMN)	
Afghan Pine	<i>Pinus eldarica</i>	Pakistan/Russia											
Alligator Juniper	<i>Juniperus deppeana</i>	north america (USDA))		recommended for buffer strips around parking lots or for median strip plantings in the highway; reclamation plant; screen; specimen; no proven urban tolerance (USDA)	alkaline (USDA)	well drained soils (USDA)				strong branches (USDA)			
American Elm	<i>Ulmus americana</i>	north america (USDA)	tolerant of extended flooding (USDA)	common street tree, beware of pests and diseases (USDA)	alkaline (USDA)	well-drained (USDA)	very sensitive to one or more pests or diseases which can affect tree health and aesthetics (USDA)	low biogenic emissions, allergy health hazard (UFEI)	dry fruit causes litter (UFEI)	medium weak (UFEI)		fall foliage (UFEI)	attracts birds and squirrels, desirable wildlife plant (UFEI)
American Sweetgum	<i>Liquidambar styraciflua</i>	north america (USDA)	extended flooding tolerant (USDA)	residential street tree (USDA)	slightly alkaline (USDA)	well-drained (USDA)	bagworm, fall webworms, leaf miner, cottony-cushion scale, sweetgum scale, walnut scale, tent caterpillars, cankers, leaf spots, leader dieback (USDA)		dry fruit, twigs and leaves cause significant litter (USDA)	strong (USDA)		unique start shaped leaves (USDA)	birds, squirrels and other mammals (USDA)
Apricot	<i>Prunus armeniaca</i>	Armenia (UFEI)			highly alkaline soils (UFEI)		Aphids, Beetle Borers, Scales and Thrip, Brown Rot, Canker, Crown Rot, Gummosis, Armillaria, Powdery Mildew, Root Rot, Rust, Sooty Mold and Verticillium (UFEI)						
Arizona Cypress	<i>Cupressus arizonica</i>	north america (USDA)			alkaline (USDA)	well-drained (USDA)	bagworms, juniper blight, stem canker (USDA)			medium (USDA)			
Arizona Sycamore	<i>Platanus wrightii</i>	Arizona (UFEI)	native habitat along streams and moist, rocky canyons (wildflower.org)	urban parks and green spaces (ASU)									
Arizona Walnut	<i>Juglans major</i>	AZ, NM, Northern Mexico (UFEI)			neutral to highly alkaline soil (UFEI)			allergy health hazard (UFEI)	dry fruit litter (UFEI)	medium strong (UFEI)	nut (UFEI)	fall foliage (UFEI)	birds, squirrels (UFEI)
Arizona White Oak	<i>Quercus arizonica</i>	Desert Southwest (wildflower.org)										ornamental plant (wildflower.org)	attracts birds and other wildlife (wildflower.org)
Atlas Cedar	<i>Cedrus atlantica</i>	Atlas Mountains of Algeria and Morocco (UFEI)			slightly alkaline (UFEI)		phytophthora, root rot and sooty mold (UFEI)		dry fruit litter (UFEI)	medium (UFEI)		fragrant bark and leaf (UFEI)	

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Common Name	Tree Species	Native Range	Flooding tolerant	Urban compaction tolerance	Alkaline Soil Tolerant	Well-drained soil	Pests/disease susceptibility	Allergens/ Toxic parts	Maintenance	Branch attachment strength/ prone to breakage	Edible parts	Fragrance, blooms, color	Supports wildlife
Burr Oak	<i>Quercus macrocarpa</i>	north america (USDA)	yes (USDA)	large parking lot islands (> 200 square feet in size); wide tree lawns (>6 feet wide); recommended for buffer strips around parking lots or for median strip plantings in the highway; shade tree; specimen; residential street tree; tree has been successfully grown in urban areas where air pollution, poor drainage, compacted soil, and/or drought are common (USDA)	alkaline (USDA)	well drained soils (USDA)				weak (USDA)		fall foliage (USDA)	squirrels and other mammals (USDA)
Catclaw Acacia	<i>Acacia syn Senegalia greggii</i>	S & W Texas to SE CA (wildflower.org)			likes deep, alkali sand (TAMU)	caliche type, well-drained sandy or rocky soils (wildflower.org)			Is thorny (TAMU)		Catclaw Honey (wildflower.org)	fragrant pale white flowers (TAMU)	goats (TAMU)
Cedar Elm	<i>Ulmus crassifolia</i>	north america (USDA)	can tolerate poor drainage (USDA)	good urban tree (USDA)	alkaline (USDA)	well-drained (USDA)	elm leaf beetles, aphids, dutch elm disease, powdery mildew (USDA)		requires pruning (USDA)	weak (USDA)		fall foliage (USDA)	
Chaste Tree	<i>Vitex agnus castus</i>	not native to NA (USDA)			alkaline (USDA)	well drained soils (USDA)	leaf spot and root rot (USDA)		requires pruning (USDA)	medium to strong (USDA)		lavender, fragrant flowers (USDA)	
Cherry Plum	<i>Prunus cerastifera</i>	Asia (UFEI)				well-drained (UFEI)	aphids, beetle borers, caterpillars and scales, armillaria, canker, leaf spot (UFEI)		flowers and wet fruit litter (UFEI)	medium (UFEI)		showy pink flowers (UFEI)	birds and bees (UFEI)

Appendix A - Additional Tree Species Characteristics

Common Name	Tree Species	Native Range	Flooding tolerant	Urban compaction tolerance	Alkaline Soil Tolerant	Well-drained soil	Pests/disease susceptibility	Allergens/ Toxic parts	Maintenance	Branch attachment strength/ prone to breakage	Edible parts	Fragrance, blooms, color	Supports wildlife
Chinese pistache	<i>Pistacia chinensis</i>	Central and West China	yes	large parking lot islands (> 200 square feet in size); wide tree lawns (>6 feet wide); medium-sized parking lot islands (100-200 square feet in size); medium-sized tree lawns (4-6 feet wide); recommended for buffer strips around parking lots or for median strip plantings in the highway; near a deck or patio; reclamation plant; shade tree; specimen; sidewalk cutout (tree pit); residential street tree; tree has been successfully grown in urban areas where air pollution, poor drainage, compacted soil, and/or drought are common (USDA)	alkaline soils (USDA)	well drained soils (USDA)			requires pruning to develop a strong structure, fruit, twigs and foliage cause significant litter (USDA)	strong branches (USDA)		showy, red flowers (USDA)	
Chinquapin Oak	<i>Quercus muhlenbergii</i>	north america (USDA)				well drained soils (USDA)			requires pruning (USDA)	medium to medium strong (USDA)		fall foliage (USDA)	squirrels and othe mammals (USDA)
Chisos Red Oak	<i>Quercus gravesii</i>	Texas (TAMU)							acorns and leaves cause litter (wildflower.org)			fall foliage (wildflower.org)	deer, birds, squirrels and other mammals (wildflower.org)
Cork Oak	<i>Quercus subur</i>	Western Mediterranean and North Africa (UFEI)		residential street tree (UFEI)	slightly alkaline (UFEI)		invasive shot hole borer, armillaria, phytophthora and root rot (UFEI)	allergy and poisonous health hazard, high biogenic emissions (UFEI)	dry fruit causes litter (UFEI)	strong (UFEI)		bark is source of commercial cork (UFEI)	desirable wildlife plant, attracts birds and squirrels (UFEI)
Corkscrew Willow	<i>Salix matsudana</i>	not native to north america (USDA)	occasionally wet (USDA)		alkaline (USDA)	well-drained (USDA)	aphids, gypsy moth, willow leaf beetles, lace bugs, poplar and willow borer, crown gall, willow scab, black canker, leaf spots, powdery mildew, rust, tar spots (USDA)		requires pruning, fruit, twigs and foliage cause significant litter (USDA)	weak (USDA)		fall foliage (USDA)	
Crabapple tree	<i>Malus</i>	Western Asia (UFEI)	occasional flooding (USDA)	good urban tree (USDA)	highly alkaline (UFEI)		aphids, beetle borers, codling moths and psyllid, armillaria, brown rot, canaker, crown rot, powdery mildew, scab and sooty mold (UFEI)	allergy health hazard (UFEI)	requires pruning (USDA)	medium strong (UFEI)	fruit (UFEI)	fragrant showy flowers, fruit is edible (UFEI)	bees, squirrels, deer, birds (UFEI)

Appendix A - Additional Tree Species Characteristics

Common Name	Tree Species	Native Range	Flooding tolerant	Urban compaction tolerance	Alkaline Soil Tolerant	Well-drained soil	Pests/disease susceptibility	Allergens/ Toxic parts	Maintenance	Branch attachment strength/ prone to breakage	Edible parts	Fragrance, blooms, color	Supports wildlife
Crape Myrtle	<i>Lagerstroemia indica</i>	not native to north america (USDA)		highly recommended for planting in urban and suburban areas (USDA)	alkaline (USDA)	well-drained (USDA)	aphids, powdery mildew, leaf spots (USDA)						
Dawn Redwood	<i>Metasequoia glyptostroboides</i>	not native to north america (USDA)	extended flooding tolerant (USDA)	residential street tree (USDA)		well-drained (USDA)	canker (USDA)		dry fruit causes litter (UFEI)	medium (UFEI)			
Deodar Cedar	<i>Cedrus deodar</i>	E Afghanistan, N Pakistan, North Central India (UFEI)			highly alkaline (UFEI)		beetle borers, armillaria, phytophthora, root rot, sooty mold (UFEI)	allergy health hazard (UFEI)	dry fruit litter (UFEI)	medium (UFEI)			squirrels (UFEI)
Desert Willow	<i>Chilopsis Linearis</i>	n Mex, s CA-TX	yes										
Eastern Cottonwood	<i>Populus deltoides</i>	Canada; US Mid-W, s	yes										
Eastern Redbud	<i>Cercis canadensis</i>	north america (USDA)		residential street tree (USDA)	alkaline (USDA)	well-drained (USDA)	borers, scale insects, webworm (USDA)		requires pruning (USDA)	weak (USDA)		fall foliage (USDA)	
Eastern Redcedar	<i>Juniperus virginiana</i>	north america (USDA)			alkaline (USDA)	well-drained (USDA)	bagworm caterpillars, juniper scale, juniper webworm, mites, twig blight, rust, ice (USDA)	allergy health hazard (USDA)		weak (USDA)		fragrant bark (USDA)	birds (USDA)
English Oak	<i>Quercus robur</i>	not native to north america (USDA)		residential street tree (USDA)	alkaline (USDA)	well-drained (USDA)	very sensitive to one or more pests or diseases which can affect tree health and aesthetics		fruit, twigs and foliage cause significant litter (USDA)	strong (USDA)		fall foliage ((USDA)	squirrels and other mammals (USDA)
Escarpment Live Oak	<i>Quercus fusiformis</i>	Texas, Oklahoma	yes										
Fragrant Ash	<i>Fraxinus cuspidata</i>	W TX to AZ, Mexico (wildflower.org)										fragrant ornamental blooms (wildflower.org)	butterflies, birds (wildflower.org)
Frontier Elm	<i>Ulmus frontier</i>	Hybrid created in the US (OSU)	tolerant of occasional flooding (Cornell)	bred to be street tree (Cornell)	alkaline soil (Cornell)	well-drained (Cornell)						varied leaf shape (Cornell)	
Gambel Oak	<i>Quercus gambelii</i>	American Southwest (UFEI)	no (UFEI)		slightly acidic to highly alkaline soils (UFEI)		beetle borers, caterpillars, insect galls and scales, armillaria, crown rot, mistletoe and root rot (UFEI)	allergy and poisonous health hazard (UFEI)	dry fruit (UFEI)	medium to medium strong (UFEI)		fall foliage (UFEI)	birds, squirrels, deer, other wildlife (UFEI)
Giant Sequoia	<i>Sequoiadendron giganteum</i>	california (UFEI)			slightly alkaline (UFEI)		carpenter ant, annosus root disease, armillaria, phytophthora root rot (UFEI)	moderate biogenic emissions (UFEI)	dry fruit causes litter (UFEI)	strong (UFEI)		largest living organism (UFEI)	attracts birds and squirrels (UFEI)
Gingko	<i>Gingko biloba</i>	not native to north america (USDA)		adapted for use as a street tree (USDA)	alkaline (USDA)	well-drained (USDA)			fruit, twigs and foliage cause significant litter (USDA)	medium (USDA)		pleasant fragrance, showy leaves (USDA)	
Golden-ball Leadtree	<i>Leucaena retusa</i>	TX, Northern Mexico (UFEI)		recommended for buffer strips around parking lots or for median strip plantings (USDA)	alkaline (USDA)	well-drained (USDA)			dry fruit, twigs and leaves cause litter (UFEI)	weak (Urban Forest Ecosystems Institute)		showy yellow flowers (UFEI)	

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Common Name	Tree Species	Native Range	Flooding tolerant	Urban compaction tolerance	Alkaline Soil Tolerant	Well-drained soil	Pests/disease susceptibility	Allergens/ Toxic parts	Maintenance	Branch attachment strength/ prone to breakage	Edible parts	Fragrance, blooms, color	Supports wildlife
Golden Rain Tree	<i>Koelreuteria paniculata</i>	Asia (UFEI)		drought and smog tolerant (UFEI)	highly alkaline (UFEI)		beetle borers, plant bug and scales, root rot, verticillium (UFEI)	allergy health hazard, high biogenic emissions (UFEI)	dry fruit litter (UFEI)	medium(UFEI)		showy yellow flowers (UFEI)	
Golden Weeping Willow	<i>Salix tristis</i>	not native to north america (UFEI)	yes, needs ample water (UFEI)		highly alkaline (UFEI)		aphids, beetle borers, caterpillars, spider mites, anthracnose, willow blight, armillaria, phytophthora, root rot, rust and sooty mold (UFEI)	allergy health hazard (UFEI)	dry fruit and twigs (UFEI)	weak (UFEI)		golden leaves (UFEI)	
Green Ash	<i>Fraxinus pennsylvanica</i>	north america (USDA)	can withstand extended flooding (USDA)	residential street tree (USDA)	alkaline (USDA)	well-drained (USDA)	borers, aphids, fall webworm, Ash flower-gall, rust, fungi, anthracnose, canker, powdery mildew, ash ring spot virus, verticillium (USDA)		requires pruning, fruit/twigs/foilage cause significant litter (USDA)	weak (USDA)		fall foliage (USDA)	birds (USDA)
Hardy Rubber Tree	<i>Eucommia ulmoides</i>	not native to north america (USDA)		hardy urban tree (USDA)	alkaline(USDA)	well-drained (USDA)			requires pruning (USDA)	strong (USDA)			
Holly Oak	<i>Quercus ilex</i>	Western Mediterranean (UFEI)			highly alkaline (UFEI)		scales and spider mites, armillaria, anthracnose, root rot (UFEI)	allergy and poisonous health hazard, high biogenic emissions (UFEI)	dry fruit causes litter (UFEI)	strong (UFEI)		silvery-white underside of leaf (UFEI)	desirable wildlife plant, attracts birds and squirrels (UFEI)
Honey Mesquite	<i>Prosopis glandulosa</i>	SW US to N Mexico											
Italian Stone Pine	<i>Pinus pinea</i>	not native to NA (USDA)		; large parking lot islands (> 200 square feet in size); wide tree lawns (>6 feet wide); medium-sized parking lot islands (100-200 square feet in size); medium-sized tree lawns (4-6 feet wide); recommended for buffer strips around parking lots or for median strip plantings in the highway; screen; shade tree; narrow tree lawns (3-4 feet wide); specimen; sidewalk cutout (tree pit); no proven urban tolerance (USDA)	slightly alkaline (USDA)	well drained soil (USDA)	many pine pests (USDA)			strong branches (USDA)			

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Common Name	Tree Species	Native Range	Flooding tolerant	Urban compaction tolerance	Alkaline Soil Tolerant	Well-drained soil	Pests/disease susceptibility	Allergens/ Toxic parts	Maintenance	Branch attachment strength/ prone to breakage	Edible parts	Fragrance, blooms, color	Supports wildlife
Japanese Black Pine	<i>Pinus thunbergiana</i>	not native to north america (USDA)		recommended for buffer strips and median planting strips (USDA)	alkaline (USDA)	well-drained (USDA)	maskell scale, adelgids, bark beetles, sawfly larvae, pine needle miner larvae, pine needle scale, pine spittle bugs, zimmerman pine moth, pine weevils (USDA)		fruit, twigs, foliage cause significant litter (USDA)	strong (USDA)		fragrant needle leaf (USDA)	
Japanese Elm	<i>Ulmus davidiana</i>	Japan, NE Asia (UFEI)		common street tree (UFEI)	aklaline (UFEI)	well-drained (UFEI)	aphids, borers, beetles, scales, armillaria, phytophthora, root rot, sooty mold, verticillium (UFEI)	allergy health hazard, low biogenic emissions (UFEI)	dry fruit causes litter (UFEI)	medium weak (UFEI)		fall foliage (UFEI)	attracts birds and squirrels, desirable wildlife plant (UFEI)
Japanese Elm	<i>Ulmus propinqua</i>	Japan, NE Asia (UFEI)		common street tree (UFEI)	aklaline (UFEI)	well-drained (UFEI)	aphids, borers, beetles, scales, armillaria, phytophthora, root rot, sooty mold, verticillium (UFEI)	allergy health hazard, low biogenic emissions (UFEI)	dry fruit causes litter (UFEI)	medium weak (UFEI)		fall foliage (UFEI)	attracts birds and squirrels, desirable wildlife plant (UFEI)
Japanese Pagoda Tree	<i>Styphnolobium japonicum</i>	not native to NA (USDA)			alkaline (USDA)	well drained soils (USDA)	potato leafhopper (USDA)		fruit, twigs or foliage cause significant litter (USDA)	weak (USDA)		yellow and white showy flowers in the summer (USDA)	
Japanese Persimmon	<i>Diospyros kaki</i>	not native to north america (USDA)			alkaline (USDA)	well-drained (USDA)			fruit, twigs and foliage can cause significant litter (USDA)	strong (USDA)	edible fruit (USDA)	spring and fall foliage (USDA)	squirrels and other mammals (USDA)
Japanese Zelkova	<i>Zelkova serrata</i>	not native to north america (USDA)	occasionally wet (USDA)	good urban tree (USDA)	slightly alkaline (USDA)	well-drained (USDA)	canker diseases (USDA)		requires pruning (USDA)	weak (USDA)		fall foliage (USDA)	
Jujube	<i>Zizyphus jujuba</i>	not native to NA (USDA)			slightly alkaline (USDA)	well drained soils (USDA)			requires pruning (USDA)	medium to strong (USDA)			squirrels and other mammals (USDA)
Kentucky Coffeetree	<i>Gymnocladus dioica</i>	Midwest/Upper South NA	yes										
Lacebark/Chinese Elm	<i>Ulmus parvifolia</i>	not native to NA (USDA)			alkaline (USDA)	well drained soils (USDA)	borers and chewing insects, twig blight (USDA)			medium to medium strong (USDA)			
Lanceleaf Cottonwood	<i>Populus acuminata</i>	high elevation riparian tree (UFEI)	Riparian species (UFEI)		highly alkaline soil (UFEI)		aphids, beetle borers, scales and thrip, anthracnose, canker, crown rot, mistletoe (UFEI)	allergy health hazard(UFEI)	dry fruit (UFEI)	weak (UFEI)		desirable wildlife plant (UFEI)	birds (UFEI)
Limber Pine	<i>Pinus flexilis</i>	north america (USDA)	occasional flooding tolerated (USDA)		alkaline (USDA)	well-drained (USDA)			requires pruning, fruit, twigs and foliage cause significant litter (USDA)	strong (USDA)		fragrant needle leaf (USDA)	
Little Leaf Mulberry	<i>Morus microphyllaa</i>	OK, NM, AZ south through MX (wildflower.org)										attractive, ornamental fruits (wildflower.org)	mammals and birds (Wildflower.org)

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Common Name	Tree Species	Native Range	Flooding tolerant	Urban compaction tolerance	Alkaline Soil Tolerant	Well-drained soil	Pests/disease susceptibility	Allergens/ Toxic parts	Maintenance	Branch attachment strength/ prone to breakage	Edible parts	Fragrance, blooms, color	Supports wildlife
Little Walnut	<i>Juglans microcarpa</i>	W OK, KS and TX to SE NM (wildflower.org)	riparian tree (wildflower.org)						litter caused by leaves, twigs and nuts (wildflower.org)		nuts (wildflower.org)		birds, butterflies (wildflower.org)
London Plane Tree	<i>Platanus x acerfolia</i>	not native to north america (USDA)	extended flooding tolerant (USDA)	good urban tree (USDA)	alkaline (USDA)	well-drained (USDA)	aphids, sycamore lace bugs, leaf spots, anthracnose, canker, bacterial leaf scorch (USDA)		fruit, twigs, foliage cause significant litter (USDA)	strong (USDA)		fall foliage (USDA)	
Loquat	<i>Eriobotrya japonica</i>	china and japan (USDA)			alkaline (USDA)	well-drained (USDA)	scales, caterpillars, fire blight, root rot (USDA)		requires pruning, fruit/leaves create litter (USDA)	strong (USDA)	edible fruit (USDA)	fragrant white flowers (USDA)	attracts birds (USDA)
Mexican Elder	<i>Sambucus mexicana</i>	north america (USDA)		parking lot buffer strips, median strip plantings (USDA)	alkaline (USDA)	well-drained (USDA)			fruit, twigs and foliage cause significant litter (USDA)	weak (USDA)	elderberries are edible (USDA)	showy white flowers (USDA)	attracts birds (USDA)
Mexican Pinyon Pine	<i>Pinus cembroides</i>	north america (USDA)		recommended for buffer strips around parking lots or for median strip plantings in the highway; reclamation plant; specimen; no proven urban tolerance (USDA)	alkaline soils (USDA)	well drained soil (USDA)			fruit, twigs and foliage create lots of litter (USDA)	strong branches (USDA)	edible fruit (USDA)		squirrels and othe mammals (USDA)
Mexican Plum	<i>Prunus mexicana</i>	US (UFEI)		buffer strip (UFEI)	acidic to alkaline (UFEI)	well drained soils (UFEI)	armillaria (UFEI)		fruit and leaves (UFEI)		edible fruit (UFEI)	Showy white fragrant flowers (UFEI)	birds (UFEI)
Mexican Redbud	<i>Cercis mexicana</i>	west of the Pecos River in TX into Nuevo Leon in MX (wildflower.org)		recommended for buffer strips around parking lots or for median strip plantings in the highway; near a deck or patio; reclamation plant; shade tree; small parking lot islands (< 100 square feet in size); narrow tree lawns (3-4 feet wide); specimen; sidewalk cutout (tree pit); residential street tree (USDA)	Alkaline Soil Tolerant (USDA)	well drained soils (USDA)	Canker, leaf spots, verticillium, webworm, scale insects, borers (USDA)		requires pruning to develop strong structure(USDA)	weak (USDA)		showy pink flowers (USDA)	birds (USDA)
Mexican Sycamore	<i>Platanus mexicana</i>	Eastern US (UFEI)	flood tolerant (UFEI)		highly alkaline (UFEI)		invasive shot hole borer, beetle borers, scales and spider mites, anthracnose, powdery mildew (UFEI)	allergy health hazard, high biogenic emissions (UFEI)	dry fruit, leaves, twigs, bark cause litter (UFEI)	medium (UFEI)		desirable wildlife plant (UFEI)	birds (UFEI)
Mexican White Oak	<i>Quercus polymorphii</i>	West Texas into Mexico (Austin)					resistant to oak wilt and other oak diseases (wildflower.org)		acorns and leaves cause litter, requires pruning (wildflower.org)				attracts wildlife (Austin)

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Common Name	Tree Species	Native Range	Flooding tolerant	Urban compaction tolerance	Alkaline Soil Tolerant	Well-drained soil	Pests/disease susceptibility	Allergens/ Toxic parts	Maintenance	Branch attachment strength/ prone to breakage	Edible parts	Fragrance, blooms, color	Supports wildlife
Modesto Ash	<i>Fraxinus velutina</i>	north america (USDA)		hardy urban tree (USDA)	alkaline (USDA)	well-drained (USDA)	borers, verticillium (USDA)		requires pruning, fruit/twigs/foilage cause significant litter (USDA)	weak (USDA)		fall foliage (USDA)	
Montezuma Cypress	<i>Taxodium mucronatum</i>	South Coastal TX and MX (UFEI)			slightly alkaline (UFEI)		beetle borers and beetle leaves (UFEI)		dry fruit causes litter (UFEI)	strong (UFEI)		fragrant fruit (UFEI)	desirable wildlife plant (UFEI)
Narrowleaf Cottonwood	<i>Populus angustifolia</i>	West and SW US	yes										
Netleaf Hackberry	<i>Celtis reticulata</i>	California(Urban Forest Ecosystem Institute)	found in riparian areas of the southwest (Urban Forest Ecosystem Institute)		neutral to highly alkaline soil pH (Urban Forest Ecosystem Institute)	moist to dry soils (Urban Forest Ecosystem Institute)	susceptible to aphids and insect galls (Urban Forest Ecosystem Institute)	Allergy health hazards (Urban Forest Ecosystem Institute)	dry fruit (Urban Forest Ecosystem Institute)	medium strength branches (Urban Forest Ecosystem Institute)	edible fruit(Urban Forest Ecosystem Institute)		desirable wildlife plant (Urban Forest Ecosystem Institute)
New Mexico Olive	<i>Forestiera Neomexicana</i>	NM, CO, AZ, CA	yes										
North Japanese Hill Cherry	<i>Prunus sergentii</i>	Japan (UFL)		street tree (UFL)	slightly alkaline (UFL)	well-drained (UFL)				medium (UFL)		showy pink flowers (UFL)	birds (UFL)
Northern Catalpa	<i>Catalpa speciosa</i>	Central US (UFEI)		street tree (UFEI)	highly alkaline (UFEI)		caterpillars, anthracnose, powdery mildew, root rot, verticillium (UFEI)	allergy and irritant health hazard (UFEI)	flowers and dry fruit litter (UFEI)	medium (UFEI)		showy, white flowers, fall foliage (UFEI)	desirable wildlife plant (UFEI)
Oklahoma Redbud	<i>Cercis reniformis</i>	SW US and Eastern US											
One-seed Juniper	<i>Juniperus monosperma</i>	west TX to SE CO & AZ (wildflower.org)											
Ornamental Pear	<i>Pyrus calleryana</i>	non-native; East, Sou	yes										
Osage Orange	<i>Maclura pomifera</i>	north america (USDA)	extended flooding tolerant (USDA)	good urban tree (USDA)	alkaline (USDA)	well-drained (USDA)			fruit, twigs, leaves cause significant litter (USDA)	strong (USDA)			squirrels and other mammals (USDA)
Pacific Willow	<i>Salix lucida</i>		yes										
Palo Blanco	<i>Mariosousa willardiana</i>	mexico, sonoran desert (UFEI)			slightly acidic to highly alkaline soil (UFEI)	well drained soil (UFEI)	invasive shot hole borer (UFEI)	allergy health hazard (UFEI)		weak branches (UFEI)		showy, fragrant pale yellow flowers (UFEI)	birds and bees (UFEI)
Palo Verde hybrids	<i>Parkinsonia x Cercidium</i>	hybrid of trees found in the sonoran and chihuahuan deserts (UFEI)		streetscape and parking lot (UFEI)	neutral to highly alkaline soil (UFEI)		invasive shot hole borer, eriophyid mite (UFEI)	moderate biogenic emissions (UFEI)	dry fruit (UFEI)	medium branch strength (UFEI)		beautiful spring bloom (UFEI)	bees, attracts wildlife (UFEI)
Pecan	<i>Carya illinoensis</i>	south central north america (UFEI)	riparian tree (UFEI)		slightly alkaline (UFEI)		aphids, beetle borers, beetle grubs and caterpillars, chlorosis, mistletoe, phytophthora, root rot, sooty mold, verticillium (UFEI)	allergy health hazard (UFEI)	wet fruit litter (UFEI)	medium strong (UFEI)	edible nut (UFEI)	fragrant leaf (UFEI)	desirable wildlife plant (UFEI)
Persian Silk Tree/ Mimosa	<i>Albizia julibrissin</i>	not native to north america (USDA)	occasional flooding (USDA)		slightly alkaline (USDA)	well drained (USDA)	sensitive to pests/diseases (USDA)		fruit/leaves cause litter (USDA)	weak (USDA)		pink, showy flowers (USDA)	
Pinchot's Juniper	<i>Juniperus pinchotii</i>	C Tx to SE NM and W OK (wildflower.org)										ornamental (wildflower.org)	birds, butterflies, small mammals (wildflower.org)

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Common Name	Tree Species	Native Range	Flooding tolerant	Urban compaction tolerance	Alkaline Soil Tolerant	Well-drained soil	Pests/disease susceptibility	Allergens/ Toxic parts	Maintenance	Branch attachment strength/ prone to breakage	Edible parts	Fragrance, blooms, color	Supports wildlife
Pistachio	<i>Pistacia vera</i>	not native to north america (UFEI)			highly alkaline (UFEI)	needs good drainage (UFEI)	crown rot, armillaria, root rot, verticillium (UFEI)	moderate biogenic emissions (UFEI)	dry fruit (UFEI)	medium (UFEI)	nut is edible (UFEI)		squirrels (UFEI)
Pomegranate	<i>Punica granatum</i>	Iran and the Himalayas (UFEI)			highly alkaline soils (UFEI)		plant bug and white fly, chlorosis and sooty mold (UFEI)		wet fruit (UFEI)	medium branch strength (UFEI)	fruit is edible (UFEI)	colorful, showy flowers (UFEI)	desirable wildlife plant (UFEI)
Ponderosa Pine	<i>Pinus ponderosa</i>												
Prairie Flameleaf Sumac	<i>Rhus lanceolata</i>	north america (USDA)			alkaline (USDA)	well drained soils (USDA)			requires pruning (USDA)	medium to medium strong (USDA)		fall foliage (USDA)	birds (USDA)
Quince	<i>Cydonia</i>	SW Asia (UFEI)			highly alkaline (UFEI)		psyllid, brown rot, chlorosis, fire blight, powdery mildew (UFEI)		wet fruit litter (UFEI)	strong (UFEI)	edible fruit (UFEI)	fragrant, edible fruit (UFEI)	attracts squirrels (UFEI)
Raywood Ash	<i>Fraxinus augustifolia oxycarpa</i>		yes										
Red Maple	<i>Acer rubrum</i>												
		north america (USDA)	can tolerate extended flooding (USDA)	residential street tree (USDA)		well drained (USDA)	susceptible to multiple pests and diseases (USDA)		requires pruning (USDA)	weak (USDA)		red flowers, fall foliage (USDA)	birds, squirrels and other mammals (USDA)
Rio Grande Cottonwood	<i>Populus deltoides var. wislizeni</i>	Southern North America (UFEI)	riparian tree (UFEI)		highly alkaline soils (UFEI)		aphids, beetle borers and scales, anthracnose, canker, crown rot, mostletoe and sooty mold (UFEI)	allergy health hazard (UFEI)	dry fruit and twigs (UFEI)	weak branches (UFEI)	wildlife eat fruit (UFEI)		deer, birds, desirable wildlife plant (UFEI)
Rocky Mountain Juniper	<i>Juniperus scopulorum</i>	north america (USDA)			alkaline (USDA)	well-drained (USDA)	bagworm caterpillars, juniper scale, juniper webworm, mites, twig blight, rust, ice (USDA)	allergy health hazard (USDA)		moderate (USDA)	can make gin from the berries (USDA)		birds (USDA)
Rose of Sharon	<i>Hibiscus syriacus</i>												
Russian Hawthorn	<i>Crataegus ambigua</i>	SE Russia, Turkey, Iran (Urban Forest Ecosystem Institute)			highly acidic to highly alkaline soil (Urban Forest Ecosystem Institute)		aphids, beetle borers, scales and spider mites, fire blight, armillaria, powdery mildew, root rot and rust (Urban Forest Ecosystem Institute)	Allergy health hazards (Urban Forest Ecosystem Institute)		strong branches (Urban Forest Ecosystem Institute)		showy white flowers (Urban Forest Ecosystem Institute)	desirable wildlife plant (Urban Forest Ecosystem Institute)
San Joaquin/ Goodding Willow	<i>Salix gooddingii</i>	SW US (UFEI)	yes, needs ample water (UFEI)		highly alkaline (UFEI)		invasive shot hole borer, aphids, beetle borers, caterpillars, spider mites, anthracnose, willow blight, armillaria, phytophthora, root rot, rust, sooty mold (UFEI)	allergy health hazard (UFEI)	dry fruit causes litter (UFEI)	weak (UFEI)		fall foliage (UFEI)	

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Common Name	Tree Species	Native Range	Flooding tolerant	Urban compaction tolerance	Alkaline Soil Tolerant	Well-drained soil	Pests/disease susceptibility	Allergens/ Toxic parts	Maintenance	Branch attachment strength/ prone to breakage	Edible parts	Fragrance, blooms, color	Supports wildlife
Scotch Pine	<i>Pinus sylvestris</i>	not native to north america (USDA)			slightly alkaline (USDA)	well-drained (USDA)	very sensitive to one or more pests/diseases which can affect tree health (USDA)		fruit, twigs, foliage cause significant litter (USDA)	weak (USDA)		fragrant needle leaf (USDA)	
Screwbean Mesquite	<i>Prosopis pubescens</i>	W TX to S CA, Coahuila to Baja CA (wildflower.org)	likes flooding periodically (wildflower.org)			well drained soils (wildflower.org)			tip-prune (wildflower.org)		edible for wildlife	showy, attractive blooms (wildflower.org)	special value for honey bees (wildflower.org)
Shoestring Acacia	<i>Acacia steophylla</i>	Australia (Urban Forest Ecosystem Institute)			can tolerate slightly acidic to highly alkaline soils (Urban Forest Ecosystem Institute)	Moist to well drained soils (Urban Forest Ecosystem Institute)	Susceptible to invasive shot hole borer (Urban Forest Ecosystem Institute)	Allergy health hazards (Urban Forest Ecosystem Institute)	Litter Issue is dry fruit (Urban Forest Ecosystem Institute)	Weak branches (Urban Forest Ecosystem Institute)		fragrant pale yellow flowers, often used as an ornamental tree (Urban Forest Ecosystem Institute)	attracts birds (Urban Forest Ecosystem Institute)
Shumard Oak	<i>Quercus shumardii</i>	north america (USDA)	occasionally wet (USDA)	good urban tree (USDA)	highly alkaline (USDA)	well-drained (USDA)	susceptible to many pests and diseases, however none are serious (USDA)		fruit, twigs and foliage cause significant litter (USDA)	strong (USDA)		fall foliage (USDA)	squirrels and other mammals (USDA)
Siberian Elm	<i>Ulmus pumila</i>		yes										
Single Leaf Ash	<i>Fraxinus anomala</i>												
Smoketree	<i>Cotinus coggygria</i>	not native to north america (USDA)		street tree (UFEI)	alkaline (USDA)	well-drained (USDA)	oblique banded leaf roller, leaf spots, scab, verticillium, stem canker (USDA)			strong (USDA)		spring bloom and fall foliage (USDA)	
Southern Live Oak	<i>Quercus virginiana</i>	north america (USDA)			alkaline (USDA)	well drained soils (USDA)			requires pruning (USDA)	medium to medium strong (USDA)			birds, squirrels, and other mammals (USDA)
Southern Magnolia	<i>Magnolia spp.</i>	SE US (UFEI)			slightly alkaline (UFEI)		invasive shot hol borer, aphids, scales, spider mites, armillaria, root rot, verticillium (UFEI)	allergy and irritant health hazard (UFEI)	flowers, dry fruit, leaves cause litter (UFEI)	medium (UFEI)		showy, fragrant white flowers (UFEI)	birds (UFEI)
Southern Waxmyrtle	<i>Morella cerifera</i>	north america (USDA)	extended flooding tolerant (USDA)	residential street tree (USDA)	alkaline (USDA)	well-drained (USDA)	caterpillars, webworms, cankers (USDA)		requires pruning (USDA)	weak (USDA)			birds, squirrels, other mammals (USDA)
Southwestern White	<i>Pinus strobiformus</i>	mountains of the trans-Pecos, TX west to AZ, south to central Mexico (wildflower.org)									edible seeds (wildflower.org)		seeds consumed by wildlife (wildflower.org)
Tartarian "Hot Wing" Maple	<i>Acer tartarica</i>	SE Europe and W Asia (UFEI)					aphids, armillaria, root rot, verticillium (UFEI)	allergy health hazard (UFEI)	dry fruit litter (UFEI)	medium (UFEI)		fall foliage (UFEI)	birds (UFEI)
Texas Ash	<i>Fraxinus tex.....</i>	north america (USDA)		residential street tree (USDA)	alkaline (USDA)	well-drained (USDA)			requires pruning (USDA)	strong (USDA)		fall foliage (USDA)	
Texas Madrone	<i>Arbutus xalapensis</i>	W Texas and NM (Urban Forest Ecosystem Institute)		container, buffer strip or street tree (Urban Forest Ecosystem Institute)	acidic to alkaline soil (Urban Forest Ecosystem Institute)	Well-drained soil requirement (Urban Forest Ecosystem Institute)		Allergy health hazards (Urban Forest Ecosystem Institute)	wet fruit and bark (Urban Forest Ecosystem Institute)	strong branches (Urban Forest Ecosystem Institute)		showy, fragrant white flowers (Urban Forest Ecosystem Institute)	birds and bees (Urban Forest Ecosystem Institute)

Appendix A - Additional Tree Species Characteristics

Common Name	Tree Species	Native Range	Flooding tolerant	Urban compaction tolerance	Alkaline Soil Tolerant	Well-drained soil	Pests/disease susceptibility	Allergens/ Toxic parts	Maintenance	Branch attachment strength/ prone to breakage	Edible parts	Fragrance, blooms, color	Supports wildlife
Texas Persimmon	<i>Diospyros texana</i>	north america (USDA)		container or above-ground planter; large parking lot islands (> 200 square feet in size); wide tree lawns (>6 feet wide); medium-sized parking lot islands (100-200 square feet in size); medium-sized tree lawns (4-6 feet wide); recommended for buffer strips around parking lots or for median strip plantings in the highway; near a deck or patio; small parking lot islands (< 100 square feet in size); narrow tree lawns (3-4 feet wide); specimen; sidewalk cutout (tree pit); residential street tree; no proven urban tolerance (USDA)	alkaline soils (USDA)	well drained soils (USDA)				strong branches (USDA)	fruit (USDA)	white flowers (USDA)	birds, squirrels, other mammals (USDA)
Texas Red Oak	<i>Quercus texana</i>	N central and central TX	yes										
Texas Redbud	<i>Cercis texicana</i>	southwestern US (USDA)		residential street tree (USDA)	alkaline (USDA)	well-drained (USDA)	treehoppers, scale insects, canker, leaf spots, verticillium (USDA)		requires pruning (USDA)	weak (USDA)		showy pink flowers, fall foliage (USDA)	
Thornless Honey Locust	<i>Gleditsia tricanthos inermis</i>	E TX to E SD, to MS & OH (wildflower.org)			highly alkaline (UFEI)		invasive shot hole borer, caterpillars, insect galls, pod gall midge, spider mites, mistletoe, phytophthora, root rot (UFEI)	allergy health hazard (UFEI)		medium (UFEI)			birds and bees (UFEI)
Triumph Elm	<i>Ulmus triumph</i>	Hybrid created in the US (UMN)	occasional flooding (UMN)	bred to be urban tree (UMN)		well-drained soils (UMN)			regular pruning and spraying (UMN)			fall foliage (UMN)	
Two-Needle Pinyon	<i>Pinus edulis</i>	Western US (UFEI)			highly alkaline (UFEI)		aphids and scales, armillaria, root rot (UFEI)	allergy health hazard, moderate biogenic emissions (UFEI)	dry fruit litter (UFEI)	medium strong (UFEI)	nuts (UFEI)	cones, edible nuts (UFEI)	birds, squirrels (UFEI)
Tx. Mt. Laurel	<i>Sophora secundiflora</i>	north america (USDA)		residential street tree (USDA)	alkaline (USDA)	well-drained (USDA)						fragrant, showy purple flowers (USDA)	
Velvet Mesquite	<i>Prosopis velutina</i>	AZ, TX, NM (UFEI)			neutral to highly alkaline soil (UFEI)				pruning required (urban forest ecosystems initiative)	medium branch strength (UFEI)	edible fruit (urban forest ecosystems initiative)	yellow flowers (urban forest ecosystem initiative)	birds and bees (UFEI)

Appendix A - Additional Tree Species Characteristics

Common Name	Tree Species	Native Range	Flooding tolerant	Urban compaction tolerance	Alkaline Soil Tolerant	Well-drained soil	Pests/disease susceptibility	Allergens/ Toxic parts	Maintenance	Branch attachment strength/ prone to breakage	Edible parts	Fragrance, blooms, color	Supports wildlife
Water Birch	<i>Betula occidentalis</i>	Western US (UFEI)	riparian tree (UFEI)				aphids, beetle borers, armillaria (UFEI)	allergy health hazard (UFEI)	dry fruit litter (UFEI)	medium strong (UFEI)		fall foliage (UFEI)	desirable wildlife plant (UFEI)
Western Redbud	<i>Cercis occidentalis</i>	CA, AZ, UT (USDA)		sidewalk cutout and residential street tree (USDA)	alkaline (USDA)	well-drained (USDA)	treehoppers, scale insects, canker, leaf spots, verticillium (USDA)		requires pruning (USDA)	strong (USDA)		showy pink flowers, fall foliage (USDA)	attracts birds(USDA)
Western Redcedar	<i>Thuja occidentalis</i>	Northern Coastal CA (UFEI)			slightly alkaline (UFEI)		beetle borers, leaf miners and spider mites, armillaria, root rot (UFEI)	low biogenic emissions (UFEI)	dry fruit causes litter (UFEI)	medium (UFEI)		fragrant bark and leaf (UFEI)	desirable wildlife plant (UFEI)
Western soapberry	<i>Sapindus saponaria var. drummondii</i>	north america (USDA)			alkaline (USDA)	well drained soils (USDA)	dwarf mistletoe(USDA)		foliage causes significant litter (USDA)	medium to medium strong (USDA)		showy fall foliage (USDA)	birds (USDA)
White Ash	<i>Fraxinus americana</i>	north america (USDA)	can withstand extended flooding (USDA)	residential street tree (USDA)	alkaline (USDA)	well-drained (USDA)	borers, aphids, fall webworm, Ash flower-gall, rust, fungi, anthracnose (USDA)		requires pruning, fruit/twigs/foilage cause significant litter (USDA)	weak (USDA)		fall foliage (USDA)	birds (USDA)
White Mulberry	<i>Morus alba</i>	not native to north america (USDA)	extended flooding tolerant (USDA)		alkaline (USDA)	well-drained (USDA)	scale, mites, leaf spot, bacterial blight, powdery mildew, cankers (USDA)		requires pruning (USDA)	weak (USDA)			
Wild Plum	<i>Prunus spp.</i>	North America (UFEI)	can be found in riparian areas in arid environments (FEIS)		slightly alkaline (UFEI)		aphids, beetle borers, caterpillars, armillaria, rust, sooty mold, verticillium (UFEI)	allergy and poisonous health hazard, has thorns (UFEI)	flower and wet fruit litter (UFEI)	strong (UFEI)	edible fruit (UFEI)	desirable wildlife plant (UFEI)	birds and squirrels (UFEI)
Wild Privet	<i>Ligustrum vulgare</i>	Europe and Northern Africa (Uconn)	yes (FEIS)			well drained soil (FEIS)	anthracnose twig blight, canker, powdery mildew, leaf spot, aphids, leaf miners, mites, whiteflies (Uconn)		prune after flowering (Uconn)			white fragrant flowers (Uconn)	
Yaupon Holly	<i>Ilex vomitoria</i>	north america (USDA)	can withstand extended flooding (USDA)	hardy urban tree (USDA)	alkaline (USDA)	well-drained (USDA)	scale, leaf miners, mites, aphids (USDA)			moderate (USDA)			birds, squirrels, other mammals (USDA)

Appendix B

This appendix offers a detailed look at each of the six site location types and provides additional examples.

LOCATION TYPES 1 & 2 - GREEN STORMWATER INFRASTRUCTURE (GSI) FEATURES

Cities are predominantly full of hard, impervious surface that rainwater runs off into designated stormwater collection systems. These networks of pipes and concrete spillways, known as grey stormwater infrastructure, are designed to redirect stormwater runoff away from vulnerable areas to reduce risk of urban flooding. Though efficient in decreasing high flow risks on streets, grey infrastructure concentrates pollution in stormwater and increases stream and river degradation by causing unnaturally high flows in riparian areas.

Green Stormwater Infrastructure (GSI) features use vegetation, soils, and other natural elements and practices to manage stormwater as a companion to grey stormwater infrastructure. GSI features slow down incoming stormwater and remove contaminants through soil infiltration, tree canopy water interception, and plant root absorption. GSI features allow stormwater to filter back into the groundwater system, replenishing the aquifer and creating a more sustainable desert water management system while decreasing the risk of urban flooding and protecting water quality and riparian habitat. GSI features also support beneficial plant habitat and increase green spaces in the city, benefitting residents in multiple ways. These features can be used alongside grey infrastructure, directing water to areas

with permeable surfaces and vegetation first, using gray infrastructure pipes and spillways as overflow.

Trees are important components of a GSI feature. They are efficient at intercepting rainwater via canopy and bark, increasing soil permeability via root structures, and facilitating absorption of pollutants via leaves, bark, and roots. GSI features also benefit trees by providing de-compacted, healthy soil and increasing water collection. Trees that can survive short term water inundation in their roots are best for the bottom of GSI features. Stormwater systems regulated by the Environmental Protection Agency and the New Mexico Environment Department may only retain stormwater onsite for up to 96 hours; trees in GSI features should be able to survive up to 96 hours of water inundation and should also have tolerance to water pollution. Trees that do not do well with inundation, can be considered for placement on higher elevations of larger GSI features.



Photo Credit: MRWM Landscape Architects

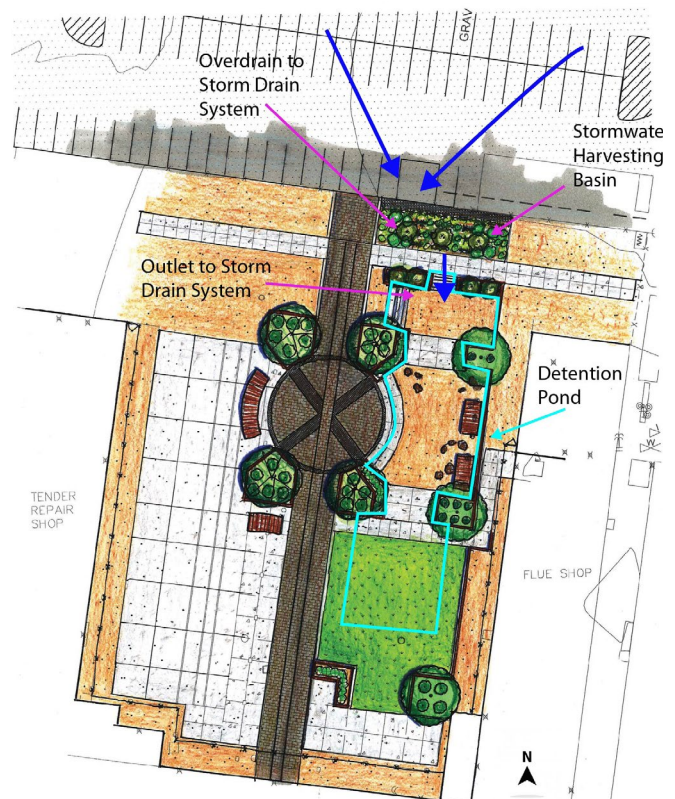


Image Credit: MRWM Landscape Architects

LOCATION TYPE 3 - XERISCAPED AREAS

Xeriscaping is the concept of transforming a high-water use landscape to a “xeric” or low water use landscape, one that thrives on rainfall and careful supplemental irrigation. The concept of xeriscaping is often misconstrued with the landscaping technique of removing most organic material and replacing with inorganic material like rock that requires no water. While inorganic material landscapes need no water, they increase the ambient temperature (often driving energy usage higher in surrounding buildings), increase stormwater runoff, and create an unsuitable habitat for plants, wildlife, and often people.

In contrast, xeriscaping incorporates low water use plants with a focus on native and arid adapted species, careful organic mulching, water catchment, and water redirection systems to support a lush landscape that is both visually enjoyable and wildlife-friendly. Trees are an important part of the “xeric” landscape but are often overlooked because of

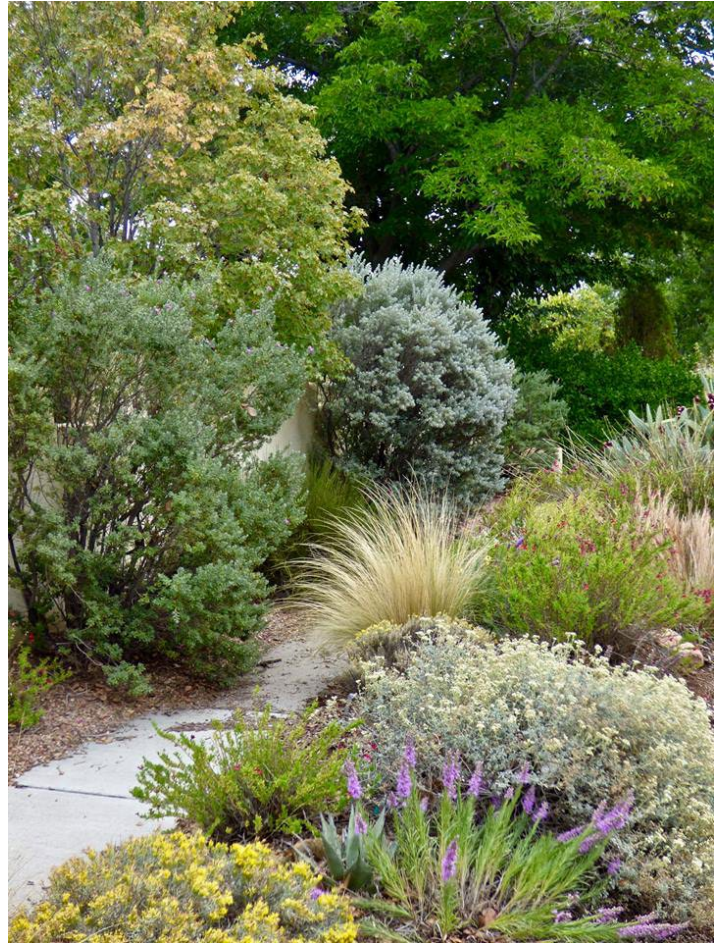


Photo Credit: Hunter Ten Broeck

the perception that they require too much water. Trees selected for a xeric landscape should be native or well adapted to xeric conditions. Supplemental irrigation will be required for all trees during establishment. Most trees will need supplemental irrigation throughout their life, but especially during drought or extended periods of heat. Xeriscaping can be combined with rain gardens, rain barrels, and other GSI features for a low impact landscape design.



Photo Credit: Hunter Ten Broeck

LOCATION TYPE 4 - HIGHLY IRRIGATED AREAS

This site location type encompasses all areas that have high irrigation potential, such as areas with lawn or turfgrass. As described above for location types 1-3, xeriscaping and GSI features are the preferred methods of sustainable, low-impact landscape design. Turfgrass can often be described as “habitat deserts” because the uniformity of the landscape does not promote ecosystem diversity. From a water conservation stand point, these areas can be a strain on limited resources, especially in the summer. However, many public recreation places such as parks, soccer fields, and golf courses necessitate turf, and can be a good use of water because they provide an alternative to individual people having private lawns. Within residential or small commercial settings, planting and irrigating larger trees can provide dense shade and refugia for people from summer heat.

Trees planted in this location type should be trees that thrive with frequent, shallow irrigation and are heat tolerant. By surrounding turf spaces, large or small, xeriscaping, can reduce water use and capture any runoff from the turf irrigation.

IMPORTANT NOTE: Typical spray irrigation of turfgrasses is often insufficient to meet the slow, deep watering requirements of large shade tree roots. Additional, deep watering is likely needed to supplement spray irrigation.



Photo Credit: Albuquerque Water Authority

LOCATION TYPE 5 - STREETSCAPES

Medians and street rights-of-way are common urban planting locations. With sufficient soil volume and above-ground space, appropriate tree species can be a cost-effective method to reduce particulate matter pollution in high traffic areas. These location types are harsh environments for trees. The soil in these areas is almost always highly compacted, preventing proper root development and therefore, tree development. Irrigation is often insufficient and infrequent, and UHI effects are intense. Mechanical damage and high pollution exposure also contribute to tree decline. Trees that are too big for the space at maturity are often planted, causing problems at a later date often ending in tree removal. Streetscape trees are often not a positive return on investment because many

of them die from some combination of those factors before the benefits of a mature tree are gained.

Ideally, traditional raised and/or curbed streetscapes will transition to GSI features with water catchment and healthy soils—both for the health of the trees and our water. In the meantime, only plant trees in areas that have sufficient soil volume to support healthy tree growth. This amount will vary depending on mature tree size but should be at minimum 6 feet wide.

Any tree in this location type will require structural pruning to maintain requisite clearance and sightlines.



Photo Credit: ABCWUA

LOCATION TYPE 6 - RESTRICTED GROWING AREA

Restricted growing areas are those with widths of 6 feet or less. The most common examples in an urban environment are spaces between streets and sidewalks, between sidewalks/streets and buildings, or in between parking lot spaces. These spaces rarely provide adequate soil volume for trees unless special infrastructure is included. They are known as “hell strips” because they are very hot, not well irrigated, and overall not conducive to tree survival. However, they are often underutilized spaces in a city that if planted can significantly contribute to beautification and cooling. They are also often well-suited spaces for flow-through GSI features and other low impact design techniques.

Smaller understory plants like bunch grasses and wildflowers are better suited for these

areas. Only small stature trees should be selected for planting, and only if the space has a minimum width of 4 feet and/or continuous soil strips, tree trenches, or suspended soils. If the area is less than 4 feet wide, do not plant any trees or large shrubs. Instead consider small understory plants and vegetation that will not only thrive in the smaller space, but will also still provide beneficial habitat, capture and clean stormwater, and create green spaces. Pair these small understory green spaces with light colored shade structures to reflect solar radiation and cool any nearby pedestrian areas.



Photo Credit: The Nature Conservancy

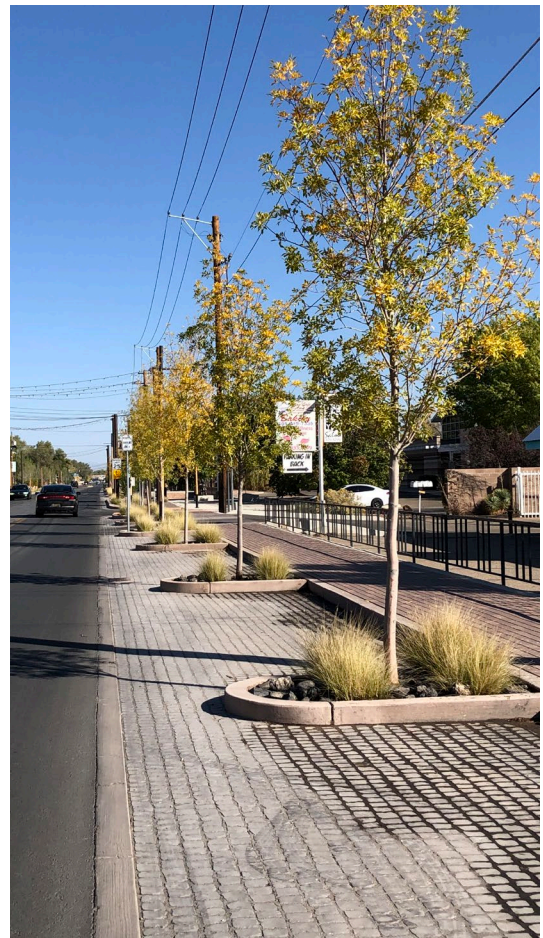


Photo Credit: The Nature Conservancy