

TREES FOR SOUTHERN CALIFORNIA'S FUTURE CLIMATE

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Los Angeles for Urban Center Natural Resources Sustainability
Partners Meeting, May 6th 2016



U.S. Department of Agriculture
**Pacific Southwest
Research Station**
Science that makes a difference



Goal: stable, healthy, functional urban forests



Urban forestry is risk management

Strategies to mitigate risk of loss:

- Increase diversity
- Phase out poorly-adapted species



Primary points of leverage

- Tree maintenance
- Tree selection



Afrocarpus falcatus, African fern pine in Santa Monica, CA

Decision support tool

High Risk Species <i>-in order of planting restriction</i>	Risk Factors*					Mitigation Strategies**
	#	Age	Pest A	Pest S	Pest E	
<i>Ash</i>			x		x	Eliminate planting, E, IPM
<i>Sycamore</i>			x	x	x	Eliminate planting, E, IPM
<i>Chinese elm</i>			x		x	Limit to < 2% of annual plantings until 2020. E, IPM
<i>Hackberry</i>			x		x	Limit to < 2% of annual plantings until 2020. E, IPM
<i>Pistache</i>	14%		x			Limit to < 5% of annual plantings until 2020. IPM

- Structure
 - Age
 - Spp dominance
- Pests (PVM)

McPherson, E.G.; Kotow, L. 2013. A municipal forest report card: Results for California. *Urban Forestry & Urban Greening*. 12: 134-143.

Result: identified species most at risk

Risk factor: drought



McPherson, E.G.; Albers, S. 2014.
Evaluation of seven drought tolerant tree
species for central California. *Western
Arborist*, 40(3): 10-15.

- 7 desert-adapted species
- Sacramento, Modesto, Davis
- Tree Evaluation: 2000 to 2014

Result: an example of
how to expand species
palette

Trees Fit for the Future

- Adds increasing awareness of **potential climate change effects**



- Forest Service PSW, U.C. Davis, U.C. Coop Ext.
- Many partners:
L.A. Center, L.A. Rec & Parks, L.A. Beautification Team, City Plants, Mnt. States Nursery, and others

Why climate change?

Survival, health & longevity

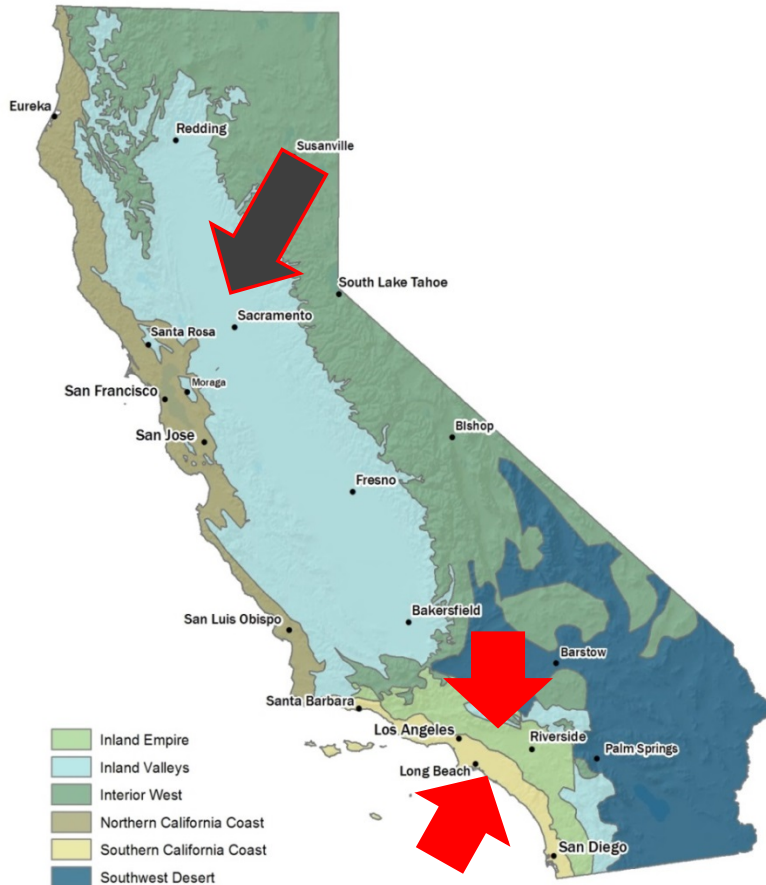
Right Tree, Right Place: Right Climate Zone

Climate zones: USDA Hardiness Zones provide a good basic guide for planning: “average annual minimum temperature”

Study focus:

- Inland Valley, CA (Davis, Sac)
- Inland Empire, CA
- Southern CA Coast

California Climate Zones



Climate zones based on Brenzel (1997)

Climate models project changes in climate zones, next 75 years

1. TEMPERATURE

Projected Changes in USDA Hardiness Zones				
City	2010-2019 Avg Min Temp (°F)	Current Hardiness Zone	2080-2089 Avg Min Temp (°F)	Predicted Hardiness Zone
Claremont	39.2	10B	44.2	11A
Santa Monica	46.6	11B	51.3	12A

Temp (F)	Zone	Temp (C)
15 to 20	8b	-9.4 to -6.7
20 to 25	9a	-6.7 to -3.9
25 to 30	9b	-3.9 to -1.1
30 to 35	10a	-1.1 to 1.7
35 to 40	10b	1.7 to 4.4
40 to 45	11a	4.4 to 7.2

For Inland Valley, model projects **1 ½ zone changes**.

For Inland Empire & S. CA Coast, model projects **½ zone changes**.

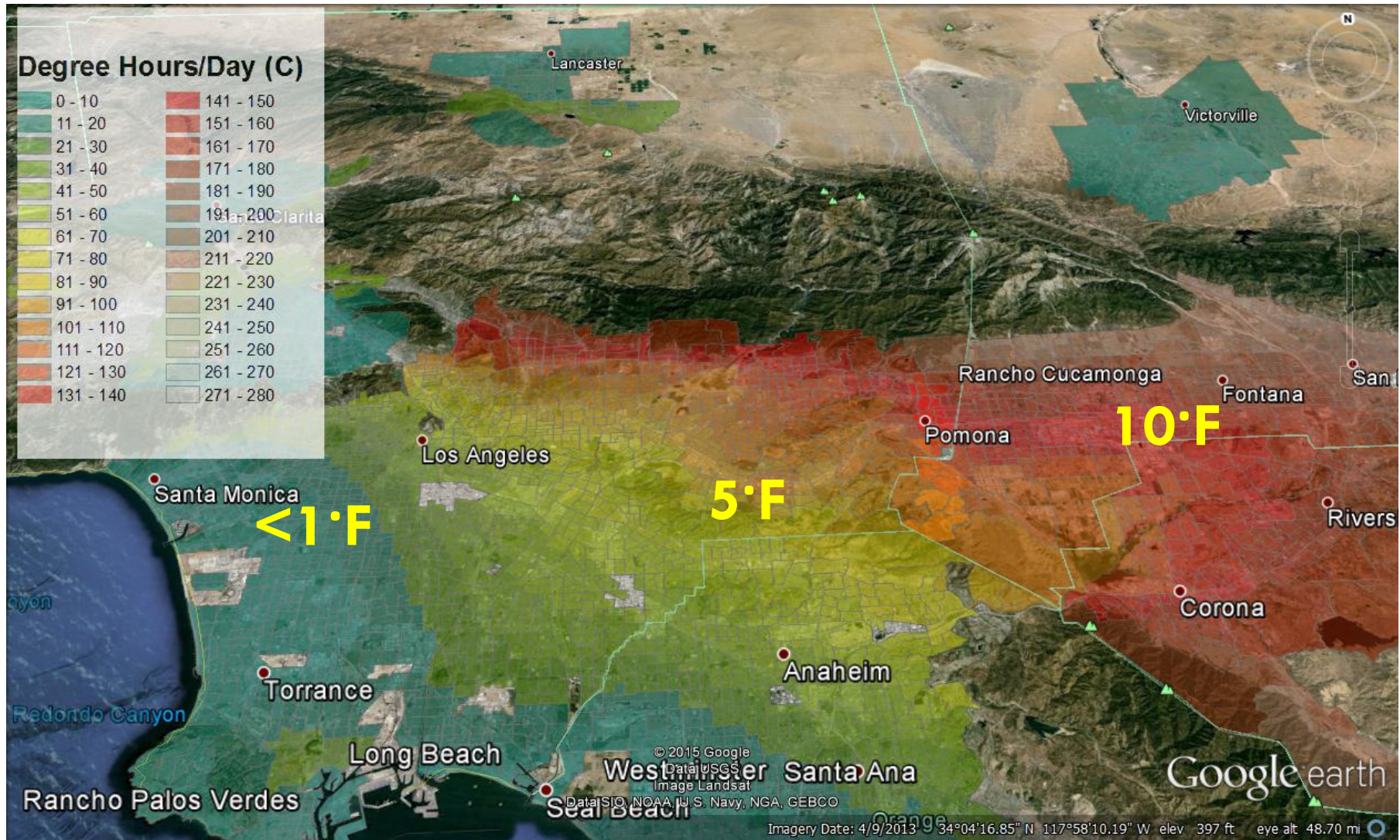
2. PRECIPITATION

- More uncertainty than with temperature predictions
- Generally: **more winter precip, less summer**.

cal-adapt pcm1

<http://cal-adapt.org/tools/>

Urban Heat Island Index (Cal – EPA)



KMZ downloaded from <http://www.calepa.ca.gov/UrbanHeat/Index.htm>

Goals of the project

- **A 20-year study** to test tree species
 - a) for their qualities as urban trees, and
 - b) their potential resilience to anticipated climate change impacts, especially
 - **seasonal drought,**
 - **higher temperatures – winter and summer**
 - **increased pest and disease pressure**
- Establish a **network of experimental planting sites and local collaborators** to evaluate the trees via repeated measurements.
- **Share information** on their performance with arborists and urban foresters throughout the region.

Criteria for tree species selection

- Currently not abundant already and not tested extensively in Inland Empire and Southern CA Coast cities.
- Proven successful in regions with somewhat warmer climates.
- Planting stock currently available in nurseries.
- Provide ample shade, need minimal care, have few problems.



Step 1: Experts helped identify promising tree species.

Step 2: Species profiles were created using an expanded Tree Vulnerability matrix* to reveal biotic or abiotic problems.

Habitat	Physiology	Biological interactions
Soil moisture	Drought tolerance	Invasiveness
Soil texture and pH	Wind tolerance	Major or minor pest and disease threats
Sunlight exposure	Salt tolerance	Emerging pest and disease threats

*based on Pest Vulnerability Matrix, Laćan & McBride 2008

Added special features to gauge suitability of species in the urban environment

Special Features		
Biogenic emissions	SelecTree	(+1) Species has low biogenic emissions.
Root damage potential	SelecTree	(+1) Species has low root damage potential.
Longevity	SelecTree	(+1) Species' longevity is over 150 years.
Carbon storage	Urban growth equations	(+1) relatively high biomass for stature class

Special Features (cont'd)

Aesthetics	SelecTree	(+1) Species has flowers or fall colors.
Tree litter	SelecTree	(+1) Species produces minimal litter
Shade potential	SelecTree	(+1) Species has moderate OR moderately dense in and out of leaf shade capacity
Biodiversity	Municipal inventories	(+1) Species is <1% of total abundance in climate zone or not in top 10 importance value

Step 3: Nursery availability

Factor	Positive Vulnerability Score
HABITAT	
Soil Moisture	(+) Species adapted to wet to dry soil.
Soil Texture and pH	(+1) Species tolerates all soil texture types and pH ranges: Soil Texture: Clay, Loam, Sand and Soil pH: Acidic, Neutral, Alkaline
Sunlight Exposure	(+1) Species is tolerant to sun, shade, and filtered exposure



Ghost gum (*Corymbia papuana*)

PHYSIOLOGY	
Drought Tolerance	(+1) Species has low or very low water needs.
Wind Tolerance	(+1) Species has strong branch strength.
Salt Tolerance	(+1) Species salinity tolerance is high.



Desert willow (*Chilopsis linearis*)

BIOLOGICAL INTERACTIONS	
Invasiveness	(+1) Species is not invasive, or is native to California.
Major or Minor Pest and Disease Threats	(+1) Species has minor or no pest and disease threats.
Emerging Pest and Disease Threats	(+1) Species has minor or no emerging pests and diseases.



Rosewood (*Dalbergia sissoo*)

DATA SOURCE: Tree characteristics

General Notes

An open, fast-growing tree with weeping, long and linear leaves. Provides light shade.

Has fragrant Flower.

Native to Australia.

SelectTree: Tree Detail

SHOESTRING ACACIA

Acacia stenophylla



Leaves Linear, Gray Green, No Change, Evergreen.

Flowers Showy. FragrantPale Yellow. Flowers in Spring or Winter. Has perfect flowers (male and female parts in each flower).

Brown Pod, Very Large (Over 3.00 inches), fruiting in Spring, Summer or Fall.

Bark Dark Gray, Furrowed or Smooth.

Shading Capacity Rated as Moderately Low in Leaf.

Litter Issue is Dry Fruit.

Tree Site Conditions & Constraints

Sunset Zones 8, 9 and 12 - 24.

USDA Hardiness Zones 8 - 11.

Exposure Full Sun.

Moist to Dry and Well Drained Soil.

nt.

Sand Texture.

to Highly Alkaline Soil pH.

nce is Moderate.

nce is Good in Mild Zone.

ty & Environmental Concerns

th Rated as Weak.

Hazard.

able.

Special Uses & Values

Ornamental.

<https://selecttree.calpoly.edu/>

DATA SOURCE: Invasiveness



California Invasive Plant Council
Cal-IPC
Protecting California's wildlands through science, education, and policy

Cal-IPC > Invasive Plants > Invasive Plant Management > plant profiles > **Eucalyptus camaldulensis**

***Eucalyptus camaldulensis* (red gum)**

Eucalyptus camaldulensis (red gum) is a tree (family Myrtaceae) found in southern California. *Eucalyptus camaldulensis* increases risk of catastrophic wildland fires and over-crowds native plants and trees.

Cal-IPC Inventory rating: Limited

Cal-IPC Resources on *Eucalyptus camaldulensis*

- [California Invasive Plant Inventory Plant Assessment Form](#) - Information gathered by Cal-IPC on the impacts, rate of spread, and distribution of invasive plants in California. Does not include management information.

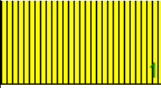




Eucalyptus camaldulensis
Photo courtesy Dr. Mark Brunell

Home
Invasive Plants
Definitions & Impacts
California Inventory
Prevention
Early Detection
Mapping
Management
Research
Symposium

<http://www.cal-ipc.org/paf/>

DATA SOURCE: Pest Vulnerability Matrix

	<i>Abutilon</i>	<i>Acacia</i>	<i>Acacia flor.</i>	<i>Agavaceae</i>	<i>Albizia</i>	<i>Alnus</i>		
Probable Cause ↓	Abutilon (Abutilon spp.), Chinese bellflower , Chinese lantern	Acacia (Acacia spp.)	Acacia floribunda	Agave (Agave spp.); Yucca (Yucca spp.)	Albizia (Albizia spp.), Mimosa , Silk tree	Alder (Alnus spp.)	Notes	Problem Description
Pest overlap →	5%	8%	2%	3%	6%	14%		
Pest count →	5	9	2	3	6	15		
Proportion of all trees	1	1	1	1	1	1		
Abutilon mosaic virus.							Often produces a desired color on leaves	Leaves with yellowish blotch
Anthracnose : Apiognomonia; Cylindrosporium; Marssonina; Glomerella; Colletotrichum							Multiple pathogens, similar symptoms	Leaves brown, dead areas; severely affected. Pale blotch drop prematurely.
Armillaria root rot or Oak root fungus.							Common with overwatering; check species/cultivar!	Leaves discolor, stunt, wilt, Minute white fungus growths
Ash dieback on Raywood ash.							Only on ' Raywood ' ash	Foliage fades, yellows, brown die. Entire plant may die.
Bacterial blight and canker or Bacterial blast.							Not Important	Blossoms, leaves, and terminal base of leaves or on fruit. C
Bacterial leaf scorch , Xylella fastidiosa.							Important on Oleander	Leaves brown around edges
Botryosphaeria canker							When planted out of native range (esp. drought)	Foliage turns red, brown, then bark.
Chestnut blight, Cryphonectria (=Endothia) parasitica.							Not in western US; but deadly in the east!	Leaves turn yellow or brown prematurely. Orange canker becomes girdled and the tree

12 tree species were selected for Inland Southern California

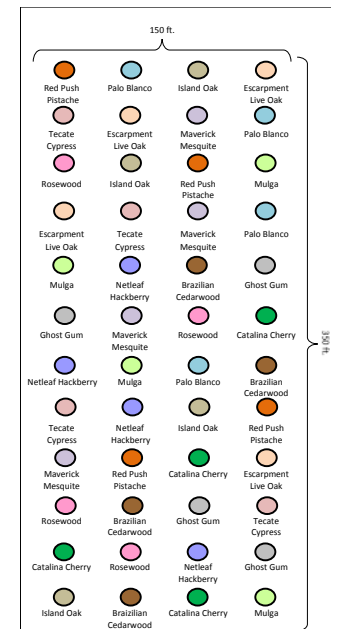
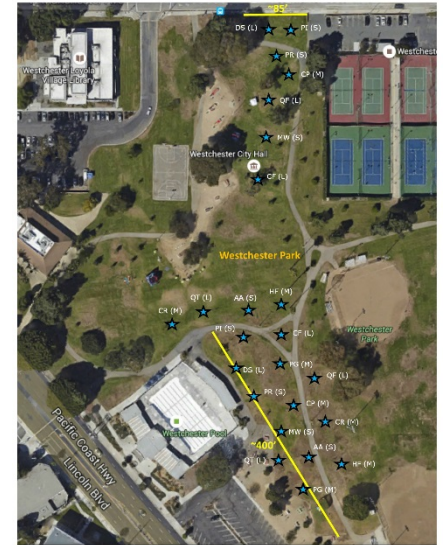
Scientific Name	Common Name
California native	
<i>Celtis reticulata</i>	Netleaf hackberry
<i>Hesperocyparis forbesii</i>	Tecate cypress
<i>Quercus tomentella</i>	Island oak
Australia	
<i>Acacia aneura</i>	Mulga
<i>Corymbia papuana</i>	Ghost gum
Southwest US	
<i>Chilopsis linearis</i> 'Bubba'	Desert willow
<i>Mariosousa willardiana</i>	Palo blanco
Oklahoma-Texas-Western US	
<i>Prosopis galindulosa</i> 'Maverick'	Maverick mesquite
<i>Quercus fusiformis</i>	Escarpment live oak
Asia/South America	
<i>Dalbergia sissoo</i>	Rosewood
Other	
<i>Pistacia</i> 'Red Push'	Red Push pistache
<i>Parkinsonia</i> x 'Desert Museum'	Desert Museum palo verde

12 tree species were selected for Coastal Southern California

Scientific Name	Common Name
California native	
<i>Celtis reticulata</i>	Netleaf hackberry
<i>Hesperocyparis forbesii</i>	Tecate cypress
<i>Prunus ilicifolia ssp. Lyonii</i>	Catalina cherry
<i>Quercus tomentella</i>	Island oak
Australia	
<i>Acacia aneura</i>	Mulga
<i>Corymbia papuana</i>	Ghost gum
Southwest US	
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Asia/South America	
<i>Dalbergia sissoo</i>	Rosewood
<i>Cedrela fissilis</i>	Brazilian cedarwood
Other	
<i>Pistacia 'Red Push'</i>	Red Push pistache

Experimental design

- Park sites
 - **City of Los Angeles Recreation and Parks Dept.**
 - In each climate zone, **96** trees total were planted across 4 parks (24 each).
 - **Los Angeles Beautification Team** (Sharyn!) organized volunteers, plus great efforts by City personnel (=Leon and crew!)
- Reference sites
 - **UC Riverside Citrus Research Center & South Coast Research and Extension Center**
 - **48** trees total were planted per site (4 each per 12 species)
 - **UC Extension staff** planted and maintain trees

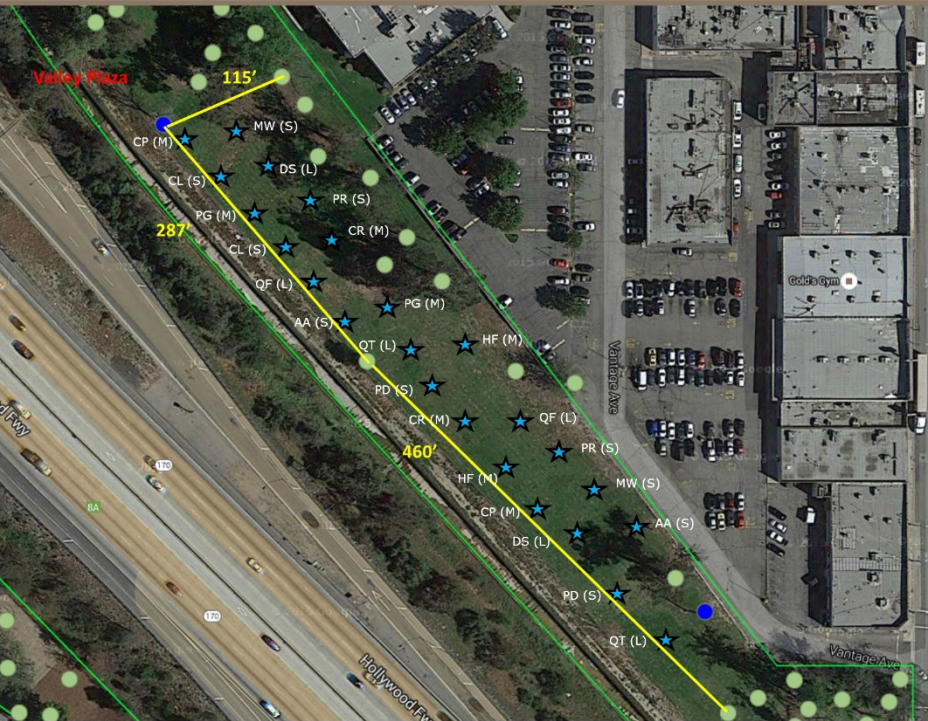


Climate Ready Tree Sites



Planting days

LA Rec & Parks ; LA
Beautification Team



Valley Plaza Park
Planting date: 02-04-2016

Planting days

Valley Plaza Park



Planting days

Valley Plaza Park



Planting days

LA Beautification Team & volunteers



Woodley Park
Planting date: 04-23-2016

Planting days

Woodley Park



Planting days



South Coast Rec Planting 2-10-2016



Planting days

South Coast Rec staff



South Coast Rec
Planting 2-10-2016

Tree monitoring

Every year for first 5 years.

Every 3 years after that.

Measurements:

- Tree size: height, DBH, canopy diameter.
- Soil type: texture, nutrients, bulk density

Monitor:

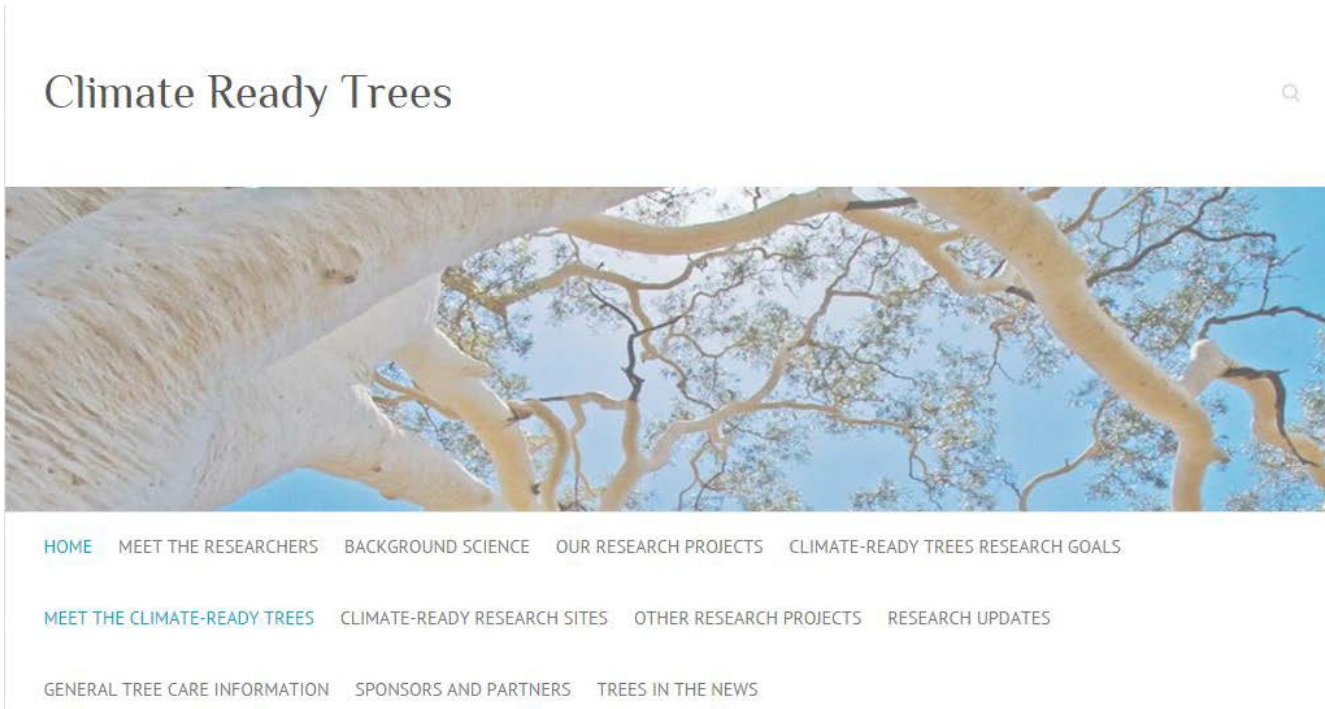
- Tree structure (branching, roots)
- Pruning done
- Any pests or diseases
- Potential causes for mortality

Environmental factors:

- Irrigation schedule
- ET, minimum temperatures (CIMIS)



Project website (coming soon)



Thank you!

Tree Planting and Maintenance

- Los Angeles Beautification Team many volunteers!!
- UC Riverside Citrus Research Center
- South Coast Research and Extension Center
- UC Cooperative Extension

Trees graciously donated

- Mountain States Wholesale Nursery

- LA Center for Urban Natural Resources Sustainability
2015-2017: “New Trees for a New Climate”
- ISA Western Chapter
- The Britton Fund
- US Forest Service, Pacific Southwest Research Station

Research partnership

