Urban Forest Resource Analysis Sacramento, CA

2018

City of SACRAMENTO

DAVEY Resource Group

Urban Forest Resource Analysis Sacramento, CA

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Executive Summary

Public trees, those trees along City streets and in City parks, play a vital role in the City of Sacramento, California. They provide numerous tangible and intangible benefits to residents, visitors, and neighboring communities. The City of Sacramento recognizes that public trees are a valued resource, a vital component of the urban infrastructure, and part of the City's identity. To support the preservation and management of public trees, the City of Sacramento provided Resource Group (DRG) an inventory of city-managed trees. Data collection included species, size, condition, maintenance needs, and geographic location. DRG used this data in conjunction with i-Tree *Streets* benefit-cost modeling software (itreetools.org) to develop a detailed and quantified analysis of the existing structure, function, and value of the public tree inventory.

Structure

A structural analysis is the first step towards understanding the benefits provided by the public trees as well as their management needs. As of 2018, Sacramento's public tree inventory includes 87,324 trees. Considering species composition, diversity, age distribution, canopy coverage, and replacement value, DRG determined that the following information characterizes Sacramento's public tree resource:

- 194 unique species were identified in the inventory.
- The predominant species are *Platanus x acerifolia* (London planetree, 15.5%), *Pistacia chinensis* (Chinese pistache, 5.2%) and *Zelkova serrata* (Japanese zelkova, 4.4%).
- 61.1 % of all trees are 12 inches in diameter (DBH[1]) or less and 16.5% are greater than 24 inches (DBH).
- 74.4% of trees in Sacramento are deciduous broadleaf, followed by evergreen conifer at 12.1%. Four percent (4.3%) of the population is comprised of palms.
- Public trees provide an estimated 1,355 acres of canopy cover, approximately 2.1% of the total land area.
- Replacement of the 87,324 public trees with trees of equivalent size, species, and condition, would cost nearly $409 million.

Benefits

Annually, Sacramento's public trees provide cumulative benefits to the community at an average value of $120.06 per tree, for a total value of nearly $10.5 million (Figure 1). These benefits include:

- Intercepting nearly 65 million gallons of stormwater, valued at $504,732, an average of $5.78 per tree.

[1] DBH: Diameter at Breast Height. DBH represents the diameter of the tree when measured at 1.4 meters (4.5 feet) above ground (U.S.A. standard)

- Reducing atmospheric carbon dioxide by 6,485 tons annually, valued at $97,275, an average of $1.11 per tree.
- Improving air quality by removing 21.4 tons of pollutants, valued at $992,296.50, an average of $11.36 per tree.
- Reducing electricity (9,872 MWh) and natural gas (22,503 therms) use through shading and climate effects for a benefit of $1.2 million, an average of $13.15 per tree.
- Increasing property values by $7.7 million, an average of $88.65 per tree.

When the annual investment of $8.2 million for the management of public trees is considered, the annual net benefit (benefits minus investment) to the community is nearly $2.3 million. In other words, for every $1 invested in public trees the community receives $1.28 in benefits.

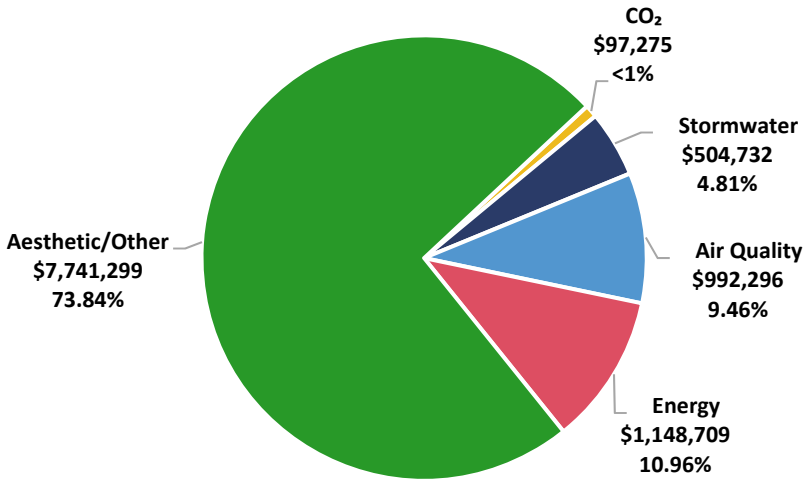
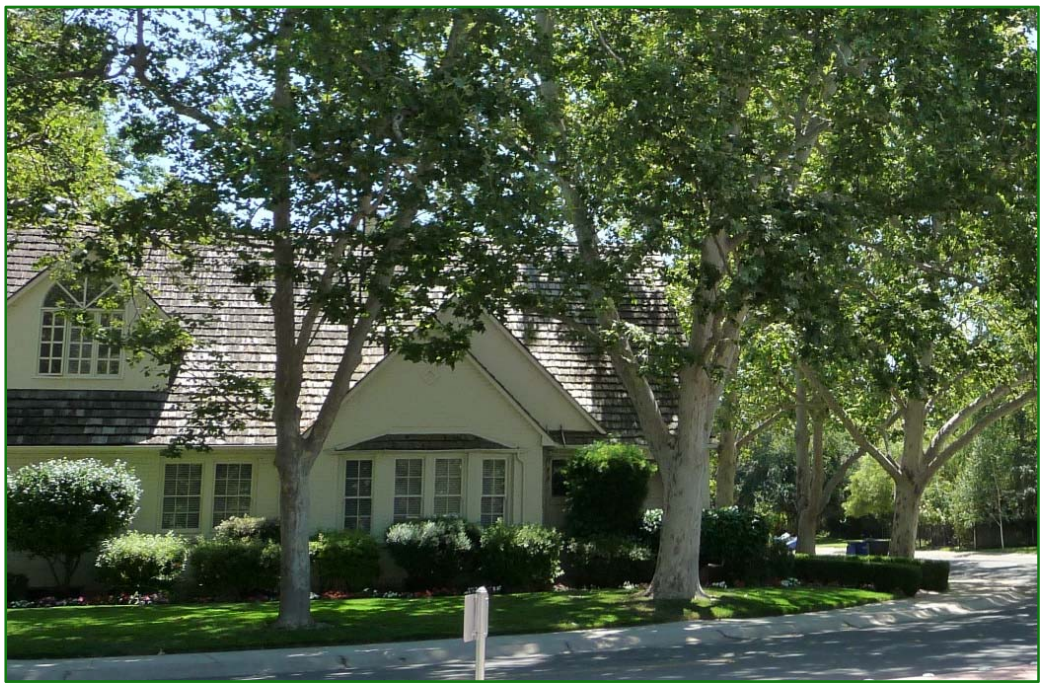


Figure 1: Annual Benefits of Public Trees in Sacramento



Trees contribute to increased property values by $7.7 million, an average of $88.65 per tree.

Management

Sacramento's public tree inventory is a dynamic resource that requires continued investment to maintain and realize its full benefit potential. Trees are one of the few community assets that have the potential to increase in value with time and proper management.

Appropriate and timely tree care can substantially increase lifespan. When trees live longer, they provide greater benefits. As individual trees mature and aging trees are replaced, the overall value of the community forest and the amount of benefits provided grow as well. However, this vital living resource is vulnerable to a host of stressors and requires ecologically sound and sustainable management to ensure a continued flow of benefits for future generations.

Overall, the public tree inventory in Sacramento is a relatively young with 61.1% of the population less than 12 inches DBH. With proactive management, planning, and new and replacement tree planting, the benefits from this resource will continue to increase as young trees mature.

Based on this resource analysis, Davey Resource Group recommends that the City continue to implement the following best practices:

- Provide structural pruning for young trees and a regular pruning cycle for all trees.
- Protect existing trees and manage risk with regular inspection to identify and mitigate structural and age-related defects to manage risk and reduce the likelihood of tree and branch failure.
- Increase species diversity in new and replacement tree plantings to reduce reliance on *Platanus x acerifolia* (London planetree).
- Continue to maintain and update the inventory database, including tracking tree growth and condition during regular pruning cycles.

With adequate protection and planning, the value of the public tree resource in Sacramento will continue to increase over time. Proactive management and a tree replacement plan are critical to ensuring that residents continue to receive a high return on their investment. Along with new tree installations and replacement plantings, funding for tree maintenance and inspection is vital to preserving benefits, prolonging tree life, and managing risk. Existing mature trees should be maintained and protected whenever possible since the greatest benefits accrue from the continued growth and longevity of the existing canopy. Public trees support the quality of life for residents and neighboring communities.

Platanus x acerifolia (London planetree) is Sacramento's most predominant tree species.

Introduction

Sacramento, the state capital of California, is in the northern part of the Sacramento Valley at the junction of the American and Sacramento Rivers. The first people to call the region home were the Plains Miwok tribe of Native Americans. In 1808, the Spanish explorer Gabriel Moraga arrived and named the Sacramento Valley and the Sacramento River. Then, in August 1839, John Sutter arrived with a Mexican land grant of 50,000 acres. In 1847, Sutter planted 2,000 fruit trees which started the agriculture industry in the Sacramento Valley (Timeline, 2004). When gold was discovered in 1848, the population of the area rose dramatically. In 1849, citizens adopted a city charter and Sutter formally planned the City of Sacramento, which was recognized by the state legislature in 1850. As such, Sacramento is the oldest city in California. In 1854, the State Legislature officially moved to Sacramento and the City was named the permanent state capital at the Constitutional Convention of 1879.

In 2002, TIME magazine dubbed Sacramento the "most diverse city". Today, with an estimated population of 493,025, the community continues to embrace diversity and boasts an expanding art scene with numerous cultural celebrations and vibrant art.

In 2017, according to the Trust for Public Land, Sacramento ranked 21st among the 100 largest US cities based on park acreage and the number of people served. With nearly 5,000 acres of parkland, an extensive trail system, and mild winters, Sacramento provides year-round opportunities for outdoor activities, including hiking, biking, and water activities.

The most notable characteristic of Sacramento are its trees. Recently Sacramento was identified as the greenest city in the United States with an estimated 23.6% canopy cover, according to TreePedia, a project conducted by MIT's Senseable City Lab, which utilized Green View Index (GVI) calculated by Google Street View (GSV) panoramas to estimate tree canopy cover from the perception of Street View[2] (2017).

Sacramento has a reputation as a "City of Trees" and is recognized by the Arbor Day Foundation as a Sterling Tree City USA. Increasingly, Sacramento has had to contend with how to protect and preserve trees in the wake of urban development. Individual trees and a healthy urban forest play an important role in the quality of life for citizens of Sacramento. Research has demonstrated that healthy urban trees can improve the local environment and lessen the impact resulting from urbanization and industry (CUFR). Urban trees slow and reduce stormwater runoff, helping to protect waterways from excess pollutants and particulates. Trees improve air quality by manufacturing oxygen and absorbing carbon dioxide (CO_2), as well as filtering and reducing airborne particulate matter such as smoke and dust. Urban trees reduce energy consumption up to 30% by shading structures from solar energy and reducing the overall rise in temperature

[2] Treepedia does not map parks, because GSV does not cover park areas, while it does include streets.

created through urban heat island effects. Critical habitat for wildlife and promote a connection to the natural world is also provided by the urban forest.

In addition to these direct improvements, healthy urban trees increase the overall attractiveness of a community and have been proven to increase the value of local real estate by 7 to 10%, as well as promoting shopping, retail sales, and tourism (Wolf, 2007). Trees support a more livable community, fostering psychological health and providing residents with a greater sense of place (Ulrich, 1986; Kaplan, 1989).

The tree inventory data was analyzed with i-Tree's *Streets*, a STRATUM Analysis Tool (*Streets* v5.1.5; i-Tree v6.1.19), to develop a resource analysis and report of the existing condition of this public tree resource. This report, unique to Sacramento, quantifies the value of the public tree resource with regard to actual benefits derived from the tree resource. In addition, the report provides baseline values that can be used to develop and update a public tree resource management plan. Management plans help communities determine where to focus available resources and set benchmarks for measuring progress.

This analysis describes the structure, function, and value of Sacramento's public tree resource. With this information, managers and citizens can make informed decisions about tree management strategies. This report provides the following information:

- A description of the current structure of Sacramento's public tree resource and an established benchmark for future management decisions.
- The economic value of the benefits from the public tree resource, illustrating the relevance and relationship of trees to local quality of life issues such as air quality, environmental health, economic development, and psychological health.
- Data that may be used by resource managers in the pursuit of alternative funding sources and collaborative relationships with utility purveyors, non-governmental organizations, air quality districts, federal and state agencies, legislative initiatives, or local assessment fees.
- Benchmark data for developing a long-term public tree resource management plan.

Individual trees and a healthy urban forest play an important role in the quality of life for citizens of Sacramento.

Public Tree Resource

A tree resource is more thoroughly understood through examination of composition and species richness of diversity (Figure 2). Consideration of canopy cover, age distribution, condition, and performance, provide a foundation for planning and management strategies. Inferences based on this data can help managers understand the importance of individual tree species to the overall forest as it exists today and provide a basis to project the future potential of the resource.

Population Composition

Broadleaf species dominate Sacramento's public tree resource, composing 83.6% of the total inventory. Broadleaf trees typically have larger canopies than coniferous trees of the same size. Since many of the measurable benefits derived from trees are directly related to leaf surface area, broadleaf trees generally provide the greatest level of benefits to a community. Larger-statured broadleaf tree species provide greater benefits than smaller-statured trees, independent of diameter. The broadleaf deciduous species is composed of three size categories; 41.7% large-stature, 23.8% medium-stature, and 8.9% small-stature trees. Coniferous evergreens comprise 12.0% of the population, with 8.8% large-stature and 3.2% medium-stature. Broadleaf evergreen trees comprise 9.3% of the population, with 3.5% large-stature, 3.1% medium-stature, and 2.6% small-stature trees. There are 983 (1.1%) large palms, 56 (<1%) medium palms, 2,737 (3.1%) small palms, composing 4.3% of the population.

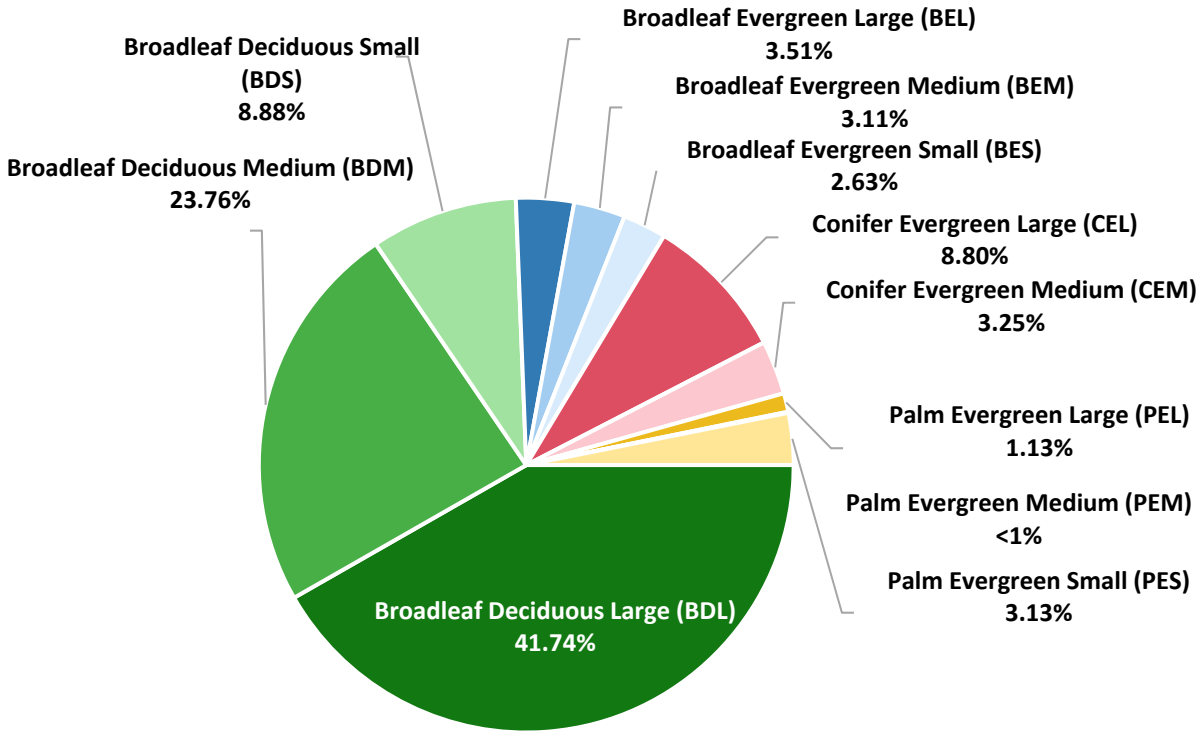


Figure 2: Composition of Tree Type and Stature in Sacramento

Species Richness and Composition.

The public tree resource includes a mix of 194 unique species (Appendix C), significantly more than that of the mean of 53 species reported by McPherson and Rowntree (1989) in their nationwide survey of street tree populations in 22 U. S. cities.

The top three prevalent species represent more than 25.2% of the overall population. These are *Platanus x acerifolia* (London planetree, 15.5%), *Pistacia chinensis* (Chinese pistache, 5.2%), and *Zelkova serrrata* (Japanese zelkova, 4.4%), In general, no single species should represent greater than 10% of the total population and no single genus more than 20% (Clark et al, 1997). *Platanus x acerifolia* exceeds this widely-accepted rule. Figure 3 shows the most prevalent species representing more than 1% of the overall tree population, while all other species (29.4%) amounts to 165 species.

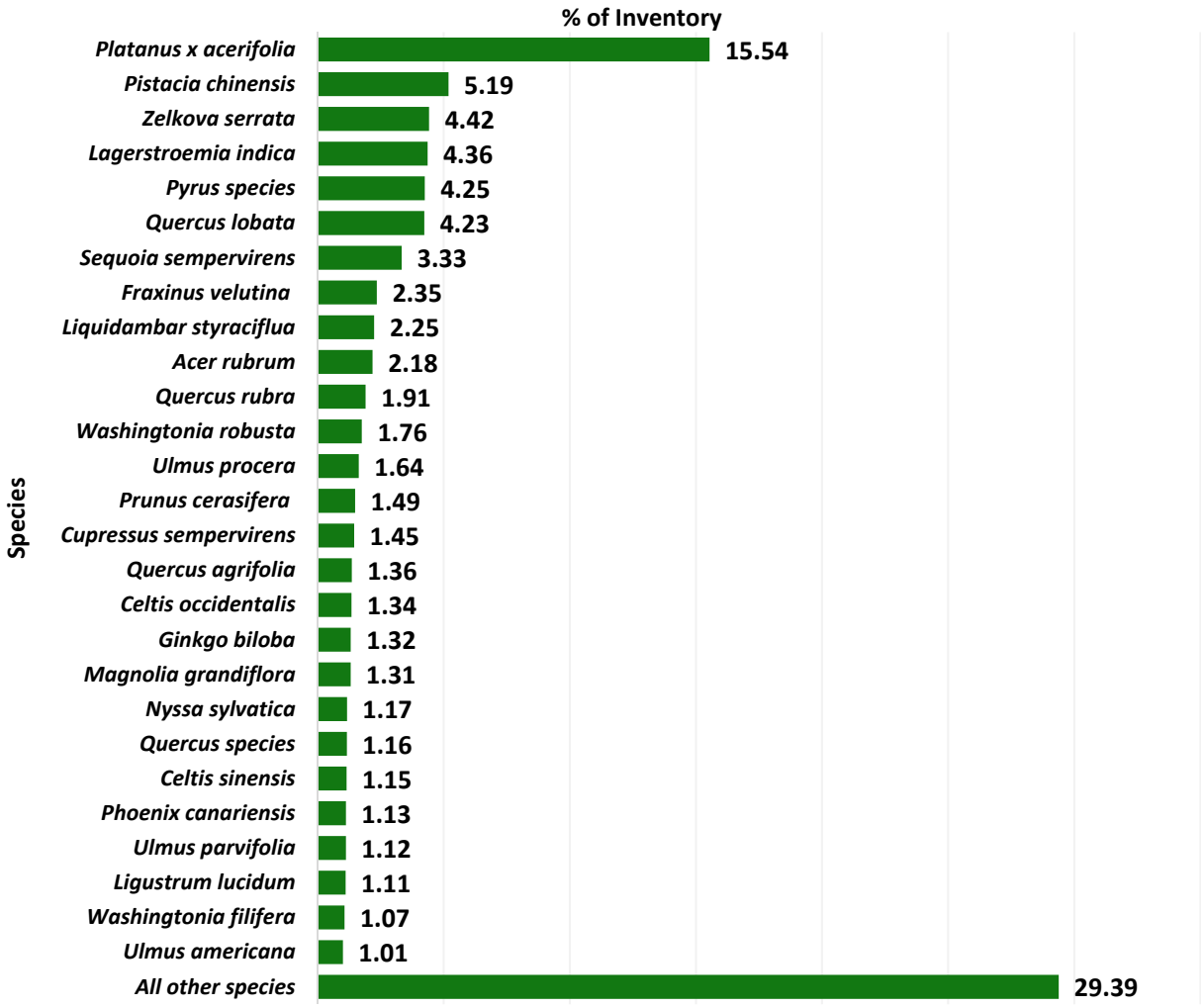


Figure 3: Most Prevalent Species in Sacramento

Maintaining diversity in a public tree resource is important. Dominance of any single species or genus can have detrimental consequences in the event of storms, drought, disease, pests, or other stressors that can severely affect a public tree resource and the flow of benefits and costs over time. Catastrophic pathogens, such as Dutch elm disease (*Ophiostoma ulmi*), Emerald Ash Borer

(*Agrilus planipennis*), Asian Longhorned Beetle (*Anoplophora glabripennis*), and Sudden Oak Death (*Phytophthora ramorum*) are some examples of unexpected, devastating, and costly pests and pathogens that highlight the importance of diversity and the balanced distribution of species and genera.

Table 1: Population Summary of Tree Species in Sacramento

	Diameter (DBH) Class									
Species	**0-3**	**3-6**	**6-12**	**12-18**	**18-24**	**24-36**	**36-48**	**> 48**	**Total**	**% of Pop.**
Broadleaf Deciduous Large (BDL)										
Platanus x acerifolia	1,174	1,636	2,217	2,005	2,570	3,365	563	44	13,574	15.5%
Quercus lobata	972	733	868	592	227	197	70	37	3,696	4.2%
Fraxinus velutina	49	23	99	327	705	806	40	3	2,052	2.3%
Liquidambar styraciflua	100	129	472	739	374	141	6	0	1,961	2.2%
Quercus rubra	740	254	424	153	48	40	7	0	1,666	1.9%
Ulmus procera	0	0	0	13	43	423	709	240	1,428	1.6%
Celtis occidentalis	671	234	138	88	38	5	0	0	1,174	1.3%
Quercus spp	500	148	204	87	28	38	8	3	1,016	1.2%
Celtis sinensis	265	327	146	96	80	66	19	5	1,004	1.1%
Ulmus parvifolia	124	109	122	159	257	202	8	1	982	1.1%
Ulmus americana	0	0	0	43	135	552	132	16	878	1.0%
All Other BDL	2,291	1,088	1,326	940	552	592	182	44	7,015	8.0%
Total	***6,886***	***4,681***	***6,016***	***5,242***	***5,057***	***6,427***	***1,744***	***393***	***36,446***	***41.7%***
Broadleaf Deciduous Medium (BDM)										
Pistacia chinensis	1,539	879	1,235	698	161	22	0	0	4,534	5.2%
Zelkova serrata	1,022	285	155	388	811	1,122	77	2	3,862	4.4%
Pyrus spp	890	1,108	1,183	464	68	0	1	0	3,714	4.3%
Acer rubrum	1,481	272	125	18	4	3	1	0	1,904	2.2%
Ginkgo biloba	621	133	233	117	29	13	3	0	1,149	1.3%
Nyssa sylvatica	792	145	75	7	3	0	0	0	1,022	1.2%
All Other BDM	1,304	668	902	747	478	423	32	5	4,559	5.2%
Total	***7,649***	***3,490***	***3,908***	***2,439***	***1,554***	***1,583***	***114***	***7***	***20,744***	***23.8%***
Broadleaf Deciduous Small (BDS)										
Lagerstroemia indica	2,729	842	216	20	3	0	0	0	3,810	4.4%
All Other BDS	2,311	771	620	156	37	39	9	1	3,944	4.5%
Total	***5,040***	***1,613***	***836***	***176***	***40***	***39***	***9***	***1***	***7,754***	***8.9%***
Broadleaf Evergreen Large (BEL)										
Quercus agrifolia	440	210	161	91	85	153	43	2	1,185	1.4%
All Other BEL	424	213	214	207	226	376	154	66	1,880	2.2%
Total	***864***	***423***	***375***	***298***	***311***	***529***	***197***	***68***	***3,065***	***3.5%***
Broadleaf Evergreen Medium (BEM)										
Magnolia grandiflora	258	157	256	259	137	72	5	2	1,146	1.3%
All Other BEM	297	339	295	242	176	173	32	13	1,567	1.8%
Total	***555***	***496***	***551***	***501***	***313***	***245***	***37***	***15***	***2,713***	***3.1%***
Broadleaf Evergreen Small (BES)										
Ligustrum lucidum	551	245	126	36	8	6	0	0	972	1.1%
All Other BES	502	350	365	84	18	6	0	0	1,325	1.5%
Total	***1,053***	***595***	***491***	***120***	***26***	***12***	***0***	***0***	***2,297***	***2.6%***
Conifer Evergreen Large (CEL)										
Sequoia sempervirens	297	384	560	408	449	555	180	79	2,912	3.3%
Cupressus sempervirens	286	507	383	65	18	8	0	0	1,267	1.5%
Pinus spp	179	170	156	117	91	88	24	10	835	1.0%
All Other CEL	517	275	400	471	455	430	102	23	2,673	3.1%
Total	***1,279***	***1,336***	***1,499***	***1,061***	***1,013***	***1,081***	***306***	***112***	***7,687***	***8.8%***
Conifer Evergreen Medium (CEM)										
Prunus cerasifera	417	499	320	63	3	0	0	0	1,302	1.5%
All Other CEM	724	328	203	130	86	60	8	1	1,540	1.8%

Species	Diameter (DBH) Class 0-3	3-6	6-12	12-18	18-24	24-36	36-48	> 48	Total	% of Pop.
Total	***1,141***	***827***	***523***	***193***	***89***	***60***	***8***	***1***	***2,842***	***3.3%***
Palm Evergreen Large (PEL)										
Phoenix canariensis	23	26	22	33	160	691	24	4	983	1.1%
Total	***23***	***26***	***22***	***33***	***160***	***691***	***24***	***4***	***983***	***1.1%***
Palm Evergreen Medium (PEM)										
Trachycarpus fortunei	5	22	29	0	0	0	0	0	56	0.1%
Total	***5***	***22***	***29***	***0***	***0***	***0***	***0***	***0***	***56***	***0.1%***
Palm Evergreen Small (PES)										
Washingtonia robusta	187	175	334	634	186	19	0	0	1,535	1.8%
Washingtonia filifera	23	48	69	55	101	584	55	0	935	1.1%
All Other PES	165	56	38	7	0	1	0	0	267	0.3%
Total	***375***	***279***	***441***	***696***	***287***	***604***	***55***	***0***	***2,737***	***3.1%***
Grand Total	***24,870***	***13,788***	***14,691***	***10,759***	***8,850***	***11,271***	***2,494***	***601***	***87,324***	***100%***

Species Importance

To quantify the significance of any one species in Sacramento's public tree resource, an importance value (IV) is derived for each of the most prevalent species. Importance values are particularly meaningful to public tree resource managers because they indicate a reliance on the functional capacity of a species. **i-Tree *Streets* calculates importance value based on the mean of three values: percentage of total population, percentage of total leaf area, and percentage of total canopy cover.** Importance value goes beyond tree numbers alone to suggest reliance on specific species based on the benefits they provide. The importance value can range from zero (which implies no reliance) to 100 (suggesting total reliance). A complete table, with importance values for all species, is included in Appendix C.

To reiterate, research strongly suggests that no single species should dominate the composition of a public tree resource. Because importance value goes beyond population numbers alone, it can help managers to better comprehend the resulting loss of benefits from a catastrophic loss of any one species. When importance values are comparatively equal among the 10 to 15 most prevalent species, the risk of significant reductions to benefits is reduced. Of course, suitability of the dominant species is another important consideration. Planting short-lived or poorly adapted species can result in short rotations and increased long-term management costs.

Table 2 lists the importance values of the most prevalent species. These 27 species represent 70.6% of the overall population, 78.7% of the total leaf area, and 77.6% of the total canopy cover for a combined importance value of 75.6. Of these, Sacramento relies most on *Platanus x acerifolia* (IV = 20.7). This species dominates the inventory, providing significant benefits and a sense of place. They are key to sustaining the benefits provided by the public tree resource, as well as preserving the essence of Sacramento for years to come. However, because this species is overrepresented in the inventory their prevalence should be reduced through future plantings.

Some species are more significant contributors to the urban forest than population numbers would suggest. For example, *Ulmus procera* (English elm) represents just 1.6% of the population, but 6.9% of canopy cover and 13.6% of leaf surface area. This large-stature species is represented entirely of established trees (>12" DBH). The high IV indicates that this species has the greatest functional capacity to provide benefits compared to their representation in the inventory.

For some species, low importance values are primarily a function of tree type. Immature or small-stature species frequently have lower importance values than their representation in the inventory might suggest. This is largely due to relatively small leaf area and canopy coverage. For example, *Lagerstroemia indica* (crapemyrtle) represents 4.4% of the population, but the importance value is 1.67 and the crowns only contribute to <1% of the total leaf area and <1% of the canopy.

Table 2: Importance Value of Sacramento's Prevalent Species

Species	*Number of Trees*	*% of Total Trees*	*Leaf Area (ft^2)*	*% of Total Leaf Area*	*Canopy Cover (ft^2)*	*% of Total Canopy Cover*	*Importance Value*
Platanus x acerifolia	13,574	15.54	48,887,051	19.78	15,759,151	26.69	**20.67**
Pistacia chinensis	4,534	5.19	6,687,978	2.71	2,231,630	3.78	**3.89**
Zelkova serrata	3,862	4.42	30,982,488	12.53	5,481,803	9.29	**8.75**
Lagerstroemia indica	3,810	4.36	593,904	0.24	232,652	0.39	**1.67**
Pyrus species	3,714	4.25	3,458,027	1.40	1,198,868	2.03	**2.56**
Quercus lobata	3,696	4.23	6,754,366	2.73	1,775,252	3.01	**3.32**
Sequoia sempervirens	2,912	3.33	8,674,381	3.51	2,409,903	4.08	**3.64**
Fraxinus velutina	2,052	2.35	8,794,875	3.56	2,704,469	4.58	**3.50**
Liquidambar styraciflua	1,961	2.25	7,200,300	2.91	1,183,207	2.00	**2.39**
Acer rubrum	1,904	2.18	689,209	0.28	219,007	0.37	**0.94**
Quercus rubra	1,666	1.91	1,488,208	0.60	446,005	0.76	**1.09**
Washingtonia robusta	1,535	1.76	248,264	0.10	124,668	0.21	**0.69**
Ulmus procera	1,428	1.64	33,821,717	13.68	4,089,201	6.93	**7.41**
Prunus cerasifera	1,302	1.49	541,698	0.22	123,376	0.21	**0.64**
Cupressus sempervirens	1,267	1.45	1,072,887	0.43	253,346	0.43	**0.77**
Quercus agrifolia	1,185	1.36	3,112,977	1.26	684,353	1.16	**1.26**
Celtis occidentalis	1,174	1.34	1,074,515	0.43	273,499	0.46	**0.75**
Ginkgo biloba	1,149	1.32	972,003	0.39	218,011	0.37	**0.69**
Magnolia grandiflora	1,146	1.31	1,453,479	0.59	441,999	0.75	**0.88**
Nyssa sylvatica	1,022	1.17	317,647	0.13	77,189	0.13	**0.48**
Quercus species	1,016	1.16	1,104,006	0.45	292,181	0.49	**0.70**
Celtis sinensis	1,004	1.15	2,431,229	0.98	622,662	1.05	**1.06**
Phoenix canariensis	983	1.13	1,080,024	0.44	1,028,218	1.74	**1.10**
Ulmus parvifolia	982	1.12	6,524,910	2.64	1,364,090	2.31	**2.02**
Ligustrum lucidum	972	1.11	505,371	0.20	157,320	0.27	**0.53**
Washingtonia filifera	935	1.07	312,646	0.13	152,631	0.26	**0.49**
Ulmus americana	878	1.01	15,827,795	6.40	2,248,993	3.81	**3.74**
All other species	25,661	29.39	52,601,839	21.28	13,245,037	22.43	**24.37**
Total	***87,324***	***100%***	***247,213,795***	***100%***	***59,038,719***	***100%***	***100.00***

Canopy Cover

The amount and distribution of leaf surface area is the driving force behind the ability of the urban forest to produce benefits for the community (Clark et al, 1997). In other words, as canopy cover increases, so do the benefits afforded by leaf area. The City of Sacramento covers 99.7 square miles (63,784 acres), i-Tree estimates that Sacramento's public trees are providing 2.1 square miles (1,355 acres) of canopy cover, which accounts for 2.1% of total land area.

Relative Age Distribution

Age distribution can be approximated by considering the DBH range of the overall inventory and of individual species. Trees with smaller diameters tend to be younger. It is important to note that palms do not increase in DBH over time, so they are not considered in this analysis. In palms, height more accurately correlates to age.

The distribution of individual tree ages within a tree population influences present and future costs as well as the flow of benefits. An ideally-aged population allows managers to allocate annual maintenance costs uniformly over many years and assures continuity in overall tree canopy coverage and associated benefits. A desirable distribution has a high proportion of young trees to offset establishment and age-related mortality as the percentage of older trees declines over time (Richards, 1982/83). This ideal, albeit uneven, distribution suggests a large fraction of trees (~40%) should be young, with a DBH less than eight (8) inches, while only 10% should be in the large diameter classes (>24 inches DBH).

The age distribution of Sacramento's public tree resource (excluding palms) reveals that 62.3% of trees are 12 inches or less DBH and 15.5% of trees are larger than 24 inches DBH (Figure 4).

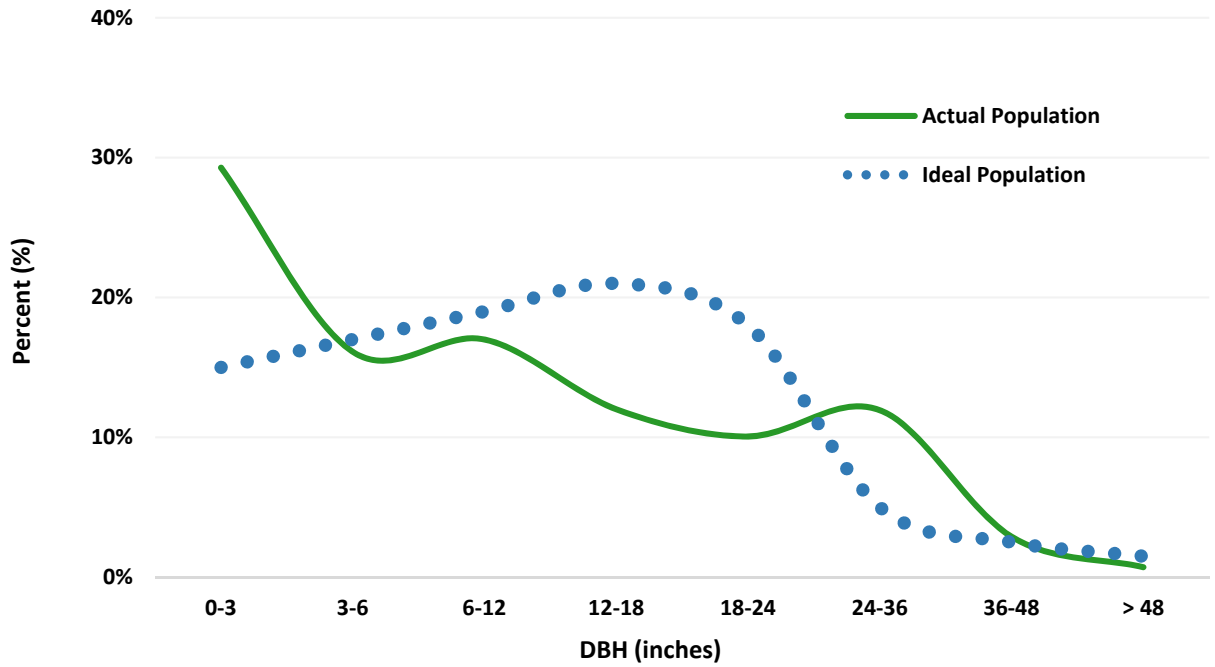


Figure 4: Public Tree Resource Age Distribution for Sacramento

Relative age distribution can also be evaluated for each individual species. The 10 most prevalent species are compared against the ideal DBH distribution in Figures 5-6. The age distribution of prevalent species can help resource managers to understand and foresee maintenance activities and budgetary needs. In addition to informing managers of the economics of prevalent species, managers can use the age distribution to determine trends in plantings and adopt strategies for species selection in the years to come.

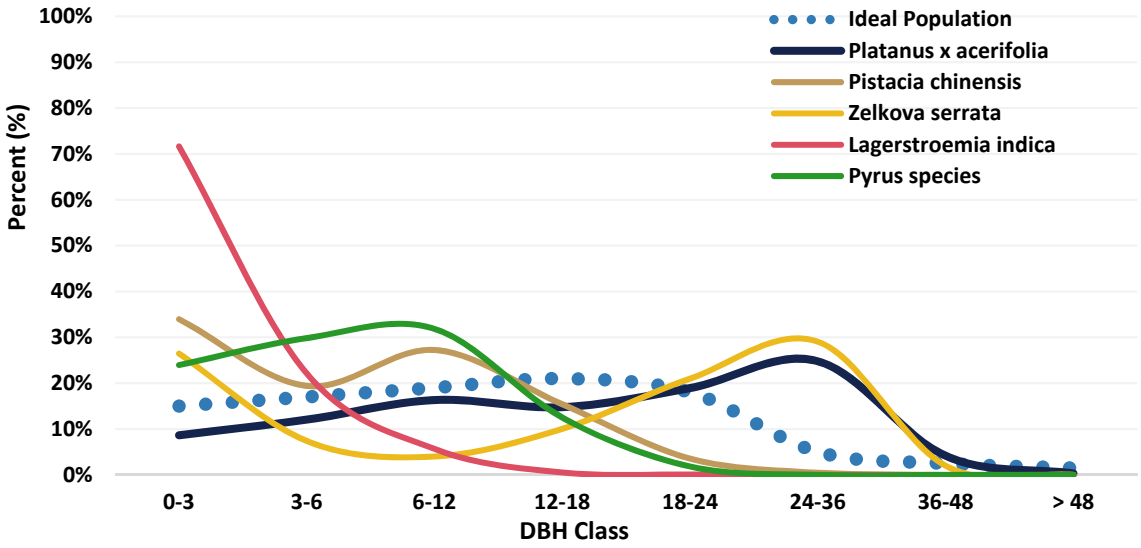


Figure 5: Relative Age Distribution of Top 10 Prevalent Non-Palm Species (Rankings 1-5)

Of Sacramento's top 10 most prevalent public tree species (Figures 5 and 6), all have significant representation in small stature, or young establishing trees (6 to 12-inch DBH). *Fraxinus velutina* (Modesto ash) is the exception to this trend, with 79.2% of the species comprised of trees larger than 18 inches.

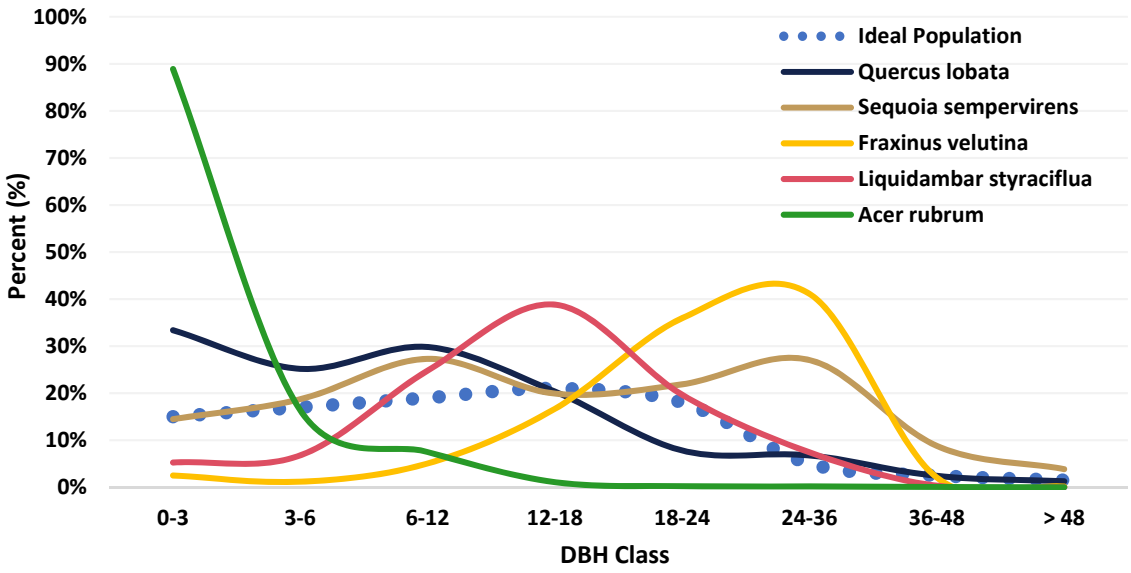


Figure 6: Relative Age Distribution of Top 10 Prevalent Non-Palm Species (Rankings 6-10)

Tree Condition

Tree condition is an indication of how well trees are managed and how well they are performing in a site-specific environment (e.g., street, median, parking lot, etc.). Condition ratings can help managers anticipate maintenance and funding needs. In addition, tree condition is an important factor for the calculation of public tree resource benefits.

Sacramento's public tree inventory does not include current information about the condition of each tree. For the purposes of this analysis, a default condition rating of good was applied to all trees in the inventory. A condition rating of good assumes that a tree has no major structural problems, no significant mechanical damage, and may have only minor aesthetic, insect, disease, or structural problems, and is in good health. While the condition rating is likely quite variable between individual street trees, this default rating was determined to be representative of the overall population.

Tree condition is an indication of how well trees are managed and how well they are performing in a site-specific environment (e.g., street, median, parking lot, etc.).

Replacement Value

The current replacement value of the urban forest in Sacramento is nearly $409 million (Table 3). The replacement value accounts for the historical investment in trees over their lifetime. The replacement value is also a way of describing the value of a tree population (and/or average value per tree) at a given time. The replacement value reflects current population numbers, stature, placement, and condition. There are several methods available for obtaining a fair and reasonable perception of a tree's value (CTLA, 1992; Watson, 2002). The cost approach, trunk formula method used in this analysis assumes the value of a tree is equal to the cost of replacing the tree in its current state (Cullen, 2002).

More than 34.5% of the overall replacement value is attributable to *Platanus x acerifolia* and *Pistacia chinensis*, for a total of nearly $141 million. These species represent 20.3% of the total tree population. *Platanus x acerifolia* has the greatest value, at nearly $88 million an average of $6,479.96 per tree. (Table 5). The average per tree replacement value is $4,684. The replacement value for Sacramento's public tree resource reflects the vital importance of these assets to the community. With proper care and maintenance, the value will continue to increase over time. It is important to recognize that replacement values are separate and distinct from the value of annual benefits produced by this public tree resource and in some instances the replacement value of a tree may be greater than or less than the benefits that that tree may provide.

The current replacement value of the urban forest in Sacramento is nearly $409 million and with proper care and maintenance, the value will continue to increase over time.

Table 3: Replacement Value for Sacramento's Most Prevalent Species

Species	*0-3*	*3-6*	*6-12*	*12-18*	*18-24*	*24-36*	*36-48*	*> 48*	*Total*	*% of Total*
Platanus x acerifolia	193,087	709,689	2,965,462	6,966,517	17,191,564	45,485,777	13,215,240	1,231,594	87,958,929	21.51
Ulmus procera	0	0	0	75,451	483,638	9,650,639	28,137,539	11,362,217	49,709,484	12.15
Zelkova serrata	193,998	183,539	337,120	2,251,930	9,121,642	25,598,150	3,055,840	94,685	40,836,904	9.98
Quercus lobata	180,069	562,517	2,376,291	4,382,862	3,269,303	5,767,081	3,567,650	2,249,981	22,355,753	5.47
Ulmus americana	0	0	0	244,448	1,488,627	12,530,743	5,238,583	757,481	20,259,882	4.95
Sequoia sempervirens	46,640	141,153	606,501	1,146,386	2,415,117	6,005,657	3,384,170	1,770,742	15,516,365	3.79
Pistacia chinensis	281,085	673,459	3,381,013	5,161,099	2,306,049	644,039	0	0	12,446,745	3.04
Liquidambar styraciflua	18,765	66,916	759,573	3,103,343	3,026,627	2,306,052	170,436	0	9,451,712	2.31
Ulmus parvifolia	23,607	69,629	265,346	917,706	2,890,582	4,608,580	317,490	47,343	9,140,282	2.23
Eucalyptus globulus	190	11,669	56,549	98,667	484,961	3,173,934	3,214,585	2,088,643	9,129,199	2.23
Quercus suber	4,542	33,079	211,122	629,296	1,785,875	4,244,806	1,274,161	243,241	8,426,121	2.06
Cinnamomum camphora	17,705	70,196	282,746	853,180	1,405,925	3,148,436	1,230,273	426,083	7,434,543	1.82
Pyrus species	168,528	712,416	2,569,152	2,687,908	764,823	0	39,686	0	6,942,513	1.70
Fraxinus velutina	9,123	6,151	56,618	419,350	1,667,132	3,779,676	327,000	29,171	6,294,222	1.54
Quercus agrifolia	66,787	104,162	266,072	401,761	726,307	2,634,781	1,295,190	71,859	5,566,919	1.36
Platanus racemosa	23,267	61,824	345,820	412,080	607,360	1,733,921	992,156	94,685	4,271,112	1.04
All other species	3,352,021	4,153,161	11,177,003	14,877,847	15,217,373	29,931,215	11,096,509	3,451,921	93,257,050	22.80
Citywide Total	***$4,579,413***	***$7,559,557***	***$25,656,390***	***$44,629,832***	***$64,852,905***	***$161,243,488***	***$76,556,507***	***$23,919,645***	***$408,997,738***	***100%***

Sacramento Tree Benefits

Public trees are important to Sacramento. They help lessen energy use, reduce global carbon dioxide (CO_2), improve air quality, and mitigate stormwater runoff. Additionally, trees provide a wealth of well-documented psychological, social, and economic benefits related primarily to their aesthetic effects. Environmentally, trees make good sense, providing quantifiable benefits to the community; however, the question remains, are the collective benefits worth the cost of management? In other words, are these trees a worthwhile investment for the community? To answer this question, the benefits must be quantified in financial terms.

The i-Tree *Streets* analysis model allows benefits to be quantified based on regional reference cities and local attributes, such as median home values and local energy prices. This analysis provides a snapshot of the annual benefits (along with the value of those benefits) produced by Sacramento's tree population. While the annual benefits produced by these trees can be substantial, it is important to recognize that the greatest benefits are derived from the benefit stream that results over time, from a mature population where trees are well managed, healthy, and long-lived.

This analysis used current inventory data for Sacramento's trees and i-Tree's *Streets* software to assess and quantify the beneficial functions of this resource and to place a dollar value on the annual environmental benefits these trees provide. The benefits calculated by i-Tree *Streets* are estimations based on the best available and current scientific research with an accepted degree of uncertainty. The data returned from i-Tree *Streets* can provide a platform from which informed management decisions can be made (Maco and McPherson, 2003). A discussion on the methods used to calculate and assign a monetary value to these benefits is included in Appendix A.

Trees help lessen energy use, reduce global carbon dioxide (CO_2), improve air quality, and mitigate stormwater runoff.

Atmospheric Carbon Dioxide Reduction

As environmental awareness continues to increase, governments are paying particular attention to global warming and the effects of greenhouse gas (GHG) emissions. As energy from the sun (sunlight) strikes the Earth's surface it is reflected back into space as infrared radiation (heat). Greenhouse gases absorb some of this infrared radiation and trap heat in the atmosphere, modifying the temperature of the Earth's surface. Many chemical compounds in the Earth's atmosphere act as GHGs, including methane (CH_4), nitrous oxide (N_2O), carbon dioxide (CO_2), water vapor, and human-made gases and aerosols. As GHGs increase, the amount of energy radiated back into space is reduced, and more heat is trapped in the atmosphere. An increase in the average temperature of the Earth may result in changes in weather, sea levels, and land-use patterns, commonly referred to as "climate change." In the last 150 years, since large-scale industrialization began, the levels of some GHGs, including CO_2, have increased by 25 percent (U.S. Energy Information Administration).

The Center for Urban Forest Research (CUFR) recently led the development of Urban Forest Project Reporting Protocol. The protocol, which incorporates methods of the Kyoto Protocol and Voluntary Carbon Standard (VCS), establishes methods for calculating reductions, provides guidance for accounting and reporting, and guides urban forest managers in developing tree planting and stewardship projects that could be registered for GHG reduction credits (offsets). The protocol can be applied to urban tree planting projects within school districts, communities, and utility service areas anywhere in the United States.

While the public tree resource in Sacramento may or may not qualify for carbon-offset credits or be traded in the open market, the City's trees are nonetheless providing a significant reduction in atmospheric carbon dioxide (CO_2) for a positive environmental and financial benefit to the community.

Urban trees reduce atmospheric CO_2 in two ways:

- Directly, through growth and the sequestration of CO_2 in wood, foliar biomass, and soil.
- Indirectly, by lowering the demand for heating and air conditioning, thereby reducing the emissions associated with electric power generation and natural gas consumption.

Stored Carbon Dioxide

To date, Sacramento trees in the public tree resource have stored 105,584.3 tons of carbon (CO_2) in woody and foliar biomass valued at $1.6 million.

Annually, all public trees directly sequester an additional 3,117.2 tons of CO_2, valued at $46,747. Accounting for estimated CO_2 emissions from tree decomposition (1,205.2 tons) tree related maintenance activity (-65.2 tons), and avoided CO_2 (4,638.2 tons), Sacramento's public trees provide an annual net reduction in atmospheric CO_2 of 6,485.0 tons, valued at $97,275, with an average value of $1.11 per tree (Table 6).

Among prevalent species, *Ulmus americana* (American elm, $2.88 /tree), *Sequoia sempervirens* (coast redwood, $2.19/tree) and *Ulmus parvifolia* (Chinese elm, $2.08 /tree) provide the greatest annual per-tree benefits to carbon sequestration (Figure 8). Due to their prevalence, *Platanus x acerifolia* (London planetree) provides the greatest carbon benefits by population, valued at $18,794, accounting for 19.3% of the total benefit.

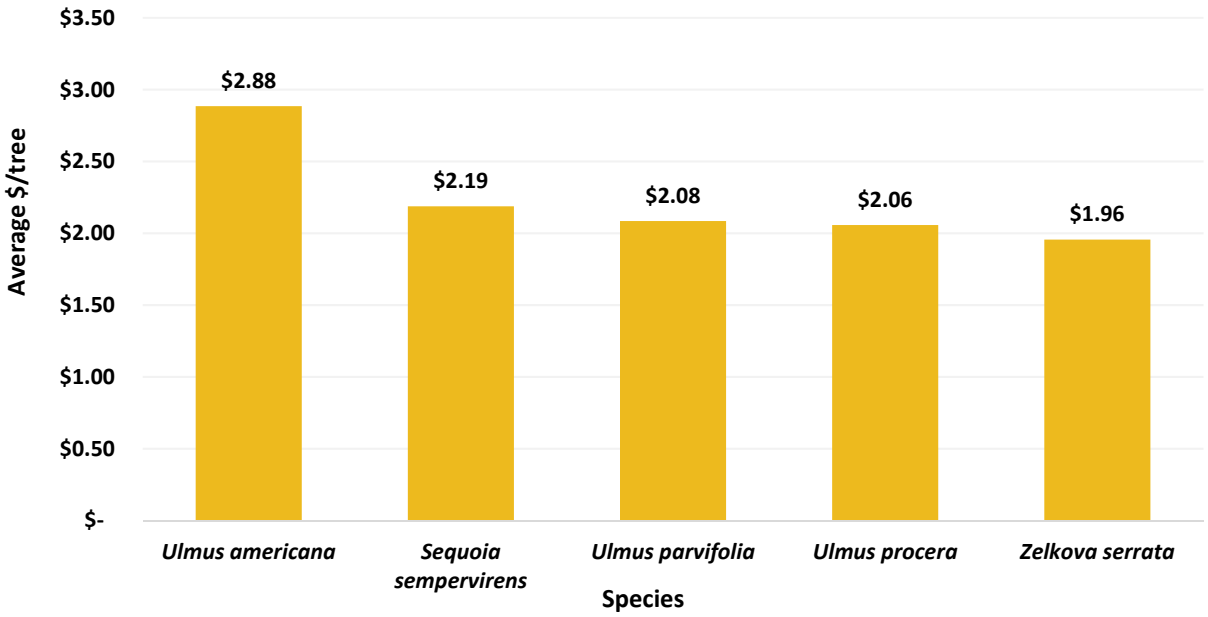


Figure 7: Top Five Species for Carbon Benefits

Table 4: Annual Carbon Benefits from Sacramento's Most Prevalent Species

Species	*Sequestered (lb)*	*Sequestered ($)*	*Decomposition Release (lb)*	*Maintenance Release (lb)*	*Total Release ($)*	*Avoided (lb)*	*Avoided ($)*	*Net Total (lb)*	*Total ($)*	*% of Total Tree Numbers*	*% of Total $*	*Avg. $/tree*
Platanus x acerifolia	748,449	5,613	-599,640	-30,434	-4,726	2,387,508	17,906	2,505,883	18,794	15.54	19.32	**1.38**
Pistacia chinensis	128,400	963.00	-26,727	-4,146	-231.55	385,393	2,890.45	482,919	3,622	5.19	3.72	**0.80**
Zelkova serrata	385,495	2,891	-192,091	-8,326	-1,503	821,784	6,163	1,006,862	7,551	4.42	7.76	**1.96**
Lagerstroemia indica	10,001	75.01	-1,458	-1,322	-20.85	30,900	231.75	38,120	285.90	4.36	0.29	**0.08**
Pyrus species	124,434	933.26	-18,305	-3,301	-162.04	211,275	1,585	314,104	2,356	4.25	2.42	**0.63**
Quercus lobata	546,966	4,102	-145,586	-4,775	-1,128	302,028	2,265	698,633	5,240	4.23	5.39	**1.42**
Sequoia sempervirens	573,008	4,298	-116,902	-6,569	-926.03	399,568	2,997	849,105	6,368	3.33	6.55	**2.19**
Fraxinus velutina	203,046	1,523	-117,575	-6,063	-927.28	425,206	3,189	504,615	3,785	2.35	3.89	**1.84**
Liquidambar styraciflua	249,879	1,874	-48,250	-3,692	-389.57	239,336	1,795	437,273	3,280	2.25	3.37	**1.67**
Acer rubrum	37,852	283.89	-1,993	-657.35	-19.88	39,624	297.18	74,826	561.19	2.18	0.58	**0.29**
Quercus rubra	175,167	1,314	-28,591	-1,413	-225.03	77,021	577.66	222,184	1,666	1.91	1.71	**1.00**
Washingtonia robusta	45,681	342.60	-11,796	-2,166	-104.71	23,551	176.63	55,270	414.53	1.76	0.43	**0.27**
Ulmus procera	79,001	592.51	-194,779	-7,068	-1,514	514,554	3,859	391,708	2,938	1.64	3.02	**2.06**
Prunus cerasifera	65,123	488.43	-2,087	-878.68	-22.25	25,268	189.51	87,425	655.69	1.49	0.67	**0.50**
Cupressus sempervirens	45,599	341.99	-3,398	-1,008	-33.04	45,704	342.78	86,897	651.73	1.45	0.67	**0.51**
Quercus agrifolia	169,577	1,272	-70,504	-1,650	-541.15	111,772	838.29	209,196	1,569	1.36	1.61	**1.32**
Celtis occidentalis	43,387	325.40	-4,972	-724.04	-42.72	43,635	327.27	81,327	609.95	1.34	0.63	**0.52**
Ginkgo biloba	59,629	447.22	-6,552.66	-835.00	-55.41	40,233	301.75	92,475	693.56	1.32	0.71	**0.60**
Magnolia grandiflora	34,571	259.28	-16,733	-1,632	-137.73	79,264	594.48	95,471	716.03	1.31	0.74	**0.62**
Nyssa sylvatica	13,850	103.88	-694.67	-348.86	-7.83	13,088	98.16	25,895	194.21	1.17	0.20	**0.19**
Quercus species	100,899	756.74	-22,449	-878.29	-174.95	49,517	371.38	127,090	953.17	1.16	0.98	**0.94**
Celtis sinensis	58,982	442.37	-18,316	-1,198	-146.36	92,133	691.00	131,601	987.01	1.15	1.01	**0.98**
Phoenix canariensis	8,125	60.94	-7,338.35	-1,824	-68.72	159,601	1,197	158,564	1,189	1.13	1.22	**1.21**
Ulmus parvifolia	105,574	791.81	-41,205	-2,080	-324.64	210,659	1,580	272,948	2,047	1.12	2.10	**2.08**
Ligustrum lucidum	17,783	133.37	-1,786.35	-511.29	-17.23	25,540	191.55	41,025	307.69	1.11	0.32	**0.32**
Washingtonia filifera	23,813	178.60	-11,201	-182.33	-85.38	20,911	156.83	33,340	250.05	1.07	0.26	**0.27**
Ulmus americana	118,025	885.19	-95,215	-3,420	-739.76	318,246	2,387	337,636	2,532	1.01	2.60	**2.88**
All other species	2,062,004	15,465	-604,209	-33,227	-4,781	2,183,056	16,373	3,607,623	27,057	29.39	27.82	**3.79**
Citywide Total	***6,234,320***	***$46,757***	***-2,410,356***	***-130,326***	***-$19,055***	***9,276,376***	***$69,573***	***12,970,015***	***$97,275***	***100%***	***100%***	***$1.11***

Air Quality Impacts

Urban trees improve air quality in five fundamental ways:

- Absorption of gaseous pollutants such as ozone (O_3), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2) through leaf surfaces
- Interception of particulate matter (PM_{10}), such as dust, ash, dirt, pollen, and smoke
- Increase of oxygen levels through photosynthesis
- Transpiration of water and shade provision, resulting in lower local air temperatures, thereby reducing ozone (O_3) levels

PM_{10} is particulate matter in the air that measures less than 10 micrometers, smaller than the width of a single human hair. These small particles or liquid droplets include smoke, soot, dust, and secondary reactions from gaseous pollutants. PM_{10} pollution is detrimental to health.

Ozone (O_3) is another air pollutant that is harmful to human health. Ozone forms when nitrogen oxide from fuel combustion and volatile organic gases from evaporated petroleum products react in the presence of sunshine. In the absence of cooling effects provided by trees, higher temperatures contribute to ozone (O_3) formation. Additionally, short-term increases in ozone concentrations are statistically associated with increased tree mortality for 95 large US cities (Bell et al., 2004). However, it should be noted that while trees do a great deal to absorb air pollutants (especially ozone and particulate matter); they also negatively contribute to air pollution. Trees emit biogenic volatile organic compounds (BVOCs), which also contribute to ozone formation. i-Tree *Streets* analysis accounts for these BVOC emissions in the air quality cumulative benefit.

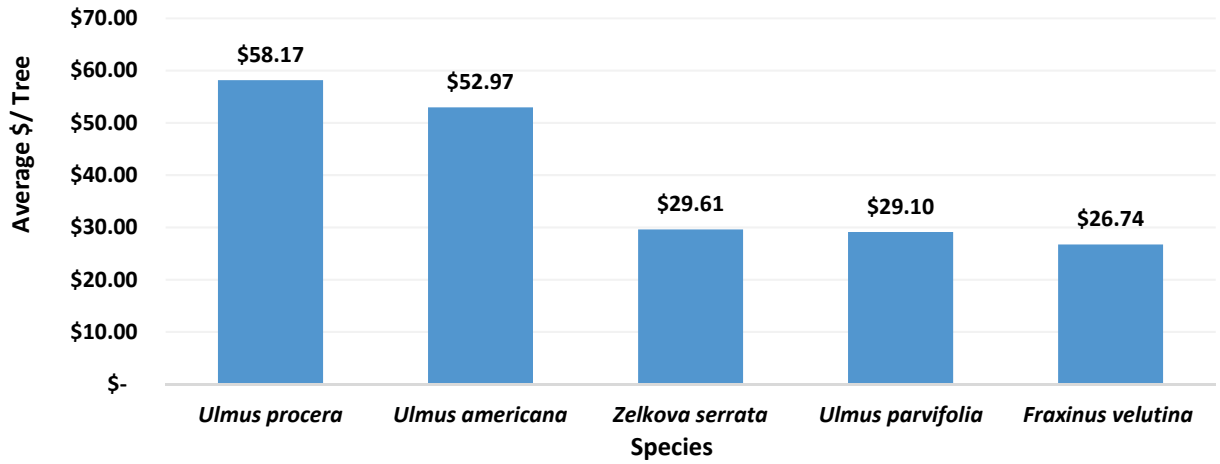


Figure 8: Top Five Species for Air Quality Benefits

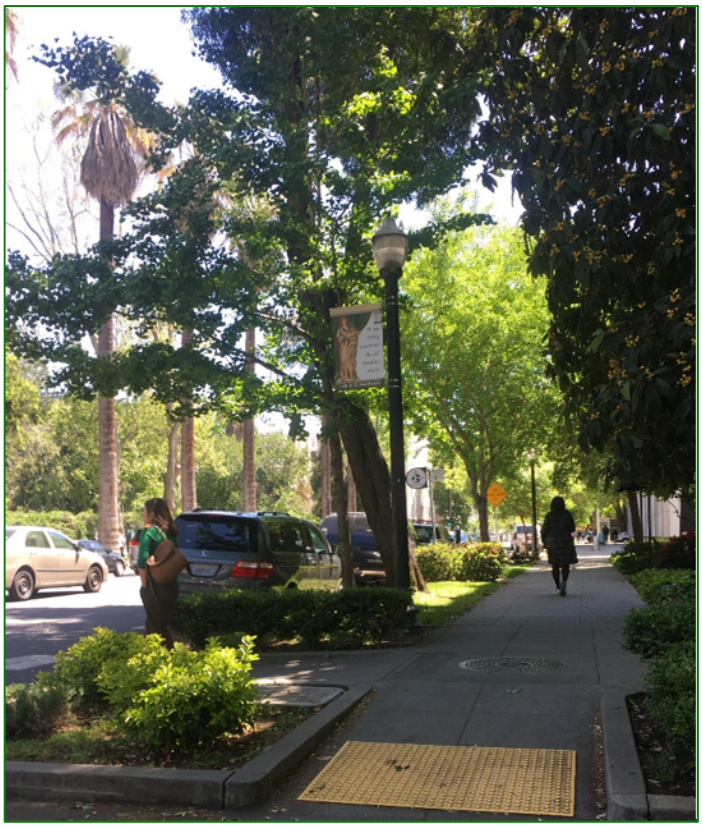
Deposition, Interception, and Avoided Pollutants

Each year, 99,189 pounds of nitrogen dioxide (NO_2), sulfur dioxide (SO_2), small particulate matter (PM_{10}), and ozone (O_3) are intercepted or absorbed by Sacramento trees, for a value of $992,296.50 (Table 5). As a population, *Platanus x acerifolia* is the greatest contributor to pollutant deposition and interception, accounting for 26.0% of these benefits, possibly a result of *Platanus x acerifolia* representing 15.5% of the overall tree population

Energy savings provided by trees have the additional indirect benefit of reducing air pollutant emissions (NO_2, PM_{10}, SO_2, and VOCs) that result from energy production. Altogether 18,541 pounds of pollutants, valued at $180,286.64, are avoided annually through the shading effects of trees.

More than 74,955 pounds of BVOCs are emitted annually from Sacramento's public trees, reducing annual benefits to air quality by -$351,541. Of prevalent species, the heaviest emitters by population are *Platanus x acerifolia* and *Liquidambar styraciflua* (American sweetgum) which together emit 48.6% of all BVOCs.

The cumulative value of air pollutants removed by public trees in Sacramento is $992,296.50 an average of $11.36 per tree. *Ulmus* procera (English elm, $58.17/tree) and *Ulmus americana* (American elm, $52.97/tree) currently produce the greatest per tree cumulative air quality benefits (Figure 8).



Sacramento trees intercept and absorb 99,189 pounds of nitrogen dioxide (NO_2), sulfur dioxide (SO_2), small particulate matter (PM_{10}), and ozone (O_3) annually, for a value of $992,296.50.

Table 5: Annual Air Quality Benefits from Sacramento's Most Prevalent Species

Species	Deposition O_3 (lb)	Deposition NO_2 (lb)	Deposition PM_{10} (lb)	Deposition SO_2 (lb)	Total Deposition ($)	Avoided NO_2 (lb)	Avoided PM_{10} (lb)	Avoided VOC (lb)	Avoided SO_2 (lb)	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	% of Total Tree Numbers	Avg. $/tree
Platanus x acerifolia	14,034	3,583	8,127	0.00	301,799	2,917	544.55	144.42	1,287	47,898	-25,668	-120,382	4,969	229,315	15.54	**16.89**
Pistacia chinensis	2,045	492.27	1,023	0.00	42,075	438.06	85.95	21.56	209.27	7,291	-2,366	-11,096	1,949	38,270	5.19	**8.44**
Zelkova serrata	4,838	1,155	2,377	0.00	99,026	920.38	181.23	45.29	442.14	15,334	0.00	0.00	9,960	114,360	4.42	**29.61**
Lagerstroemia indica	193.41	45.70	93.51	0.00	3,938	36.89	6.94	1.82	16.48	606.95	0.00	0.00	394.76	4,545	4.36	**1.19**
Pyrus species	1,108	284.34	647.88	0.00	23,910	264.10	48.92	13.09	115.05	4,328	0.00	0.00	2,482	28,237	4.25	**7.60**
Quercus lobata	1,803	514.13	1,284	0.00	41,710	340.55	67.10	16.76	163.77	5,675	-7,751	-36,353	-3,563	11,032	4.23	**2.98**
Sequoia sempervirens	2,447	697.93	1,742	0.00	56,622	483.80	91.19	23.93	216.80	7,965	-1,170	-5,488	4,533	59,099	3.33	**20.29**
Fraxinus velutina	2,331	525.67	1,029	0.00	46,227	527.05	97.70	26.11	229.91	8,638	0.00	0.00	4,767	54,865	2.35	**26.74**
Liquidambar styraciflua	1,044	249.37	513.15	0.00	21,374	272.22	53.72	13.39	131.23	4,538	-10,731	-50,329	-8,454	-24,417	2.25	**-12.45**
Acer rubrum	193.29	46.16	94.98	0.00	3,956	43.39	8.75	2.13	21.63	727.68	-59.74	-280.19	350.57	4,404	2.18	**2.31**
Quercus rubra	452.91	129.17	322.46	0.00	10,479	85.85	17.04	4.22	41.76	1,434	-1,708	-8,010	-654.42	3,903	1.91	**2.34**
Washingtonia robusta	126.60	36.10	90.13	0.00	2,929	29.97	5.51	1.49	12.91	490.22	-124.27	-582.81	178.45	2,837	1.76	**1.85**
Ulmus procera	3,609	861.82	1,773	0.00	73,869	549.19	110.19	26.96	271.68	9,198	0.00	0.00	7,202	83,067	1.64	**58.17**
Prunus cerasifera	125.29	35.73	89.20	0.00	2,899	25.94	5.47	1.27	13.85	440.72	-27.40	-128.51	269.34	3,211	1.49	**2.47**
Cupressus sempervirens	257.27	73.37	183.17	0.00	5,952	50.02	10.05	2.45	24.82	838.14	-144.73	-678.76	456.42	6,112	1.45	**4.82**
Quercus agrifolia	694.94	198.20	494.79	0.00	16,079	127.74	24.93	6.29	60.51	2,123	-3,572	-16,755	-1,965	1,448	1.36	**1.22**
Celtis occidentalis	250.62	60.33	125.34	0.00	5,156	50.73	9.78	2.50	23.58	840.32	0.00	0.00	522.88	5,997	1.34	**5.11**
Ginkgo biloba	192.41	45.95	94.55	0.00	3,938	50.17	9.33	2.49	21.98	822.92	-167.82	-787.10	249.05	3,974	1.32	**3.46**
Magnolia grandiflora	448.84	128.01	319.57	0.00	10,385	98.52	18.32	4.88	43.18	1,616	-924.62	-4,336	136.69	7,664	1.31	**6.69**
Nyssa sylvatica	71.36	18.31	41.71	0.00	1,539	16.39	3.03	0.81	7.13	268.52	0.00	0.00	158.76	1,808	1.17	**1.77**
Quercus species	296.70	84.62	211.25	0.00	6,865	55.67	10.99	2.74	26.83	928.02	-1,267	-5,942	-578.15	1,851	1.16	**1.82**
Celtis sinensis	570.57	137.35	285.35	0.00	11,740	107.63	20.63	5.31	49.56	1,780	0.00	0.00	1,176	13,519	1.15	**13.47**
Phoenix canariensis	1,044	297.78	743.40	0.00	24,158	197.71	36.63	9.80	86.17	3,240	-1,522	-7,140	893.27	20,259	1.13	**20.61**
Ulmus parvifolia	1,204	287.49	591.60	0.00	24,642	236.22	46.53	11.62	113.55	3,936	0.00	0.00	2,491	28,578	1.12	**29.10**
Ligustrum lucidum	159.76	45.56	113.74	0.00	3,696	30.47	5.79	1.51	13.83	502.73	0.00	0.00	370.66	4,199	1.11	**4.32**
Washingtonia filifera	154.99	44.20	110.35	0.00	3,586	28.14	4.99	1.40	11.40	455.82	-156.49	-733.95	198.99	3,308	1.07	**3.54**
Ulmus americana	1,985	473.99	975.38	0.00	40,627	352.80	69.71	17.35	170.39	5,884	0.00	0.00	4,044	46,510	1.01	**52.97**
All other species	12,576	3,293	7,588	0.00	274,372	2,569	492.53	126.80	1,183	42,488	-17,595	-82,519	10,234	234,341	29.39	**9.13**
Citywide Total	***54,258***	***13,845***	***31,086***	***0.00***	***$1,163,550***	***10,906***	***2,088***	***538.38***	***5,009***	***$180,287***	***-74,955***	***-$351,541***	***42,774***	***$992,296***	***100%***	***$11.36***

Stormwater Runoff Reductions

Rainfall interception by trees reduces the amount of stormwater that enters collection and treatment facilities during large storm events. Trees intercept rainfall in their canopy, acting as mini-reservoirs, controlling runoff at the source. Healthy urban trees reduce the amount of runoff and pollutant loading in receiving waters in three primary ways:

- Leaves and branch surfaces intercept and store rainfall, thereby reducing runoff volumes and delaying the onset of peak flows.
- Root growth and decomposition increase the capacity and rate of soil infiltration by rainfall and reduce overland flow.
- Tree canopies reduce soil erosion and surface flows by diminishing the impact of raindrops on bare soil.

Trees in Sacramento intercept more than 64.7 million gallons of stormwater annually for an average of over 741 gallons per tree (Table 6). The total value of this benefit to the community is $504,732, an average of $5.78 per tree.

Table 6: Annual Stormwater Benefits from Sacramento's Most Prevalent Species

Species	*Total Rainfall Interception (Gal)*	*Total ($)*	*% of Total Tree Numbers*	*% of Total $*	*Avg. $/tree*
Platanus x acerifolia	15,381,137	119,973	15.54	23.77	**8.84**
Pistacia chinensis	1,610,945	12,565	5.19	2.49	**2.77**
Zelkova serrata	4,371,203	34,095	4.42	6.76	**8.83**
Lagerstroemia indica	162,025	1,264	4.36	0.25	**0.33**
Pyrus species	1,128,395	8,801	4.25	1.74	**2.37**
Quercus lobata	3,272,523	25,526	4.23	5.06	**6.91**
Sequoia sempervirens	4,502,837	35,122	3.33	6.96	**12.06**
Fraxinus velutina	2,032,851	15,856	2.35	3.14	**7.73**
Liquidambar styraciflua	985,311	7,685	2.25	1.52	**3.92**
Acer rubrum	160,050	1,248	2.18	0.25	**0.66**
Quercus rubra	756,737	5,903	1.91	1.17	**3.54**
Washingtonia robusta	311,977	2,433	1.76	0.48	**1.59**
Ulmus procera	3,448,735	26,900	1.64	5.33	**18.84**
Prunus cerasifera	254,740	1,987	1.49	0.39	**1.53**
Cupressus sempervirens	517,744	4,038	1.45	0.80	**3.19**
Quercus agrifolia	1,412,777	11,020	1.36	2.18	**9.30**
Celtis occidentalis	215,160	1,678	1.34	0.33	**1.43**
Ginkgo biloba	167,111	1,303	1.32	0.26	**1.13**
Magnolia grandiflora	765,940	5,974	1.31	1.18	**5.21**
Nyssa sylvatica	78,417	611.65	1.17	0.12	**0.60**
Quercus species	533,251	4,159	1.16	0.82	**4.09**
Celtis sinensis	499,012	3,892	1.15	0.77	**3.88**
Phoenix canariensis	901,015	7,028	1.13	1.39	**7.15**
Ulmus parvifolia	1,052,479	8,209	1.12	1.63	**8.36**
Ligustrum lucidum	268,598	2,095	1.11	0.42	**2.16**
Washingtonia filifera	265,684	2,072	1.07	0.41	**2.22**
Ulmus americana	1,865,302	14,549	1.01	2.88	**16.57**
All other species	17,787,236	138,740	29.39	27.49	**5.41**
Citywide total	***64,709,193***	***$504,732***	***100%***	***100%***	***$5.78***

Among the most prevalent species, *Ulmus procera* currently provides the greatest per tree benefit of $18.84 per tree (Figure 9). The population of *Platanus x acerifolia* provides the largest portion of stormwater benefit at 23.8%, which aligns with the fact that they 15.5% of all trees, and this significant portion of the population. Combined with the age distribution and stature of these trees, this explains the larger benefit that they provide by comparison to other species.

As trees grow, the benefits that they provide tend to grow as well. Admittedly, some species incur more benefits than others will, and a component of that reality is biology. Some trees have characteristics that hinder their ability to be strong contributors to stormwater runoff reduction, possibly due to a tree having smaller leaves and thinner canopies.

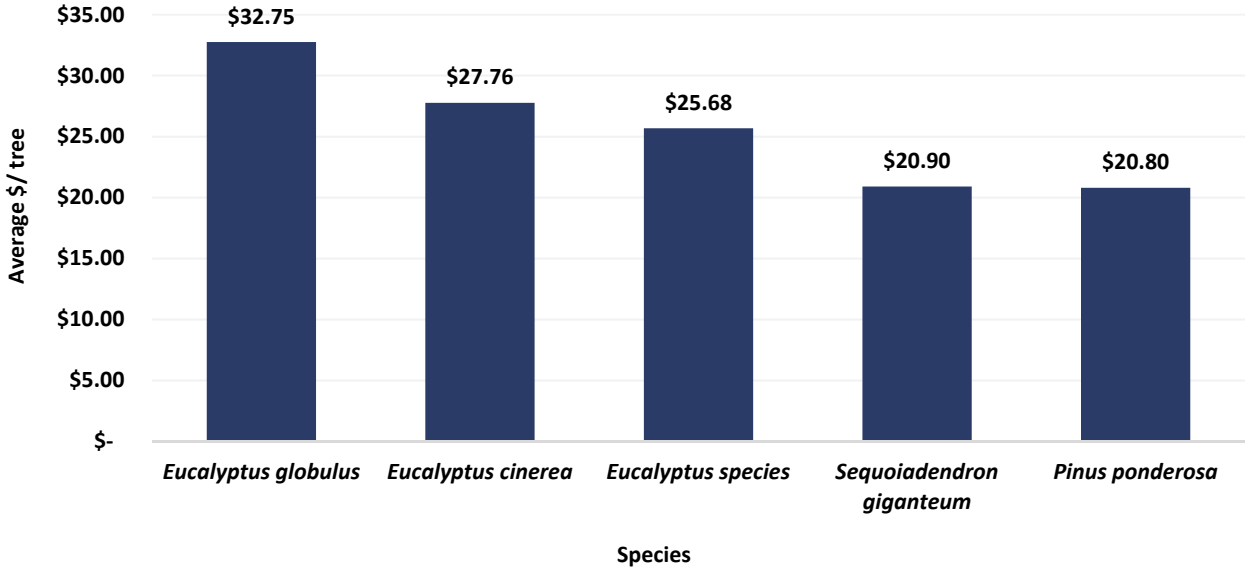


Figure 9: Top Five Species for Stormwater Benefits

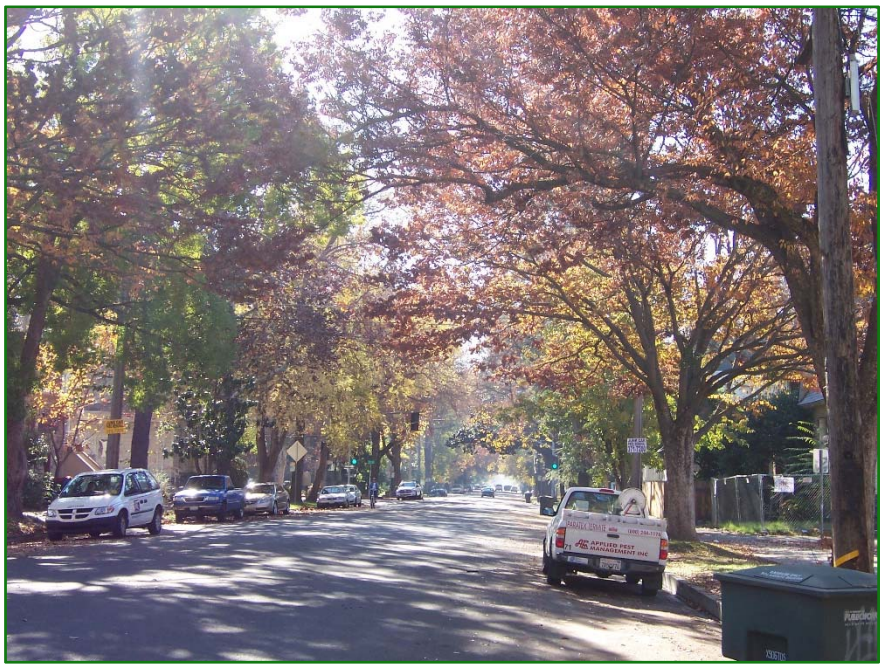
Trees in Sacramento intercept more than 64.7 million gallons of stormwater annually for an average of over 741 gallons per tree.

Energy Savings

Trees modify climate and conserve energy in three principal ways:

- Shading reduces the amount of radiant energy absorbed and stored by hardscape surfaces, thereby reducing the heat island effect.
- Transpiration converts moisture to water vapor, thereby cooling the air by using solar energy that would otherwise result in heating of the air.
- Reduction of wind speed plus the movement of outside air into interior spaces, and conductive heat loss where thermal conductivity is relatively high (e.g., glass windows) (Simpson, 1998).

The *heat island effect* describes the increase in urban temperatures in relation to surrounding suburban and rural areas. Heat islands are associated with an increase in hardscape and impervious surfaces. Trees and other vegetation within an urbanized environment help reduce the heat island effect by lowering air temperatures 4-6°F (5°C) compared with outside the green space (EPA, 2008). On a larger scale, temperature differences of more than 9°F (5°C) have been observed between city centers without adequate canopy coverage and more vegetated suburban areas (Akbari et al., 1992). The relative importance of these effects depends upon the size and configuration of trees and other landscape elements (McPherson, 1993). Tree spacing, crown spread, and vertical distribution of leaf area each influence the transport of warm air and pollutants along streets and out of urban canyons. Trees reduce conductive heat loss from buildings by reducing air movement into buildings and against conductive surfaces (e.g., glass, metal siding). Trees can reduce wind speed and the resulting air infiltration by up to 50%, translating into potential annual heating savings of 25% (Heisler, 1986).



Trees reduce the amount of radiant energy absorbed and stored by hardscape surfaces through shading, thereby reducing the heat island effect.

Electricity and Natural Gas Reduction

Electricity and natural gas saved annually in Sacramento from both the shading and climate effects of trees is equal to 9,872 MWh (valued at over $1.1 million) and 22,503 therms ($33,136), for a total retail savings of approximately $1.2 million and an average of $13.15 per tree (Table 7). The species that contribute most to energy benefits on a per-tree basis are large-stature broadleaf evergreens and deciduous trees including *Ulmus americana* (American Elm), with an average value of $41.56 and Ulmus procera (English elm) with an average value of $39.98 per tree (Figure 10).
On a per-tree basis, *Lagerstroemia indica* (crapemyrtle) provides $1.06 in average energy benefits, just 0.35% of the total energy benefits. This is the least amount of energy benefits provided per tree, among prevalent tree species.

Figure 10: Top Five Species for Energy Benefits

Trees in Sacramento contribute to electrical and natural gas reductions, for a total retail savings of approximately $1.2 million and an average of $13.15 per tree.

Table 7: Annual Energy Benefits for Sacramento's Most Prevalent Species

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	% of Total Tree Numbers	% of Total $	Avg. $/tree
Platanus x acerifolia	2,541	287,121	17,942	26,419	313,540	15.54	27.29	**23.10**
Pistacia chinensis	410	46,347	-855	-1,259	45,089	5.19	3.93	**9.94**
Zelkova serrata	875	98,827	-2,591	-3,815	95,012	4.42	8.27	**24.60**
Lagerstroemia indica	33	3,716	218	321	4,037	4.36	0.35	**1.06**
Pyrus species	225	25,408	2,002	2,948	28,356	4.25	2.47	**7.63**
Quercus lobata	321	36,322	-939	-1,383	34,939	4.23	3.04	**9.45**
Sequoia sempervirens	425	48,052	2,179	3,209	51,260	3.33	4.46	**17.60**
Fraxinus velutina	453	51,135	3,830	5,640	56,775	2.35	4.94	**27.67**
Liquidambar styraciflua	255	28,782	-856	-1,261	27,522	2.25	2.40	**14.03**
Acer rubrum	42	4,765	-285	-420	4,345	2.18	0.38	**2.28**
Quercus rubra	82	9,263	-334	-492	8,770	1.91	0.76	**5.26**
Washingtonia robusta	25	2,832	261	384	3,217	1.76	0.28	**2.10**
Ulmus procera	548	61,880	-3,249	-4,783	57,097	1.64	4.97	**39.98**
Prunus cerasifera	27	3,039	-377	-555	2,484	1.49	0.22	**1.91**
Cupressus sempervirens	49	5,496	-295	-435	5,061	1.45	0.44	**3.99**
Quercus agrifolia	119	13,442	-157	-232	13,210	1.36	1.15	**11.15**
Celtis occidentalis	46	5,248	52	76	5,324	1.34	0.46	**4.53**
Ginkgo biloba	43	4,838	351	518	5,356	1.32	0.47	**4.66**
Magnolia grandiflora	84	9,532	684	1,007	10,540	1.31	0.92	**9.20**
Nyssa sylvatica	14	1,574	128	189	1,763	1.17	0.15	**1.72**
Quercus species	53	5,955	-165	-244	5,711	1.16	0.50	**5.62**
Celtis sinensis	98	11,080	195	287	11,367	1.15	0.99	**11.32**
Phoenix canariensis	170	19,194	1,482	2,183	21,376	1.13	1.86	**21.75**
Ulmus parvifolia	224	25,334	-671	-988	24,345	1.12	2.12	**24.79**
Ligustrum lucidum	27	3,071	112	165	3,236	1.11	0.28	**3.33**
Washingtonia filifera	22	2,515	410	603	3,118	1.07	0.27	**3.33**
Ulmus americana	339	38,272	-1,211	-1,783	36,489	1.01	3.18	**41.56**
All other species	2,323	262,533	4,644	6,838	269,371	29.39	23.45	**10.50**
Total	***9,872***	***$1,115,573***	***22,503***	***$33,136***	***$1,148,709***	***100%***	***100%***	***$13.15***

Aesthetic, Property Value, and Socioeconomic Benefits

Trees provide beauty in the urban landscape, privacy to homeowners, improved human health, a sense of comfort and place, and habitat for urban wildlife. Research shows that trees promote better business by stimulating more frequent and extended shopping and a willingness to pay more for goods and parking (Wolf, 1999). Some of these benefits are captured as a percentage of the value of the property on which a tree stands. To determine the value of these less tangible benefits, i-Tree *Streets* uses research that compares differences in sales prices of homes to estimate the contribution associated with trees. Differences in housing prices in relation to the presence (or lack) of a street tree help define the aesthetic value of street trees in the urban environment.

The calculation of annual aesthetic and other benefits corresponds with a tree's annual increase in leaf area. When a tree is actively growing, leaf area may increase dramatically. Once a tree is mature, there may be little or no net increase in leaf area from one year to the next; thus, there is little or no incremental annual aesthetic benefit for that year, although the cumulative benefit over the course of the entire life of the tree may be large. Since this report represents a one-year sample snapshot of the inventoried tree population, **aesthetic benefits reflect the increase in leaf area for each species population over the course of a single year.**

The total annual benefit from Sacramento trees associated with property value increases and other less tangible benefits is over $7.7 million, an average of $88.65 per tree (Table 8). Among prevalent species, *Ulmus americana* ($275.45) and *Zelkova serrata* (Japanese zelkova, $195.95) provide the greatest per-tree aesthetic value annually (Figure 11).

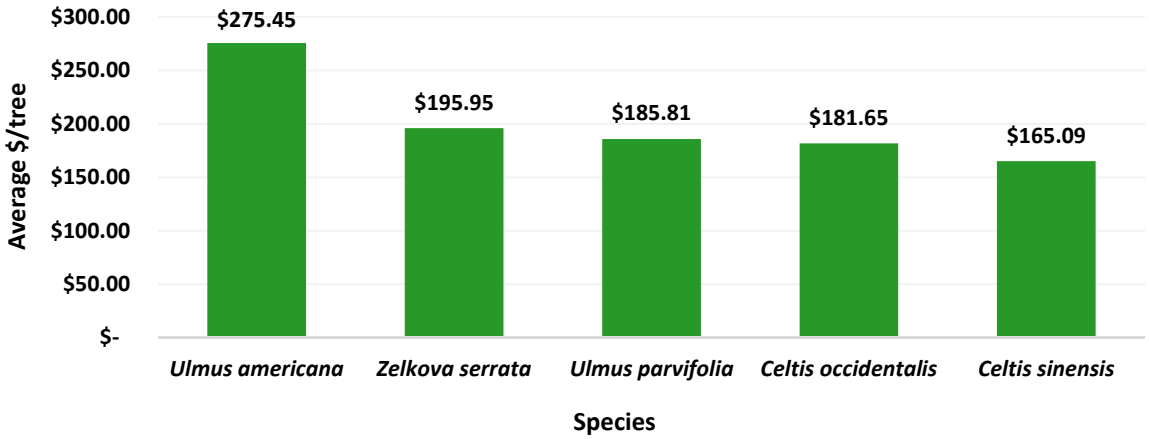


Figure 11: Top Five Species for Aesthetic Benefits

Table 8: Annual Aesthetic Benefits from Sacramento's Most Prevalent Species

Species	*Total ($)*	*% of Total Tree Numbers*	*% of Total $*	*Avg. $/tree*
Platanus x acerifolia	975,394	15.54	12.60	**71.86**
Pistacia chinensis	356,359	5.19	4.60	**78.60**
Zelkova serrata	756,746	4.42	9.78	**195.95**
Lagerstroemia indica	42,454	4.36	0.55	**11.14**
Pyrus species	269,494	4.25	3.48	**72.56**
Quercus lobata	283,246	4.23	3.66	**76.64**
Sequoia sempervirens	300,078	3.33	3.88	**103.05**
Fraxinus velutina	123,572	2.35	1.60	**60.22**
Liquidambar styraciflua	320,185	2.25	4.14	**163.28**
Acer rubrum	164,421	2.18	2.12	**86.36**
Quercus rubra	110,804	1.91	1.43	**66.51**
Washingtonia robusta	25,545	1.76	0.33	**16.64**
Ulmus procera	170,092	1.64	2.20	**119.11**
Prunus cerasifera	129,553	1.49	1.67	**99.50**
Cupressus sempervirens	124,234	1.45	1.60	**98.05**
Quercus agrifolia	99,757	1.36	1.29	**84.18**
Celtis occidentalis	213,253	1.34	2.75	**181.65**
Ginkgo biloba	85,193	1.32	1.10	**74.15**
Magnolia grandiflora	32,009	1.31	0.41	**27.93**
Nyssa sylvatica	98,858	1.17	1.28	**96.73**
Quercus species	67,891	1.16	0.88	**66.82**
Celtis sinensis	165,749	1.15	2.14	**165.09**
Phoenix canariensis	4,014	1.13	0.05	**4.08**
Ulmus parvifolia	182,463	1.12	2.36	**185.81**
Ligustrum lucidum	57,470	1.11	0.74	**59.13**
Washingtonia filifera	14,162	1.07	0.18	**15.15**
Ulmus americana	241,847	1.01	3.12	**275.45**
All other species	2,326,457	29.39	30.05	**13,835**
Citywide Total	***$7,741,299***	***100%***	***100%***	***$88.65***

Annual Per Tree Benefits of Most Prevalent Species

Of Sacramento's most prevalent species, *Ulmus americana* (American elm) provides the greatest cumulative annual per tree benefits at $389.44/ tree. For the species that represent less than 1% of the population, the cumulative annual benefit of those trees is less a $1 dollar per tree.

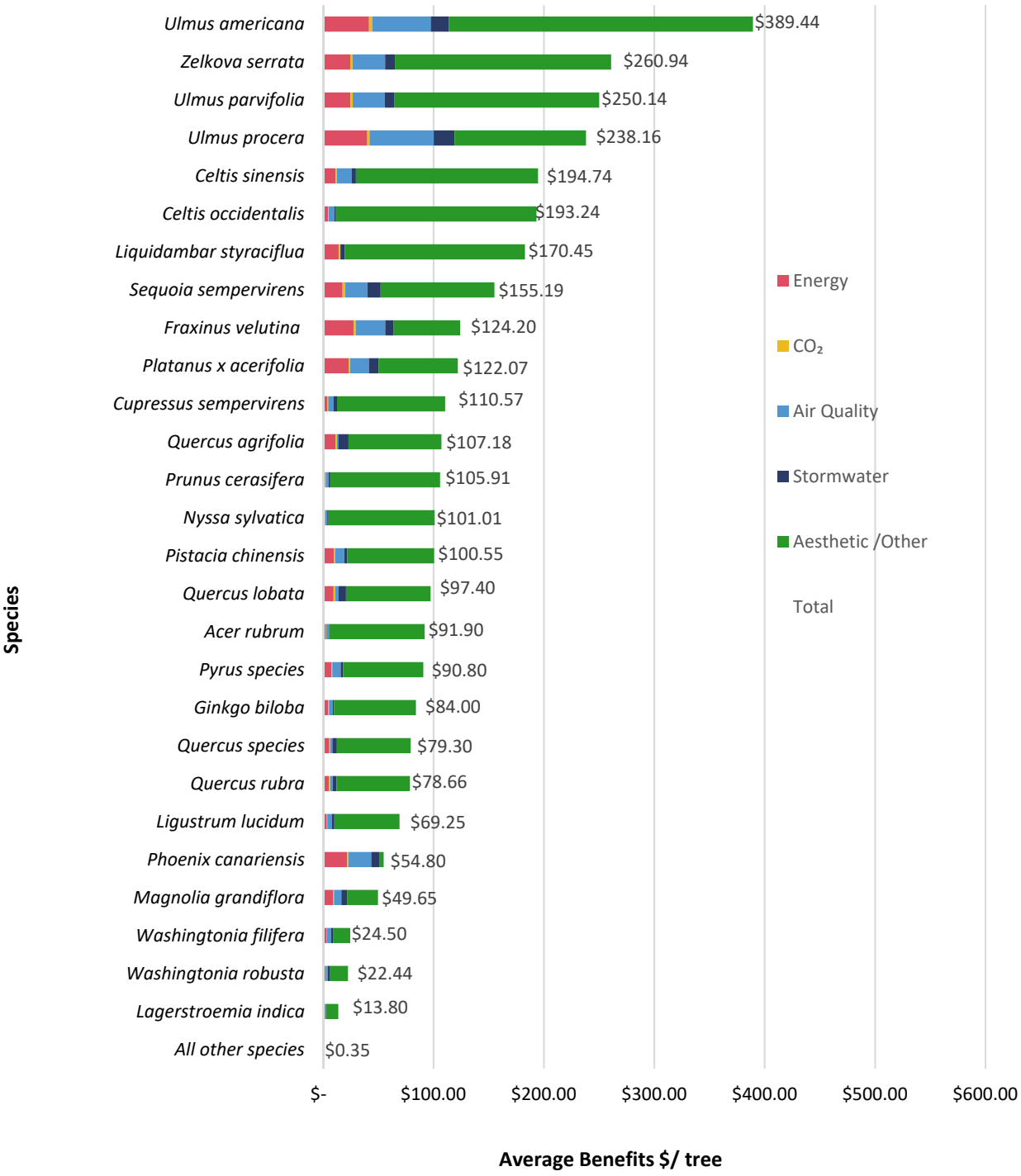


Figure 12: Summary of Annual per Tree Benefits for Most Prevalent Species

Table 9: Summary of Annual Per-Tree Benefits of Prevalent Species

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic /Other	Total
Platanus x acerifolia	23.1	1.38	16.89	8.84	71.86	122.07
Pistacia chinensis	9.94	0.8	8.44	2.77	78.6	100.55
Zelkova serrata	24.6	1.96	29.61	8.83	195.95	260.94
Lagerstroemia indica	1.06	0.08	1.19	0.33	11.14	13.8
Pyrus species	7.63	0.63	7.6	2.37	72.56	90.8
Quercus lobata	9.45	1.42	2.98	6.91	76.64	97.4
Sequoia sempervirens	17.6	2.19	20.29	12.06	103.05	155.19
Fraxinus velutina	27.67	1.84	26.74	7.73	60.22	124.2
Liquidambar styraciflua	14.03	1.67	-12.45	3.92	163.28	170.45
Acer rubrum	2.28	0.29	2.31	0.66	86.36	91.9
Quercus rubra	5.26	1	2.34	3.54	66.51	78.66
Washingtonia robusta	2.1	0.27	1.85	1.59	16.64	22.44
Ulmus procera	39.98	2.06	58.17	18.84	119.11	238.16
Prunus cerasifera	1.91	0.5	2.47	1.53	99.5	105.91
Cupressus sempervirens	3.99	0.51	4.82	3.19	98.05	110.57
Quercus agrifolia	11.15	1.32	1.22	9.3	84.18	107.18
Celtis occidentalis	4.53	0.52	5.11	1.43	181.65	193.24
Ginkgo biloba	4.66	0.6	3.46	1.13	74.15	84
Magnolia grandiflora	9.2	0.62	6.69	5.21	27.93	49.65
Nyssa sylvatica	1.72	0.19	1.77	0.6	96.73	101.01
Quercus species	5.62	0.94	1.82	4.09	66.82	79.3
Celtis sinensis	11.32	0.98	13.47	3.88	165.09	194.74
Phoenix canariensis	21.75	1.21	20.61	7.15	4.08	54.8
Ulmus parvifolia	24.79	2.08	29.1	8.36	185.81	250.14
Ligustrum lucidum	3.33	0.32	4.32	2.16	59.13	69.25
Washingtonia filifera	3.33	0.27	3.54	2.22	15.15	24.5
Ulmus americana	41.56	2.88	52.97	16.57	275.45	389.44
All other species	0.03	0	0.03	0.02	0.27	0.35
Citywide Total	***$13.15***	***$1.11***	***$11.36***	***$5.78***	***$88.65***	***$120.06***

Net Benefits and Benefit versus Investment Ratio (BIR)

Sacramento receives substantial benefits from its public tree resource (Figure 13); however, managers should examine the investments involved in preserving the public tree resource and the benefits that it provides.

A *benefit-investment ratio* (BIR) is an indicator used to summarize the overall value created compared to the investments of a given resource. For this analysis, BIR is the ratio of the total value of benefits provided by all Sacramento trees, compared to the cost associated with their management.

Benefits

Sacramento's public tree resource has beneficial effects on the environment. Approximately $2.7 million of the total annual benefits quantified in this study are environmental services (Figure 13). Annually, Sacramento trees provide a total benefit of nearly $10.5 million, a value of $120.06 per tree and $21.17 per capita. Individual components of the environmental benefits include: stormwater management for $504,732 (4.8%), improved air quality $992,296 (9.5%), carbon reductions of $97,275 (0.9%), and energy savings of nearly $1.2 million (11.0%) (Table 10). The remainder of the total annual benefits, over $7.7 million (73.8%), are related to aesthetic and socioeconomic benefits including increased property values.

The total estimated benefits provided by Sacramento's public tree resource is nearly $10.5 million, a value of $120.06 per tree and $21.17 per capita. These benefits are realized on an annual basis.

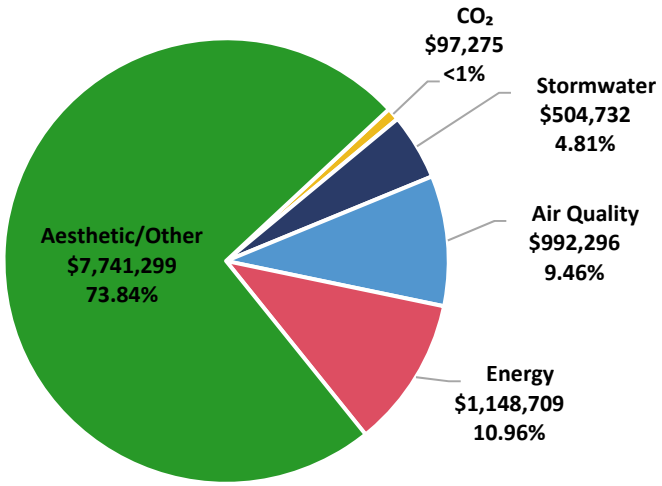


Figure 13: Annual Benefits from Sacramento's Public Trees

Total Annual Benefits: $10,484,311

Average Annual Per Tree Benefit: $120.06

Average Annual Per Capita Benefit: $21.17

A limitation of the annual benefits summary is that it does not fully account for all benefits provided by the public tree resource, as some benefits are intangible and/or difficult to quantify, such as impacts on psychological health, crime, and violence.

Empirical evidence of these benefits does exist (Wolf, 2007; Kaplan, 1989; Ulrich, 1986), but there is limited knowledge about the physical processes at work and the complex nature of interactions make quantification imprecise. Tree growth and mortality rates are highly variable. A true and full accounting of benefits and investments must consider variability among sites (e.g., tree species, growing conditions, maintenance practices) throughout the City, as well as variability in tree growth. In other words, trees are worth far more than what one can ever quantify!

Investment

Investment costs were provided by the City of Sacramento (Table 10). The total annual cost of managing the public tree resource is approximately $8.2 million, the bulk of which goes to operational costs for Urban Forestry and tree contracts (73.3%) and the remainder to green waste management (20.6%).

Benefit versus Investment Ratio

When the Sacramento's annual estimated expenditure (or investment) of $8.2 million in this resource is considered, the net annual benefit (benefits minus investment) to the City is $2.3 million. The average net benefit for an individual tree at Sacramento is $26.16. The average per capita net benefit provided by community trees is $4.61. Therefore, Sacramento is currently receiving $1.28 in benefits for every $1 invested in community trees.

Table 10: Benefits and Investments in the Public tree resource of Sacramento

Benefits	***Total ($)***	***$/Tree***	***$/Capita***
Energy	1,148,709	13.15	2.32
CO_2	97,275	1.11	0.20
Air Quality	992,296	11.36	2.00
Stormwater	504,732	5.78	1.02
Aesthetic/Other	7,741,299	88.65	15.63
Total Benefits	***$10,484,311***	***$120.06***	***$21.17***

Investments			
Operations	6,400,000	73.29	12.92
Green Waste Disposal	1,800,000	20.61	3.63
Total Investments	***$8,200,000***	***$93.90***	***$16.56***

Net Benefits	***$2,284,311.44***	***$26.16***	***$4.61***

Benefit-Investment Ratio	***1.28***

Conclusion

This analysis describes the current structural characteristics of Sacramento's tree resource, using established tree sampling, numerical modeling, and statistical methods to provide a general accounting of the benefits. The analysis provides a "snapshot" of this resource at its current population, structure, and condition. Trees are providing quantifiable impacts on air quality, reduction in atmospheric CO_2, stormwater runoff, and aesthetic benefits. The 87,324 trees provide cumulative annual benefits worth over $10.5 million, a value of $120.06 per tree and $21.17 per capita.

Industry standards suggest that no one tree species should represent more than 10% of the urban forest. Sacramento only has one species, *Platanus x acerifolia*, that represents greater than 10% of the population. Future new and replacement tree plantings should focus on increasing species diversity and reducing reliance on *Platanus x acerifolia*.

Sacramento's public tree resource is comprised primarily of younger trees, with 61.1% of the population less than 12 inches DBH. Sacramento should continue to focus resources on preserving existing and mature trees to promote health, strong structure, tree longevity, and manage risk. Structural and training pruning for young trees will maximize the value of this resource, reduce long-term maintenance costs, and ensure that as trees mature they provide the greatest benefits.

Based on this resource analysis, Davey Resource Group recommends that the City continue to implement the following best practices:

- Provide structural pruning for young trees and a regular pruning cycle for all trees.
- Protect existing trees and manage risk with regular inspection to identify and mitigate structural and age-related defects to manage risk and reduce the likelihood of tree and branch failure.
- Increase species diversity in new and replacement tree plantings to reduce reliance on the most prevalent species.
- Continue to maintain and update the inventory database, including tracking tree growth and condition during regular pruning cycles.

The City can better anticipate future trends with an understanding of the status of the tree population and can also anticipate challenges and devise plans to increase the current level of benefits. Performance data from this analysis can be used to make determinations regarding species selection, distribution, and maintenance policies. Documenting current structure is necessary for establishing goals and performance objectives and can serve as a benchmark for measuring future success. Information from the public tree resource analysis can be referenced in development of a public tree resource management or master plan. An urban forest master plan is a critical tool for successful public tree resource management, inspiring commitment and providing vision for communication with key decision-makers both inside and outside the organization.

Sacramento's trees are of vital importance to the environmental, social, and economic well-being of the community. Trees are a valued community resource, a vital component of the City infrastructure, and an important part of the community's identity. The inventory data can be used

to plan a proactive and forward-looking approach to the future care of public trees. Updates should continue to be incorporated into the inventory a regular maintenance is performed, including updating the DBH and condition of existing trees. Current and complete inventory data will help staff to more efficiently track maintenance activities and tree health and will provide a strong basis for making informed management decisions. A continued commitment to planting, maintaining, and preserving these trees, will support the health and welfare of the City and community at large.

Sacramento's 87,324 public trees provide cumulative annual benefits worth over $10.5 million.

Appendix A: Methodology

In 2017, the City of Sacramento provided public tree inventory data to Davey Resource Group. This inventory included details about each tree, including species, size, and condition. DRG formatted the data for use in i-Tree *Streets*, a STRATUM Analysis Tool (Streets v 5.1.5; i-Tree v 6.1.15). i-Tree *Streets* assesses tree population structure and the function of those trees, such as their role in energy use, air pollution removal, stormwater interception, carbon dioxide removal, and property value increases. To analyze the economic benefits of Sacramento's public trees, i-Tree *Streets* calculates the dollar value of annual resource functionality. This analysis combines the results of the tree inventory with benefit modeling data to produce information regarding resource structure, function, and value for use in determining management recommendations. i-Tree *Streets* regionalizes the calculations of its output by incorporating detailed reference city project information for 17 climate zones across the United States. Sacramento is in the Inland Valleys Climate Zone. The reference city is Modesto, California.

An annual resource unit was determined on a per tree basis for each of the modeled benefits. Resource units are measured as MWh of electricity saved per tree; MBtu of natural gas conserved per tree; pounds of atmospheric CO_2 reduced per tree; pounds of NO_2, SO_2, O_3, PM_{10}, and VOCs reduced per tree; cubic feet of stormwater runoff reduced per tree; and square feet of leaf area added per tree to increase property values. Price values assigned to each resource unit (tree) were generated based on economic indicators of society's willingness to pay for the environmental benefits trees provide. The City of Sacramento provided the estimated investment costs.

Estimates of benefits are initial approximations as some benefits are difficult to quantify (e.g. impacts on psychological health, crime, and violence). In addition, limited knowledge about the physical processes at work and their interactions makes estimates imprecise (e.g., fate of air pollutants trapped by trees and then washed to the ground by rainfall). Therefore, this method of quantification provides first-order approximations based on current research. It is intended to be a general accounting of the benefits produced by urban trees.

i-Tree *Streets* default values (Table 11) from the South Climate Zone were used for all benefit prices except for the median home value, and electrical and natural gas rates. Using these rates, the magnitude of the benefits provided by the public tree resource was calculated using i-Tree *Streets***.** Electrical and gas rates, and program investment costs were supplied by public tree resource managers for Sacramento.

Table 11: Benefit Prices Used in This Analysis

Benefits	*Price*	*Unit*	*Source*
Electricity	0.131	$/Kwh	Pacific Gas and Electric Company
Natural Gas	1.4726	$/Therm	Pacific Gas and Electric Company
CO_2	0.0075	$/lb	i-Tree Default
PM_{10}	9.41	$/lb	i-Tree Default
NO_2	12.79	$/lb	i-Tree Default
SO_2	3.72	$/lb	i-Tree Default
VOC	4.69	$/lb	i-Tree Default
Stormwater Interception	0.0078	$/gallon	i-Tree Default
Median Home Price	342,800	$	Zillow

The status of the tree population and can help the city anticipate challenges and devise plans to increase the current level of benefits.

Appendix B: References

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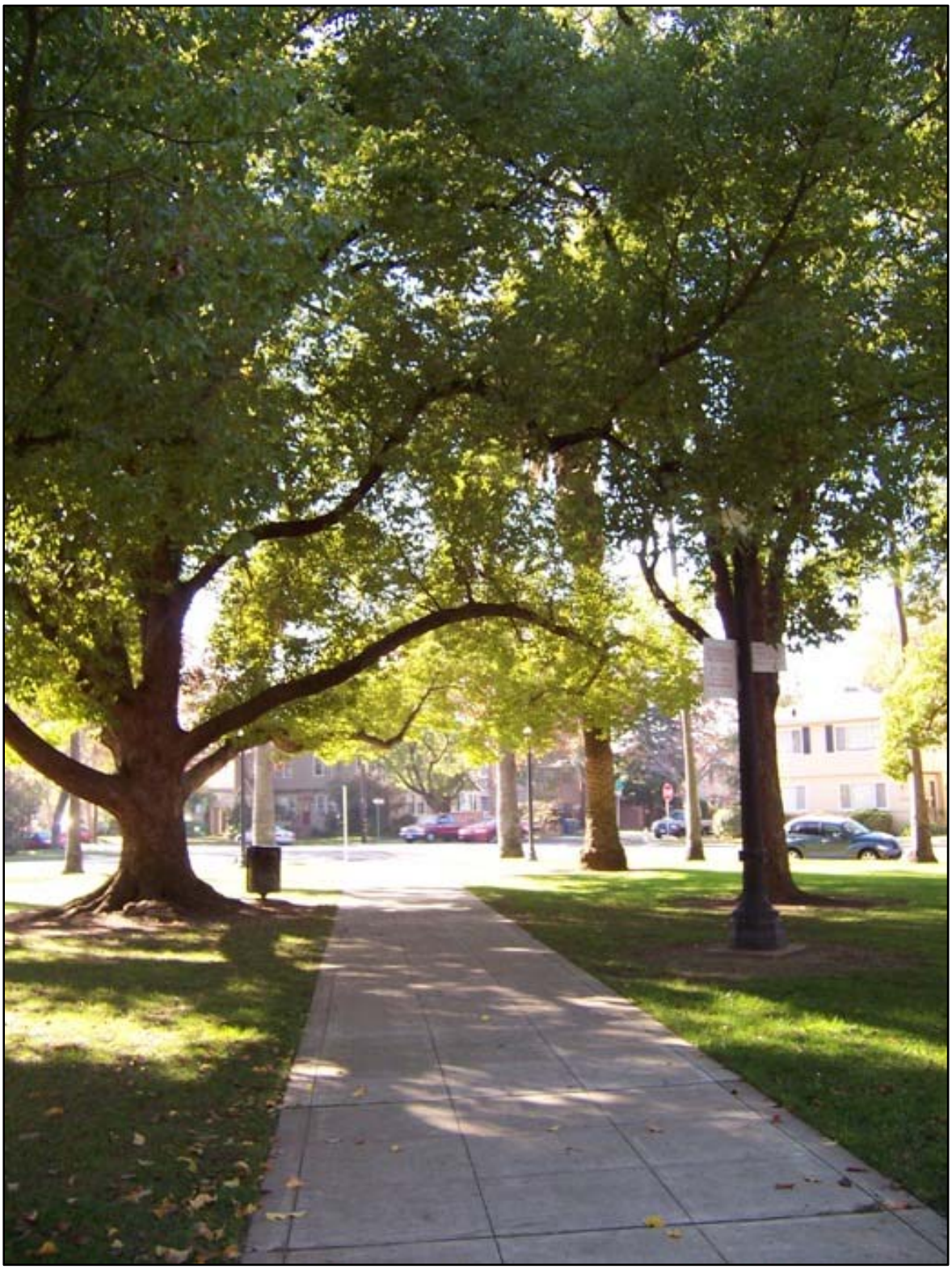

Sacramento's trees are of vital importance to the environmental, social, and economic well-being of the community.

Appendix C: Tables

Table 12: Botanical and Common Species Names

Botanical Name	Common Name	Total
Acacia species	Acacia species	129
Acer buergerianum	trident maple	572
Acer negundo	boxelder	54
Acer palmatum	Japanese maple	308
Acer platanoides	Norway maple	78
Acer rubrum	red maple	1,904
Acer saccharinum	silver maple	358
Acer species	maple	639
Acer tataricum ginnala	Amur maple	68
Acer x freemanii	Freeman maple	3
Aesculus californica	California buckeye	16
Aesculus californica	California buckeye	1
Aesculus carnea	red horsechestnut	40
Aesculus pavia	red buckeye	34
Ailanthus altissima	tree of heaven	165
Albizia julibrissin	silk tree	129
Alnus cordata	Italian alder	152
Alnus rhombifolia	white alder	143
Araucaria species	Araucaria species	2
Arbutus unedo	strawberry tree	189
Arecastrum romanzoffianum	queen palm	96
Betula pendula	European white birch	279
Betula species	birch	63
Brachychiton populneus	bottle tree	8
Callistemon citrinus	lemon bottlebrush	8
Callistemon viminalis	weeping bottlebrush	36
Calocedrus decurrens	incense cedar	272
Carpinus betulus	European hornbeam	16
Carpinus caroliniana	American hornbeam	19
Carya illinoensis	pecan	155
Casuarina equisetifolia	river-she oak	492
Catalpa speciosa	horsetail tree	166
Cedrus atlantica	atlas cedar	50
Cedrus deodara	deodar cedar	679
Celtis australis	European hackberry	334
Celtis occidentalis	northern hackberry	1,174
Celtis reticulata	western hackberry	296
Celtis sinensis	Chinese hackberry	1,004
Ceratonia siliqua	Carob	67
Cercis canadensis	eastern redbud	256
Cercis species	redbud	526
Chamaerops humilis	Mediterranean fan palm	27

Botanical Name	*Common Name*	*Total*
Chionanthus retusus	Chinese fringe tree	85
Chitalpa tashkentensis	chitalpa	81
Cinnamomum camphora	camphor tree	782
Citrus species	citrus	324
Cornus florida	eastern dogwood	58
Cornus species	dogwood species	74
Crataegus laevigata	smooth hawthorn	145
Crataegus lavallei	Washington hawthorn	110
Cupressocyparis X leylandii	Japanese cryptomeria	85
Cupressus arizonica	Leyland cypress	83
Cupressus macrocarpa	Arizona cypress	44
Cupressus sempervirens	Italian cypress	1,267
Diospyros kaki	Japanese persimmon	7
Dodonaea viscosa	hobseed bush	6
Eriobotrya deflexa	bronze loquat	11
Eriobotrya japonica	loquat tree	128
Eucalyptus cinerea	silver dollar tree	2
Eucalyptus globulus	blue gum	373
Eucalyptus nicholii	peppermint gum	1
Eucalyptus polyanthemos	silver dollar gum eucalyptus	7
Eucalyptus sideroxylon	red ironbark	3
Eucalyptus species	gum	202
Fagus sylvatica	European beech	82
Feijoa sellowiana	pineapple guava	6
Ficus nitida	Indian laurel fig	30
Ficus rubiginosa	rusty-leaf fig	16
Fortunella species	kumquat spp	12
Fraxinus angustifolia 'Raywood'	raywood ash	93
Fraxinus excelsior	European ash	7
Fraxinus pennsylvanica	green ash	526
Fraxinus species	Ash species	294
Fraxinus uhdei	evergreen ash	25
Fraxinus velutina	velvet ash	44
Fraxinus velutina 'Modesto'	Modesto ash	2,052
Geijera parviflora	Australian willow	46
Ginkgo biloba	ginkgo	1,149
Gleditsia triacanthos	honeylocust	307
Grevillea robusta	silk oak	12
Gymnocadus dioicus	Kentucky coffeetree	2
Ilex aquifolium	holly	27
Jacaranda mimosifolia	jacaranda	42
Juglans hindsii	hind walnut	79
Juglans nigra	black walnut	110
Juglans regia	English walnut	109
Juniperus species	juniper	444

Botanical Name	*Common Name*	*Total*
Koelreuteria bipinnata	flame tree	4
Koelreuteria paniculata	goldenrain tree	129
Laburnum anagyroides	goldenchain tree	8
Lagerstroemia indica	crapemyrtle	3,810
Lagerstroemia species	crape myrtle hybrid	29
Laurus nobilis	laurel de olor	234
Ligustrum japonica	Chinese privet	2
Ligustrum lucidum	Japanese privet	972
Liquidambar formosana	Chinese sweet gum	16
Liquidambar styraciflua	sweetgum	1,961
Liriodendron tulipifera	tulip tree	716
Magnolia grandiflora	southern magnolia	1,146
Magnolia stellata	star magnolia	39
Magnolia x soulangiana	saucer magnolia	152
Malus species	flowering crabapple	424
Maytenus boaria	mayten tree	32
Melia azedarach	chinaberry	47
Metasequoia glyptostroboi	dawn redwood	41
Morus alba	white mulberry	593
Musa species	Banana	40
Nerium oleander	oleander	55
Nyssa sylvatica	black tupelo	1,022
Olea europaea	olive	240
Other species	Other species	149
Parrotia persica	Persian parrotia	1
Paulownia tomentosa	empress tree	12
Persea species	Avocado	6
Phoenix canariensis	Canary Island date palm	983
Photinia x fraseri	fraser photinia	18
Picea abies	Norway spruce	13
Picea pungens	blue spruce	64
Pinus canariensis	Canary Island pine	287
Pinus eldarica	Mondell pine	170
Pinus halepensis	Aleppo pine	158
Pinus pinea	Italian stone pine	38
Pinus ponderosa	Ponderosa pine	17
Pinus radiata	Monterey pine	109
Pinus species	Pine	835
Pinus thunbergiana	Japanese black pine	76
Pistacia atlantica	Mt. Atlas mastic tree	16
Pistacia chinensis	Chinese pistache	4,534
Platanus racemosa	western sycamore	607
Platanus X acerifolia	London planetree	13,574
Platycladus orientalis	oriental arborvitae	151
Podocarpus gracilior	fern pine	8

Botanical Name	*Common Name*	*Total*
Podocarpus macrophyllus	yew pine	1
Podocarpus species	podocarpus	10
Populus alba	white poplar	26
Populus fremontii	Fremont cottonwood	449
Populus grandidentata	bigtooth aspen	18
Populus nigra italica	Lombardy poplar	46
Prunus caroliniana	cherry laurel	48
Prunus cerasifera	cherry plum	1,302
Prunus dulcis	European plum	107
Prunus laurocerasus	almond	7
Prunus lyonii	Catalina cherry	14
Prunus serrulata	Japanese flowering cherry	96
Prunus species	plum	614
Pseudotsuga menziesii	Douglas fir	21
Pterocarya stenoptera	Chinese wingnut	4
Punica granatum	pomegranate	13
Pyrus kawakamii	evergreen pear	344
Pyrus species	pear	3,714
Quercus agrifolia	coastal live oak	1,185
Quercus castaneafolia	chestnut-leaved oak	39
Quercus coccinea	scarlet oak	427
Quercus douglasii	blue oak	486
Quercus ilex	holly oak	57
Quercus kelloggii	valley oak	14
Quercus lobata	burr oak	3,696
Quercus macrocarpa	pin oak	45
Quercus palustris	pin oak	287
Quercus phellos	willow oak	94
Quercus rubra	northern red oak	1,666
Quercus species	oak	1,016
Quercus suber	cork oak	529
Quercus virginiana	southern live oak	307
Quercus wislizeni	interior live oak	594
Rhus lancea	African sumac	44
Robinia ambigua idahoensis	Idaho locust	63
Robinia pseudoacacia	black locust	160
Salix babylonica	weeping willow	43
Salix species	willow	274
Sapium sebiferum	Chinese tallowtree	372
Schinus molle	California peppertree	48
Sequoia sempervirens	coast redwood	2,912
Sequoiadendron giganteum	Japanese pagoda tree	65
Sophora japonica	Japanese pagoda tree	133
Taxodium distichum	baldcypress	83
Taxus brevifolia	Pacific yew	31

Botanical Name	Common Name	Total
Thuja species	cedar species	53
Tilia americana	American linden	303
Tilia cordata	little-leaf linden	719
Trachycarpus fortunei	windmill palm	56
Ulmus americana	American elm	878
Ulmus parvifolia	Chinese elm	982
Ulmus procera	English elm	1,428
Ulmus pumila	Siberian elm	153
Ulmus spp	elm	686
Umbellularia californica	California laurel	93
Unknown species	Unknown species	43
Vitex negundo	chastetree	6
Washingtonia filifera	California palm	935
Washingtonia robusta	Mexican fan palm	1,535
Xylosma congestum	xylosma	7
Yucca faxoniana	yucca	144
Zelkova serrata	Japanese zelkova	3,862

Table 13: Importance Value for All Tree Species

Species	Number of Trees	% of Total Trees	Leaf Area (ft^2)	% of Total Leaf Area	Canopy Cover (ft^2)	% of Total Canopy Cover	Importance Value
Platanus x acerifolia	13,574	15.54	48,887,051	19.78	15,759,151	26.69	**20.67**
Pistacia chinensis	4,534	5.19	6,687,978	2.71	2,231,630	3.78	**3.89**
Zelkova serrata	3,862	4.42	30,982,488	12.53	5,481,803	9.29	**8.75**
Lagerstroemia indica	3,810	4.36	593,904	0.24	232,652	0.39	**1.67**
Pyrus species	3,714	4.25	3,458,027	1.40	1,198,868	2.03	**2.56**
Quercus lobata	3,696	4.23	6,754,366	2.73	1,775,252	3.01	**3.32**
Sequoia sempervirens	2,912	3.33	8,674,381	3.51	2,409,903	4.08	**3.64**
Fraxinus velutina	2,052	2.35	8,794,875	3.56	2,704,469	4.58	**3.50**
Liquidambar styraciflua	1,961	2.25	7,200,300	2.91	1,183,207	2.00	**2.39**
Acer rubrum	1,904	2.18	689,209	0.28	219,007	0.37	**0.94**
Quercus rubra	1,666	1.91	1,488,208	0.60	446,005	0.76	**1.09**
Washingtonia robusta	1,535	1.76	248,264	0.10	124,668	0.21	**0.69**
Ulmus procera	1,428	1.64	33,821,717	13.68	4,089,201	6.93	**7.41**
Prunus cerasifera	1,302	1.49	541,698	0.22	123,376	0.21	**0.64**
Cupressus sempervirens	1,267	1.45	1,072,887	0.43	253,346	0.43	**0.77**
Quercus agrifolia	1,185	1.36	3,112,977	1.26	684,353	1.16	**1.26**
Celtis occidentalis	1,174	1.34	1,074,515	0.43	273,499	0.46	**0.75**
Ginkgo biloba	1,149	1.32	972,003	0.39	218,011	0.37	**0.69**

Species	Number of Trees	% of Total Trees	Leaf Area (ft^2)	% of Total Leaf Area	Canopy Cover (ft^2)	% of Total Canopy Cover	Importance Value
Magnolia grandiflora	1,146	1.31	1,453,479	0.59	441,999	0.75	**0.88**
Nyssa sylvatica	1,022	1.17	317,647	0.13	77,189	0.13	**0.48**
Quercus species	1,016	1.16	1,104,006	0.45	292,181	0.49	**0.70**
Celtis sinensis	1,004	1.15	2,431,229	0.98	622,662	1.05	**1.06**
Phoenix canariensis	983	1.13	1,080,024	0.44	1,028,218	1.74	**1.10**
Ulmus parvifolia	982	1.12	6,524,910	2.64	1,364,090	2.31	**2.02**
Ligustrum lucidum	972	1.11	505,371	0.20	157,320	0.27	**0.53**
Washingtonia filifera	935	1.07	312,646	0.13	152,631	0.26	**0.49**
Ulmus americana	878	1.01	15,827,795	6.40	2,248,993	3.81	**3.74**
Pinus species	835	0.96	1,684,418	0.68	450,323	0.76	**0.80**
Cinnamomum camphora	782	0.90	4,215,155	1.71	682,981	1.16	**1.25**
Tilia cordata	719	0.82	953,522	0.39	262,860	0.45	**0.55**
Liriodendron tulipifera	716	0.82	2,863,163	1.16	359,811	0.61	**0.86**
Ulmus spp	686	0.79	1,115,071	0.45	276,464	0.47	**0.57**
Cedrus deodara	679	0.78	1,606,170	0.65	461,084	0.78	**0.74**
Acer species	639	0.73	461,742	0.19	156,346	0.26	**0.39**
Prunus species	614	0.70	177,875	0.07	63,331	0.11	**0.29**
Platanus racemosa	607	0.70	1,295,129	0.52	408,524	0.69	**0.64**
Quercus wislizeni	594	0.68	810,717	0.33	199,738	0.34	**0.45**
Morus alba	593	0.68	1,389,049	0.56	484,089	0.82	**0.69**
Acer buergerianum	572	0.66	454,892	0.18	173,506	0.29	**0.38**
Quercus suber	529	0.61	2,779,121	1.12	630,978	1.07	**0.93**
Cercis species	526	0.60	49,832	0.02	19,497	0.03	**0.22**
Fraxinus pennsylvanica	526	0.60	1,361,122	0.55	483,500	0.82	**0.66**
Casuarina equisetifolia	492	0.56	1,663,786	0.67	414,662	0.70	**0.65**
Quercus douglasii	486	0.56	1,359,424	0.55	329,416	0.56	**0.55**
Populus fremontii	449	0.51	1,678,482	0.68	411,874	0.70	**0.63**
Juniperus species	444	0.51	169,588	0.07	36,007	0.06	**0.21**
Quercus coccinea	427	0.49	483,838	0.20	155,427	0.26	**0.32**
Malus species	424	0.49	107,563	0.04	39,818	0.07	**0.20**
Eucalyptus globulus	373	0.43	3,672,336	1.49	678,647	1.15	**1.02**
Sapium sebiferum	372	0.43	573,078	0.23	209,269	0.35	**0.34**
Acer saccharinum	358	0.41	1,441,562	0.58	410,581	0.70	**0.56**
Pyrus kawakamii	344	0.39	330,115	0.13	120,060	0.20	**0.24**
Celtis australis	334	0.38	479,277	0.19	130,701	0.22	**0.27**
Citrus species	324	0.37	211,156	0.09	70,323	0.12	**0.19**
Acer palmatum	308	0.35	146,717	0.06	54,068	0.09	**0.17**

Species	Number of Trees	% of Total Trees	Leaf Area (ft^2)	% of Total Leaf Area	Canopy Cover (ft^2)	% of Total Canopy Cover	Importance Value
Quercus virginiana	307	0.35	346,506	0.14	113,239	0.19	**0.23**
Gleditsia triacanthos	307	0.35	955,870	0.39	300,255	0.51	**0.42**
Tilia americana	303	0.35	784,471	0.32	210,492	0.36	**0.34**
Celtis reticulata	296	0.34	195,523	0.08	61,552	0.10	**0.17**
Fraxinus species	294	0.34	482,140	0.20	76,555	0.13	**0.22**
Pinus canariensis	287	0.33	670,054	0.27	162,316	0.27	**0.29**
Quercus palustris	287	0.33	251,873	0.10	76,091	0.13	**0.19**
Betula pendula	279	0.32	302,313	0.12	76,695	0.13	**0.19**
Salix species	274	0.31	174,868	0.07	54,696	0.09	**0.16**
Calocedrus decurrens	272	0.31	892,319	0.36	253,085	0.43	**0.37**
Cercis canadensis	256	0.29	30,965	0.01	11,697	0.02	**0.11**
Olea europaea	240	0.27	254,764	0.10	78,497	0.13	**0.17**
Laurus nobilis	234	0.27	270,388	0.11	58,552	0.10	**0.16**
Eucalyptus species	202	0.23	1,534,228	0.62	297,101	0.50	**0.45**
Arbutus unedo	189	0.22	140,603	0.06	47,110	0.08	**0.12**
Pinus eldarica	170	0.19	64,175	0.03	21,106	0.04	**0.09**
Catalpa speciosa	166	0.19	876,214	0.35	227,079	0.38	**0.31**
Ailanthus altissima	165	0.19	167,663	0.07	55,721	0.09	**0.12**
Robinia pseudoacacia	160	0.18	497,886	0.20	153,368	0.26	**0.21**
Pinus halepensis	158	0.18	423,794	0.17	115,199	0.20	**0.18**
Carya illinoensis	155	0.18	460,934	0.19	125,087	0.21	**0.19**
Ulmus pumila	153	0.18	1,173,153	0.47	195,059	0.33	**0.33**
Alnus cordata	152	0.17	265,513	0.11	92,185	0.16	**0.15**
Magnolia x soulangiana	152	0.17	94,688	0.04	27,712	0.05	**0.09**
Platycladus orientalis	151	0.17	55,393	0.02	10,966	0.02	**0.07**
Other species	149	0.17	115,805	0.05	20,788	0.04	**0.08**
Crataegus laevigata	145	0.17	39,717	0.02	13,314	0.02	**0.07**
Yucca faxoniana	144	0.16	2,519	0.00	1,344	0.00	**0.06**
Alnus rhombifolia	143	0.16	267,513	0.11	93,757	0.16	**0.14**
Sophora japonica	133	0.15	161,820	0.07	53,873	0.09	**0.10**
Acacia species	129	0.15	118,704	0.05	34,611	0.06	**0.08**
Albizia julibrissin	129	0.15	149,932	0.06	52,753	0.09	**0.10**
Koelreuteria paniculata	129	0.15	65,782	0.03	26,094	0.04	**0.07**
Eriobotrya japonica	128	0.15	63,494	0.03	18,935	0.03	**0.07**
Juglans nigra	110	0.13	597,078	0.24	150,807	0.26	**0.21**
Crataegus lavallei	110	0.13	8,944	0.00	3,428	0.01	**0.05**
Juglans regia	109	0.12	250,429	0.10	88,370	0.15	**0.13**

Species	Number of Trees	% of Total Trees	Leaf Area (ft^2)	% of Total Leaf Area	Canopy Cover (ft^2)	% of Total Canopy Cover	Importance Value
Pinus radiata	109	0.12	300,265	0.12	72,980	0.12	**0.12**
Prunus dulcis	107	0.12	38,062	0.02	13,037	0.02	**0.05**
Prunus serrulata	96	0.11	33,637	0.01	11,385	0.02	**0.05**
Arecastrum romanzoffianum	96	0.11	5,030	0.00	2,695	0.00	**0.04**
Quercus phellos	94	0.11	211,940	0.09	49,603	0.08	**0.09**
Fraxinus angustifolia 'Raywood'	93	0.11	204,300	0.08	55,021	0.09	**0.09**
Umbellularia californica	93	0.11	143,695	0.06	34,643	0.06	**0.07**
Chionanthus retusus	85	0.10	7,358	0.00	2,799	0.00	**0.04**
Cupressocyparis x leylandii	85	0.10	60,037	0.02	14,718	0.02	**0.05**
Taxodium distichum	83	0.10	287,443	0.12	74,742	0.13	**0.11**
Cupressus arizonica	83	0.10	154,183	0.06	25,381	0.04	**0.07**
Fagus sylvatica	82	0.09	169,854	0.07	47,641	0.08	**0.08**
Chitalpa tashkentensis	81	0.09	8,055	0.00	3,473	0.01	**0.03**
Juglans hindsii	79	0.09	416,877	0.17	106,955	0.18	**0.15**
Acer platanoides	78	0.09	37,751	0.02	11,880	0.02	**0.04**
Pinus thunbergiana	76	0.09	65,607	0.03	27,747	0.05	**0.05**
Cornus species	74	0.08	14,850	0.01	3,379	0.01	**0.03**
Acer tataricum ginnala	68	0.08	8,958	0.00	1,978	0.00	**0.03**
Ceratonia siliqua	67	0.08	381,044	0.15	105,967	0.18	**0.14**
Sequoiadendron giganteum	65	0.07	322,523	0.13	98,961	0.17	**0.12**
Picea pungens	64	0.07	104,201	0.04	24,724	0.04	**0.05**
Betula species	63	0.07	47,870	0.02	8,935	0.02	**0.04**
Robinia ambigua idahoensis	63	0.07	202,987	0.08	55,018	0.09	**0.08**
Cornus florida	58	0.07	11,133	0.00	4,210	0.01	**0.03**
Quercus ilex	57	0.07	42,164	0.02	12,857	0.02	**0.03**
Trachycarpus fortunei	56	0.06	8,226	0.00	6,631	0.01	**0.03**
Nerium oleander	55	0.06	18,677	0.01	5,047	0.01	**0.03**
Acer negundo	54	0.06	85,098	0.03	30,230	0.05	**0.05**
Thuja species	53	0.06	3,644	0.00	801.13	0.00	**0.02**
Cedrus atlantica	50	0.06	176,481	0.07	54,553	0.09	**0.07**
Prunus caroliniana	48	0.05	46,309	0.02	16,821	0.03	**0.03**
Schinus molle	48	0.05	135,691	0.05	24,767	0.04	**0.05**
Melia azedarach	47	0.05	131,289	0.05	45,096	0.08	**0.06**
Populus nigra italica	46	0.05	84,015	0.03	23,833	0.04	**0.04**
Geijera parviflora	46	0.05	36,686	0.01	12,086	0.02	**0.03**
Quercus macrocarpa	45	0.05	77,330	0.03	21,945	0.04	**0.04**
Fraxinus velutina	44	0.05	149,799	0.06	46,585	0.08	**0.06**

Species	Number of Trees	% of Total Trees	Leaf Area (ft^2)	% of Total Leaf Area	Canopy Cover (ft^2)	% of Total Canopy Cover	Importance Value
Cupressus macrocarpa	44	0.05	89,872	0.04	23,057	0.04	**0.04**
Rhus lancea	44	0.05	48,931	0.02	18,550	0.03	**0.03**
Unknown species	43	0.05	46,628	0.02	8,108	0.01	**0.03**
Salix babylonica	43	0.05	73,947	0.03	25,901	0.04	**0.04**
Jacaranda mimosifolia	42	0.05	64,826	0.03	23,651	0.04	**0.04**
Metasequoia glyptostroboi	41	0.05	55,694	0.02	14,515	0.02	**0.03**
Musa species	40	0.05	4,627	0.00	1,169	0.00	**0.02**
Aesculus carnea	40	0.05	86,986	0.04	29,528	0.05	**0.04**
Quercus castaneafolia	39	0.04	87,841	0.04	22,013	0.04	**0.04**
Magnolia stellata	39	0.04	17,641	0.01	6,413	0.01	**0.02**
Pinus pinea	38	0.04	106,601	0.04	27,127	0.05	**0.04**
Callistemon viminalis	36	0.04	8,248	0.00	1,679	0.00	**0.02**
Aesculus pavia	34	0.04	7,677	0.00	2,501	0.00	**0.02**
Maytenus boaria	32	0.04	41,298	0.02	15,123	0.03	**0.03**
Taxus brevifolia	31	0.04	104,488	0.04	25,836	0.04	**0.04**
Ficus nitida	30	0.03	24,295	0.01	4,226	0.01	**0.02**
Lagerstroemia species	29	0.03	4,412	0.00	1,025	0.00	**0.01**
Ilex aquifolium	27	0.03	12,730	0.01	3,803	0.01	**0.01**
Chamaerops humilis	27	0.03	2,980	0.00	1,534	0.00	**0.01**
Populus alba	26	0.03	43,404	0.02	10,290	0.02	**0.02**
Fraxinus uhdei	25	0.03	76,805	0.03	27,358	0.05	**0.04**
Pseudotsuga menziesii	21	0.02	63,888	0.03	16,074	0.03	**0.03**
Carpinus caroliniana	19	0.02	21,831	0.01	7,463	0.01	**0.01**
Populus grandidentata	18	0.02	59,726	0.02	8,793	0.01	**0.02**
Photinia x fraseri	18	0.02	13,087	0.01	3,821	0.01	**0.01**
Pinus ponderosa	17	0.02	84,797	0.03	25,317	0.04	**0.03**
Pistacia atlantica	16	0.02	50,917	0.02	13,770	0.02	**0.02**
Aesculus californica	16	0.02	2,551	0.00	252.38	0.00	**0.01**
Carpinus betulus	16	0.02	15,737	0.01	5,647	0.01	**0.01**
Liquidambar formosana	16	0.02	30,721	0.01	4,190	0.01	**0.01**
Ficus rubiginosa	16	0.02	3,985	0.00	1,662	0.00	**0.01**
Quercus kelloggii	14	0.02	4,762	0.00	1,215	0.00	**0.01**
Prunus lyonii	14	0.02	5,404	0.00	1,963	0.00	**0.01**
Punica granatum	13	0.01	1,602	0.00	709.97	0.00	**0.01**
Picea abies	13	0.01	28,637	0.01	6,469	0.01	**0.01**
Fortunella species	12	0.01	4,239	0.00	1,127	0.00	**0.01**
Grevillea robusta	12	0.01	19,303	0.01	5,282	0.01	**0.01**

Species	Number of Trees	% of Total Trees	Leaf Area (ft^2)	% of Total Leaf Area	Canopy Cover (ft^2)	% of Total Canopy Cover	Importance Value
Paulownia tomentosa	12	0.01	29,227	0.01	10,151	0.02	**0.01**
Eriobotrya deflexa	11	0.01	2,697	0.00	569.93	0.00	**0.00**
Podocarpus species	10	0.01	1,519	0.00	375.23	0.00	**0.00**
Brachychiton populneus	8	0.01	44,063	0.02	7,277	0.01	**0.01**
Laburnum anagyroides	8	0.01	4,645	0.00	1,473	0.00	**0.00**
Callistemon citrinus	8	0.01	6,054	0.00	2,132	0.00	**0.01**
Podocarpus gracilior	8	0.01	6,581	0.00	2,710	0.00	**0.01**
Diospyros kaki	7	0.01	2,552	0.00	639.80	0.00	**0.00**
Xylosma congestum	7	0.01	12,760	0.01	5,219	0.01	**0.01**
Fraxinus excelsior	7	0.01	12,098	0.00	3,606	0.01	**0.01**
Eucalyptus polyanthemos	7	0.01	5,086	0.00	1,640	0.00	**0.00**
Prunus laurocerasus	7	0.01	3,354	0.00	976.92	0.00	**0.00**
Persea species	6	0.01	2,052	0.00	585.87	0.00	**0.00**
Feijoa sellowiana	6	0.01	1,062	0.00	179.56	0.00	**0.00**
Vitex negundo	6	0.01	1,169	0.00	386.06	0.00	**0.00**
Dodonaea viscosa	6	0.01	1,062	0.00	179.56	0.00	**0.00**
Koelreuteria bipinnata	4	0.00	4,135	0.00	1,458	0.00	**0.00**
Pterocarya stenoptera	4	0.00	22,705	0.01	6,190	0.01	**0.01**
Eucalyptus sideroxylon	3	0.00	14,983	0.01	3,663	0.01	**0.01**
Acer x freemanii	3	0.00	548.36	0.00	105.99	0.00	**0.00**
Eucalyptus cinerea	2	0.00	17,439	0.01	3,075	0.01	**0.00**
Ligustrum japonica	2	0.00	354.03	0.00	59.85	0.00	**0.00**
Araucaria species	2	0.00	2,627	0.00	610.30	0.00	**0.00**
Gymnocadus dioicus	2	0.00	404.29	0.00	15.64	0.00	**0.00**
Podocarpus macrophyllus	1	0.00	1,167	0.00	436.24	0.00	**0.00**
Aesculus californica	1	0.00	65.61	0.00	14.17	0.00	**0.00**
Eucalyptus nicholii	1	0.00	4,126	0.00	1,205	0.00	**0.00**
Parrotia persica	1	0.00	1,175	0.00	441.49	0.00	**0.00**
Total	***87,324***	***100%***	***247,213,795***	***100%***	***59,038,719***	***100%***	***100.00***