Sustaining the Legacy

Palo Alto Urban Forest Master Plan

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Vision

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Vision

Our Urban Forest is the heart of Palo Alto's urban and natural landscape.

It is an essential economic, community, environmental and ecological asset that provides a tangible connection to the natural world for our citizens in their everyday lives, enhancing their health, intellect and wellbeing.

Trees, vegetation, soil, water and wildlife have great individual value and interdependent attributes, and must be cared for as a whole.

Palo Alto City leaders, city staff, residents, property owners, business owners and partner organizations are caretakers of the Urban Forest. The caretakers collaborate to protect, create, restore and enhance environmental and ecological functions and biodiversity of the Urban Forest.

Careful planning insures that the forest thrives and is contiguous, complex, and resilient in the face of continued urbanization and climate change.

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Executive Summary

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Executive summary

The legacy

Palo Alto's urban forest has been nurtured by citizens and staff for more than a hundred and twenty years.

Measurable benefits define it as valuable infrastructure and immeasurable benefits help define Palo Alto's quality of life.

In deed, Palo Alto has already achieved many of the goals that are the focus of other urban forest master plans. [1]

But, the future cannot be taken for granted.

Sustaining the legacy

Urban forest concerns overlap those of water, infrastructure, development, solar, and budget.

Following are the main concepts of the master plan—with the take-home message and applicable policies and programs for each.

Many programs will require collaboration between multiple city departments—and the community.

1 *See "Defining the urban forest & scope of the plan" chapter.*

Benefits & Value = Canopy Cover & Composition

Coordinated sustainability planning

Two analyses done for the master plan (2010) established Palo Alto's urban canopy cover to be a healthy 37.6% with a majority of the trees being of a benefit-rich broadleaf species. [1]

To sustain this scenario and related ecological benefits (such as carbon sequestration) would require the retention and continued planting of large stature broadleaf trees.

However, the canopy cover and composition of the future urban forest will also be influenced by other sustainability concepts and programs e.g:

- An emphasis on drought and recycled-water tolerance may result in choosing trees with less dense canopies.
- Solar panel installations may result in the voluntary removal of large trees or may prevent new large trees from being planted. *(E.g., where solar panels might be used—instead of trees—to meet shading requirements for parking lots.)*
- The "Right Tree Right Place" program subsidizes the exchange of large trees for smaller ones near power lines.
- An emphasis on appropriate species for riparian corridors may result in choosing smaller trees.
- An emphasis on wildlife benefits in parks and natural areas may result in choosing smaller, fruiting trees.
- The increasing importance of local food may result in choosing smaller, fruiting trees.

An even greater influence will be how future development proceeds. [2]

Intensification and related underground utility requirements threaten to result in fewer planting sites with sufficient soil volume for large trees.

It will be important for the urban forestry staff to work with the city's sustainability team to:

- Ensure that the benefits and needs of the urban forest are formally incorporated into citywide sustainability planning.
- Identify potential conflicts with other programs—and propose mitigation practices such as enhanced soil space.
- Adopt an official list of preferred and restricted species that complements the city's considerations for BVOC emissions and acknowledges the role large broadleaf trees.
- Evaluate carbon credit programs.

Equitable solutions may not always be obvious; in fact, they may require debate. But a citywide *Sustainability Plan* is an opportunity to consider the compatibility and desired balance of all environmental policies and programs.

The interdisciplinary, collaborative, cooperative, and comprehensive nature of the solutions will determine the urban forest's sustainability, environmental value, economic benefit, equability—and ultimately, the quality of life in Palo Alto.

Applicable policies: 1.A., 1.G., 2.A., 2.B., 2.C., 3.A., 3.B., 4.A., 4.B., 4.E., 4.F., 4.G.

Applicable programs: 1.A.i., 1.A.ii., 1.A.iii., 1.G.i., 1.G.ii., 2.A.i., 2. A.ii., 2.A.iii., 2.A.iv., 2.A.vi., 2.B.i., 2.B.ii., 2.B.iii., 2.C.i., 2.C.ii., 2.C.iii., 3.A.iii., 3.B.i., 3.B.iii., 3.B.iv., 4.A.i., 4.A.ii., 4.B.i., 4.B.ii., 4.B.iii., 4.B.iv., 4.B.v., 4.E.i., 4.F.i., 4.F.ii., 4.G.i., 4.G.ii..

[1] *Results of these and other analyses are described further in the "Canopy," "Composition," and "Value" chapters.*
[2] *Development is discussed further in "Challenges & Opportunities."*

Challenges & Opportunities

Water

The need for water conservation is incontrovertible and the master plan envisions an urban forest that is more climate adapted with a much smaller proportion of trees being vulnerable to water constraints.

The transition to a more climate adapted urban forest will be accomplished through master plan programs that emphasize the planting of drought and recycled-water tolerant species as well as programs for coaching other—benefit-rich—species to adapt to local conditions.

It will be important to:

- Develop protocols for coaching and encouraging adaptability.
- Establish an accurate account of how much water the trees really need and current sources of supplemental water.
- Review the health of the trees currently irrigated with recycled water and close gaps in the knowledge of how trees respond to recycled water.
- Follow up on the progress of the Salinity Reduction Policy for Recycled Water and review its relationship to city requirements for using recycled water for landscape irrigation.
- Encourage nurseries to carry appropriate species.
- Work with Canopy to encourage property owners to plant appropriate species such as drought tolerant native oaks.

Until the proportion of vulnerable trees is reduced—impacts to the urban forest could be ameliorated by introducing water conservation programs in phases. In other words:

- Early phases could employ short-term strategies that accommodate existing vulnerable trees—until their numbers can be reduced through natural mortality.
- Later phases could be less accommodating.

Ameliorating the impacts of water conservation upon the urban forest will require respect for differing view points and the collaboration of multiple departments—and is an appropriate topic for coordinated sustainability planning.

Applicable policies: 1.A., 1.B., 1.C., 2.A., 2.B., 2.C., 3.B., 4.A., 4.B.

Applicable programs: 1.A.ii., 1.A.iii., 1.B.i., 1.C.ii., 2.A.iii., 2.B.i., 2.B.ii., 2.B.iii., 2.C.i., 2.C.ii., 2.C.iii., 3.B.i., 4.A.i., 4.A.ii., 4.B.i.

Line clearing

This emerged from the master plan's community survey as a "Hot Topic" and the city acknowledges that power line clearing can result in a less than desirable tree form. However, like water conservation, the need is incontrovertible.

Palo Alto's fairly unique status—as the utility provider within the city limits—means that the utility, poles, transformers, and wires are public assets—just like the street trees. So, staff and the community have a vested interest in both sides of this issue.

Illustrative outreach about the need and protocols for line clearing may be helpful toward the goal of engaging the community as a partner in stewarding the urban forest.

Meanwhile, to reduce the number of conflicts, the city's *Right Tree Right Place* program encourages and even subsidizes the exchange of large trees for smaller ones—near power lines. But, as appropriate as it is, this program will likely diminish the number of large (benefit-rich) broadleaf trees and mitigation of this loss should be considered in the city's coordinated sustainability planning.

Applicable policies: 1.A., 2.A., 3.A., 3.B., 4.H.

Applicable programs: 1.A.i., 1.A.ii., 1.A.iii., 2.A.i., 3.A.i., 3.B.iii., 4.H.i.,

Solar

Solar power is important to the City's renewable energy program and incentives are available for **properly sited** solar panels.

The City's review of conflicts between solar panels and trees is based on the California Solar Shade Act (Public Resource Code Section 25980-25986).

However, neither the Shade Act nor existing City policy speak to the increasing interest in using solar panels—instead of trees—to meet the zoning requirement for 50% shading of a parking lot.

The potential impact of this trend is huge and it is an appropriate topic for coordinated sustainability planning.

Applicable policies: 1A., 1F., 1G., 1H., 2A., 2B., 3A., 4A., 4B., 4C., 4E., 4H.

Applicable programs: 1.A.iii., 1.D.i., 1.E.iii., 1.Fi., 1.G.i., 1.G.ii., 1.Hi., 1.H.ii., 2.A.i., 2.A.ii., 2.A.iii., 2.A.iv., 2.A.vi., 2.B.i., 2.B.ii., 2.B.iii., 3.A.ii., 3.A.v., 3.A.vii., 3.A.ix., 3.B.ii., 4.A.i., 4.A.ii., 4.B.i., 4.B.ii., 4.B.iii., 4.B.iv., 4.B.vi., 4.E.i., 4.E.ii., 4.F.i., 4.G.i., 4.G.vi., 4.H.ii.

Development

There is little vacant land in Palo Alto and most redevelopment is more intense than what it replaces. The resulting competition for space often leads to the irrevocable loss of planting sites—including street tree planting sites—thus permanently scarring the street scape.

But, unlike the impacts of water conservation, power-line clearing, or solar installations, there is little or no argument for allowing this impact.

In fact, it is within this challenge that opportunities are the greatest. The master plan posits that—with protective policies and procedures in place—development projects can be embraced as opportunities to enhance both the built and natural environment.

It will be important to:

- Develop canopy thresholds or minimum tree planting requirements for development projects.
- Develop standards for soil (volume and condition) as well as drainage (on-site water infiltration in conjunction with natural drainage).
- Explore ways to prevent conflicts with underground infrastructure such as a requirement to locate underground utilities to a corridor—preferably coincident with the driveway.
- Evaluate the 50% shading requirement for parking lots (public and private) i.e., identify reasons for success and or failure, modify as needed, and clarify the city's policy regarding solar panels as a substitute for trees.
- Evaluate the recent procedure change (intended to expedite the development permitting process) that allows permits to be granted before tree protection installations have been inspected.
- Ensure that recommendations of programs such as CalGreen and Sustainable Sites Initiative are incorporated into the development standards.
- Evaluate current guidelines for El Camino Real.
- Create guidelines for successfully incorporating solar panels and trees into site design.

Responses to the master plan survey indicate that the community perceives development/redevelopment to be the greatest threat to the urban forest.

Preventing the loss of canopy and/or planting sites due to development will require improvements to project review and inspection procedures—and likely—changes to the Municipal Code.

This will affect multiple departments as well the development community and is an appropriate topic for coordinated sustainability planning.

Applicable policies: 1.C., 1.D., 1.E., 1.F., 1.G., 1.H., 2.A., 2.B., 3.B., 4.A., 4.B., 4.C., 4.D., 4.E., 4.F., 4.G., 4.H., 4.K.

Applicable programs: 1.C.i., 1.C.iv., 1.D.i., 1.E.i., 1.E.ii., 1.E.iii., 1.E.iv., 1.E.v., 1.F.i., 1.G.i., 1.G.ii.,1.H.i.,1.H.ii., 2.A.iv., 2.A.v., 2.B.i., 2.B.ii., 2.B.iii., 3.B.i., 3.B.ii., 4.A.i., 4.A.ii., 4.B.i., 4.B.ii., 4.B.iii., 4.B.iv., 4.B.v., 4.C.i., 4.C.ii., 4.D., 4.E.i. 4.F.i., 4.F.ii., 4.G.i., 4.G.ii., 4.G.v., 4.G.vi., 4.G.vii., 4.G.viii., 4.H.ii., 4.H.iv., 4.H.v., 4.H.vi., 4.K.i., 4.K.ii., 4.K.iii., 5.1.

Community Engagement

The master plan survey

The bulk of the urban forest is made up of privately owned trees and successful implementation of the master plan is anticipated to be closely tied to a partnership between staff and the community.

To this end, the city conducted an online survey (2011) to better understand the community's perceptions—related to both trees and tree management by the City. There were over 600 respondents and following is a summary of their responses. [1]

1: Who took the survey?

- 60 Members of Palo Alto leadership *(elected official, neighborhood board, school board, etc.)*
- 45 Tree and landscape professionals.
- 557 Interested citizens *(live in, work in, or frequently visit—Palo Alto.)*
- 18 Undefined.

2: Respondent zip codes (home):

1. 94306 (33%)
2. 94303 (28%)
3. 94301 & 94304 (26%)
4. Other (13%)

2: Respondent zip codes (work):

1. Other (50%)
2. 94301 & 94304 (18%)
3. 94306 (17%)
4. 94303 (15%)

4: Importance of trees: The 3 most popular responses were:

1. Provide shade and cool buildings.
2. Are beautiful.
3. Reduce air pollution.

5: What trees mean to you: Response themes included global issues, a calmer and more beautiful community, and a connection to nature.

6: What you don't like about the public and private trees around you: The 3 most popular responses were:

1. Damage caused by tree roots.
2. Mess from fallen leaves or fruit.
3. Potential damage or injury from fallen branches.

7: What changes are needed regarding more, different, or fewer trees: A majority indicated that they would like more trees within the city; but few wanted more trees in their own yards.

8: Expected benefits from more, different, or fewer trees: Responses indicated expectations regarding size, species, and the related consequences such as shade, root damage, debris, and allergies. However, in each category, expectations were varied and often opposing.

9: Serious threats: The 3 threats for which most respondents gave a ranking of either "Serious" or "Very Serious":

1. Urban Development/Redevelopment *(Note: Responses to #11 indicated that threats from City projects are perceived to be equal to or greater than threats from private projects.)*
2. Lack of proper care.
3. Drought and water constraints.

10: Additional thoughts about threats: Response themes reiterated the multiple choices *(see #9)* and added topics such as power line clearing, the city's budget, and "High Speed Rail".

11: Areas in which the City needs to improve management of trees: Although there was no consensus, the 3 areas that garnered the strongest majorities were:

1. Informing residents about proposed removals of community trees.
2. Informing residents about tree regulations.
3. Making good choices about tree removals.

12: Additional thoughts about City management of trees: Response themes reiterated the multiple choices *(see #11)* and added topics such as obscured street signs, improper irrigation systems, electric line clearing, species selection, and responsiveness to requests.

[1] *There is an expanded representation of the survey responses in "Community Surveys" chapter of this master plan; and a full report of the survey is available on the Urban Forestry website.*

13: Areas for City focus: The 3 most popular choices are:

1. Encouraging drought tolerant species.
2. Providing more tree maintenance.
3. Planting more trees.

14: Additional thoughts about trees: Response themes reiterate concerns about maintenance, species selection, and budget, and mention a need to coordinate with other agencies, taxes, and property rights.

It is likely that the Urban Forestry website will be the most cost efficient way to facilitate community input and outreach; but master plan programs also call for community meetings and workshops to:

- Introduce resources such as the Urban Forestry and Canopy websites.
- Address "Hot Topics" from the master plan survey *("Hot Topics" are discussed further on this and following pages).*
- Provide information and motivation—to make responsible choices about private trees.

Applicable policies: 1.D., 1.H., 2.A., 2.A., 3.A., 3.B., 4.G., 4.I., 4.K.

Applicable programs: 1.D.i., 1.H.ii., 2.A.iv., 2.A.v., 3.A.i., 3.A.ii., 3.A.iii., 3.A.iv., 3.A.v., 3.A.vi., 3.A.vii., 3.B.iv., 4.G.iii., 4.I.x., 4.I.xiii., 4.K.ii.,

Hot Topics

In addition to challenges and "hot topics" already mentioned, these are priority concerns that emerged from either the master plan survey or reviews of the draft plan.

1. The disparity between north and south Palo Alto canopy cover.
2. Special considerations for trees within parks and preserves.
3. Species selection.

1. Disparity between north & south Palo Alto

Two citywide canopy analyses done for this master plan enabled staff to identify a disturbing trend. In 1982, the average canopy for the predominately residential sections in the north was 11% greater than the average for those in the south—and by 2010, that disparity had grown to 22%. *(See below.)*

	10 residential neighborhoods of North Palo Alto	1982	2010
1	College Terrace	39.9	41.6
2	Southgate	36.4	45
3	Community Center	44.3	51.1
4	Duveneck/ St Francis	45.5	51.3
5	Crescent Park	49.4	55.1
6	University South	34.8	38.6
7	Professorville	49.6	53.4
8	Leland Manor/ Garland	45.2	47.5
9	Old Palo Alto	54.2	55.8
10	Downtown North	29	38.7
	Average	**42.83**	**47.81**

	7 residential neighborhoods of South Palo Alto	1982	2010
1	Green Acres	35.1	39.9
2	Midtown/ Midtown West	36.9	38.6
3	Barron Park	44.9	46.5
4	Palo Verde	37.3	37.7
5	Greenmeadow	35.5	35.3
6	Fairmeadow	41.5	38.9
7	Charleston Meadows	37.7	36.9
	Average	**38.41**	**39.11**

To investigate and reverse this trend is a master plan priority.

Applicable policies: 1.C., 1.D., 1.E., 1.F., 1.G., 3.A., 3.B., 4.B., 4.E., 4.F., 4.G., 4.K.

Applicable programs: 1.C.i., 1.D.i., 1.E.i., 1.E.iii., 1.E.v., 1E.vi., 1.F.i., 1.G.i., 1.G.ii., 3.A.i., 3.B.i., 3.B.ii., 4.B.i., 4.B.ii., 4.B.iii., 4.E.i., 4.F.i., 4.F.ii., 4.G.v., 4.G.viii., 4.K.ii..

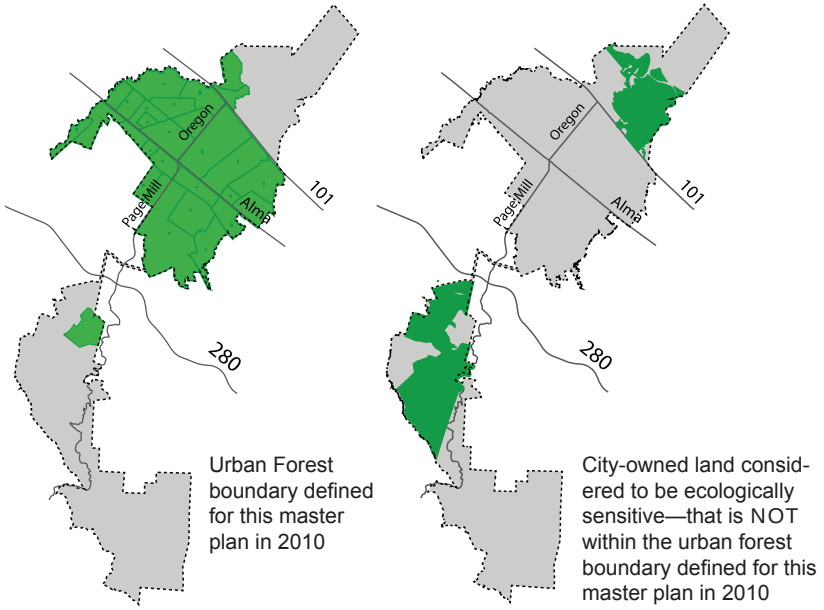
2. Special considerations for parks & preserves

In concept the urban forest may be considered to encompass all the trees, plants and associated organisms that inhabit the shared ecosystem within Palo Alto—overflowing and interacting across the border.

However, tangible limits are necessary to enable meaningful measurements—that can be repeated for monitoring—and to ensure that policies are applicable—rather than vague.

Therefore, in 2010, the master plan team identified a boundary for the urban forest—to enable acquisition of two canopy analyses. This boundary (which has been retained and utilized throughout development of the plan), encompasses the area between Highways 101 and 280, the Municipal Golf Course, and a small area west of 280 that includes a single-family neighborhood zoned Residential Estate (RE). Excluded are the city-owned lands of the Pearson-Arastradero Preserve, Baylands, and Foothill Park. *(See below.)*

As the city implements this master plan, it will become better and better informed—and may change the boundary or other parameters that define its urban forest.



Meanwhile, master plan policies and programs related to species include language to ensure appropriate considerations within areas that are more ecologically sensitive i.e., parks and preserves. For example:

- For parks within the urban forest, program language provides that:
  - The diversity requirement (no species to exceed 10% of the population), may be relaxed to ensure a preference for native species.
  - The city should make the most of opportunities to plant species that are rich in wildlife benefits—including messy trees that are seldom chosen as street trees or yard trees.
- For parks, preserves, and open spaces outside the urban forest, programs call for:
  - Ensuring that the preferred and restricted species list will provide consideration of the unique needs of these areas.
  - Conducting analyses to establish baselines.
  - Developing or enhancing Comprehensive Conservation Plans.
  - Ensuring adequate training for staff.
  - Ensuring adequate review of CIP projects.
  - Nurturing volunteer programs.
  - Updating existing individual park and preserve plans to ensure that they adequately address trees

Policies for areas outside the urban forest will be further developed in the future *Comprehensive Conservation Plan* which is one of the master plan's programs (4.I.iv.) and a significant portion of the master plan's budget. *(See Implementation Plan for budget information.)*.

Applicable policies: 1.A., 1.B., 1.G., 2.A., 2.B., 2.C., 3.A., 4.B., 4.F., 4.G., 4.I., 4.J., 5.1.

Applicable programs: 1.A.ii., 1.A.iii., 1.B.i., 1.G.i., 2.A.i., 2.A.ii., 2.B.i., 2.B.iii., 2.B.iv., 2.B.v., 2.C.i., 2.C.ii., 2.C.iii., 3.A.ii., 4.B.iii., 4.F.i., 4.G.ii., 4.G.iv., 4.G.vi., 4.I.i., 4.I.ii., 4.I.iii., 4.I.iv., 4.I.v. 4.I.v., 4.I.,vii., 4.I.viii., 4.I.ix., 4.I.x., 4.I.xi., 4.I.xii., 4.I.xiii., 4.I.xiv., 4.J.i.,

3. Species selection

The master plan does not make species recommendations for either:

- Environmental categories such as streets, parks, or preserves, or,
- Planning categories such as gateways, view corridors, boulevards, etc.[1]

Such recommendations would lack consideration of essential information about the site conditions (or micro ecosystems) e.g:

- Soil type and available volume.
- Water type and availability.
- Adjacent uses including playing fields.
- Potential conflicts with overhead power lines, hardscape, underground infrastructure, existing solar installations, hiking trails, etc.
- For street trees, there must be the consideration of existing themes.
- Within more natural areas, there must be a preference for native species and considerations for wildlife breeding and habitat needs.

Therefore, the plan directs the development of tools to help staff and the community make informed decisions on a site-by-site basis:

These tools will include:

1. A preferred and restricted species list.
2. An online species library.
3. A protocol for selecting species based on specific site conditions.
4. Updated management documents such as the *Street Tree Management Plan* and associated block-site species list

These tools are intended to be:

- Available through the internet.
- For use by staff, property and business owners, the development community, entities such as neighborhood associations, and the Palo Alto Unified School Board, as well as nurseries that provide trees to these groups.

These tools are a master plan priority

Applicable policies:1.A., 1.B., 1.D., 1.E., 1.Hi., 2.A., 2.C., 3.A., 3.B., 4.A., 4.B., 4.E., 4.G., 4.H., 4.I.

Applicable programs: 1.A.i., 1.A.ii., 1.A.iii., 1.B.i., 1.B.ii., 1.D.i., 1.E.i., 1.E.iii., 1.H.ii., 2.A.i., 2.A.ii., 2.A.vi., 2.C.i., 2.C.ii., 2.C.iii., 3.A.i., 3.B.i., 3.B.iii., 4.A.i., 4.A.ii., 4.B.i., 4.B.iv., 4.E.i., 4.G.i., 4.G.v., 4.G.vi.,4.G.vii., 4.G.viii., 4.H.ii., 4.I.vii., 4.I.ix.

[1] *If a **landscape plan** with species recommendations were deemed desirable, several master plan programs would be on the critical path of that task— including but not limited to: 1.A.i., 1.A.ii., 1.A.iii.,4.G.iv., 4.G.v., 4.G.vi., 4.I.ix.*

Current Baselines & Future Monitoring

2010 master plan baselines

Analyses and research done for this master plan have yielded the following 2010 baselines—for future monitoring:

1. Citywide canopy cover..... 37.6%
2. North/south canopy disparity (difference between average of north neighborhoods and that of south neighborhoods) . 20.0%
2. Street tree canopy cover ..... 36.8%.
3. Street tree stocking level 92.5%
4. Street tree conditions (wood):
   - Good 58.4%
   - Fair.....35.3%
   - Poor, critical, or dead.....6.3%
5. Street tree conditions (foliage):
   - Good 80.2%
   - Fair.....17.6%
   - Poor, critical, or dead.....2.2%
6. Street trees (% large stature broadleaf):
   - Deciduous.....26%
   - Evergreen.....5%
7. Street (and park) tree thirst ratings:
   - Low.....23.0%
   - Moderate.....42.0%
   - High 35.0%
8. Street trees (% native species)..... 0.4%
9. Street tree benefits (annual value per tree):
   - Energy use reduction $20.23
   - C02 sequestration $1.77
   - Air quality..... -$1.61
   - Storm water interception $5.85
   - Aesthetics/Other $201.49
10. Street trees benefits investment ratio (BIR—annually per tree)..... $3.22

A baseline comparison of 25 cities

Additional information—relevant to future monitoring-—is provided in the following ranking of cities known to have conducted i-Tree streets analyses between 2000 and 2010. The first list ranks performance based on the benefit-to-investment ratio (BIR) of costs. The second list reflects the differential in actual costs—per capita. Both methods are limited to comparing benefits data which can be monetized against recorded costs and should be considered as indicators— not comprehensive measures. Many values such as wildlife habitat or enhanced learning environment cannot be effectively monetized. *(More details are available in tables in the "Benefits and Value" chapter.)*

A comparison of **benefits to investment ratios** *(BIRS)*

1.	Elk Grove, CA (2007)	$14.97
2.	Austin, TX (2008)	$9.87
3.	Indianapolis, IN (2008)	$6.09
4.	New York City, NY (2007)	$5.80
5.	Davis, CA (2003)	$3.78
6.	Boulder, CO (2005)	$3.64
7.	Portland, OR (2007)	$3.61
8.	Charlotte, NC (2004)	$3.25
9.	Palo Alto, CA (2011)	$3.22
10.	Bismarck, ND (2004)	$3.09
11.	Honolulu, HI (2007)	$2.98
12.	Pittsburgh PA (2008)	$2.94
13.	Glendale, AZ (2002)	$2.41
14.	Fort Collins, CO (2003)	$2.18
15.	Cheyenne, WY (2004)	$2.09
16.	Orlando, FL (2009)	$1.87
17.	Goleta, CA (2007)	$1.81
18.	Santa Monica, CA (2001)	$1.61
19.	Minneapolis, MN (2005)	$1.57
20.	Berkeley, CA (2005)	$1.37
21.	Charleston, SC (2006)	$1.34
22.	Albuquerque, NM (2006)	$1.31
23.	Boise, ID (2007)	$1.30
24.	San Francisco, CA (2003)	$1.01

A comparison of the **benefit to investment differential in real dollars** *(instead of a ratio)*—**per capita**

1.	Elk Grove, CA (2007)	$95.46
2.	Palo Alto, CA (2011)	$73.21
3.	Minneapolis, MN (2005)	$42.20
4.	Portland, OR (2007)	$32.23
5.	Boulder, CO (2005)	$21.73
6.	Davis, CA (2003)	$20.48
7.	Fort Collins, CO (2003)	$12.98
8.	Austin, TX (2008)	$12.75
9.	New York City, NY (2007)	$12.29
10.	Bismarck, ND (2004)	$12.10
11.	Santa Monica, CA (2001)	$10.77
12.	Goleta, CA (2007)	$10.01
13.	Cheyenne, WY (2004)	$8.78
14.	Berkeley, CA (2005)	$8.62
15.	Orlando, FL (2009)	$8.37
16.	Charlotte, NC (2004)	$6.49
17.	Indianapolis, IN (2008)	$6.09
18.	Pittsburgh PA (2008)	$5.17
19.	Honolulu, HI (2007)	$2.88
20.	Charleston, SC (2006)	$1.73
21.	Glendale, AZ (2002)	$1.44
22.	Boise, ID (2007)	$1.17
23.	Albuquerque, NM (2006)	$0.47
24.	San Francisco, CA (2003)	$0.08

Future monitoring

Among the highest priorities for monitoring are:

- An increase in the percentage of native species (oaks in particular) in the street tree population—thereby capturing their adapted water conservation and hardiness.
- A reversal of the canopy cover decreases identified in three south Palo Alto neighborhoods—thereby improving canopy equity throughout the city.
- Sustained benefits.

The master plan also recommends analyses to establish additional baselines for monitoring e.g:

- Canopy cover in the open spaces. *(Currently done for street trees and urban area only.)*
- Benefits and value for overall citywide canopy. *(Currently done for street trees only; may be established with only sample data set.)*
- Wildlife benefits of urban forest and natural area forests. *(Unprecedented; also may be established with sample data set.)*

Regardless of whether specific and/or numeric goals are set, conducting follow up analyses and monitoring change is fundamental to the vision and goals of this plan. Baseline information developed for areas outside the urban forest will also be relevant to the future *Comprehensive Conservation Plan* which, as mentioned earlier, is one of this plan's programs and a part of this plan's budget.

Applicable policies: 1.C., 1.D., 1.E., 1.F., 4.B., 4.F., 4.G., 4.I.,

Applicable programs: 1.C.ii., 1.C.iii., 1.D.i., 1.E.v., 1.F.i., 4.B.i., 4.F.i., 4.F.ii., 4.G.ii., 4.I.i., 4.I.ii.,

The Urban Forestry Division

In parallel with the development of the urban forest master plan, the city adopted a tree removal policy, hired its first urban forester, reorganized tree responsibilities, created the urban forestry division, and began the urban forestry website.

All programs in this master plan aim to improve the urban forestry division and its ability to function. Programs that may not have been mentioned so far relate to:

- Qualifications of staff with tree care or tree-care related responsibilities.
- Awareness of city policies that affect trees—by all staff.
- Community input and outreach.
- Supportive technology.

Applicable policies: 1.B, 1.C., 1.E., 1.F., 1.H., 2.B., 3.A., 4.B., 4.C., 4.G., 4.H., 4.I., 4.J., 4.K.

Applicable programs: 1.B.ii., 1.C.iii., 1.C.iv., 1.E.ii., 1.E.v., 1.F.i., 1.H.ii., 2.B.i., 2.B.ii., 3.A.iv., 4.B.i., 4.B.ii., 4.B.iii., 4.C.i., 4.C.ii., 4.G.i., 4.G.iii., 4.G.iv., 4.G.v., 4.G.vii., 4.G.viii., 4.G.ix., 4.H.i., 4.H.iii., 4.H.v., 4.H.vi., 4.I.vi., 4.I.viii., 4.I., ix, 4.I.x., 4.I.xii., 4.I.xiv., 4.J.i., 4.K.iii.

The Role of the Master Plan

The "Implementation Plan" accommodates year by year planning for:

- Budget needs.
- Inter-depertmaneal collaboration logistics.
- Municipal Code updates.
- Monitoring

The "Goals, Policies, and Programs" are embedded with details to ensure that:

- The thoughtful contributions of the many participants will be retained through out its 10 year implementation schedule.
- Implementation will fully address the needs that were identified during the process of developing the plan.

The "Information," "Challenges," and "Stewardship" chapters reaffirm the intent of the plan and inform the implementation effort with articulate descriptions of:

- Existing conditions.
- Concerns and threats.
- Parameters and resources.

The "Vision" will serve as inspiration as the city and community undertake the implementation of the master plan.

Where we are now

Introduction

- Defining the urban forest & scope of the plan

Information about the trees

- A Brief History
- Benefits & Value
- Canopy Cover
- Composition

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Defining the urban forest & scope of the plan

Defining the urban forest

In concept the urban forest may be considered to encompass all the trees, plants and associated organisms that inhabit the shared ecosystem within Palo Alto—overflowing and interacting across the border.

However, tangible limits are necessary to enable meaningful measurements—that can be repeated for future monitoring and to ensure that policies are applicable—rather than vague.

In 2010, the master plan team identified a boundary for the urban forest—to enable acquisition of a canopy analysis.

The boundary encompasses the area between Highways 101 and 280 as well as the Municipal Golf Course and a small area west of 280 that includes a single-family neighborhood zoned Residential Estate (RE). *(Fig. 0a)*

- The Airport was excluded because landscape decisions within the airport are subject to rigorous review and other, more restrictive, policies and regulations.
- The Baylands, Atrastradero Preserve, Foothills Park *(Fig. 0b)*, and the majority of the private lands west of Highway 101—were excluded because they are not urban and landscape decisions within these areas are subject to rigorous review and other, more restrictive, policies and regulations.

As the city implements this 10-year plan, it will become better and better informed—and may change the boundary or other parameters that define its urban forest.

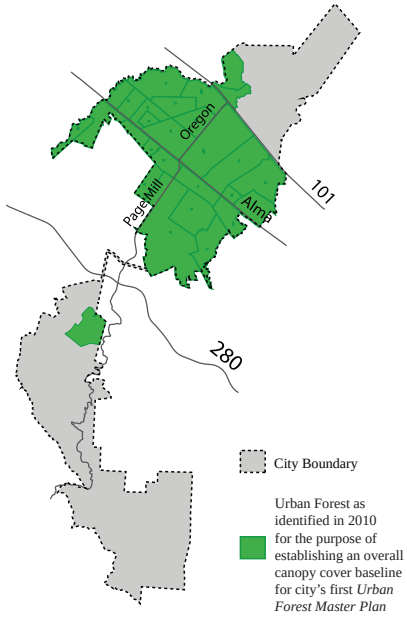

Fig. 0a: Urban Forest as defined in 2010 for the city's *Urban Forest Master Plan.*

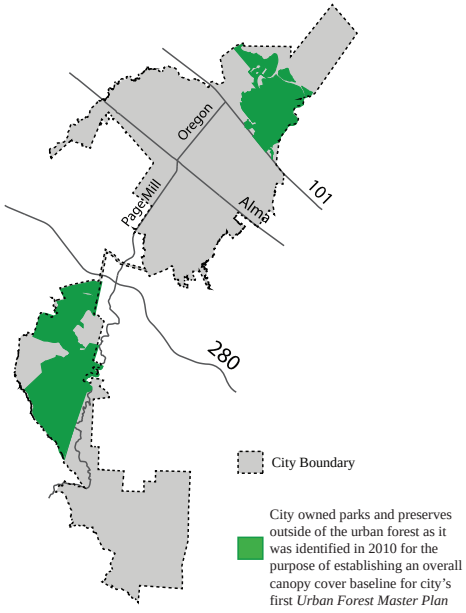

Fig. 0b: City owned parks and preserves outside the urban forest (as it was defined in 2010 for the *Urban Forest Master Plan).*

Defining the scope of the master plan

More than street trees

Many urban forest master plans are about street trees—focusing on goals that Palo Alto has already achieved.

This is not to say that Palo Alto street trees do not have issues. Development, infrastructure, solar, and water entail intense concerns.

However, given that…

- The street tree program had a solid foundation,
- Private trees make up the bulk of the urban forest,
- Issues apply to both public and private trees, and
- City Council discussion included a desire for a baseline of the citywide urban forest...

...the goals, policies and programs of this master plan strive to speak to the whole urban forest. .

To this end, the master plan team invested in two citywide canopy analyses—one for 1982 and one for 2010—and conducted an in depth comparison to:

- Identify trends of the last 30 years and
- Establish existing conditions for future monitoring.

Also to this end, the plan accentuates the overlapping roles of city staff and property owners in stewarding all the trees within the urban forest.

Having said this, the lengthy history of management of the street trees does mean that the master plan is able to present more detailed information about the street trees than of any other trees. Indeed, the plan suggests that the city's care for street trees is paramount—not only because they are a beloved community asset, but also because...how the city cares for the street trees sets a highly visible example for those who own and care for private trees.

Palo Alto has already achieved many of the goals found in other urban forest master plans; such as:

1. A single responsible party for the street trees, sidewalk, and associated liabilities.
2. A geocoded digital inventory of 100% of the street trees (not a sampling), their condition, and related maintenance tasks.
3. An annual program to survey and monitor the condition of baby street trees (conducted by Canopy and volunteers.)
4. A tree protection ordinance (& illustrated supplement that has received national recognition).
5. A planning arborist.
6. A program for ongoing community workshops and tree walks (conducted by Canopy and volunteers.)
7. An i-Tree streets analysis of 100% (rather than a sampling) of the street tree population and baseline of hard numbers for and economic relevance of the urban forest benefits.
8. A relatively dense canopy (both for the street trees and citywide).
9. An urban forester.
10. A recycling program for tree trimmings.
11. Recognition as a "tree city" by the National Arbor Day Foundation.
12. A volunteer program (coordinated by Canopy.)
13. While it is not as detailed or as extensive as the information about street trees, Palo Alto also has extremely valuable information about private trees such as the historical overall canopy analyses, Heritage Tree Inventory, Oakwell survey, and approved landscape plans for commercial and multi-family projects.

Objectives

1. Establish value: Communicate information about benefits that are integral to Palo Alto's high quality of life—to affirm that trees should be considered when:

- The City Council establishes sustainability policies and makes budget decisions.
- Boards and commissions make development recommendations.
- Staff make field decisions.
- Residents, property owners, and business owners make landscaping decisions.

2. Document baselines for future monitoring.

3. Engage the community: Describe:

- Overlapping roles of staff and community.
- Resources such as Canopy.

Communicate that the City:

- Is committed to sustaining the urban forest.
- Is aware of challenges.
- Is aware of the need to manage the public trees cost effectively.
- Acknowledges community concerns.
- Is committed to improving outreach.

4. Provide an action plan: goals, policies and programs.

Action plan (Goals, Policies, and Programs)

There are many valuable ways to categorize trees. For example, city-owned trees—which in turn includes:

- Rights-of-way.
- Developed parks.
- Open spaces, and preserves.
- Facilities such as the City Hall and libraries.
- Facilities such as the Municipal Services Center, and Regional Water Quality Control Plant, and fire stations.
- Municipal Golf Course.
- Parking lots.

To address each category in an effective way is be beyond the scope of this document. The master plan provides over arching goals and policies—and an action plan for the Urban Forestry Division that directs further advance planning such as:

1. Updating the *Street-Tree Management Plan*. *(Program 4.G.viii.)*
2. Developing *Comprehensive Conservation Plans*. *(Program 4.I.iv.)*
3. Updating existing park plans and/or developing new plans to ensure that tree issues are addressed. *(Program 4.I.v.)*

To make species recommendations based on categories of any kind—including city planning categories such as gateways, view corridors, boulevards, etc. would lack consideration of essential information because within any category are site specific conditions (microecosystems) defined by:

- Water availability and type (e.g., creek, high water table, or irrigation systems, recycled water, etc.)
- Soil type and available volume.
- Adjacent property use including proximity to playing fields.
- Potential conflicts with overhead power lines, hardscape, underground infrastructure, existing solar installations, hiking trails, etc.
- Within more natural areas, there must be a preference for native species and considerations for wildlife breeding and habitat needs.
- For street trees, there must be the consideration of existing themes.

Therefore, instead of making species recommendations, the plan directs the development of tools to help both staff and property owners make decisions on a site-by-site basis:

1. A preferred species list. *(Program 1.A.ii.)*
2. A restricted species list. *(Program 1.A.ii.)*
3. An online species library—searchable by attributes. *(Program 1.A.i.)*
4. A protocol for selecting species based on specific site conditions. *(Program 1.A.iii.)*

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A Brief History

A brief history of the urban forest and the evolution of the city street tree system

The following draws from several sources including:

- The 1982 Street Tree Management Plan.
- "The Ecological Street Tree: Mainstreaming the Production of Street Tree-based Ecosystem Services in Northern California Cities, 1980-2008" by Georgia Norma Silvera Seamans.

1890—1920: Early plantings

In the early years there was no distinction between public and private trees; they were all planted by residents—who were mostly from the east and mid west and tended to plant species they had enjoyed back home e.g., elms, lindens, black walnuts, sycamores.

The agricultural explosion brought English walnuts, apricot, almond and other orchard trees.

Residents such as Senator Stanford, imported exotic species from Australia such as the acacias, eucalyptus, and grevillea.

The Australian imports, as well as other fast-growing species, were popular in subdivisions created after World War I.

There were no parks (or park trees) yet but that would soon change because—as illustrated by the excerpt *on the next page*—Palo Alto was destined to become a tree city.

Photos courtesy of the Palo Alto Historical Association

Fig. 1: Professorville streets were already lined with trees when they were paved. Presumably some of these trees were native and some planted by residents. This photo shows paving work being done to the section of Waverley Street between Kingsley and Lincoln circa 1902.

1920—1950: A street tree system and park improvements

Street trees: During the 1920s, the City established a municipal nursery and took on the responsibility of furnishing and planting "street trees". The City was willing to plant any species and quantity a resident might request as long the trees were available in the nursery.

In the 1930s, laborers of the federal government's Work Projects Administration (WPA) produced the city's first street tree survey—identifying 96 species along 90 miles of streets.

By 1946, the post World War II building boom had begun and the Federal Housing Authority required a tree on every lot which resulted in about 2,000 additional trees a year along the streets—especially in south Palo Alto.

As with the earlier, boom of the 1920s, the preference was for fast-growing species.

Parks: In 1922, the City acquired Rinconado Park and the grove of redwoods now known as "The Magic Forest" came under public ownership. In 1925, the annexation of Mayfield brought Mayfield, Cameron, Weisshaar, and Werry parks under City management and in 1928, the City planted the trees along the El Camino Real border of El Camino Park.

Excerpted from the "Trees of Palo Alto," published by the City of Palo Alto in 1976

"...From 1903-1916, the women of Palo Alto adopted the role of... guardian angels to all trees.

The town could not even cut the trees in the roadways.

Teams of horses were adept at circling the trees. You can't fool a horse, but humans behind the wheel of the newfangled automobiles had problems.

There were several accidents, followed by damage claims. One night a local doctor, returning from a mission of mercy, drove into one of the roadway trees.

The incident rocked the town, and precipitated the "Great Oak War," as the newspapers dubbed the controversy.

Tree lovers suggested that the doctor should have been more careful. Some irate citizens wanted all the roadway trees removed. Thoughtful citizens suggesting lighting the trees.

The town held an initiative election that was inconclusive because of six questionable votes. One councilman resigned in indignation.

The increasing popularity of automobiles smoothed the way for removal of trees in the streets, but Palo Alto's passion for trees had become firmly rooted..."

1950—1980: A critique of the street tree system and more parks

Street trees: During the 1950s, the Assistant City Engineer, Irwin Johnson, was determined to bring order out of chaos. He analyzed the then street tree system and concluded that:

1. The City's willingness to plant whatever was requested had resulted in 9,000 sycamores planted 25-30 feet apart and over 10,000 magnolias planted 12-25 feet apart. In his opinion, 30,000 trees were growing where 18,000 would be adequate.
2. Only 7 of the 96 species were good street trees. The rest were fast-growing forest giants that were raising sidewalks, bursting curbs, interfering with storm drainage, plugging sanitary laterals, interrupting gas and water services and growing into the overhead wires.

Mr. Johnson approved 30 species for street trees and throughout the next three decades, 60,000 of these were planted. The result was a city of tree-lined streets that were known for their beauty—but costly to maintain.

In 1959, the City, Chamber of Commerce, and Civic Association jointly published, *Trees of Palo Alto* noting their aesthetic and practical benefits.

Parks: During the 1950s, Hoover, Robles, Ramos, and Seale parks were developed south of Oregon through a program that called for a park within a half-mile of any residence and next to a school site. During the 1960s and 70s several more parks and open spaces were acquired and the

City passed the Park Dedication Ordinance which continues to protect trees within parks. In 1972 the city added an Open Space element to the *Comprehensive Plan* which establishes the importance of trees at the highest level of city policy.

1982: A street tree management plan and task force

Street trees: By the 1980s, environmental protection was a priority. In 1981, the Council created the Palo Alto Tree Advisory Task Force to develop a plan. The Task Force identified three concerns:

1. Even-aged stands can decline simultaneously, leaving areas of the City without trees.
2. Mono cultures are more vulnerable to a single threat than areas of diverse species.
3. Species selection had been dominated by the desire for fast-growth for 100 years.

The resulting *Palo Alto Street Tree Management Plan* focused on these three concerns and, unlike the City Engineer's analysis in the 1950s, acknowledged the value of the urban forest citing the role trees play in protection from climate, habitat for birds, insects, and mammals, visual beauty, and a tangible link to our most fundamental heritage. In conjunction with adopting the plan, Palo Alto hired its first City Arborist.

Also during the 1980s, the city began keeping an electronic inventory of the street trees—to record data about individual trees, prioritize maintenance requirements, and help set budget needs.

Parks: It is interesting to note that the Baylands—identified for park use in the 1930s—had for decades been envisioned as a traditional park with big leafy trees. However, in the 1980s the environmentally savvy community rejected this vision, and instead, allowed much of the area to revert to its, treeless, natural state.

1990—2010: Canopy, tree-protection, and *Master Plan*

In 1993, the City Council appointed a second Task Force and by 1996, the Council had:

- Allocated funding for Canopy, non-profit organization—founded by a group of residents—to serve as the community's resource on tree-related matters and act as the City's advisor and partner for tree planting and tree care activities.
- Adopted a Tree Protection Ordinance and developed the *Tree Technical Manual* to guide implementation of the ordinance.
- Hired a Planning Arborist.

In 1999, a group of residents came together with the goal of transforming El Camino Real into a safe, welcoming, tree-lined boulevard. By 2001, they had formed the Trees for El Camino Project—a 501(c)(3) public benefit organization—to raise money. The combined efforts of this organization and the City, resulted in the repair of the irrigation system and the planting of over 100 trees. The the organization also spearheaded negotiations with Stanford University and Caltrans to increase the number of plantings along El Camino Real.

In 1998, the City adopted a *Comprehensive Plan* that including several goals, policies, and programs to preserve, maintain, and enhance the city's urban forest.

On Earth Day 2006,Council directed staff to create a new *Street Tree Management Plan* to implement those *Comprehensive Plan* goals and policies. .

In 2007, the City collaborated with Canopy to apply for two CAL FIRE grants:

1. To update and geocode the street tree inventory.
2. To develop a *Master Plan*.

In August of 2008, the grant was awarded; however, due to staffing and budget constraints, the *Master Plan* was delayed.

During 2010 and 2011, the City adopted a tree removal policy for public trees and conducted studies to inform the *Master Plan.*

- Online Community Survey
- Citywide Canopy Analysis
- Update of Street Tree Inventory and geocoding of records

2012—2013: An Urban Forester

In 2012, the City began implementing changes that addressed needs identified in the early stages of the *Master Plan* process e.g., the City:

- Created of an urban forestry section and consolidated tree-care activities
- Hired first urban forester to oversee new division and complete the *Urban Forest Master Plan.*

2014: Completion of the *Master Plan*

Under the leadership of the new Urban Forester, the *Master Plan* is being completed.

Figs. 2a-c: **University Circle 1894, 1941, and 2011:**

Although each of these photos is shot from a different angle, the train tracks and familiar curve of University Circle provide enough orientation for the viewer to appreciate the changes during the 117 years spanned by the photos.

1894: These oak trees may well be native —and over 100 years old at the time of the photo.

1941: The downtown area was cleared to accommodate development.

2011: Now, there is very little space for private landscaping in the downtown. However, since the 1970s, the City has aggressively planted street trees and it is not unusual for downtown-oriented advertisements to mention the tree-lined streets.

Two historical photos (top and bottom left) courtesy of the Palo Alto Historical Association

Aerial photo (bottom right) from Google Maps

Benefits & Value

Information about the benefits of the entire urban forest and of the street tree system

Trees provide enormous environmental and social benefits. They also require investment. To enable a comparison of benefits and investment, the USDA Forest Service developed the analytical software:

i-Tree eco for analyzing entire urban forests.

i-Tree streets for analyzing street-tree systems.

These financial analyses of ecosystem benefits are limited and do not include benefits such as wildlife habitat, enhanced learning environment, or increased asphalt duration; however, they are the industry standard and widely accepted as being relevant to city planning.

This chapter presents and compares information from an analysis of each type.

A view of the overall urban forest

Photo by Scott Haefner—Courtesy of Canopy

1. i-Tree eco analysis of the Bay Area's urban forest: *San Francisco Bay Area State of the Urban Forest Final Report*

In 2007, the Center for Urban Forest Research published a report by James R. Simpson and E. Gregory McPherson. For this report, the authors used the i-Tree eco model to quantify—in dollars— the benefits of the vast urban forest of the entire Bay Area—county by county. *(Fig 3)*

A view of the street trees

Photo courtesy of Canopy

2. i-Tree streets analysis of the Palo Alto street trees: *City of Palo Alto, California Right-of-Way Urban Forest Resource Analysis.*

In 2010 the City engaged Davey Resource Group to do a i-Tree streets analysis of the street trees. *(Figs 4-6)*

1. Bay Area report:

The 2007 bay-area analysis is gross; but the consistency between the reports is worth noting. For example:

- Table 11 of the Bay Area report states that the "Total" annual value of the benefits of the trees within Santa Clara County—per tree—is $125.

- This (Table 11) "Total" value incorporates a variety of values associated with transportation, open space, institutional, and commercial/industrial land uses.

- Table 11 indicates that for low-density residential land use, the annual value of the benefits of the trees within Santa Clara County—per tree—is $181.

- A large percentage—but not all—of the land within the Palo Alto urban forest boundary is low-density residential. So, to be consistent with the bay-area report, the Palo Alto report would need to indicate an annual benefit—per tree—somewhere between $125 and $181.

- Table 14 of the Palo Alto report indicates that the annual benefits of the trees within Palo Alto—per tree— is $156.

(Figs 3 & 4)

Fig. 3: Excerpt from Bay Area Report: *(Table 11: i-Tree eco analysis of 9 Bay Area counties.) Note: "low" and "high" refer to density.*

Table 11—Total net benefits (dollars/tree) by county and land use

County	Residential low	Residential high	Commercial / industrial	Institu-tional	Transpor-tation	Open space	Total
Alameda	156	116	95	80	3	90	105
Contra Costa	151	110	91	72	2	82	109
Marin	189	139	109	89	4	106	136
Napa	185	134	107	89	3	99	130
San Francisco	197	148	114	107	5	119	110
San Mateo	197	148	114	107	5	119	139
Santa Clara	181	132	107	89	3	99	125
Solano	152	109	90	72	2	80	100
Sonoma	185	134	107	89	3	99	137
Bay Area	172	126	102	86	3	97	120

Fig. 4: Excerpt from the Palo Alto Report *(Table 14: i-Tree-streets analysis of Palo Alto street trees)*

Table 14. Benefit Versus Investment Summary for Palo Alto's Right-of-Way Tree Resource

Benefits	Total ($)	$/tree	$/capita
Energy	589,805	20.23	9.22
CO2	51,563	1.77	0.81
Air Quality	- 46,888	- 1.61	- 0.73
Stormwater	170,504	5.85	2.66
Aesthetic/Other	5,873,529	201.49	91.77
Total Benefits	$6,638,513	$227.73	$103.73
Investment			
Purchasing/Planting Trees	68,750	2.36	1.07
In-house and Contract Pruning	454,458	15.59	7.10
Pest Management	10,000	0.34	0.16
Irrigation	60,000	2.06	0.94
Removal	164,000	5.63	2.56
Administration	216,792	7.44	3.39
Inspection/Service	200,000	6.86	3.13
Infrastructure Repairs	800,000	27.44	12.50
Litter Clean-up	90,000	3.09	1.41
Total Investment	$2,064,000	$70.80	$32.25
Net Benefits	$4,574,513	$156.93	$71.48
Benefit-Investment Ratio	3.22		

2. Palo Alto street-tree report

The 2010 i-Tree streets analysis measured the benefits of Palo Alto's street trees and indicated that the annual value of the street-tree benefits is $6,638,513—and that the annual cost of maintaining the street trees is $2,064,000. Following are highlights from the analysis.

A. Building energy use reduction

In hot months, urban trees reduce the need for of air conditioning (electricity) by shading hardscape surfaces and thereby reducing how much radiant heat is transferred into buildings.

Trees also help to cool ambient temperature as their leaves convert moisture to water vapor because they are using solar energy that would otherwise heat the air.

In cool months, urban trees reduce the amount of electricity and natural gas used to heat interior spaces by reducing the wind speed and, therefore, how much cold air moves into a building through openings or is conducted in through window surfaces.

The Palo Alto i-Tree streets analysis indicates that the shading and climate effect of the street trees provides an annual electricity-reduction benefit valued at $485,512 and an annual natural gas-reduction benefit valued at $104,293.

The I-Tree streets analysis indicates that the annual benefit from energy reduction has a value of $589,805 or $20.23/tree.

The i-Tree streets analysis goes on to say that liquidambar, modesto ash, and tulip trees are currently the greatest contributors—due to their large stature and relative maturity; however, chinese pistache, red maple, yarwoodsycamore, red oak, and ginkgo can be expected to make higher contributions as their populations mature.

B. Carbon dioxide sequestration

Urban trees reduce atmospheric carbon dioxide (CO2) in two ways:

1. Directly:
   a. Trees absorb and sequester C02.
   b. Trees shade parked cars and hardscape thereby reducing the release of hydrocarbons that are involved in ozone formation.
2. Indirectly:
   Trees lower the demand for heating and air conditioning, thereby avoiding the emissions associated with electric power generation and natural gas consumption.

The Palo Alto i-Tree streets analysis indicates that Palo Alto's street trees reduce CO2 as follows:

1. Directly: They sequester 2,263.8 tons/year
2. Indirectly: They avoid 1,567.3 tons/year.

The total C02 reduction (direct and indirect) is 3,832.1 tons/year.

On the other hand, CO2 is released by vehicles and combustion engines associated with tree maintenance; and when a tree dies, CO2 that has accumulated as woody biomass is released back into the atmosphere (unless the wood is recycled).

The Palo Alto i-Tree streets analysis indicates that the urban forest contributes CO2 as follows:

1. Tree-maintenance activities emit -1.7 tons/year.
2. Tree decomposition emits an estimated -391.9 tons/year.

The total C02 contribution 393.6 tons/year..

Subtraction of the total C02 contribution from the total C02 reduction results in a net reduction of 3,437.5 tons/year.

C02 Reduction and Emission Summary

Reduction		
Sequestration…….	2,263.8	tons/year
Avoidance…….	1,567.3	tons/year
Emissions		
Decomposition…….	(391.9)	tons/year
Mainenance activities…	(1.7)	tons/year
Net Reduction……	**3,437.5**	**tons/year**

The I-Tree streets analysis indicates that the net annual benefit from CO2 reduction has a value of $51,563 or $1.77/tree.

Modesto ash, holly oak, and coast live oak are currently providing the highest per tree benefit. Southern magnolia are providing the greatest percentage of overall benefits due to their prevalence in the street-tree population.

C. Air quality

Urban trees improve air quality by:

- Absorbing or intercepting nitrogen dioxide, small particulate matter (dust, ash, dirt, pollen, and smoke), sulfur dioxide, and ozone.
- Reducing energy consumption and thereby avoiding air pollutants from being emitted into the atmosphere.
- Increasing oxygen levels through photosynthesis.
- Reducing air temperature and thereby reducing ozone levels.

On the other hand, trees emit various biogenic volatile organic compounds (BVOCs). These emissions are accounted for by i-Tree Streets in the air quality net benefit.

Species vary dramatically in their ability to produce net air quality benefits. While all emit some BVOCs, most species contribute benefits to overall air quality that far outweigh these emissions. Typically, large-canopied trees with large leaf surface areas that are not high emitters of BVOCs produce the greatest benefits

The Palo Alto i-Tree streets analysis indicates that most of Palo Alto's street trees produce the following positive air quality benefits annually. They:

- Absorb or intercept 6.7 tons of nitrogen dioxide.
- Avoid 2 tons of air pollutants .
- Increase of oxygen levels through photosynthesis.
- Reduce air temperature and there by reduce ozone levels.

Chinese elm, modesto ash, and camphor currently produce the greatest per tree net air quality improvements. Due to its prevalence in the inventory, and its relative maturity, the Modesto ash species accounts for the greatest air quality improvements within the street-tree system.

However, four out of the top ten most prevalent tree species in Palo Alto's public tree inventory are high BVOC emitters that result in net negative air quality for the overall tree resource. Liquidambar, —a species that is no longer planted by the City— results in the greatest overall net loss, followed by southern magnolia, coast live oak, and red oak for a net of 6.7 tons BVOC emissions which has a cost of $82,542 or $10.26 per tree.

All the other species demonstrate a net benefit by removing 366 pounds of air pollutants. This has a value of $35,654 or $1.69 per tree.

The i-Tree streets analysis indicates that, unfortunately, the bottom line is a annual net air quality loss with an associated cost of $46,888 or $1.61/tree.

D. Storm water runoff reductions

Urban trees reduce the amount of runoff and pollutants that reach water bodies in three ways:

1. Tree leaves and branches intercept rainfall and act as mini-reservoirs that delay flows and reduce the volume of peak flows. This is especially important in urban settings with significant impervious surfaces near waterways.
2. Root growth and decomposition increase the capacity and rate of soil infiltration by rainfall—thereby reducing overland flow.
3. Tree canopies reduce soil erosion and surface flows by diminishing the impact of raindrops on barren surfaces.

The Palo Alto i-Tree streets analysis indicates that, annually, the street trees intercept 42,600,000 gallons of storm water—1,462 gallons per tree.

The i-Tree streets analysis indicates that the annual storm-water runoff reduction benefit has a value of $170,504 or $5.85/tree.

Camphor trees provide the greatest per tree benefit. Southern magnolias provide the second greatest. Many of the species currently demonstrating very low benefits, including ginkgo, red maple, chinese pistache, and yarwood sycamore, are immature populations of medium and large-growing trees. With appropriate maintenance, benefits from storm water runoff reductions as well as for energy, air quality, carbon sequestration, and aesthetics will increase significantly.

E. Aesthetics and property values

Trees make a community more attractive and add value to property. To assign a value to this less tangible benefit, i-Tree Streets compares sales prices of homes with and without trees—giving consideration to circumstances such as:

1. Land use e.g., street trees have the most affect of the value of single-family properties, less on multi-family, and even less on commercial and nonresidential properties.

Fig. 5: Table 13 from the Palo Alto report breaks down the benefits per species—for the 22 most populous species in the street tree component of the urban forest.

Table 13 Summary of Overall Current Annual Per Species Benefits from Palo Alto's Right -of- Way Tree Resource

Common name	Species	Total Energy ($)	Total CO_2 ($)	Total Air Quality ($)	Total Stormwater ($)	Total Aesthetic/Other ($)	Total All Benefits	% of Pop
Southern Magnolia	Magnolia grandiflora	95,018.83	8,128.83	- 6,322.11	35,905.91	815,617.33	948,348.79	13.93
London Plane	Platanus acerifolia	74,618.45	6,564.88	6,778.74	23,834.72	585,257.80	697,054.59	9.71
Liquidambar	Liquidambar styraciflua	95,525.89	5,894.32	- 59,093.52	19,588.86	817,989.08	879,904.63	9.16
Modesto Ash	Fraxinus velutina 'Modesto'	51,270.27	5,107.92	15,044.75	12,283.67	425,592.96	509,299.57	5.08
Camphor	Cinnamomum camphora	23,104.81	2,363.10	10,428.93	10,074.13	180,937.82	226,908.79	3.89
Chinese Pistache	Pistacia chinensis	10,877.15	513.32	2,162.08	2,303.78	106,242.08	122,098.41	3.52
Chinese Elm	Ulmus parvifolia	17,452.89	1,177.58	9,622.32	7,111.09	75,973.69	111,337.57	2.81
Red Oak	Quercus rubra	8,780.68	1,029.02	- 7,281.84	2,434.74	176,651.03	181,613.63	2.67
Ginkgo	Ginkgo biloba	7,215.28	388.97	1,164.51	1,144.13	66,290.42	76,203.31	2.17
Coast Live Oak	Quercus agrifolia	11,300.52	1,434.47	- 9,844.07	4,482.10	131,303.95	138,676.97	1.83
Yarwood	Platanus acerifolia 'Yarwood	5,781.80	451.13	- 378.65	1,292.14	132,920.94	140,067.36	1.77
Holly Oak	Quercus ilex	11,438.10	1,390.54	- 9,978.24	4,020.18	130,558.26	137,428.84	1.77
Red Maple	Acer rubrum	4,666.94	316.37	480.23	741.89	71,808.26	78,013.69	1.43
Linden	Tilia cordata	7,395.09	557.11	1,114.13	1,351.35	80,527.82	90,945.50	1.43
Silver Birch	Betula pendula	5,666.29	404.67	718.95	975.55	68,558.33	76,323.79	1.28
Raywood Ash	Fraxinus oxycarpa	7,399.53	580.16	1,251.70	1,412.27	75,561.63	86,205.29	1.28
Glossy Privet	Ligustrum lucidum	3,616.06	361.80	1,175.34	1,504.43	33,851.61	40,509.24	1.24
Tulip Tree	Liriodendron tulipifera	9,560.04	413.59	1,675.89	1,452.79	23,192.05	36,294.36	1.19
Moraine Ash	Fraxinus holotricha 'Moraine	5,636.96	419.21	816.13	1,008.36	63,451.31	71,331.97	1.15
European Hackberry	Celtis australis	4,359.52	543.90	1,522.51	1,412.10	76,700.65	84,538.68	1.09
Japanese Hackberry	Celtis sinensis	3,076.75	382.11	1,021.94	1,062.36	61,186.74	66,729.90	1.04
Bradford Pear	Pyrus calleryana	4,636.70	286.05	1,755.83	919.03	42,802.87	50,400.48	1.03
	Other trees	121,406.47	12,853.60	- 10,723.45	34,187.98	1,630,552.81	1,788,277.41	29.53
	Total	**589,805.00**	**51,562.63**	**-46,887.89**	**170,503.55**	**5,873,529.44**	**6,638,512.73**	**100%**

2. Tree location
3. Tree maturity: 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.

The I-Tree streets analysis indicates that the annual benefit associated with property-value increases is nearly $5,900,000 or $201.49/tree.

Although aesthetic value makes up 91% of the total value per the I-Tree streets model, aesthetic value alone is not an indication that a species is an appropriate street tree. For example, liquidambar is currently providing the most aesthetic benefits, but, the species is the highest emitter of BVOCs and is no longer planted by the City.

Note: Although i-Tree streets analysis does not explicitly say so, Canopy suggests that the measurement of "aesthetic and property value" may reflect certain public health benefits.

These excerpts from online advertisements are designed to "sell" Palo Alto in one way or another and indicate perceived value for trees.

- House sale: "Charming house in a convenient and tree-lined neighborhood..."
- House sale: "$999900 / 3br - TREE LINED STREET **(palo alto)**..."
- House sale:"On quiet, tree-lined street near..."
- Creekside Inn: "...Stroll down.. and **Palo Alto's tree-lined streets** to..."
- Crown Plaza Hotel: "Enjoy... a sophisticated university town filled with parks and tree-lined streets..."
- Garden Court Hotel: "...Situated on the tree lined streets of Palo Alto's..."
- Music @ Menlo Chamber Music Festival and Institute: "...The towns of Menlo Park and **Palo Alto offer** tree-lined streets featuring..."
- Dishcrawl: "..This is your chance to get a taste of what the tree lined streets of Palo Alto have to offer..."

Benefit-Investment Ratio

The purpose of quantifying the annual benefits of the street trees—in dollars—has been to compare that amount to the annual cost of maintaining the street trees and thereby establish the benefit-investment-ratio (BIR).

The Palo Alto I-Tree streets analysis documents that the annual value of the street-tree benefits is $6,638,513—and that the annual cost of maintaining the street trees is $2,064,000.

The I-Tree streets analysis indicates that the BIR is 3.22:1.

That is ...for every $1 that the City spends on street trees ...the City reaps $3.22 in benefits.

A comparison of 24 cities

i-Tree streets has become the standard for analyzing municipal street tree systems. It enables unprecedented comparisons and the following table compares 24 cities known to have conducted an i-Tree streets analysis so far.

Palo Alto ranks high among these cities—all of which have invested in quality tree maintenance, maintain high occupancy rates for available planting spaces, and obtain favorable returns on public investment.

The 2-part table *(Figs 6a-b)* compares each city's population, urban forest, urban forestry budget, and benefits-investment-ratio established by their i-Tree streets analyses.

Fig. 6a: This comparison of 23 cities indicates that Palo Alto ranks high among these cities that have invested in quality tree maintenance, maintain high occupancy rates for available planting spaces, and obtain favorable returns on public investment. *(continued on next page)*

	Characteristics of each City's population		Characteristics of each City's Urban Forest and its Relationship to that City's Population						Characteristics of each City's Urban Forestry Budget and its Relationship to both that City's Population and that City's Urban Forest		
City, State Year of Study	Population (206 US Census est)	Per Capita Income (adj to 2010 $)	# of Public Trees studied	Species Diversity (# species)	Planting Spaces vacant **	Occupancy Rate (stocking)	Managed Trees per Capita *	Street Trees per Capita	Total Forestry Budget (time of study)	Per Capita Budget (US $) ***	Per Tree Budget (US $)
Albuquerque, NM (2006)	504,949	$27,516	21,519	73	N/A	N/A	0.03	0.03	$428,500	$0.64	$20.00
Austin, TX (2008)	709,893	$31,836	123,395	143	190,000	39.4%	0.18	0.18	$1,038,873	$1.69	$10.00
Berkeley, CA (2005)	101,555	$40,155	36,485	279	15,105	70.7%	0.30	0.30	$2,372,000	$23.36	$65.01
Bismarck, ND (2004)	58,333	$26,641	17,821	93	30,738	36.7%	0.31	0.31	$273,212	$4.68	$18.00
Boise, ID (2007)	198,638	$29,903	23,262	179	145,000	13.8%	0.12	0.12	$770,784	$3.88	$33.13
Boulder, CO (2005)	91,481	$35,919	25,281	105	100,000	20.2%	0.28	0.28	$752,606	$8.23	$29.77
Charleston, SC (2006)	107,845	$29,532	15,244	136	3,764	80.2%	0.15	0.15	$531,200	$4.92	$34.85
Charlotte, NC (2004)	630,478	$35,341	85,146	215	285,054	23.0%	0.14	0.20	$1,819,460	$2.89	$21.37
Cheyenne, WY (2004)	55,314	$26,100	17,010	58	6,300	73.0%	0.31	0.16	$469,207	$8.48	$27.58
Davis, CA (2003)	60,964	$30,221	23,810	N/A	736	97.0%	0.39	0.39	$449,353	$7.37	$18.72
Elk Grove, CA (2007)	129,184	$27,558	111,924	N/A	0	100.0%	0.07	0.07	$883,069	$6.84	$7.89
Fort Collins, CO (2003)	129,467	$29,162	16,408	95	75,772	17.8%	0.13	0.13	$490,763	$3.79	$29.91
Glendale, AZ (2002)	246,531	$25,197	21,480	104	429	98.0%	0.09	0.06	$276,436	$1.26	$12.87
Goleta, CA (2007)	29,182	$33,264	9,855	N/A	2,952	77.0%	0.34	0.23	$351,322	$12.04	$35.65
Indianapolis, IN (2008)	785,597	$28,512	117,525	177	620,975	15.9%	0.15	0.15	$940,130	$1.20	$8.00
Honolulu, HI (2007)	905,000	$31,873	141,480	213	265,000	34.8%	0.38	0.38	$1,315,281	$1.45	$9.30
Minneapolis, MN (2005)	372,833	$29,889	198,633	60	29,681	87.0%	0.53	0.53	$9,200,000	$24.68	$46.31
New York City, NY (2007)	8,214,426	$29,516	584,036	168	31,526	94.9%	0.07	0.07	$21,000,000	$2.56	$37.00
Orlando, FL (2009)	220,186	$27,954	68,211	202	16,882	80.2%	0.31	0.31	$2,128,025	$9.66	$31.20
Palo Alto, CA (2011)	62,486	$70,242	29,151	230	2,353	92.5%	0.47	0.47	$2,064,000	$33.03	$70.80
Pittsburgh PA (2008)	312,819	$24,791	29,641	130	250,000	10.6%	0.09	0.09	$816,400	$2.51	$27.54
Portland, OR (2007)	537,081	$29,834	236,000	171	531,100	30.8%	0.44	0.44	$1,286,060	$2.39	$19.50
San Francisco, CA (2003)	744,041	$45,530	98,534	115	127,500	43.6%	0.13	0.02	$3,432,000	$4.61	$188.22
Santa Monica, CA (2001)	88,050	$56,489	29,229	215	1,218	96.0%	0.32	0.32	$1,540,000	$17.49	$52.69
Mean	637,347	$33,457	86,712				0.24		$2,276,195	$7.90	$35.64
Min	29,182	$24,791	9,855				0.03		$273,212	$0.64	$7.89
Max	8,214,426	$70,242	584,036				0.53		$21,000,000	$33.03	$188.22

Table notes:

*
In 1990, Keilbaso and Cotrone reported that the national mean stocking level was 38%.

**
In 1989, McPherson and Rowntree reported that national mean of species diversity (for 22 cities) was = 53.

***
Honolulu's actual total forestry budget is $5.4 million; 1.3 million reflects portion allocated to inventoried trees.

San Francisco: City assigns maintenance to adjacent private owner (total cost $7,481,466 public + private.)

Fig. 6b: This comparison of 23 cities *(continued from previous page),* indicates that Palo Alto ranks high among these cities that have invested in quality tree maintenance, maintain high occupancy rates for available planting spaces, and obtain favorable returns on public investment.

	Results of the I-tree Streets Analysis done for each City				
City, State Year of Study	Total Benefits (time of study)	Benefits Per Tree	Benefits Per Capita	**BIR** Benefit Investment Ratio (@ time of study)	Benefit Cost differential per capita
Albuquerque, NM (2006)	$560,979	$26.07	$1.11	$1.31	$0.47
Austin, TX (2008)	$10,251,979	$83.08	$14.44	$9.87	$12.75
Berkeley, CA (2005)	$3,247,545	$89.01	$31.98	$1.37	$8.62
Bismarck, ND (2004)	$979,094	$54.94	$16.78	$3.09	$12.10
Boise, ID (2007)	$1,002,263	$43.09	$5.05	$1.30	$1.17
Boulder, CO (2005)	$2,740,905	$108.42	$29.96	$3.64	$21.73
Charleston, SC (2006)	$717,034	$47.04	$6.65	$1.34	$1.73
Charlotte, NC (2004)	$5,910,889	$69.42	$9.38	$3.25	$6.49
Cheyenne, WY (2004)	$954,477	$56.11	$17.26	$2.09	$8.78
Davis, CA (2003)	$1,697,815	$71.31	$27.85	$3.78	$20.48
Elk Grove, CA (2007)	$13,215,361	$118.07	$102.30	$14.97	$95.46
Fort Collins, CO (2003)	$2,170,799	$132.30	$16.77	$2.18	$12.98
Glendale, AZ (2002)	$665,856	$31.00	$2.70	$2.41	$1.44
Goleta, CA (2007)	$643,574	$65.30	$22.05	$1.81	$10.01
Indianapolis, IN (2008)	$5,728,373	$48.74	$7.29	$6.09	$6.09
Honolulu, HI (2007)	$3,923,010	$27.73	$4.33	$2.98	$2.88
Minneapolis, MN (2005)	$24,933,434	$125.53	$66.88	$1.57	$42.20
New York City, NY (2007)	$121,963,347	$208.83	$14.85	$5.80	$12.29
Orlando, FL (2009)	$3,971,487	$58.22	$18.04	$1.87	$8.37
Palo Alto, CA (2011)	$6,638,513	$227.73	$106.24	$3.22	$73.21
Pittsburgh PA (2008)	$2,400,975	$81.00	$7.68	$2.94	$5.17
Portland, OR (2007)	$18,591,104	$78.78	$34.62	$3.61	$32.23
San Francisco, CA (2003)	$7,542,059	$76.54	$10.14	$1.01	$0.08
Santa Monica, CA (2001)	$2,488,550	$85.14	$28.26	$1.61	$10.77
Mean				$3.46	
Min				$1.01	
Max				$14.97	

Ecological services

Although the focus of this chapter is the i-Tree eco and streets analyses, it would be remiss not to include further discussion about ecological services. The following incorporates information from Acterra and Wildcare, (non-profit environmental groups serving Silicon Valley and the Bay Area), as well as information from the Sustainable Cities Institute web page.

Overall function

Trees provide substantial benefits without which other ecosystem components would suffer. Likewise trees are influenced by associated vegetation where grasslands or riparian areas provide critical habitat for pollinators and seed distributors, introduce needed fire on occasion, harbor beneficial predators, and reduce grazing pressure on young seedlings. A comprehensive

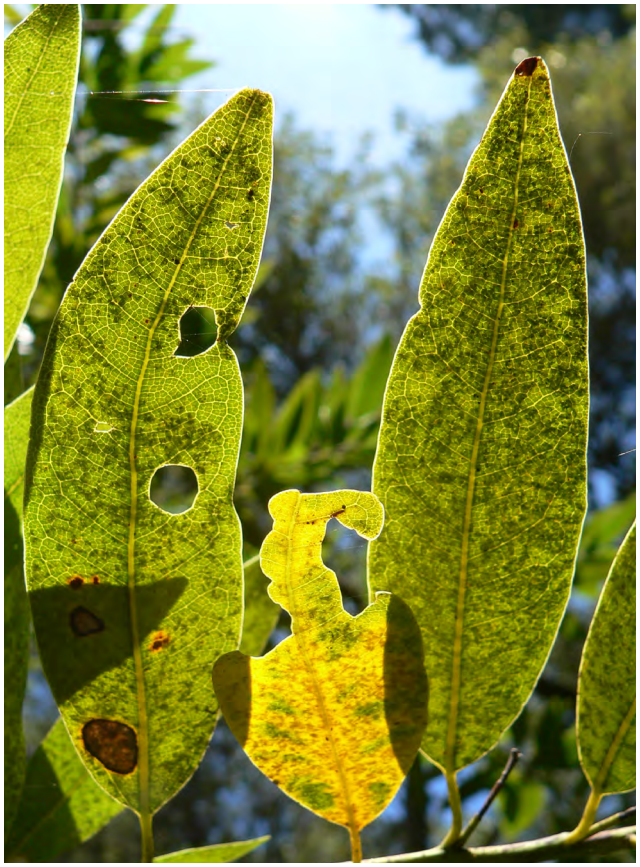

Photo courtesy of Acterra

Fig. 7: Insect bites on these California Bay leaves illustrate how locally evolved trees support a variety of insects that, in urban areas, are often a missing link needed to move solar energy up the food chain from plants to wildlife such as the family of hummingbirds in the next photo.

Photo by Sharon Osberg; courtesy of WildCare wildcarebayarea.org"

Fig. 8: Most bird species rely on insects for protein especially when they are laying eggs and rearing chicks.

Note: WildCare's Wildlife Hospital admits over a hundred Anna's Hummingbirds every year. Many are orphaned babies that grow up healthy in the hospital. Caring for the hummingbird babies includes feeding them every 20 minutes from dawn until dusk!

understanding of the urban forest recognizes companion vegetation as an important contributor to tree health as well as urban forest function. Layers, ladders, zones, and edges all form vital niches, provide unique benefits and relationships, and subtly influence overall function.

Wildlife habitat

Life thrives where the complex interactions between organisms and their surroundings are balanced. Trees provide habitat for a wide variety of wildlife that might otherwise have a difficult time living in our cities. Native trees support insects that provide pollination services and that move energy up the food chain from plants to birds, frogs, lizards and other wildlife. For example, a single oak tree can support up to 500 species of insects and invertebrate species, thereby providing a broad range of dietary choices for birds, bats, and other wildlife. This wildlife can in turn provide pest control services in our gardens and agricultural areas. Additionally, by reducing both the amount of pollutants that reach the Bay and soil erosion, the trees support aquatic and riparian wildlife as well as micro-organisms that live in the soil itself.

Photo courtesy of Acterra

Fig. 9: An Acterra volunteer holds a frog at one of one of Acterra's ongoing Planting Projects for San Francisquito Creek. It is a reminder that trees contribute to riparian habitat by helping to prevent erosion along creek banks.

Photo by Laura Milholland; courtesy of WildCare wildcarebayarea.org"

Fig. 10: The migration route of the monarch butterfly includes the Bay Area and during the winter months, they can be seen clustered together—by the thousands—on tree limbs.

Social and health benefits

It is also worth reiterating that respondents to the *Master Plan* survey gave numerous descriptions of how the urban trees provide people with both tangible and intangible social benefits including a connection to nature, a connection to the past and future, a sense of calm, a reminder of the big picture, etc.

Photo courtesy of Canopy

Fig. 11: Events such as the El Palo Alto Spa Day Celebration in El Palo Alto Park *(part of the Arbor week events put on by Canopy and the City of Palo Alto in 2013)* allow kids to experience and explore nature right here in town—in Palo Alto's urban forest.

Photo courtesy of Ohashi Design Studio, Architects and J. Michael Tucker Photography

Fig. 12: By incorporating an existing oak tree into the design of this Palo Alto residence, the architect has incorporated nature into the daily lives of this family.

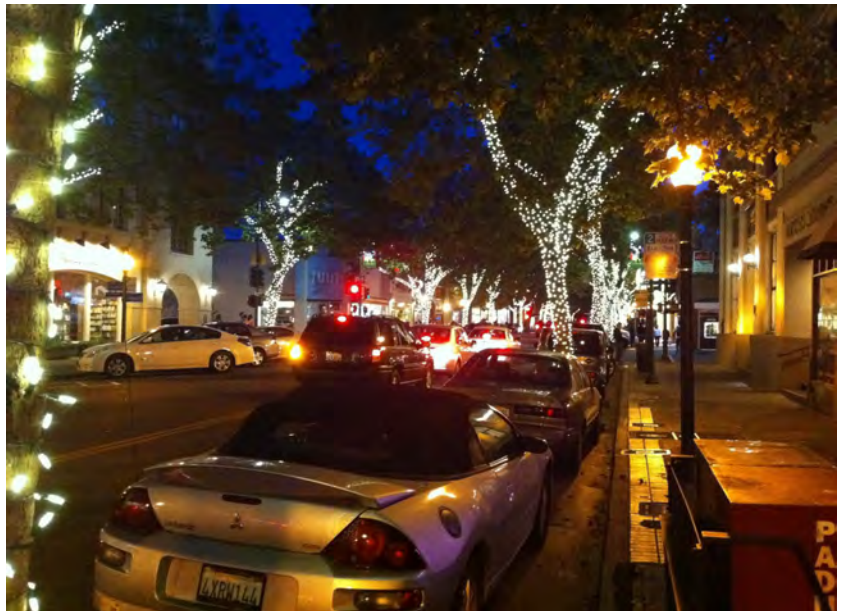

Photo by, and courtesy of, Agur Jogi, ex-Skyper, Estonia

Fig. 13: In addition to having a calming effect—during the day—lighted street trees add to the festive atmosphere of University Avenue—at night.

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Canopy Cover

Information about the canopy of the entire urban forest and of the street tree system

Measuring canopy cover requires sophisticated analysis of aerial photography and or inventory data. This chapter presents information from three such analyses.

View of entire urban forest

Photo by Scott Haefner—Courtesy of Canopy

1. Overall canopy of the Bay Area: *San Francisco Bay Area State of the Urban Forest Final Report*

In 2007, the Center for Urban Forest Research published a report by James R. Simpson and E. Gregory McPherson. For this report, Dr. Qingfu Xaio of UC Davis compared the Bay Area's overall urban canopy for the years of 1984, 1995, and 2002.

2. Overall canopy of Palo Alto: *Canopy Cover Assessment of Palo Alto's Urban Forest*

Although the Bay Area report is interesting; it was too gross to provide an acceptable baseline for the *Master Plan*. Therefore, in 2011, the City engaged Dr. Xiao (UC Davis) to do a more refined analysis—comparing Palo Alto's overall urban canopy for the years of 1982 and 2010.

Photo courtesy of Canopy

A view of the street trees

3. Canopy of the Palo Alto's street trees: *City of Palo Alto, California Right-of-Way Urban Forest Resource Analysis*

In 2010, the City engaged Davey Resource Group to analyze the street -tree canopy.

1. Bay Area report

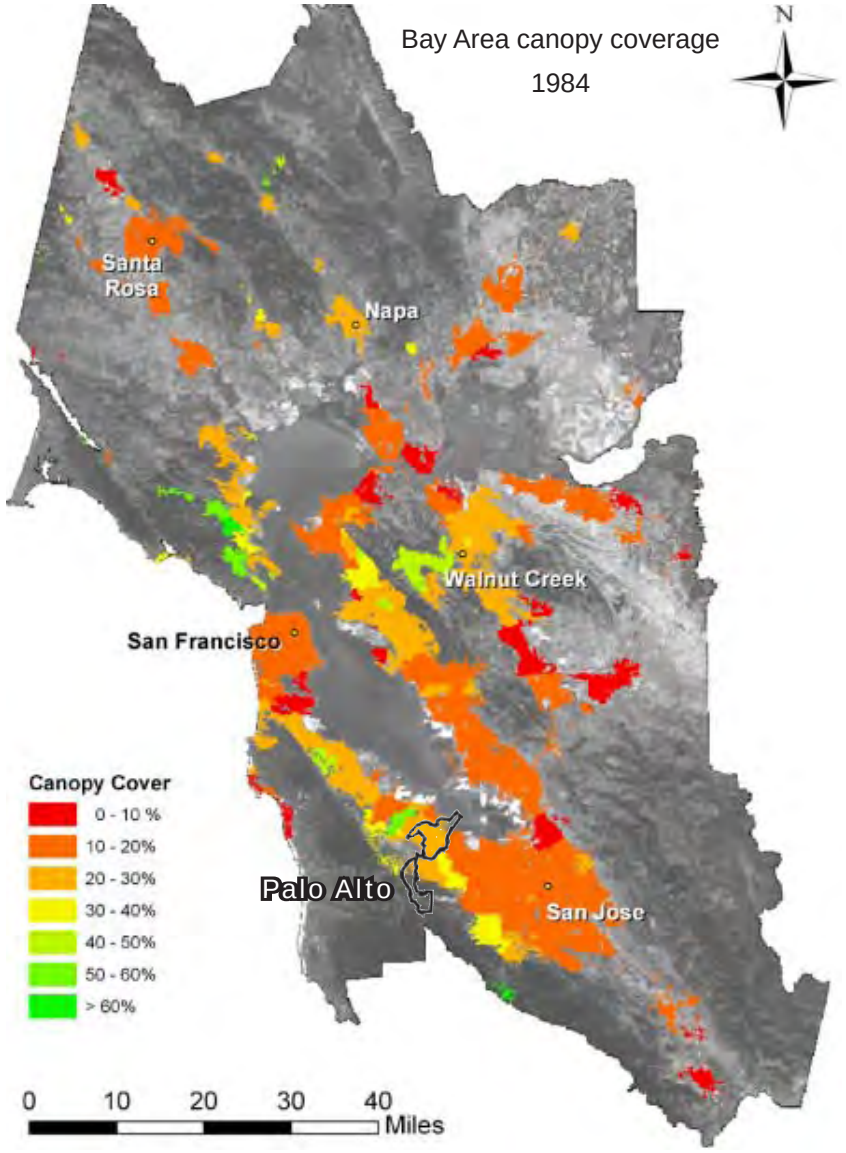
Fig. 14: This map is provided to assist in reading the maps from the Bay Area report.

The 2007 Bay Area analysis—of canopy cover for the entire Bay Area (not just Palo Alto)—yielded the following:

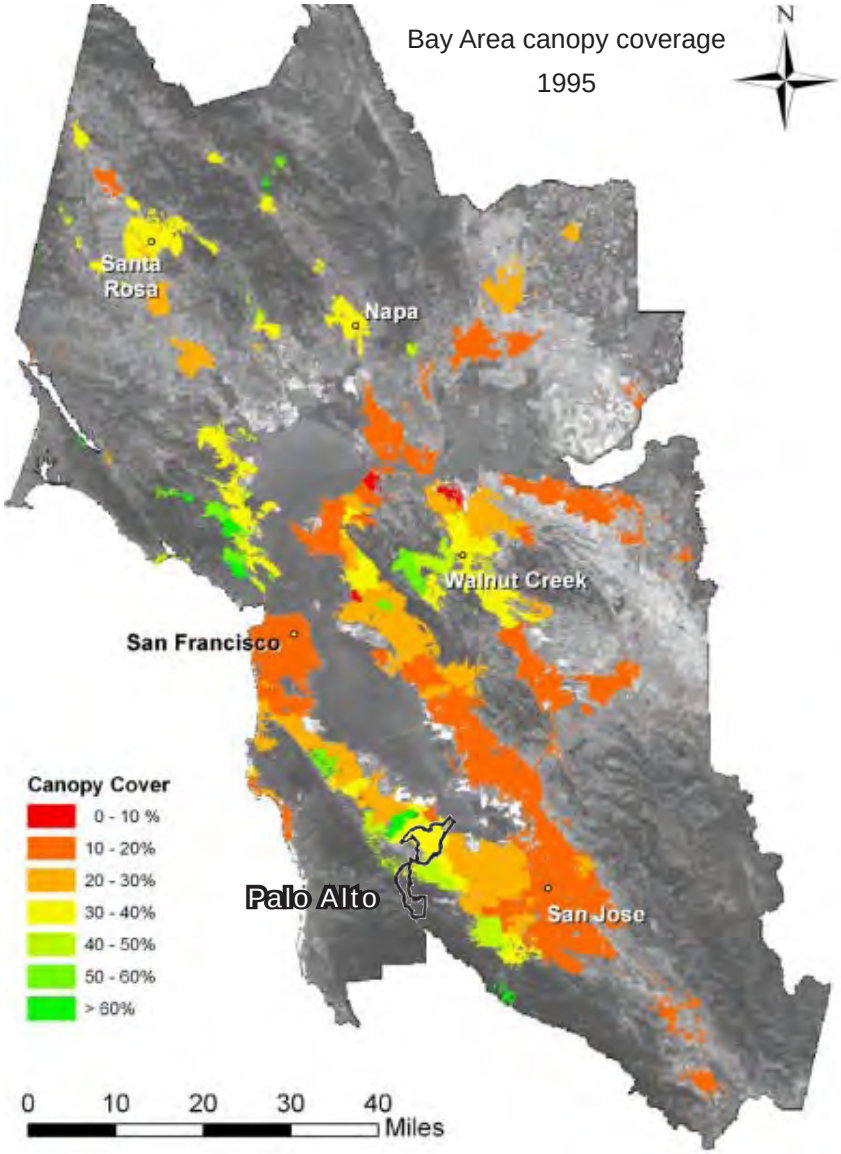
Year:	1984	1995	2002
Canopy cover:	19%	25%	29%

The report concludes that urban expansion was the primary reason for the increase—citing that urban areas have more trees than natural areas and maps from the report support this conclusion. *(Figs 15a-c)*

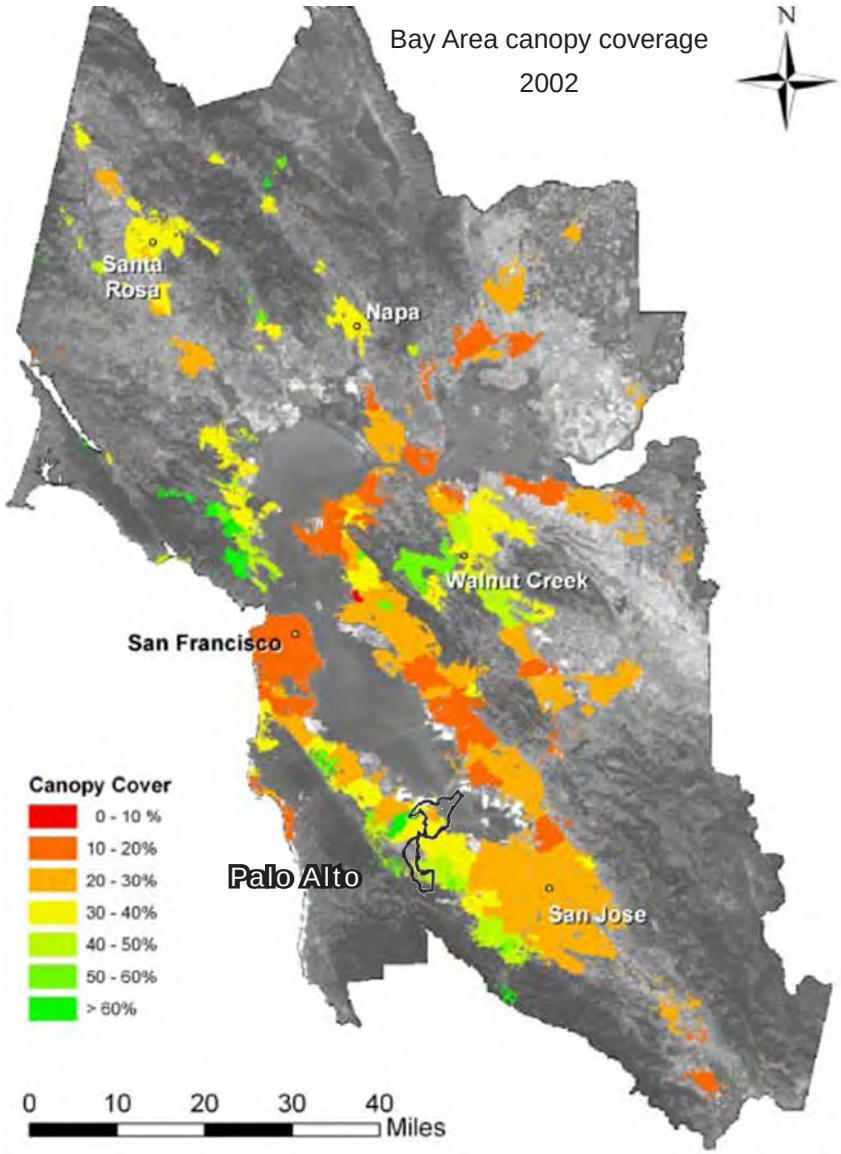
Figs. 15a-c are maps excerpted from the 2007 Bay Area Report. They compare the canopy cover of the Bay Area's urbanized areas for 1984, 1995, and 2002. *Note: Palo Alto City boundary line added to map.*



8a: Bay Area canopy coverage in 1984—from the 2007 report, *San Francisco Bay Area State of the Urban Forest Final Report*



15b: Bay Area canopy coverage in 1995—from the 2007 report: *San Francisco Bay Area State of the Urban Forest Final Report*



15c: Bay Area canopy coverage in 2002—from the 2007 report: *San Francisco Bay Area State of the Urban Forest Final Report*

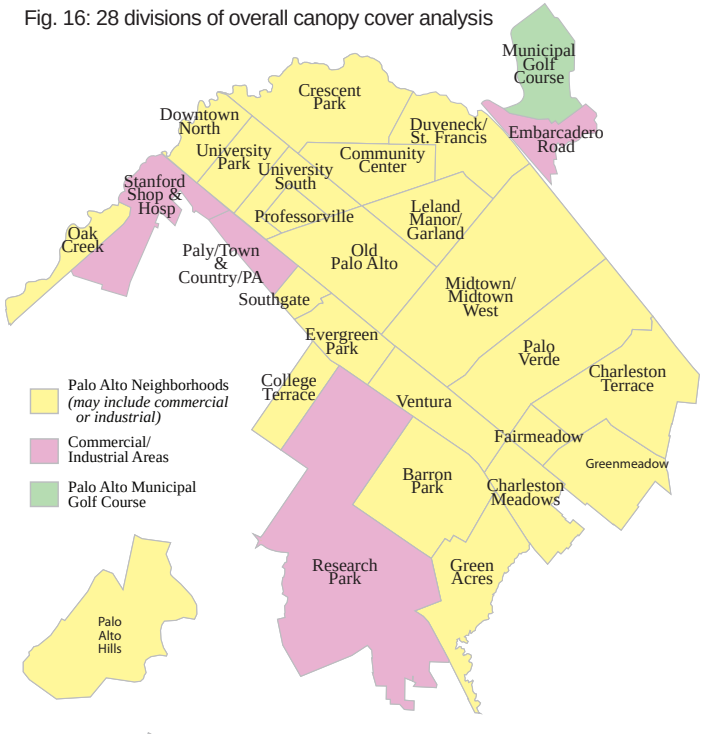
2. Palo Alto overall canopy report

The 2011 analysis of overall canopy, yielded the following comparison:

1982 overall canopy cover 32.8%
2010 overall canopy cover 37.6%

To make the analysis as meaningful as possible, the analysis is divided into 28 sections that broadly correspond to neighborhoods. *(Fig 16)*

Fig. 16: 28 divisions of overall canopy cover analysis



	Neighborhoods	Commercial/ industrial	Golf Course
1982 averages	36.6%	14.0%	6.7%
2010 averages	41.1%	23.6%	13.8%

The tables and maps show that canopy cover is not evenly distributed. The following pages discuss some of the extreme increases and decreases. *(Figs 17-19a-f)*

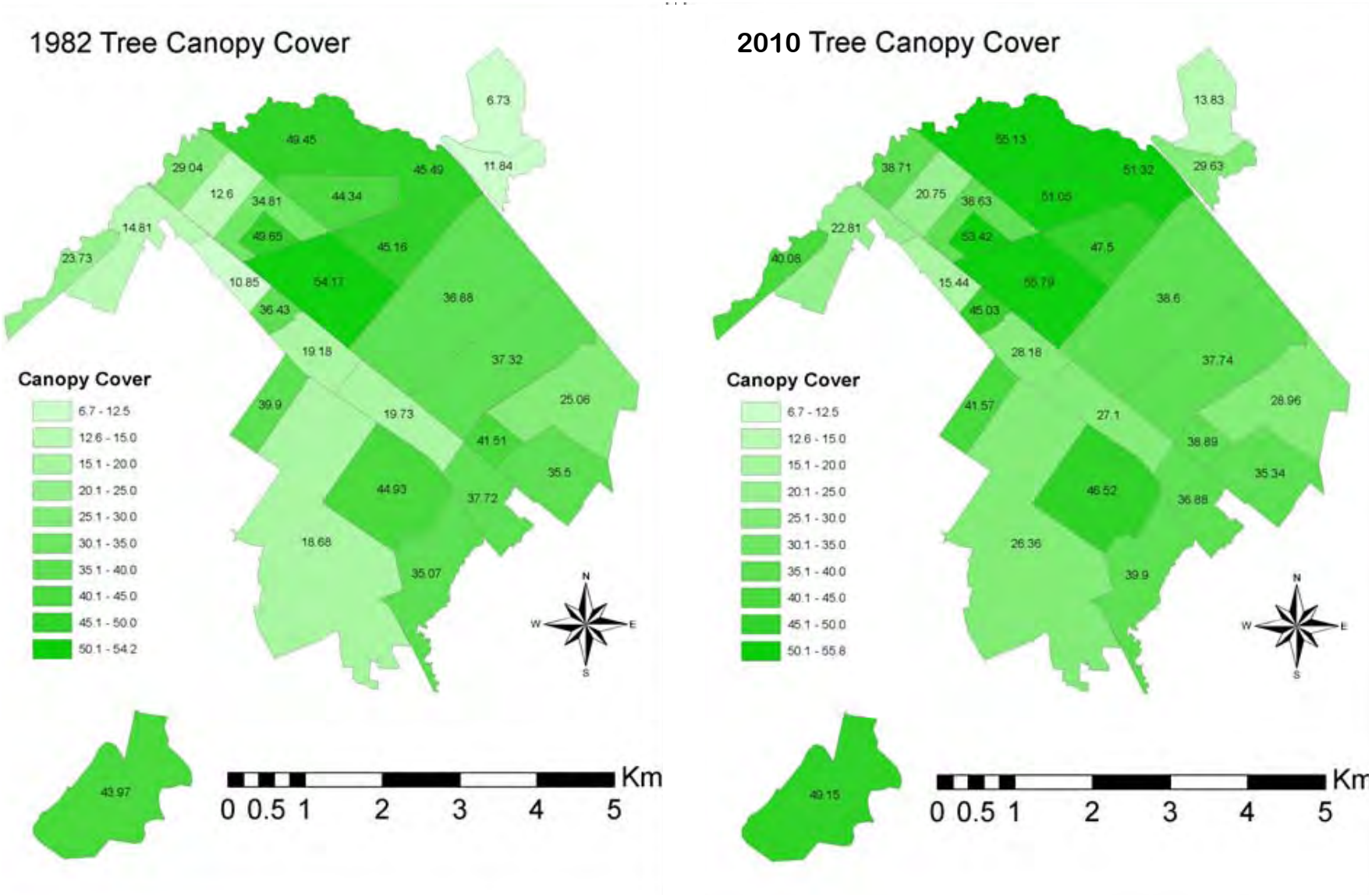
Fig. 17: Table 2 from the Palo Alto report compares the canopy cover, impervious surface, and pervious surface of Palo Alto's urban forest for the years of 1982 and 2010.

Table 2. Land cover types by neighborhood for 1982 and 2010

Neighborhood	Total area (m2)	1982			2010			% Change		
		T	I	P	T	I	P	T	I	P
Embarcadero Road	487,714.1	11.8	76.3	11.9	29.6	61.7	8.7	150.4	-19.2	-26.5
Golf Course	809,049.3	6.7	27.5	65.8	13.8	12.9	73.2	105.5	-52.9	11.3
Oak Creek	457,640.2	23.7	25.3	51.0	40.1	45.2	14.7	68.9	78.6	-71.1
University Park	580,816.3	12.6	83.6	3.8	20.8	79.1	0.1	64.7	-5.3	-96.3
Stanford Shop and Hosp	1,006,896.6	14.8	68.6	16.6	22.8	67.8	9.4	54.0	-1.2	-43.2
Evergreen Park	612,588.1	19.2	71.6	9.2	28.2	65.1	6.8	46.9	-9.1	-26.6
Paly Town Country Pamf	388,603.4	10.8	77.1	12.1	15.4	79.0	5.6	42.3	2.5	-54.0
Research Park	4,794,299.5	18.7	60.2	21.2	26.4	56.6	17.1	41.1	-6.0	-19.2
Ventura	866,900.1	19.7	72.8	7.5	27.1	63.7	9.2	37.3	-12.5	22.8
Downtown North	515,221.4	29.0	61.1	9.8	38.7	60.7	0.6	33.3	-0.7	-94.0
Southgate	221,356.9	36.4	53.5	10.0	45.0	54.4	0.5	23.6	1.7	-94.7
Charleston Terrace	1,601,165.9	25.1	64.3	10.7	29.0	57.8	13.3	15.6	-10.1	24.5
Community Center	825,865.3	44.3	43.9	11.8	51.1	46.5	2.5	15.1	5.9	-79.1
Green Acres	1,250,006.2	35.1	49.3	15.6	39.9	44.6	15.5	13.8	-9.5	-1.0
Duveneck/ St Francis	1,060,242.6	45.5	45.8	8.7	51.3	47.0	1.6	12.8	2.7	-81.2
Palo Alto Hills	1,984,204.6	44.0	13.3	42.7	49.1	12.2	38.6	11.8	-8.2	-9.6
Crescent Park	1,516,114.6	49.4	38.3	12.2	55.1	42.9	2.0	11.5	11.9	-83.9
University South	581,350.1	34.8	58.0	7.2	38.6	59.7	1.7	11.0	2.9	-76.8
Professorville	237,752.6	49.6	43.0	7.3	53.4	45.5	1.1	7.6	5.7	-85.1
Leland Manor/ Garland	859,592.3	45.2	44.8	10.1	47.5	47.6	4.8	5.2	6.5	-51.9
Midtown/ Midtown West	3,124,664.3	36.9	54.2	8.9	38.6	50.9	10.5	4.7	-6.1	17.9
College Terrace	509,102.9	39.9	47.6	12.5	41.6	46.6	11.8	4.2	-2.0	-5.6
Barron Park	1,569,508.6	44.9	45.1	9.9	46.5	42.4	11.1	3.5	-6.2	12.0
Old Palo Alto	1,502,229.1	54.2	37.6	8.2	55.8	41.9	2.3	3.0	11.4	-71.7
Palo Verde	2,038,633.5	37.3	56.6	6.1	37.7	51.5	10.7	1.1	-9.0	77.3
Greenmeadow	1,032,519.8	35.5	54.8	9.7	35.3	52.6	12.1	-0.4	-4.1	24.8
Charleston Meadows	800,660.1	37.7	55.8	6.4	36.9	53.0	10.1	-2.2	-5.1	57.1
Fairmeadow	276,801.5	41.5	53.4	5.1	38.9	51.6	9.5	-6.3	-3.3	85.6
Total	31,511,500. 3	32.8	51.6	15.6	37.6	49.4	13.0	14.6	-4.3	-16.3

T= Tree (%), I= Impervious (%), P= Pervious (%) m^2 = square meters

Fig. 18: These maps from the Palo Alto report compare the overall canopy coverage of the Palo Alto Urban Forest in 1982 and in 2010.



Increases due to private landscaping

Like the Bay Area report, the Palo Alto report also attributes increases to new development. This is supported by the extreme increases in the Embarcadero, Oak Creek, and the Stanford Hospital/ Shopping Center sections where large, previously bare areas, are now covered with buildings and private landscaping.

The following paragraphs describe the gains in these sections; however, it must be noted that vacant land is rare and in other sections—where new development replaced existing development—there was a net loss.

The Embarcadero Road Commercial Section had the highest increase of all 28 sections—150% (from 11.8% to 29.6%). The aerial photos *(Fig 19a)* show the development and landscaping that contributed to this dramatic change. However, even with the increase, its canopy is still less than that of most residential neighborhoods and it is unlikely that any large trees will be added in the future as the Baylands design guidelines (adopted in 2008) stress that the natural state of the Baylands is treeless and that new development should respect the unobstructed view of the horizon.

The Oak Creek Neighborhood Section increased by 69% (from 23.7% to 40.1%) and the aerial photos *(Fig 19b)* show new landscaping for the Stanford West Apartments, VI Senior Housing, and Ronald McDonald House.

The Stanford Hospital and Shopping Center Section increased by 54% (from 14.8% to 22.8%); the aerial photos *(Fig 19b)* indicate that this is due to both new landscaping and maturation of existing landscaping.

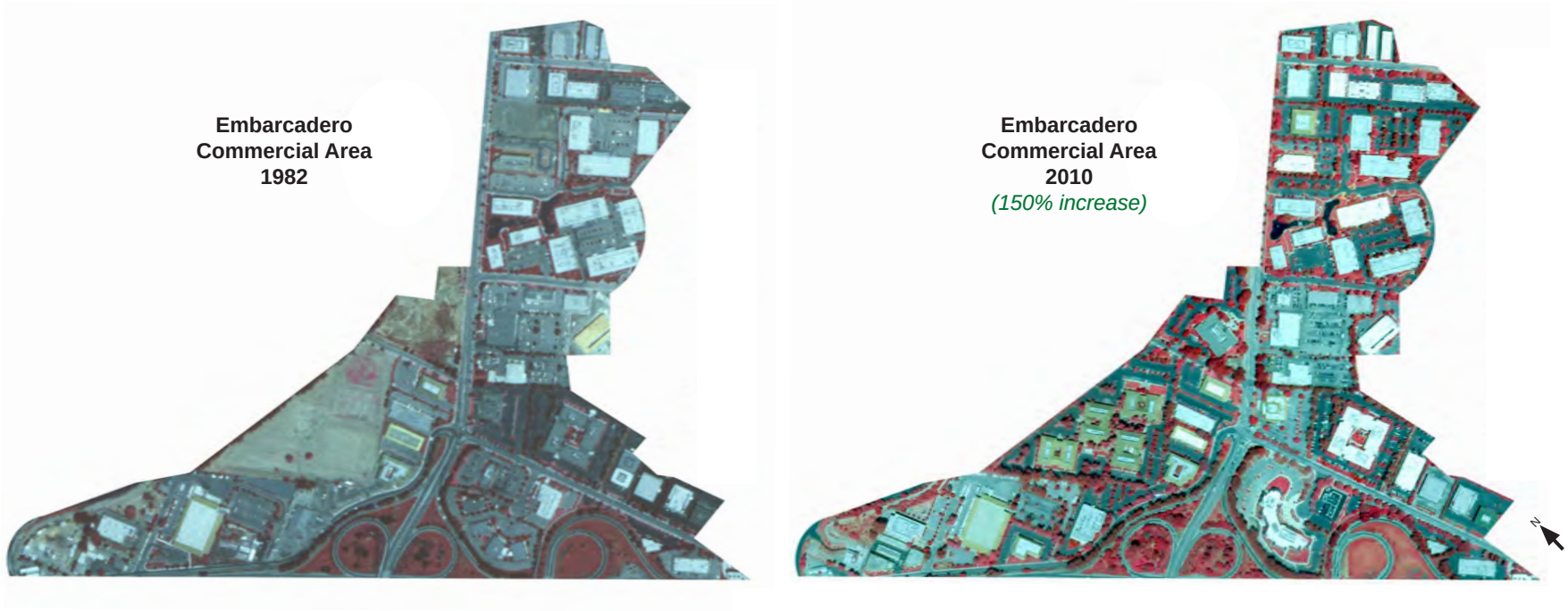


Fig. 19a: Infrared aerial photos indicate that the 150% canopy increase in the Embarcadero Commercial Area was due to landscaping associated with development of previously bare land; however, even with this massive increase this area's canopy cover is less than the average for residential areas. *(Note: Vegetation indicated in red.)*

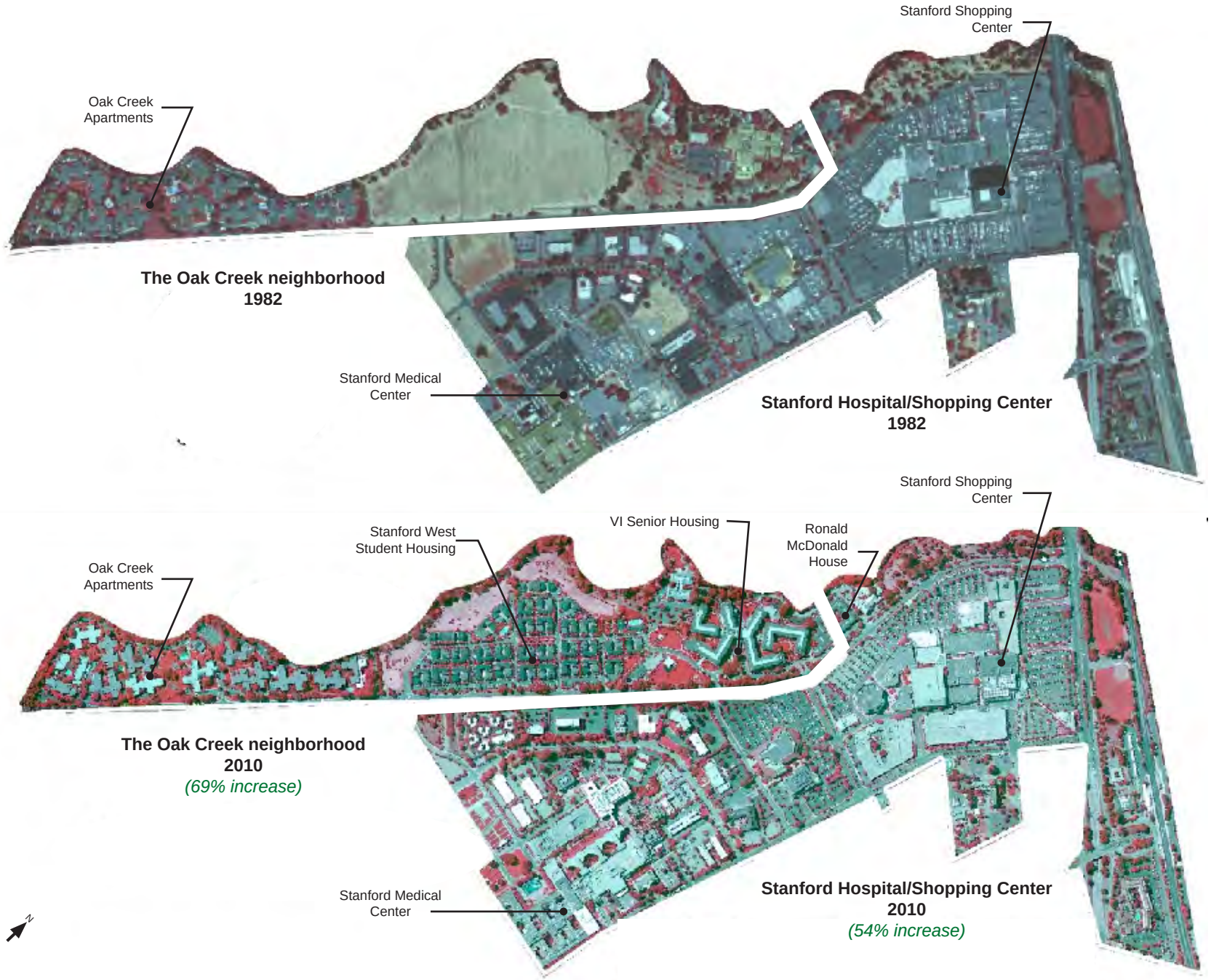


Fig. 19b: Infrared aerial photos indicate that the 69% canopy increase in the Oak Creek Neighborhood section was due to landscaping associated with development of bare land i.e., Stanford West Apartments, VI Senior Housing, and the Ronald McDonald House. And that the 54% increase in the canopy of the Stanford Hospital/Shopping Center area was due to both new landscaping and maturation of existing landscaping . (Note: Vegetation indicated in red.)

Increases due to public trees

The University Park Neighborhood increased by 64.7% (from 12.6% to 20.8%). The aerial photos *(Fig 19c)* indicate that the building footprints preclude much landscaping on private property and the increase in this section is likely due to new public trees—and maturation of existing public trees—along streets and in public parking lots.

As with the Embarcadero commercial area, the significant increase in the downtown still leaves its canopy below that of most residential sections.

The Municipal Golf Course also had a dramatic increase—105% (from 6.7% to 13.8%). However, it was so low to begin with that—even doubled—it is still the lowest of all 28 sections. In fact, the increase is not readily discernible from the aerial photos and they are not included.

It is worth noting that:

- Trees are not native to to this part of Palo Alto and have had difficulty thriving.
- The Golf Course trees, along with the trees in Greer Park, are irrigated with recycled water and it will be important to monitor their health.

Fig. 19c: Infrared aerial photos indicate indicate that the building footprints preclude much landscaping on private property and that the 64.7% canopy increase in this section is likely due to new public trees—and maturation of existing public trees—along streets and in public parking lots

University Park 1982 above

University Park 2010 below *(64.7% increase)*

Decreases due to private landscaping

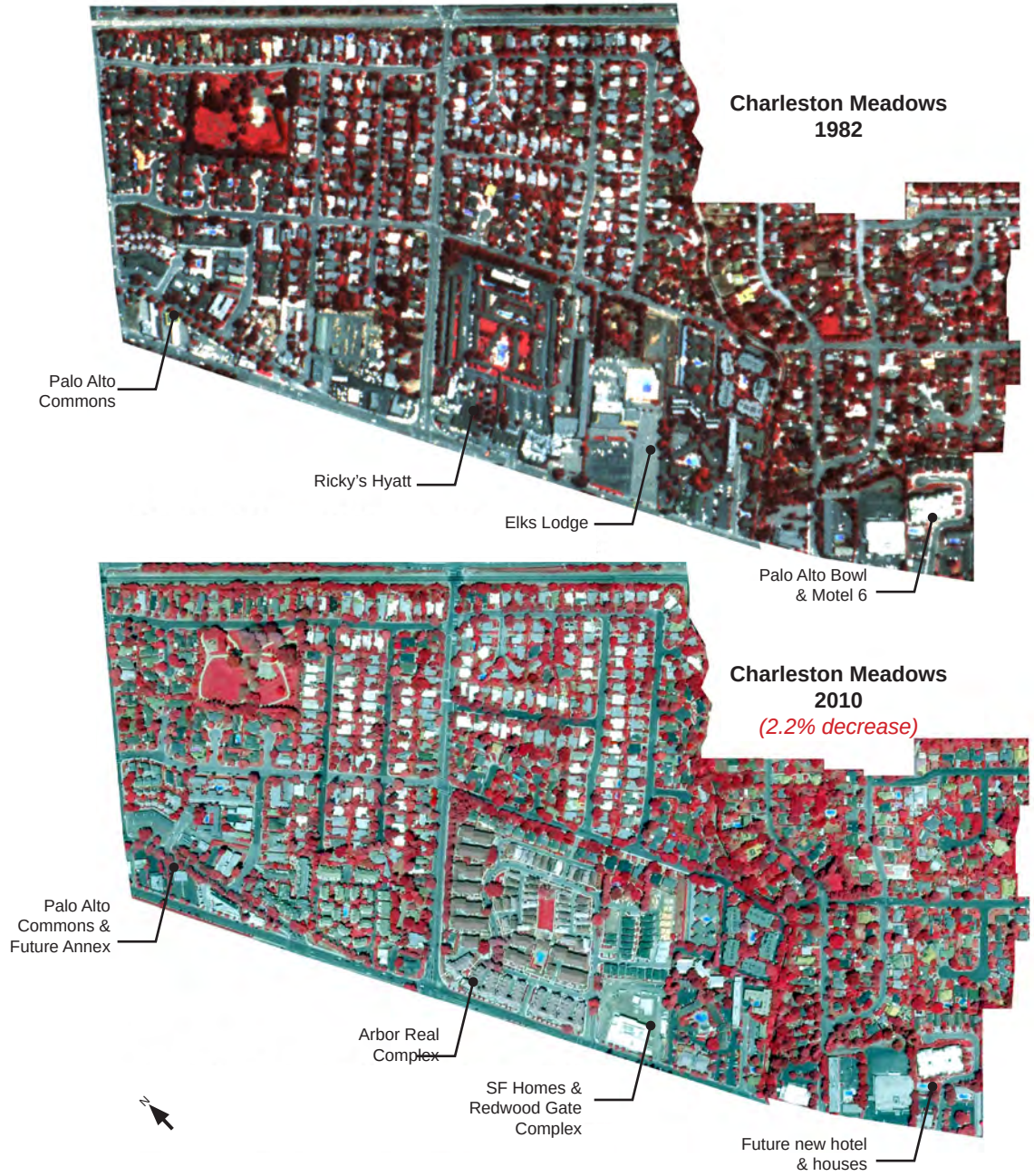
As mentioned earlier, new development that replaces existing landscaping can result in a temporary, or even permanent, loss.

The Charleston Meadows Neighborhood decreased by 2.2% (from 37.7% to 36.9) and the aerial photos *(Fig 19d)* indicate that interior landscaping was eliminated when the Ricky's Hyatt Hotel site was redeveloped as the Arbor Real multi-family complex. On the other hand, the perimeter trees along Wilkie Way and Charleston Road were preserved and new street trees were planted along El Camino Real.

Interior landscaping was also eliminated when the Elk's Lodge was redeveloped as a combination of single-family homes and the Redwood Gate multi-family complex. Additionally, some mature street trees along Wilkie Way were replaced with young ones. On the other hand, the grove of redwoods at the north west corner of the Elk's Lodge site is now a public park and a new bike path will soon connect Wilkie Way to the park.

The aerial photos also indicate that the losses described above were somewhat offset by the maturation of existing trees—both private and public—and this gain will continue as the newly planted street trees along El Camino Real and Wilkie Way mature. However, another redevelopment project is already in process. The Palo Alto Bowl and Motel 6 sites are to be redeveloped with a new hotel and single-family homes and staff anticipates this will result in a loss of canopy. And, in the adjacent section—the Ventura neighborhood—the Palo Alto Commons will soon add an annex. Again staff anticipates that this project will result in a loss of canopy.

Fig. 19d: Infrared aerial photos indicate that the 2.2% decrease in canopy in Charleston Meadows is due to the elimination of landscaping when the Ricky's Hyatt Hotel site was redeveloped as the Arbor Real multi-family complex. In general, development along El Camino has resulted in loss of private landscaping and more losses are expected.



Decreases likely due to street trees

The Fairmeadow Neighborhood had the most decrease. It went down by 6.3% (from 41.5% to 38.9%). However, in this single-family neighborhood the decrease is not due to large redevelopment projects (though increasing home sizes have impacted space for trees). The aerial photos *(Fig 19e)* indicate that the decrease is due to loss of street trees and staff confirms that this reflects unfortunate circumstances typical in south Palo Alto. That is, when these post-war subdivisions were developed, there was a push to plant fast growing trees—many of which are:

- Short-lived species that have reached the end of their life span.
- Problematic for the underground pipes associated with Eichler and Eichler-like construction e.g., radiant heating.
- Problematic for the soil volume or watering of other landscape elements.

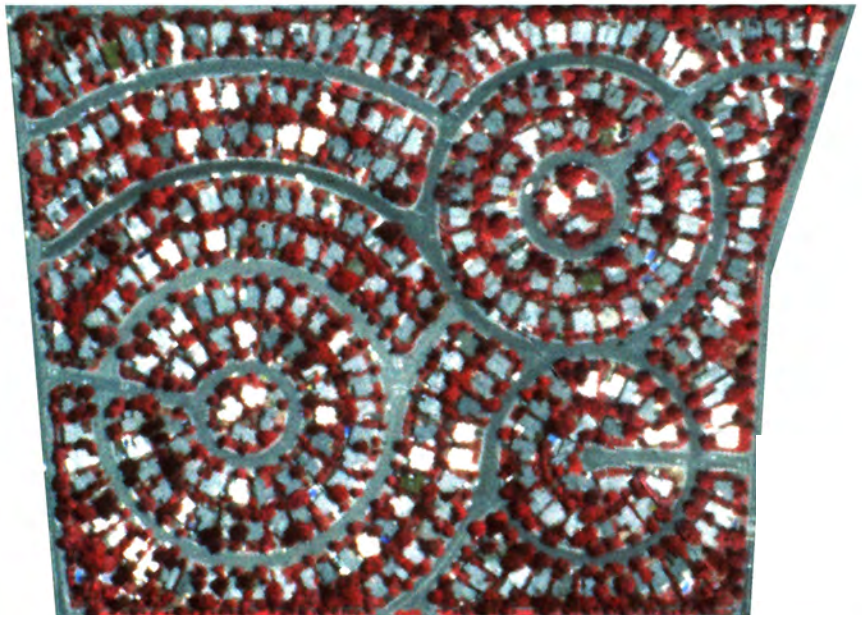
As a result, it is not unusual for a home owner to request removal of the street tree in front of his/her house; and staff indicates that, in many such cases, the home owner requests no replacement. Private trees may be removed for the same reasons.

Additionally, homes in post-war subdivisions tend to be single story; therefore, most remodels expand the building footprint—which sometimes triggers the removal of private trees.

It is worth noting that, one of the circumstances listed above does not apply in the Fairmeadow Neighborhood. That is, while high-clay content (Basin) soils are prevalent in south Palo Alto, the Soils Map *(Fig 64)* indicates that this section is mostly Alluvial Deposit.

Fig. 19e: Infrared aerial photos indicate that the 6.3% canopy decrease in the Fairmeadow neighborhood s not due to large redevelopment projects and is perhaps due to a loss of street trees. Typical south Palo Alto street tree issues include: 1950s species choices, compatibility issues with soil, and requests from property owners to remove the street trees. *(Note: Vegetation indicated in red.)*

Fairmeadow 1982



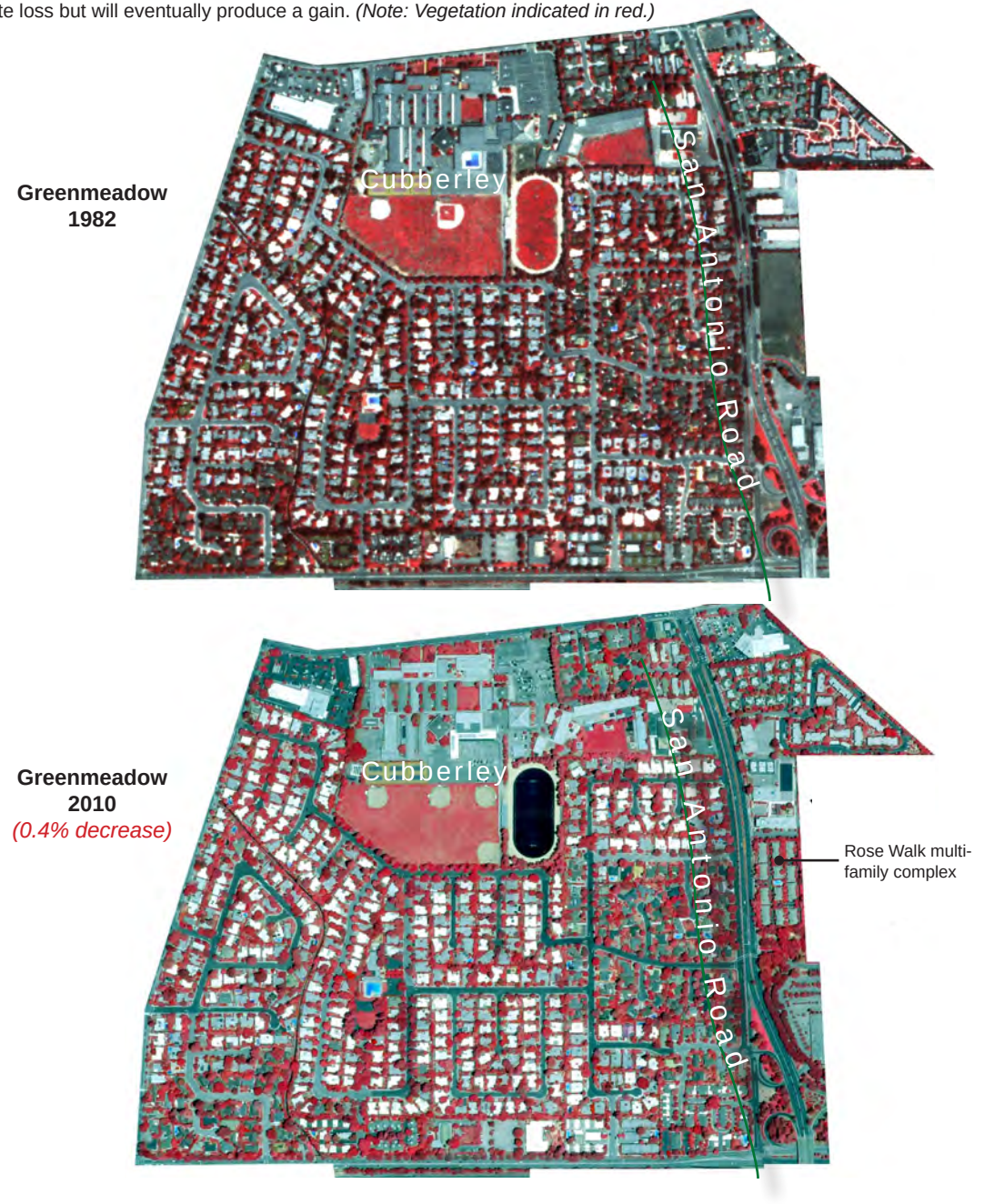
Fairmeadow 2010

(6.3% decrease)

The Greenmeadow Neighborhood had a minor loss. It went down by 0.4% (from 35.5% to 35.3%). In this case, the aerial photos *(Fig 19f)* indicate losses and gains that almost cancel each other. For example, a loss was caused by the relandscaping of San Antonio Road that replaced the existing stone pines with more appropriate, native oaks—which will eventually contribute even more to the canopy in this section. Gains resulted from:

- New private landscaping of the Rose Walk multi-family complex—another example of development replacing bare land.
- Additions to and maturation of both private and public trees along Middlefield e.g., the Charleston Plaza and Cubberly Community Center parking lots.

Fig. 19f: Infrared aerial photos indicate both losses and gains in the Greenmeadow neighborhood. New landscaping associated with the Rose Walk, Charleston Plaza, and Cubberly resulted in gains. The relandscaping of San Antonio resulted in an immediate loss but will eventually produce a gain. *(Note: Vegetation indicated in red.)*



Disparity between north and south Palo Alto

Historical comparisons

All three sections with decreases are located in south Palo Alto. Furthermore, the *Master Plan* survey indicates that disparity between north and south Palo Alto is a "Hot Topic." The following paragraphs examine the analysis results multiple ways to illustrate information regarding the disparity between north and south Palo Alto.

Comparison 1 *(Fig. 20)* considers 24 of the 28 divisions shown in Fig 9. It excludes Palo Alto Hills, the Municipal Golf Course, and the Embarcadero Commercial area because of their distance from core residential areas; and it excludes the Stanford Research Park because it is 100% industrial.

Comparison 1 indicates that, in 1982, the average canopy cover for the south sections was slightly higher than that of the north sections (north 33.96%; south 34.86%). But by 2010 the north average was 10% greater than the south average (north 40.36%; south 36.66%).

	15 sections of North Palo Alto	1982	2010
1	College Terrace	39.9	41.6
2	Evergreen Park	19.2	28.2
3	Southgate	36.4	45
4	Community Center	44.3	51.1
5	Duveneck/ St Francis	45.5	51.3
6	Crescent Park	49.4	55.1
7	University South	34.8	38.6
8	Professorville	49.6	53.4
9	Leland Manor/ Garland	45.2	47.5
10	Old Palo Alto	54.2	55.8
11	University Park	12.6	20.8
12	Downtown North	29	38.7
13	Paly Town Country Pamf	10.8	15.4
14	Oak Creek	23.7	40.1
15	Stanford Shop and Hosp	14.8	22.8
	Average	**33.96**	**40.36**

	9 sections of South Palo Alto	1982	2010
1	Green Acres	35.1	39.9
2	Midtown/ Midtown West	36.9	38.6
3	Charleston Terrace	25.1	29
4	Barron Park	44.9	46.5
5	Palo Verde	37.3	37.7
6	Greenmeadow	35.5	35.3
7	Charleston Meadows	37.7	36.9
8	Fairmeadow	41.5	38.9
9	Ventura	19.7	27.1
	Average	**34.86**	**36.66**

Fig. 20: Comparison 1 considers 24 of the 28 divisions shown in Fig 9. It excludes Palo Alto Hills, the Municipal Golf Course, and the Embarcadero Commercial area because of their distance from core residential areas; and it excludes the Stanford Research Park because it is 100% industrial. Comparison 1 indicates that, in 1982, the average canopy cover for the south sections was slightly higher than that of the north sections (north 33.96%; south 34.86%). But by 2010 the north average was 10% greater than the south average (north 40.36; south 36.66).

Comparison 2 (*Fig 21)* considers only the 17 predominantly residential sections. That is, in addition to the exclusions from Comparison 1, this comparison also excludes Oak Creek, Stanford Hospital and Shopping Center, Paly/PAMF/Town & Country, Evergreen Park, Ventura, and Charleston Terrace.

Comparison 2 indicates that in 1982, the average canopy cover of the residential sections of the north was already 11% greater than that of the south residential sections (north 42.83%; south 38.41%) ; and by 2010, the disparity had grown to 22% (north 47.81%; south 39.11).

Contributing factors

1. As mentioned in the section about the Fairmeadow neighborhood post-war subdivisions tended to plant fast growing trees—many of which are:
   - Short-lived species that have reached the end of their life span.
   - Problematic for the underground pipes associated with Eichler and Eichler-like construction e.g., radiant heating.

   As a result, it is not unusual for a home owner to request removal of the street tree in front of his/her house; and staff indicates that, in many such cases, the home owner requests no replacement. Private trees may be removed for the same reasons.
2. Additionally, residential homes in south Palo Alto tend to be single story structures which:
   - Cover more of the land than a two-story structure—leaving less room for trees in the yards.
   - Are less subject to discretionary review—and therefore less likely to have any trees be designated for retention.

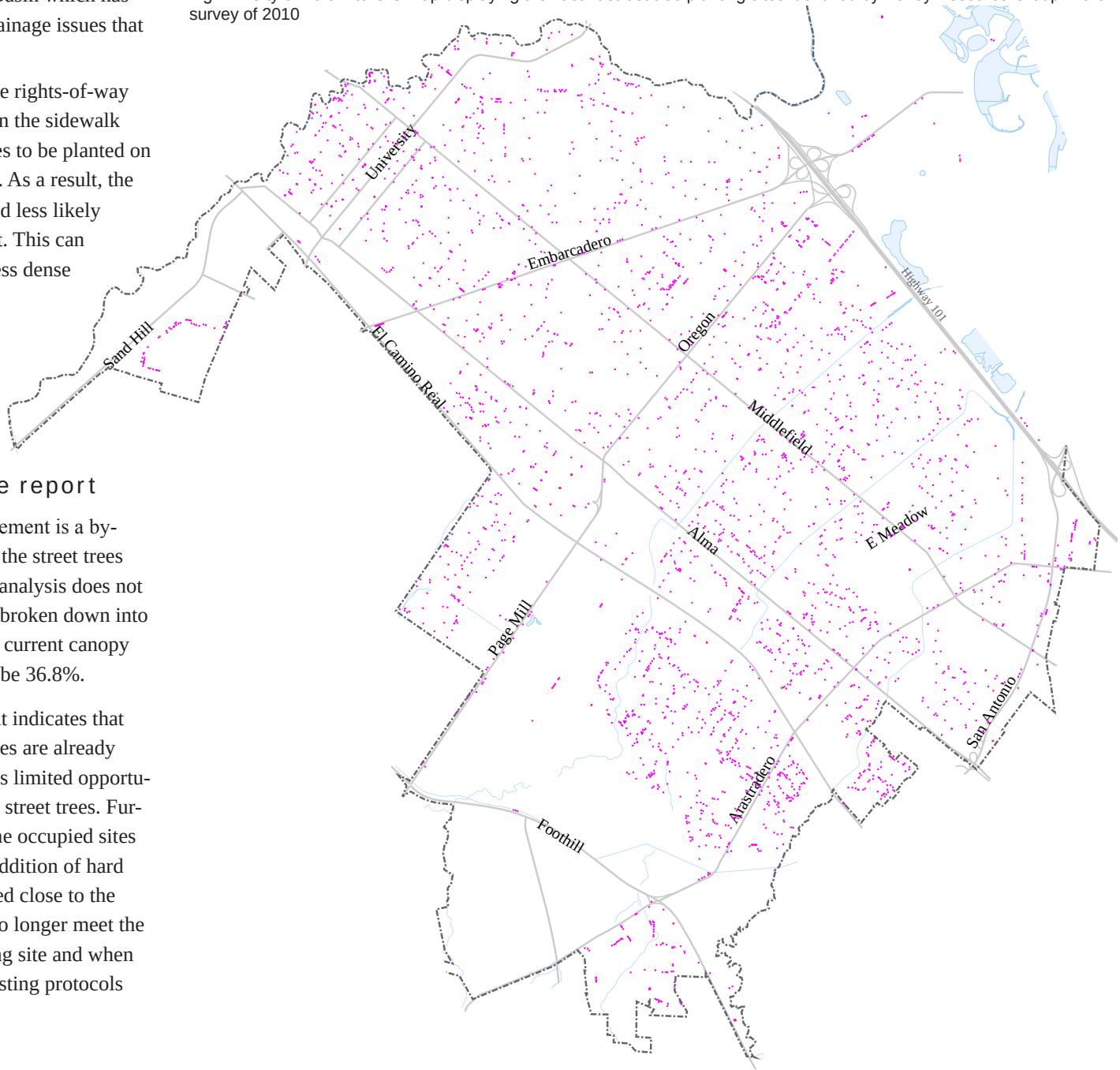
	10 residential neighborhoods of North Palo Alto	1982	2010
1	College Terrace	39.9	41.6
2	Southgate	36.4	45
3	Community Center	44.3	51.1
4	Duveneck/ St Francis	45.5	51.3
5	Crescent Park	49.4	55.1
6	University South	34.8	38.6
7	Professorville	49.6	53.4
8	Leland Manor/ Garland	45.2	47.5
9	Old Palo Alto	54.2	55.8
10	Downtown North	29	38.7
	Average	**42.83**	**47.81**

	7 residential neighborhoods of South Palo Alto	1982	2010
1	Green Acres	35.1	39.9
2	Midtown/ Midtown West	36.9	38.6
3	Barron Park	44.9	46.5
4	Palo Verde	37.3	37.7
5	Greenmeadow	35.5	35.3
6	Fairmeadow	41.5	38.9
7	Charleston Meadows	37.7	36.9
	Average	**38.41**	**39.11**

Fig. 21: Comparison 2 considers only the 17 predominantly residential sections. That is, in addition to the exclusions from Comparison 1, this comparison also excludes Oak Creek, Stanford Hospital and Shopping Center, Paly/PAMF/Town & Country, Evergreen Park, Ventura, and Charleston Terrace. Comparison 2 indicates that in 1982, the average canopy cover of the residential sections of the north was already 11% greater than that of the south residential sections (north 42.83%; south 38.41%) ; and by 2010, the disparity had grown to 22% (north 47.81%; south 39.11%).

3. The predominant soil type is Basin which has a high clay content and has drainage issues that are not optimal for trees.
4. Many south sections have wide rights-of-way with no planting strips between the sidewalk and curb forcing the street trees to be planted on the house side of the sidewalk. As a result, the street trees are farther apart and less likely to join canopies over the street. This can make the canopy seem even less dense than it actually is.

Fig. 22: City of Palo Alto GIS Map displaying the vacant street tree planting sites identified by Davey Resource Group in their survey of 2010



3. Palo Alto street tree report

The 3rd and final canopy measurement is a by-product of the 2010 inventory of the street trees by Davey Resource Group. This analysis does not compare multiple years, nor is it broken down into sections; but it does establish the current canopy over the streets and sidewalks to be 36.8%.

And, perhaps more importantly, it indicates that 92.5% of the viable street tree sites are already occupied. This means that there is limited opportunity for increasing the number of street trees. Furthermore, staff indicates that some occupied sites have been compromised by the addition of hard scape or utilities equipment placed close to the tree. In such cases the site may no longer meet the City's criteria for a viable planting site and when the existing street tree is lost, existing protocols may prohibit replacement.

Composition

Information about the composition of the entire urban forest and of the street tree system

This chapter presents information about the composition of the urban forest—from 5 sources:

A. The first 4 sources pertain to the entire urban forest i.e., both public and private trees

B. The 5th source pertains only to Palo Alto's street trees

View of entire urban forest

Photo by Scott Haefner—Courtesy of Canopy

Photo coutesy of Canopy

A view of the street trees

A. Information about the composition of the entire urban forest

The bulk of the urban forest is composed of private trees and an inventory would be very expensive. Therefore, knowledge will always be limited. Current documentation includes:

1. Oakwell Survey (oak trees only).
2. List of Heritage Trees.
3. Inventory of private trees within the utility easement.
4. Approved landscape plans showing designated trees

B. Information about the composition of Palo Alto's street trees

The City's inventory of street trees (begun in the 1920s and converted to an electronic database in the 1980s) was updated with information from the 2010 survey by Davey Resource Group (DRG). The DRG assessment of the composition is in the same report as their analysis of the benefits i.e.,

5. City of Palo Alto, California Right-of-Way Urban Forest Resource Analysis.

1. Oakwell survey

Soon after the adoption of the *Tree Protection Ordinance (Municipal Code 8.10)*, which protects Coast Live Oaks and Valley Oaks, Canopy initiated a survey to establish a baseline for future monitoring.

Four years later, with the help of forty-seven volunteers, Canopy published the *Oakwell Survey* documenting their inventory of "all native oaks east of Deer Creek Road"—regardless of land use classification. Highlights of the survey include:

1. Palo Alto had about 9,000 oaks clusters or 13,000 single oaks

2. 85% ....coast live oaks (quercus agrifolia)
   15% ....valley oaks (quercus lobata)
   1% .....black oaks (quercus kelloggii)

3. Most were less than 48" in diameter

4. About 13% of the parcels had at least one oak. Neighborhoods farther from the Bay had more oaks.

5. 14% were within Barron Park .

6. 10% were street trees.
   50% were on single-family use properties.
   18% were on commercial use properties.
   20% were on a mix of multi-family use properties, parks, medians, schools, government facilities, on the rail right-of-way, vacant lots, etc.

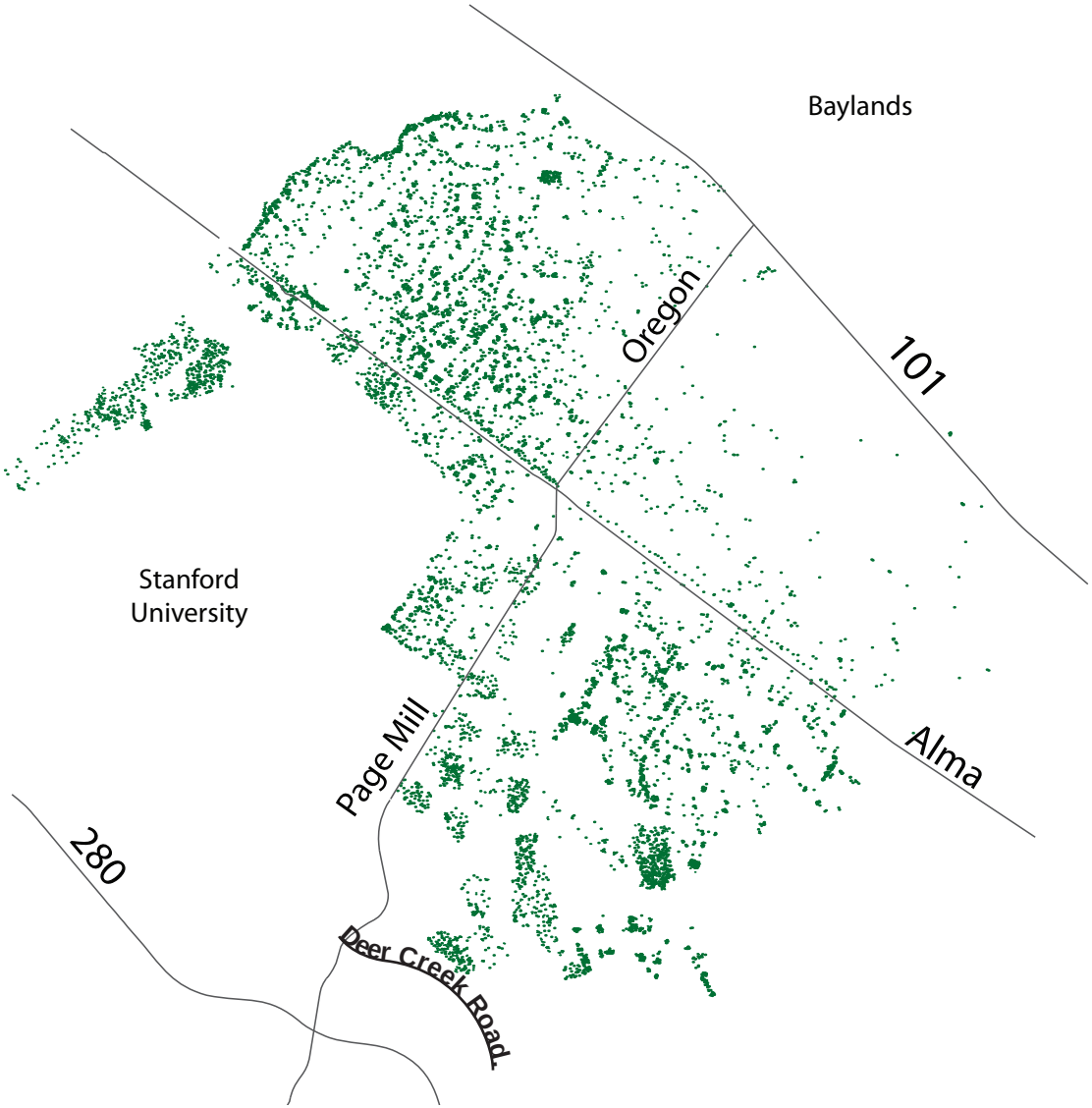


Fig. 23: General location Deer Creek Road and the 9,000 native oaks identified in the Oakwell survey of 1997.

2. Heritage trees

Upon nomination by any person and with the written consent of the property owner(s), the City Council may designate a tree as a heritage tree.

Usually, a tree is designated because it:

1. Is an outstanding specimen of a desirable species.
2. Is one of the largest or oldest trees in Palo Alto
3. Possesses distinctive form, size, age, location, and/or historical significance.

To date, 7 heritage trees have been designated:

1. El Palo Alto
2. The Rinconada Oak, in Rinconada Park
3. A coast redwood, on private property in the rear of 3759 La Donna Street
4. A dawn redwood, on private property in the front of 1032 Forest Avenue
5. A silver maple, on private property in the rear of 1872 Edgewood Drive
6. An American elm, on private property in the center of the San Alma Homeowners Association property, 4256 Ponce Drive
7. An aleppo pine, on private property in front of 12291 Ramona Street

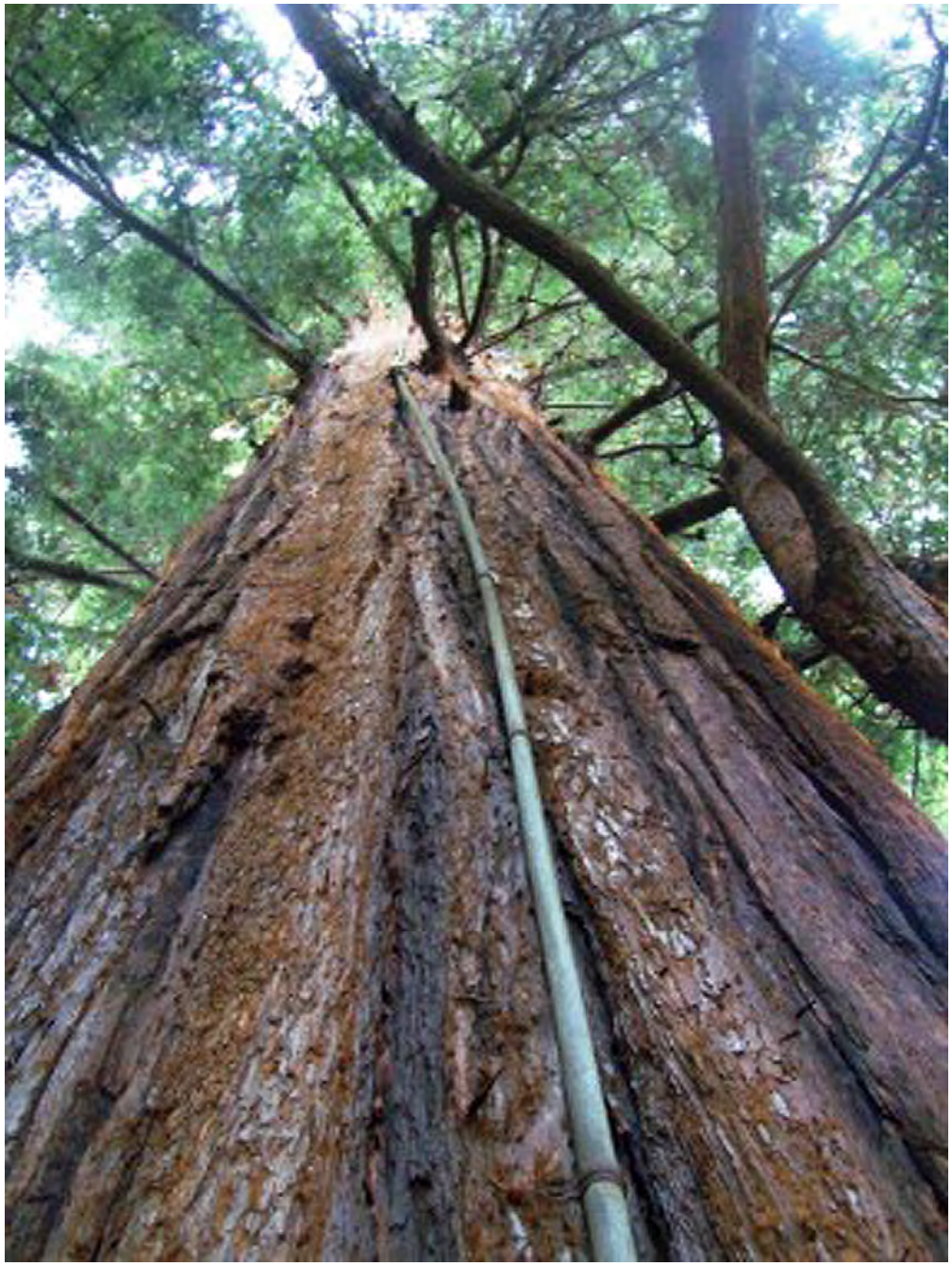


Photo courtesy of paloaltohistory.com

Fig. 24: Supreme among the Heritage Trees is El Palo Alto. This photo shows the misting pipe installed to simulate the fog—which occurs regularly in the foothills where redwoods are indigenous.

3. Inventory of private trees within the utility easement

The City maintains an electronic database of the privately-owned trees that must be pruned for overhead electric lines.

4. Approved landscape plans

Landscaping plans for commercial, industrial and multi-family development are routinely reviewed and approved plans are not to be altered without additional review. These approved plans provide a permanent record of the species on that property.

5. Palo Alto street tree report

Davey Resource Group made the following observations about the composition of the composition of the street-tree population in their 2010 report, *City of Palo Alto, California Right-of-Way Urban Forest Resource Analysis*.

Species diversity

With the exception of southern magnolias, Palo Alto's street trees suggest fairly adequate diversification. That is they comply with the widely accepted rule that no single species should represent more than 10% of the population.

- 38% of the total is made up of only 4 species.:
  1. Southern magnolia—13.9%
  2. London plane—9.7%
  3. Liquidambar—9.2%
  4. Modesto ash—5.1%
- In contrast, 58% of the total is made up of dozens of species that are represented by 10 or fewer trees each.
- 95% of the total are broadleaf species

Notes:
See Fig 18, a list of all street trees by species.

Although large broadleaf species tend to provide the most benefits, some of these species have been identified as undesirable because of their water requirements or impacts to sidewalks and overhead wires. The future value of the street trees will be affected by species choices for replacement plantings and, of course, their management.

See Table, "Thirst Ratings for public trees" available in appendix.

Age diversity

The report suggests that a desirable age distribution might have:

- 40% young trees i.e., diameters less than 8"
- 10% with diameters more than 24"

The age distribution of Palo Alto street trees are as follows:

- 34.8% —less than 8" diameter
- 14.4% —more than 24" diameter

Three of the top ten species have significant representation in the small diameter class—indicating that recent plantings have focused on these species. They are:

- Ginkgo—47.4%
- Red oak—43.8%
- Chinese pistache—36.8%

It is worth noting that these three species have low to moderate water thirst ratings.

Six of the top ten species have significant representation in the large diameter class—indicating that they were favored in the past:

- Modesto ash—56%
- Camphor—36.6%
- Southern magnolia—19.8%
- London plane—17.2%
- Chinese elm—17.2%
- Coast live oak—15.7%

Of these six mature populations, coast live oak is the only species that is also well represented in the small diameter class (19.9%) —indicating that recent plantings have focused on this species too.

Species with little representation in the small class—indicating that they are not being planted in as great of numbers are:

- Southern magnolia—4.3%
- London plane—4.1%
- Liquid amber—3.8%
- Modesto ash—1.6%

Native species within the street tree population

The Davey Resource Group does not discuss the number of native species within the street tree population that they inventoried and analyzed; however, Dr. James Clark of Hortscience created a list that associates certain native species with Palo Alto habitats.

The table in *Fig 25* reflects that list and indicates the frequency of each species within the street tree population.

Drought tolerant species within the street tree population

See "Water" chapter for information and see "Appendices" for list.

Street tree population by species

The table in *Fig 26* shows all the species within the street tree population and the frequency of each one. The native species identified by Dr. Clark are highlighted.

Fig. 25: This list—created by Dr. James Clark of Hortscience—associates native species with Palo Alto habitat types. It also indicates the frequency of each species within the street tree population.

Palo Alto Native Species by habitat

Habitat	Common name	Frequency in street tree population
Oak woodland		**534**
	Coast live oak	534
	Blue oak	0
Oak woodland, riparian		**328**
	Bigleaf maple	98
	Toyon	1
	Valley oak	215
	California bay	14
	California buckeye	0
Oak woodland, foothills		**21**
	Western redbud	13
	California flannel bush	0
	Catalina cherry	0
	California black oak	8
Foothillls		**277**
	Madrone	1
	California Incense cedar	33
	California Wax myrtle	0
	Coast redwood	243
Riparian		**8**
	Boxelder	0
	White alder	8
	Oregon ash	0
	Western sycamore	0
	Fremont cottonwood	0
	Yellow willow	0
	Blue elderberry	0

Fig. 26: Street-Tree Population by Species with native species highlighted *(continues on following pages); Note: similar table with water needs in Appendices.*

Street Tree Population by Species

Common Name	Frequency in Street Tree Population	% of Street Tree Population
Southern magnolia	4,061	13.97%
London plane	2,832	9.74%
Liquidambar	2,669	9.18%
Modesto ash	1,481	5.09%
Camphor	1,133	3.90%
Chinese pistache	1,027	3.53%
Chinese elm	820	2.82%
Red oak	778	2.68%
Ginkgo	633	2.18%
Coast live oak	534	1.84%
Yarwood sycamore	517	1.78%
Holly oak	515	1.77%
Red maple	418	1.44%
Littleleaf linden	416	1.43%
White birch	374	1.29%
Raywood ash	373	1.28%
Glossy privet	361	1.24%
Tuliptree	346	1.19%
Moraine ash	334	1.15%
European hackberry	318	1.09%
Chinese hackberry	302	1.04%
Ornamental pear	301	1.04%
Coast redwood	243	0.84%
Purpleleaf plum	242	0.83%
Autumn Purple ash	238	0.82%
Chinese tallow	226	0.78%
Valley oak	215	0.74%
Shamel ash	196	0.67%
Crape myrtle	189	0.65%
Red horsechestnut	187	0.64%
Shumard oak	157	0.54%
Deodar cedar	148	0.51%
Italian cypress	147	0.51%
Cork oak	147	0.51%

Fig. 26 continued: Street Tree Population by Species *w/ native species highlighted (continues on following pages) Note: similar table with water needs in Appendices.*

Street Tree Population by Species (continued from previous page)

Common Name	Frequency in Street Tree Population	% of Street Tree Population
October Glory maple	140	0.48%
Carob	140	0.48%
Japanese maple	138	0.47%
Chanticleer pear	135	0.46%
Columbia sycamore	132	0.45%
Hawthorn	129	0.44%
Autumn Gold ginkgo	121	0.42%
Frontier elm	119	0.41%
Monterey pine	110	0.38%
Japanese pagoda tree	109	0.37%
White mulberry	104	0.36%
Bradford pear	104	0.36%
Silver maple	101	0.35%
Blackwood acacia	100	0.34%
Western catalpa	100	0.34%
Bigleaf maple	98	0.34%
Italian stone pine	92	0.32%
Carolina cherry laurel	91	0.31%
English walnut	90	0.31%
Southern live oak	87	0.30%
Greenspire linden	84	0.29%
Tupelo	82	0.28%
Fern pine	79	0.27%
Horsetail tree	74	0.25%
Honey locust	69	0.24%
Japanese flowering cherry	68	0.23%
Purple Robe locust	65	0.22%
Loquat	64	0.22%
Australian willow	63	0.22%
Crape myrtle 'Natchez'	63	0.22%
Edible plum	63	0.22%
Eastern redbud	60	0.21%
Calif. pepper	60	0.21%
Canary Island pine	57	0.20%

Common Name	Frequency in Street Tree Population	% of Street Tree Population
Mexican fan palm	55	0.19%
Sawleaf zelkova	55	0.19%
Evergreen pear	54	0.19%
Other, deciduous medium	54	0.19%
Mayten	53	0.18%
Idaho locust	53	0.18%
Green Mountain linden	50	0.17%
Green Column maple	49	0.17%
Black locust	49	0.17%
Freeman maple	48	0.17%
Xylosma	48	0.17%
Flowering plum	47	0.16%
American elm	47	0.16%
Weeping bottlebrush	44	0.15%
Scarlet oak	44	0.15%
Pin oak	44	0.15%
Olive	43	0.15%
Mimosa	42	0.14%
Crabapple	40	0.14%
Aristocrat pear	39	0.13%
Almond	38	0.13%
Red Sunset red maple	37	0.13%
Lemon bottlebrush	37	0.13%
Arizona ash	37	0.13%
Water gum	37	0.13%
Silver dollar gum	36	0.12%
Stone fruit	36	0.12%
Lemon	34	0.12%
Red mulberry	34	0.12%
Brazilian pepper	34	0.12%
Calif. incense cedar	33	0.11%
Saucer magnolia	33	0.11%
Canary Island Date palm	33	0.11%
Oak	33	0.11%

Common Name	Frequency in Street Tree Population	% of Street Tree Population
Athena elm	33	0.11%
Evergreen maple	32	0.11%
Apricot	32	0.11%
Tree-of-heaven	31	0.11%
Maple	30	0.10%
Upright hornbeam	30	0.10%
Silver linden	30	0.10%
Water gum (Elegant)	30	0.10%
Calif. fan palm	30	0.10%
Hollywood juniper	29	0.10%
Sterling linden	29	0.10%
Jacquemontii birch	28	0.10%
Bloodgood sycamore	28	0.10%
European beech	27	0.09%
	26	0.09%
Snakebark maple	24	0.08%
River she-oak	24	0.08%
Jacaranda	24	0.08%
Chinese fringe	23	0.08%
Other, broadleaf small	23	0.08%
Green dracaena	22	0.08%
Edible apple	21	0.07%
Aleppo pine	21	0.07%
Ruby horsechestnut	20	0.07%
Horsechestnut	20	0.07%
European hornbeam	20	0.07%
Eucalyptus	20	0.07%
Elm	20	0.07%
Spanish dagger	20	0.07%
Other, deciduous large	20	0.07%
Oleander	19	0.07%
Colorado spruce	19	0.07%
Windmill palm	19	0.07%
Other, deciduous small	19	0.07%

Fig. 26 continued: Street-Tree Population by Species *w/ native species are highlighted (continues on following pages) Note: similar table with water needs in Appendices.*

Street-Tree Population by Species (continued from previous page)

Common Name	Frequency in Street Tree Population	% of Street Tree Population
Hedge maple	18	0.06%
Calif. black walnut	18	0.06%
Orange	17	0.06%
Yoshino cherry	17	0.06%
Edible pear	17	0.06%
Paul's Scarlet hawthorn	16	0.06%
Blue gum	16	0.06%
Magnolia	16	0.06%
Norway maple	15	0.05%
Strawberry tree	15	0.05%
Pink Dawn chitalpa	15	0.05%
Eastern black walnut	15	0.05%
Jap. black pine	15	0.05%
Pittosporum	15	0.05%
Yew pine	15	0.05%
Soapbark tree	15	0.05%
Akebono cherry	14	0.05%
Douglas-fir	14	0.05%
Queen palm	14	0.05%
Calif. bay	14	0.05%
Western redbud	13	0.04%
Dogwood	13	0.04%
Red ironbark	13	0.04%
Sycamore	13	0.04%
Edible peach	13	0.04%
Other, broadleaf medium	13	0.04%
Paperbark maple	12	0.04%
River birch	12	0.04%
Crape myrtle 'Tuscarora'	12	0.04%
Bottle tree	11	0.04%
Japanese persimmon	11	0.04%
Silk oak	11	0.04%
Pine	11	0.04%
Lily of the valley tree	10	0.03%
Silver dollar tree	9	0.03%
Juniper	9	0.03%
Mock orange	9	0.03%
Victorian box	9	0.03%
White alder	8	0.03%
Edible fig	8	0.03%
Avocado	8	0.03%
Fraser photinia	8	0.03%
Calif. black oak	8	0.03%
Other, palm	8	0.03%
Fig	7	0.02%
Goldenrain	7	0.02%
Fern-Leaf Catalina ironw	7	0.02%
Jelecote pine	7	0.02%
American arborvitae	7	0.02%
African sumac	6	0.02%
Linden	6	0.02%
Atlas cedar	5	0.02%
Monterey cypress	5	0.02%
Bushy yate	5	0.02%
Wilson holly	5	0.02%
Flax-leaf paperbark	5	0.02%
Myoporum	4	0.01%
Karo	4	0.01%
Leyland cypress	3	0.01%
Arizona cypress	3	0.01%
Rubber tree	3	0.01%
Juniper	3	0.01%
Cape pittosporum	3	0.01%
Interior live oak	3	0.01%
English yew	3	0.01%
Other, conifer small	3	0.01%
Guadalupe palm	2	0.01%
Mediterranean	2	0.01%
Grapefruit	2	0.01%
Carrotwood	2	0.01%
Sweetshade	2	0.01%
Calif. juniper	2	0.01%
Sweet bay	2	0.01%
Blue potato bush	2	0.01%
Cajeput tree	2	0.01%
Tarata	2	0.01%
Pyracantha	2	0.01%
Willow	2	0.01%
Japanese viburnum	2	0.01%
Yucca	2	0.01%
Other, broadleaf large	2	0.01%
Other, conifer medium	2	0.01%
Madrone	1	0.00%
Western hackberry	1	0.00%
Port Orford cedar	1	0.00%
Hopseed	1	0.00%
Red-flowering gum	1	0.00%
Pineapple guava	1	0.00%
Toyon	1	0.00%
Burford holly	1	0.00%
Australian tea tree	1	0.00%
Date palm	1	0.00%
Giant sequoia	1	0.00%
Western redcedar	1	0.00%
Other, conifer large	1	0.00%

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Where we are now

Information from the community

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Community Surveys

This chapter presents results from two surveys.

1. Annual Service Efforts and Accomplishments survey

In these annual surveys—conducted by the City Auditor—citizens rate their satisfaction with street-tree maintenance. In each year shown here, a majority have rated the service as either "good" or "excellent". However, in some years as many as 34% have rated the service as either "fair" or "poor."*(Fig. 27)*

2. ***Master Plan*** survey

In January 2011, the *Master Plan* team conducted an online survey to get input from a broad cross section of the community about perceptions related to trees as well as tree management by the City.

The City and Canopy co-conducted a campaign to encourage participation (e-mails, web announcements, new letters, and networking) and more than 600 members of the community logged on to contribute their thoughts about the "trees around them."

The results were analyzed using Vovici's Enterprise Feedback Management (EFM) software—and published in a report titled, *Survey Results & Analysis for Urban Forest Master Plan Survey*. The Vovici report is available on the City's website.

In this chapter are:

1. An Executive Summary of the responses.
2. An expanded review of the responses.
3. Excerpts from the open-ended responses .

Fig. 27: Historical results excerpted from the "Service Effort and Accomplishments" reports

					Budget benchmarking measures					Citizen Survey Results	
Year of survey	Operating expenditures (in millions)	Authorized staffing (FTE) (General Fund)	Total number of City maintained trees (includes trees planted by Canopy)	Number of trees planted (includes trees planted by Canopy)	Number of trees trimmed or removed (excludes trees trimmed to clear power lines)	Percent of urban forest pruned	Percent of total utility lines cleared	Number of tree related electrical service disruptions	Average cost per tree maintained	Percent rating street tree maintenance **"excellent" or "good"**	Percent rating street tree maintenance **"fair" or "poor"**
2002	$2.7	16	37,941	295	5,986				$71.79		
2003	$2.3	16	34,939	322	5,298				$66.93	66%	34%
2004	$1.9	14	35,440	242	5,222				$53.52	70%	30%
2005	$1.9	14	35,096	164	4,775	14%	26%	5	$54.42	82%	18%
2006	$2.2	14	34,841	263	3,422	10%	21%	13	$63.28	72%	28%
2007	$2.3	14	34,556	164	3,409	10%	30%	15	$67.90	67%	33%
2008	$2.5	14	35,322	188	6,579	18%	27%	9	$71.52	68%	32%
2009	$2.2	14	35,255	250	6,618	18%	33%	5		72%	28%
2010	$2.4	14	35,472	201	6,094	18%	27%	4		69%	31%
2011*	$2.8	14	33,146	150	5,045	15%	26%	8		70%	30%

* FY 2011 was the first year, since 1989, the trees were officially counted. Data prior to to FY 2011 was estimated.

Urban Forest Master Plan survey & responses

Like the Executive Summary, this expanded review reflects information in the Vovici report, *Survey Results & Analysis for Urban Forest Master Plan Survey.* It is expanded in that it reflects all the multiple choices (instead of just three), briefly describes the question, and includes excerpts from the open-ended responses *(in the "Hot Topics" section.)* The complete Vovici report is available on the City website.

#1: Who took the survey?

60 Members of Palo Alto leadership *(elected official, neighborhood association board, school board, etc.)*
45 Tree and landscape professionals.
557 Interested citizens *(live, work, or frequently visit Palo Alto.)*
18 Undefined.

#1: Order here is same as in survey question; respondents chose first that applied. Number reflects total number of responses to each choice.

#2: Home zip codes of respondents

1. 94306 (33%)
2. 94303 (28%)
3. 94301 & 94304 (26%)
4. Other (13%)

#2: Order reflects response popularity; % reflects portion of total responses.

#3: Work zip codes of respondents

1. Other (50%)
2. 94301 & 94304 (18%)
3. 94306 (17%)
4. 94303 (15%)

#3: *Order reflects response popularity; % reflects portion of total responses.*

#4: Trees are important to me because they...

Responses to 4 rank positive tree attributes and it is worth noting that almost all of the positive attributes were selected—by a strong majority.

1. Provide shade and cool buildings (97%)
2. Are beautiful (94.7%)
3. Reduce air pollution (86.5%)
4. Combat global climate change (81.2%)
5. Provide habitat (80.9%)
6. Reduce Noise (72.5%)
7. Add to property values (71.6%)
8. Aid in storm water management (70.8%)
9. Provide edible fruits and nuts (61.7%)
10. Calm traffic (44.6%)
11. Other (9.6%)

#4: Respondents were asked to choose "all that apply." Therefore, % reflects portion of total respondents that chose each response as one of their choices. Order reflects relative popularity of response. #4 also provided for additional thoughts (open-ended responses) and common themes that emerged are reflected in excerpts within the "Hot Topics" section.

#5: What do trees mean to you?

This was an open ended question; themes that emerged include:

- The big picture and environmental benefits
- How trees affect a community / daily life
- Personal experiences.

#5: This was an open ended question and common themes that emerged are reflected in excerpts within the "Hot Topics" section.

#6: What don't you like about the public and private trees around you?

Responses to 6 rank what are generally deemed to be negative tree attributes and it is worth noting that ONLY ONE of the negative attributes was selected by a majority—and a slim majority at that.

1. Damage caused by tree roots (51%)
2. Mess from fallen leaves or fruit (35.2%)
3. Potential damage or injury from fallen branches (28%)
4. Other (20%)
5. Maintenance costs (19.7%)
6. Amount of water needed (13.3%)
7. I am allergic to some trees (12.6%)
8. Shade my home and yard too much (9.5%)

#6: Respondents were asked to choose "all that apply." Therefore, % reflects portion of total respondents that chose each response as one of their choices. Order reflects relative popularity of response #6 also provided for additional thoughts (open-ended responses) and common themes that emerged are reflected in excerpts within the "Hot Topics" section.

#7: What would benefit my yard, my neighborhood, the area around my work, the City of Palo Alto?

Responses indicate that a majority of the respondents would like to see more trees within the City; but few would like to see more trees in their own yards. Responses to this four-part question are as follows:

7.1: My yard would benefit from...

1. OK as is or no opinion (46.1%)
2. Different trees (28.7%)
3. More trees (23.3%)
4. Fewer trees (5.1%)

7.2: My neighborhood would benefit from...

1. More trees (44.2%)
2. OK as is or no opinion (32.4%)
3. Different trees (29.7%)
4. Fewer trees (1.1%)

7.3: The Area around my workplace would benefit from...

1. More trees (40.5%)
2. OK as is or no opinion (33.1%)
3. Different trees (12.7%)
4. Fewer trees (.05%)

7.4: The city of Palo Alto would benefit from...

1. More trees (57.5%)
2. Different trees (30.1%)
3. OK as is or no opinion (20.3%)
4. Fewer trees (1.1%)

#7: Respondents were asked to choose "all that apply." Therefore, % reflects portion of total respondents that chose each response as one of their choices. Order reflects relative popularity of response.

#8: What benefits would you expect from more, different, or fewer trees?

Expected benefits (from more, different, or fewer trees): Common themes that emerged have to do with size, species, and the related consequences such as shade, root damage, debris, and allergies. However, in each category, expectations vary—and are sometimes opposing

#8: This was an open ended question and common themes that emerged are reflected in excerpts within the "Hot Topics" section.

#9: How serious are these threats to the health of the community trees in Palo Alto?

The following ranking indicates the threats for which most respondents gave a ranking of either "Serious" or "Very Serious":

1. Urban Development/Redevelopment (69.4%)
2. Lack of proper care (64.5%)
3. Drought and water constraints (61.2%)
4. Tree Removals (56.9%)
5. Insects and disease (53.8%)
6. Major storms (42.2%)
7. Climate change (41%)
8. Fire (23.5%)

#9: Respondents were able to choose "all that apply." Therefore, % reflects portion of total respondents that chose each response as one of their choices. Order reflects relative popularity of response.

#10: Additional thoughts about threats to the health of the community trees in Palo Alto?

Common themes reiterated the multiple choices *(from #9)* and added topics such as electric line clearing, the city's budget, and "High Speed Rail"

#10: This was an open ended question and some of the common themes that emerged are reflected in excerpts within the "Hot Topics" section.

#11: How is the City doing in the following areas?

The strongest majorities, or concentration of responses, indicate a strong desire for improved communication from the city about tree removals and regulations. Responses to the eleven parts were as follows:

11.1: Managing street trees:

1. Needs improvement (48.7%)
2. Good job (40.5%)
3. No opinion (10.8%)

11.2: Managing trees in parks:

1. Good job (53.1%)
2. Needs improvement (27%)
3. No opinion (19.9%)

11.3: Managing trees in open space:

1. Good job (47.1%)
2. No opinion (36.3%)
3. Needs improvement (16.6%)

11.4: Managing trees near power lines:

1. Good job (42.3%)
2. Needs improvement (37.4%)
3. No opinion (20.2%)

11.5: Planting new trees:

1. Needs improvement (49.8%)
2. Good job (25.5%)
3. No opinion (24.7%)

11.6: Making good choices about tree removals:

1. Needs improvement (57.7%)
2. No opinion (22.3%)
3. Good job (20%)

11.7: Protecting trees from negative impacts of private development:

1. Needs improvement (40.7%)
2. Good job (29.9%)
3. No opinion (29.4%)

11.8: Protecting trees from negative impacts of City projects and maintenance tasks:

1. Needs improvement (42.3%)
2. No opinion (33.2%)
3. No opinion (24.5%)

11.9: Setting appropriate tree regulations:

1. Needs improvement (38.8%)
2. No opinion (35.6%)
3. Good job (25.5%)

11.10: Informing residents about tree regulations:

1. Needs improvement (60.9%)
2. No opinion (24%)
3. Good job (15.1%)

11.11: Informing residents about proposed removals of community trees:

1. Needs improvement (64.2%)
2. Good job (18.6%)
3. No opinion (17.2%)

#11: Respondents were unable to choose multiple responses." Therefore, % reflects portion of total responses for each ranking choice. Order reflects relative popularity of response.

#12: Additional thoughts about the City of Palo Alto's management of the urban forest?

Response themes reiterate the multiple choices *(from #11)* and add topics such as obscured street signs, improper irrigation systems, electric line clearing, species selection, and responsiveness to work requests.

#12: This was an open ended question and common themes that emerged are reflected in excerpts within the "Hot Topics" section.

#13: Rate the 3 most important areas the City of Palo Alto should focus on.

Responses yielded a ranking of eight areas for the City's focus:.

1. Encouraging the planting of drought tolerant species (24.4%)
2. Providing more tree maintenance (pruning, disease and insect control, etc.) (23.1%)
3. Planting more trees (21.7%)
4. Increasing the amount of resources committed to tree care (11.4%)
5. Reducing the number of tree removed (11.1%)
6. Making tree regulations less restrictive (4.1%)
7. Making tree regulations more restrictive (3.3%)
8. Reducing the amount of resources committed to tree care (0.9%)

#13: Respondents were asked to rank any three of the choices with a value of 1, 2, or 3. Order reflects popularity of choice.; % reflects portion of total responses.

However, the popularity, or ranking was calculated in a way that is more complicated than the other responses. That is, per the Vovici report, these percentages "were calculated on the sum of points obtained by each focus area item. Items that were ranked as a number 1 (or highest) received a point value of 3, whereas a ranking of 2 received 2 points, and a 3 received 1 point. For instance "encouraging the planting of drought…" received 883 points out of 3,621 total points, or 24.4% of the points.

#14: Additional thoughts about trees

Response themes reiterate concerns about maintenance, species selection, and budget, and mention of a need to coordinate with other agencies, taxes, and property rights. As with other open-ended responses, preferences and desires vary and are sometimes opposing.

#12: This was an open ended question and common themes that emerged are reflected in excerpts within the "Hot Topics" section.

Hot Topics

Themes emerged from responses to open-ended questions and on the following pages are excerpts from those responses—grouped into these 9 themes or, "Hot Topics":

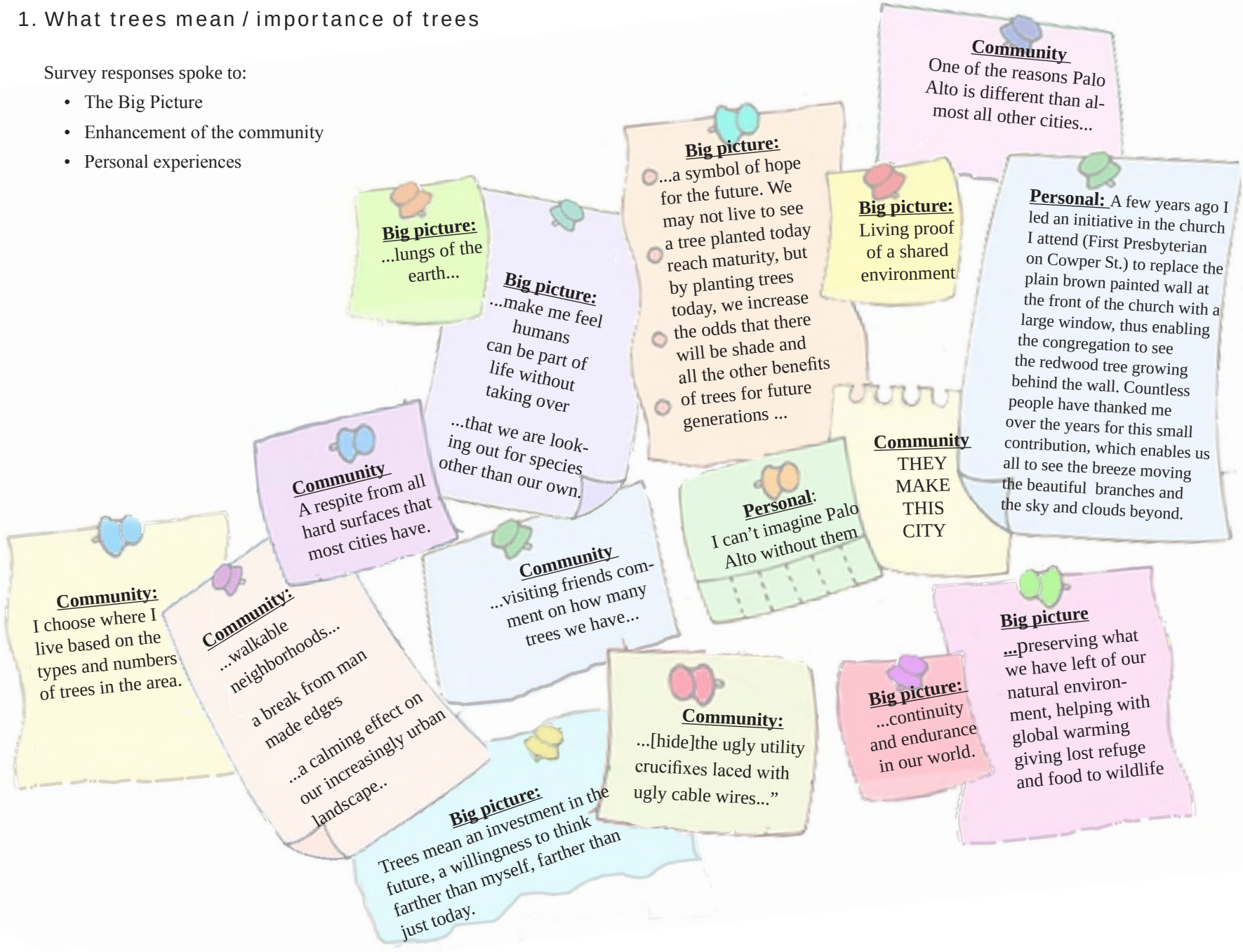
1. What trees mean / importance of trees
2. Species selection
3. Drought and water constraints
4. Negative impacts from development
5. Negative impacts from city projects and maintenance activities
6. Removals
7. Communication (from the city)
8. Disparity between north and south Palo Alto
9. City performance and budget

It is worth mentioning that a common theme does not imply consensus. The following excerpts illustrate that, for each theme, desires and expectations can vary and can even be opposing.

1. What trees mean / importance of trees

Survey responses spoke to:

- The Big Picture
- Enhancement of the community
- Personal experiences



2. Species selection

The consequences of species include but are not limited to size, diversity, mess, damage, allergies, drought resistance, etc. And opinions about each varied greatly.

3. Drought and water constraints

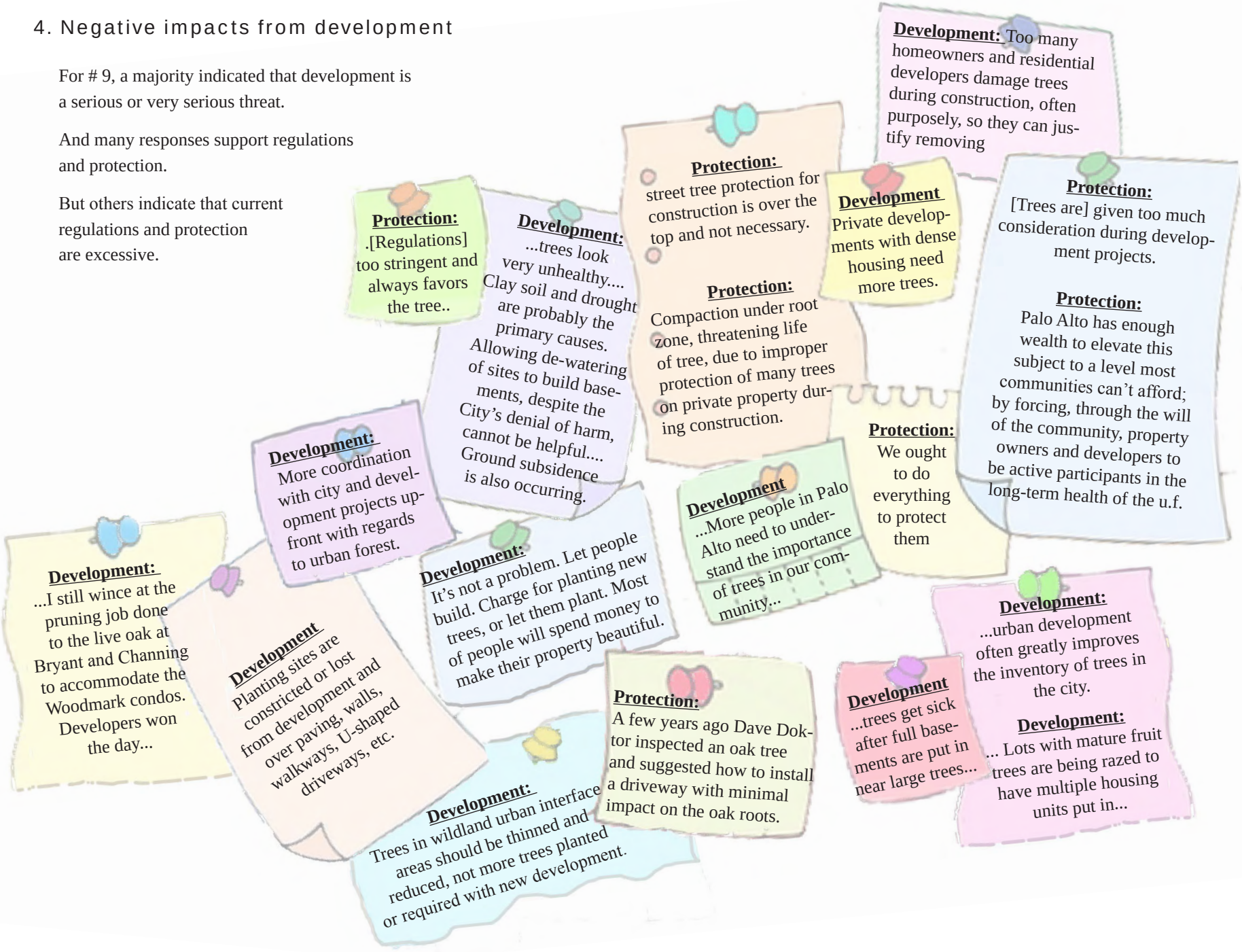
Respondents often expressed their concerns about drought and water constraints by advocating native species.

4. Negative impacts from development

For # 9, a majority indicated that development is a serious or very serious threat.

And many responses support regulations and protection.

But others indicate that current regulations and protection are excessive.



5. Negative impacts from city projects and maintenance activities

In #11 respondents indicated that they think the threat from city projects and maintenance activities is equal to or greater than the threat from private projects.

6. Removals

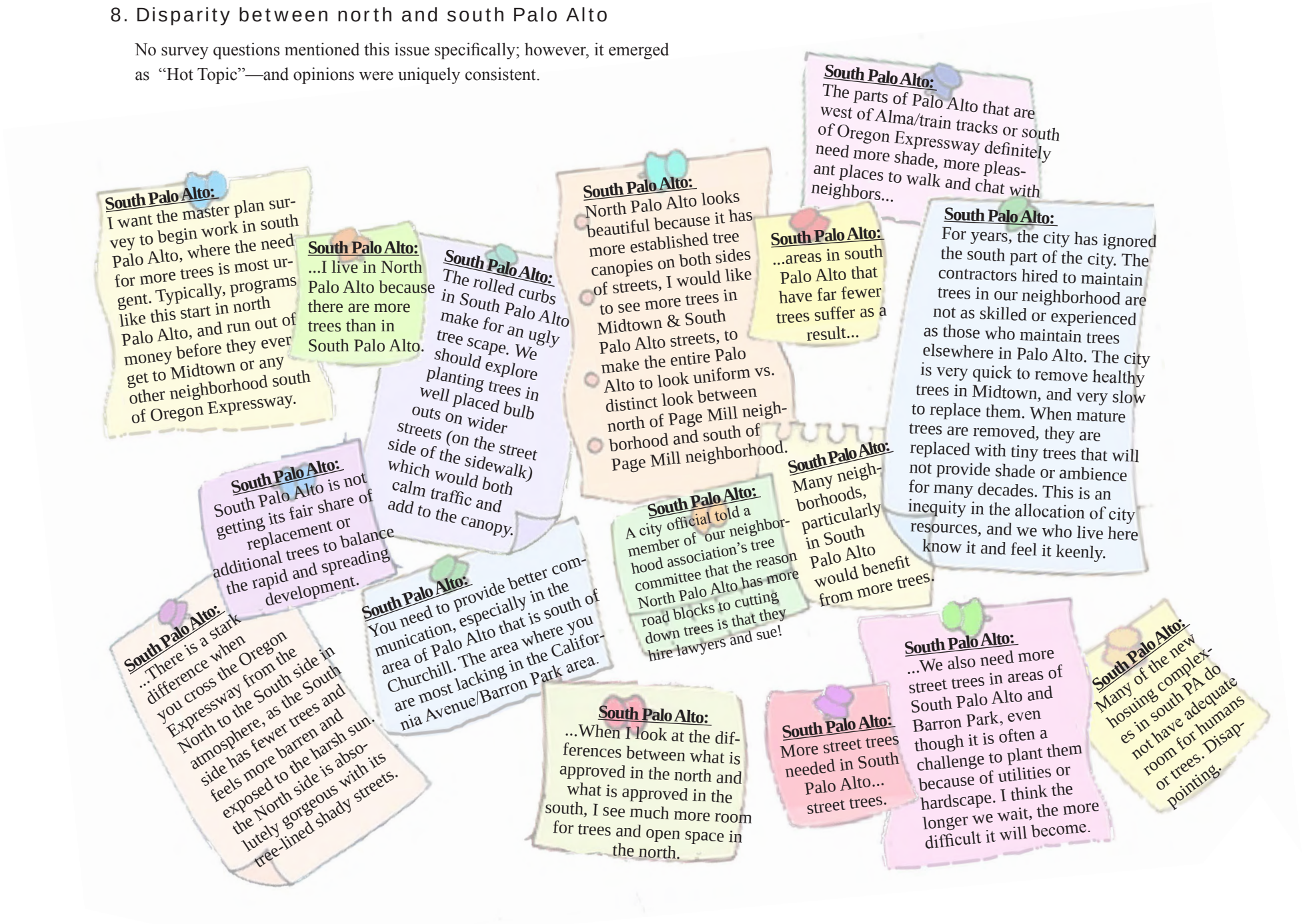
The topic of tree removals appears in the responses to several survey questions. Opinions vary.

7. Communication (from the city)

Responses were fairly consistent i.e., that communication from the City is appreciated—and more communication would be appreciated...more.

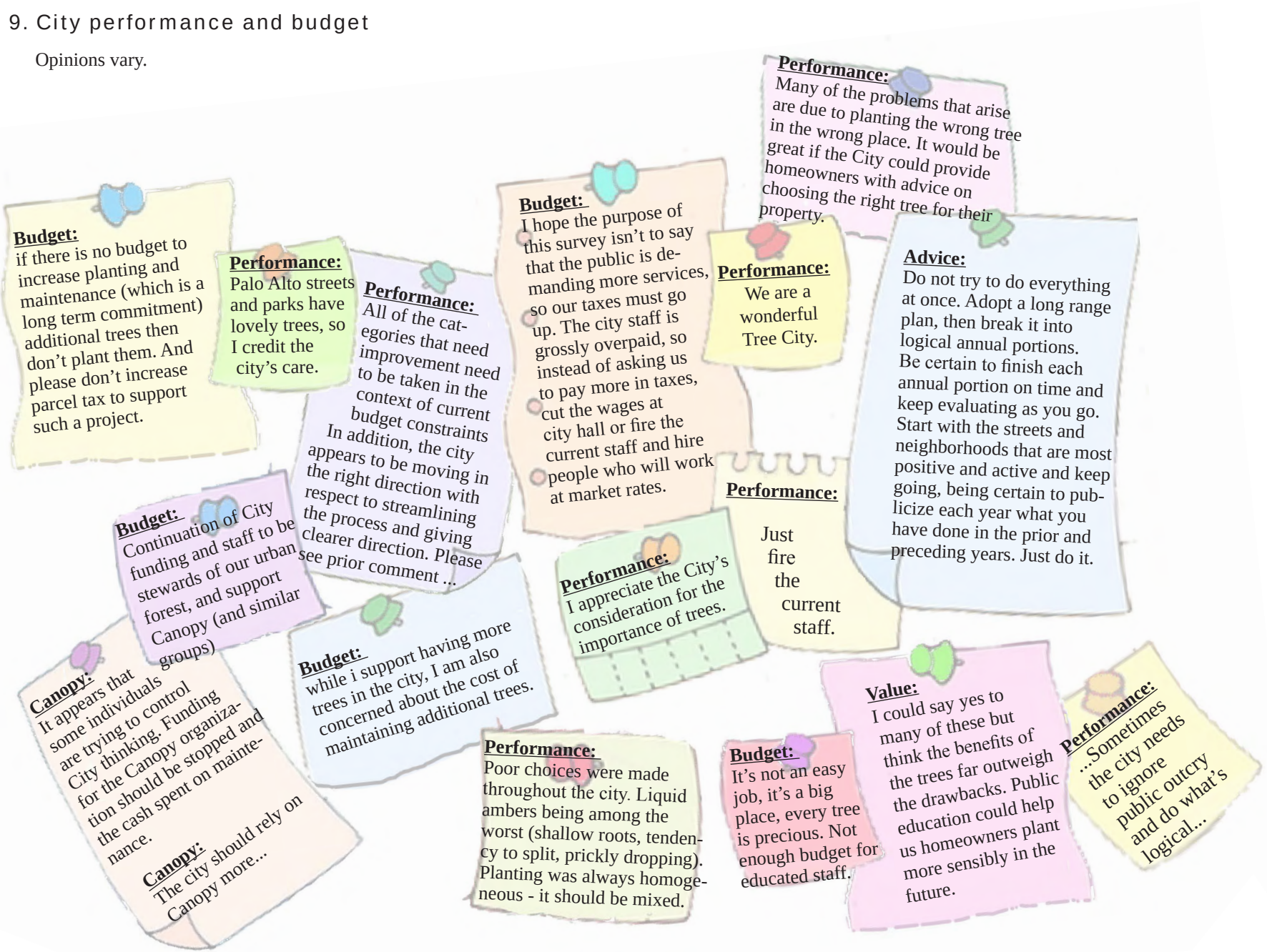
8. Disparity between north and south Palo Alto

No survey questions mentioned this issue specifically; however, it emerged as "Hot Topic"—and opinions were uniquely consistent.



9. City performance and budget

Opinions vary.



Where we are now

Information about challenges

- Water
- Development
- Line Clearing

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Water usage

Potable water usage

The *Urban Water Management Plan (UWMP)* is the guiding document to assess the reliability of the City's water sources, support long-term resource planning, and ensure adequate water supplies are available to meet existing and future demands. Updated every five years, the *UWMP* documents historic and projected water use.

Excerpts from the most recent update (*2010 UWMP*) show water sales data by customer class *(Fig 28)*.

Total 2010 usage: 3,661,261,836 gallons

2010 Water usage by customer class

Customer class	Acres feet/ year	Gallons/ year
Single family	5,334	1,738,089,234
Multiple family	1,806	588,486,906
Commercial	2,311	753,041,661
Industrial	847	275,995,797
City facilities	544	177,262,944
Public facilities	395	128,711,145
Total	**11,236**	**3,661,261,836**

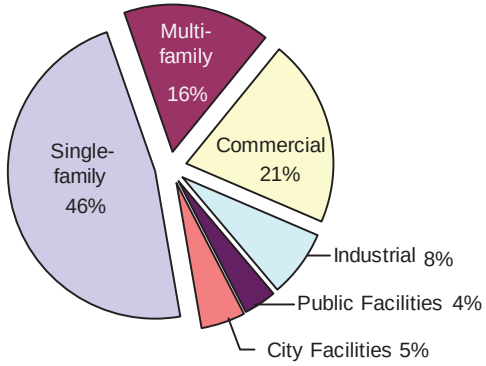


Fig. 28: 2010 water usage by customer class in acres feet/year and gallons/years *(Excerpted from the 2010 Urban Water Management Plan: Table data from Table 10 on page 41 and pie chart from page 43)*

Potable water usage and trees

What is NOT known about public trees

Although many parks and large landscape areas are separately metered for irrigation use, the *UWMP* does not indicate how much water is used for outdoor purposes at city and public facilities.

Furthermore, outdoor usage does not imply irrigation. For example, one analysis found that a significant amount of city facility usage was related to wetting down compostable materials.

Even further, irrigation is not necessarily for trees. Most irrigation systems exist for turf.

What is known about public trees

Very few irrigation systems exist for public trees. They receive supplemental water as follows:

Temporary supplies of water to public trees

Regardless of species, new plantings need supplemental water during the first three years. This is accomplished as follows:

1. For new trees in parks or at city facilities, temporary irrigation systems are set ups.
2. For some new street trees in residential neighborhoods, close-by residents agree to provide the water.
3. For other new street trees and trees located in places such as medians, City trucks deliver water. This amounts to approximately 486,000 gallons/year—0.013 % of the citywide usage of potable water documented for 2010.

Permanent supplies of water to public trees

4. Permanent systems are established for certain downtown tree wells that lack adequate soil space to store necessary water.
5. Public trees near turf irrigation systems at city/ public facilities may receive water from that system. The amount is not documented. Furthermore, most systems use a mix of potable and recycled water e.g.,
   - Golf course.....60% recycled
   - Greer Park.....60% recycled
   - Baylands Athletic.....60% recycled
   - Animal Services.....70% recycled

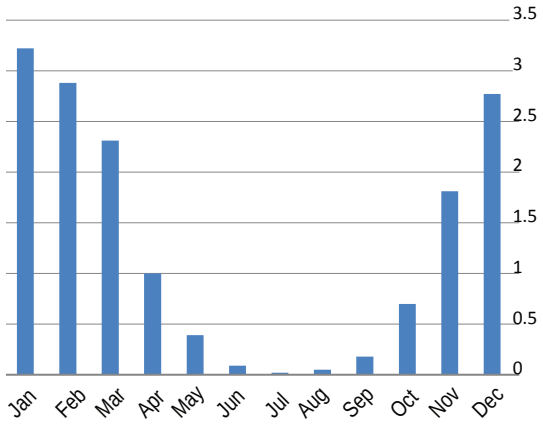
What is estimated about private trees

It is roughly estimated that outdoor water use accounts for 50% of residential use, though most is applied frequently and shallowly for turf and not much is accessible by trees.

Rain water

Palo Alto's Mediterranean climate of cool wet winters and warm dry summers is illustrated by the following chart. *(Fig 29).*

Fig. 29: Western Regional Climate Center
Precipitation Statistics for Palo Alto:
Average Total Precipitation (in.) for 1/1953 to 12/31/2005



What is known about public trees

US Climate Data indicates that the average annual rainfall for Palo Alto is 15.8" or 21,909 acre feet of water.

The Davey Resource Group street tree analysis indicates that trees intercept 42.6 million gallons annually or 131 acre feet of water. Therefore, street trees intercept approximately 0.6% of the annual rainfall.

Estimate of total water usage for entire urban forest

What is known

The Davey Resource Group street tree analysis indicates that street trees cover approximately 574 acres or 3.5% of the total land area and 36.8% of the street and sidewalk area. Therefore, that analysis and information about water usage applies to about 9.37% of Palo Alto's total land area.

What can be extrapolated

Since the street tree data provides information about water usage for 9.37% of Palo Alto's total land area, an estimate of the total water usage can be extrapolated by multiplying that amount by 10.67 (9.37 x 10.67 = 100%).

Bottom line:

1. Street trees receive 486,000 gallons /year of supplemental water via truck: 10.67 x 486,000 = 5,185,620 gallons or 0.14 % of citywide water usage documented for 2010.
2. Street trees intercept 131 acre feet/year of rain water: 10.67 x 131 acre feet/year = 1,397.8 acre feet/year or 6.4% of the average annual rainfall.

What is not known & CANNOT be extrapolated

1. The amount of water from the residents who water a young street tree near their home.
2. The amount of water from turf irrigation systems that reach trees.

Fig. 30:Table summarizes known and extrapolated data about water use by the entire urban forest.

	Water source	Water type i.e., potable or recycled	Usage known for Street trees		Extrapolation factor *(available street tree data represents 9.37% of total land area)*	Usage extrapolated for entire urban forest	
			Amount in gallons	Percentage of total usage (2010)		Amount in gallons	Percentage of total usage (2010)
Temporary	Temporary irrigation for new trees in parks and at CIP projects.	Both	Unknown				
Temporary	Water from residents to nearby new street trees	Unknown	Unknown				
Temporary	Water trucked to new street trees	Both	486,000	0.013%	10.67	5,185,620	0.14%
Ongoing	Irrigation for certain downtown tree wells that lack adequate space to store necessary water.	Both	Unknown				
Ongoing	Irrigation (primarily for turf) at city/public facilities.	Both	Unknown				
Ongoing	Rain water intercepted by street trees	Rain	42,600,000	0.600%	10.67	454,542,000	6.40%

Water conservation

Potable water supply

Palo Alto receives water from the City and County of San Francisco's Regional Water System, operated by the San Francisco Public Utilities Commission (SFPUC). This supply consists almost entirely of snow-melt from the Sierra Nevada mountains delivered through the Hetch Hetchy aqueducts. Precipitation levels can vary greatly within any given year. Climate conditions coupled with long-term limited supplies mean it is in our best interest to use water as efficiently as possible.

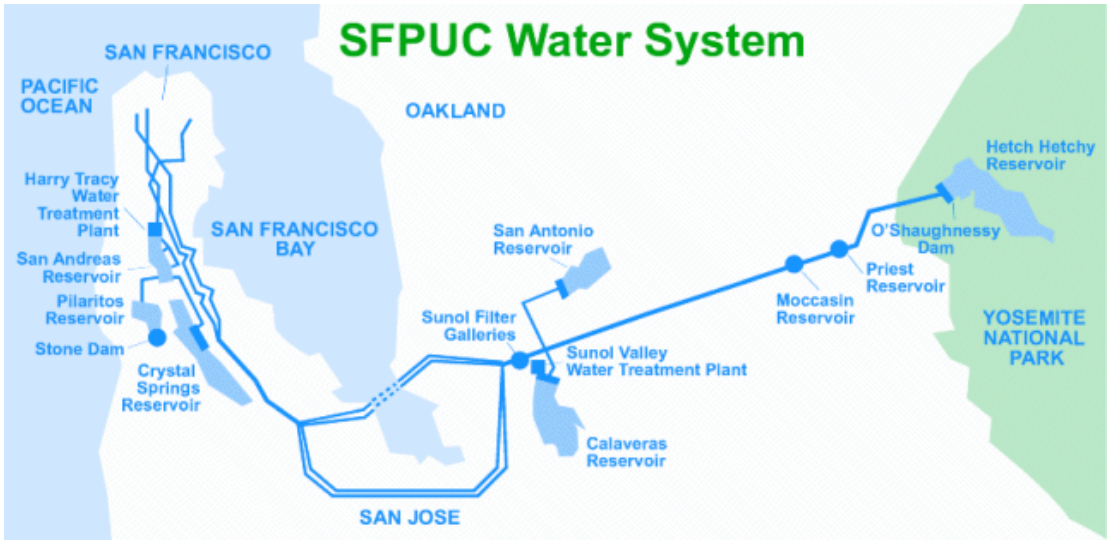


Fig. 31: Palo Alto's potable water comes from the Hetch Hetchy system through a wholesale contract with the City and County of San Francisco.

State Water Conservation Act

In 2009, California enacted the State Water Conservation Act (SBx7-7) which **mandates** a 20% reduction in the state wide use of water—by the year 2020. To comply, the City will establish a baseline for daily per capita water use and establish a target that is 80% of that usage.

Water conservation & trees

Waste avoidance strategies

Waste Not, Want Not: The Potential for Urban Water Conservation in California—by the Pacific Institute (2003) suggests that..."Existing technologies have enormous untapped potential for reducing waste and therefore use."

Waste avoidance strategies that focus on leaks and other inefficiencies do not impact the urban forest and the more that usage can be reduced through these waste avoidance measures, the less need there will be for more drastic measures.

To this end the *Municipal Code* includes prohibitions against defected irrigation equipment and incorporates Green Building Standards for water efficiency in new construction.

Additionally, the city's *Urban Water Management Plan (UWMP)* includes programs that offer significant incentives to improve leaky or inefficient equipment. *(Fig 32)*

More drastic measures

While the state advocates waste avoidance it mandates 20% reduction in use. And, though the use of water for trees is a small percentage of the per capita usage, there are existing trees that could be impacted by the implementation of drastic water-conservation measures e.g.:

- Public trees planted near turf irrigation were chosen with the assumption that they would receive supplemental potable water throughout their lives. They are dependent on that water.
- Any mature street tree that has been receiving supplemental water from a nearby irrigation system for its entire life has likely become dependent—regardless of species.
- Private trees near irrigation whether chosen to be or not, are now likely dependent.
- New 15-gallon street trees need water for the first three years..

Consideration for trees when implementing water-conservation strategies

Impact to existing trees—i.e., that may be accustomed to supplemental water—from-conservation strategies might be mitigated by allowing for both short and long term versions of those strategies.

Short-term strategies

Short-term strategies would not modify water supplies to these trees in a way that would traumatize them.

For example:

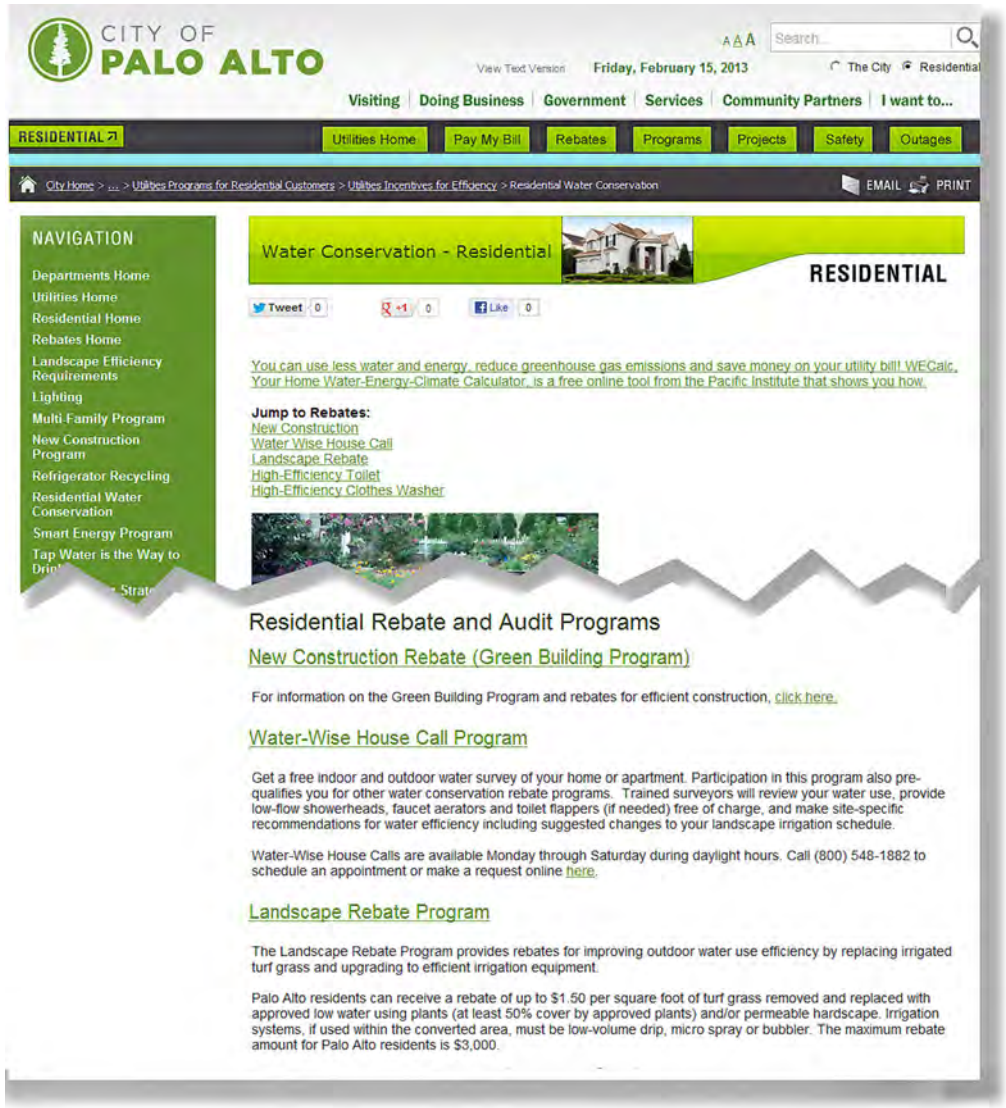
- City programs that encourage recycled water might consider a mix of recycled and fresh water for certain areas or trees—for the short term.
- Turf replacement programs might include the task of identifying any nearby trees that might be impacted by the removal of an existing turf irrigation system—and mitigate that impact by installing tree-specific irrigation.

This approach would contribute to accomplish the city's goal for coordinated citywide sustainability planning.

Long-term strategies

Over time, the number of existing trees—that may be accustomed to supplemental water—will diminish through implementation of the *Master Plan* policies *(as described on the following pages and as recommended in the Goals, Policies, and Programs)* and natural attrition. At that point, water-conservation strategies will not need to be so accommodating.

Fig. 32: Urban Forest Master Plan programs offer significant incentives and invite the community to partner with the City in an effort to reduce waste and thereby avoid water conservation measures that might be more detrimental to the urban forest. Details are available on the city's website.



An urban forest that is... climate adapted

The *Master Plan* advocates drought tolerant species. It also advocates adaptation of other species—which may not be drought tolerant but provide needed benefits—to Palo Alto's climate and growing conditions. Adaptation will be crucial to maintaining:

1. Diversity—which makes the urban forest less vulnerable to species-specific diseases.
2. A full spectrum of benefits such as those described in the "Benefits" chapter and/or submtted by survey participants.

Drought tolerant species

WUCOLS

The California Department of Water Resources maintains a list referred to as WUCOLS (Water Use Classification of Landscape Species). It rates the water needs of 1,9000 species as:

High: requires irrigation throughout summer.

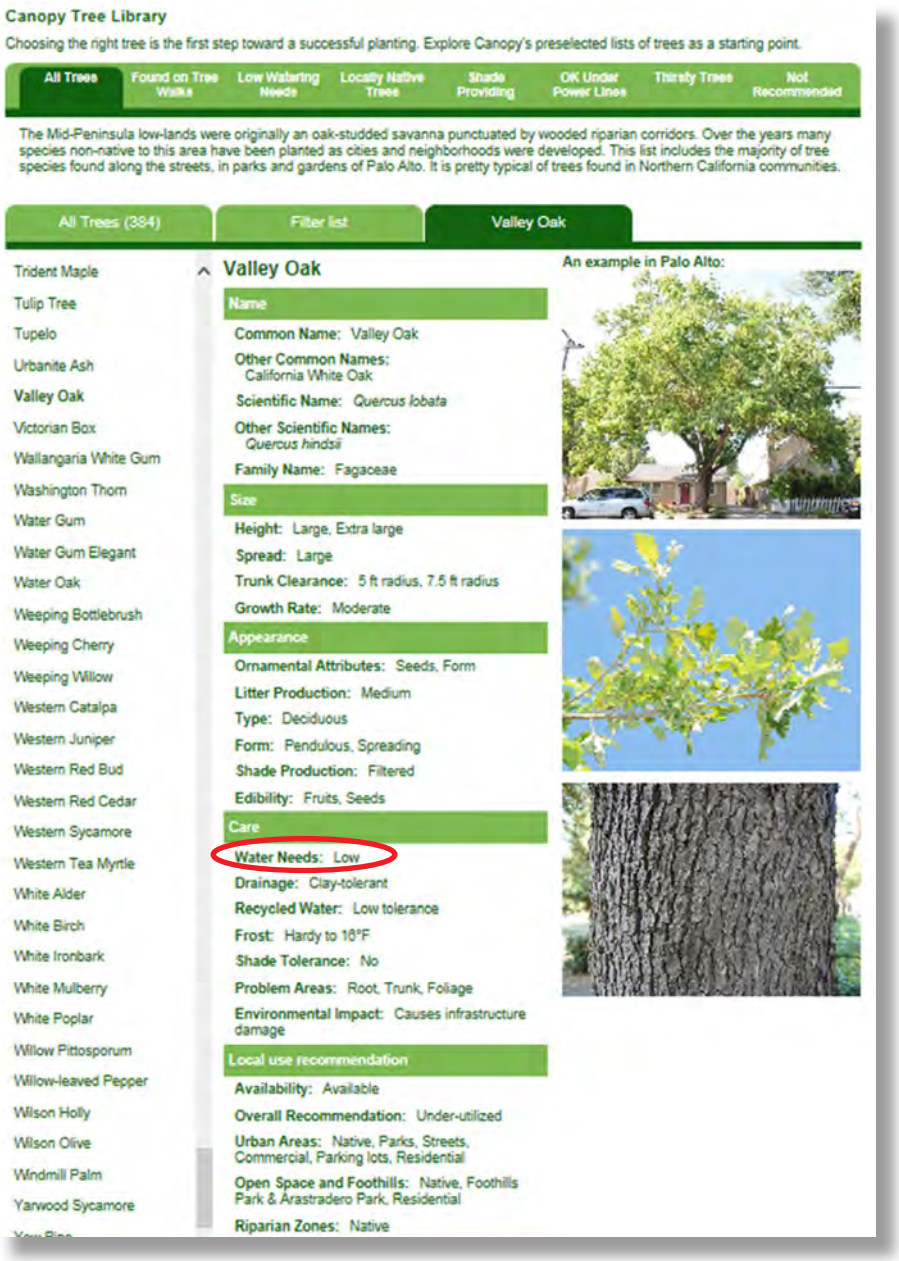
Moderate: able to tolerate periods without water but not several years of drought.

Low: requires irrigation until established; will then survive without supplemental water.

Modified WUCOLS

In 2009, a team of Canopy staff and board members, city-taff, and community members agreed to modifications to the WUCOLS ratings deemed appropriate for Palo Alto. Canopy incorporated the modified ratings into their online Tree Library.*(Fig 33)*

Fig. 33: Canopy's online "Tree Library": Although it is still a work in progress, this interactive database is already an easy-to-use resource for members of the community interested in helping the city transition to a less thirsty forest.



Drought tolerant public trees

The *Master Plan* applied the modified WUCOLS ratings to TreeKeeper data to develop the following information and tables:

1. The table in *Fig 34 (below)* shows that, by 2010, the city had begun planting fewer thirsty trees.
2. The table in *Fig 35 (below)* shows what percentage of the street and park tree population (as inventoried in 2010) falls into each of the three rating categories. This will serve as a baseline for future monitoring.
3. A table, "Thirst Ratings for public trees," *(in the Appendices)* lists:
   a. Modified WUCOLS ratings for 400 species
   b. Frequency of each species in street tree population as inventoried in 2010.

Drought tolerant private trees

There is not enough available data to assess.

Coaching a species to adapt to Palo Alto conditions

To maintain diversity as well as environmental and social benefits, it will be important to encourage adaptability in species with desirable attributes.

Strategies for coaching adaptability include:

- Planting very young/small trees or even seeds.
- Planting methods such as bare rooting that encourage rapid development of a fully capable root system.
- Providing adequate non-compacted soil.
- Providing mulch to help soil retain water.
- Avoiding competition from other plants.
- Avoiding opportunities for dependency on supplemental water.

Fig. 34: By 2010, the city had begun to plant fewer thirsty trees and more moderate trees.

Compares thirst ratings of street & park trees planted prior to 2000...
...and those planted between 2000 and 2010

Rating	High	Moderate	Low
% of total planted > 10 years ago	36%	41%	23%
% of total planted within past 10 years	30%	50%	20%
% change (approximate)	17% fewer	22% more	13% fewer

Fig. 35: 2010 baseline for monitoring progress towards less thirsty forest.

Modified WUCOLs thirst ratings
for all street/park trees as of spring 2010

Rating	High	Moderate	Low
% of total	35%	42%	23%

Alternative waters for landscape irrigation

Alternatives to potable water for landscaping irrigation are rapidly evolving in terms of legislation, technology, and knowledge of the results.

Rainwater

As of late 2009, California had no regulations pertaining to rainwater collection. But, in 2012, the state adopted the Rainwater Capture Act which recognized its usefulness and clarified its legality.

By then, the City of Palo Alto already had incentive programs in place in the form of rebates for measures to reduce runoff to the storm drain system. Example measures include capturing rainwater in rain barrels or cisterns for use on landscaping and gardens.

Palo Alto continues to offer incentives for qualifying systems. Permit requirements depend on the complexity of the system and what it involves.

Greywater

Generally, greywater is wastewater from wash hand basins, showers, baths, and in some cases, washing machines, that has been captured and filtered for reuse. Note that wastewater from dishwashers and kitchen sinks is generally excluded due to the high nutrient levels.

In California, greywater systems:

1. Must adhere to Chapter 16A of the California Plumbing Code: "Nonpotable Water Reuse Systems."

2. May require a permit e.g., laundry-to-landscape systems no longer require a permit.
3. Must be contained within their own property.
4. May be eligible for rebates e.g., laundry-to-landscape systems are eligible for rebates from the Santa Clara Valley Water District.

Greywater systems are most popular in single-family residences where regulation criteria can be more easily met; however, the water-conservation potential would naturally be greater for an industrially-sized system.

Greywater systems for landscape irrigation vary widely e.g., some rely on gravity—while others employ pumps. Evapotranspiration systems typically involve a septic tank for pre-treatment and perforated pipes for distribution into a shallow sand bed below the target plant roots. Note that the sand bed must be lined with either plastic or very impermeable soil to prevent the greywater from seeping into the ground. Shallow trench greywater which is piped from the house into shallow trenches that are properly spaced and close to the surface.

Currently, Palo Alto has no incentive programs for greywater. However, permits for proper installations of greywater systems may be obtained.

Recycled water

In California, legislation increasingly encourages and, in some cases, requires the expansion of the use of recycled water.

In Palo Alto, recycled water comes from the Regional Water Quality Control Plant. It is currently used for landscape irrigation at several sites; however, concerns—raised by experts—about the salinity levels and its potentially detrimental affect on the urban forest have triggered a full Environmental Impact Report—still underway.

Resolution 9035: Salinity Reduction

In January of 2010, the City Council responded to the above mentioned concerns by adopting the Salinity Reduction Policy for Recycled Water *(Resolution 9035—Fig 36).*

The accompanying staff report (CMR: 111:10) states, "The issue of salinity of recycled water was raised by Canopy and the Stanford Real Estate office when they reviewed the recycled water project's draft environmental document..."

The policy itself states that the purpose is to, "... ensure that the City is taking all practical steps to reduce salinity in recycled water."

The policy language refers to the salinity level in terms of Total Dissolved Solids (TDS)—a common measure of salinity in a water system

Highlights of the policy are:

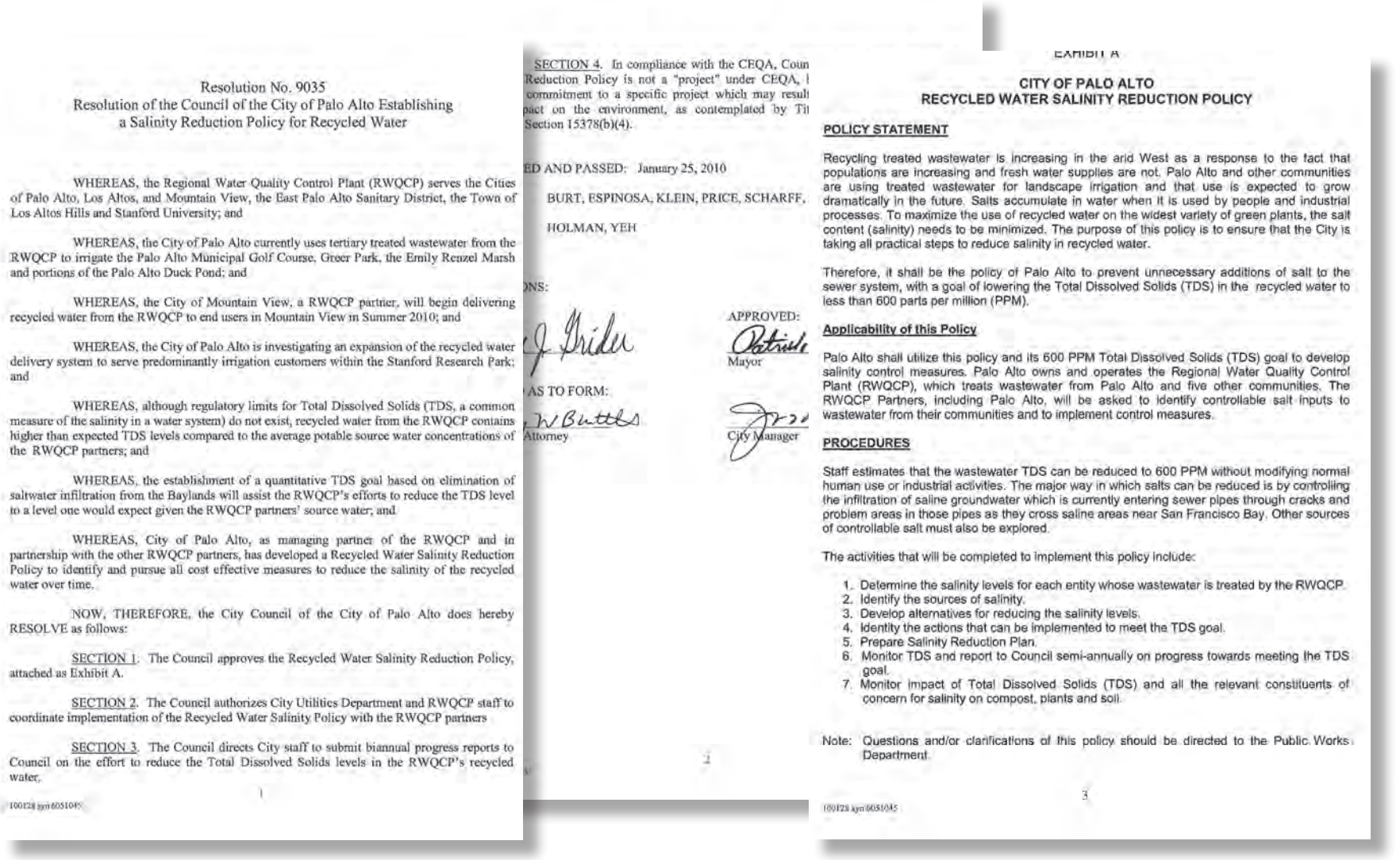
- It shall be the policy...to prevent unnecessary additions of salt ...with a goal of lowering the TDS...to less than 600 parts per million.
- The major way in which salts can be reduced is by controlling the infiltration of saline groundwater which is currently entering sewer pipes through cracks and problem areas in those pipes as they cross saline areas near San Francisco Bay. Other sources of controllable salt must also be explored.
- RWQCP Partners, including Palo Alto, will be asked to identify controllable salt inputs to wastewater from their communities and to implement control measures.
- Implementation shall include:
  1. Determine the salinity levels for each entity whose wastewater is treated by the RWQCP.
  2. Identify the sources of salinity.
  3. Develop alternatives for reducing the salinity.
  4. Identity the actions that can be implemented to meet the TDS goal.
  5. Prepare Salinity Reduction Plan.
  6. Monitor TDS and report to Council biannually on progress...
  7. Monitor impact of TDS and all the relevant constituents of concern for salinity on compost, plants, and soil.

Mixtures of recycled & fresh water

Mixtures of recycled and freshwater are a fourth possible alternative to using potable water for landscape irrigation. For example, in 2013, the Australian Water Recycling Centre of Excellence began a trial at a vineyard—using recycled water diluted with freshwater to reduce the salinity.

Potential sources for the freshwater component of a mixture might even be greywater and/or captured rainwater.

Fig. 36: Resolution 9035: Salinity Reduction Policy for Recycled Water—adopted in January of 2010.



Resolution No. 9035
Resolution of the Council of the City of Palo Alto Establishing
a Salinity Reduction Policy for Recycled Water

WHEREAS, the Regional Water Quality Control Plant (RWQCP) serves the Cities of Palo Alto, Los Altos, and Mountain View, the East Palo Alto Sanitary District, the Town of Los Altos Hills and Stanford University; and

WHEREAS, the City of Palo Alto currently uses tertiary treated wastewater from the RWQCP to irrigate the Palo Alto Municipal Golf Course, Greer Park, the Emily Renzel Marsh and portions of the Palo Alto Duck Pond; and

WHEREAS, the City of Mountain View, a RWQCP partner, will begin delivering recycled water from the RWQCP to end users in Mountain View in Summer 2010; and

WHEREAS, the City of Palo Alto is investigating an expansion of the recycled water delivery system to serve predominantly irrigation customers within the Stanford Research Park; and

WHEREAS, although regulatory limits for Total Dissolved Solids (TDS, a common measure of the salinity in a water system) do not exist, recycled water from the RWQCP contains higher than expected TDS levels compared to the average potable source water concentrations of the RWQCP partners; and

WHEREAS, the establishment of a quantitative TDS goal based on elimination of saltwater infiltration from the Baylands will assist the RWQCP's efforts to reduce the TDS level to a level one would expect given the RWQCP partners' source water; and

WHEREAS, City of Palo Alto, as managing partner of the RWQCP and in partnership with the other RWQCP partners, has developed a Recycled Water Salinity Reduction Policy to identify and pursue all cost effective measures to reduce the salinity of the recycled water over time.

NOW, THEREFORE, the City Council of the City of Palo Alto does hereby RESOLVE as follows:

SECTION 1. The Council approves the Recycled Water Salinity Reduction Policy, attached as Exhibit A.

SECTION 2. The Council authorizes City Utilities Department and RWQCP staff to coordinate implementation of the Recycled Water Salinity Policy with the RWQCP partners

SECTION 3. The Council directs City staff to submit biannual progress reports to Council on the effort to reduce the Total Dissolved Solids levels in the RWQCP's recycled water.

1

100128 sym 6051045

SECTION 4. In compliance with the CEQA, Coun
Reduction Policy is not a "project" under CEQA,
commitment to a specific project which may result
pact on the environment, as contemplated by Ti
Section 15378(b)(4).

ED AND PASSED: January 25, 2010

BURT, ESPINOSA, KLEIN, PRICE, SCHARFF,

HOLMAN, YEH

ONS:

APPROVED:

Mayor

AS TO FORM:

Attorney

City Manager

2

EXHIBIT A

CITY OF PALO ALTO
RECYCLED WATER SALINITY REDUCTION POLICY

POLICY STATEMENT

Recycling treated wastewater is increasing in the arid West as a response to the fact that populations are increasing and fresh water supplies are not. Palo Alto and other communities are using treated wastewater for landscape irrigation and that use is expected to grow dramatically in the future. Salts accumulate in water when it is used by people and industrial processes. To maximize the use of recycled water on the widest variety of green plants, the salt content (salinity) needs to be minimized. The purpose of this policy is to ensure that the City is taking all practical steps to reduce salinity in recycled water.

Therefore, it shall be the policy of Palo Alto to prevent unnecessary additions of salt to the sewer system, with a goal of lowering the Total Dissolved Solids (TDS) in the recycled water to less than 600 parts per million (PPM).

Applicability of this Policy

Palo Alto shall utilize this policy and its 600 PPM Total Dissolved Solids (TDS) goal to develop salinity control measures. Palo Alto owns and operates the Regional Water Quality Control Plant (RWQCP), which treats wastewater from Palo Alto and five other communities. The RWQCP Partners, including Palo Alto, will be asked to identify controllable salt inputs to wastewater from their communities and to implement control measures.

PROCEDURES

Staff estimates that the wastewater TDS can be reduced to 600 PPM without modifying normal human use or industrial activities. The major way in which salts can be reduced is by controlling the infiltration of saline groundwater which is currently entering sewer pipes through cracks and problem areas in those pipes as they cross saline areas near San Francisco Bay. Other sources of controllable salt must also be explored.

The activities that will be completed to implement this policy include:

1. Determine the salinity levels for each entity whose wastewater is treated by the RWQCP.
2. Identify the sources of salinity.
3. Develop alternatives for reducing the salinity levels.
4. Identify the actions that can be implemented to meet the TDS goal.
5. Prepare Salinity Reduction Plan.
6. Monitor TDS and report to Council semi-annually on progress towards meeting the TDS goal.
7. Monitor impact of Total Dissolved Solids (TDS) and all the relevant constituents of concern for salinity on compost, plants and soil.

Note: Questions and/or clarifications of this policy should be directed to the Public Works Department.

3

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Development

Urban Planning

The urban forest provides many functions that enhance development locally such as gateways, focal points, sense of place, screening incompatible land uses, transportation calming and separation of users (pedestrian, bicycle, vehicle), noise control, access control, parking enhancements, and connectedness or transitions between parcels or areas. In architectural terms the urban forest provides the natural doorways, walls, windows, roof, skylights, and porches of the community.

Comprehensive Plan

These concepts are supported throughout Palo Alto's *Comprehensive Plan*. Additionally, the *Comprehensive Plan* refers to the *Urban Forest Master Plan* for policy regarding the urban forest.

American Planning Association

The American Planning Association Policy Guide (2000) supports planning policies, programs, and state and federal legislation that support incentives and other economic tools to improve the sustainability of our natural environment, enhance natural resources, and improve community subdivision and building design standards.

American Society of Landscape Architects

The American Society of Landscape Architects program for "Sustainable Landscapes" provides guidelines to promote the use of urban forests to improve development and provide benefits such as cleaner and cooler air, human health, energy efficiency, water quality and quantity management, and others.

Individual projects

However as much as people may subscribe to these concepts, the landscaping of individual development projects is often defined by the challenge of balancing parameters such as:

1. Economic considerations such as the operating budget for the project and its potential value upon completion.
2. The desire to achieve maximum development potential *(perhaps to support premium land prices.)*
3. Government regulations.

The following pages discuss these parameters relative to trees.

Economics: property values

This excerpt from Kathleen Wolf's, "City Trees and Property Values" *(International Society of Aboriculture, 2007),* augments the messages of the "Value" and "Community Surveys" chapters.

Hedonic Pricing Method

...Hedonic pricing is a revealed willingness-to-pay technique. [In this case] the proportion of property prices that are derived from the non-use value of trees and other natural elements...

Hedonic pricing studies have been done since the 1960s. Most use least squares regression analysis as the primary statistical tool. Property prices or assessments are regressed against sets of control variables: environmental attributes of the house or property, other neighborhood variables (such as the quality of local schools), and structural characteristics of the house (such as number of bedrooms). One can then estimate how a change in a natural feature, such as yard trees or proximity to a nearby park, is related to a change in property value, holding other characteristics of the property constant. The advantage of this method over others is its use of actual market transactions versus hypothetical questionnaires or indirect assessments.

Urban areas are ideal for application of hedonic pricing because there is usually a wealth of data available on house and property sales. Geographic databases enable analysis of value increments based on proximity to natural features such as parks. Hedonic values can be capitalized by local governments as increased property tax assessments or as excise taxes paid on property sales. The calculated value across all properties influenced by a natural feature can be aggregated, and the case may be made that the sum is adequate to pay for annual debt and maintenance of the feature, such as street trees or greenspace.

Review of Valuations

...The remainder of this section emphasizes studies using statistical analysis of market sales or appraisals.

Yard and Street Trees

...Although there have been a few exceptions, homes with trees are generally preferred to comparable homes without trees, with the trend across studies being a price increase of about seven percent. Here are results from a selection of studies:

Increase	Condition
2%	mature yard trees (greater than 9-inch dbh)
3-5%	trees in front yard landscaping
6-9%	good tree cover in a neighborhood
10-15%	mature trees in high-income neighborhoods

Price effect is variable and depends on how tree presence is defined. In addition, the socioeconomic condition of a residential area makes a difference. For instance, greater increments of value are seen for tree planting and landscape improvements in lower-quality neighborhoods.

Tree Retention in Development

Market price studies of treed versus untreed lots show this range:

Increase	Condition
18%	lots with substantial mature tree cover
22%	tree-covered undeveloped acreage
19-35%	lots bordering suburban wooded preserves
37%	open land that is two-thirds wooded

Generally, trees and forest cover in development growth areas add value to parcels. One study found that development costs were 5.5 percent greater for lots where trees were conserved. Given increased lot and home valuations, builders have reported that they were able to recover the extra costs of preserving trees in a higher sales price for a house and that homes on wooded lots sell sooner than homes on unwooded lots.

Additional economic analyses yield the following:

"Nationally, business districts with street trees were found to generate 9 to 12 percent more consumer spending than districts without trees."

—Wolf, K.L. 2005. "Business District Streetscapes, Trees and Consumer Response." Journal of Forestry 103, 8:396-400.

Photo by Megha Makam

Fig 37: World Music Day (2011): Crowds linger to shop and dine on pleasant tree-lined streets in the downtown.

"New tree plantings are associated with a 9 percent increase in property values."

—Wachter & Gillen, Public Investment Strategies: How They Matter for Neighborhoods in Philadelphia," The Wharton School, University of Pennsylvania (April 2006).

Photo from zillow.com posting of 2011

Fig 38: Residences on tree lined streets are in high demand.

"Good aesthetic value was also shown to increase average commercial office rental rates by 7 percent."

—Laverne, R.J., & K. Winson-Geideman. 2003. "The Influence of Trees and Landscaping on Rental Rates at Office Buildings. "Journal of Arboriculture 29, 5:281-290. Clevelan

Photo from autoblog.com posting of 2009

Fig 39: The beautifully forested Stanford Research Park attracts significant tenants.

Development: impacts to & protection

Photo by staff

Fig 40: This century-old valley oak framed this Lowell Avenue house beautifully until it fell in 2004. Extensive analysis traced the cause back to trenching—done for a gas line in the 1990s. The roots on one side of the tree had been severed.

This tragedy neither was, nor is, unique. In fact, by the time this tree fell, the City had already adopted the Tree Protection ordinance (in 1996), published the Tree Technical Manual, hired a Planning Arborist, and begun rigorous review of site plans..

However, in spite of these precautions, trenching and tunneling continue to pose potential impact that may not be realized for more than a decade. The *Master Plan* recommends that site plans limit trenching to an identified utility corridor—coincident with the driveway—to preserve undisturbed area for existing and future trees.

It is worth noting that, currently, some permits involving trenching—such as installations of back-flow preventers—require only a plumbing permit and are not reviewed for tree impacts. The installation of back-flow preventers often involves digging close to the street trees.

Impacts

There is little vacant land in Palo Alto and most re-development will be more dense than what it replaces. This can lead to crowding components on a site:

- Street-trees or planting sites can be diminished if utilities or driveways are installed too close.
- Private trees or planting sites can be diminished by basements, foundations, and hard scape that leave little space for landscaping.
- Trees and future trees may be forfeited to avoid:
  - Root damage.
  - Shading of solar panels.
  - Obscuring commercial signage.

Additionally:

- Trees can be damaged by construction-related activity e.g.,
  - Trenching and excavation can damage roots.
  - Storing equipment against a trunk or within the drip line can damage trunk or roots.
- Soil can become compacted—or compromised by toxins.

Protection

City protection procedures can be effective; but they require commitment from both the City and the Community. For example, although trees add value to a property, Kathleen Wolf advises that,

> "One study found that development costs were 5.5 % greater for lots where trees were conserved."

As a result, project participants whose benefit is tied only to the efficiency of the process—who will not benefit from added value to the site and community—may perceive tree protection as a burden.

Government: representation & influence

Representation & influence

The City strives to represent the environment and the community with regulations for development.

The City influences development through project review, mitigation, inspection, enforcement, and outreach.

Project review, entitlements, & permits

Non-discretionary and discretionary review

Ministerial applications are not subject to discretionary review. In these cases projects are reviewed only for potential impacts to regulated trees *(see chart center of page).*

Regulated Trees

Title 8 of the Palo Alto Municipal Code provides regulation for specific trees to protect them from removal or disfigurement.

- Publicly-owned trees such as street trees or trees on public land.
- All coast live oak and valley oak trees ≥ 11.5" in diameter.
- Coast redwood trees ≥ 18" in diameter.
- Heritage Trees (designated by City Council).
- All trees that have been designated by the City to be saved and protected through a discretionary review process such as a variance, home improvement exception, architectural review, site and design, subdivision, etc.

Significant projects are subject to discretionary review which is not limited to regulated trees. This provides an opportunity to designate any tree for retention and/or protection.

Where potential impact is identified—either through , those trees must be protected. *(Fig 33)*

Note: When the tree protection ordinance was adopted, protection had to be installed and inspected prior to the issuance of any permit. Recent changes—intended to expedite the permitting process—allow permits to be issued first. This change has resulted in increased instances of noncompliance.

Fig 41: Examples of required tree protection: Proven best practices of retaining a tree's value and survivability during remodeling or development activity requires an expert's help, typically provided as a tree protection report for staff review. These best management practices, integrated with other City sustainability policies from water quality, public works engineering and planning department conditions of adopted approval become part of the building permit construction documents. Advances such as this have bridged a gap that traditionally has plagued cities for years, and allows for more order, construction and compliance monitoring for truly successful outcomes.

Note: Some permit applications are not reviewed. Back-flow preventers require only a plumbing permit—even though installation involves excavation near street trees.

The following paragraphs discuss criteria and regulations applicable to all projects that are reviewed—discretionary or non-discretionary.

Zoning setback requirements

Most applications must meet front, rear, and side setbacks that provide room for landscaping features such as tree roots. *However, setback requirements do not preclude trenching or even constructs such as light wells which can impact trees on the project parcel as well as the adjacent parcel.*

Solar panel permits & the California Solar Shade Act

Solar power is important to the City's renewable energy program and incentives are available for properly sited solar panels. However, shade trees are also important. The City's review of solar panel installations that involve tree conflicts is based on the California Solar Shade Act:

Provision

- Section 25982 prohibits a newly planted tree to cast a shadow over more than 10% of a solar panel on a neighboring property at any time between 10 a.m. and 2 p.m.

Exemptions:

- Section 25984(a) exempts trees that were planted prior to installation of a solar panel.
- Section 25984(c) exempts trees that replace exempt trees that die or are removed for the protection of public health, safety, or the environment.

Photo by and courtesy of Dave Edwards Photography

Fig 42 a & b: For conflicts between the optimal performance of a solar panel and nearby trees, City policy is based on the Solar Shade Act. For non regulated trees, such as the privately owned trees shown above, the City gives precedence to whichever came first. For regulated trees, such as the street trees shown below *(also see "Regulated Trees" in the "Development" Chapter),* the City does not consent to removing or pruning to optimize solar panel performance.

Photo courtesy of Canopy.

- Section 25984(d) exempts regulated trees such as protected species, designated trees, and heritage trees.
- Section 25985(a) empowers cities to exempt—via an ordinance—trees that are planted and maintained by the city.

Therefore:

- For non regulated trees, the City gives precedence to whichever came first.
- For regulated trees, the City does not consent to removing or pruning to optimize solar panel performance.

Note: See "Evolving Technology" (this chapter) for discussion of solar studies.

Shade requirements for parking lots

Currently the zoning ordinance 18.54.040 requires that 50% of a parking lot's surface be shaded and, traditionally, this shading has been provided exclusively by trees. However, increasingly, developers are expressing an interest in substituting solar panels for trees—to meet the shade requirement.

City policy regarding such substitutions will be significant because trees, larger trees in particular, produce benefits which cannot be equaled or fully replaced by solar panels.

Fig 43a:

Giant oak trees make the Town & Country Village parking lot a pleasant place for summer concerts. Shown is 2013 concert arranged by Celebrity Concerts.

Fig 43b:

This West Valley College parking lot provides a local example of a partial conversion from shade trees to solar panels.

Designated trees

Discretionary review may result in designating a non-regulated tree for retention. Although the Arbor Real project was a much denser use of the site (than Ricky's Hyatt Hotel), early review enabled the design to accommodate:

- Designation of mature oak trees for retention.
- Appropriate placement of driveways and hardscape.
- Appropriate placement of underground utilities

The result was that many mature oak trees were preserved. *(Fig 44)*

Note: Even though several oaks were preserved, the Arbor Real development did result in a net canopy loss and currently, there are no policies regarding canopy loss or gain—per project.

Mitigation

Replacement of removed trees

Even if discretionary design review does require keeping a tree—it might require mitigation for its removal—e.g., transplanting or replacing it.

Key issues for transplanting trees are: clearance at the receiving site, lengthy recovery from shock and root loss of 75-90%, new irrigation. Property owners must provide a two-year status report on the transplanted tree's health to the city arborist. *(Fig 45)*

Inspection & enforcement

Changes to approved plans are not permitted.—unless they are reviewed again and approved again.

Note: Hard scape NOT installed per approved plans can trigger a series of changes e.g., location of utilities which can impact an existing tree or planned tree. And site inspections may not discover this in time to prevent issues.

Photo by staff

Fig 44: The increase in density resulted in a net loss of canopy; however, early review resulted in saving many mature oak trees such as the ones shown below.

Photo by staff

Fig.45: This oak tree was moved from a residential development site to Heritage Park and several oaks were transplanted as part of the new Stanford Medical Center project.

Outreach

As well as supporting Canopy financially, the city collaborates with Canopy on outreach programs.

Education

Each year Canopy conducts at least 3 workshops—a planting leader training in the fall, a young tree pruning workshop in the spring, and a tree talk on various subjects each summer.

In 2001, the City and Canopy conducted the "PALO ALTO TREE TECHNICAL MANUAL: A WORKSHOP FOR THE GENERAL PUBLIC" to introduce newly adopted requirements and recommended practices for homeowners and developers. The workshop provided an overview of city regulations, explained the city's Tree Management Program, discussed what permits are required for different types of work, and provided valuable information on how to care for protected trees.

Recognition and positive reinforcement

Each year, at the Mayor's Tree Planting and Canopy Awards, Canopy acknowledges projects that have made a significant contribution to the health of Palo Alto's urban forest. *(Figs 46 & 47)*

Photography Copyright: Dean J Birinyi Photography

Photos courtesy of Canopy

Fig 46: Left: In 2013, Canopy presented the Arnold Sofrenko Award to King Asset Management, DES Architects + Engineers, Urban Tree Management, Inc. the Wentz Group as well as others involved with the successful preservation of this mature oak tree as part of the 265 Lytton Avenue redevelopment.

Fig 47: Above: In 2014, Canopy presented the Arnold Sofrenko Award to Hewlett Packard, Gensler and Associates, Barrie D. Coate and Associates, as well as others involved with the successful preservation of a historic oak tree at the entrance of Hewlett Packard World Headquarters and Executive Briefing Center. The tree is now the centerpiece of the redesigned building. Above left is the tree in 1979; above right is the tree in 2014.

Opportunities

Evolving influences

Construction standards and criteria are evolving under the influence of sustainability goals. However, so far, they have not been tree centric and have a complicated effect on the urban forest--adding to the need and opportunity for a coordinated *Sustainability Plan*.

Green Building Standards

In 2000, the Green Building Council released the Leadership in Energy and Environmental Design (LEED) rating system for new construction. In 2004, the Green Building Initiative (created to assist the National Association of Homebuilders in promoting Green Building Guidelines for Residential Structures) introduced the Green Globes® environmental assessment and rating tool to the US. These programs inspired others and, today, there are likely over 100 such rating programs in the marketplace.

Sustainable Sites Initiative

The Sustainable Sites Initiative is an effort by the American Society of Landscape Architects, the Lady Bird Johnson Wildflower Center, and the U. S. Botanic Garden—to extend green building concepts outside—to create more sustainable landscapes. This group is in the process of publishing voluntary national guidelines and performance benchmarks for sustainable land design, construction and maintenance practices.

Inhouse water and energy efficiency programs

- Some programs (required or encouraged by the city) add to the competition for space—underground e.g.,
  - Separate water systems for recycled water.
  - Electric charging stations.
- Installation of solar panels has the potential to make existing and future trees less desirable because of shade.

Fig 48: Sustainable Sites Initiative website

Evolving city policy

A major goal of this Master Plan is to promote a complementary relationship between development and the urban forest. See subsections of "Moving towards the Vision" e.g.,

- "Message from the Urban Forester."
- "Considerations for the goals, policies, and programs."
- "Goals, Policies and Programs."

A recent and promising example of evolving city policy is the Municipal Golf Course Renovation. It challenged the city to broaden its definition of urban forestry to include a diversity of ecosystems from the bay wetlands where trees are rare sentinels in the landscape, to the foothills oak woodlands and grasslands.

A similar expansion of how regulations and mitigation are interpreted—and applied—will enable insightful decision making, create healthy, productive, and thriving urban ecosystems, and ultimately, yield the maximum long term benefits in the most efficient manner. Ecosystem services will be the natural currency of the future.

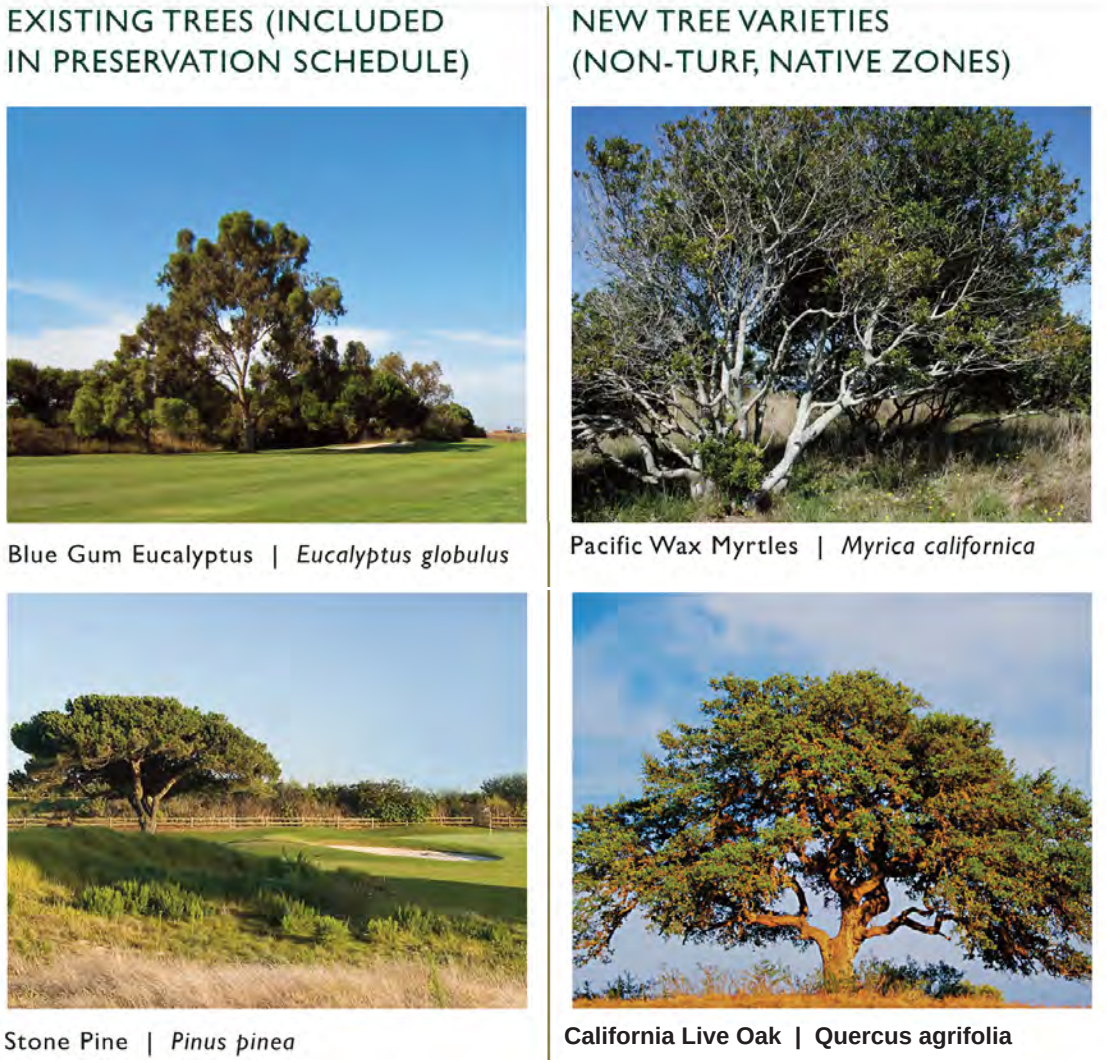


Fig 49: The new Golf Course design reflects insightful decision-making that will result in a productive and thriving urban ecosystems. Fifty-four acres of thirsty turf will be replaced by native grasses and shrubs. Trees will include existing Blue Gum Eucalyptus and Stone Pine trees as well as new, native, Pacific Wax Myrtle and California Live Oak trees.

Note: This image is excerpted from the (slide show) presentation by Forrest Richardson & Associates, Golf Course Architects to the City of Palo Alto Planning and Transportation Commission on February 13, 2013.

Soil volume solutions

Crowded sites often don't provide acceptable growing conditions. When there is not enough soil volume or when the soil becomes compacted under hardscape, existing trees die and new trees cannot become established.

Engineered soil

Engineered soil mix is designed to be compacted enough to support pavement yet permit root growth and can be a valid option for some hardscape challenges. Key issues are its limitations. Structural rock provides a good foundation, but only a small amount of viable soil per volume (5-15%); so, the benefit may not be sufficient for all challenges. *(Fig 50)*

Structural grids

Structural grids of interlocking frames filled with non-compacted healthy soil can be employed to provide an adequate volume of quality soil to grow trees to the desired mature size. Suspended pavement using structural concrete over a foundation of piers and/or bridging may also be employed to provide a similar function.

Using Silva Cell™ technology to accommodate root growth under the asphalt was an important design component of the new Mitchell Park Library. *(Fig 51)*

Fig 50: Palo Alto was the first western city to ust the Cornell University patented method planting mix (390 Lytton—not shown) and in the above photo, structural soil 24" deep provided room for the roots of this Chinese pistache—below the parking lot surface—at another downtown location.

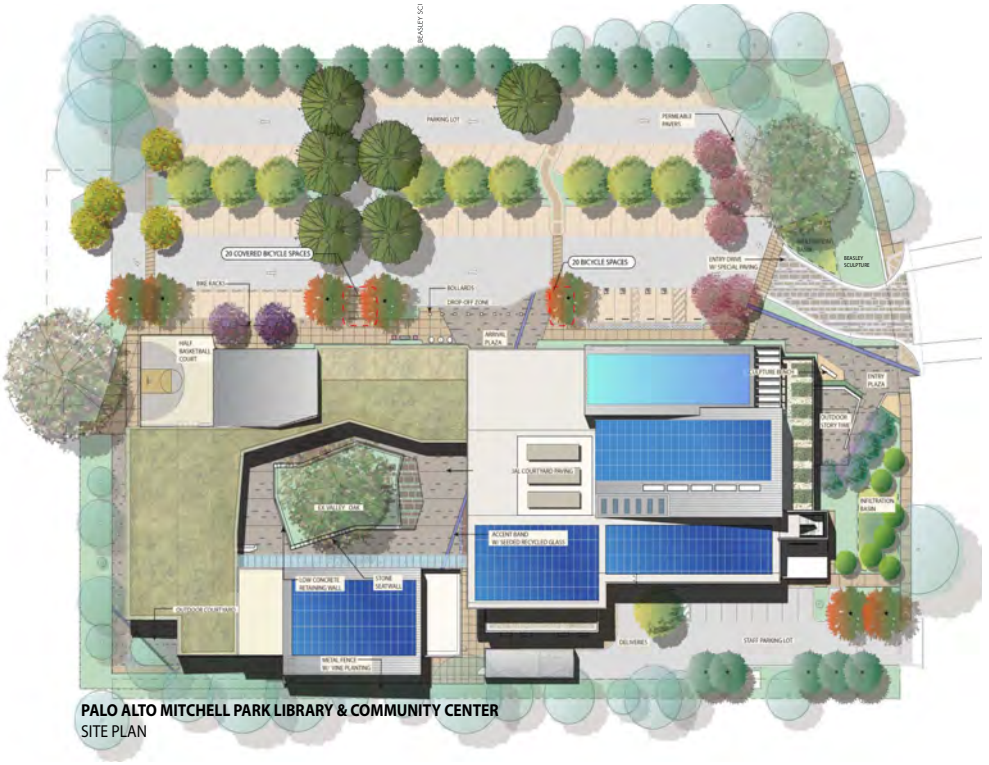
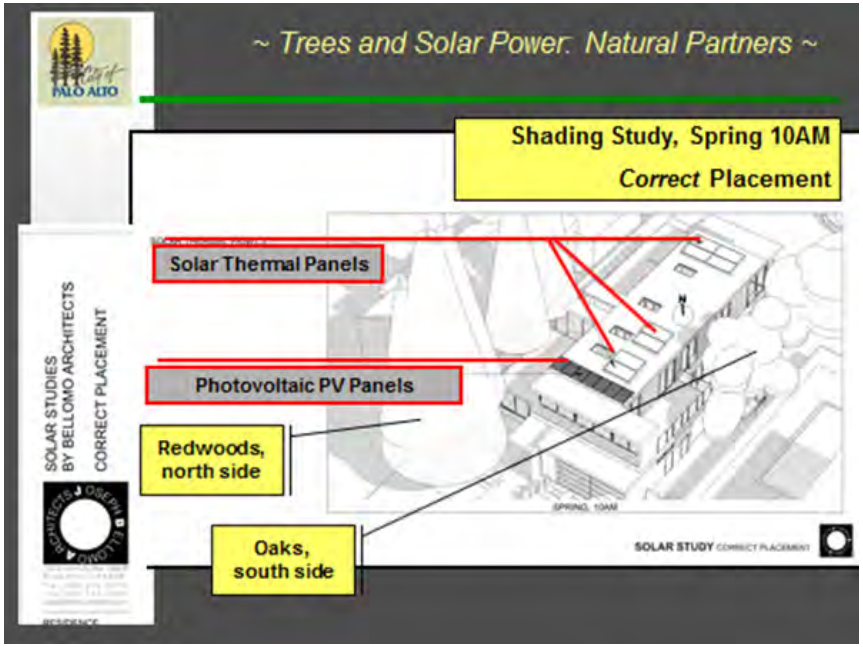


Fig 51: (below) Beneath the new library parking lot structural grids work in concert with the bioswales to enable both maximum surface and maximum shade. Using Silva Cell™ technology to accommodate root growth under the asphalt was an important design component.

Solar studies for site planning

Although existing trees and (in most cases) their replacements may be exempt form the Solar Shade Act restrictions, future plantings may need to consider existing solar panels.

In most cases, including a solar study that indicates plot, plan, & trees as part of the development application package will help ensure that new solar installations will function efficiently and that future conflict evaluations can be resolved.



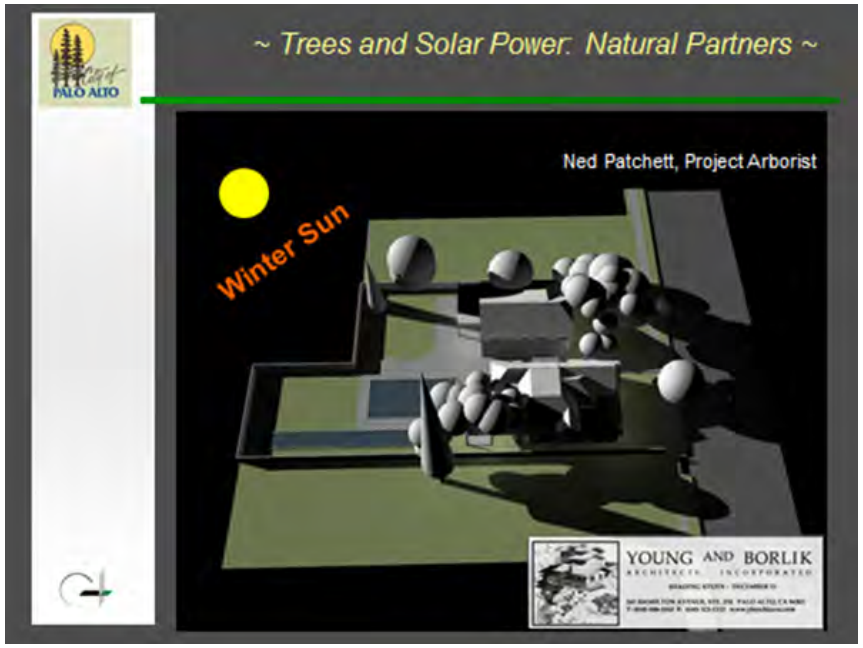


Fig 52: Several solar study applications like the ones shown above already exist. In order to identify the most efficient way to aid in site planning decisions related to trees and solar panels, the city is exploring not only available tools but also evaluating the potential capabilities of the city's GIS in combination with lidar technology—to enable a much more detailed and reliable estimation of the ecosystem services of private trees (or any subset of data points that can be delineated).

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Line Clearing

Trees and power lines

The City's Urban Forestry website acknowledges the conflict between trees and power lines—stating that,

> "Often, power line clearing can result in a less than desirable tree form."

Power line clearing is performed for the following reasons:

To comply with state law

The California Public Utilities Commission (CPUC) requires all electrical-service providers to ensure that higher voltage electric conductors ("wires", "lines") are kept clear of vegetation at all times and that specified distances are kept between conductors and vegetation when line clearing work is done. Failure to comply can result in citations and fines.

To help ensure continued service

While it may appear that excessive distances are kept clear, most electrical outages occur during storms when high winds blow limbs or tree tops into the conductors. Rain-heavy limbs can droop into the power lines and also cause outages.

To help ensure safety

If a tree limb causes a conductor to break and fall to the ground it may pose a dangerous safety hazard to anyone coming in contact with the wire.

Palo Alto public assets

Cities around the world face this conflict; but for most of those cities—only the trees are a public asset. For Palo Alto—operator of its own electric utility—the poles, transformers, and wires, are also public assets. Therefore, staff and community have a vested interest in both sides of this issue.

Photo by staff

Fig. 53: Communication wires may run through canopy. However, power lines have strict clearance requirements established by the California Public Utility Commission.

Procedures/standards for pruning

- Pruning for line clearance is managed by the Urban Forestry staff.
- Pruning is done by contractors with specific expertise.
- Contracts specify standards established by the International Society of Aboriculture.
- Most trees are pruned for line clearance every two years.
- Fast-growing trees are pruned for line clearance every year.
- In some cases, removal of the tree may be best.
- In addition to pruning that is done as part of the power line clearing, public trees are pruned every 5-7 years to clear dead branches and branches that may be crossed or rubbing.

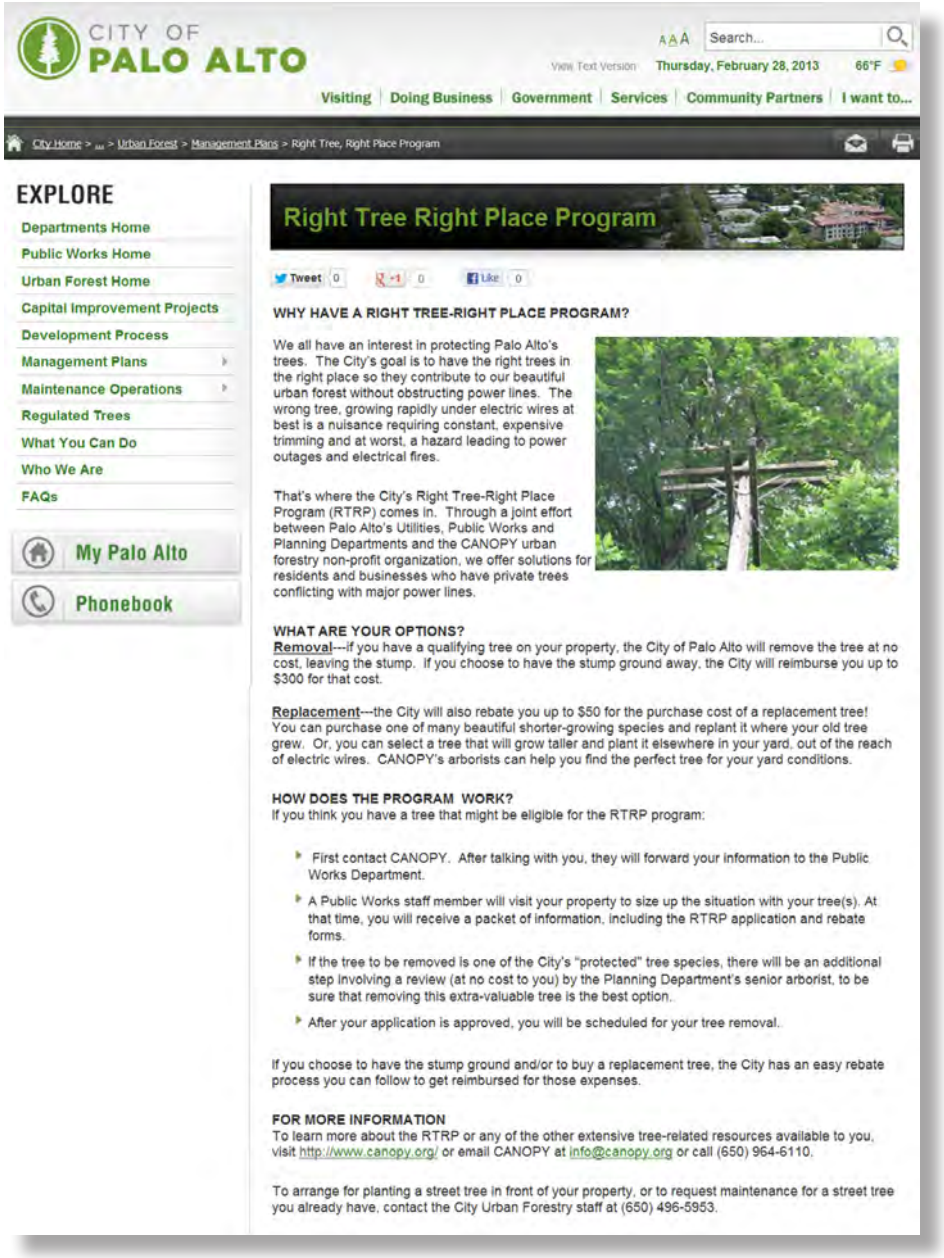
Right Tree Right Place program

Property owners facing conflicts between power lines and trees on their property are eligible for help through this program e.g.,

- Removal of qualifying trees at no cost
- Reimbursement for stump removal.
- Reimbursement for appropriate replacement.

Information about this program is available on both the City's website and Canopy's website.

Fig 54:City website page for Right Tree Right Place Program



Where we are now

Information about stewardship

- Ownership & Overlapping Roles
- City Hall

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Ownership & Overlapping Roles

Ownership

Public Trees may be what people think of as the urban forest; however, as the four schematic maps (right) show...the vast bulk of the urban forest is made up of Private Trees. *(Figs. 55 a, b, c, & d)*

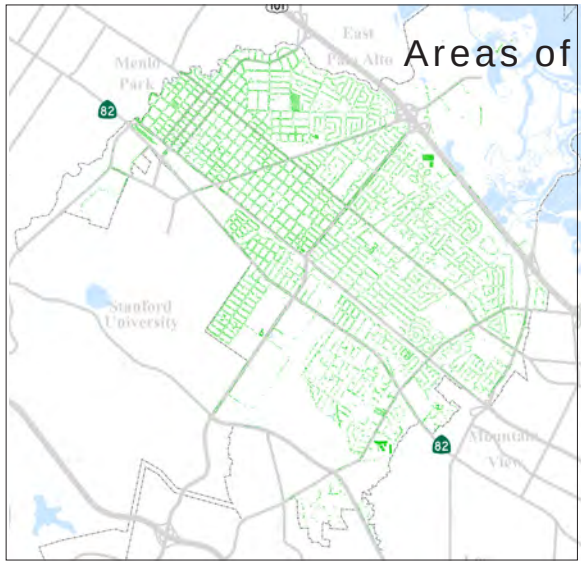

Fig 55a. The most familiar category of publicly-owned trees are those located within the rights-of-way.

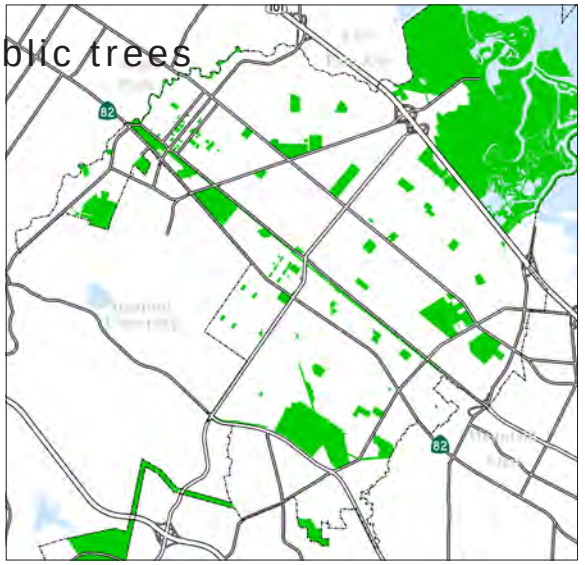

Fig 55b: Other publicly-owned trees are located at parks, preserves, libraries, City Hall, fire stations, parking lots, etc.

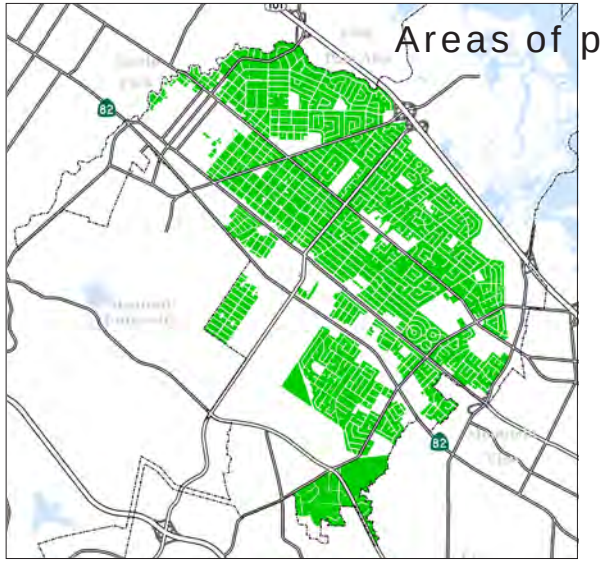

Fig 55c: Many more trees are located on privately-owned land zoned for single-family use....or...

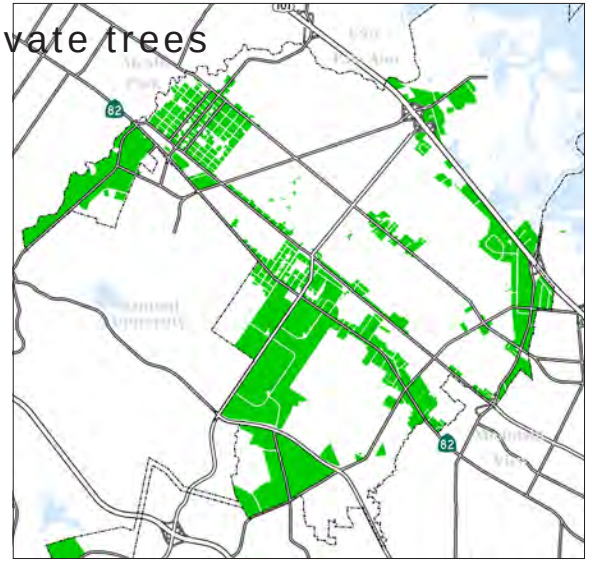

Fig 55d: ...on privately-owned land zoned for commercial, industrial, or multi-family residential use.

Overlapping Stewardship Roles

Palo Alto's legacy is the result of—both citizens and staff—acting as both stakeholder and stewards—for both public and private trees.

Public trees

Public trees can be said to fall into two categories:

1. Street trees (within rights-of-way) *(Fig 56a)*
2. Trees within parks, the municipal golf course, open space, public facilities such as the water treatment plant, libraries, fire stations, and public parking lots.*(Fig 56b)*

Overlapping stewardship of public trees

Public trees are managed by city staff; however, they are a community asset and private citizens have important roles:

1. Informally—by watering nearby young street trees.
2. More formally—by protecting street trees during construction projects.
3. At a higher level—by volunteering to organizations like Canopy or Friends of the Parks.
4. At the highest level—by voting for City Council members who :
    - Appoint commissioners to review projects, budgets, policies, and legislation and make recommendations to the council
    - Adopt budgets, policies, and legislation that affect trees.

Private trees

Private trees can be said to fall into two categories:

- Trees within single-family residential zones. *(Fig 56c)*
- Trees within commercial or multi-family zones. *(Fig 56d)*

Overlapping stewardship of private trees

In general, private trees are managed by property owners; however, some private trees are subject to regulations i.e.,

1. Coast and valley oaks as well as coast redwoods of a certain size.
2. Heritage trees—designated by the City Council.
3. Trees designated for retention or protection as a condition of approval for a permit are protected.
4. Trees that interfere with utility lines.

City Hall

Photo provided by Canopy

Barry Coates leading one of several Palo Alto tree walk—showcased above are the magnolias in front of the Palo Alto Art Center.

A History of Committment

In January 2014, Barrie Coates—a renowned arborist who has been a valued consultant to Getty Museum, Disneyland, multiple state agencies, and many local residents—received Canopy's Soforenko Award for a life time of contributions.

His acceptance remarks (which follow) salute Palo Alto's history of commitment:

> "It is an honor to be given Canopy's Soforenko award, and I appreciate it, but the real honor must go to the vision of a tree canopy covered city, created many years ago by a city government and a strong planning department that recognized the value that trees contribute to our lives.
>
> The continuing support for effective tree preservation regulations, followed by sincere attention to adherence to those regulations is virtually unique to Palo Alto.
>
> The results are apparent when we leave this meeting, no matter which direction we go we will encounter the city forest that makes Palo Alto the delightful, healthy city it is."

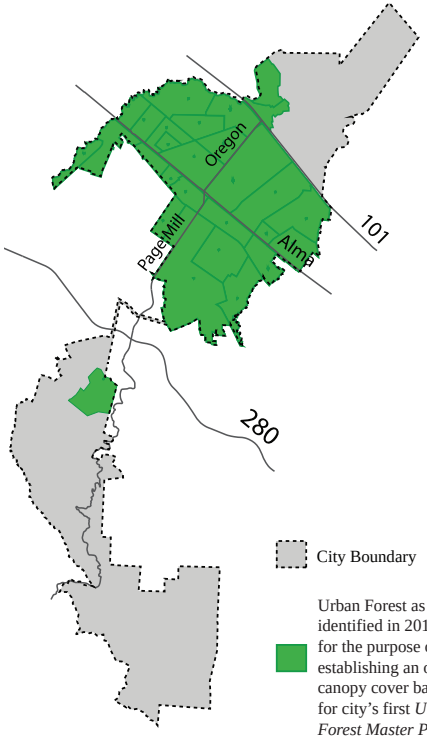

Fig. 56a: The Urban Forest Boundary—defined for the purposes of this Master Plan—reflects the area for which the overall canopy was measured ("Canopy" chapter).

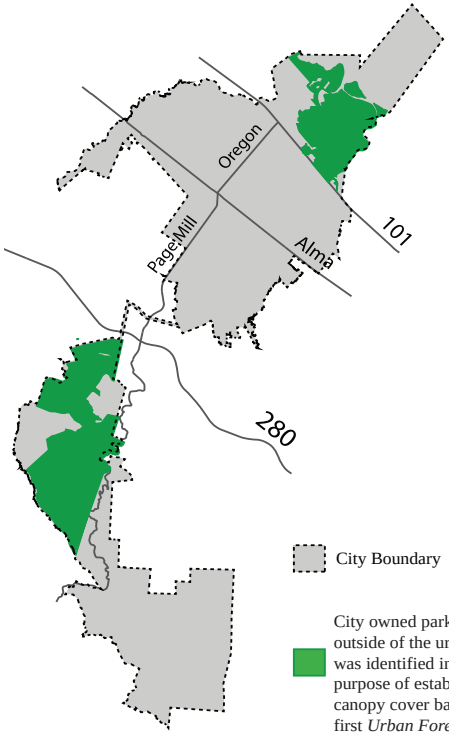

Fig. 56b: Palo Alto Parks and Open Space outside of the Urban Forest boundary.

Areas of Concern

The City's forestry concerns are not limited to the urban forest *(Fig. 56a)* which includes:

- Municipal Golf Course....approx. 180 acres
- 32 Urban parks.....approx..170 acres
- Street tree system.....approx. 29,074 trees
- Some private trees.....unknown

They extend to 4,000 acres of park and open space as well *(Fig. 56b)* which includes:

- Baylands Preserve.....approx. 1,940 acres
- Arastadero Preserve .....approx.622 acres
- Foothills Park .....approx.1,400 acres

This chapter discusses these concerns in terms of:

1. Policies & protocols e.g., master plans, regulations, and project review.
2. Field activities such as planting and maintenance tasks.
3. Resources e.g., humans, technology, and budget.

1. Policies & protocols

Comprehensive Plan (1998)

The "Natural Environment" chapter establishes...

- A goal for, "...a thriving urban forest that provides ecological, economic and aesthetic benefits..."
- A policy to protect, revitalize, and expand the urban forest.
- Programs to implement the policy and achieve the goal.

The "Community Services" and "Land Use" chapters include protective programs that apply to development and capital improvement projects.

Municipal Code

Authority and Protection of Trees

Title 8 (1996)

- Establishes city control of trees on public land.
- Incorporates the tree protection ordinance.
- Provides protection for certain trees.
- Authorizes the *Tree Technical Manual*.

Titles 18 and 21 include landscaping requirements for private development.

Title 22 protects trees in parks and open space.

Conservation of Potable Water

Title 12 prohibits defective irrigation equipment.

Title 16...

- Incorporates California Green Building Standards
- Establishes the existence of "recycled water project areas."
- Requires installation of recycled water infrastructure and separate meters for certain projects within the "recycled water project areas."

Encouragement of Solar Energy

Titles 2, 16, 18, and 21 encourage installation of solar panels.

Climate Protection Plan (2006)

In 2006, the mayor's Green Ribbon Task Force recommended to:

a. Expand City urban forest management/master plan to recognize energy savings and CO2 sequestration benefits.

b. Expand utilities' "right tree in the right place" program to accommodate solar access for PV and hot water.

c. Increase tree canopy coverage for parking lots. Reduces fuel consumption for car air conditioners and heat island effect."

In 2007, the *Climate Protection Plan* states,

- "6. Employ Urban Forest Opportunities to Reduce Energy Use and Increase Carbon Sequestration..."
- "...Promote use of shade trees that reduce energy use and trap carbon as an extension to the "Right Tree in Right Place" program."
- "Implement water efficiency. Examples might include Xeriscaping, weather linked irrigation controllers, native plantings." (Appendix I.)

Urban Water Management Plan (2011)

The 2011 update includes a multi-faceted program that assists residents and property owners upgrade irrigation systems to avoid wasting water.

- For the "recycled water project areas", the UWMP Table 9 indicates a potential 3-fold increase in the use of recycled water for landscape irrigation over the next 4 years.
- On the other hand, for City facilities, the UWMP Table 11 indicates only limited increases stating, "...The City has not made a commitment to expand the use of recycled water in the City..."

Utilities Strategic Plan (2011)

The stated mission of this plan is to , "Provide valued utility services to customers and dependable returns to the City" and in the plan's "Key Strategies with Tactics" (Attachment C), trees are mentioned as follows:

- Key Strategy 1-M: Continue the citywide undergrounding of utility wires. Minimize the impacts of under grounding on street tree root systems and planting areas.
- Key Strategy 1-N: Continue with line clearing and vegetation management activities and meet the goal of 9000 trees per year that interfere with power lines.
- Strategy 6 includes continued support for the Right Tree Right Place as well as the Shade Tree Program.

Public Tree Removal Policy

In 2009 the City established protocols for street tree removal that provide:

- Detailed criteria for determining if a street tree should be removed.
- A detailed series of steps to follow including inspections, authorizations, and notification prior to removing the street tree.

Recycled Water Policy (2010)

Resolution 9035,_the Recycled Water Salinity Reduction Policy—states that its purpose is to ensure that the City is taking all practical steps to reduce salinity in recycled water and that the policy acts to prevent unnecessary additions of salt to the sewer system, with a goal of lowering the Total Dissolved Solids (TDS) in the recycled water to less than 600 parts per million (PPM).

The policy statement also includes development of "alternatives for reducing the salinity levels."

Baylands Master Plan (2008)

Includes design guidelines that promote low native marsh vegetation allowing for panoramic views that are not interrupted by tall trees.

Various Park and Facility Master Plans

Trees within different parks face different challenges and the *Urban Forest Master Plan* includes a program that calls for updating and/or developing park plans where appropriate.

Project review

Review by Urban Forestry staff

Most permit applications are subject to review by the Urban Forestry staff—for potential impact to the health of a regulated trees e.g., street trees, heritage trees, and species protected by ordinance.

Review by additional departments

Projects requiring discretionary review and large projects require coordination with staff from multiple departments including:

- Planning and Community Development: Building and Planning Divisions
- Community Services: Parks and Recreation Division
- Fire Department
- Utilities Department

These reviews are not limited to regulated trees; but rather they consider the entire site.

No review required

Some permits are considered ministerial and do not require review for impact to either regulated or non-regulated trees.

Courtesy reviews

Staff sometimes review projects outside of the city limits—that do not require permits from Palo Alto. In these cases staff recommendations are not likely to be compulsory. On the other hand, review of the Caltrans project to add auxiliary lanes to Highway 101 resulted in saving 5 historic eucalyptus trees at a city gateway (San Antonio Road and Oregon Expressway). They had been identified for removal by Caltrans.

Manuals and Guidelines

Tree Technical Manual (2001)

Provides the criteria, procedures, and standards for implementing tree protection regulations. *Note*: *Written by the City of Palo Alto Planning Arborist and—intentionally not copyrighted—this document has become a standard resource for communities across the nation.*

Street Tree Management Plan (1982)

Sets strategies for the preservation and care of the street tree system—one component of the urban forest. This document is currently being updated.

Programs

Right Tree Right Place Program

Assists residents and businesses to remove / replace private trees that conflict with power lines.

Shade Tree Program

Funds replacement of municipal shade trees in order to mitigate the "heat island effects" within the community.

Photovoltaic Partners Program

Encourages photovoltaic installations.

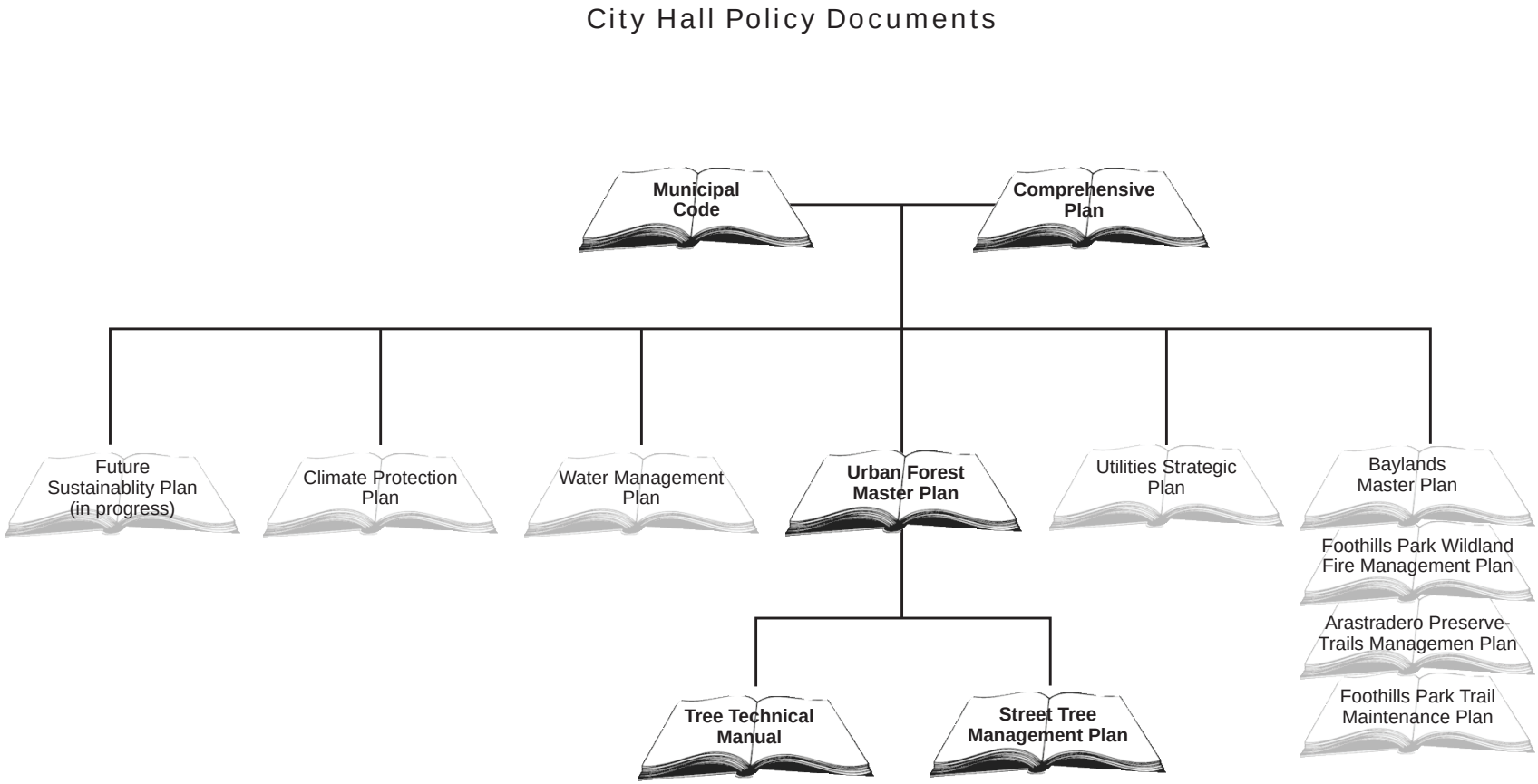

Fig. 57: A schematic representation of the rleationships between select major policy documents. Note: Not all relevant documents are shown.

2. Field activities

City maintenance activities generally apply to public trees. (Exceptions are emergencies and tree trimming for power lines.) Whenever possible, maintenance procedures follow Best Management Practices established by the International Society of Arboriculture.

Planting

Each year, city staff and Canopy staff and volunteers participate in planting public trees— generally between November and March to take advantage of the dormant season. Planting street trees includes::

- Stump removals
- Repositioning of the site to minimize conflicts
- Notifications to residents
- Agreements with residents to irrigate the tree during the establishment period.
- Species selection
- Acquisition

Currently, there is not a reliable monitoring plan to assess the number of plantings and removals in comparison to the number of vacant sites. A *Master Plan* policy establishes a goal to ensure that plantings exceed removals until a 98% stocking level can be verified and to monitor results.

Species selection

When replacing street trees, staff take many things into consideration such as:

- Ecological benefits
- Storm water runoff reduction potential
- Aesthetics

Photo provided by Canopy

Fig. 58: Each year, city staff and Canopy staff and volunteers participate in planting public trees. Shown is a tree planting event in Greer Park organized by Canopy.

- City's goal of 50% shading goals for rights-of-way
- Preference for native species
- Availability of water and the City goals for conserving potable water
- Availability of recycled water and the City goals for recycled water
- Need for age diversity
- Preference for species with fewer undesirable traits such as surface rooting, prolific fruit or seed production, susceptibility to insects and diseases (e.g., sooty mold and aphids), and other documented impacts specific to a species.
- Resident's request
- Surrounding theme i.e., predominant species on that block— and the past performance of that species
- Adjacent property use
- Potential visibility issues (e.g., intersections)
- Available soil volume
- Available water

- Potential conflicts with overhead power lines
- Potential conflicts with hard scape
- Potential conflicts with underground utilities
- Avoidance of monocultures

For sites in parks staff must also consider:

- Existing and future irrigation systems for nearby park turf.
- Maintenance issues specific to each park e.g., litter on playing fields.

For sites in natural areas, it is even more important to choose native species and to consider:

- Threats such as Sudden Oak Death (SOD).
- Wildlife breeding time lines.
- Wildlife habitat needs.
- Relationship and impact to trails.

Natural succession and disturbance trends which transform species composition over time

Photo provided by staff

Fig. 59: Tree trimming training for city staff organized by Canopy.

Early tree care

Even drought tolerant trees need water during the early years.

1. Young street trees get watered by:
    - City trucks deliver some potable water and some recycled water to young street trees.
    - Residents provide water to young street trees nearby.
2. Young trees in urban parks often get water from the irrigation systems that are there for the turf.

Pruning

Unlike line clearing, pruning is done for the benefit of the trees.

- For young trees, the goal is to promote good structure and growth.
- For mature trees, the goal is to reduce incidences of branch failure by removing:
    - Dead wood
    - Crossing and/or rubbing branches

Note: In 1999, the City implemented a program to prune every 5 years and this increase in frequency resulted in a reduction in emergencies. However, since then, budget constraints have required changing to a 7-year cycle.

In addition to cyclical pruning, staff provides pruning services on an as-needed basis. Most often this service is provided in response to a request from a resident.

Line clearing

See “Line Clearing” chapter.

Removals

See “Management” section.

Emergency response

A Public Works Operations standby crew is available for emergencies 24 hours per day every day of the year, including holidays.

- Internal and external communications methods are established.
- Contracts are in place for a variety of services.
- Staff is trained in standards established by the Federal Emergency Management Act (Incident Command System standards) and the American National Standards Institute.

Wood & green waste recycling

Loose branches and limbs that result from maintenance on city trees are made into wood chips and used as mulch in the city parks, open spaces, and at the Municipal Golf Course.

Photo provided by staff

Fig. 60: City crews remove a street tree (Cowper Street) with decayed roots to abate a public safety risk. The branches and trunk will be recycled—perhaps as wood chips to be used as mulch in the city parks, open spaces, and at the municipal Golf Course.

3. Resources

City staff

Most tree-related tasks are performed by the Urban Forestry Division which comprises:

- An Urban Forester: inter-departmental collaboration, technical liaison, and designated representative.
- Planning Arborist: project review.
- Project Manager: contracts and utilities
- Project Manager: Parks and Public Works
- 2 Tree maintenance specialists: contract compliance, utilities vegetation management, and inspection services
- 8 Tree trimmers/line clearers
- 1 Administrative Assistant.

Additionally, Community Services Parks Division staff perform tree-related activities as part of managing 4,000+ acres of parks, open space, natural areas, and other public land such as medians.

Canopy

Begun in 1996, and now partially funded by the city, Canopy is a non-profit group that serves as a community resource on tree related matters. In addition to implementing the Right Tree Right Place program, Canopy conducts:

- Tree-planting/tree-care events with volunteers.
- Surveys such as the:
  - Oakwell survey: documented existing native oaks.
  - Young Tree survey: documented status of newest street trees.

Photo courtesy of Arborist OnSite Horticultrual Consulting, Inc.

Fig. 61: One of the most important tree-related activities of the City is the ongoing monitoring and care of El Palo Alto. In 2013, the City engaged Arborist OnSite Horticultural Consulting Inc. to locate the magnificent redwood's roots behind the concrete channel wall of San Francisquito Creek— using ground penetrating radar technology.

- Tree walks for each neighborhood.
- Tree care classes for property owners.
- Programs that foster collaboration with schools other communities, and other agencies.
- Inspirational events that:
  - Recognize (and encourage) stewardship.
  - Expose Palo Alto to exceptional speakers and ideas.
- Advocacy to the city, county, and state levels.
- Consultancy.

Volunteers

The importance of volunteers cannot be overstated. For example, in addition to Canopy volunteer activities, Acterra volunteers provide invaluable help to city rangers by helping to plant trees and remove invasive plants in the Pearson-Arastradero Preserve and along San Francisquito Creek.

Urban Forestry Website

Ongoing enhancements including open portal will improve interaction between the community and staff.

TreeKeeper

The city has maintained a digital database of public trees—and maintenance activities—for more than 20 years in TreeKeeper. As a result of the 2010 inventory update, those records are now geocoded and can be viewed as "dots" on a map in TreeKeeper. However TreeKeeper cannot show the "dots" with other map layers of the City's GIS.

Citywide Geographic Information System (GIS)

When (TreeKeeper) data is moved to the City's GIS database, the "dots" can be viewed atop other relevant layers of information. *(Like the layers shown in Fig 63)* However, as TreeKeeper is updated constantly, diligent procedures are required to keep the two data sets synchronized.

Land Use Designations
(as of 2012)

Soil Types
(from 1982 Street Tree Management Plan)

Canopy Cover by Neighborhood
(2010 analysis)

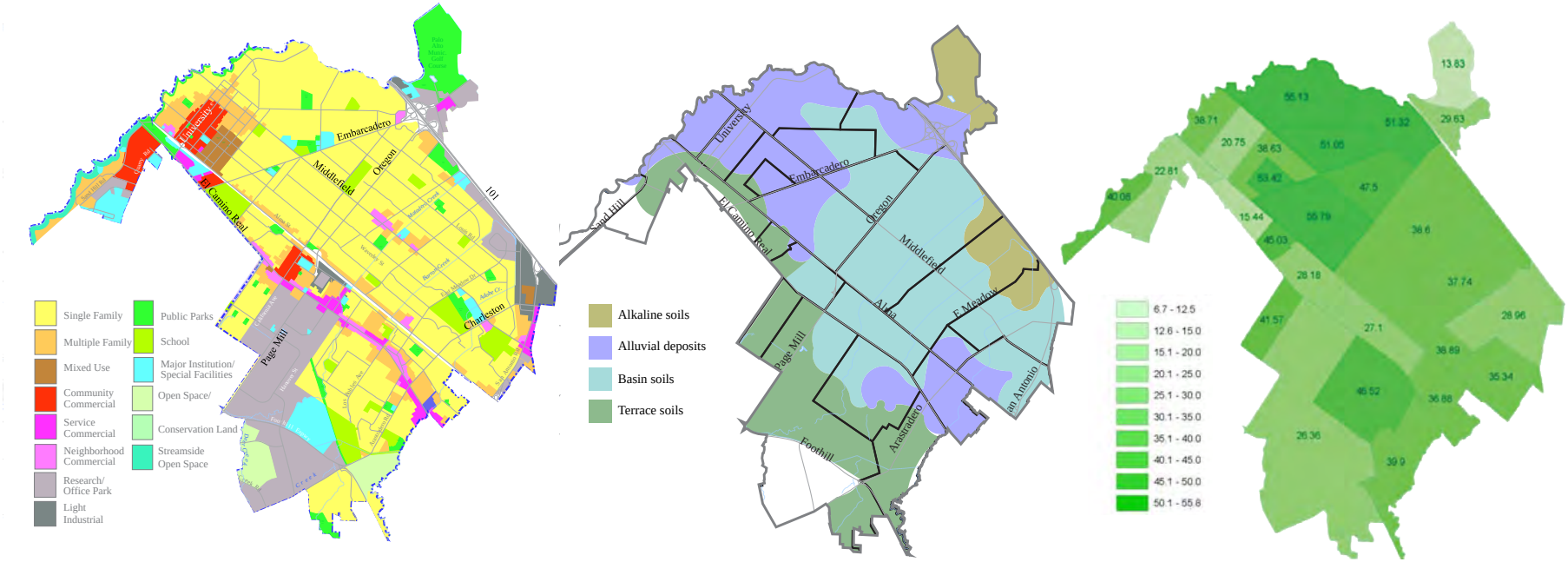

Fig. 63: In the City's GIS, tree data from TreeKeeper can be viewed atop other relevant information and map layers. Examples (in addition to the ones shown) include: watershed boundaries, overhead lines and pole, underground infrastructure, current trenching projects.

Citizen Oversight

Landscape plans may be reviewed by the:

1. Planning and Transportation Commission.
2. Architectural Review Board.
3. Historic Resources Board.
4. Parks and Recreation Commission.

Whereas the traditional focus for many of these bodies tended to be privacy, historical, and aesthetic issues, ecological view points are increasingly a part of the process—in particular in reviews by the Parks and Recreation Commission.

However, there is no elected or appointed body intended specifically to investigate and comment on the impact of projects on trees, or more broadly the ecosystem.

Funding

General fund

- The 2013 Urban Forestry Program budget is $2.4 million (1.6% of the General Fund.)
- The Parks Division also uses budget resources for tree-related activities.
- Capital Improvement Projects may receive additional funding on an as-needed basis.

Utilities

- The 2013 power-line clearing contract budget is $1,062,000 not including administrative and oversight budget.

Grants

The City has received grants from the California Department of Forestry and Fire Protection (CAL FIRE) including recent grants that enabled:

- The Urban Forest Master Plan.
- Urban Forest Inventory update and geocoding.

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Moving toward the Vision

- A Message from the Urban Forester
- Goals, Policies, and Programs
- Implementation Plan

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A Message from the Urban Forester

To the Palo Alto Community,

Working on this plan has provided a great introduction to my job.

It's helped me to see what efforts have resulted in this robust urban forest that is a hallmark of the city.

Quantitative measures such as size, health, and diversity tell me that Palo Alto is out-performing many of its neighbors. The cost benefit analysis tells me that the street trees are a bona fide asset. And the qualitative measures tell me that the forest is in good condition, well cared for, and productive.

On the other hand, some chapters indicate room for improvement and I look forward to building on this strong foundation to create an even richer fabric of people interacting with the urban forest in a symbiotic relationship that strives toward harmony with the natural environment.

I believe that Palo Alto's urban forest is poised for a renaissance and that we'll move toward our stated vision by preserving past successes while acknowledging that influences on the forest are changing. We must anticipate and prepare. Innovation will be imperative.

Fig. 64: Walter Passmore joined the City in 2012—Palo Alto's first Urban Forester.

Challenges that I think we'll face include:

- *The time it takes for results: It takes a long time before a new tree is mature enough to make an observable difference in the landscape or to provide ecological benefits. The City must engage the community's trust and patience.*
- *Changes in the perceptions and values of the community: Cultural, generational, and societal influences mold choices. Through action or inaction people are the most significant influence on how nature functions. Partnerships and relationships must be enhanced or forged perpetually.*

Fig. 65: Although the Forest Spiral development—designed by Hundertwasser and located in Darmstadt, Germany—is a much denser than would be appropriate in Palo Alto, it is certainly inspiring.

Trees and landscape are engineered into every elevation contributing to the urban forest and its benefits.

- *Water: Its vital role to all life on earth and uncertain reliability make water usage a passionate debate. We will treat it with respect—considering supply, movement, storage, consumption, transpiration, and utilization.*
- *Soil: While the formation of soil may require thousands of years, common human activities can rapidly degrade it; and even unseen changes in the soil can have significant impacts on trees and vegetation, water availability, and habitat. Protection of and improvements to soil health will benefit all the inhabitants of the urban forest (including people).*
- *Redevelopment and densification on existing sites: This is where innovation will be most needed if we are to sustain existing canopy and benefits and establish productive new urban ecosystems. The Forest Spiral development in Germany (Fig. 65) is much denser than would be appropriate in Palo Alto; however, the project serves as an inspiring example of innovation. Trees and landscape are engineered into every elevation contributing to the urban forest and its benefits*

Fig. 66: Although the scale and densities of Dallas Texas are not comparable to those of Palo Alto, Dallas' Klyde Warren is a reminder of what is possible. This well used park improbably spans the Woodall Rogers Freeway to create a social corridor, valuable green space, and an opportunity for anyone to have a personal connection to nature in between the busy downtown and uptown.

Solutions and innovations that I will be striving to employ include:

- *Connections: I will always be looking for ways to create and strengthen bonds between people and nature while avoiding the creation of obstacles. Although the scale and densities of Dallas Texas (Fig. 66) are not comparable to those of Palo Alto, Dallas' Klyde Warren Park is a reminder of what is possible. This well-used park improbably spans the Woodall Rogers Freeway to create a social corridor, valuable green space, and an opportunity for anyone to have a personal connection to nature in between the busy downtown and uptown.*
- *Native ecosystems: These will be established, protected, or enhanced whenever possible. Fully functioning ecotypes should represent the natural history of the area with a complete complement of plants and wildlife. Edge effect, dead or dying woody material, as well as different successional stages should all be considered as important indicators of environmental health.*

Fig. 67: The high line rail conversion in New York City is an stunning example of the reuse and recycle philosophy. So, while there are likely no comparable opportunities within Palo Alto, it does tempt the imagination.

- *Layering: A compatible and complete forest needs the anchor of established mature trees along with a diversity of younger/ smaller trees, compatible trees and vegetation of various species, and complementary organisms. Rich and complex ecosystems can thrive with proper care in conjunction with unity of purpose across ownerships. More collaborative and cooperative relationships are important.*

- *Reduce, reuse and recycle philosophy: The high line rail conversion in New York City (Fig. 67) is an stunning example of the reuse and recycle philosophy. So, while there are likely no comparable opportunities within Palo Alto, it does tempt the imagination. And, in that vein, I hope to enhance existing programs and be open to opportunities of an nontraditional nature including short term opportunities—such as vacant properties.*

Before closing, I'd like to acknowledge ….

- *The community: This legacy would not exist if not for support from the community and I will always keep this in mind. As improved communication was a recurring theme in the Master Plan survey responses, this will be a priority. I will explore the potential for a recurring forum—perhaps here at City Hall. Or, we may find that, as the City expands its use of open portals, the internet will be the most convenient way for us to stay in touch.*
- *Canopy: The support of the community comes in many ways, thanks to Canopy (See back cover of Canopy's 2012 Annual Report to the Community—Fig 68) and I cannot overstate the value of this partnership. I look forward to working with Canopy on many of the Master Plan programs.*
- *My colleagues at City Hall: In developing this plan, it became clear that the relationship between the Urban Forest Master Plan and the citywide sustainability policies will be paramount and I look forward to working with the other departments to create a citywide plan.*

Urban forest concerns overlap concerns for water, development, infrastructure, and economics, so solutions may not always be obvious or absent of debate. To that end, this plan intends to demonstrate the value of the urban forest, define its needs, and make it easier to identify appropriate solutions.

The interdisciplinary, collaborative, cooperative, and comprehensive nature of the solutions we employ, will determine the urban forest's sustainability, environmental value, economic benefit, and equability–and ultimately—the quality of life in Palo Alto.

Sincerely,

Walter Passmore

City of Palo Alto Urban Forester

It Takes A Village To Grow A Forest

Many generous donors, volunteers, and friends make Canopy's tree plantings and community education possible. We thank you for the tremendous support you provide.

HONOR SOMEONE WITH A TREE GIFT
A tree gift helps Canopy plant a new tree at a school, in a community park, or along a street. Buy a tree gift online at canopy.org or call 650 964 6110.

CREATE A LEGACY
To discuss a planned gift, email catherine@canopy.org or call 650 964 6110.

GIVE STOCKS
Transfer tax deductible shares to Canopy. Email catherine@canopy.org or call 650 964 6110.

VOLUNTEER
Sign up for a tree planting or to volunteer for a community education event. Visit canopy.org.

DONATE A CAR
Donate a vehicle to Canopy, a simple process that includes free towing. Call 877 676 8733 or visit canopy.org/pages/donate/car-donations.

LEARN ABOUT THE URBAN FOREST
Join a Canopy Tree Walk. Sign up for our TreE-NEWS updates at info@canopy.org.

JOIN US ON:
Facebook Twitter: CanopyTrees

CANOPY
3921 East Bayshore Road
Palo Alto, CA 94303
t: 650 964 6110/f: 650 964 6173
info@canopy.org/www.canopy.org
Tax ID: 01-0565752

Canopy grows healthy trees and healthy communities.

CANOPY'S MISSION: Because trees are a critical element of a livable, sustainable urban environment, Canopy's mission is to educate, inspire, and engage residents, businesses, and government agencies to plant, protect, and enhance local urban forests.

Printed on recycled FSC Certified paper using vegetable-based inks.

Fig. 68: Back cover of Canopy's CANOPY Annual Report to the Community Fiscal Year 2012

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Goals, Policies, and Programs

2nd Edition

Goal 1. A well developed contiguous, healthy, and ecologically resilient citywide urban forest that:

- Is a mix of native and introduced climate adaptive species—to minimize vulnerability to disease, storms, drought, pests, and other stressors.
- Emphasizes locally-evolved species, with particular focus on regenerating a native woodland ecosystem on a landscape scale.
- Avoids invasive species
- Is a mix of young, semi-mature and mature ages—to facilitate uniformity in annual maintenance costs and continuity of benefits.
- Maximizes habitat, environmental, and aesthetic benefits while minimizing conflicts with infrastructure and water-conservation goals.
- Maximizes the potential in each neighborhood—to achieve the greatest possible canopy equity.

Policy 1.A. Strive for:

- A greater percentage of native, drought-tolerant, and fruit tree species.
- Species choices that are appropriate to the setting and site conditions e.g.,
  - Maximize opportunities for fruit, nut, and flower bearing trees where there are fewer maintenance concerns.
  - Maximize opportunities to include less drought tolerant trees where water is not as limited such as riparian corridors, special design or bioretention landscapes, or where groundwater level is higher e.g., plant riparian trees such as box elder, sycamores, cottonwood and willows near creeks and where groundwater conditions allow.
  - Maximize opportunities for species groupings that form interconnected ecosystems and an ecologically resilient landscape that supports birds, pollinators, and other beneficial insects with an emphasis on oak woodland species based on the principles of San Francisco Estuary Institute's "Landscape resilient Framework" and "Vision for a resilient Silicon Valley Landscape".
  - Minimize infrastructure conflicts, hazards, and maintenance issues.

Appropriate age diversity.

- No loss of benefits—as defined in iTree eco analysis *(or other peer-reviewed benefits-estimation model.)*
- Increased habitat, health, and social benefits.

Program 1.A.i. Work with Canopy to complete the online "Tree Library"—to achieve a helpful tool for staff and property owners. Include information from the Santa Clara Valley Audubon Society and Native Plant Society about the value for birds and butterflies of species listed in the library. Ensure that searches can include multiple attributes.

Program 1.A.ii. Work with Canopy and stakeholders to develop a "Preferred and Restricted Species List" that will be a helpful tool for staff and property owners.

The list will acknowledge differing priorities for:

- Public street trees
- Public park trees near playing fields or playing fields, paths, or hardscape.

Attachment A

- Public park trees further from playing fields, paths, or hardscape.
- Public trees in nature preserves.
- Private trees on single-family residential property.
- Private trees on multi-family residential property.
- Private trees on commercial property.
- All trees in riparian corridors.

The list will consider:

- Habitat value and attractiveness for birds, butterflies and pollinators.
- Opportunities to create riparian habitat.
- Ecological benefits such as shelter, food, and breeding sites for both resident and migratory birds and pollinators.
- Energy use reduction potential.
- Carbon sequestration potential.
- Stormwater treatment potential.
- City goals for conserving potable water.
- City goals for recycled water.
- Infrastructure conflicts.
- Maintenance issues.
- Aesthetics.
- City's goal of 50% shading goals for rights-of-way, parking lots, and heat islands.
- City's goal to emphasize native species.
- Need for age diversity.
- Toxicity to birds.
- Potential to become invasive.
- Potential to provide healthy, local food to residents.

Notes:

- *The resulting list should be searchable by attributes.*
- *Special consideration should be given to the golf course.*
- *A comprehensive conservation plan is needed to address the complexity of the ecosystems of preserves, and open spaces recognizing that the desirability of traits is often contingent upon location or limited rooting area i.e., problems on one site may be benefits on another. For example, species with maintenance concerns such as those that drop fruit, nuts, and flowers might not be appropriate in some urban areas.*
- *Although allergens are a concern, current research does not support species selection for allergens.*

Program 1.A.iii Work with Canopy and stakeholders to develop site-specific-species-selection protocols to complement the "Preferred and Restricted Species List." In addition to the criteria above, include consideration of:

- Resident's requests.
- Regeneration of native woodland.
- Surrounding species theme and the past performance of that species.
- Adjacent property use.
- Potential visibility issues (e.g., at intersections).
- Available soil volume.
- Available water.

  Potential conflicts with overhead power lines.
- Potential conflicts with hardscape.
- Potential conflicts with underground utilities.
- Avoidance of monocultures.
- Avoidance of inappropriate species in areas that are ideal for rainwater bioretention areas.
- Creation of habitat corridors and ecologically resilient landscapes, contribution to native woodland recovery.

For sites within parks, selection should also consider:

- The *Comprehensive Plan's* vision that parks should integrate nature with recreation and aesthetics and strive to bring people closer to nature.
- Existing and future irrigation systems for nearby park turf.
- Maintenance issues specific to each park e.g., litter on playing fields.
- Wildlife habitat needs e.g., the creation of understory to provide shelter for birds.

Additionally, species selection for trees in natural areas should prefer native species and also consider:

- Threats that may be more likely to affect trees in natural areas than in urban areas—especially Sudden Oak Death.
- Relationship and impact to trails.
- Soil types and natural heritage.
- Opportunities for planting species that drop fruit, nuts, and flowers in areas where maintenance is not as big of a concern.

Note: As mentioned earlier, a separate Resource Management Plan—or Comprehensive Conservation Plan—is needed to address the complexity of the ecosystems of preserves, and open spaces.

Program 1.A.iv. Manage species diversity in such a way as to:

- Emphasize regeneration of an native woodland landscape through the creation of species patches at a scale that supports regional ecological resilience.
- Avoid monocultures that create vulnerability to catastrophic losses due to species-specific threats—especially in the urbanized area.

Note: Urban forestry guidelines suggest that—as a precaution against catastrophic losses due to species-specific threats—no one species should account for more than 10% of the population and no one genus for more than 20% of the population.

Policy 1.B. Endeavor to ensure commercial availability of appropriate tree species.

Program 1.B.i. Upon completing the "Preferred and Restricted Species List", work with Canopy to encourage local and regional nurseries and garden centers to defer to stock the "preferred" species—with emphasis on increasing the availability of species that are drought-tolerant as well as tolerant to recycled water—and to avoid stocking invasive species.

Program 1.B.ii. Consider feasibility of a city-owned nursery or partnership with California Native Plant Society, Acterra, or other local non-profits.

Policy 1.C. Conserve viable street tree planting sites.

Program 1.C.i. Work with relevant departments to develop criteria for viable street tree planting sites, increased planting of street trees, and related protocols to ensure optimal stocking level of 98%. Add criteria to *Tree Technical Manual*.

Program 1.C.ii. Use criteria for viable street planting sites to review and update information about existing and available viable sites in TreeKeeper, and GIS—as well as an interactive open-source mapping solution such as OpenTreeMap.

Program 1.C.iii. Work with relevant departments to evaluate implementation and effectiveness of the requirement for 50% shading for parking lots (public and private) and identified heat islands. Identify reasons for success and or failure. Modify as needed.

Program 1.C.iv. Work with relevant departments to develop requirements for new commercial, multi-unit, and single-family housing development projects to provide street trees (or space for future trees) and related irrigation systems. *Note: The requirement for public art may be a useful model.*

Policy 1.D. Strive for optimal stocking levels for street trees. Plantings should exceed removals until a goal of 98% full stocking of identified viable planting sites within right-of-ways and parks is achieved. Assume an average 50 year life span and consistent replacement and removal rates. Fluctuations should be expected due to past trends of planting as well as other variables.

Program 1.D.i. Develop a monitoring program and produce annual reports of removals and plantings to show progress toward the goal of 98% full stocking of identified viable planting sites within right-of-ways and parks.

Goal 2. Re-generated native woodland and riparian landscapes as the key ecological basis of the urban forest with focus on native species and habitat.

Policy 2.A. Conserve and grow native and introduced climate adaptive tree population to regenerate and recover native woodland ecosystem on a landscape scale .

Program 2.A.i. Work with Canopy to update the Oakwell survey to:

- Assess changes in the population of native oaks since 1997.
- Evaluate the health of existing native trees and take actions to improve conditions as needed (e.g., remove hardscaping or turf watering around tree drip line.)
- Evaluate gaps and opportunities to plant native oaks and native woodland species to create a mosaic of native woodland species distribution that mimics the spatial distribution of an native woodland ecosystem.

Program 2.A.ii. Incorporate the Oakwell survey data into Tree-Keeper, the City's GIS, and an interactive open-source mapping system such as OpenTreeMap.

Program 2.A.iii. Develop a plan for restoring a city-wide native woodland landscape by increasing the percentages of native trees especially oaks and by tracking progress. Implementation should begin as soon as possible by providing more native trees and introduce climate adaptive species for all tree installations——to create a mosaic of native woodland species distribution that mimics the spatial distribution of an native woodland ecosystems. Specifically, achieve the following goals:

- Street trees: Increase native woodland and introduced climate adaptive trees from 7% to 10% within the life of this 10-year plan—and to 20% within the next 20 years.
- Urban parks: Increase native woodland and introduced climate adaptive trees from 11% to 25% within the life of this 10-year plan—and to 50% within the next 20 years.
- Open spaces and preserves: Existing to at least 80% native woodland and introduced climate adaptive trees within the life of this 10-year plan.
- Private land: Increase percentage of native trees by providing property owners, gardeners, landscapers, and developers with educational resources, supply information, and incentives for native plants, emphasizing native woodland species.
- Re-oaking where oaks are appropriate—ensuring that oaks are spaced so there are no gaps wider than 100-ft among the trees.

Program 2.A.iv. Initiate "tree giveaway" events that provide residents with free fruit trees, native trees and introduced climate adaptive trees.

Program 2.A.v. Work with Canopy and stakeholders such as the California Native Plant Society, and Acterra to:

- Inventory the invasive tree species population as defined by the Recommended and Restricted list.
- Formalize a plan for decreasing that population *(Note: This will need to be a recurring task..)*

Upon completion of the inventory and establishment of a plan work with Canopy, and stakeholders such as the California Native Plant Society, and Acterra to:

- Develop procedures and coordinate field activities for removing invasive species—with special attention given to the removal of seedlings and saplings
- Provide education and incentives to homeowners to remove invasive species on their property.
- Develop specifications for invasive species removal to be conditionally applied during Planning development review for projects, when appropriate, in all zoning districts or abutting creek areas (e.g. open space, residential estates, commercial, research park, etc.)
- Develop monitoring programs to track progress.

Program 2.A.vi. Utilize public space opportunities--and encourage the use of private space opportunities--to implement management techniques that enable trees, shrubs, and compatible

vegetation to coexist with the goals of producing ecosystem benefits, aesthetic interest, layered wildlife habitat, and food for people.

Program 2.A.vii. Create educational materials on oak tree care and pro actively reach out to property owners, landscaping firms, real estate agents and other audiences to educate them about the importance of oaks, other native, and introduced climate adaptive trees and how to care for these trees.

Program 2.A.viii. When a property transfers, provide information on how to care for oaks

Goal 3.

A citywide *Sustainability Plan* that integrates the goals of the *Urban Forest Master Plan* with other sustainability goals such as those related to water conservation, carbon neutrality, and solar energy—and communicates the value of the urban forest and the importance of tree protection.

Policy 3.A. The City's *Sustainability Plan* shall...

- Incorporate the contributions and needs (including water needs) of the urban forest emphasizing the importance of habitat as well as carbon sequestration by the urban forest and the need to preserve canopy and ecosystems.
- Identify conflicts as well as alignment between urban forest goals and those of other sustainability concepts especially Green Building water use review and the associated *Water Use Classification Of Landscape Species* (WUCOLS) plant species list.
- Describe procedures for prioritizing and mitigating conflicts.

Program 3.A.i. Work with the city's *Office of Sustainability* as well as Canopy and other related organizations (herein after et.al.) to evaluate the "Preferred and Restricted Species List" to ensure that it complements the City's *Sustainability Plan* and incorporates the need to preserve public health as well as ecological and habitat benefits pro-vided by native species such as oak trees, cottonwood and willows, large broadleaf trees, and key introduced climate adaptive species.

Program 3.A.ii. Work with the city's *Office of Sustainability et.al.* to evaluate future participation in carbon credit programs.

Program 3.A.iii. Work with the city's *Office of Sustainability et.al.* to evaluate the establishment of an oversight group (elected or appointed by the City Council), to investigate and comment on the impact of projects on the urban forest and overall ecosys-tem—and monitor the progress of the *Urban Forest Master Plan* goals.

Program 3.A.iv. Work with the Utilities Department to publish tools and priorities for siting of solar collection devices.

Program 3.A.v. Work with the city's *Office of Sustainability et.al.* and/or the Utilities Department and Canopy to create a guidance document—how to successfully incorporate solar collection and trees into site design—for those considering solar.

Program 3.A.vi. Work with the city's *Office of Sustainability et.al* to explore new funding sources for the Urban Forestry program.

Program 3.A.vii. Work with the city's *Office of Sustainability* et.al. to reevaluate costs and fees related to efforts to coordinate sustainability programs.

Policy 3.B. The well being of the urban forest and preservation of its ecological, environmental, public health, aesthetic, economical, social, and community benefits will be considered in all decisions pertaining to the environment, sustainability, and capital improvements.

Program 3.B.i. Formalize the Urban Forester's role relative to:

- Citywide *Sustainability Plan*.
- Development of citywide policy.
- Inter-departmental collaboration.
- Technical advice.

Program 3.B.ii. Work with the city's *Office of Sustainability* et.al. to develop a "Landscape Sustainabil-ity Checklist"—for development review—that incorporates

citywide goals for water use, sustainability, storm water management, tree pruning, tree retention, and tree selection —and strives for ecological balance and resilience. Incorporate into the *Landscape Technical Manual*.

Program 3.B.iii. Work with the city's *Office of Sustainability* et.al. to educate staff about the importance of describing potentially negative—or unintended—impacts to the urban forest and ecologic bal-ance/resilience in staff reports about Capital Improvement Projects—whether or not California Environmental Quality Act (CEQA) review is required.

Policy 3.C. Monitor the salinity levels of recycled water and explore options for adjusting potable/recycled mix rates, soil modification/augmentation—to improve leaching—on a site by site basis.

Program 3.C.i. Review existing monitoring programs regarding the use of recycled water for landscape irrigation at the Municipal Golf Course and Greer Park. Modify as needed.

Program 3.C.ii. Develop a report describing what has been achieved relative to the City's goals for reducing the salinity of recycled water from the Regional Water Quality Control Plant since Council adopted Resolution 9035 in January of 2010. The report should include a draft handout brochure for property owners considering conversion to recycled water--outlining site drainage expectations, exemption process and new plant material conversion and responsibilities. Ensure that staff are aware of this City policy and understand its implications.

Program 3.C.iii. Work with Canopy and stakeholders such as the California Native Plant Society, Acterra, and the Santa Clara Valley Audubon Society to develop a list of tree species appropriate for use in areas where recycled water is or may be used for irrigation. Incorporate into the *Landscape Technical Manual.*

Program 3.C.iv. Work with relevant departments to develop an emergency program to provide water to trees during severe drought.

Program 3.C.v. Work with relevant departments to encourage construction of rain gardens and use of condensation water from air-conditioning units, groundwater dewatering water, and hydrant flushing water to provide water for "thirsty" habitat trees such as willows, sycamores and cottonwoods

Program 3.C.vi. Emphasize the Utilities Department's "Waste Avoidance" programs (for water) on the Urban Forestry website.

Policy 3.D. Use wood chips and mulch appropriately.

Program 3.D.i. Review existing procedures and protocols for using mulch to suppress weeds (including state requirements) and develop site-specific criteria to ensure minimal impacts to wildlife–especially in the wetlands and natural areas. Upon completion:

- Incorporate into the *Tree Technical Manual*.
- Incorporate into the *Landscape Technical Manual (Program 6.F.i.)*
- Work with stakeholders such as the California Native Plant Society, Acterra, the Santa Clara Valley Audubon Society on an outreach program to educate property owners and residents about mulch use.

Program 3.D.ii. To prevent runoff of polluted water, avoid use of recycled-tire or synthetic mulch and discourage use of recycled-tire or synthetic mulch on private property

Program 3.D.iii. To prevent runoff of polluted water, avoid use of dyed mulch and discourage use of dyed mulch on private property.

Program 3.D.iv. Explore an expansion of the existing urban-wood recycling program to include higher end products that do not break the wood down. Include consideration of the following:

- Breaking wood up to create mulch releases previously sequestered carbon.
- Conversion to energy requires burning which releases previously sequestered carbon.
- Recycling urban wood as a higher end product that does not break it down e.g., using logs for habitat or outdoor furniture, will allow the carbon to remain sequestered within the wood.
- Carbon credit programs.

Goal 4. A community that appreciates its urban forest and partners with the city, Canopy, and other local organizations and stakeholders to steward it.

Policy 4.A Optimize communication between the City, residents, property owners, business owners, other cities and other government agencies, and non-profits.

Program 4.A.i. Work with Canopy and stakeholders such as the California Native Plant Society, Acterra, the Santa Clara Valley Audubon Society to conduct at least 4 community outreach meetings to educate and get feedback:

- Introduce the website as a resource.
- Discuss "Hot Topics" from Master Plan survey.
- Discuss interactive open-source mapping.

Program 4.A.ii. Work with Canopy and stakeholders such as the California Native Plant Society, Acterra, the Santa Clara Valley Audubon Society and the community to develop outreach procedures to follow prior to making any significant changes to the urban forest —whether or not California Environmental Quality Act (CEQA) review is required.

Program 4.A.iii. Work with Canopy and stakeholders such as the California Native Plant Society, Acterra, and the Santa Clara Valley Audubon Society to establish a recurring forum that provides the community an opportunity to communicate with staff and members of the decision making bodies about tree benefits, concerns, and ideas. *Note: this may coincide with the similar ideas for the citywide Sustainability Plan.*

Program 4.A.iv. Continue pruning workshops and tree walks and consider additional ways for community and staff to interact.

Program 4.A.v. Coordinate with the Palo Alto Unified School District regarding plantings, species selection, maintenance, management of landscapes, Arbor Day, and other events.

Program 4.A.vi. Develop a capability for community input on the Urban Forestry website.

Program 4.A.vii. Work with Canopy the California Native Plant Society, Acterra, and the Santa Clara Valley Audubon Society to develop the content for outreach possibilities such as city mailings, e-mail blasts, door hangers, bill inserts, social media, press releases, and newspaper columns.

Program 4.A.viii. Partner with Santa Clara Valley Audubon Society for the Palo Alto Christmas Bird Count, Spring Bird Count, and the Backyard Bird Count.

Program 4.A.ix. Work with Santa Clara Valley Audubon Society to develop programs to familiarize residents with Palo Alto's urban forest's birds and butterflies—and ways to attract them.

Program 4.A.x. Educate citizens about correct pruning at the best time to protect bird habitat and nesting.

Program 4.A.xi. Partner with Acterra, Audubon and California Native Plant Society to develop educational materials and workshops on native woodland ecosystems, other native habitats and the benefits of native tree species in the urban landscape for both the public and urban forestry staff.

Policy 4.B. Ensure exhaustive exploration into the common concerns that emerged from the responses to the Master Plan survey and ensure that the resulting information is well communicated.

Program 4.B.i. Work with relevant departments to develop ways to avoid root damage to sidewalks beyond just matching growth characteristics to the conditions of the planting site. Explore root barriers and special design solutions such as meandering sidewalks around trees, suspending sidewalks above tree roots, and replacing concrete sidewalks with sidewalks made of recycled rubber or other material.

Program 4.B.ii. Work with relevant departments to develop ways to prevent conflicts between tree roots and underground infrastructure such as requirements that limit the location of underground utilities to a corridor—preferably coincident with driveway.

Program 4.B.iii. Work with relevant departments to develop ways to avoid disfigurement of trees from power line clearing such as running the power lines through protective conduits that don't require as much clearance.

Program 4.B.iv. Work with relevant departments to develop funding goals and strategies to obtain desired tree pruning cycle.

Goal 5 An effective and efficient Urban Forestry Division.

Policy 5.A. Ensure that the City has adequate baseline information—so changes in the urban forest and ecological benefits can be monitored.

Program 5.A.i. Follow up the 2010 canopy cover assessment done by UC Davis that established the baseline for this master plan—with a similar assessment in approximately 2020. Present a comparison of the two assessments to the City Council.

Ensure that the follow-up canopy cover assessment considers the open spaces as well as the urban forest.

Note: This type of survey will provide canopy density of the entire urban forest—both public and private trees and is generally accepted as the best method for comparisons between municipalities, assessing canopy equity, and monitoring change from development impacts etc.

Program 5.A.ii. Follow up the 2010 inventory update and i-Tree streets analysis done by Davey Resources with either:

- A similar comprehensive inventory update and i-Tree streets analysis in approximately 2020.
- OR a series of seven partial inventories done—annually—on one-seventh of the entire street tree population.
- Ensure that follow-up analyses consider open spaces as well.
- Ensure that any economic analysis of tree value consider the costs inherent in invasive trees.

Note: This type of survey will provide multi-faceted and detailed data about each city-owned tree and is essential to the City's asset management requirements.

Program 5.A.iii. Conduct an i-Tree eco analysis (or similar) to establish a city wide benchmark that spans the entire population of both public and private trees and then to monitor change in the future.

Metrics should be compared to changes in order to craft policies, provide incentives, and adapt partnerships.

Note: This type of survey will provide multi-faceted information such as health and composition of the entire urban forest—both public and private trees.

Program 5.A.iv. Conduct an i-Tree wildlife (or similar) assessment of the existing habitat and biodiversity—to establish a baseline and help identify and prioritize needs.

Note: The software used for this type of analysis is relatively new. This type of survey will provide information about the potential for both public and private trees to provide habitat or to damage habitat (e.g., species that can be invasive) and will help the City incorporate ecological needs into the decision making process for many issues.

Policy 5.B. Strive for best possible tools—such as technology, information about the trees, procedural documentation, knowledgeable staff, and fiscal resources—to support the Urban Forest Master Plan vision, goals, policies and programs.

Program 5.B.i. Conduct electronic tree surveys to enable analysis of development impact.

Program 5.B.ii. Develop database management tools to assist with monitoring, documentation, and evaluation of tree restoration work.

Program 5.B.iii. Develop open portals for data entry–as a way of engaging the community as partners in stewardship and to improve data currency and accuracy:

- Electronic submittals of tree surveys might allow more accurate queries and reports to quantify the influence of development.
- Open source mapping might allow input by anyone agreeing to comply with standards and complete training.
- Open portals might accommodate reports of maintenance needs from community members.

Note: Any such tools should be compatible with the mobile reporting application that is currently being developed for the city to both report and monitor service requests.

Program 5.B.iv. Update the City's GIS and Tree Keeper database information about trees within the 32 parks, Municipal Golf Course,

utility easements, city facilities, and city-owned property such as fire stations—to ensure completeness and accuracy.

Program 5.B.v. Integrate the information in Tree-Keeper with the city's GIS to enable review of the relationship between trees and other relevant geographic information such as parcel lines, land uses, zoning, soil types, watersheds, creeks, pavement, hazard areas, and utility infrastructure.

Program 5.B.vi. Use the City's GIS system to highlight native trees especially oak species, and create a layer that identifies connectivity and spatial distribution of oaks and riparian tree species.

Program 5.B.vii. Develop or obtain a more up-to-date and accurate soils map and add it into the GIS.

Program 5.B.viii. Develop a map showing the depth of available water within the urban forest.

Program 5.B.ix. Update the *Tree Technical Manual*. The update should be coordinated with the *Landscape Technical Manual* as well as the *Sustainability Plan*—and should:

- Include new and innovative ways to add trees in difficult circumstances.
- Review and expand the requirements and options for mitigating the removal of existing trees for development projects and consideration of alternatives to removal. For example, *roof top plantings-which are expensive initially but have a long term life cycle may be worth more as a mitigation measure than a transplanted tree–which often suffer from diminished survival potential.*
- Include information, specifications, and standard details for employing structural grids to provide an adequate volume of quality soil to grow trees to desired mature size.
- Establish soil volume requirements in a manner similar to those described in the city of Raleigh's Landscape Manual.
- Work with Public Works sidewalk maintenance to consider contract language to implement rooting channels for confined existing or new trees to achieve longer life and tree benefits.
- Establish requirements for providing independent spaces for trees and turf so that water can be applied appropriately and efficiently and nearby plantings will support optimal performances e.g., only forest species should be planted near trees where as turf areas may support ornamental landscape plants or riparian habitat trees and shrubs.
- Prohibit the planting of new turf in public rights-of-way, medians, planter strips, and other roadway adjacent areas of landscaping.

Note: In addition to the above listed enhancements, the Tree Technical Manual will be the repository for many of the products called for by programs in this master plan such as: criteria for a viable street tree planting site. As a result, the role of the Tree Technical Manual will be significantly expanded.

Program 5.B.x. Incorporate stormwater treatment and bioretention best management practices into the *Tree & Landscape Technical Manual,* Standard Conditions of Approval, and Standard Details, and citywide *Sustainability Plan*, Include best practices and other requirements from both Municipal and Regional Permits and emphasize the advantages (or disadvantages) of:

- Planting trees, shrubs, and ground cover to provide an understory and a more complex habitat for birds in private and public landscaping.
- Planting less drought resistant species (e.g., native riparian species that provide habitat), where there is a natural water sources such as a creek or higher water table level—to help provide diversity.
- Planting larger broadleaf trees where there are no overhead wires—to help provide ecological benefits.
- Planting introduced climate adaptive trees in areas that are ideal for bioretention of stormwater.
- Rain gardens and use of condensation water from air-conditioning units to provide water for "thirsty" habitat trees such as willows, sycamores and cottonwoods

Program 5.B.xi. Complete the update of the *Street Tree Management Plan*. Include information,criteria, procedures, and strategies regarding:

- Selecting street tree species.
- Providing for age diversity.
- Ensuring that planting parallels tree removal to avoid canopy and benefit loss.
- Young tree care.
- Preventing loss of viable street tree sites.
- Optimizing opportunities for adding trees for new private development and Capital Improvement projects.
- Canopy disparity between north and south Palo Alto.
- Standards used for line clearing and criteria for selecting contractors.
- Sidewalk repair.
- Recycled water and progress relative to the Salinity Reduction Policy for Recycled Water.
- Benefits to local birds, butterflies, bees, and other pollinators.
- Regeneration of spatially connected native woodland ecosystem.
- Shade for pedestrians.

Program 5.B.xii. Work with relevant departments to improve the way maintenance work done by field crews is documented and uploaded into TreeKeeper and/or the City's GIS. Improvements should explore Smart Phone capabilities as well as the ability for the public to both access information about tree maintenance and contribute information about potential maintenance needs.

Program 5.B.xiii. Consider transferring maintenance responsibilities from Community Services Parks Division to Public Works Urban Forestry Division for:

- All trees on the golf course.
- Trees in developed areas of Open Space (along park roads and around structures/park facilities)

Program 5.B.xiv. Nurture existing volunteer support groups and work with non-profit organizations to reach out to businesses and corporate sponsors for forest-restoration projects.

Program 5.B.xv. Work with relevant departments to explore a collaboration between relevant local fire protection districts and CAL FIRE regarding an educational campaign to inform homeowners about selecting species and pruning trees to achieve "defensible spaces" as part of vegetation management in appropriate areas of the city. Incorporate into *Sustainability Plan* as well as the *Tree and Landscape Technical Manual.*

Program 5.B.xvi. Provide opportunities for training Urban Forest staff and park rangers that include:

- Certification as arborist.
- Certification in pesticide application.
- Education in Integrated Pest Management.
- Education in Best Management Practices for management of invasive plants.
- Education in ecology and native plant management.
- Proficiency in relevant software programs.
- Tree Risk Management Protocols.

Review should include exploration of conferences, in-house training, online training, etc.

Program 5.B.xvii. Develop a flexible staffing model that ensures staffing commensurate to work load increases and decreases. (*Manpower shortages cause delays in project review.)*

Program 5.B.xviii. Work with relevant departments to update development review fees—to accommodate intensification of the review process to ensure that all ecological and environmental concerns are met.

Program 5.B.xix. Work with relevant departments to establish written risk management protocol and training for scheduled inspections.

Goal 6. An Urban Forest that enhances the built environment and connects it to the natural environment.

Policy 6.A. Updates to Palo Alto's Zoning Regulations, Green Building Standards, Standard Conditions of Approval, Standard Details, Green Infrastructure Practices, and stormwater permitting procedures shall consider the following as key factors:

- Conservation of existing trees and replacement of undesirable species when appropriate.
- Appropriate native and introduced climate adaptive species and placement for new trees.
- Respect for regional ecosystems and natural functions.
- Respect for watersheds and wildlife corridors.
- Habitat overlay zones.
- Green space systems within and among communities.
- Absorption of carbon dioxide and air pollutants.
- Responsible storm water management.
- Responsible ground water management.
- Responsible soil conservation.
- Vibrancy of the community.
- Quantification of ecological benefits based on peer-reviewed models such as the analytical software, iTree.

Program 6.A.i. Work with relevant departments, divisions, Canopy, and related organizations to review up-to-date sources for new measures and possible modifications to Palo Alto's Zoning Regulations, Building Standards, Green Building Standards, Standard Conditions of Approval, Standard Details, Green Infrastructure Practices, storm water permitting procedures, and other relevant documents—to ensure currency with environmental laws, best practices, and innovative solutions and to enable the policies and goals of this plan.

Review to include but not be limited to these resources:

- Updated Green Building Standards.
- Sustainable Sites Initiative.
- American Planning Association recommendations for land use objectives and actions.
- Best Practices for responsible stormwater management.
- Best Practices for soil conservation.
- Landscape Resilience Framework and Vision for a resilient Silicon Valley Landscape (San Francisco Estuary Institute.)

Program 6.A.ii. Work with relevant departments to augment project-review standard conditions of approval with:

- Requirements for no net canopy loss per project site.
- Soil volume requirements for trees per species group.
- Habitat connectivity and regeneration of an native woodland ecosystem on a landscape scale.

Program 6.A.iii. Ensure that *(in addition to building standards)* Palo Alto's standards for landscape installations and renovations, consider appropriate species selection and placement of trees—especially relative to existing trees and habitat value.

Program 6.A.iv. Work with relevant departments, Canopy and related organizations to analyze the impact of basement construction—and dewatering by wells and basement sump pumps—on tree health and the urban forest. Focus shall include but not be limited to:

- Soil volume.
- Water table.
- Root impact on the development and/or adjacent sites.

Policy 6.B. Review of both private and public projects will:

Occur early in the design phase.

- Be coordinated with the reviews of other departments.
- Seek ways to add trees, canopy, and habitat benefits.
- Promote solutions that promote regional ecosystems and natural functions including watersheds and wildlife connectivity.
- Promote regionally native and introduced climate adaptive plants and discourage the use of invasive species.
- Promote green space systems within/among communities.
- Promote bicycle and public transportation nodes and routes.
- Promote shade to encourage pedestrian and bicycle mobility.
- Consider absorption of carbon dioxide and air pollutants.
- Evaluate impacts to ecosystems and natural functions.
- Evaluate impacts to watersheds and wildlife corridors.
- Evaluate impacts to stormwater systems.
- Evaluate impacts to existing impervious surfaces.
- Evaluate impacts to groundwater.
- Evaluate impacts to soil volume and quality.
- Evaluate impacts to bird especially re: nesting seasons.

Program 6.B.i. Work with relevant departments and divisions to ensure that the Urban Forestry Division is included in the early phases of design and review of private projects. For discretionary reviewed projects, work with the Planning Department to ensure that in each environmental assessment prepared it will include trees in the aesthetic resources section (designated landscape and public trees) and biological resource section (protected trees) as applicable in the early review phase.

Program 6.B.ii. Work with the relevant departments and divisions to ensure that the Urban Forestry Division is included in the early phases of budgeting (for staff resources) as well as the early phases of design for Capital Improvement Projects.

Program 6.B.iii. Provide education to Urban Forestry staff about innovative ways to add trees to development projects and in limiting situations.

Program 6.B.iv. Provide education to all relevant staff about the "Preferred and Restricted Species List."

Program 6.B.v. Provide education to citywide development review staff about City *Sustainability Plan* priorities and need for staff reports to include information about the role of trees in moderating potential negative impacts to the environment or add beneficial services related to:

- Canopy.
- Birds and pollinators.
- Watershed health.
- Storm water systems.
- Ground water stability.
- The need for adequate soil volume and/or quality.
- Soil stability on hillsides.
- The value of trees with regard to aesthetics and privacy concerns.

Program 6.B.vi. Educate citywide development review staff about City priorities and need for staff reports to include information about potential opportunities to enhance:

- The vibrancy of the community including economy and employment opportunities e.g., teen career opportunities, training, and local food production.
- Human health benefits —both physical and psycho-social health—of green spaces within and among communities.
- Bicycle and public-transportation nodes and routes.

Program 6.B.vii. Provide education to citywide development review staff to ensure that tree maintenance practices continue to consider bird nesting seasons.

Program 6.B.viii. Work with Canopy and other stakeholders to educate the development community about the need to discuss trees during the early stage of a project's design.

Program 6.B.ix. Work with Santa Clara Valley Audubon Society and other organizations to educate the development community about minimizing project effects on local wildlife.

Policy 6.C. Strive for no net loss /increase in canopy cover.

Program 6.C.i. Continue to enforce the City's Tree Protection Ordinance but also review it to ensure that it reflects state water efficiency standards as well as this master plan's goals for regeneration of native woodland landscape.

Program 6.C.ii. Evaluate needs and benefits of a possible requirement that digital information about protected trees be submitted to the City as a condition of approval for permit applications.

Program 6.C.iii. Work with relevant departments to develop canopy thresholds—possibly based on zoning and land use goals of the *Comprehensive Plan*. Consider appropriateness to the ecotype e.g., Baylands canopy should be much less than riparian corridors.

Note: This program does not intend to concentrate plantings in open space grasslands and, thereby, reduce plantings in developed areas. Thresholds suggested by organizations such as American Forests may be helpful as guidelines. However, where such suggestions are less than existing density, they should not imply a need or desire to reduce density.

Policy 6.D. Strive for canopy equity—prioritizing areas in which the UC Davis report indicated a decrease between 1982 and 2010.

Program 6.D.i. Investigate reasons for less canopy in south Palo Alto. This should include evaluation of:

- Development review procedures.
- Maintenance activities and contracts
- Property-owner objections to street trees.
- Prohibitive physical conditions such as soil type, absence of planting strip, etc.

Program 6.D.ii. Develop strategies to end the trend of decreasing canopy in South Palo Alto e.g.,

- Work with Canopy and stakeholders such as Acterra, the California Native Plant Society, and the Audubon Society on an outreach program to ensure residents, property owners, and business owners understand how their decisions affect the canopy and encourage them to plant trees.
- Create incentives for home and business owners.
- Add new planting sites for street trees where possible—and focus on planting native species.
- Incorporate the use of interactive open source mapping.

Program 6.D.iii. Ensure that staff and contractors performing maintenance tasks in South Palo Alto know that preserving and increasing the canopy—and focus on native and introduced climate adaptive species—in South Palo Alto is a City priority.

Program 6.D.iv. Ensure adequate budget to accomplish the strategies—including incentives—for preserving and increasing the canopy in South Palo Alto.

Policy 6.E . Recognize El Camino Real's importance as the preeminent link between Palo Alto and adjoining communities.

Program 6.E.i. Utilize the following resources when reviewing projects on El Camino Real:

- *El Camino Real Master Planning Guidelines and Appendices.* Incorporate into sidewalk maintenance replacement contracts and *Landscape Technical Manual,* the remedial specification BMP's for existing trees (Appendix 5) and design guidelines for new trees.(Section 5.4)
- Appropriate scenic design plans
- Appropriate plans of nearby jurisdictions and agencies
- Santa Clara Valley Urban Runoff Pollution Prevention Program

Program 6.E.ii. Coordinate with nearby jurisdictions and agencies regarding trees within the El Camino Real Corridor e.g.,

- Management of existing trees.
- Development impacts and opportunities.
- Projected future needs.
- Grand Boulevard Project.

Note: These guidelines for reviewing projects within the El Camino Real Corridor should be reflected in the Tree Technical Manual.

Policy 6.F. Private and public landscape and irrigation plans that include both trees and turf will be reviewed to ensure that each is provided enough independent space to ensure that their differing maintenance needs can be met efficiently e.g., so that:

- Water can be applied appropriately and efficiently.
- Nearby plantings will support optimal performance e.g., only forest species *(e.g., understory species)* should be planted near trees whereas turf areas may support ornamental landscape plants *(e.g., plants requiring more frequent watering.)*

Program 6.F.i. Develop a *Landscape Technical Manual* that aggregates landscape requirements and best management practices from all relevant sections of the Municipal Code as well as the *Baylands Master Plan, El Camino Real Master Plan* and Appendices, *Comprehensive Plan, Sustainability Plan, Green Building Code*, and T*ree Technical Manual.* Focus to include but not be limited to:

- Solutions to promote canopy equity for South Palo Alto e.g., planting, soil, and watering recommendations.
- Special concerns related to the development of properties within OS (Open Space) and Residential Estate Zoning Districts e.g., fire safe landscapes and hydroseeding.
- Retention of existing mature (non-invasive) trees.
- Regeneration of an native woodland ecosystem on a landscape scale.

Policy 6.G. Provide incentives to increase canopy and ecological benefits.

Program 6.G.i. Work with relevant departments to monitor and comment on proposed changes to relevent zoning policies and regulations to ensure that the process considers the impacts on the ability to add tree canopy and to preserve planting sites. If changes to zoning policies and regulations occur, look for opportunities to increase the canopy.

Program 6.G.ii. Work with relevant departments to develop incentives to retain and plant trees—and where appropriate, trees of high habitat value and fruit trees—through additional points via LEED certification , Build It Green (BIG) Green Points, Backyard Habitat Programs, and/or similar certification systems such as those defined by the Sustainable Sites Initiative, the National Wildlife Federation, and the San Francisco Estuary Institute's Vision for a Resilient Silicon Valley.

Program 6.G.iii. Work with relevant departments to explore the feasibility of a tree adoption program—possibly to be modeled after programs offered by the Sacramento Municipal Utility District (SMUD) which has been operating successfully for 15 years.

Policy 6.H. Minimize the negative effect on the urban forest from development and infrastructure maintenance.

Program 6.H.i. Work with relevant departments to review line clearing standards and criteria for selecting contractors; publish on the Urban Forest website.

Program 6..H.ii. Work with relevant departments to analyze and resolve conflicts regarding the space required between utilities underground equipment and other criteria related to what makes a planting site viable for street trees.

Program 6.H.iii. Evaluate the current street tree pruning program and the possible advantages of a more frequent pruning cycle. Ensure that pruning continues to consider bird nesting seasons.

Program 6.H.iv. Work with relevant departments to create criteria for minimum tree plantings as development requirements.

Program 6.H.v. Work with relevant departments to review and update current fines and incentives as related to tree malpractice and vandalism.

Program 6.H.vi. Work with relevant departments to amend fee schedule to include development fees to enable appropriate participation in project review, building and other permit issuance, regulatory compliance, and auditing.

Policy 6.I. Approved development plans shall not be modified in any way that may affect street trees or approved landscape plans without review of those modifications by the Urban Forestry Division.

Program 6.I.i. Work with relevant departments to reevaluate and adjust development review fees to accommodate work load increases and staffing impacts if necessary in order to address:

- Failure to include tree protection review in the permitting process.
- Failure to comply with tree protection requirements.
- Unapproved modifications to approved plans—made in the field.

Policy 6.J. Strive for optimal conditions in the natural areas of the city preserves and open spaces.

Note: the needs of preserves and open spaces may differ from those of the urban forest and Resource Management Plans—specific to those environments—are needed.

Program 6.J.i.. Ensure that the follow up citywide canopy cover analysis *(Program 5.A.i.)* is sufficient to establish a baseline of canopy cover in the city's preserves and open spaces.

Note: Natural habitats are complex and it is important to keep both habitat diversity and specific species interactions in mind when dealing with natural areas. Therefore, although the percentage of canopy cover in the natural areas is worth monitoring, it may not have the same relevance—in terms of optimal conditions—as it does in the urban forest.

Program 6.J.ii. Establish a baseline for relevant information to be monitored—in addition to canopy cover—such as native versus non-native species populations.

A statistically valid sample should be collected to analyze current conditions. Sampling methodology should enable long term monitoring, direct management decisions, and analyze the effectiveness of current practices. A permanent plot system would be an option.

Experimentation in conjunction with analysis of natural regeneration practices, simulated disturbance regimes, and predation relationships should be employed.

Note: This is not redundant with programs 5.A.iii. the analysis of 5.A.iii. will inform this task.

Program 6.J.iii. Work with relevant departments to develop a long-range budget for tree management and maintenance in the open spaces that includes:

- Tree inspections.
- Tree removal and replacements.
- Forest restoration.
- Training for rangers.
- Technology for tracking maintenance tasks.
- Retention of dead trees and snags.
- Protection of native volunteer saplings.
- Survey of invasive tree species.
- Mapping of soil types and depth to water table to inform selection of ideal locations for a variety of tree species.
- A plan to increase native canopy and decrease the population of invasive tree species—and monitor results.

Program 6.J.iv. Work with relevant departments to develop a Comprehensive Conservation Plan that includes and/or considers:

- Up-to-date information regarding Sudden Oak Death Disease and other pathogens that impact the local ecosystem.
- Maintaining healthy ecosystems by reducing the impact on trees by the implementation of fire management plans.
- Best Management Practices for forest restoration.
- A well-defined plan for tree replacement within the parks and open spaces.
- Detailed map of locations of sensitive species.
  Consideration of snags and dead trees.
- Protection of native volunteer tree saplings.
- Consideration for removal of invasive trees and replacement with native trees.
- Trail placement that avoids impacts to native trees and sensitive understory species.

Program 6.J.v. Work with relevant departments to update existing park plans and/or develop new plans to ensure that tree issues are addressed.

Program 6..J.vi. Coordinate between departments and outside partners re:

- Appropriate mixes of trees, shrubs, and grasses
- Natural cycles of disturbance such as fire
- Response to use and impacts.
- Appreciation by the community.

Program 6.J.vii. Ensure that the "Restricted Species List" includes consideration of species appropriate for the golf course, parks, preserves, and open spaces e.g.,

- Importance of native species in natural areas.

- Importance of avoiding invasive species.
- Importance of fruit trees.
- Need for evergreen canopy to support watershed protection and wildlife habitat.
- Need for shrub and understory species for increased and multi-layered canopy and habitat.
- Maintenance impacts of root damage to trails.
- Maintenance impact of litter on playing fields.

Program 6.J.viii. Work with Canopy to educate the community regarding the necessity of tree removals— and where safe, snag preservation—in the parks and open spaces.

Program 6.J.ix. Work with relevant departments to ensure consideration of tree preservation and tree replacement for capital improvement projects within city parks and open spaces.

Implementation Plan

2nd Edition

In May of 2015, the City Council adopted the Urban Forest Master Plan—and directed staff to develop a 2nd Edition of the "Goals, Policies, and Programs.

In April of 2016, the City Council adopted the 2nd Edition "Goals, Policies, and Programs"--and directed staff to make minor modification

The following timeline, implementation plan, and annual budget needs apply to the 2nd Edition programs *(adopted in April 2016)* **as well as the modifications directed by the City Council at that time. Timing and amounts are approximate.**

Some programs will require collaboration between departments and/or changes to the Municipal Code.

Some programs support the main focus by means of technology, administration, partner-ships, and monitoring.

For readability, the program are abbreviated; for complete language, see "Goals, Policies,& Programs" section.

Attachment B

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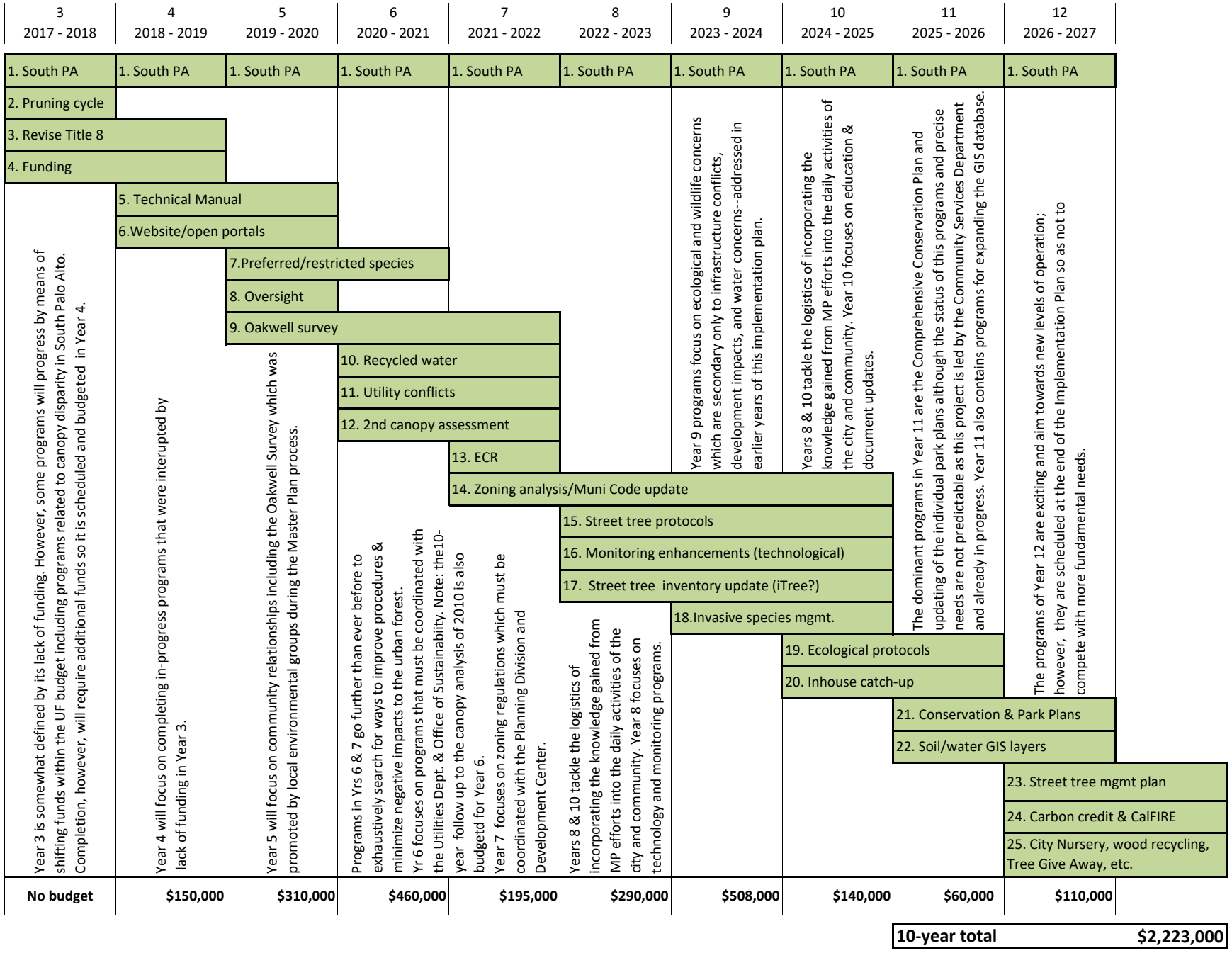
Implementation Timeline & Annual Budget Needs for the Remaining Years of the **2nd Edition** of the ***Urban Forest Master Plan***



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Completed Years 1 & 2 — July 1, 2015 thru June 30, 2017 — Yrs 1-2

In years 1 & 2 the South Palo Alto analysis was completed enabling work towards increasing that area of canopy to begin in year 3. The online tree library was also completed providing a helpful tool for species selection. The UF staff began several inhouse interdepartmental dialogs pertaining to organization and procedure--which will be continued as other programs are implemented. Staff collaborated with local environmental groups and produced the 2nd Edition of the UFMP in which programs have been added or enhanced to A) require more rigorous attention to ecological concerns during development review and B) collect and monitor more data about ecological conditions.

	Overview of Program or Program Group		Individual Programs		Costs
1	COMPLETED as 1.D.i.: Findings presented to CC in 2017.	6.D.i.	Investigate reasons for less canopy in south Palo Alto…	NA	**NA**
2	COMPLETED as 1.A.i.: Tree library is now available via UF & Canopy websites.	1.A.i.	Work with Canopy to complete the online "Tree Library" to achieve a helpful tool for staff and property owners.	NA	**NA**
3	COMPLETED as 3.Ai., 3.A.vii., & 4.i.xiii. UF Division collaborated with Canopy, California Native Plant Society, Acterra, the Santa Clara Valley Audubon Society to incorporate additional ecologically oriented paramaters and requirements into the programs for this 2nd Edition. UF Division collaborated w/stakeholders to revise outreach/notification procedures for utility pruning--and w/ local realtors about distributing FAQ list. Stewardship Agreement with Acterra enhanced to protect native seedlings within Arastradero Preserve.	4.A.i.	Work with Canopy and stakeholders such as the California Native Plant Society, Acterra, the Santa Clara Valley Audubon Society to conduct at least 4 community outreach meetings to educate and get feedback: Introduce the website as a resource, Discuss "Hot Topics" from Master Plan survey, Discuss interactive open-source mapping.	NA	**NA**
		4.A.vii.	Work with Canopy the California Native Plant Society, Acterra, and the Santa Clara Valley Audubon Society to develop the content for outreach possibilities such as city mailings, e-mail blasts, door hangers, bill inserts, social media, press releases, and newspaper columns.	NA	
		5.B.xiv.	Nurture existing volunteer support groups and work with non-profit organizations to reach out to businesses and corporate sponsors for forest-restoration projects.	NA	
4	COMPLETED as 3.A.iv.: Stanford tree tour piloted in October of 2015. Stanford pruning workshop held in July 2016.	4.A.iv.	Continue pruning workshops and tree tours and consider additional ways for community and staff to interact.	NA	**NA**

Completed programs continued on next page

5	COMPLETED as 2.B.i,. 4.B.ii., 4.K.ii., 4.K.iii., 4.I.xii., 4.I.xi., 3.B.i., The new Urban Forester has begun discussions to identify and mitigate the potential conflicts between the multiple departments and disciplines of the city's functions. So far.... UF Division's role at the DRC meetings formalized / counter technicians trained to provide back up for UF staff. Power Point presentation developed for both staff & developers (at DC.) Initiated contract for an arborist to review the IR compliance requirements regarding tree protection. The UF and Parks Divisions jointly updated language in Parks Master Plan-- also coordinating with the JPA and SCVWD regarding impacts along San Francisquito Creek and Palo Alto Golf Course. Parks Division staff can now log into TreeKeeper to input data / produce reports. The UF Division developed / presented possible design solutions to the Engineering Division re: future sidewalk design and maintenance tasks.	3.B.i.	Formalize the Urban Forester's role relative to: • Citywide Sustainability Plan; • Development of citywide policy; • Inter-departmental collaboration; • Technical advice.	NA	**NA**
		6.B.i.	Ensure that the UF Division is included in the early phases of design and review of private projects. For discretionary review projects, work with Planning to ensure that each environmental assessment... will include trees in the aesthetic resources section... and biological resource section... as applicable in the early review phase.	NA	
		6.B.viii.	Work with Canopy to educate the development community about the need to discuss trees during the early stage of a project's design.	NA	
		5.B.xvii.	Develop a flexible staffing model that ensures staffing commensurate to work load increases and decreases.	NA	
		5.B.xiii.	Consider transferring maintenance responsibilities from Community Services Parks Division to Public Works Urban Forestry Division for: • All trees on the golf course. • Trees in developed areas of Open Space (along park roads and around structures/park facilities)	NA	
		6.J.ix.	Ensure consideration of tree preservation and tree replacement for capital improvement projects within city parks and open spaces.	NA	
		4.B.i.	Explore ways to avoid root damage to sidewalks… explore root barriers and solutions such as meandering sidewalks around trees, suspending sidewalks above tree roots, and replacing concrete sidewalks with recycled rubber sidewalks.	NA	
6	COMPLETED as 3.A.iv.: Stanford tree tour (by Canopy) piloted in October of 2015. Stanford pruning workshop held in July 2016.	4.A.iv.	Continue pruning workshops and tree tours and consider additional ways for community and staff to interact.	NA	**NA**
Completed Programs (Yrs 1 & 2)					**NA**

Year 3 July 1, 2017 thru June 30, 2018 — Yr 3

Year 3 is somewhat defined by its lack of funding. However, some programs progressed by means of shifting funds within the UF budget. *Note: Programs related to canopy disparity in South Palo Alto will also progress in Year 3 by means of shifting funds within the UF budget; however, completion will require additional funds so it is scheduled and budgeted in Year 4.*

Overview of Program or Program Group		Individual Programs	Costs Program	Costs Group
1 This MP priority is long range and recurs in each remaing year of the plan. Based on the analysis done in Yrs 1 & 2 (Program 6.D.i.), these programs aim to ensure the addition of at least 1000 trees per year. Work commences in Year 3--even without specific funding by shifting existing funds within the UF budget. Continued progress inYears 4 through 12 will rely on specific funding.	6.D.ii.	Develop strategies to end the trend of decreasing canopy in South Palo Alto….	NA	**NA**
	6.D.iii.	Ensure that staff and contractors performing maintenance tasks in South Palo Alto know that preserving and increasing the canopy—and focus on native and introduced climate adaptive species—in South Palo Alto is a City priority.		
2 The City Council identified this as a priority and although there is no funding for Year 3, it is scheduled for completion by means of shifting funds within the UF budget.	6.H.iii.	Evaluate the current street tree pruning program and the possible advantages of a more frequent pruning cycle. Ensure that pruning continues to consider bird nesting seasons.	NA	**NA**
3 This program is ongoing and even though there is no funding in Year 3, progress will continue by means of shifting funds within the UF budget. The main task in Year 3 will be to revise Title 8 of the Muni Code, "Trees and Vegetation."	6.C.i.	Continue to enforce the City's Tree Protection Ordinance but also review it to ensure that it reflects state water efficiency standards as well as this Master Plan's goals for regeneration of native woodland landscape	NA	**NA**

Year 3 continuted on next page

4	6.H.vi.	Amend fee schedule to include development fees to enable appropriate participation in project review, building and other permit issuance, regulatory compliance, and auditing.		
	5.B.xviii.	Work with relevant departments to update development fees--to accommodate intensification of the review process to ensure that all ecological and environmental concerns are met.		
	3.A.vii.	Work with the city's Office of Sustainability to reevaluate costs and fees related to efforts to coordinate sustainability programs.	NA	
	6.I.i.	Reevaluate and adjust development review fees to accommodate work load increases and staffing impacts…		
These funding-oriented programs reflect multiple constituencies and vantage points; however, they have been consolidated in Year 3 for discussion--with the goal of precipitating funding in Years 4-12. Discussion resulted in the conclusion that implementation of the UFMP should be an ongoing budget adjustment.	6.H.v.	Review and update current fines and incentives as related to tree malpractice and vandalism.		
	6.J.iii.	Develop long range operating budget that includes: •Inspections; •Removal / replacements; • Restoration.; Training; •Technology; •Retention of dead trees and snags; •Protection of native saplings.; Survey of invasive species; •Mapping of soil and water table; •Increase native/decrease invasives—monitor results.		**NA**
	3.A.vi.	Work with the city's Office of Sustainability to explore new funding sources for the Urban Forestry program.	NA	
	6.B.ii.	Ensure that the Urban Forestry Division is included in the early phases of budgeting (for staff resources) as well as the early phases of design for Capital Improvement Projects.		
	6.D.iv.	Ensure adequate budget to accomplish the strategies for preserving and increasing the canopy in South Palo Alto.		
	4.B.iv.	Work with relevant departments to develop funding goals and strategies for desired tree pruning cycle.	NA	
Year 3 total				**NA**

Year 4 July 1, 2018 thru June 30, 2019 — Yr 4

Year 4 will focus on completing in-progress programs that were interupted by lack of funding in Year 3.

Overview of Program or Program Group		Individual Programs	Costs Program	Costs Group
1 This MP priority is long range and recurs in each remaing year of the plan. Based on the analysis done in Yrs 1 & 2 (Program 6.D.i.), these programs aim to ensure the addition of at least 300 trees per year. Work commences in Year 3--even without specific funding by shifting existing funds within the UF budget. Continues progress inYears 4 through 12 will rely on specific funding.	6.D.ii.	Develop strategies to end the trend of decreasing canopy in South Palo Alto….		
	6.D.iii.	Ensure that staff and contractors performing maintenance tasks in South Palo Alto know that preserving and increasing the canopy—and focus on native and introduced climate adaptive species—in South Palo Alto is a City priority.	$50,000	**$50,000**
5 Updating the *Tree Technical Manual* is now merged with devleoping a *Tree & Landscape Technical Manual*-- and is in progress. Completion of the manual will encompass all the programs within this group. *Note: Funding will be provided by means of shifting $55,000 from existing funds previously allocated for Years 1& 2.*	5.B.ix.	Update the *Tree Technical Manual*		
	6.F.i.	Develop a *Tree & Landscape Technical Manual (T&LTM)*		
	6.J.vi.	Coordinate between departments and with partners re: • Appropriate mixes of trees, shrubs, and grasses; • Natural cycles of disturbance such as fire; • Response to use and impacts; and • Appreciation by the community.		
	5.B.x.	Incorporate stormwater treatment and bioretention BMPs into the *T&LTM*….		
	3.D.i.	Review existing procedures and protocols for using mulch to suppress weeds (including state requirements) and develop site-specific criteria to ensure minimal impacts to wildlife…	$0	**$0**
	3.D.ii.	To prevent runoff of polluted water, avoid use of recycled-tire or synthetic mulch and discourage use of recycled-tire or synthetic mulch on private property		
	3.D.iii.	To prevent runoff of polluted water, avoid use of dyed mulch and discourage use of dyed mulch on private property.		
	3.B.ii.	Work with the *Office of Sustainability* and environmental groups to develop a "Landscape Sustainability Checklist"—for development review.		

Year 4 continuted on next page

7	4.A.vi.	Develop a capability for community input on the Urban Forestry website.	$10,000	
These programs aim to make the UF website an easy means of communication--and a useful tool.	5.B.iii.	Develop open portals for data entry as a way of engaging the community as partners in stewardship and to improve data currency and accuracy….Ensure compatibility with mobile reporting application developed by the city.	$10,000	
15	5.B.xii.	Improve the way maintenance work is documented/uploaded into TreeKeeper/GIS. Explore Smart Phone capabilities as well as the ability for the public to both access information about tree maintenance and contribute information about maintenance needs.	$10,000	**$100,000**
	5.B.v.	Integrate the information in Tree-Keeper with the city's GIS to enable review of the relationship between trees and other relevant geographic information such as parcel lines, land uses, zoning, soil types, watersheds, creeks, pavement, hazard areas, and utility infrastructure.	$60,000	
21	5.B.iv.	Update the City's GIS and Tree Keeper database information about trees within the 32 parks, Municipal Golf Course, utility easements, city facilities, and city-owned property such as fire stations—to ensure completeness and accuracy.	$10,000	
Year 4 total				**$150,000**

Year 5 July 1, 2019 thru June 30, 2020 — Yr 5

Year 5 will focus on community relationships including the Oakwell Survey which was promoted by local environmental groups during the Master Plan process.

Overview of Program or Program Group		Individual Programs	Costs: Program	Costs: Group
1 This MP priority is long range and recurs in each remaing year of the plan. Based on the analysis done in Yrs 1 & 2 (Program 6.D.i.), these programs aim to ensure the addition of at least 300 trees per year. Work commences in Year 3--even without specific funding by shifting existing funds within the UF budget. Continues progress inYears 4 through 12 will rely on specific funding.	6.D.ii.	Develop strategies to end the trend of decreasing canopy in South Palo Alto….		
	6.D.iii.	Ensure that staff and contractors performing maintenance tasks in South Palo Alto know that preserving and increasing the canopy—and focus on native and introduced climate adaptive species—in South Palo Alto is a City priority.	$0	**$0**
6 Development of the "Preferred and Restricted Species List" will be informed by the "Tree Library" (Program 1.A.i.) and will--inturn--inform the Tree & Landscape Technical Manual (Program 6.F.i.,) Completion will encompass the other programs in this group. Funding for this group is budgeted for Year 5; completion may take more than one year.	1.A.ii.	Work with Canopy and stakeholders to develop a "Preferred and Restricted Species List" that will be a helpful tool for staff and property owners.		
	6.J.vii.	Ensure that the "Restricted Species List" includes consideration of species appropriate for the golf course, parks, preserves, and open spaces e.g., importance of native species, avoiding invasive species, fruit trees, watershed protection, wildlife habitat, need for understory species, layerd canopy, root damage to trails, and litter on playing fields.		
	3.A.i.	Work with the *Office of Sustainability* and environmental groups to ensure that the "Preferred and Restricted Species List" complements the City's Sustainability Plan.		
	1.A.iii.	Develop site-specific species selection protocols to complement the "Preferred and Restricted Species List"	$75,000	**$75,000**
	1.A.iii.	Work with Canopy and stakeholders to develop site-specific-species-protocols to complement the "Preferred Species List"…		
	6.B.iv.	Provide education to all relevant staff about the "Preferred and Restricted Species List."		
	1.B.i.	Work with Canopy to encourage local and regional nurseries and garden centers to defer to stock the "preferred species"…		
	1.A.iv.	Manage species diversity in such a way as to: • Emphasize regeneration of a native woodland landscape. • Avoid monocultures that create vulnerability.		

Year 5 continuted on next page

8				
These programs seek to establish a forum for interaction and explore the possibility of an oversight group simililar to existing boards and commissions.	3.A.iii.	Work with the city's Office of Sustainability to evaluate the establishment of an oversight group... to investigate and comment on the impact of projects on the urban forest and overall ecosystem—and monitor the progress of the *Urban Forest Master Plan* goals.	$55,000	**$55,000**
	4.A.iii	Work with Canopy and stakeholders such as the California Native Plant Society, Acterra, and the Santa Clara Valley Audubon Society to establish a recurring forum that provides the community an opportunity to communicate with staff and members of the decision making bodies...		
9				
Local environmental groups have expressed an urgent need to update the Oakwell survey done in 1997 and have contributed several programs related to that need. These programs will involve the participation of Canopy and local environmental groups. Funding is budgeted for Year 5; it may take multiple years to complete these programs.	2.A.i.	Update the Oakwell survey to: • Assess changes since 1997; • Evaluate the health/take actions to improve conditions; • Evaluate gaps and opportunities.	$30,000	**$180,000**
	2.A.ii.	Incorporate the Oakwell survey data into Tree-Keeper, the City's GIS, and an interactive open-source mapping system such as OpenTreeMap.	$15,000	
	2.A.vii.	Create educational materials on oak tree care and pro actively reach out to property owners, landscaping firms, real estate agents and other audiences to educate them about the importance of oaks, other native, and introduced climate adaptive trees and how to care for these trees.	$45,000	
	2.A.viii.	When a property transfers, provide information on how to care for oaks	$45,000	
	4.A.xi.	Partner with Acterra, Audubon and California Native Plant Society to develop educational materials and workshops on native woodland ecosystems, other native habitats and the benefits of native tree species in the urban landscape for both the public and urban forestry staff.	$30,000	
	5.B.vi.	Use the City's GIS system to highlight native trees especially oak species, and create a layer that identifies connectivity and spatial distribution of oaks and riparian tree species.	$15,000	
Year 5 total				**$310,000**

Year 6 July 1, 2020 thru June 30, 2021 — Yr 6

Programs in Yrs 6 & 7 go further than ever before to exhaustively search for ways to improve procedures & minimize negative impacts to the urban forest. **Yr 6 focuses on programs that must be coordinated with the Utilities Dept. & Office of Sustainabiity.** *Note: the10-year follow up to the canopy analysis of 2010 is also budgetd for Year 6.*

Overview of Program or Program Group		Individual Programs	Costs: Program	Costs: Group
1 This MP priority is long range and recurs in each remaing year of the plan. Based on the analysis done in Yrs 1 & 2 (Program 6.D.i.), these programs aim to ensure the addition of at least 1000 trees per year. Work commences in Year 3--even without specific funding by shifting existing funds within the UF budget. Progress inYears 4 through 12 will rely on partnership funding beyond the budget shown.	6.D.ii.	Develop strategies to end the trend of decreasing canopy in South Palo Alto….	$0	**$0**
	6.D.iii.	Ensure that staff and contractors performing maintenance tasks in South Palo Alto know that preserving and increasing the canopy—and focus on native and introduced climate adaptive species—in South Palo Alto is a City priority.		
10 These Year 6 programs address a variety of water concerns. Success will involve the cooperation of the Office of Sustainabiity, multiple departments, and possible changes to the Munidipal Code. ** Note: Program 3.C.iv. (emergency program to provide water to trees during severe drought) aims to ensure that money is held in reserve for if and when needed. These reserves do not necessarily need to be associated with funding for the UFMP. Rather, these funds can be part of citywide emergency funds.*	3.C.ii.	Develop a report re: achievements towards reducing salinity of recycled water from the RWQCP since Resolution 9035.	$8,000	**$235,000**
	3.C.iii.	Work with Canopy and stakeholders… to develop a list of tree species appropriate for use in areas where recycled water is or may be used for irrigation.	$1,000	
	3.C.i.	Review existing monitoring programs regarding the use of recycled water for landscape irrigation at the Municipal Golf Course and Greer Park. Modify as needed.	$8,000	
	3.C.vi.	Emphasize the Utilities Department's "Waste Avoidance" programs (for water) on the Urban Forestry website.	$1,000	
	3.C.iv.	Work with relevant departments to develop an emergency program to provide water to trees during severe drought.*	$200,000	
	3.C.v.	Work with relevant departments to encourage construction of rain gardens and use of condensation water from air-conditioning units, groundwater dewatering water, and hydrant flushing water to provide water for "thirsty" habitat trees…	$17,000	

Year 6 continuted on next page

11				
These Year 6 programs focus on improvements that must be worked out with the help of the Utilities Department and are fundamental to sustaining Palo Alto's legacy of beautiful tree-lined streets. * Note: Programs 6.H.ii., 4.B.ii, 6.H.i., & 4.B.iii. funded by Utilities Depart.	6.H.ii.	Analyze and resolve conflicts regarding the space required between utilities underground equipment and other criteria related to what makes a planting site viable for street trees.*	$0	**$50,000**
	4.B.ii.	Explore ways to prevent conflicts between tree roots and underground infrastructure such as requirements that limit the location of underground utilities to a corridor…*		
	6.H.i.	Review line clearing standards and criteria for selecting contractors; publish on the Urban Forest website.*		
	4.B.iii.	Develop ways to avoid disfigurement of trees from power line clearing such as running the power lines through protective conduits that don't require as much clearance.*		
	3.A.iv.	Work with the Utilities Department to publish tools and priorities for citing of solar collection devices. Same	$25,000	
	3.A.v.	Work with the city's Office of Sustainability and/or the Utilities Department and Canopy to create a guidance document—how to successfully incorporate solar collection and trees into site design—for those considering solar.	$25,000	
12				
A canopy comparison (1982 to 2010) was done to inform this MP. It clarified many questions about development impacts and identified where the urban forest most needed help. Subsequent discussions indicated a desire to repeat a similar comparison every 10 years.	6.J.i.	Ensure that the follow up citywide canopy cover analysis (Program 5.A.i.) is sufficient to establish a baseline of canopy cover in the city's preserves and open spaces.	$175,000	**$175,000**
	5.A.i.	Follow up the 2010 canopy cover assessment done by UC Davis that established the baseline for this master plan—with a similar assessment in approximately 2020. Present a comparison of the two assessments to the City Council.		
	6.J.ii.	Establish a baseline for relevant information to be monitored (in addition to canopy cover). *Note: This is not necessarily redundant with Program 5.A.iii..*		
Year 6 total				**$460,000**

Year 7 July 1, 2021 thru June 30, 2022 — Yr 7

Programs in Years 6 & 7 go further than ever before to exhaustively search for ways to improve procedures and minimize negative impacts to the urban forest. **Year 7 focuses on zoning regulations which must be coordinated with the Planning Division and Development Center.**

Overview of Program or Program Group		Individual Programs	Costs Program	Costs Group
1 This MP priority is long range and recurs in each remaing year of the plan. Based on the analysis done in Yrs 1 & 2 (Program 6.D.i.), these programs aim to ensure the addition of at least 1000 trees per year. Work commences in Year 3--even without specific funding by shifting existing funds within the UF budget. Progress inYears 4 through 12 will rely on partnership funding beyond the budget shown.	6.D.ii.	Develop strategies to end the trend of decreasing canopy in South Palo Alto….	$0	**$0**
	6.D.iii.	Ensure that staff and contractors performing maintenance tasks in South Palo Alto know that preserving and increasing the canopy—and focus on native and introduced climate adaptive species—in South Palo Alto is a City priority.		
13 Like Group 12, these programs also involve Zoning; and therefore, coordination with the Planning Division. The initial scope of these programs was completed in 2016; however, 2nd Edition augmentation will likely require furrther review and additional efforts. * *Note: Most costs associated with these programs should be funded by application fees. Although some changes to the fees and fines were accomplished in Year 2, additional changes may be required. Further review of fees and fines is scheduled for Year--Program Group 4.*	6.E.i.	Utilize the following resources when reviewing projects on El Camino Real (ECR): • ECR Master Planning Guidelines.; •... scenic design plans; • ... plans of nearby jurisdictions and agencies; and • County Urban Runoff Pollution Prevention Program.*	$0	**$0**
	6.E.ii.	Coordinate with nearby jurisdictions/agencies re: trees within the ECR Corridor e.g., • Management of existing trees; • ...impacts and opportunities; and •...future needs; • Grand Boulevard Project.*		

Year 7 continuted on next page

14					
	1.C.iii.	Evaluate implementation/effectiveness of the requirement for 50% shading for parking lots and identified heat islands. Identify reasons for success and or failure. Modify as needed.	$45,000	
	6.A.iv.	Analyze the impact of basement construction—and dewatering by wells and basement sump pumps—on tree health and the urban forest. Focus shall include but not be limited to: • Soil volume; • Water table; • Root impact on the development and/or adjacent sites.	$50,000	
These Year 7 programs focus on improvements that can only be provided through zoning-and can only be accomplished with the help of the Planning Division. These programs are fundamental to sustaining Palo Alto's legacy of an urban canopy that is above average in density. These programs will likely require changes to Title 18 of the Municipal Code, "Zoning."	6.G.i.	Work with relevant departments to monitor and comment on zoning changes.		
	6.C.iii.	Develop canopy thresholds— possibly based on zoning and land use goals of the Comprehensive Plan…		
	6.G.ii.	Develop incentives to retain/plant trees...of high habitat value and fruit trees—through... LEEDs , Build It Green, Green Points, & Backyard Habitat Programs, and/or similar...such as defined by Sustainable Sites Initiative, National Wildlife Federation, and San Francisco Estuary Institute's Vision for a Resilient Silicon Valley.		**$195,000**
	1.C.iv.	Develop requirements for new commercial, multi-unit, and single-family housing development projects to provide street trees (or space for future trees) and related irrigation systems. *Note: The requirement for public art may be a useful model.*	$100,000	
	6.A.iii.	Ensure that (in addition to building standards) Palo Alto's standards for landscape installations and renovations, consider appropriate species selection and placement of trees—especially relative to existing trees and habitat value.		
	6.H.iv.	Work with relevant departments to create criteria for minimum tree plantings as development requirements.		
	6.A.ii.	Augment project-review standard conditions w/ • Requirements for no net canopy loss per project site; • Soil volume requirements for trees per species group.; and • Habitat connectivity and regeneration of a native woodland ecosystem on a landscape scale.		
Year 7 total				**$195,000**

Year 8 July 1, 2022 thru June 30, 2023 — Yr 8

Years 8 & 10 tackle the logistics of incorporating the knowledge gained from MP efforts into the daily activities of the city and community. **Year 8 focuses on technology and monitoring programs.**

Overview of Program or Program Group		Individual Programs	Costs Program	Costs Group
1 This MP priority is long range and recurs in each remaing year of the plan. Based on the analysis done in Yrs 1 & 2 (Program 6.D.i.), these programs aim to ensure the addition of at least 1000 trees per year. Work commences in Year 3--even without specific funding by shifting existing funds within the UF budget. Progress inYears 4 through 12 will rely on partnership funding beyond the budget shown.	6.D.ii.	Develop strategies to end the trend of decreasing canopy in South Palo Alto….	$0	**$0**
	6.D.iii.	Ensure that staff and contractors performing maintenance tasks in South Palo Alto know that preserving and increasing the canopy—and focus on native and introduced climate adaptive species—in South Palo Alto is a City priority.		
15 These programs aim to monitor the city's commitment to achieving a 98% stocking level for street trees.	1.C.i.	Develop criteria for viable street tree planting sites, increased planting of street trees, and related protocols to ensure stocking level of 98%.	$70,000	**$70,000**
	1.C.ii.	Use criteria for viable street planting sites to review and update information about existing and available viable sites in TreeKeeper, and GIS—as well as an interactive open-source mapping solution such as OpenTreeMap.		
	1.D.i.	Develop a monitoring program and produce annual reports of removals and plantings to show progress toward the goal of 98% full stocking of identified viable planting sites within right-of-ways and parks.		
	5.B.xii.	Improve the way maintenance work is documented/uploaded into TreeKeeper/GIS. Explore Smart Phone capabilities as well as the ability for the public to both access information about tree maintenance and contribute information about maintenance needs.		
	5.B.v.	Integrate the information in Tree-Keeper with the city's GIS to enable review of the relationship between trees and other relevant geographic information such as parcel lines, land uses, zoning, soil types, watersheds, creeks, pavement, hazard areas, and utility infrastructure.		

Year 8 continuted on next page

16	These programs aim to grow a database of explicit knowledge about individual properties and development projects.	6.C.ii.	Evaluate needs and benefits of a possible requirement that digital information about protected trees be submitted to the City as a condition of approval for permit applications.	$2,000	**$80,000**
		5.B.i.	Conduct electronic tree surveys to enable analysis of development impact.	$58,000	
		5.B.ii.	Develop database management tools to assist with monitoring, documentation, and evaluation of tree restoration work.	$20,000	
17	The street tree inventory was updated in 2010 as part of this MP. 2022 is a logical time for a follow up.	5.A.ii.	Follow up 2010 inventory update and i-Tree streets analysis with either: • A similar cmprehensive inventory & analysis OR a series of 7 partial ones done annually.	$140,000	**$140,000**
Year 8 total					**$290,000**

Year 9 July 1, 2023 thru June 30, 2024 — Yr 9

Year 9 programs focus on ecological and wildlife concerns which are secondary only to infrastructure conflicts, development impacts, and water concerns--addressed in earlier years of this implementation plan.

Overview of Program or Program Group		Individual Programs	Costs: Program	Costs: Group
1 This MP priority is long range and recurs in each remaing year of the plan. Based on the analysis done in Yrs 1 & 2 (Program 6.D.i.), these programs aim to ensure the addition of at least 1000 trees per year. Work commences in Year 3--even without specific funding by shifting existing funds within the UF budget. Progress inYears 4 through 12 will rely on partnership funding beyond the budget shown.	6.D.ii.	Develop strategies to end the trend of decreasing canopy in South Palo Alto….	$0	**$0**
	6.D.iii.	Ensure that staff and contractors performing maintenance tasks in South Palo Alto know that preserving and increasing the canopy—and focus on native and introduced climate adaptive species—in South Palo Alto is a City priority.		
18 The i-Tree eco analysis (or similar) and the i-Tree wildlife (or similar) assessment will be demanding endeavors. These programs will involve working closely with local environmental groups. ** Note: Inventory of invasive species (a component of Program 2.A.v.) to be coordinated with the Parks & Open Spaces Division--and may begin as early as Year 3 or 4.*	5.A.iii.	Conduct an i-Tree eco analysis (or similar) to establish a citywide benchmark...both public and private trees and then to monitor change in the future. Metrics should be compared to changes in order to craft policies, provide incentives, and adapt partnerships.	$95,000	**$508,000**
	5.A.iv.	Conduct an i-Tree wildlife (or similar) assessment of the existing habitat and biodiversity—to establish a baseline and help identify and prioritize needs.	$45,000	
	2.A.iii.	Develop a plan for restoring a city-wide native woodland landscape..... Specifically, • Street trees: from 7% to 10% within 10-year plan / 20% within 20 years.• Urban parks: from 11% to 25% within 10-year plan / 50% within 20 years. • OS/preserves: to at least 80% within 10-year plan....	$60,000	
	2.A.v.	Work with Canopy/stakeholders to: • Inventory the invasive tree species population as defined by the Recommended and Restricted list; • Formalize a plan for decreasing that population; • Develop procedures...;• Develop specifications…• Develop monitoring program.*	$275,000	
	4.A.ix.	Work with Santa Clara Valley Audubon Society to develop programs to familiarize residents with Palo Alto's urban forest's birds and butterflies—and ways to attract them.	$30,000	
	4.A.viii.	Partner with Santa Clara Valley Audubon Society for the Palo Alto Christmas Bird Count, Spring Bird Count, and the Backyard Bird Count.	$3,000	
Year 9 total				**$508,000**

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Year 10 July 1, 2024 thru June 30, 2025 — Yr 10

Years 8 & 10 tackle the logistics of incorporating the knowledge gained from MP efforts into the daily activities of the city and community. **Year 10 focuses on education and document updates.**

Overview of Program or Program Group		Individual Programs	Costs: Program	Costs: Group
1 This MP priority is long range and recurs in each remaing year of the plan. Based on the analysis done in Yrs 1 & 2 (Program 6.D.i.), these programs aim to ensure the addition of at least 1000 trees per year. Work commences in Year 3--even without specific funding by shifting existing funds within the UF budget. Progress inYears 4 through 12 will rely on partnership funding beyond the budget shown.	6.D.ii.	Develop strategies to end the trend of decreasing canopy in South Palo Alto….	$0	**$0**
	6.D.iii.	Ensure that staff and contractors performing maintenance tasks in South Palo Alto know that preserving and increasing the canopy—and focus on native and introduced climate adaptive species—in South Palo Alto is a City priority.		
19 These educational and outreach programs aim to share the benefits--derived from the MP programs--with the community--to enhance the urban forest and ecological environment.	4.A.ii.	Work with Canopy and stakeholders such as the California Native Plant Society, Acterra, the Santa Clara Valley Audubon Society and the community to develop outreach procedures to follow prior to making any significant changes to the urban forest —whether or not CEQA review is required.	$5,000	**$40,000**
	6.J.viii.	Work with Canopy to educate the community regarding the necessity of tree removals…	$1,000	
	6.B.ix.	Work with Santa Clara Valley Audubon Society and other organizations to educate the development community about minimizing project effects on local wildlife.	$11,000	
	4.A.x.	Educate citizens about correct pruning at the best time to protect bird habitat and nesting.	$13,000	
	2.A.vi.	Utilize public space opportunities--and encourage the use of private space opportunities--to implement management techniques that enable trees, shrubs, and compatible vegetation to coexist with the goals of producing ecosystem benefits, aesthetic interest, layered wildlife habitat, and food for people.	10000	

Year 10 continuted on next page

20	3.B.iii.	Work with the city's Office of Sustainability to educate staff about the importance of describing potentially negative—or unintended—impacts to the urban forest and ecologic balance/ resilience ...whether or not CEQA review is required.		
	6.B.v.	Provide education to DR staff about City Sustainability Plan priorities and need for staff reports to include information about the role of trees in moderating potential negative impacts... or add beneficial services related to...	$20,000	
	6.B.vi.	Educate DR staff about City priorities and need for staff reports to include information about potential opportunities to enhance: • The vibrancy of the community..; • Human health benefits ...; • Bicycle and public-transportation…		
These programs aim to ensure that staff are informed and equipped to make use of the benefits derived from the MP programs to enhance the urban forest and ecological environment.	6.B.vii.	Provide education to staff and ensure that tree maintenance practices continue to consider bird nesting seasons.		**$100,000**
	5.B.xvi.	Provide training UF staff and park rangers that includes: • Certification as arborist & pesticide application; • Education in Integrated Pest Management, .mgmt of invasive plants, and ecology and native plants; • Proficiency in relevant software; • Tree Risk Management Protocols. ...	$10,000	
	5.B.xix.	Establish written risk management protocol and training for scheduled inspections.	$50,000	
	6.A.ii.	Augment project-review standard conditions w/ • Requirements for no net canopy loss per project site; • Soil volume requirements for trees per species group; • Habitat connectivity and regeneration of an native woodland ecosystem on a landscape scale.		
	6.A.i.	Review up-to-date sources for ... possible modifications to Zoning Regss, Building Standards, Green Building Standards, Standard Conditions of Approval, Standard Details, Green Infrastructure Practices, storm water permitting procedures, etc.	$20,000	
Year 10 total				**$140,000**

Year 11 July 1, 2025 thru June 30, 2026 — Yr 11

The dominant programs in Year 11 are the Comprehensive Conservation Plan and updating of the individual park plans although the status of this programs and precise needs are not predictable as this project is lead by the Community Services Department and already in progress. Year 11 also contains programs for expanding the GIS database.

Overview of Program or Program Group		Individual Programs	Costs: Program	Costs: Group
1 This MP priority is long range and recurs in each remaing year of the plan. Based on the analysis done in Yrs 1 & 2 (Program 6.D.i.), these programs aim to ensure the addition of at least 1000 trees per year. Work commences in Year 3--even without specific funding by shifting existing funds within the UF budget. Progress inYears 4 through 12 will rely on partnership funding beyond the budget shown.	6.D.ii.	Develop strategies to end the trend of decreasing canopy in South Palo Alto….		
	6.D.iii.	Ensure that staff and contractors performing maintenance tasks in South Palo Alto know that preserving and increasing the canopy—and focus on native and introduced climate adaptive species—in South Palo Alto is a City priority.	$0	**$0**
21 The specific tasks and budget needs of these programs to be further defined through future collaboration with the Parks Division. ** Note: Comprehensive Conservation Plan (Program 6.J.iv.) to be coordinated with Parks & Open Spaces Division--and funded by Parks & Open Spaces CIP.*	6.J.iv.		$0	
	6.J.v.	Update existing park plans and/or develop new plans to ensure that tree issues are addressed.	$20,000	**$20,000**
22 Having this information in the GIS is a lofty goal that would provide unprecedented guidance towards species selection and other choices relevant to the urban forest.	5.B.vii.	Develop or obtain a more up-to-date and accurate soils map and add it into the GIS.	$25,000	**$40,000**
	5.B.viii.	Develop a map showing the depth of available water within the urban forest.	$15,000	
Year 11 total				**$60,000**

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Year 12 July 1, 2026 thru June 30, 2027 — Yr 12

The programs of Year 12 are exciting and aim towards new levels of operation; however, they are scheduled at the end of the Implementation Plan so as not to compete with more fundamental needs.

Overview of Program or Program Group		Individual Programs	Costs: Program	Costs: Group
1 This MP priority is long range and recurs in each remaing year of the plan. Based on the analysis done in Yrs 1 & 2 (Program 6.D.i.), these programs aim to ensure the addition of at least 1000 trees per year. Work commences in Year 3--even without specific funding by shifting existing funds within the UF budget. Progress inYears 4 through 12 will rely on partnership funding beyond the budget shown.	6.D.ii.	Develop strategies to end the trend of decreasing canopy in South Palo Alto….		
	6.D.iii.	Ensure that staff and contractors performing maintenance tasks in South Palo Alto know that preserving and increasing the canopy—and focus on native and introduced climate adaptive species—in South Palo Alto is a City priority.	$0	**$0**
23 The needs of this program will be informed by the success of the site-specific species selection protocols (Program 1.A.iii. - in Year 4).	5.B.xi.	Complete the update of the *Street Tree Management Plan* ….	$70,000	**$70,000**
24 These valuable programs may happen sooner; however, as mentioned, they're scheduled at the end of the Implementation Plan so as not to compete with more fundamental needs.	3.A.ii.	Work with the city's *Office of Sustainability* to evaluate future participation in carbon credit programs.	$0	**$10,000**
	5.B.xv.	Explore a collaboration between relevant local fire protection districts and CAL FIRE regarding an educational campaign...about vegetation management in appropriate areas of the city. Incorporate into Sustainability Plan as well as the *T&LTM*..	$10,000	

Year 12 continuted on next page

25	If exploration of these possibilities indicates feasibity, they could become unique enhancements to both the city and community.	1.B.ii.	Consider feasibility of a city-owned nursery or partnership with California Native Plant Society, Acterra, or other local non-profits.	$10,000	**$30,000**
		6.G.iii.	Explore the feasibility of a tree adoption program—possibly to be modeled after programs offered by the Sacramento Municipal Utility District (SMUD) which has been operating successfully for 15 years.	$2,500	
		3.D.iv.	Explore an expansion of the existing urban-wood recycling program to include higher end products that do not break the wood down…	$15,000	
		2.A.iv.	Initiate "tree giveaway" events that provide residents with free fruit trees, native trees and introduced climate adaptive trees.	$2,500	
Year 12 total					**$110,000**

Appendicies

- Thirst ratings of known public tree population
- Master Plan Sources, Resources, & Terms

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Thirst ratings for known public tree population based on Davey Resource Group inventory update of 2010

WUCOLS

The California Department of Water Resources maintains a list referred to as WUCOLS (Water Use Classification of Landscape Species) that rates the water needs of 1,9000 species as:

High: requires irrigation throughout summer.

Moderate: able to tolerate periods without water but not several years of drought.

Low: requires irrigation until established; will then survive without supplemental water.

Modified WUCOLS

In 2009, a team of Canopy staff and board members, city staff, and community members agreed to modifications to the WUCOLS ratings deemed appropriate for Palo Alto.

The *Master Plan* applied the modified WUCOLS ratings to TreeKeeper data to develop this tables which shows

a. Modified WUCOLS ratings for 400 species

b. Frequency of that species within the street tree population as inventoried in 2010.

Baseline for future monitoring

The City's goal of a hearty and sustainable urban forest will include emphasizing less thirsty species for new plantings and this list will provide a baseline for measuring the progress of that strategy.

Diversity and benefits are also important; therefore, the City will also employ strategies to coach a variety of species to adapt to Palo Alto's conditions.

Fig _: "Modified WUCOLs" ratings for 400 species and frequency of each species within the public tree population as inventoried in 2010 by Davey Resource Group. *(Table continues)*

Thirst rating (Modified WUCOLS)	Common name	Davey 2010 inventory count of… Street & park trees	Street trees	Park trees	Scientific name
Low	Pyracantha	--	2	--	*Pyracantha* spp.
Low		--	19	--	*Tristaniopsis conferta*
Low	Coast live oak	1213	534	679	*Quercus agrifolia*
Low	Chinese pistache	1141	1027	114	*Pistacia chinensis*
Low	Chinese elm	962	820	142	*Ulmus parvifolia*
Low	Holly oak	701	515	186	*Quercus ilex*
Low	Glossy privet	565	361	204	*Ligustrum lucidum*
Low	European hackberry	332	318	14	*Celtis australis*
Low	Chinese hackberry	318	302	16	*Celtis sinensis*
Low	Valley oak	297	215	82	*Quercus lobata*
Low	Italian stone pine	251	92	159	*Pinus pinea*
Low	Deodar cedar	230	148	82	*Cedrus deodara*
Low	Shamel ash	228	196	32	*Fraxinus uhdei*
Low	Blackwood acacia	220	100	120	*Acacia melanoxylon*
Low	Carob	202	140	62	*Ceratonia siliqua*
Low	Italian cypress	177	147	30	*Cupressus sempervirens*
Low	Blue gum	164	16	148	*Eucalyptus globulus*
Low	Cork oak	154	147	7	*Quercus suber*
Low	Calif. pepper	136	60	76	*Schinus molle*
Low	Olive	135	43	92	*Olea europaea*
Low	Almond	133	38	95	*Prunus dulcis*
Low	Canary Island pine	122	57	65	*Pinus canariensis*
Low	Eucalyptus	121	20	101	*Eucalyptus* spp.
Low	Horsetail tree	109	74	35	*Casuarina equisetifolia*
Low	Silver dollar gum	109	36	73	*Eucalyptus polyanthemos*
Low	Western catalpa	102	100	2	*Catalpa speciosa*
Low	Red ironbark	100	13	87	*Eucalyptus sideroxylon*
Low	Tree-of-heaven	96	31	64	*Ailanthus altissima*
Low	Loquat	80	64	16	*Eriobotrya japonica*
Low	Lemon bottlebrush	78	37	41	*Callistemon citrinus*
Low	River she-oak	68	24	44	*Casuarina cunninghamiana*
Low	Atlas cedar	63	5	58	*Cedrus atlantica*
Low	Mexican fan palm	58	55	3	*Washingtonia robusta*
Low	Mimosa	56	42	14	*Albizia julibrissin*
Low	Calif. incense cedar	55	33	22	*Calocedrus decurrens*
Low	Canary Island Date palm	54	33	21	*Phoenix canariensis*
Low	Green Mountain linden	52	50	2	*Tilia tomentosa Green Mountain*
Low	Silver linden	50	30	20	*Tilia tomentosa*
Low	Weeping bottlebrush	49	44	5	*Callistemon viminalis*
Low	Xylosma	48	48	--	*Xylosma congestum*
Low	Calif. bay	45	14	31	*Umbellularia californica*
Low	River red gum	42	--	42	*Eucalyptus camaldulensis*

Fig _ continued: "Modified WUCOLs" ratings for 400 species and frequency of each species within the public tree population as inventoried in 2010 by Davey Resource Group. *(Table continues on following pages.)*

Thirst rating (Modified WUCOLS)	Common name	Davey 2010 inventory count of…			Scientific name
		Street & park trees	Street trees	Park trees	
Low	Arizona ash	38	37	1	*Fraxinus velutina*
Low	Aleppo pine	37	21	16	*Pinus halepensis*
Low	Calif. fan palm	36	30	6	*Washingtonia filifera*
Low	Green dracaena	35	22	13	*Cordyline australis*
Low	Oleander	35	19	16	*Nerium oleander*
Low	Fern-Leaf Catalina ironwood	33	7	26	*Lyonothamnus floribundusasplenifolius*
Low	Windmill palm	33	26	7	*Trachycarpus fortunei*
Low	Athena elm	33	33	--	*Ulmus parvifolia Athena*
Low	Brisbane box	32	--	32	*Lophostemon confertus*
Low	English yew	32	3	29	*Taxus baccata*
Low	Spanish dagger	31	20	11	*Yucca gloriosa*
Low	Hollywood juniper	29	29	--	*Juniperus chinensis Torulosa*
Low	Sterling linden	29	29	--	*Tilia tomentosa Sterling*
Low	Strawberry tree	28	15	13	*Arbutus unedo*
Low	Myoporum	26	4	22	*Myoporum laetum*
Low	Edible pear	26	17	9	*Pyrus communis*
Low	Bailey acacia	25	--	25	*Acacia baileyana*
Low	Bushy yate	25	5	20	*Eucalyptus lehmannii*
Low	Juniper	24	3	21	*Juniperus chinensis*
Low	Silk oak	23	11	12	*Grevillea robusta*
Low	Douglas-fir	23	14	9	*Pseudotsuga menziesii*
Low	Red river gum	22	--	22	*Eucalyptus rudis*
Low	Calif. buckeye	21	--	21	*Aesculus californica*
Low	Juniper	19	9	10	*Juniperus* spp.
Low	Siberian elm	18	--	18	*Ulmus pumila*
Low	Mock orange	17	9	8	*Pittosporum tobira*
Low	Soapbark tree	17	15	2	*Quillaja saponaria*
Low	Allee elm	17	--	17	*Ulmus parvifolia Allee*
Low	Western redbud	16	13	3	*Cercis occidentalis*
Low	Italian buckthorn	16	--	16	*Rhamnus alaternus*
Low	Pink Dawn chitalpa	15	15	--	*Chitalpa Pink Dawn*
Low	Japanese persimmon	15	11	4	*Diospyros kaki*
Low	Dwarf blue gum	15	--	15	*Eucalyptus globulus Compacta*
Low	White ironbark	15	--	15	*Eucalyptus leucoxylon*
Low	Toyon	15	1	14	*Heteromeles arbutifolia*
Low	Bottle tree	14	11	3	*Brachychiton populneus*
Low	Queen palm	14	14	--	*Syagrus romanzoffianum*
Low	Green wattle	13	--	13	*Acacia decurrens*
Low	Edible fig	13	8	5	*Ficus carica*
Low	Pecan	12	--	12	*Carya illinoinensis*
Low	Calif. black oak	12	8	4	*Quercus kelloggii*
Low	Manna gum	11	--	11	*Eucalyptus viminalis*

Fig _ continued: "Modified WUCOLs" ratings for 400 species and frequency of each species within the public tree population as inventoried in 2010 by Davey Resource Group. *(Table continues on following pages.)*

Thirst rating (Modified WUCOLS)	Common name	Davey 2010 inventory count of… Street & park trees	Street trees	Park trees	Scientific name
Low	Silver dollar tree	10	9	1	*Eucalyptus cinerea*
Low	Pomegranate	9	--	9	*Punica granatum*
Low	Firethorn	9	--	9	*Pyracantha coccinea*
Low	Nepal camphor	8	--	8	*Cinnamomum glanduliferum*
Low	Hollyleaf cherry	8	--	8	*Prunus ilicifolia*
Low	Forest Green oak	8	--	8	*Quercus frainetto Schmidt*
Low	African sumac	8	6	2	*Rhus lancea*
Low	Other palm	8	8	--	
Low	Sydney golden wattle	7	--	7	*Acacia longifolia*
Low	Arizona cypress	7	3	4	*Cupressus glabra*
Low	Hackberry	6	--	6	*Celtis* spp.
Low	Drooping she-oak	5	--	5	*Casuarina stricta*
Low	Quince	5	--	5	*Cydonia oblonga*
Low	Lemon-scented gum	5	--	5	*Eucalyptus citriodora*
Low	Red-flowering gum	5	1	5	*Eucalyptus ficifolia*
Low	Flax-leaf paperbark	5	5	--	*Melaleuca linariifolia*
Low	Marina madrone	4	--	4	*Arbutus Marina*
Low	Calif. juniper	4	2	2	*Juniperus californica*
Low	Sweet bay	4	2	2	*Laurus nobilis*
Low	Swiss mountain pine	4	--	4	*Pinus mugo*
Low	Catalina cherry	4	--	4	*Prunus lyonii*
Low	Blue elderberry	4	--	4	*Sambucus caerulea*
Low	Silver wattle	3	--	3	*Acacia dealbata*
Low	Common hackberry	3	--	3	*Celtis occidentalis*
Low	Cypress	3	--	3	*Cupressus nevadensis*
Low	Hopseed	3	1	2	*Dodonaea viscosa*
Low	Swamp mahogony	3	--	3	*Eucalyptus robusta*
Low	Chinaberry	3	--	3	*Melia azedarach*
Low	Boobyalla	3	--	3	*Myoporum insulare*
Low	Mexican palo verde	3	--	3	*Parkinsonia aculeata*
Low	Keith Davey pistache	3	--	3	*Pistacia chinensis Keith Davey*
Low	Chinkapin oak	3	--	3	*Quercus muehlenbergii*
Low	Interior live oak	3	3	--	*Quercus wislizenii*
Low	Yucca	3	2	1	*Yucca recurvifolia*
Low	Guadalupe palm	2	2	--	*Brahea edulis*
Low	Calif. lilac	2	--	2	*Ceanothus spp.*
Low	Texas redbud	2	--	2	*Cercis canadensis texensis*
Low	Mediterranean fan palm	2	2	--	*Chamaerops humilis*
Low	Russian olive	2	--	2	*Elaeagnus angustifolia*
Low	Lilac melaleuca	2	--	2	*Melaleuca decussata*
Low	Western tea myrtle	2	--	2	*Melaleuca nesophila*
Low	Cajeput tree	2	2	--	*Melaleuca quinquenervia*

Fig _ continued: "Modified WUCOLs" ratings for 400 species and frequency of each species within the public tree population as inventoried in 2010 by Davey Resource Group. *(Table continues on following pages.)*

Thirst rating (Modified WUCOLS)	Common name	Davey 2010 inventory count of… Street & park trees	Street trees	Park trees	Scientific name
Low	Calif. wax myrtle	2	--	2	*Myrica californica*
Low	Ponderosa pine	2	--	2	*Pinus ponderosa*
Low	Blue oak	2	--	2	*Quercus douglasii*
Low	Satin Shadow linden	2	--	2	*Tilia tomentosa Satin Shadow*
Low	Knife acacia	1	--	1	*Acacia cultriformis*
Low	Madrone	1	1	--	*Arbutus menziesii*
Low	Coyote bush	1	--	1	*Baccharis pilularis*
Low	Western hackberry	1	1	--	*Celtis reticulata*
Low	Cotoneaster	1	--	1	*Cotoneaster buxifolius*
Low	Red clusterberry	1	--	1	*Cotoneaster lacteus*
Low	Cotoneaster	1	--	1	*Cotoneaster* spp.
Low	Willowleaf peppermint	1	--	1	*Eucalyptus nicholii*
Low	Wallangaria white gum	1	--	1	*Eucalyptus scoparia*
Low	Evergreen euonymus	1	--	1	*Euonymus japonica*
Low	Pineapple guava	1	1	--	*Feijoa sellowiana*
Low	Chinese parasol tree	1	--	1	*Firmiana simplex*
Low	Flannel bush	1	--	1	*Fremontodendron* spp.
Low	Kentucky coffee tree	1	--	1	*Gymnocladus dioica*
Low	English holly	1	--	1	*Ilex aquifolium*
Low	Burford holly	1	1	--	*Ilex cornuta Burfordii*
Low	Primrose tree	1	--	1	*Lagunaria patersonii*
Low	Australian tea tree	1	1	--	*Leptospermum laevigatum*
Low	Drooping melaleuca	1	--	1	*Melaleuca armillaris*
Low	Date palm	1	1	--	*Phoenix dactylifera*
Low	Peruvian pepper	1	--	1	*Schinus polygamus*
Total for Low rating		**10,294**	**6,563**	**3,752**	
Low - moderate	Pine	52	11	41	*Pinus* spp.
Low - moderate	Oak	49	33	16	*Quercus* spp.
Low - moderate	Araucaria species	4	--	4	*Araucaria* spp.
Low - moderate	Holly	3	--	3	*Ilex* spp.
Total for Low-moderat rating		**108**	**44**	**64**	
Moderate	Goldenrain	--	7	--	*Koelreuteria* spp.
Moderate	Sycamore	--	13	--	*Platanus* spp.
Moderate	London plane	3362	2832	530	*Platanus* x *acerifolia*
Moderate	Modesto ash	1480	1481	--	*Fraxinus velutina Modesto*
Moderate	Camphor	1214	1133	81	*Cinnamomum camphora*
Moderate	Red oak	841	778	63	*Quercus rubra*
Moderate	Ginkgo	712	633	79	*Ginkgo biloba*
Moderate	Yarwood sycamore	519	517	2	*Platanus x acerifolia Yarwood*
Moderate	Ornamental pear	368	301	67	*Pyrus calleryana*
Moderate	Purpleleaf plum	344	242	102	*Prunus cerasifera*

Fig _ continued: "Modified WUCOLs" ratings for 400 species and frequency of each species within the public tree population as inventoried in 2010 by Davey Resource Group. *(Table continues on following pages.)*

Thirst rating (Modified WUCOLS)	Common name	Davey 2010 inventory count of… Street & park trees	Street trees	Park trees	Scientific name
Moderate	Moraine ash	334	334	--	*Fraxinus holotricha Moraine*
Moderate	Monterey pine	279	110	169	*Pinus radiata*
Moderate	Chinese tallow	242	226	16	*Sapium sebiferum*
Moderate	Crape myrtle	238	189	49	*Lagerstroemia indica*
Moderate	Red horsechestnut	236	187	49	*Aesculus carnea*
Moderate	Shumard oak	159	157	2	*Quercus shumardii*
Moderate	Hawthorn	156	129	27	*Crataegus laevigata*
Moderate	Japanese flowering cherry	153	68	85	*Prunus serrulata*
Moderate	Chanticleer pear	134	135	--	*Pyrus calleryana Chanticleer*
Moderate	Columbia sycamore	132	132	--	*Platanus x acerifolia Columbia*
Moderate	White mulberry	131	104	27	*Morus alba*
Moderate	Evergreen pear	126	54	72	*Pyrus kawakamii*
Moderate	Silver maple	122	101	21	*Acer saccharinum*
Moderate	Autumn Gold ginkgo	121	121	--	*Ginkgo biloba Autumn Gold*
Moderate	Frontier elm	121	119	2	*Ulmus Frontier*
Moderate	Carolina cherry laurel	117	91	26	*Prunus caroliniana*
Moderate	Edible plum	116	63	53	*Prunus domestica*
Moderate	English walnut	114	90	24	*Juglans regia*
Moderate	Japanese pagoda tree	112	109	3	*Sophora japonica*
Moderate	Bradford pear	104	104	--	*Pyrus calleryana Bradford*
Moderate	Fern pine	98	79	19	*Podocarpus gracilior*
Moderate	Southern live oak	97	87	10	*Quercus virginiana*
Moderate	Australian willow	92	63	29	*Geijera parviflora*
Moderate	Apricot	90	32	58	*Prunus armeniaca*
Moderate	Honey locust	85	69	16	*Gleditsia triacanthos*
Moderate	Eastern redbud	73	60	13	*Cercis canadensis*
Moderate	Purple Robe locust	65	65	--	*Robinia ambigua Purple Robe*
Moderate	Crape myrtle 'Natchez'	63	63	--	*Lagerstroemia Natchez*
Moderate	Black locust	59	49	10	*Robinia pseudoacacia*
Moderate	Water gum	57	37	20	*Tristaniopsis laurina*
Moderate	Eastern black walnut	54	15	39	*Juglans nigra*
Moderate	Scarlet oak	51	44	7	*Quercus coccinea*
Moderate	Pin oak	50	44	6	*Quercus palustris*
Moderate	Green Column maple	49	49	--	*Acer nigrum Green Column*
Moderate	Flowering plum	49	47	2	*Prunus x blireiana*
Moderate	Victorian box	46	9	37	*Pittosporum undulatum*
Moderate	Brazilian pepper	43	34	9	*Schinus terebinthifolius*
Moderate	Jap. flowering crabapple	42	--	42	*Malus floribunda*
Moderate	Lemon	40	34	6	*Citrus limon*
Moderate	Aristocrat pear	39	39	--	*Pyrus calleryana Aristocrat*
Moderate	Stone fruit	38	36	2	*Prunus* spp.
Moderate	Red mulberry	37	34	3	*Morus rubra*

Fig _ continued: "Modified WUCOLs" ratings for 400 species and frequency of each species within the public tree population as inventoried in 2010 by Davey Resource Group. *(Table continues on following pages.)*

Thirst rating (Modified WUCOLS)	Common name	Davey 2010 inventory count of… Street & park trees	Street trees	Park trees	Scientific name
Moderate	Edible apple	33	21	12	*Malus sylvestris*
Moderate	Evergreen maple	32	32	--	*Acer oblongum*
Moderate	Ash	32	--	32	*Fraxinus* spp.
Moderate	Jacaranda	32	24	8	*Jacaranda mimosifolia*
Moderate	Upright hornbeam	31	30	1	*Carpinus betulus Fastigiata*
Moderate	Western sycamore	31	--	31	*Platanus racemosa*
Moderate	Water gum (Elegant)	31	30	1	*Tristaniopsis laurina Elegant*
Moderate	Chinese fringe tree	28	23	5	*Chionanthus retusus*
Moderate	Colorado spruce	28	19	9	*Picea pungens*
Moderate	Bloodgood sycamore	28	28	--	*Platanus x acerifolia Bloodgood*
Moderate	Edible peach	28	13	15	*Prunus persica*
Moderate	Orange	26	17	9	*Citrus sinensis*
Moderate	Jap. black pine	25	15	10	*Pinus thunbergiana*
Moderate	Flowering ash	24	--	24	*Fraxinus ornus*
Moderate	Blue potato bush	24	2	22	*Lycianthes rantonnei*
Moderate	Yew pine	23	15	8	*Podocarpus macrophyllus*
Moderate	Edible cherry	23	--	23	*Prunus avium*
Moderate	Ruby horsechestnut	21	20	1	*Aesculus carnea Briotii*
Moderate	Yoshino cherry	19	17	2	*Prunus yedoensis*
Moderate	Hedge maple	18	18	--	*Acer campestre*
Moderate	Norway maple	18	15	3	*Acer platanoides*
Moderate	Calif. black walnut	18	18	--	*Juglans hindsii*
Moderate	Pittosporum	17	15	2	*Pittosporum* spp.
Moderate	American arborvitae	17	7	10	*Thuja occidentalis*
Moderate	Paul's Scarlet hawthorn	16	16	--	*Crataegus laevigata Pauls Scarlet*
Moderate	Fraser photinia	16	8	8	*Photinia* x fraseri
Moderate	Port Orford cedar	15	1	14	*Chamaecyparis lawsoniana*
Moderate	Tarata	15	2	13	*Pittosporum eugenioides*
Moderate	Akebono cherry	14	14	--	*Prunus yedoensis Akebono*
Moderate	Jelecote pine	13	7	6	*Pinus patula*
Moderate	Karo	13	4	9	*Pittosporum crassifolium*
Moderate	Pittosporum	13	--	13	*Pittosporum ralphii*
Moderate	Crape myrtle 'Tuscarora'	12	12	--	*Lagerstroemia Tuscarora*
Moderate	Crabapple	12	40	--	*Malus* spp. & cultivars
Moderate	Avocado	12	8	4	*Persea americana*
Moderate	New Bradford pear	12	--	12	*Pyrus calleryana New Bradford*
Moderate	Lily of the valley tree	11	10	1	*Crinodendron patagua*
Moderate	Goldenrain	10	--	10	*Koelreuteria paniculata*
Moderate	Trident maple	9	--	9	*Acer buergeranum*
Moderate	Carrotwood	9	2	7	*Cupaniopsis anacardioides*
Moderate	Flowering dogwood	8	--	8	*Cornus florida*
Moderate	Fig	8	7	1	*Ficus* spp.

Fig _ continued: "Modified WUCOLs" ratings for 400 species and frequency of each species within the public tree population as inventoried in 2010 by Davey Resource Group. *(Table continues on following pages.)*

Thirst rating (Modified WUCOLS)	Common name	Davey 2010 inventory count of…			Scientific name
		Street & park trees	Street trees	Park trees	
Moderate	Washington thorn	7	--	7	*Crataegus phaenopyrum*
Moderate	Japanese cedar	7	--	7	*Cryptomeria japonica*
Moderate	Zumi crabapple	7	--	7	*Malus x zumi Calocarpa*
Moderate	Tawhiwhi	7	--	7	*Pittosporum tenuifolium*
Moderate	Krauter Vesuvius plum	7	--	7	*Prunus cerasifera Krauter Vesuvius*
Moderate	English oak	7	--	7	*Quercus robur*
Moderate	Dogwood	6	13	--	*Cornus* spp.
Moderate	Monterey cypress	6	5	1	*Cupressus macrocarpa*
Moderate	Walnut	6	--	6	*Juglans* spp.
Moderate	Formosan sweetgum	6	--	6	*Liquidambar formosana*
Moderate	Leyland cypress	5	3	2	*Cupressocyparis leylandii*
Moderate	Wilson holly	5	5	--	*Ilex altaclerensis Wilsonii*
Moderate	Prairiefire crabapple	5	--	5	*Malus Prairiefire*
Moderate	Cape pittosporum	5	3	2	*Pittosporum viridiflorum*
Moderate	Oriental plane	5	--	5	*Platanus orientalis*
Moderate	Portugal laurel	5	--	5	*Prunus lusitanica*
Moderate	Japanese viburnum	5	2	3	*Viburnum japonicum*
Moderate	Silver Cloud michelia	4	--	4	*Michelia doltsopa Silver Cloud*
Moderate	Madeira Bay fig	4	--	4	*Persea indica*
Moderate	Thundercloud plum	4	--	4	*Prunus cerasifera Thundercloud*
Moderate	Linden	4	6	--	*Tilia* spp.
Moderate	Forest Pansy redbud	3	--	3	*Cercis canadensis Forest*
Moderate	Hinoki falsecypress	3	--	3	*Chamaecyparis obtusa*
Moderate	Grapefruit	3	2	1	*Citrus x paradisi*
Moderate	Rubber tree	3	3	--	*Ficus elastica*
Moderate	Chinese photinia	3	--	3	*Photinia serrulata*
Moderate	Japanese red pine	3	--	3	*Pinus densiflora*
Moderate	Cherry plum	3	--	3	*Prunus cerasifera Green*
Moderate	Mt. Fuji cherry	3	--	3	*Prunus serrulata Mt. Fuji*
Moderate	Shirofugen cherry	3	--	3	*Prunus serrulata Shirofugen*
Moderate	Water oak	3	--	3	*Quercus nigra*
Moderate	English oak (Skyrocket)	3	--	3	*Quercus robur Fastigiata*
Moderate	English oak (Skymaster)	3	--	3	*Quercus robur Pyramich*
Moderate	Brush cherry	3	--	3	*Syzygium paniculatum*
Moderate	Western redcedar	3	1	2	*Thuja plicata*
Moderate	English elm	3	--	3	*Ulmus procera*
Moderate	Calamondin	2	--	2	*Citrofortunella x mitis*
Moderate	Common hawthorn	2	--	2	*Crataegus monogyna*
Moderate	Cockspur coral tree	2	--	2	*Erythrina crista-galli*
Moderate	Sweetshade	2	2	--	*Hymenosporum flavum*
Moderate	Flame tree	2	--	2	*Koelreuteria bipinnata*
Moderate	Goldenchain tree	2	--	2	*Labernum x waterii Vossii*

Fig _ continued: "Modified WUCOLs" ratings for 400 species and frequency of each species within the public tree population as inventoried in 2010 by Davey Resource Group. *(Table continues on following pages.)*

Thirst rating (Modified WUCOLS)	Common name	Davey 2010 inventory count of… Street & park trees	Street trees	Park trees	Scientific name
Moderate	Colorado spruce	2	--	2	*Picea pungens Viridis*
Moderate	Oriental arborvitae	2	--	2	*Platycladus orientalis*
Moderate	Redmond linden	2	--	2	*Tilia euchlora Redmond*
Moderate	Elm	2	20	--	*Ulmus* spp.
Moderate	Flowering maple	1	--	1	*Abutilon hybridum*
Moderate	Orchid tree	1	--	1	*Bauhinia variegata*
Moderate	Camellia	1	--	1	*Camellia japonica*
Moderate	American chestnut	1	--	1	*Castanea dentata*
Moderate	Red flowering dogwood	1	--	1	*Cornus florida Rubra*
Moderate	Kousa dogwood	1	--	1	*Cornus kousa*
Moderate	Cockspur thorn	1	--	1	*Crataegus crus-galli*
Moderate	Downy hawthorn	1	--	1	*Crataegus mollis*
Moderate	Common persimmon	1	--	1	*Diospyros virginiana*
Moderate	Bronze loquat	1	--	1	*Eriobotrya deflexa*
Moderate	Coral tree	1	--	1	*Erythrina* spp.
Moderate	Hardy rubber tree	1	--	1	*Eucommia ulmunoides*
Moderate	Japanese euonymus	1	--	1	*Euonymus fortunei*
Moderate	Hupeh evodia	1	--	1	*Evodia hupehensis*
Moderate	Moreton Bay fig	1	--	1	*Ficus macrophylla*
Moderate	Saratoga ginkgo	1	--	1	*Ginkgo biloba Saratoga*
Moderate	S. Calif. black walnut	1	--	1	*Juglans californica*
Moderate	Oriental sweetgum	1	--	1	*Liquidambar orientalis*
Moderate	Fan palm	1	--	1	*Livistona* spp.
Moderate	Hop hornbeam	1	--	1	*Ostrya virginiana*
Moderate	Persian ironwood	1	--	1	*Parrotia persica*
Moderate	False pine	1	--	1	*Podocarpus* spp.
Moderate	Lombardy poplar	1	--	1	*Populus nigra Italica*
Moderate	Japanese flowering apricot	1	--	1	*Prunus mume*
Moderate	Snow Fountains cherry	1	--	1	*Prunus x Snow Fountain*
Moderate	Chinese wingnut	1	--	1	*Pterocarya stenoptera*
Moderate	Sawtooth oak	1	--	1	*Quercus acutissima*
Moderate	Giant sequoia	1	1	--	*Sequoiadendron giganteum*
Moderate	European mountain ash	1	--	1	*Sorbus aucuparia*
Total for moderate rating		**14,440**	**12,125**	**2,392**	
High	Freeman maple	--	48	--	*Acer x freemanii*
High	Southern magnolia	4198	4061	137	*Magnolia grandiflora*
High	Liquidambar	2992	2669	323	*Liquidambar styraciflua*
High	Coast redwood	946	243	703	*Sequoia sempervirens*
High	White birch	560	374	186	*Betula pendula*
High	Red maple	453	418	35	*Acer rubrum*
High	Littleleaf linden	435	416	19	*Tilia cordata*

Fig _ continued: "Modified WUCOLs" ratings for 400 species and frequency of each species within the public tree population as inventoried in 2010 by Davey Resource Group. *(Table continues on following pages.)*

Thirst rating (Modified WUCOLS)	Common name	Davey 2010 inventory count of… Street & park trees	Street trees	Park trees	Scientific name
High	Tuliptree	387	346	41	*Liriodendron tulipifera*
High	Raywood ash	372	373	--	*Fraxinus oxycarpa Raywood*
High	Autumn Purple ash	241	238	3	*Fraxinus americana Junginger*
High	Japanese maple	166	138	28	*Acer palmatum*
High	October Glory maple	142	140	2	*Acer rubrum October Glory*
High	Mayten	109	53	56	*Maytenus boaria*
High	White alder	106	8	98	*Alnus rhombifolia*
High	Bigleaf maple	103	98	5	*Acer macrophyllum*
High	Tupelo	88	82	6	*Nyssa sylvatica*
High	Greenspire linden	85	84	1	*Tilia cordata Greenspire*
High	American elm	68	47	21	*Ulmus americana*
High	Saucer magnolia	65	33	32	*Magnolia x soulangiana*
High	Sawleaf zelkova	57	55	2	*Zelkova serrata*
High	Idaho locust	53	53	--	*Robinia ambigua Idahoensis*
High	Autumn Blaze maple	43	--	43	*Acer x freemanii Autumn Blaze*
High	Magnolia	39	16	23	*Magnolia* spp.
High	Red Sunset red maple	37	37	--	*Acer rubrum Franks Red*
High	Jacquemontii birch	31	28	3	*Betula jacquemontii*
High	Snakebark maple	25	24	1	*Acer capillipes*
High	Horsechestnut	22	20	2	*Aesculus hippocastanum*
High	European hornbeam	20	20	--	*Carpinus betulus*
High	Paperbark maple	17	12	5	*Acer griseum*
High	New Zealand Xmas tree	17	--	17	*Metrosideros excelsus*
High	European beech	15	27	--	*Fagus sylvatica*
High	Maple	13	30	--	*Acer* spp.
High	River birch	12	12	--	*Betula nigra*
High	Village Green zelkova	12	--	12	*Zelkova serrata Village Green*
High	Schlesinger Red maple	10	--	10	*Acer rubrum Schlesingerii*
High	Copper beech	10	--	10	*Fagus sylvatica Atropunicea*
High	Sugar maple	9	--	9	*Acer saccharum*
High	Cimmaron ash	9	--	9	*Fraxinus pennsylvanica Cimmzam*
High	Patmore ash	8	--	8	*Fraxinus pennsylvanica Patmore*
High	Boxelder	7	--	7	*Acer negundo*
High	Autumn Fantasy maple	7	--	7	*Acer x freemanii Autumn Fantasy*
High	Urbanite ash	7	--	7	*Fraxinus pennsylvanica Urbanite*
High	Bloodgood Japanese maple	6	--	6	*Acer palmatum Bloodgood*
High	Star magnolia	6	--	6	*Magnolia stellata*
High	Willow	6	2	4	*Salix* spp.
High	Big-toothed maple	5	--	5	*Acer saccharumgrandidentatum*
High	Weeping willow	5	--	5	*Salix babylonica*

Fig _ continued: "Modified WUCOLs" ratings for 400 species and frequency of each species within the public tree population as inventoried in 2010 by Davey Resource Group. *(Last page)*

Thirst rating (Modified WUCOLS)	Common name	Davey 2010 inventory count of… Street & park trees	Street trees	Park trees	Scientific name
HIgh	Cutleaf weeping birch	4	--	4	*Betula pendula Dalecarlica*
High	Dawn redwood	4	--	4	*Metasequoiaglyptostroboides*
High	Full-moon maple	3	--	3	*Acer japonicum*
HIgh	Globe maple	3	--	3	*Acer platanoides Globe*
High	Italian alder	3	--	3	*Alnus cordata*
High	Purple River beech	3	--	3	*Fagus sylvatica Riversii*
High	Marshall ash	3	--	3	*Fraxinus pennsylvanica Marshall*
High	Redbay	3	--	3	*Persea borbonia*
High	White poplar	3	--	3	*Populus alba*
High	Cutleaf purple Japanese maple	2	--	2	*Acer palmatum Filiferum Purpureum*
HIgh	Purple beech	2	--	2	*Fagus sylvatica Purpurea*
High	Oregon ash	2	--	2	*Fraxinus oregona*
HIgh	Green ash	2	--	2	*Fraxinus pennsylvanica*
High	Edith Bouge magnolia	2	--	2	*Magnolia grandiflora Edith Bouge*
High	Majestic Beauty magnolia	2	--	2	*Magnolia grandiflora Majestic Beauty*
High	David maple	1	--	1	*Acer davidii*
High	American hornbeam	1	--	1	*Carpinus caroliniana*
High	Campbell magnolia	1	--	1	*Magnolia campbellii*
High	Samuel Sommer magnolia	1	--	1	*Magnolia grandiflora Samuel Sommer*
High	St. Mary magnolia	1	--	1	*Magnolia grandiflora St. Mary*
High	Quaking aspen	1	--	1	*Populus tremuloides*
High	Soquel redwood	1	--	1	*Sequoia sempervirens Soquel*
High	Liberty elm	1	--	1	*Ulmus americana Liberty*
Total for high rating		**12,073**	**10,205**	**1,946**	
Unknown	Other broadleaf large	--	2	--	
Unknown	Other broadleaf small	--	23	--	
Unknown	Other conifer large	--	1	--	
Unknown	Other conifer medium	--	2	--	
Unknown	Other conifer small	--	3	--	
Unknown	Other dediduous large	--	20	--	
Unknown	Other deciduous medium	--	54	--	
Unknown	Other deciduous small	--	19	--	
Unknown	Other not classified	123	--	123	
Unknown	Needle bush	1	--	1	*Vachellia farnesiana*
Unknown	Other broad leaf medium		13	--	
Total for unknown rating		**124**	**135**	**124**	

Sources, Resources, & Terms

City of Palo Alto	
Department of Public Works	
Canopy Cover Assessment of Palo Alto's Urban Forest (Dr. Xiao of UC Davis)	Contact the Public Works Urban Forestry Section (650) 496-5953
Heritage Tree List	http://www.cityofpaloalto.org/news/displaynews.asp?NewsID=179&TargetID=64
Preliminary Sustainable Urban Forest Report (Jim Clark of Hort Science)	Contact the Public Works Urban Forestry Section (650) 496-5953
Right-of-Way Urban Forest Resource Analysis (Davey Resource Group)	http://www.cityofpaloalto.org/civicax/filebank/documents/36188
Street Tree Management Plan (1982)	Contact the Public Works Urban Forestry Section (650) 496-5953
Survey Results and Analysis for Urban Forest Master Plan Survey	http://www.cityofpaloalto.org/civicax/filebank/documents/26236
Tree Technical Manual	https://www.cityofpaloalto.org/civicax/filebank/documents/6436
Protected tree removal policy	http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=2588
Tree Removal Policy—2009 PW Report	http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=18091
Power line clearing contract with standards	
Construction with ROW documents	http://www.cityofpaloalto.org/depts/pln/development_center/during_construction.asp
Golf Course Reconfiguration Project website	http://www.cityofpaloalto.org/gov/depts/csd/golf/new/default.asp
Department of Planning and Community Environment	
Baylands Master Plan	http://www.cityofpaloalto.org/gov/depts/pln/advance/area/baylandsmp.asp
Comprehensive Plan	http://www.cityofpaloalto.org/gov/topics/projects/landuse/compplan.asp
California Green Building Code	http://www.documents.dgs.ca.gov/bsc/CALGreen/2010_CA_Green_Bldg.pdf
El Camino Real Master Planning Study	http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=14241
Development Center (DC)Blueprint Project	http://www.horizoncentre.com/new_site_2009/palo_alto_119/sat_document_links.html

Protected Tree and Landscaping Information	http://www.cityofpaloalto.org/environment/news/details.asp?NewsID=177&TargetID=64
Palo Alto's Heritage Trees	http://www.cityofpaloalto.org/environment/news/details.asp?NewsID=179&TargetID=64
Tree FAQs	http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=2591
Utilities Department	
Urban Water Management Plan (2010)	http://www.cityofpaloalto.org/gov/depts/utl/eng/water/watermgmt.asp
Photovoltaic Partners Program	http://www.cityofpaloalto.org/gov/depts/utl/residents/sustainablehome/pvpartners.asp
Solar Water Heating Program	http://www.cityofpaloalto.org/gov/depts/utl/residents/sustainablehome/swh.asp
Waste Avoidance programs (wter)	http://www.cityofpaloalto.org/gov/depts/utl/residents/resrebate/resiwater.asp#Water-Wise House Call Program
Palo Alto Green	http://www.cityofpaloalto.org/civicax/filebank/documents/15138
Landscape Water Efficiency Standards	http://www.cityofpaloalto.org/civicax/filebank/documents/8771
Recycled Water Ordinance # 5002 of 2008	http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=13200
Recycled Water Matrix 2008	http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=13201
Recycled Water Resolution to Reduce Salinity CMR:111:10	http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=18432
Reduce Potable Water Use CMR 212:10	http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=19735
Water Fund Budget Amendment Contract with RMC CMR:207:10	http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=19683
Community Services	
Foothills Park Fire Master Plan	http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=15866
Open Space website	http://www.cityofpaloalto.org/depts/csd/parks_and_open_space/preserves_and_open_spaces/foothills_park.asp
Pearson Arastradero Preserve Master Plan	http://www.cityofpaloalto.org/depts/csd/parks_and_open_space/preserves_and_open_spaces/pearson_arastradero.asp
Office of the City Clerk	
Municipal Code	http://www.cityofpaloalto.org/gov/depts/clk/municode.asp
Office of the City Auditor	
Annual Service Efforts and Accomplishments Reports	http://www.cityofpaloalto.org/gov/depts/aud/reports/accomplishments.asp
Mayor's Green Ribbon Task Force	
Climate Protection Plan (2007)	https://www.cityofpaloalto.org/civicax/filebank/documents/9986/

Canopy	
Canopy website	http://www.canopy.org/index.php
Canopy's Species Database	http://www.canopy.org/pages/about-trees/canopy-tree-library.php
Oakwell Survey Report	Contact Canopy (650) 964-6110
Additional	
San Francisco Bay Area State of the Urban Forest Final Report by James R. Simpson and E. Gregory McPherson (USDA Center for Urban Forest Research in 2007)	http://www.fs.fed.us/psw/programs/uesd/uep/products/2/psw_cufr719_SFBay.pdf
"The Ecological Street Tree: Mainstreaming the Production of Street Tree-based Ecosystem Services in Northern California Cities, 1980-2008" by Georgia Norma Silvera Seamans	Contact the Department of Landscape Architecture and Environmental Planning, University of California, Berkeley, 202 Wurster Hall #2000, Berkeley, CA 94720-2000, Phone: (510) 642-2962
Waste Not, Want Not: The Potential for Urban Water Conservation in California , by California Department of Water Resources and the Collaboration Among State and Federal Agencies to Improve California's Water Supply (Pacific Institute 2003)	http://www.pacinst.org/wp-content/uploads/2013/02/waste_not_want_not_full_report3.pdf
"A Model of Urban Forest Sustainability" by Jim Clark published in the Journal of Arboriculture, Volume 23, Issue 1, January 1997.	http://www.naturewithin.info/Policy/ClarkSstnabltyModel.pdf
Australian Broadcasting Corporation website (ABC News)	http://www.abc.net.au/news/2008-03-20/tree-row-heads-to-court/1078732
"City Trees and Property Values", by Kathleen Wolf, published by the International Society of Aboriculture, 2007	http://www.naturewithin.info/Policy/Hedonics_Citations.pdf

Where are the Cool Parking Lots , published by Center for Urban Forestry Research 2007	Contact the Center for Urban Forestry Research, Pacific Southwest Research Station, 800 Buchanan Street, West Annex Building, Albany, CA 94710-0011, Phone (510) 559-6300 or http://www.fs.fed.us/psw/programs/uesd/uep/
Benefits of Trees published by Gregory McPherson, Continuing Education Unit, International Society of Aboriculture, Volume 13 No. 6 2004	Contact the Center for Urban Forestry Research, Pacific Southwest Research Station, 800 Buchanan Street, West Annex Building, Albany, CA 94710-0011, Phone (510) 559-6300 or http://www.fs.fed.us/psw/programs/uesd/uep/
Palo Alto Historical Association photograph archives	http://images.pahistory.org/
American Forests	http://www.americanforests.org/
CalGreen	http://www.martindale.com/natural-resources-law/article_Cox-Castle-Nicholson-LLP_1272200.htm
City of Raleigh Landscape Manual	
USDA Nor Cal Coast Community Tree Guide	http://www.fs.fed.us/psw/publications/documents/psw_gtr228/psw_gtr228.pdf
USDA Sustaining America's Trees and Urban Forest	http://nrs.fs.fed.us/pubs/gtr/gtr_nrs62.pdf
Sustainable Cities Institute: Benefits of Trees & the Urban Forest. (n.d.)	http://www.sustainablecitiesinstitute.org/view/page.basic/class/feature.class/Lesson_Benefits_Urb_Forest_Trees
Urban Wildlife - US Forest Service Research & Development (n.d.)	http://www.fs.fed.us/research/wildlife-fish/themes/urban-wildlife.php
American Planning Association (2000, April 17). *Policy Guide on Planning for Sustainability*	http://www.planning.org/policy/guides/adopted/sustainability.htm
2. American Society of Landscape Architects (n.d.). *Designing Our Future: Sustainable Landscapes*	http://www.asla.org/sustainablelandscapes/vid_urbanforests.html

Urban Forestry Programs and Technologies

iTree Streets & iTree eco	http://www.itreetools.org/
UFORE	http://www.itreetools.org/eco/resources/UFORE%20Model%20FAQs.pdf

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