Urban Tree Canopy Assessment

Tracy, California

2019

TRACY

DAVEY Resource Group

Urban Tree Canopy Assessment

Tracy, California

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Executive Summary

The amount and distribution of leaf surface area is the driving force behind the urban forest's ability to produce benefits for the community (Clark et al, 1997). As canopy cover increases, so do the benefits contributed by leaf area. These benefits, which include energy savings, air quality, water quality, stormwater interception, aesthetic and other socioeconomic benefits can be quantified for their value to the community. Understanding the location and extent of tree canopy is key to developing and implementing sound management strategies that promote the sustainability and growth of Tracy's urban forest resource and the benefits it provides.

To evaluate the urban forest, the City of Tracy contracted with Davey Resource Group (DRG) in 2018 to conduct a comprehensive Urban Tree Canopy (UTC) Assessment. The UTC Assessment provides a birds-eye view of the entire urban forest (public and privately-owned trees) and establishes a tree canopy baseline of known accuracy and classification methodology. This helps managers understand several factors about the tree canopy, including quantity and distribution of existing tree canopy; potential impacts of tree planting and removal; quantified annual benefits trees provide to the community; and benchmark canopy percent values.

The current land cover in Tracy is comprised of:

- 7.4% Tree Canopy
- 37.9% Impervious Surface (roads, parking lots, structures)
- 53.9% Pervious Surfaces (bare soils and low-lying vegetation)
- Less than 1% Open Water

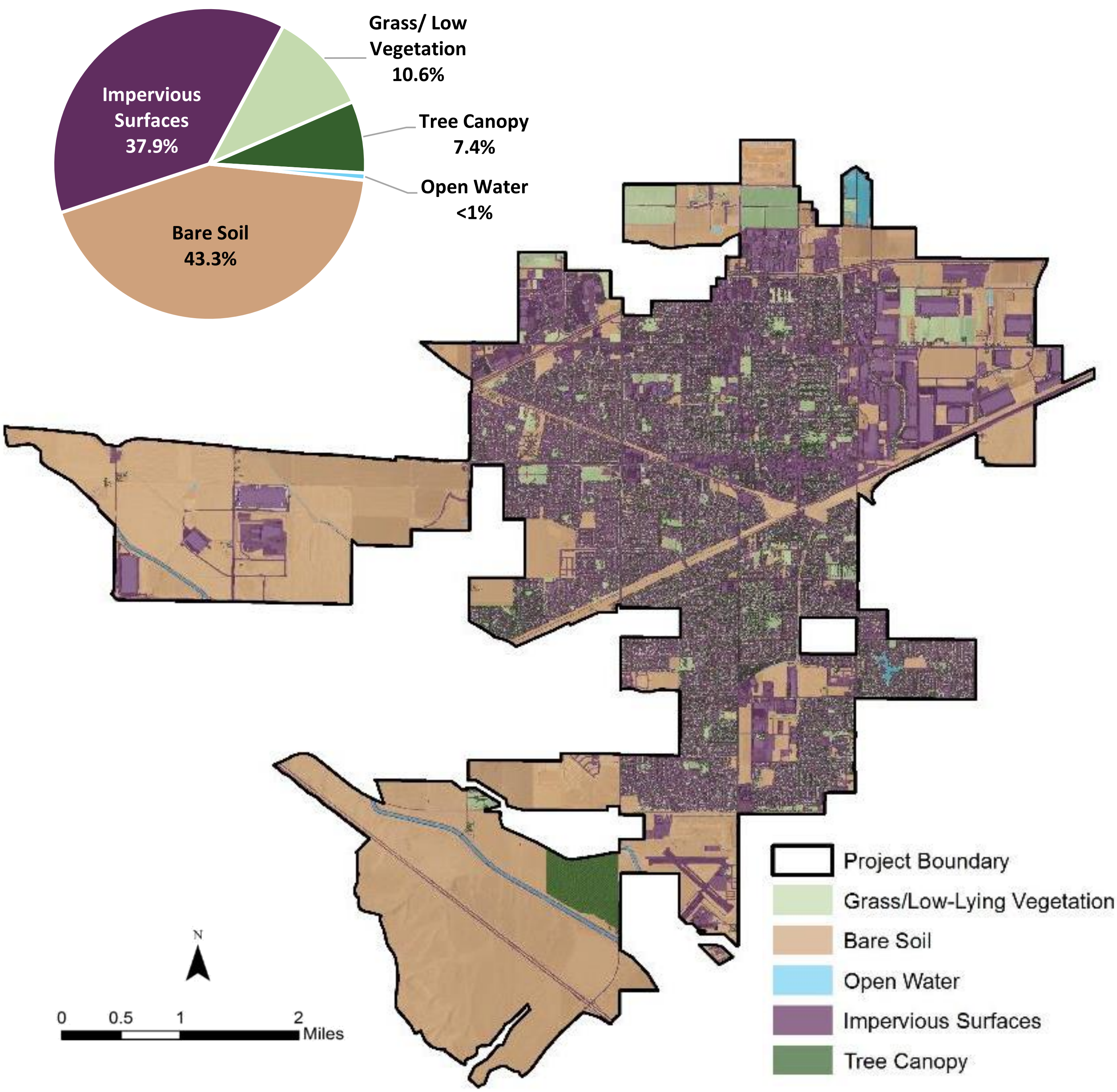
Land Cover

The City of Tracy encompasses approximately 26 square miles (16,615.9 acres) (Map 1). Excluding impervious surface (6,299.8 acres) and open water (123.2 acres), Tracy contains approximately 9.7 square miles (6,233.8 acres) which has the potential to support tree canopy. The following characterizes land cover in Tracy:

- 7.4% (1,233.1 acres) tree canopy, including trees and woody shrubs.
- 12.8% (1,123 acres) tree canopy on residential and park land use parcels
- 37.9% (6,299.8 acres) impervious surface, including roads; parking lots, and structures.
- 40.8 acres of tree canopy in parks, an average of 25.7% canopy cover.
- 498.7 acres of tree canopy over street rights-of-way, an average of 7.1% canopy cover
- 79.4% of the urban forest canopy is in fair or better condition.
- More than 342 million tons of carbon (CO_2) is stored in the woody and foliar biomass of Tracy's urban forest (public and private), valued at nearly $5.5 million.

- A maximum potential canopy of 44.9% for the total urban forest (public and private), which excludes cemeteries, ball fields, agricultural land, or other areas that are not suitable for planting trees.
- Tree canopy cover increased from 4.2% (1993) to 6.2% (2010), which is a 47.6% increase

Map 1: Tracy Land Cover Classification



Environmental Benefits

To determine the environmental benefits from the urban forest (public and private trees), Tracy's land cover was analyzed with i-Tree *Canopy* (v6.1). The analysis estimates that Tracy's trees annually provide $48,260 in benefits to air quality and stormwater runoff reduction (Figure 2, Table 1), including:

- Removing 101,228 pounds of air pollutants, including carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulate matter (PM_{10}), valued at $7,462.
- Reducing stormwater runoff by 5.1 million gallons annually, valued at $40,798.
- Removing (sequestering) an additional 13.6 million tons of CO_2, valued at $217,495.

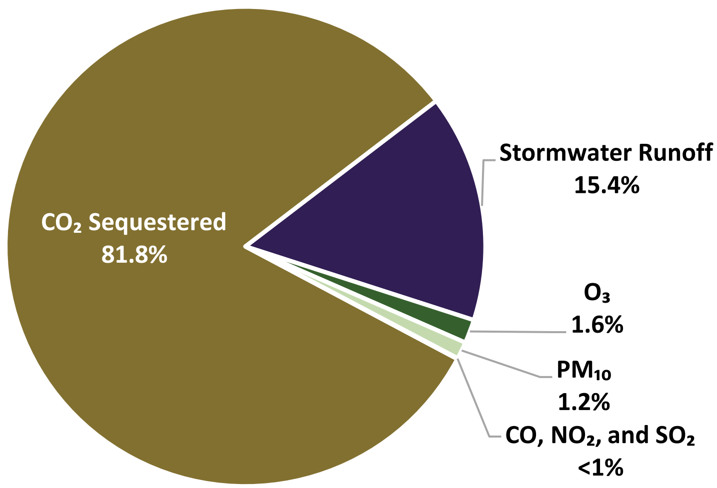


Figure 1: Annual Benefits Summary for Tracy

Table 1: Annual Environmental Benefits Summary

Item	Value ($)	% of Total Benefits
CO_2 Sequestered	$217,495	81.8
Stormwater Runoff	$40,798	15.4
O_3	$4,241	1.6
PM_{10}	$3,079	1.2
CO, NO_2, and SO_2	$143	0.1
Total	**$265,755**	**100%**

Management Applications

Understanding the location and extent of tree canopy is key to developing and implementing sound management strategies that promote the sustainability of Tracy's urban forest resource. The data, combined with existing and emerging research, enables managers to balance urban growth with tree preservation and aids in identifying and assessing urban forestry opportunities. A spatial understanding of tree canopy can help urban forest managers and city leadership align urban forestry objectives with community vision. Identifying priority planting areas that yield the most return on investment is especially important.

Tracy has an existing tree canopy cover of 7.4% and a maximum potential for 44.9% canopy. To help identify the most beneficial sites for expanding canopy, potential sites were mapped and then prioritized based on soils, slope, and existing canopy. These maps are valuable tools for guiding tree planting projects. Recommendations for maintaining existing canopy and promoting growth include:

- Use priority planting site analyses to identify new tree planting locations to reduce erosion and soil degradation and decrease canopy fragmentation.
- Use the canopy health map to identify and explore locations where environmental factors like soil and/or water conditions may be impacting tree or species health.
- Promote species diversity for greater resilience and pest resistance.
- Plant large-stature shade trees where space and design allow.
- Remove and replace failing and over-mature trees.
- Incentivize tree planting on private property, particularly in high and very high priority planting areas.

Introduction

Tracy is in San Joaquin County, within an hour of San Jose, San Francisco, and Sacramento. Although Tracy is generally considered a bedroom community, the City is currently experiencing significant growth in the industrial and commercial employment sectors. Tracy is located inside a geographic triangle formed by Interstate 205, Interstate 5, and Interstate 580, which contributes to the City's motto of "Think inside the Triangle". In addition to the laid back and friendly character of Tracy, the city is close to numerous recreational opportunities, such as, Lake Tahoe, Yosemite, and San Francisco Bay.

Tracy has a semidesert climate with an average annual precipitation around 13.3 inches, which is less than other communities in the San Joaquin Valley. With the average low temperature in winter of 37°F and summers with an average high temperature of 93°F (U.S. Climate Data, 2018). The average annual wind speed for Tracy is 7.6 MPH, with a prevailing wind from the northwest (Weather Spark, 2018)

Individual trees play an essential role in the community of Tracy by providing many benefits, tangible and intangible, to residents, visitors, and neighboring communities. Research demonstrates that healthy urban trees can improve the local environment and lessen the impact resulting from urbanization and industry (Center for Urban Forest Research, 2017). Trees improve air quality, reduce energy consumption, help manage stormwater, reduce erosion, provide critical habitat for wildlife, and promote a connection with nature.

Urban Tree Canopy and Geographic Information Systems

Urban Tree Canopy is the layer of leaves, branches, and stems that cover the ground when viewed from above. Since trees provide benefits to the community that extend beyond property lines, the assessment includes all tree canopy within the borders of the community and does not distinguish between publicly-owned and privately-owned trees. To place tree canopy in context and better understand its relationship within the community, the assessment included other primary landcover classifications, including impervious surfaces, pervious surfaces, bare soils, and water.

As more communities focus attention on environmental sustainability, community forest management has become increasingly dependent on geographic information systems (GIS). GIS is a powerful tool for urban tree canopy mapping and analysis. Understanding the extent and location of the existing canopy is key to identifying various types of community forest management opportunities, including:

- Future planting plans
- Stormwater management
- Water resource and quality management
- Impact and management of invasive species
- Preservation of environmental benefits

- Outreach and education

High-resolution aerial imagery (2016) and infrared technology remotely mapped tree canopy and land cover (Map 2). The results of the study provide a clear picture of the extent and distribution of tree canopy within Tracy. The data developed during the assessment becomes an important part of the City's GIS database and provides a foundation for developing community goals and urban forest policies. The primary purpose of the assessment was to update benchmark values and assess change since 2009. The results will enable managers to understand recent changes in the urban forest and measure the success of long-term management objectives over time. With this data, managers can determine:

- Tracy's progress towards local and regional canopy goals.
- Changes in tree canopy over time and in relation to growth and development.
- The location and extent of canopy at virtually any level, including land use, zoning, parks.
- The location of available planting space to develop strategies for increased canopy in underserved areas.

In addition to quantifying existing urban tree canopy, this assessment illustrates the potential for increasing tree canopy across Tracy. The data, combined with existing and emerging urban forestry research and applications, can provide additional guidance for determining a balance between growth and preservation and aid in identifying and assessing urban forestry opportunities.

Figure 2: Land Cover Mapping

High-resolution aerial imagery (left) is used to remotely identify existing land cover. infrared technology delineates living vegetation including tree canopy (middle). Remote sensing software identifies and maps tree canopy and other land cover (right).

Benefits of Urban Tree Canopy

Urban forests continuously mitigate the effects of urbanization and development and protect and enhance the quality of life within the community. The amount and distribution of leaf surface area is the driving force behind the ability of the urban forest to produce benefits for the community (Clark et al, 1997). Healthy trees are vigorous, often producing more leaf surface area each year. Trees and urban forests provide quantifiable benefits to the community in the following ways:

Air Quality

Urban trees improve air quality in five fundamental ways:

- Reducing particulate matter (dust)
- Absorbing gaseous pollutants
- Providing shade and transpiration
- Reducing power plant emissions
- Increasing oxygen levels

Urban trees protect and improve air quality by intercepting particulate matter (PM_{10}), including dust, ash, pollen, and smoke. The particulates are filtered and held in the tree canopy. Trees and forests also absorb harmful gaseous pollutants like ozone (O_3), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2). Shade and transpiration reduce the formation of O_3, which is created during higher temperatures. In fact, scientists are now finding that some trees may absorb more volatile organic compounds (VOC's) than previously thought (Karl et al, 2010). VOC's are a class of carbon-based particles emitted from automobile exhaust, lawnmowers, and other human activities. By reducing energy needs, trees also reduce emissions from the generation of power. Also, through photosynthesis, trees and forests increase oxygen levels.

Annually, in Tracy, trees remove 101,228 pounds of air pollutants for a total value of $7,642, including: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulate matter (PM_{10}).

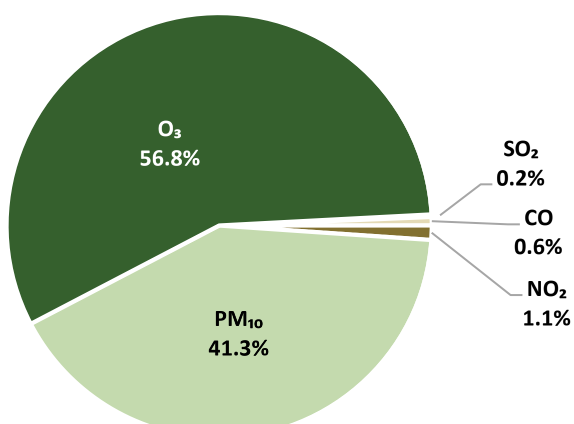


Figure 3: Air Pollutant Benefits

Carbon Reduction

Trees and forests directly reduce CO_2 in the atmosphere through growth and sequestration of carbon as woody and foliar biomass. When trees die and decay, they release much of the stored carbon back to the atmosphere. In urban environments, most trees that die are removed and chipped or disposed of as firewood, releasing stored carbon. Thus, carbon storage is an indication of the amount of carbon that can be gained and lost over the course of a tree's lifecycle through growth and decomposition. Indirectly, trees and forests reduce CO_2 by lowering the demand for energy and reducing the CO_2 emissions from the consumption of natural gas and the generation of electric power.

Purchasing emission allowances (offsets) has led to the acceptance of carbon credits as a commodity that can be exchanged for financial gain. Thus, some communities are exploring the concept of planting trees to develop a carbon offset (or credit). UESPD and USDA Forest Service recently led the development of Urban Forest Greenhouse Gas Reporting Protocol (McPherson et al, 2008/2010). The protocol establishes methods for calculating reductions and provides guidance for accounting and reporting. These methods guide urban forest managers in developing tree planting and stewardship projects that could be registered for greenhouse gas reduction credits.

The urban forest in Tracy currently stores over 342 million tons of carbon (CO_2) in woody biomass, valued at over $5.4 million. Furthermore, annually, Tracy trees sequester 13.6 million tons of carbon valued at $217,495.

Stormwater Reduction

Trees and forests improve and protect the quality of surface waters, such as creeks, rivers, and lakes, by reducing the impacts of stormwater runoff through:

- Interception
- Increasing soil capacity and rate of infiltration
- Reducing soil erosion

Trees intercept precipitation in their canopy, which acts as a mini-reservoir (Xiao et al, 1998). During storm events, this interception reduces and slows runoff. In addition to catching stormwater, canopy interception lessens the erosive impact of raindrops on bare soil. Root growth and root decomposition increase the capacity and rate of soil infiltration by rainfall and snowmelt (McPherson et al, 2002). Each of these processes greatly reduces the flow and volume of stormwater runoff, avoiding erosion and preventing sediments and other pollutants from entering local creeks and waterways.

Surface runoff is a cause for concern in many urban areas as it contributes to the pollution and flooding of streams, wetlands, rivers, lakes, and oceans. Figure 4 illustrates the benefits of trees to reducing stormwater runoff. When rain falls on impervious surfaces it cannot permeate into the soil. Instead, it collects into flows and runoff. The runoff picks up sediment, trash, oil, bacteria, and other contaminants from paved surfaces and carries this non-point source pollution to bodies of water. Along with pollutants, stormwater runoff can produce flows with large volumes of water in a short period of time, causing flooding and erosion.

During precipitation events, some portion of the precipitation is intercepted by vegetation (trees, shrubs, grass, other vegetation). Some of the water is temporarily held by leaves and bark and later evaporates or gradually infiltrates the soil, which slows the movement of water off site. The portion of the precipitation that reaches the ground and does not infiltrate into the soil or falls on impervious surfaces, becomes surface runoff (Hirabayashi, 2012). In urban areas, the substantial extent of impervious surface increases the amount of surface runoff and the cost of infrastructure a community must invest to manage stormwater for the safety of residents and property.

Annually, the urban forest in Tracy reduces stormwater runoff by nearly 5.1 million gallons valued at $40,798. This accounts for 15.6% of the annual environmental benefits provided by Tracy's urban forest. A full explanation of stormwater value calculations can be found in Appendix B.

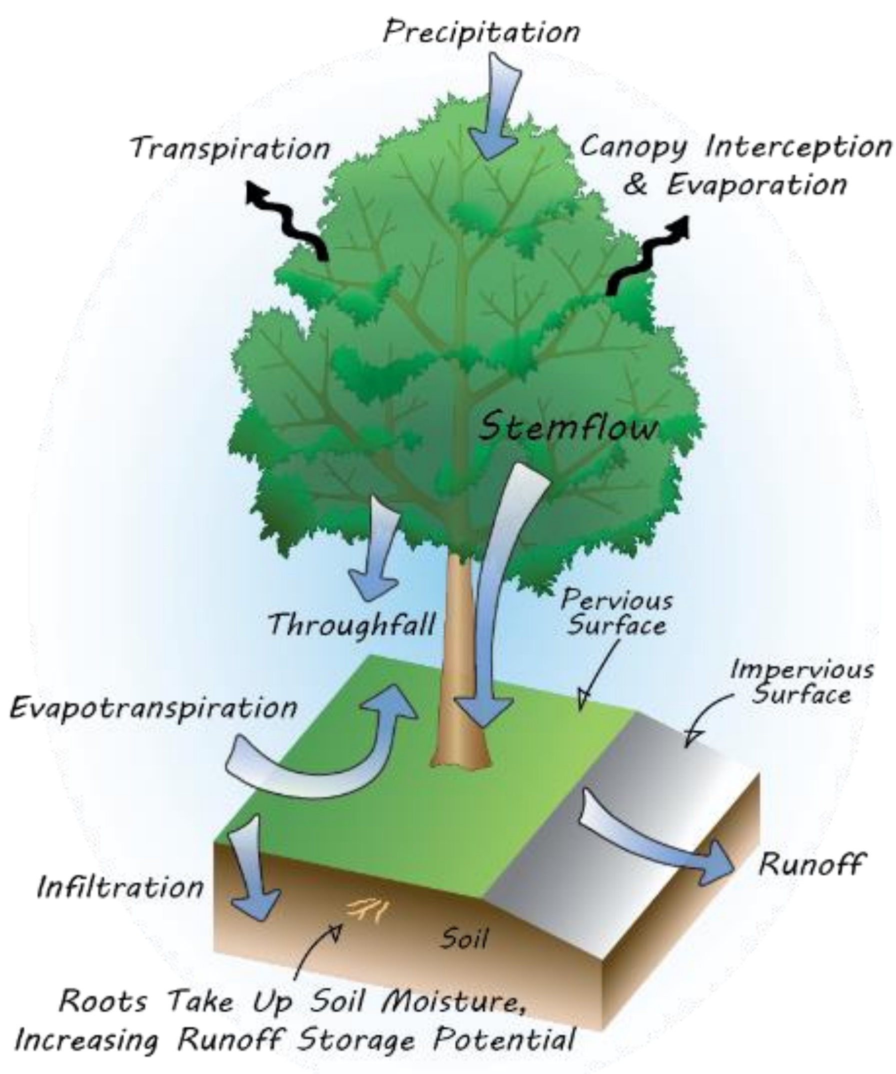


Figure 4: Stormwater Runoff Diagram

Energy Savings

Urban trees and forests modify climate and conserve energy in three principal ways:

- Shading dwellings and hardscape
- Transpiration
- Wind reduction

Shade from trees reduces the amount of radiant energy absorbed and stored by hardscapes and other impervious surfaces, thereby reducing the heat island effect, a term that describes the increase in urban temperatures in relation to surrounding locations. Transpiration releases water vapor from tree canopies, which cools the surrounding area. Through shade and transpiration, trees and other vegetation within an urban setting modify the environment and reduce heat island effects. Temperature differences of more than 9°F (5°C) have been observed between city centers without adequate canopy cover and more vegetated suburban areas (Akbari et al, 1997).

Trees reduce wind speeds relative to their canopy size and height by up to 50%. Trees also influence the movement of warm air and pollutants along streets and out of urban canyons. By reducing air movement into buildings and against conductive surfaces (e.g., glass and metal siding), trees reduce conductive heat loss from buildings, translating into potential annual heating savings of 25% (Heisler, 1986). Reducing energy needs has the bonus of reducing carbon dioxide (CO_2) emissions from fossil fuel power plants.

Aesthetics and Socioeconomics

While perhaps the most difficult to quantify, the aesthetic and socioeconomic benefits from trees may be among their greatest contributions, including:

- Beautification, comfort, and aesthetics
- Shade and privacy
- Wildlife habitat and ecosystem health
- Opportunities for recreation
- Creation of a sense of place and history
- Human health

Many of these benefits are captured as a percentage of property values, through higher sales prices where individual trees and forests are located.

Calculating Tree Benefits

While all these tree benefits are provided by the urban forest, it can be useful to understand the contribution of just one tree. Individuals can calculate the benefits of individual trees to their property by using the National Tree Benefit Calculator or with i-Tree *Design*. (design.itreetools.org).

Calculate My Tree Benefits

Land Cover

Overall Canopy

Tracy encompasses an area of approximately 26 square miles (16,615.9 acres), of which nearly 2 square miles (1,233.1 acres) is tree canopy (Figure 5). In addition to tree canopy, Tracy's land cover includes 37.9% impervious surface, 43.3% bare soil, 10.6% grass and low-lying vegetation, and less than 1% open water (Map 2).

A determination of canopy potential takes into consideration areas of bare soil and low-lying vegetation where additional trees and canopy could exist. In addition to impervious areas (roads, buildings, and parking spaces), the City of Tracy has identified 3,311.4 acres that are currently considered as not suitable for additional tree planting, including agricultural land and areas set aside for future development. Excluding impervious and non-suitable sites (agricultural, sports fields, cemeteries, and areas set aside for development), there are still 6,233.8 acres (public and private) where additional trees might be planted. Based on this methodology, the potential for tree canopy in Tracy is 44.9%. However, actual determination on where trees can and should be planted requires additional site analysis. Furthermore, additional trees can also be planted to shade impervious surfaces.

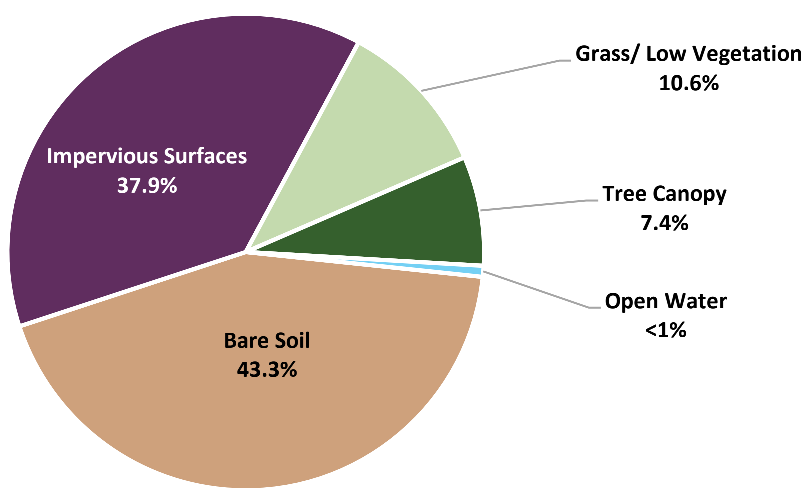


Figure 5: Tracy Land Cover Classification Summary

Table 2: Tracy Land Cover Classification Summary

Land Cover Class	Acres	% of Land Cover
Bare Soil	7,191.66	43.28
Impervious Surfaces	6,299.83	37.91
Grass/ Low Vegetation	1,768.01	10.64
Tree Canopy	1,233.13	7.42
Open Water	123.22	0.74
Total	**16,615.86**	**100%**

Map 2: Tree Canopy by Land Cover Class

Tree canopy can shade impervious surfaces such as roads, parking lots, and buildings

Tree Canopy Health

Canopy health can be determined using near-infrared imagery and Normalized Difference Vegetation Index (NDVI) transformation. NDVI values are averaged over time to establish normal growing conditions in a region. Further analysis can then characterize the health of vegetation relative to the established normal condition. This allows identification of where plants are in very good condition, and where they are in decline.

In Tracy, 79.5% of the canopy is comprised of trees in fair or better condition. Healthy trees are vigorous, often producing more leaf surface area each year. 18.3% of Tracy's canopy is made up of trees in poor condition or dead or dying. The remaining 2.3% of canopy was unclassified based on shadows or other issues with aerial imagery. This important baseline data can contribute to understanding forest health over time. The data can also be used as a comparison should emerging pests or disease become an issue.

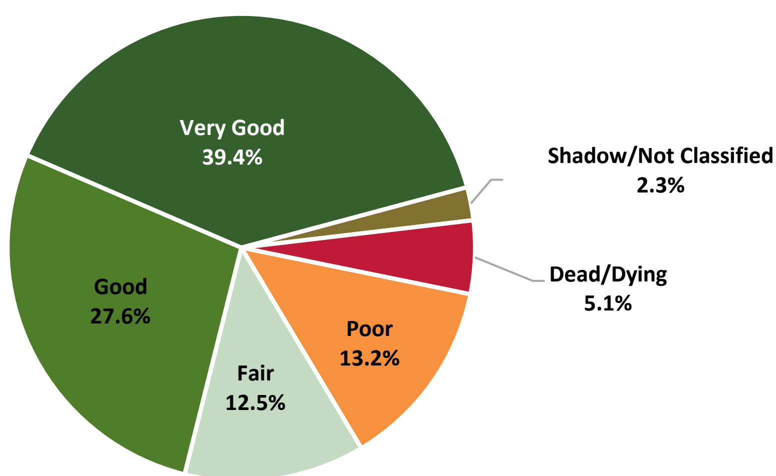


Figure 6: Summary of Canopy Health

Table 3: Summary of Canopy Health

Health Rating	Acres	%
Very Good	485.24	39.35
Good	340.04	27.58
Fair	153.95	12.49
Poor	163.01	13.22
Dead/Dying	62.49	5.07
Shadow/Not Classified	28.31	2.30
Total	**1,233.05**	**100%**

Map 3: Tree Canopy Health

Trees along walking path in Veteran's Park.

Tree Canopy by Parks

The City of Tracy has 73 areas designated as parks (Map 4, Table 4). The form and use of these areas vary from ball fields to detention ponds to open green spaces. The availability of space to plant trees is limited by these types of use. For example, ball fields are unsuitable sites for trees.

Of Tracy's 73 parks, the top ten largest by acreage are summarized in Table 11. Tracy's largest parks are Tracy Sports Complex which encompasses 26.8 acres with 1.5 acres of tree canopy cover, or 5.4%, and Plasensia Fields which encompasses 20.8 acres with 1.1 acres of tree canopy cover, or 5.4%. The maximum potential UTC for both parks is lower than the next six (6) parks, largely because Tracy Sports Complex and Plasensia Fields are primarily covered by ball fields. The third largest park, Veteran's Park; however, contrasts with the first two parks in that it encompasses 15.8 acres with 2.31 acres of tree canopy cover, or 14.6%, and a potential canopy cover of 65.8%. Ceciliani Park has the highest canopy cover among the top 10 largest parks, with 30.2% canopy cover (2.5 acres).

Table 4: Canopy Cover in Tracy's Top Ten Largest Parks

Park Name	Acres	Canopy Acres	Canopy %	Impervious Acres	Grass/Low Veg. Acres	Bare Soil Acres	Water Acres	Potential Plantable Acres	Potential UTC
Ceciliani Park	8.21	2.48	30.24	1.82	3.40	0.51	0.00	2.78	64.08
Lincoln Park	13.74	2.92	21.23	2.60	8.22	0.00	0.00	8.20	80.88
Dr. Powers Park	8.57	1.81	21.15	1.88	2.30	2.58	0.00	4.87	78.02
Gretchen Talley Park	6.67	1.32	19.83	1.11	3.84	0.40	0.00	4.24	83.35
El Pescadero Park	13.82	2.67	19.33	2.91	8.24	0.00	0.00	8.21	78.76
Veteran's Park	15.78	2.31	14.63	3.66	9.50	0.31	0.00	8.07	65.77
Clyde Bland Park	8.65	0.86	9.90	1.35	4.52	1.93	0.00	4.33	60.02
Tracy Sports Complex	26.76	1.45	5.43	5.08	17.79	2.44	0.00	0.10	5.82
Plasensia Fields	20.82	1.13	5.41	2.83	12.59	4.27	0.00	1.56	12.89
Tracy Ball Park	7.31	0.08	1.14	0.29	5.87	1.06	0.00	0.04	1.73
All other parks	117.96	23.77	20.15	22.60	69.24	2.35	0.00	63.27	73.79
All parks total	**248.29**	**17.03**	**6.86%**	**46.13**	**145.51**	**15.85**	**0.00**	**105.68**	**49.42%**

Map 4: Tracy Parks

Trees shading a playground.

Tree Canopy by Landscape Maintenance District

Tracy maintains 49 mini parks, over 220 acres in landscaping, over 28,000 trees, landscaped channel ways, and bike trails through a Landscape Maintenance District (LMD). The LMD consists of 41 zones (Map 5) (Table 5, Appendix C), which are funded through an assessment that property owners pay with property tax bill (Landscape Maintenance District, 2018).

Of these zones, Zone 36 has the highest canopy cover 28.9%, followed by Zone 25 with 25.7%%. Zone 33 is the largest with 941.4 acres and 11.0 acres of tree canopy, or 1.17%, and a potential canopy cover of 52.6%. Zone 41 encompasses 1.0 acres with nearly 0.2 acres of tree canopy, or 14.7%.

Landscape Maintenance Districts include landscaped channel ways, and bike trails.

Map 5: Tree Canopy by Landscape Maintenance District

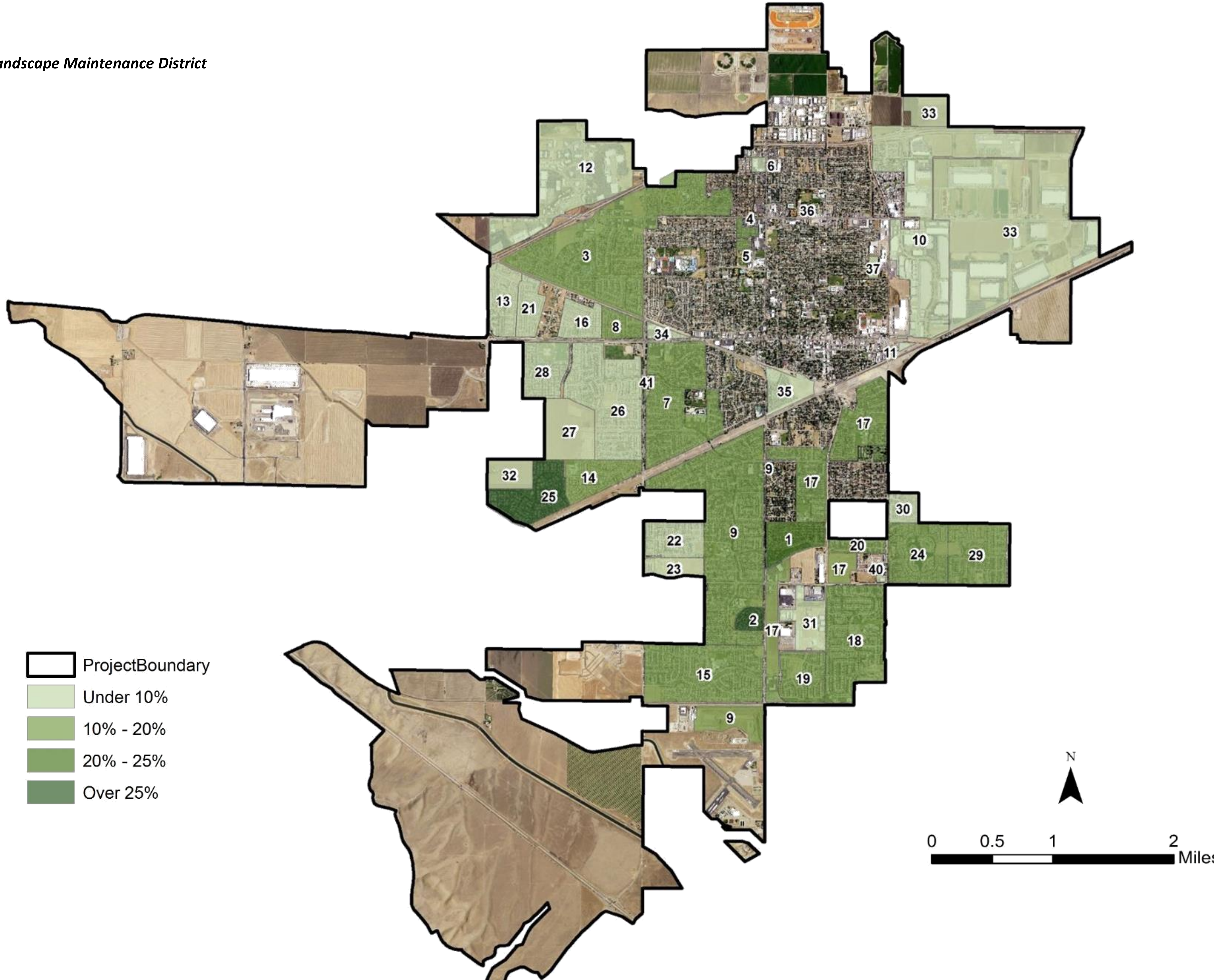


Table 5: Canopy Cover by Landscape Maintenance District Zones

Zone	Acres	Canopy Acres	Canopy %	Impervious Acres	Grass/ Low Veg. Acres	Bare Soil Acres	Water Acres	Potential Plantable Acres	Potential UTC
1	82.86	18.54	**22.38**	49.02	14.96	0.24	0.10	14.37	39.72
2	25.91	6.50	**25.08**	12.73	6.68	0.00	0.00	6.69	50.92
3	550.19	62.93	**11.44**	341.95	92.26	53.05	0.00	130.79	35.21
4	11.69	2.29	**19.58**	8.53	0.87	0.00	0.00	0.87	27.04
5	5.80	1.02	**17.64**	3.94	0.84	0.00	0.00	0.83	31.91
6	9.04	0.81	**8.96**	8.04	0.18	0.00	0.00	0.18	10.97
7	294.67	39.56	**13.42**	192.33	57.36	5.42	0.00	51.79	31.00
8	44.69	5.88	**13.16**	31.23	6.24	1.33	0.00	7.57	30.09
9	643.15	102.21	**15.89**	336.24	118.79	85.91	0.00	124.04	35.18
9	1.09	0.21	**19.47**	0.52	0.35	0.01	0.00	0.36	52.53
10	527.06	22.83	**4.33**	366.07	18.59	117.00	2.57	130.36	29.06
11	3.56	0.00	**0.00**	2.55	0.40	0.61	0.00	0.52	14.64
12	367.22	20.37	**5.55**	255.17	63.52	28.16	0.00	62.60	22.59
13	85.51	7.44	**8.71**	57.88	13.71	6.47	0.00	20.16	32.28
14	97.19	11.25	**11.57**	66.50	18.36	1.08	0.00	19.47	31.60
15	295.37	30.17	**10.21**	190.03	59.71	15.47	0.00	72.88	34.89
16	62.83	5.07	**8.06**	46.83	10.86	0.08	0.00	10.91	25.43
17	363.66	47.96	**13.19**	171.97	58.79	84.92	0.02	109.36	43.26
18	274.37	44.68	**16.28**	156.78	60.48	12.44	0.00	71.12	42.21
19	96.40	11.56	**12.00**	54.96	19.89	9.99	0.00	29.80	42.91
20	35.49	5.34	**15.06**	23.29	5.11	1.75	0.00	6.24	32.65
21	59.83	4.51	**7.54**	45.09	10.17	0.06	0.00	10.23	24.64
22	91.58	7.06	**7.71**	60.82	19.25	4.45	0.00	23.69	33.58
23	46.82	0.41	**0.88**	9.95	0.08	36.37	0.00	36.57	78.99
24	155.21	28.69	**18.48**	86.73	24.04	6.74	9.02	27.76	36.37
25	134.10	34.43	**25.67**	72.51	27.03	0.14	0.00	27.21	45.97
26	283.54	26.97	**9.51**	195.27	42.57	18.72	0.00	61.25	31.12
27	125.26	0.09	**0.07**	7.40	0.04	117.73	0.00	117.74	94.07
28	103.86	9.74	**9.38**	62.85	28.78	2.49	0.00	11.03	20.00
29	153.49	19.51	**12.71**	100.27	27.62	6.09	0.00	33.76	34.71
30	37.16	2.01	**5.40**	28.57	6.58	0.00	0.00	6.60	23.17
31	79.68	2.41	**3.02**	37.31	2.40	37.56	0.00	32.65	43.99
32	58.95	1.83	**3.10**	0.44	0.58	56.10	0.00	56.67	99.23
33	941.40	11.04	**1.17**	350.86	118.79	456.94	3.77	483.92	52.58
34	17.67	0.65	**3.66**	15.47	0.44	1.11	0.00	1.58	12.59
35	63.53	4.99	**7.86**	28.69	6.68	23.17	0.00	7.34	19.42
36	4.00	1.15	**28.86**	2.40	0.44	0.00	0.00	0.45	40.18
37	9.00	0.64	**7.14**	7.78	0.49	0.09	0.00	0.58	13.53
40	2.61	0.20	**7.59**	1.89	0.03	0.49	0.00	0.47	25.50
41	1.01	0.15	**14.64**	0.75	0.11	0.01	0.00	0.13	27.19

Tree Canopy by Subdivision

Tracy has 89 subdivisions, with an average of 45 acres and an average canopy cover of nearly 14.0%. All of Tracy's subdivisions have a potential tree canopy cover of greater than 20%.

Of Tracy's top 10 largest subdivisions Redbridge has the highest canopy cover 25.6% (34.6 acres). Brookview has the greatest potential tree canopy cover of 99.0% and it currently has less than 1% canopy cover. Santana has the greatest canopy cover of 29.7%, yet still has a potential canopy cover of 61.1%.

Table 6: Canopy Cover in Tracy's Top 10 Largest Subdivisions

Subdivision Name	Acres	Canopy Acres	Canopy %	Impervious Acres	Grass/Low Veg. Acres	Bare Soil Acres	Open Water Acres	Potential Plantable Acres	Potential UTC
Redbridge	135.15	34.55	**25.56**	72.63	27.07	0.90	0.00	27.96	46.25
Muirfield	120.20	22.00	**18.31**	74.65	23.24	0.31	0.00	23.59	37.93
Eastlake	147.73	26.96	**18.25**	84.06	22.58	5.11	9.02	24.65	34.93
Glenbriar Estates	244.01	39.26	**16.09**	139.50	54.65	10.61	0.00	63.43	42.08
Elissagaray Ranch	153.36	19.46	**12.69**	100.17	27.64	6.09	0.00	33.68	34.65
Gabriel Estates	97.16	11.24	**11.57**	66.50	18.35	1.07	0.00	19.48	31.61
Woodfield Estates	94.45	10.36	**10.97**	64.07	18.20	1.82	0.00	18.47	30.53
Edgewood	288.60	29.45	**10.20**	188.48	59.28	11.40	0.00	68.38	33.90
Presidio	147.90	14.33	**9.69**	94.42	34.78	4.37	0.00	18.94	22.49
San Marco	123.63	11.18	**9.05**	86.84	18.05	7.55	0.00	25.54	29.71
All other subdivisions	2,444.47	345.72	**14.14**	1,480.78	462.37	100.61	0.12	535.63	36.05
All subdivision total	**3,996.66**	**564.50**	**14.12%**	**2,452.09**	**766.21**	**149.85**	**0.00**	**859.74**	**35.64%**

Map 6: Tree Canopy by Subdivision

Tracy has 89 subdivisions, with an average canopy cover of nearly 14.0%.

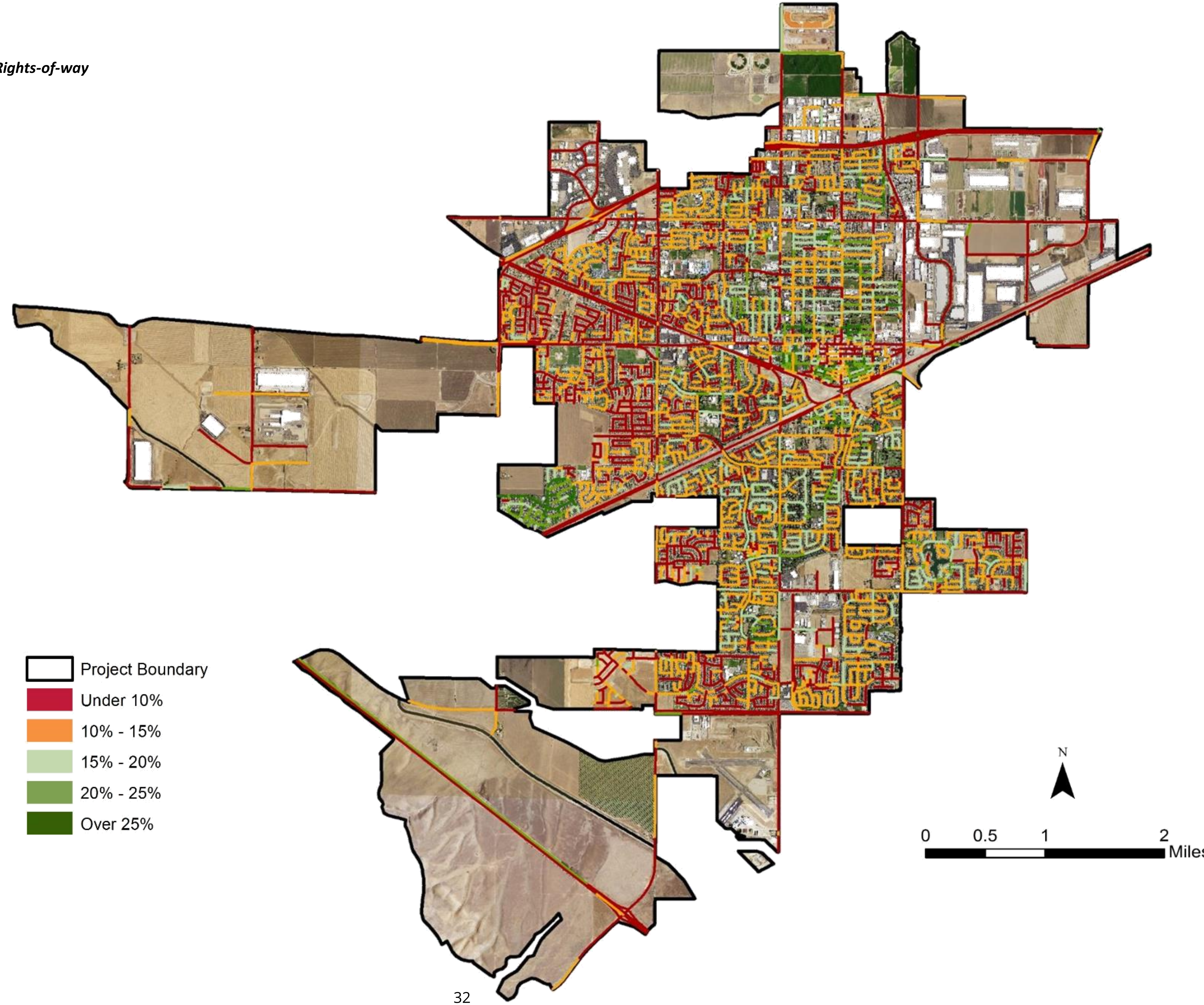
Tree Canopy by Street Rights-of-way

Tracy has 4,034.8 acres of public rights-of-way (ROW):

- Nearly 498.7 acres of canopy in ROW (12.4%), with 77 acres of available planting space.
- The potential tree canopy cover for the ROW is 31.81%.

Street trees along Tracy's public rights-of-way.

Map 7: Tree Canopy by Rights-of-way



Trees along the public rights-of-way.

Tree Canopy by Land Use

Because Tracy is experiencing a lot of development of previous agricultural lands and there are areas that are dominated by industrial and commercial properties, which can skew the data and not reflect the urban core which typically has greater canopy coverage. The following divides the community into four land use classifications to help gauge the canopy cover in the central urban core of Tracy. If industrial and commercial areas and some select previously agricultural land is excluded, residential areas and parks combined make up nearly 9,080 acres with nearly 1,123 acres or 12.8%.

Table 7: Canopy Cover by Tracy Land Use

Land Use	Acres	Canopy Acres	Canopy %	Impervious Acres	Grass/ Low Veg. Acres	Bare Soil Acres	Water Acres	Potential Plantable Acres	Potential UTC
Residential	8,753.41	1,122.93	**12.83**	4,110.77	1,333.88	2,137.59	48.23	3,216.69	49.58
Industrial	4,732.85	65.58	**1.39**	1,603.80	277.74	2,718.64	67.09	2,248.06	48.88
Commercial	410.48	32.20	**7.84**	299.84	23.94	54.50	0.00	64.09	23.46
Park[1]	326.26	0.06	**0.02**	27.16	108.65	188.38	2.01	296.91	91.02

Residential areas and parks have 12.8% tree canopy cover.

[1] Land use designation for parks is different than previous park designation.

Map 8: Tracy Land Use Zones

Tree-lined street in residential land use.

Forest Fragmentation

In addition to numerous environmental and socioeconomic benefits, urban forests also benefit wildlife. The urban ecosystem is extremely complex and diverse; existing in a multitude of layers formed by small, functional ecosystems that together form a larger system. The overall health of the urban ecosystem depends highly on the ability of the trees, plants, wildlife, insects, and humans to interact collectively as a whole. However, a key factor in declining urban health is urban build-up and sprawl, which can lead to the removal and decrease of canopy across a community. Often this effect causes canopies to be fragmented and leads to the degradation of ecosystem health, which in turn leads to a decline in habitat quality and canopy connectivity. This decline results in changes and imbalance to microclimates and increases the risk and susceptibility to invasive species.

As a part of the UTC assessment, Davey Resource Group analyzed Tracy's existing UTC for fragmentation to discover the distribution of canopy. Often, the health and diversity of the overall canopy will vastly improve by creating linkages between multiple patches of forest. The analysis found that Tracy's urban forest includes the following:

- **178.5 acres of Core Canopy (14.5%):** Tree canopy that exists within and relatively far from the forest/non-forest boundary (i.e., forested areas surrounded by more forested areas).
- **0 acres of Perforated Canopy (0.0%):** Tree canopy that defines the boundary between core forests and relatively small clearings (perforations) within the forest landscape.
- **1,039.7 acres of Patch Canopy (84.3%):** Tree canopy of a small-forested area that is surrounded by non-forested land cover.
- **15.02 acres of Edge Canopy (1.2%):** Tree canopy that defines the boundary between core forests and large core forests and large non-forested land cover features. When large enough, edge canopy may appear to be unassociated with core forests.

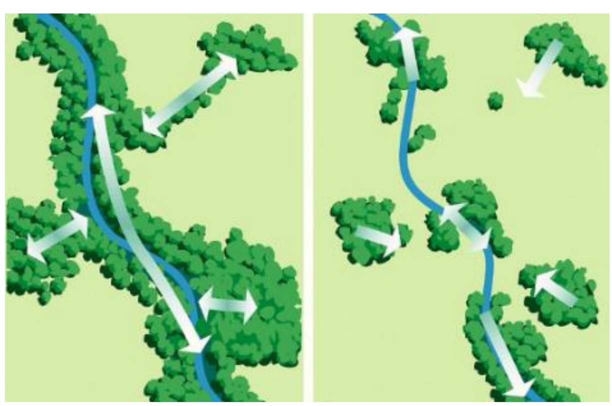
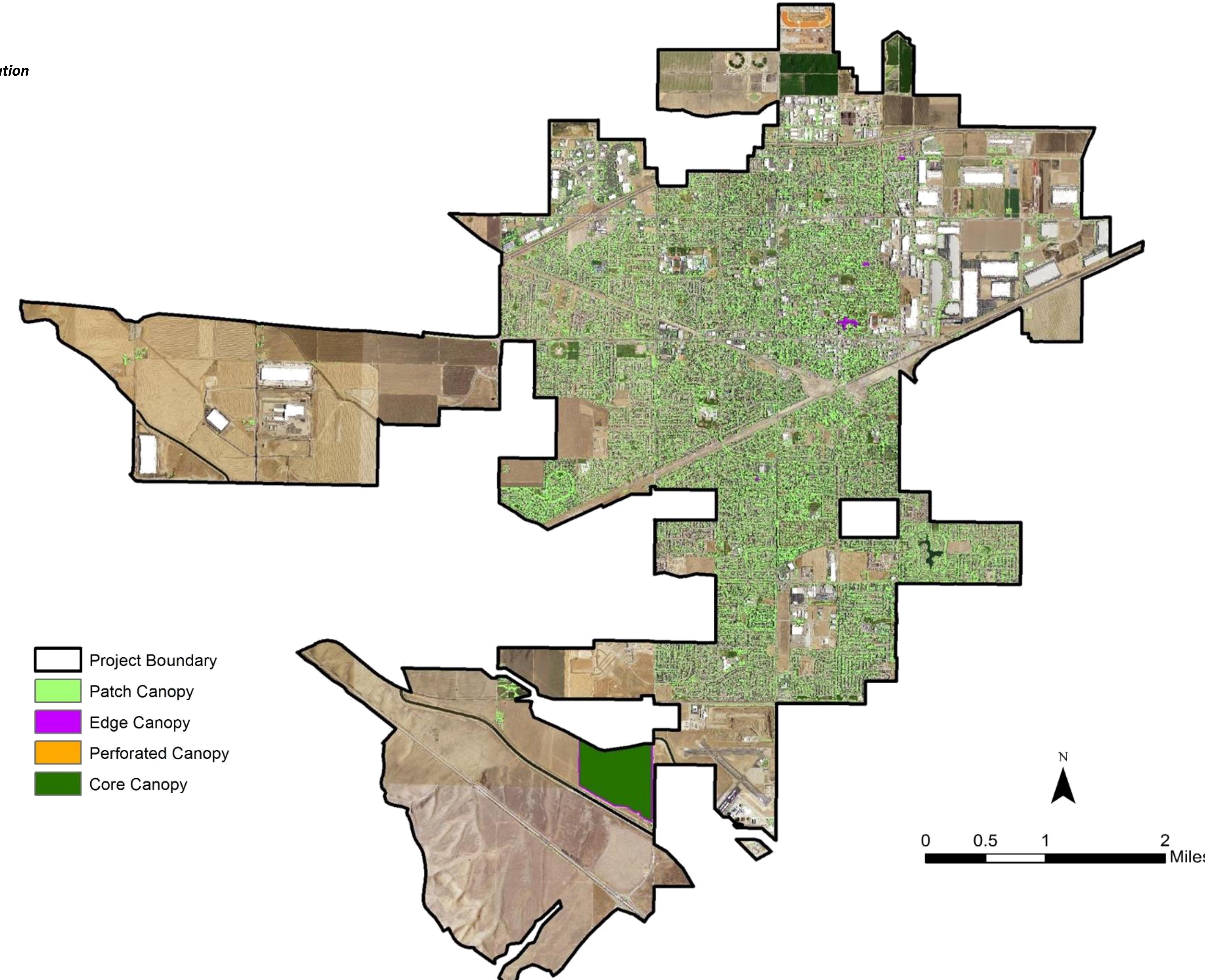


Figure 7: Canopy Fragmentation Comparison[2]

[2] Wildlife corridors (far left) link habitats while fragmented

Map 9: Forest Fragmentation



Tree Canopy Comparison with Neighboring Communities

Tracy has approximately 12.8% canopy cover when previous agriculture areas, industrial, and commercial areas are excluded. Of neighboring communities (Figure 8), Patterson has the highest canopy cover at 21.3%.

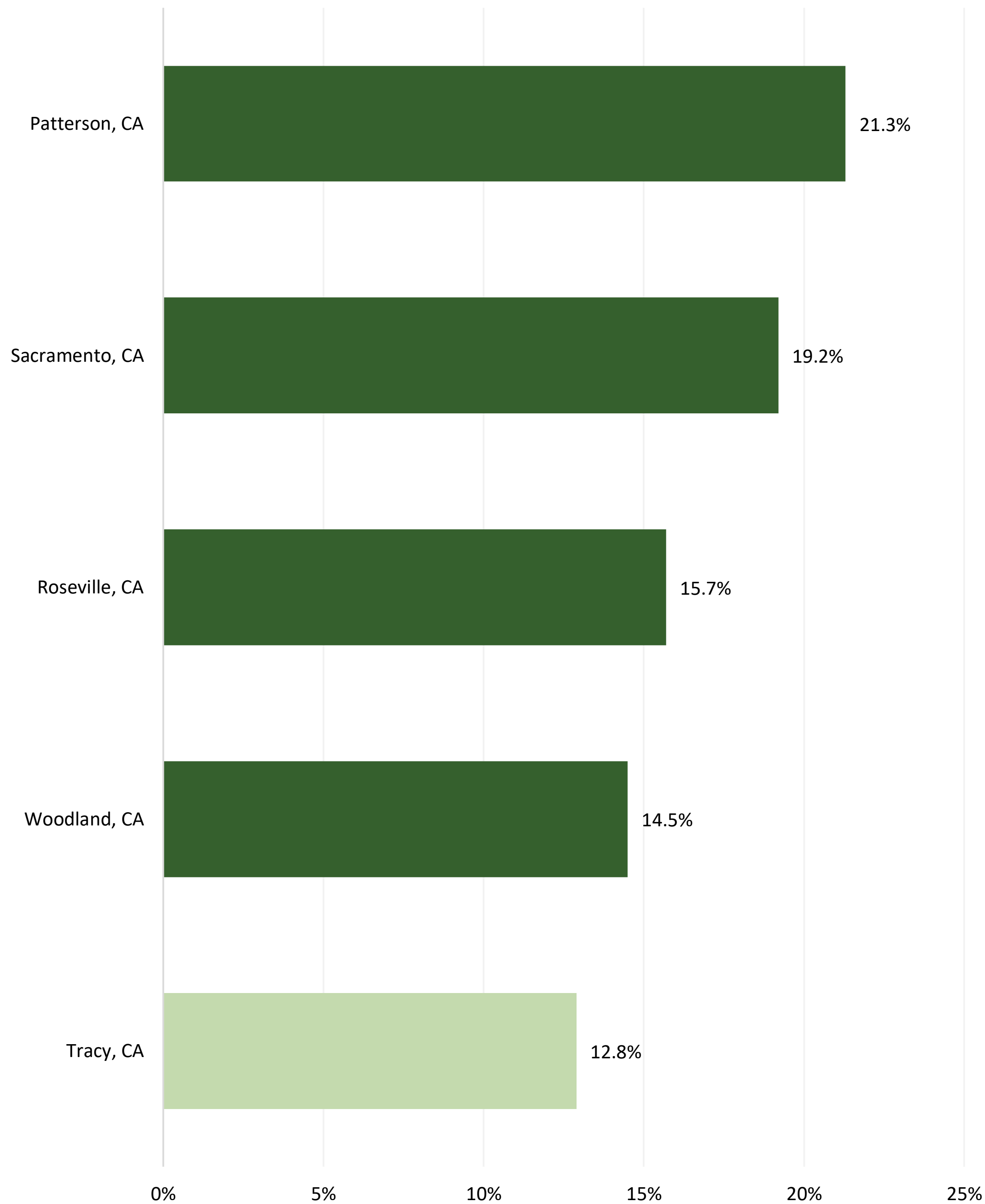


Figure 8: Neighboring Communities Canopy Cover

Historic Change

A point sampling was conducted using canopy data derived from 1993 and 2010 imagery was used to determine change in canopy cover over a period of 17 years. Land cover was visually inspected at each point for both years simultaneously and was specified as one of five classes: tree canopy, impervious surfaces, grass/shrub, bare soil, and open water. Tree canopy cover was analyzed using a “top-down” or “birds’-eye” approach, therefore where tree canopy visibly overlaps another land cover class, tree canopy was recorded at the point location. For a complete methodology for this analysis, refer to Appendix B.

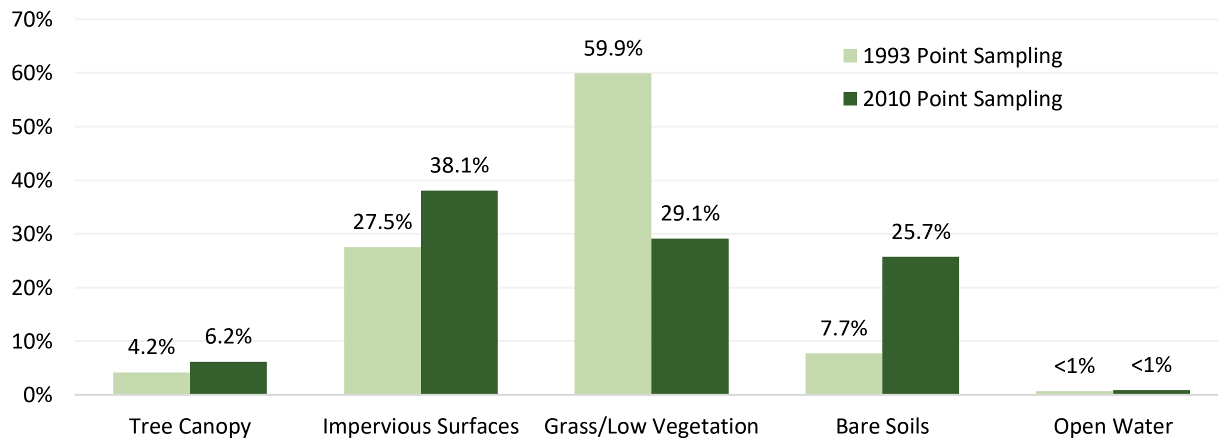


Figure 9: Land Cover Percentage for Point Sampling from 1993 and 2010

From 1993 to 2010, tree canopy cover increased from 4.2% to 6.2%, which is a 47.6% increase (Figure 9). As identified in this analysis canopy cover for the overall community identified in this analysis is 7.4%. In comparison to 1993 the estimated canopy cover from the point sampling is 4.2%, this is a 76.25% increase over a 17-year period (Figure 10).

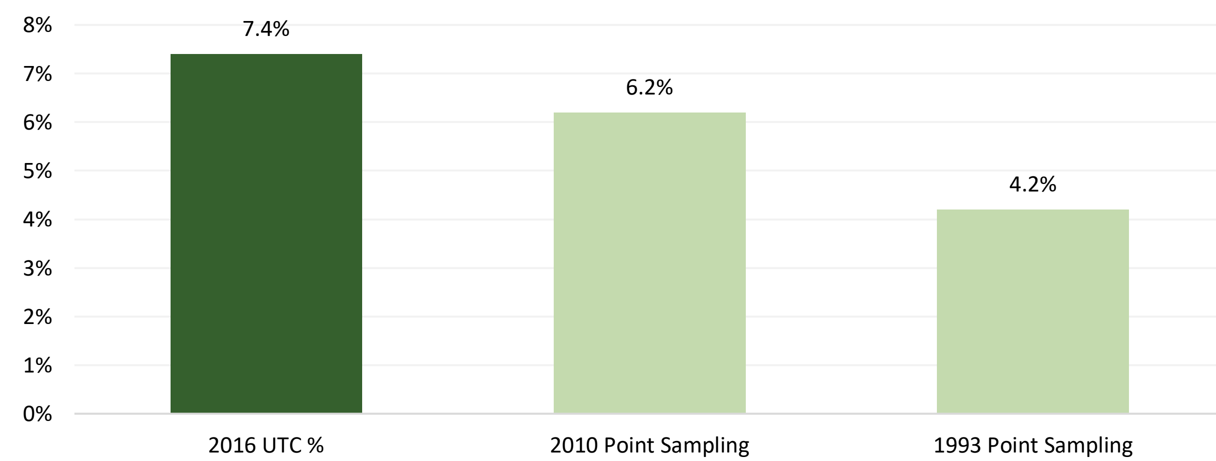


Figure 10: Historic Tree Canopy Cover Percentage Comparison

Children enjoying a shaded playground in Tracy.

Preferred Planting Sites

To identify and prioritize planting potential, DRG assessed environmental features to identify and prioritize the risk potential for soil loss and degradation from storm and flood events. Weighted consideration was provided for proximity to hardscape and canopy, soil permeability, location within a floodplain, slope, population density, road density, and a soil erosion factor (K-factor) (Table 8). Each feature was assessed using a separate grid map. A value between zero (0) and four (4) (with zero (0) having the lowest risk potential) was assigned to each feature/grid assessed. Overlaying these grid maps and averaging the values provided the risk potential at any given point. A priority ranging from very low to very high was assigned to areas on the map based on the calculated average.

While available planting sites may ultimately be planted over the next several decades, the trees that are planted in the next several years, should be planned for areas of greatest need, and where they will provide the most benefits and return on investment.

The analysis identified the following acres of planting:

- Very Low–5,435.3 acres
- Low–325.2 acres
- Moderate–197.7 acres
- High–141.6 acres
- Very High–107.0 acres

Table 8: Stormwater Factors Used to Prioritize Tree Planting Sites

Dataset	Source	Weight
Urban Heat Island Index	Urban Tree Canopy Assessment	0.25
Proximity to Hardscape	Urban Tree Canopy Assessment	0.20
Floodplain Proximity	National Hydrologic Dataset	0.15
Soil Permeability	Natural Resource Conservation Service	0.15
Slope	National Elevation Dataset	0.10
Soil Erosion (K-factor)	Natural Resource Conservation Service	0.10
Canopy Fragmentation	Urban Tree Canopy Assessment	0.05

Map 10: Planting Priority

Disadvantaged Communities

California SB 535 targets disadvantaged communities for investment of proceeds from the state cap-and-trade program. Funding is aimed at improving public health, quality of life, and economic opportunity while reducing pollution that causes climate change. Disadvantage communities are identified using the CalEnviroScreen tool (About CalEnviroScreen, 2019) to rank each of California's 8,000 census tracts with data on 20 indicators of pollution, environmental quality, and socioeconomic and public health conditions (Disadvantaged Communities, 2019). Disadvantaged communities are defined as the top 25% scoring areas from CalEnviroScreen along with other areas with high amounts of pollution and low populations (SB 535 Disadvantaged Communities, 2019).

Four census tracts in northeast Tracy have been identified as disadvantaged communities: 6077005302, 6077005305, 6077005308, and 6077005502. The UTC assessment analyzed canopy cover in conjunction with sensitive populations (health status and age) and socioeconomic factors (income) for these four census tracts. No correlation was found between those population characteristics and tree canopy cover.

Even though there were no correlations found, evidence shows that some of the pollution burdens that CalEnviroScreen considers in its analysis, like air quality, are positively impacted by trees. For a complete methodology of CalEnviroScreen, refer to Appendix C.

"Disadvantaged Community" identified in CAL FIRE grant.

Conclusion

The UTC assessment establishes a new baseline for monitoring overall tree canopy cover throughout the community and augments the City's GIS database with a landcover layer that identifies the location and extent of existing canopy. This data layer can be used in conjunction with other infrastructure layers to prioritize planting sites and increase canopy cover strategically by subdivision, parks, or zones. This assessment provides a foundation for developing urban forest management strategies and measuring the success of those strategies over time.

With an average overall canopy of 7.4% and a potential UTC potential 44.9%, Tracy has ample opportunity to expand the urban forest. Community engagement and support are vital to a successful urban forestry program. Based on this assessment, urban forest managers have the following opportunities:

- When industrial and commercial areas and some select previously agricultural land is excluded, residential areas and parks make up nearly 9,080 acres with nearly 1,123 acres (12.8%). If we focus solely on these areas, the canopy potential is 56%
- Considering that 37.9% of Tracy is covered by impervious surface and that the current canopy cover is 7.4% with 10.6% cover by grass and low-lying vegetation and 43.3% by bare soil, the potential UTC is 44.9%. Given the maximum potential UTC of 44.9%, the community must decide what is a reasonable UTC goal for their needs.
- Prioritized maps provide a basis for a strategically focused planting plan to increase trees and canopy that will support stormwater management, preserve soil, and complement the existing urban infrastructure for the greatest impact and return on investment. These prioritized maps exclude open spaces that will never get planted, such as athletic fields.
- Tracy parks have an average potential UTC above 49.4%, with nearly 105.7 acres of preferred planting sites, which could be a fantastic opportunity for adding large-stature shade trees.
- Tracy’s ROW has the potential to support an additional 784.8 acres of tree canopy, for a maximum potential canopy of 31.8%.
- Incentivize tree planting on private property, particularly in high and very high priority planting areas. An area that could benefit from this incentive is Landscape Maintenance District Zone 27 with a potential UTC of 94.1%, with 117.7 acres of preferred plantable acres.

Tracy's ROW has the potential to support an additional 784.8 acres of tree canopy.

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Trees shading a meandering sidewalk along a busy street in Tracy.

Appendix B: Methodology

Calculating Benefits

Air Quality

The i-Tree *Canopy* v6.1 Model was used to quantify the value of ecosystem services for air quality. i-Tree *Canopy* was designed to give users the ability to estimate tree canopy and other land cover types within any selected geography. The model uses the estimated canopy percentage and reports air pollutant removal rates and monetary values for carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulate matter (PM) (Hirabayashi 2014).

Within the i-Tree *Canopy* application, the U.S. EPA's BenMAP Model estimates the incidence of adverse health effects and monetary values resulting from changes in air pollutants (Hirabayashi 2014; US EPA 2012). Different pollutant removal values were used for urban and rural areas. In i-Tree *Canopy*, the air pollutant amount annually removed by trees and the associated monetary value can be calculated with tree cover in areas of interest using BenMAP multipliers for each county in the United States.

To calculate ecosystem services for the study area, canopy percentage metrics from UTC land cover data performed during the assessment were transferred to i-Tree *Canopy*. Those canopy percentages were matched by placing random points within the i-Tree *Canopy* application. Benefit values were reported for each of the five listed air pollutants.

Carbon Storage and Sequestration

The i-Tree *Canopy* v6.1 Model was used to quantify the value of ecosystem services for carbon storage and sequestration. i-Tree *Canopy* was designed to give users the ability to estimate tree canopy and other land cover types within any selected geography. The model uses the estimated canopy percentage and reports carbon storage and sequestration rates and monetary values. Methods on deriving storage and sequestration can be found in (Nowak et al, 2013).

To calculate ecosystem services for the study area, canopy percentage metrics from UTC land cover data performed during the assessment were transferred to i-Tree *Canopy*. Those canopy percentages were matched by placing random points within the i-Tree *Canopy* application. Benefit values were reported for carbon storage and sequestration.

Stormwater

The i-Tree *Hydro* v5.0 Model was used to quantify the value of ecosystem services for stormwater runoff. i-Tree *Hydro* was designed for users interested in analysis of vegetation and impervious cover effects on urban hydrology. This most recent version (v5.0) allows users to report hydrologic data on the city level rather than just a watershed scale giving users more flexibility. For more information about the model, please consult the i-Tree *Hydro* v5.0 manual (http://www.itreetools.org).

To calculate ecosystem services for the study area, land cover percentages derived for the project area and all municipalities that were included in the project area were used as inputs into the model. Precipitation data from 2005-2012 was modeled within the i-Tree *Hydro* to best represent the average conditions over an eight-year time period. Model simulations were run under a Base Case as well as an Alternate Case. The Alterative Case set tree canopy equal to 0% and assumed that impervious and vegetation cover would increase based on the removal of tree canopy. Impervious surface was increased 0.7% based on a percentage of the amount of impervious surface under tree canopy and the rest was added to the vegetation cover class. This process was completed to assess the runoff reduction volume associated with tree canopy since i-Tree *Hydro* does not directly report the volume of runoff reduced by tree canopy. The volume (in cubic meters) was converted to gallons to retrieve the overall volume of runoff avoided by having the current tree canopy.

Through model simulation, it was determined that tree canopy decreases the runoff volume in the project area by nearly 5.1 million gallons per year using precipitation data from 2005-2012. This equates to approximately 4,135 gallons per acre of tree canopy (5.1 million gals/1,233.17 acres).

To place a monetary value on storm water reduction, the cost to treat a gallon of storm/waste water was taken from (McPherson et al, 1999). This value was $0.008 per gallon. Tree canopy was estimated to contribute roughly $40,798 to avoided runoff annually to the project area.

Priority Planting Analysis

The planting location polygons were created by taking all grass/open space and bare ground areas and combining them into one dataset. Non-feasible planting areas such as agricultural fields, recreational fields, major utility corridors, airports, etc. were removed from consideration. The remaining planting space was consolidated into a single feature and, then, exploded back out to multipart features creating separate, distinct polygons for each location. Using zonal statistics, the priority grid raster was used to calculate an average value for each planting location polygon. The averages were binned into five (5) classes with the higher numbers indicating higher priority for planting. These classes ranged from very low to very high.

Land Cover Extraction and Accuracy Assessment

Davey Resource Group utilized an object-based image analysis (OBIA) semi-automated feature extraction method to process and analyze current high-resolution color infrared (CIR) aerial imagery and remotely-sensed data to identify tree canopy cover and land cover classifications. The use of imagery analysis is cost-effective and provides a highly accurate approach to assessing your community's existing tree canopy coverage. This supports responsible tree management, facilitates community forestry goal-setting, and improves urban resource planning for healthier and more sustainable urban environments.

Advanced image analysis methods were used to classify, or separate, the land cover layers from the overall imagery. The semi-automated extraction process was completed using Feature Analyst, an extension of ArcGIS®. Feature Analyst uses an object-oriented approach to cluster together objects with similar spectral (i.e., color) and spatial/contextual (e.g., texture, size, shape, pattern, and spatial association) characteristics. The land cover results of the extraction process were post-processed and clipped to each project boundary prior to the manual editing process in order to create smaller, manageable, and more efficient file sizes. Secondary source data, high-resolution aerial imagery provided by each UTC city, and custom ArcGIS® tools were used to aid in the final manual editing, quality checking, and quality assurance processes (QA/QC). The manual QA/QC process was implemented to identify, define, and correct any misclassifications or omission errors in the final land cover layer.

Classification Workflow

1. Prepare imagery for feature extraction (resampling, rectification, etc.), if needed.
2. Gather training set data for all desired land cover classes (canopy, impervious, grass, bare soil, shadows). Water samples are not always needed since hydrologic data are available for most areas. Training data for impervious features were not collected because the City maintained a completed impervious layer.
3. Extract canopy layer only; this decreases the amount of shadow removal from large tree canopy shadows. Fill small holes and smooth to remove rigid edges.
4. Edit and finalize canopy layer at 1:2000 scale. A point file is created to digitize-in small individual trees that will be missed during the extraction. These points are buffered to represent the tree canopy. This process is done to speed up editing time and improve accuracy by including smaller individual trees.
5. Extract remaining land cover classes using the canopy layer as a mask; this keeps canopy shadows that occur within groups of canopy while decreasing the amount of shadow along edges.
6. Edit the impervious layer to reflect actual impervious features, such as roads, buildings, parking lots, etc. to update features.
7. Using canopy and actual impervious surfaces as a mask; input the bare soils training data and extract them from the imagery. Quickly edit the layer to remove or add any features. Davey Resource Group tries to delete dry vegetation areas that are associated with lawns, grass/meadows, and agricultural fields.
8. Assemble any hydrological datasets, if provided. Add or remove any water features to create the hydrology class. Perform a feature extraction if no water feature datasets exist.
9. Use geoprocessing tools to clean, repair, and clip all edited land cover layers to remove any self-intersections or topology errors that sometimes occur during editing.
10. Input canopy, impervious, bare soil, and hydrology layers into Davey Resource Group's Five-Class Land Cover Model to complete the classification. This model generates the pervious (grass/low-lying vegetation) class by taking all other areas not previously classified and combining them.

11. Thoroughly inspect final land cover dataset for any classification errors and correct as needed.
12. Perform accuracy assessment. Repeat Step 11, if needed.

Automated Feature Extraction Files

The automated feature extraction (AFE) files allow other users to run the extraction process by replicating the methodology. Since Feature Analyst does not contain all geoprocessing operations that Davey Resource Group utilizes, the AFE only accounts for part of the extraction process. Using Feature Analyst, Davey Resource Group created the training set data, ran the extraction, and then smoothed the features to alleviate the blocky appearance. To complete the actual extraction process, Davey Resource Group uses additional geoprocessing tools within ArcGIS®. From the AFE file results, the following steps are taken to prepare the extracted data for manual editing.

1. Davey Resource Group fills all holes in the canopy that are less than 30 square meters. This eliminates small gaps that were created during the extraction process while still allowing for natural canopy gaps.
2. Davey Resource Group deletes all features that are less than 9 square meters for canopy (50 square meters for impervious surfaces). This process reduces the number of small features that could result in incorrect classifications and helps computer performance.
3. The Repair Geometry, Dissolve, and Multipart to Singlepart (in that order) geoprocessing tools are run to complete the extraction process.
4. The Multipart to Singlepart shapefile is given to GIS personnel for manual editing to add, remove, or reshape features.

Table 9: Classification Matrix

	Classification Data								
Reference Data	Classes	Tree Canopy	Impervious	Grass/Vegetation	Bare Soils	Water	Row Total	Producer's Accuracy	Errors of Omission
	Tree Canopy	64	1	1	0	0	66	96.97%	3.03%
	Impervious	1	381	10	5	0	397	95.97%	4.03%
	Grass/Vegetation	2	1	85	2	0	90	94.44%	5.56%
	Bare Soils	0	6	7	429	0	442	97.06%	2.94%
	Water	0	0	0	0	5	5	100.00%	0.00%
	Column Total	67	389	103	436	5	1000		
	User's Accuracy	95.52%	97.94%	82.52%	98.39%	100.00%		Overall Accuracy	96.40%
	Errors of Comission	4.48%	2.06%	17.48%	1.61%	0.00%		Kappa Coefficent	0.9437

Accuracy Assessment Protocol

Determining the accuracy of spatial data is of high importance to Davey Resource Group and our clients. To achieve to best possible result, Davey Resource Group manually edits and conducts thorough QA/QC checks on all urban tree canopy and land cover layers. A QA/QC process will be completed using ArcGIS® to identify, clean, and correct any misclassification or topology errors in the final land cover dataset. The initial land cover layer extractions will be edited at a 1:2000 quality control scale in the urban areas and at a 1:2500 scale for rural areas utilizing the most current high-resolution aerial imagery to aid in the quality control process.

To test for accuracy, random plot locations are generated throughout the city area of interest and verified to ensure that the data meet the client standards. Each point will be compared with the most current NAIP high-resolution imagery (reference image) to determine the accuracy of the final land cover layer. Points will be classified as either correct or incorrect and recorded in a classification matrix. Accuracy will be assessed using four metrics: overall accuracy, kappa, quantity disagreement, and allocation disagreement. These metrics are calculated using a custom Excel® spreadsheet.

Land Cover Accuracy

The following describes Davey Resource Group's accuracy assessment techniques and outlines procedural steps used to conduct the assessment.

1. ***Random Point Generation***—Using ArcGIS, 1,000 random assessment points are generated.
2. ***Point Determination***—Each point is carefully assessed by the GIS analyst for likeness with the aerial photography. To record findings, two new fields, CODE and TRUTH, are added to the accuracy assessment point shapefile. CODE is a numeric value (1–5) assigned to each land cover class (Table 1) and TRUTH is the actual land cover class as identified according to the reference image. If CODE and TRUTH are the same, then the point is counted as a correct classification. Likewise, if the CODE and TRUTH are not the same, then the point is classified as incorrect. In most cases, distinguishing if a point is correct or incorrect is straightforward. Points will rarely be misclassified by an egregious classification or editing error. Often incorrect points occur where one feature stops and the other begins.

3. ***Classification Matrix***—During the accuracy assessment, if a point is considered incorrect, it is given the correct classification in the TRUTH column. Points are first assessed on the NAIP imagery for their correctness using a "blind" assessment—meaning that the analyst does not know the actual classification (the GIS analyst is strictly going off the NAIP imagery to determine cover class). Any incorrect classifications found during the "blind" assessment are scrutinized further using sub-meter imagery provided by the client to determine if the point was incorrectly classified due to the fuzziness of the NAIP imagery or an actual misclassification. After all random points are assessed and recorded; a classification (or confusion) matrix is created. The classification matrix for this project is presented in Table 9. The table allows for assessment of user's/producer's accuracy, overall accuracy, omission/commission errors, kappa statistics, allocation/quantity disagreement, and confidence intervals (Table 10).
4. Following are descriptions of each statistic as well as the results from some of the accuracy assessment tests.

Overall Accuracy – Percentage of correctly classified pixels; for example, the sum of the diagonals divided by the total points ((64+381+85+429+5)/1,000 = 96.40%).

User's Accuracy – Probability that a pixel classified on the map represents that category on the ground (correct land cover classifications divided by the column total [64/67 = 95.52%]).

Producer's Accuracy – Probability of a reference pixel being correctly classified (correct land cover classifications divided by the row total [64/66 = 96.97%]).

Kappa Coefficient – A statistical metric used to assess the accuracy of classification data. It has been generally accepted as a better determinant of accuracy partly because it accounts for random chance agreement. A value of 0.80 or greater is regarded as "very good" agreement between the land cover classification and reference image.

Errors of Commission – A pixel reports the presence of a feature (such as trees) that, in reality, is absent (no trees are actually present). This is termed as a false positive. In the matrix below, we can determine that 4.48% of the area classified as canopy is most likely not canopy.

Errors of Omission – A pixel reports the absence of a feature (such as trees) when, in reality, they are actually there. In the matrix below, we can conclude that 3.03% of all canopy classified is actually classified as another land cover class.

Allocation Disagreement – The amount of difference between the reference image and the classified land cover map that is due to less than optimal match in the spatial allocation (or position) of the classes.

Quantity Disagreement – The amount of difference between the reference image and the classified land cover map that is due to less than perfect match in the proportions (or area) of the classes.

Confidence Intervals – A confidence interval is a type of interval estimate of a population parameter and is used to indicate the reliability of an estimate. Confidence intervals consist of a range of values (interval) that act as good estimates of the unknown population parameter based on the observed probability of successes and failures. Since all assessments have innate error, defining a lower and upper bound estimate is essential.

Table 10: Confidence Intervals

95% Confidence Intervals

Landcover Assessment

Class	Acreage	Percentage	Lower Bound	Upper Bound
Tree Canopy	1,233.2	7.4%	7.2%	7.6%
Impervious	6,315.0	38.0%	37.6%	38.4%
Grass/Vegetation	1,751.3	10.5%	10.3%	10.8%
Bare Soils	7,193.2	43.3%	42.9%	43.7%
Water	123.3	0.7%	0.7%	0.8%
Total	16,615.9	100.00%		

Statistical Metrics Summary:

Overall Accuracy = 96.40%
Kappa Coefficent = 0.9437
Allocation Disagreement = 2%
Quantity Disagreement = 1%

Accuracy Assessment

Class	User's Accuracy	Lower Bound	Upper Bound	Producer's Accuracy	Lower Bound	Upper Bound
Tree Canopy	95.5%	93.0%	98.0%	97.0%	94.9%	99.1%
Impervious	97.9%	97.2%	98.7%	96.0%	95.0%	97.0%
Grass/Vegetation	82.5%	78.8%	86.3%	94.4%	92.0%	96.9%
Bare Soils	98.4%	97.8%	99.0%	97.1%	96.3%	97.9%
Water	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Calculating Historic Change

To assess historical land cover at each point, DRG visually inspected imagery at each point for both years simultaneously. Land cover was specified as one of five classes: tree canopy, impervious surfaces, grass/shrub, bare ground, and water. Tree canopy percentage was analyzed using a "top-down" or "bird's-eye" approach, meaning that where tree canopy visibly overlaps another land cover class, tree canopy was still recorded for the point location. Points and imagery were overlaid in ArcGIS for inspection and classification.

The above-described assessment used the following rules for evaluation; establishing and following such rules ensured consistent assessment in leaf-off conditions:

1. Scrutinize 1993 image and determine the best classification per point.
2. Scrutinize 2010 image and determine the best classification per point.
3. If images match beyond a reasonable doubt, classification is recorded the same for both years.
4. If images clearly show a visible change, classification is recorded differently for 1993 and 2010 to the respective land cover class of the image year.

The land cover assessment was completed by two analysts who have fifteen years of combined experience classifying land cover data. Though no formal accuracy assessment was performed, DRG conducted a thorough quality control check on all point data for analyst agreement and to reduce bias and error. When disagreement occurred, analysts met to deliberate and decide on the final classification based on discussion.

Special considerations were taken to account for parallax (difference in the apparent position of an object viewed along two different lines of sight), image shift, and shadowing. In the case of shadowing, the base of the tree was located before appropriately determining whether or not the point could have fallen within the tree crown. Occasionally, shadows fully engulf the sampling point where no definitive assessment can be made using the 1993 or 2010 imagery. For these situations, the analysts converged to make the most reasonable classification based on surrounding land cover. For image shifts and parallax, contextual observation at and around the point location was considered before recording the classification. These deficiencies were somewhat common due to the flight collection patterns and flight times being different for both sets of images. Parallax variance is usually less than five feet but can still alter the classification of a point if not examined thoroughly. Best judgments were used to make a defensible and consistent inspection of each classified point.

Trees shading parked cars along a residential street.

Appendix C: CalEnviroScreen

1. The CalEnviroScreen model includes two components representing:
   - Pollution Burden – Exposures and Environmental Effects – and two components representing.
   - Population Characteristics – Sensitive Populations (e.g., in terms of health status and age) and Socioeconomic Factors.

2. The model uses a suite of statewide individual indicators to characterize both Pollution Burden and Population Characteristics.

3. Uses percentiles to assign scores for each of the indicators in a given geographic area. The percentile represents a relative score for the indicators.

4. Uses a scoring system in which the percentiles are averaged for the set of indicators in each of the four components (Exposures, Environmental Effects, Sensitive Populations, and Socioeconomic Factors).

5. Combines the component scores to produce a CalEnviroScreen score for a given place relative to other places in the state, using the formula below.

6. CalEnviroScreen 2.0 uses the census tract scale as the unit of analysis

7. CalEnviroScreen uses data relating to pollution sources, releases, and environmental concentrations as indicators of potential human **exposures** to pollutants. Seven indicators were identified and found consistent with criteria for exposure indicator development
   - Ozone concentrations in air
   - PM 2.5 concentrations in air
   - Diesel particulate matter emissions
   - Drinking water contaminants
   - Use of certain high-hazard, high volatility pesticides
   - Toxic releases from facilities
   - Traffic density

8. **Environmental effects** are adverse environmental conditions caused by pollutants. Statewide data on the following topics were identified and found consistent with criteria for indicator development:
   - Toxic cleanup sites
   - Groundwater threats from leaking underground storage sites and cleanups
   - Hazardous waste facilities and generators
   - Impaired water bodies
   - Solid waste sites and facilities

9. Sensitive populations are populations with biological traits that result in increased vulnerability to pollutants. sensitive populations affected by toxic chemical exposures were identified and found consistent with criteria for development of these indicators:

- Asthma emergency department visits
- Cardiovascular disease (emergency department visits for heart attacks)
- Low birth-weight infants

10. Socioeconomic factors are community characteristics that result in increased vulnerability to pollutants. Data on the following socioeconomic factors were identified and found consistent with criteria for indicator development:

- Educational attainment
- Housing burdened low income households
- Linguistic isolation
- Poverty
- Unemployment

11. For a given census tract, scores for the Pollution Burden and Population Characteristics are calculated as described below. An example calculation is provided on pages 16 to 19:

- First, the percentiles for all the individual indicators in a component are averaged. This becomes the score for that component. When combining the Exposures and Environmental Effects components, the Environmental Effects score was weighted half as much as the Exposures score. This was done because the contribution to possible pollutant burden from the Environmental Effects component was considered to be less than those from sources in the Exposures component. More specifically, the Environmental Effects components represent the presence of pollutants in a community rather than exposure to them. Thus, the Exposure component receives twice the weight as Environmental Effects component
- The Population Characteristics score is the average of the Sensitive Population score and Socioeconomic Factors score.
- The Pollution Burden and Population Characteristics scores are then scaled so that they have a maximum value of 10 and a possible range of 0 to 10. A value of zero, typically implies that monitoring or reporting was conducted, but no impacts were present.

The **overall** CalEnviroScreen score is calculated by multiplying the Pollution Burden and Population Characteristics scores. Since each group has a maximum score of 10, the maximum CalEnviroScreen Score is 100.

Appendix D: Tables and Figures

Table 11: Canopy Cover in Tracy Parks

Park Name	Acres	Canopy Acres	Canopy %	Impervious Acres	Grass/Low Veg. Acres	Bare Soil Acres	Water Acres	Potential Plantable Acres	Potential UTC
Tracy Sports Complex	26.76	1.45	**5.43**	5.08	17.79	2.44	0.00	0.10	5.82
Plasencia Fields	20.82	1.13	**5.41**	2.83	12.59	4.27	0.00	1.56	12.89
Veteran's Park	15.78	2.31	**14.63**	3.66	9.50	0.31	0.00	8.07	65.77
El Pescadero Park	13.82	2.67	**19.33**	2.91	8.24	0.00	0.00	8.21	78.76
Lincoln Park	13.74	2.92	**21.23**	2.60	8.22	0.00	0.00	8.20	80.88
Clyde Bland Park	8.65	0.86	**9.90**	1.35	4.52	1.93	0.00	4.33	60.02
Dr. Powers Park	8.57	1.81	**21.15**	1.88	2.30	2.58	0.00	4.87	78.02
Ceciliani Park	8.21	2.48	**30.24**	1.82	3.40	0.51	0.00	2.78	64.08
Tracy Ball Park	7.31	0.08	**1.14**	0.29	5.87	1.06	0.00	0.04	1.73
Gretchen Talley Park	6.67	1.32	**19.83**	1.11	3.84	0.40	0.00	4.24	83.35
Kenner Park	6.01	0.83	**13.79**	0.85	4.16	0.17	0.00	4.33	85.86
Hoyt Park	5.80	0.97	**16.82**	1.92	2.91	0.00	0.00	2.91	66.94
Thoming Park	5.44	1.31	**23.99**	1.07	3.06	0.00	0.00	3.07	80.32
Larsen Park	5.11	1.64	**32.05**	1.01	2.47	0.00	0.00	2.45	80.04
Zanussi Park	4.99	0.82	**16.36**	0.40	3.77	0.00	0.00	3.76	91.85
William Adams Park	4.69	1.52	**32.30**	0.93	2.24	0.01	0.00	2.25	80.28
Galli Family Park	4.67	0.67	**14.29**	1.27	2.46	0.28	0.00	1.93	55.71
South School Park	4.66	0.15	**3.24**	0.65	3.53	0.33	0.00	0.23	8.22
Robert Kellogg Park	4.08	0.74	**18.22**	0.99	2.35	0.00	0.00	2.34	75.69
Joseph Tiago Park	4.02	0.62	**15.33**	0.51	2.89	0.00	0.00	0.02	15.82
Marlow Brothers Park	3.87	0.48	**12.51**	0.64	2.69	0.06	0.00	2.76	83.69
John Erb Park	3.84	0.62	**16.26**	1.10	1.50	0.61	0.00	2.13	71.90
Don Cose Park	3.74	0.27	**7.23**	0.85	2.53	0.09	0.00	2.63	77.49
Vernor Hansen Park	3.45	0.60	**17.29**	0.39	2.28	0.18	0.00	2.45	88.46
Richard Hastie Park	3.43	0.41	**11.84**	0.45	2.58	0.00	0.00	2.58	87.03
Bill Schwartz Park	3.41	0.46	**13.52**	1.04	1.91	0.00	0.00	1.91	69.49
Alden Park	3.35	0.20	**6.02**	0.47	2.68	0.00	0.00	2.68	85.93
Yasui Park	3.15	0.49	**15.47**	0.38	2.27	0.01	0.00	2.28	87.73
Daniel Busch Park	2.41	0.37	**15.30**	0.44	1.61	0.00	0.00	1.61	82.15
Souza Family Park South	2.30	0.47	**20.45**	0.30	1.53	0.00	0.00	1.53	87.10
Barboza Park	2.22	0.22	**9.88**	0.91	1.09	0.00	0.00	1.09	59.13
Glover Park	2.14	0.85	**39.89**	0.27	1.01	0.00	0.00	1.02	87.74
Fisher Park	2.00	0.59	**29.39**	0.24	1.18	0.00	0.00	1.18	88.24
William Lowes Park	1.99	0.40	**19.99**	0.34	1.25	0.01	0.00	1.26	83.07
Joan Sparks	1.75	0.40	**22.61**	0.50	0.85	0.01	0.00	0.85	70.97
Kingsley Chadeayne Park	1.72	0.16	**9.46**	0.26	1.30	0.00	0.00	1.30	84.78
Souza Family Park North	1.59	0.31	**19.63**	0.44	0.84	0.00	0.00	0.84	72.11
Jim Raymond Park	1.49	0.34	**22.67**	0.34	0.81	0.00	0.00	0.80	76.28
American Legion	1.27	0.14	**11.23**	0.11	1.02	0.00	0.00	0.00	0.00

Park Name	Acres	Canopy Acres	Canopy %	Impervious Acres	Grass/Low Veg. Acres	Bare Soil Acres	Water Acres	Potential Plantable Acres	Potential UTC
Dorlane Thrasher Park	1.18	0.13	**10.99**	0.15	0.90	0.00	0.00	0.89	86.64
Fabian Park	1.01	0.39	**38.50**	0.15	0.07	0.41	0.00	0.48	85.55
Dr. Ralph Allen Park	0.81	0.29	**35.61**	0.08	0.44	0.00	0.00	0.43	89.37
McCray Family Park	0.80	0.14	**17.60**	0.13	0.53	0.00	0.00	0.53	83.96
Fine Park	0.76	0.17	**23.11**	0.05	0.52	0.01	0.00	0.52	92.46
McDonald Park	0.73	0.39	**53.53**	0.20	0.14	0.00	0.00	0.13	71.94
McDonald Park	0.65	0.36	**54.92**	0.01	0.28	0.00	0.00	0.28	97.79
Evans Park	0.57	0.16	**27.60**	0.18	0.09	0.15	0.00	0.23	67.29
Rippin Park	0.56	0.09	**15.50**	0.15	0.33	0.00	0.00	0.33	73.93
Clyde Abbott Park	0.55	0.10	**19.11**	0.16	0.26	0.02	0.00	0.28	70.13
Eagan Family Park	0.53	0.07	**13.19**	0.14	0.32	0.00	0.00	0.32	74.80
Evelyn Costa Park	0.53	0.28	**52.66**	0.12	0.13	0.00	0.00	0.13	77.43
Tracy Press Park	0.52	0.17	**33.05**	0.11	0.23	0.00	0.00	0.23	78.01
Sullivan Park	0.52	0.26	**50.16**	0.05	0.21	0.00	0.00	0.22	92.31
Kimball Park	0.51	0.24	**46.57**	0.12	0.16	0.00	0.00	0.16	77.03
Huck Park	0.51	0.28	**53.97**	0.02	0.22	0.00	0.00	0.22	96.78
Westside Pioneer Park	0.51	0.26	**51.47**	0.03	0.22	0.00	0.00	0.22	94.71
Golden Spike Park	0.50	0.10	**18.84**	0.23	0.18	0.00	0.00	0.18	54.80
Pombo Family Park	0.50	0.07	**13.29**	0.16	0.28	0.00	0.00	0.27	67.49
New Harmon Park	0.50	0.16	**31.49**	0.08	0.26	0.00	0.00	0.27	84.36
Valley Oak Park	0.50	0.36	**70.82**	0.00	0.15	0.00	0.00	0.15	100.33
Kelly Park	0.50	0.19	**37.92**	0.07	0.24	0.00	0.00	0.24	85.92
Sister Cities Park	0.50	0.28	**55.87**	0.06	0.16	0.00	0.00	0.16	87.53
Patzer Park	0.50	0.17	**33.65**	0.01	0.32	0.00	0.00	0.32	97.85
Kit Fox Park	0.50	0.15	**29.95**	0.07	0.28	0.00	0.00	0.27	85.15
Slayter Park	0.49	0.30	**61.39**	0.10	0.09	0.00	0.00	0.09	78.99
Bailor Hennan Park	0.48	0.15	**32.10**	0.18	0.15	0.00	0.00	0.15	62.71
Emhoff Park	0.48	0.17	**35.39**	0.13	0.18	0.00	0.00	0.18	72.68
Stevens Park	0.47	0.15	**32.61**	0.00	0.32	0.00	0.00	0.32	99.49
Harvest Park	0.47	0.08	**16.74**	0.15	0.24	0.00	0.00	0.25	69.65
Fitzpatrick Park	0.46	0.09	**19.20**	0.13	0.24	0.00	0.00	0.24	71.19
Mount Oso Park	0.44	0.17	**39.10**	0.14	0.12	0.00	0.00	0.12	67.09
Mount Diablo Park	0.41	0.20	**49.43**	0.11	0.09	0.00	0.00	0.10	72.92
Fred Icardi Park	0.40	0.17	**43.57**	0.07	0.16	0.00	0.00	0.16	83.77

Table 12: Tree Canopy by Subdivision

Subdivision Name	Acres	Canopy Acres	Canopy %	Impervious Acres	Grass/Low Veg. Acres	Bare Soil Acres	Open Water Acres	Potential Plantable Acres	Potential UTC
Alden Glen	63.31	9.45	**14.92**	41.87	11.70	0.28	0.00	11.98	33.84
Alden Meadows	48.71	5.81	**11.92**	33.49	9.09	0.33	0.00	9.43	31.29
Alegre Commons	10.02	1.45	**14.44**	6.77	1.81	0.00	0.00	1.77	32.06
Arnaudo Village	55.81	7.98	**14.29**	38.93	8.90	0.00	0.00	8.87	30.18
Belconte	23.23	3.92	**16.87**	15.17	3.65	0.49	0.00	4.13	34.63
Belconte North	21.28	1.94	**9.11**	15.91	2.60	0.83	0.00	3.44	25.26
Blossom Valley	57.74	7.63	**13.22**	37.51	11.86	0.73	0.00	12.59	35.02
Bridle Creek	55.24	8.32	**15.06**	36.07	10.48	0.36	0.00	10.68	34.40
Brookview	10.01	0.04	**0.42**	0.11	0.11	9.75	0.00	9.84	98.69
Buena Vista Estates	15.97	2.37	**14.87**	10.51	3.05	0.04	0.00	3.08	34.17
California Cameo	10.41	1.61	**15.51**	6.02	2.78	0.00	0.00	2.79	42.31
California Collections	2.10	0.20	**9.72**	1.46	0.44	0.00	0.00	0.43	30.06
California Espirit	26.15	4.38	**16.77**	18.53	3.19	0.04	0.00	3.25	29.21
California Marquis	37.62	6.29	**16.71**	22.47	8.01	0.85	0.00	8.85	40.23
California Parkside	3.15	0.74	**23.44**	1.78	0.62	0.00	0.00	0.62	43.15
Centennial	37.42	9.10	**24.31**	16.41	11.27	0.64	0.00	11.92	56.17
Chaparal	34.65	4.76	**13.73**	22.29	7.42	0.17	0.00	7.61	35.69
Cintra Park	63.46	7.08	**11.15**	44.59	11.62	0.18	0.00	11.76	29.68
Circle B Ranch 4	7.78	1.01	**13.04**	5.36	1.40	0.01	0.00	1.41	31.14
Corral Hollow Estates	31.40	3.48	**11.07**	22.37	5.19	0.37	0.00	5.36	28.14
Country Vista	37.26	2.02	**5.42**	28.63	6.62	0.00	0.00	6.62	23.17
Countrywood	5.34	0.56	**10.49**	2.25	0.86	1.67	0.00	2.52	57.76
Eastgate	45.40	2.93	**6.45**	28.10	9.89	4.48	0.00	14.40	38.18
Eastlake	147.73	26.96	**18.25**	84.06	22.58	5.11	9.02	24.65	34.93
Edgewood	288.60	29.45	**10.20**	188.48	59.28	11.40	0.00	68.38	33.90
Elissagaray Ranch	153.36	19.46	**12.69**	100.17	27.64	6.09	0.00	33.68	34.65
Fairhaven	25.91	6.49	**25.06**	12.74	6.68	0.00	0.00	6.69	50.86
Fitzpatrick Estates	5.18	0.40	**7.78**	3.57	1.04	0.16	0.00	1.22	31.34
Foothill Ranch Estates	18.06	2.54	**14.07**	12.56	2.96	0.00	0.00	2.95	30.41
Foothill Vista	23.28	3.60	**15.46**	13.12	6.28	0.28	0.00	5.75	40.16
Forest Glen	25.03	5.51	**22.00**	14.49	5.03	0.00	0.00	4.94	41.76
Fox Hollow	74.22	11.26	**15.17**	48.56	13.09	1.32	0.00	14.38	34.54
Gabriel Estates	97.16	11.24	**11.57**	66.50	18.35	1.07	0.00	19.48	31.61
Garden Square	86.40	11.53	**13.34**	54.86	19.78	0.23	0.00	20.02	36.51
Glen Creek	17.77	3.12	**17.57**	11.07	3.01	0.58	0.00	3.46	37.01
Glenbriar Estates	244.01	39.26	**16.09**	139.50	54.65	10.61	0.00	63.43	42.08
Harvest Glen	48.43	8.16	**16.84**	28.89	10.76	0.62	0.00	11.38	40.34
Harvest Landing	26.46	3.64	**13.77**	17.67	5.14	0.00	0.00	5.13	33.18
Harvest Ridge	26.47	3.88	**14.67**	16.71	5.87	0.01	0.00	5.65	36.00
Hearthstone	56.94	12.65	**22.22**	31.18	13.12	0.00	0.00	13.12	45.25
Hearthstone 3	15.94	2.22	**13.92**	10.63	3.09	0.00	0.00	3.07	33.21
Heartland	61.93	6.89	**11.13**	40.59	12.20	2.25	0.00	12.29	30.98
Huntington Park	59.76	4.50	**7.54**	45.04	10.15	0.06	0.00	10.21	24.63
Kagehiro Phase 3	46.84	0.41	**0.88**	9.95	0.09	36.39	0.00	36.47	78.74
Larkspur Estates	35.51	5.35	**15.05**	23.30	5.12	1.75	0.00	6.20	32.51
Laurelbrook	26.31	3.12	**11.86**	18.47	4.15	0.56	0.00	4.53	29.08
Lyon Crossroads	62.76	5.04	**8.03**	46.83	10.81	0.08	0.00	10.90	25.40
Mt Diablo Estates	6.59	0.79	**11.94**	4.08	1.58	0.14	0.00	1.65	37.03

Subdivision Name	Acres	Canopy Acres	Canopy %	Impervious Acres	Grass/Low Veg. Acres	Bare Soil Acres	Open Water Acres	Potential Plantable Acres	Potential UTC
Mt. Diablo Park	50.09	10.23	**20.42**	27.25	12.19	0.42	0.00	12.37	45.12
Muirfield	120.20	22.00	**18.31**	74.65	23.24	0.31	0.00	23.59	37.93
Muirfield 7	47.39	4.17	**8.80**	33.81	9.42	0.00	0.00	9.39	28.60
Muirfield 8	9.49	1.31	**13.84**	6.77	1.40	0.00	0.00	1.39	28.49
Muirfield 9	6.87	1.03	**14.99**	5.29	0.55	0.00	0.00	0.55	22.94
Northgate	7.85	0.94	**11.96**	5.69	1.22	0.00	0.00	1.22	27.46
Parkside Estates	19.86	3.68	**18.54**	12.28	3.90	0.00	0.00	3.87	38.04
Pebblebrook	25.86	4.46	**17.25**	15.01	4.70	1.68	0.00	6.37	41.88
Pheasant Crossing 2	7.72	1.56	**20.19**	4.56	1.60	0.00	0.00	1.59	40.73
Presidio	147.90	14.33	**9.69**	94.42	34.78	4.37	0.00	18.94	22.49
Quail Glen	8.61	1.09	**12.65**	5.36	1.41	0.76	0.00	2.18	37.93
Quail Meadows	32.00	5.08	**15.87**	21.26	5.66	0.01	0.00	5.66	33.55
Quail Run	24.73	4.59	**18.57**	14.46	4.67	1.02	0.00	4.95	38.58
Rancho Pacific	35.43	4.40	**12.41**	21.70	9.33	0.00	0.00	9.32	38.72
Rebeiro	1.93	0.23	**12.07**	1.51	0.19	0.00	0.00	0.19	21.86
Redbridge	135.15	34.55	**25.56**	72.63	27.07	0.90	0.00	27.96	46.25
Regency Square	39.61	7.23	**18.25**	24.68	7.71	0.00	0.00	7.71	37.71
Ryland Junction	29.44	4.63	**15.74**	18.33	6.40	0.07	0.00	6.39	37.45
San Marco	123.63	11.18	**9.05**	86.84	18.05	7.55	0.00	25.54	29.71
Santana	39.11	11.63	**29.74**	15.24	11.71	0.53	0.00	12.26	61.09
Schulte Ranch	7.56	1.37	**18.16**	4.19	1.99	0.01	0.00	2.01	44.74
Sienna Park	19.76	2.86	**14.49**	12.46	4.18	0.26	0.00	4.43	36.89
Sienna Park 2	8.43	1.03	**12.27**	5.42	1.97	0.00	0.00	1.98	35.76
Southgate	21.36	0.10	**0.46**	8.13	0.10	13.03	0.00	13.14	61.98
Sterling Estates	27.35	3.78	**13.84**	18.62	4.82	0.13	0.00	4.94	31.89
Sterling Park	67.27	6.32	**9.40**	45.81	9.88	5.26	0.00	15.17	31.95
Summergate	20.21	3.78	**18.68**	14.67	1.77	0.00	0.00	1.75	27.37
Summerset	37.35	6.61	**17.69**	21.23	7.67	1.84	0.00	9.50	43.12
Sycamore Village	82.88	18.55	**22.38**	49.02	14.98	0.24	0.10	14.29	39.62
Tennis Village	38.58	5.46	**14.16**	23.76	9.33	0.02	0.00	9.24	38.13
Tennis Vista	40.62	5.89	**14.50**	24.13	10.58	0.01	0.00	10.55	40.48
The Classics	9.47	0.00	**0.00**	6.87	0.58	2.02	0.00	2.58	27.24
Tiburon Village	22.28	0.93	**4.17**	14.32	0.70	6.34	0.00	7.02	35.68
Victoria Greens	35.52	5.12	**14.42**	22.58	7.82	0.00	0.00	7.85	36.51
Victoria Park	43.41	8.32	**19.18**	26.40	8.59	0.08	0.02	8.50	38.75
Victoria Park 3	16.90	3.56	**21.06**	9.97	3.36	0.01	0.00	3.17	39.80
Vintage Estates	8.59	1.56	**18.12**	4.88	1.53	0.63	0.00	2.18	43.43
Westchester Green	22.46	3.65	**16.23**	13.95	4.67	0.19	0.00	4.86	37.88
Westgate	74.48	6.39	**8.57**	54.92	13.15	0.03	0.00	13.22	26.33
Westgate Remainder	0.73	0.00	**0.00**	0.21	0.15	0.37	0.00	0.52	70.63
Woodfield Estates	94.45	10.36	**10.97**	64.07	18.20	1.82	0.00	18.47	30.53
All subdivisions	**3,996.66**	**564.50**	**14.12%**	**2,506.95**	**766.21**	**149.85**	**9.14**	**879.75**	**36.14**