

Oakland, CA

Urban Forest

Council District Summary Draft

2021



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Introduction

The urban forest includes all trees and woody shrubs in Oakland. The community tree resource is a subset of the urban forest that includes all publicly owned trees along streets and rights-of-way, in parks, and at city facilities. In 2019, The City of Oakland contracted with Davey Resource Group, Inc. (DRG) to develop a comprehensive urban forest master plan that will guide the management, preservation, and enhancement of Oakland's urban forest over the next 50 years.

To better understand the existing urban forest, DRG performed a comprehensive tree canopy and land cover assessment (Land Cover Assessment, 2020) and an analysis of the community tree resource (Community Tree Resource Analysis, 2021). The Land Cover Assessment used 2018 aerial imagery from the National Agriculture Imagery Program (NAIP) to map the extent and distribution of tree canopy and other primary land cover. The assessment provides a birds-eye view of the entire urban forest and establishes a tree canopy baseline for discussion, planning, and assessing future change and progress towards canopy goals. The Community Tree Resource Analysis used public tree inventory data in conjunction with i-Tree *Eco*, a benefit-cost modeling software, to develop a detailed assessment of the current structure, function, benefits, and value of the community tree resource. To further explore the relationship of the urban forest to community demographics and key environmental and socioeconomic indicators, Oakland's land cover and community tree distribution were analyzed along with data from the US Census,¹ CalEnviroScreen,² and the CDC 500 Cities Project.³ To observe trends between canopy cover and other variables, DRG graphed scatterplots and defined r-square values to explore relationships. For additional information, see *Oakland, CA Urban Forest Council District Summary: Supplemental Materials (2021)*.

The *urban forest* includes all trees and woody shrubs in Oakland.

Community trees are publicly owned trees along streets and rights-of-way, in parks,

An equitable future

Trees and urban forests provide essential benefits to the community and residents. Some of the most familiar benefits include improving air quality, reducing stormwater runoff, lowering demand for electricity and natural gas to cool and heat buildings, decreasing the effects of urban heat islands, sequestering carbon, increasing property values and commerce, enhancing emotional and physical health, creating wildlife habitat, decreasing incidents of crime, shading, reducing noise, and providing screening and privacy. As we continue to learn more about the importance of trees

¹ US Census Data is collected by the Census Bureau to understand the social, economic, and demographic conditions locally and nationally. The data reported is from the 2015-2019 census data, except where otherwise noted.

² CalEnviroScreen uses environmental, health, and socioeconomic information to produce scores for every census tract.

³ 500 Cities Project provides census tract-level estimates for chronic disease risk factors, health outcomes, and clinical preventive services.

and nature in urban environments, ongoing research contributes to our greater understanding of how vital trees are to quality of life in the urban built environment.

Trees and urban forests continuously mitigate the effects of urbanization and development and protect and enhance life within the community. The driving force behind the ability of the urban forest to produce benefits is the amount and distribution of leaf surface area (Clark et al., 1997). A balanced distribution of canopy and leaf surface area is key to ensuring equitable exposure and access to the benefits of the urban forest for all residents. The City of Oakland is committed to achieving equitable opportunities for all people and communities in Oakland and are guided by the Strategic Goals for Race and Equity as the City works to build an equitable urban forest program that enhances the lives of all residents.

A balanced distribution of canopy and leaf surface area is key to ensuring equitable exposure and access to the benefits of the urban forest for all residents.

This report explores the current distribution of canopy and community trees between Oakland's seven Council Districts and in relation to key environmental and socioeconomic indicators. The City of Oakland and DRG are providing this information to inform and contribute to community discussion and planning for Oakland's future urban forest. An informed and engaged community is key to this process.



Tree Canopy and Land Cover

Oakland encompasses 78 square miles (49,909 acres), including 21.2 square miles (13,536 acres) of the San Francisco Bay. As tree cover cannot be expanded in areas of open water, this report focuses on land area (36,373 acres). Oakland's land area is divided between seven Council Districts (Map 1). Excluding the bay, the following information summarizes land cover in Oakland:

- 21.5% (7,819 acres) tree canopy, including all trees and woody shrubs on public and privately-owned land
- 53.8% (19,578 acres) impervious surfaces, including roads and buildings
- 22.4% (8,141 acres) pervious surfaces, including bare soils, grass, and low-lying vegetation
- 2.3% (833.3 acres) open water (ponds, lakes, creeks, streams)
- 70.9% (5,545 acres) of tree canopy is on private property

Historic Canopy Cover

From 2014 to 2020, Oakland lost approximately 275 acres of tree canopy and impervious surfaces increased by 1,296 acres (Figure 1).

Impervious surfaces, including streets, freeways, buildings, parking lots, and sidewalks, reduce the area that is available for tree planting and root expansion. Generally, as impervious surfaces increase, the potential for trees and canopy cover decreases. With thoughtful design and adequate space for tree roots, canopy can be expanded to cover impervious surfaces in many areas.

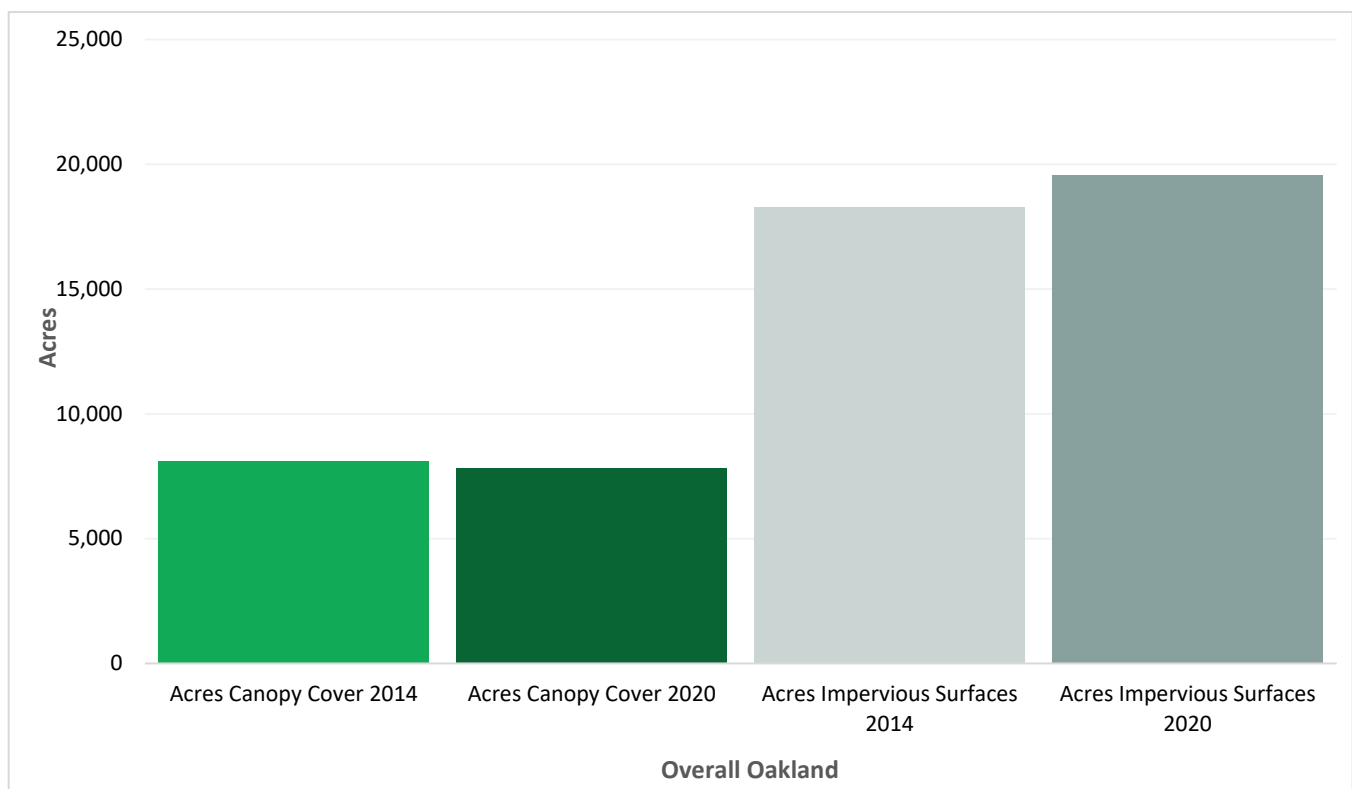
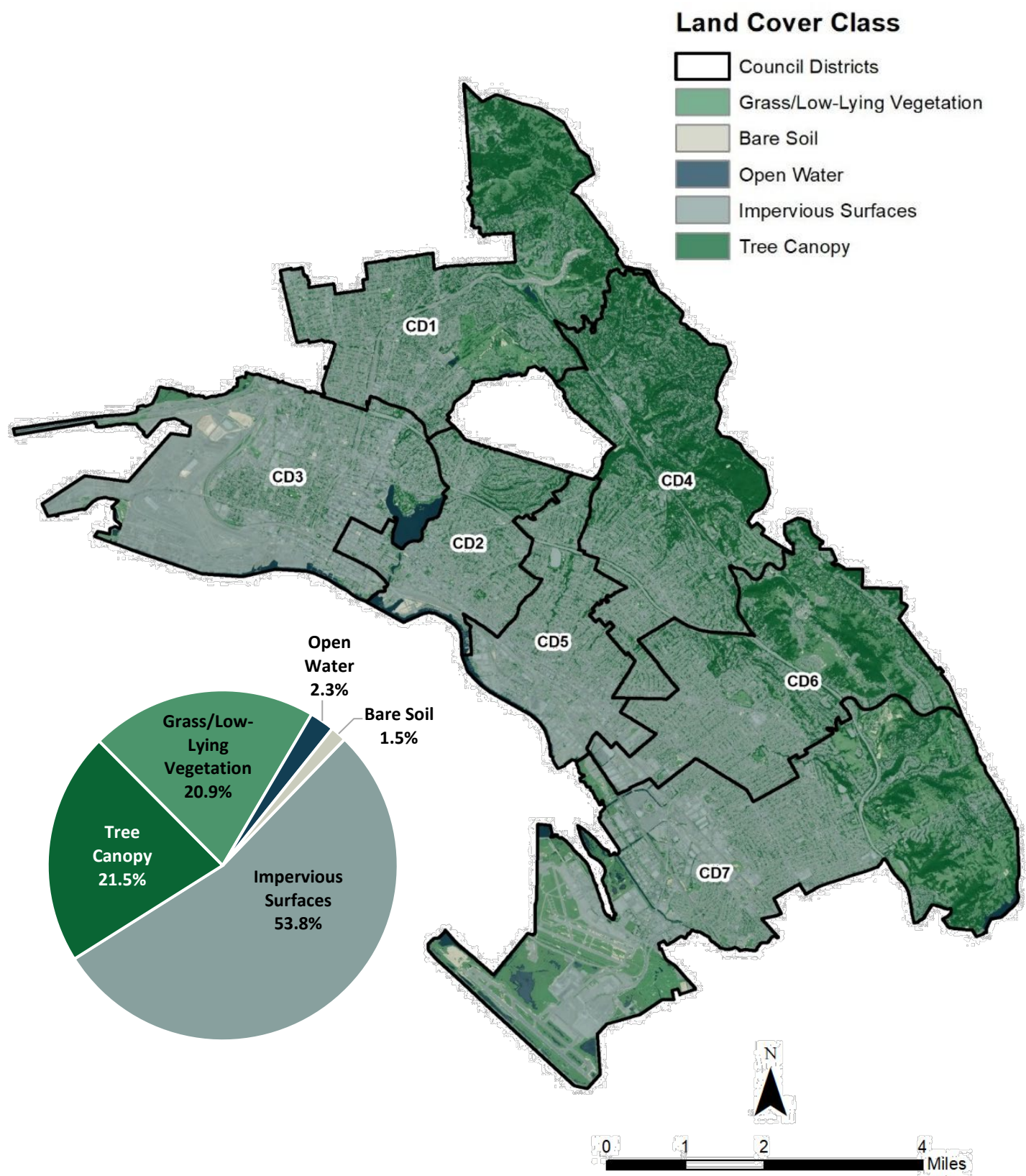


Figure 1: Overall Change in Canopy and Impervious Acres from 2014 to 2020



Map 1: Oakland Land Cover

Land Cover Distribution by Council District

The highest canopy cover is found in Council Districts that include sections of the Oakland Hills, including Council District 1 (31%), Council District 4 (43.1%), and Council District 6 (28%) (Figure 2 and Table 1). These Districts also have the lowest percentage of impervious surfaces.

Council District 3 has the lowest average canopy cover at 5.3% and the highest percentage of impervious surface (78.7%), including the Port of Oakland. This District also includes Lake Merritt which accounts for 6% of overall land cover.

Council District 7, which has an average canopy cover of 15.3%, benefits partially from the higher canopy cover in Oakland Hills, but also includes a high percentage of impervious surfaces (48%), including Oakland International Airport.

Council District 2 has an average of 13.1% canopy cover and 69.3% impervious surfaces. This district includes the Lake Merritt District, a mixed-use area including residential, commercial, and institutional that accounts for 9.5% of overall zoning.

Council District 5 has an average of 9% canopy cover and 77.8% impervious surfaces. This District includes 12% industrial zoning.

All Council Districts have the potential ⁴ for additional canopy cover (Table 1).

Canopy Potential
is the total
amount of canopy
cover possible if
additional trees
are planted in
existing areas of
pervious surface,
including bare
soils, turf, and

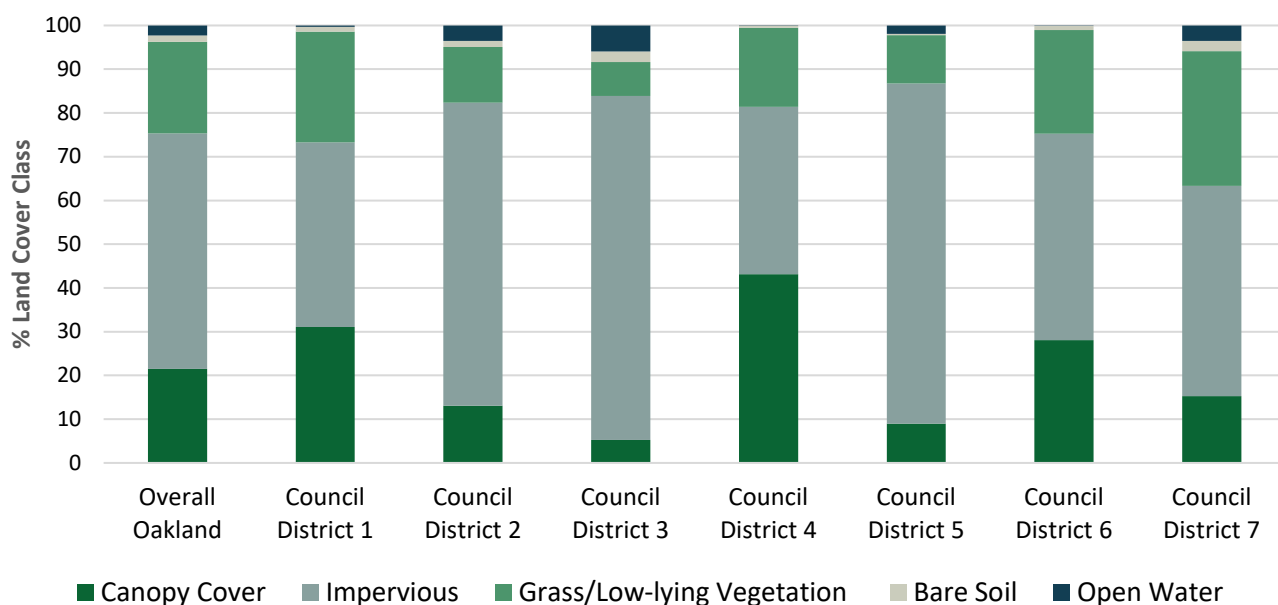


Figure 2: Land Cover by Council District

⁴ Potential canopy represents the total amount of canopy cover that might be achieved if all areas of pervious land cover were planted with trees and existing canopy is preserved. It is important to recognize that not all potential sites are suitable for tree planting and canopy can also be increased over impervious surfaces when large-stature trees are planted.

Table 1: Land Cover by Council District

	Overall Oakland	Council District 1	Council District 2	Council District 3	Council District 4	Council District 5	Council District 6	Council District 7
Total Acres	36,367.13	5,619.65	2,504.86	5,503.81	5,450.00	2,650.88	4,929.88	9,708.04
Canopy Acres	1,484.76	1,745.16	327.11	288.80	2,350.18	238.70	1,382.92	1,484.76
Canopy %	15.29	31.05	13.06	5.25	43.12	9.00	28.05	15.29
Impervious Acres	4,661.88	2,374.96	1,735.21	4,329.87	2,087.26	2,060.97	2,326.18	4,661.88
Impervious %	12.82	42.26	69.27	78.67	38.30	77.75	47.19	48.02
Grass/Low-lying Vegetation Acres	3,216.54	1,481.56	354.97	558.25	1,011.50	300.23	1,216.91	3,216.54
Grass/Low-lying Vegetation %	8.84	26.36	14.17	10.14	18.56	11.33	24.68	33.13
Open Water Acres	344.86	17.97	87.57	326.89	1.07	50.98	3.87	344.86
Open Water %	0.95	0.32	3.50	5.94	0.02	1.92	0.08	3.55
Potential Canopy %	43.88	57.42	27.23	15.39	61.68	20.33	52.74	48.43

Historic Change by Council District

All Council Districts saw an increase in impervious surfaces from 2014 to 2020 (Figure 3). With the exception of Council District 1, which saw an increase in canopy (30.3% to 31.1%), all other Council Districts lost tree cover.

Council District 2 saw the greatest loss in percentage of canopy cover (15.9% to 13.1%) and impervious surfaces increased from 64.4% to 69.3%.

Council District 5 saw the greatest increase in impervious surfaces (68.7% to 77.7%) and canopy cover decreased from 11.1% to 9.0%.

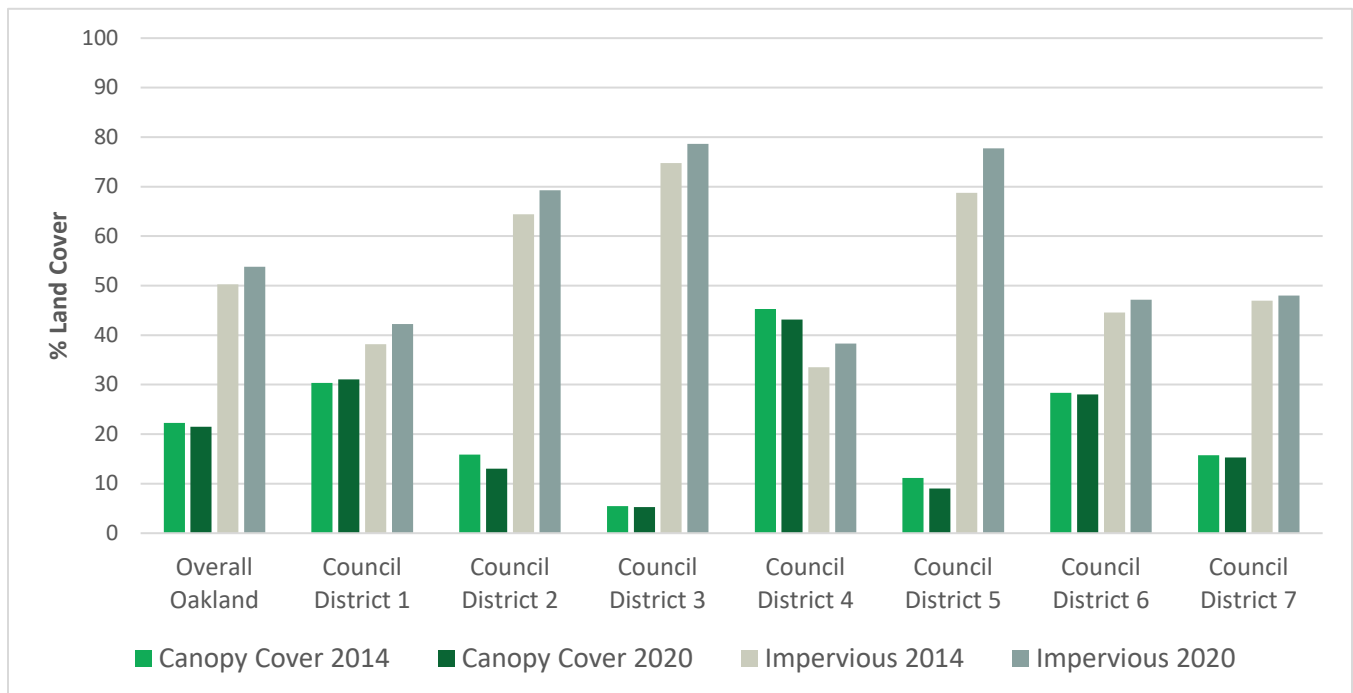


Figure 3: Historic Change in Canopy and Impervious Surfaces by Council District

Zoning

Zoning and land use can have a big impact on canopy potential (Figure 5). Areas zoned for commercial and industrial purposes often have lower tree canopy potential due to high levels of impervious surfaces, including large warehouses, commercial buildings, and parking lots. In Oakland, commercial and industrial zoning represents more than 23% of overall area (Figure 4).

Open space and residential zoned areas often have the highest potential for tree canopy because they include parks, natural areas, and residential yards. In Oakland, residential zoning represents 59% of overall space and open space represents 11%.

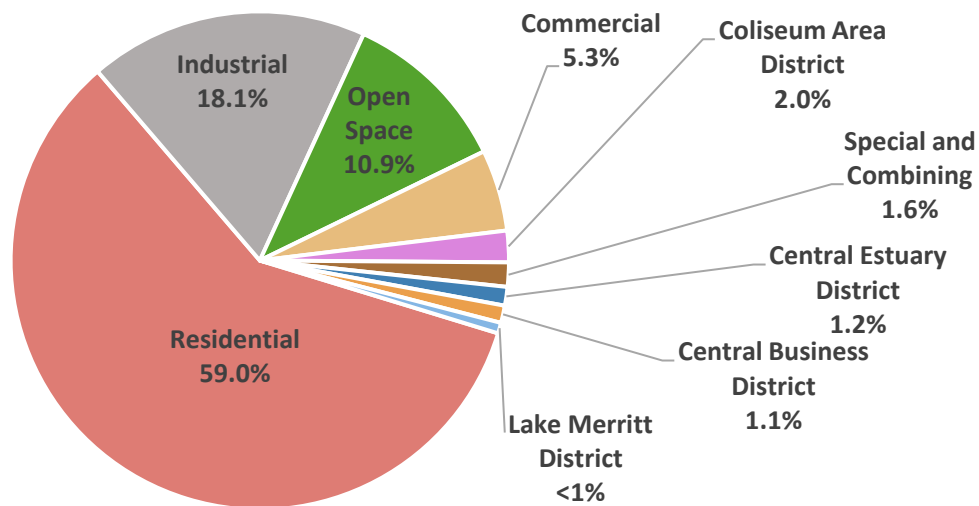


Figure 4: Oakland Overall Zoning

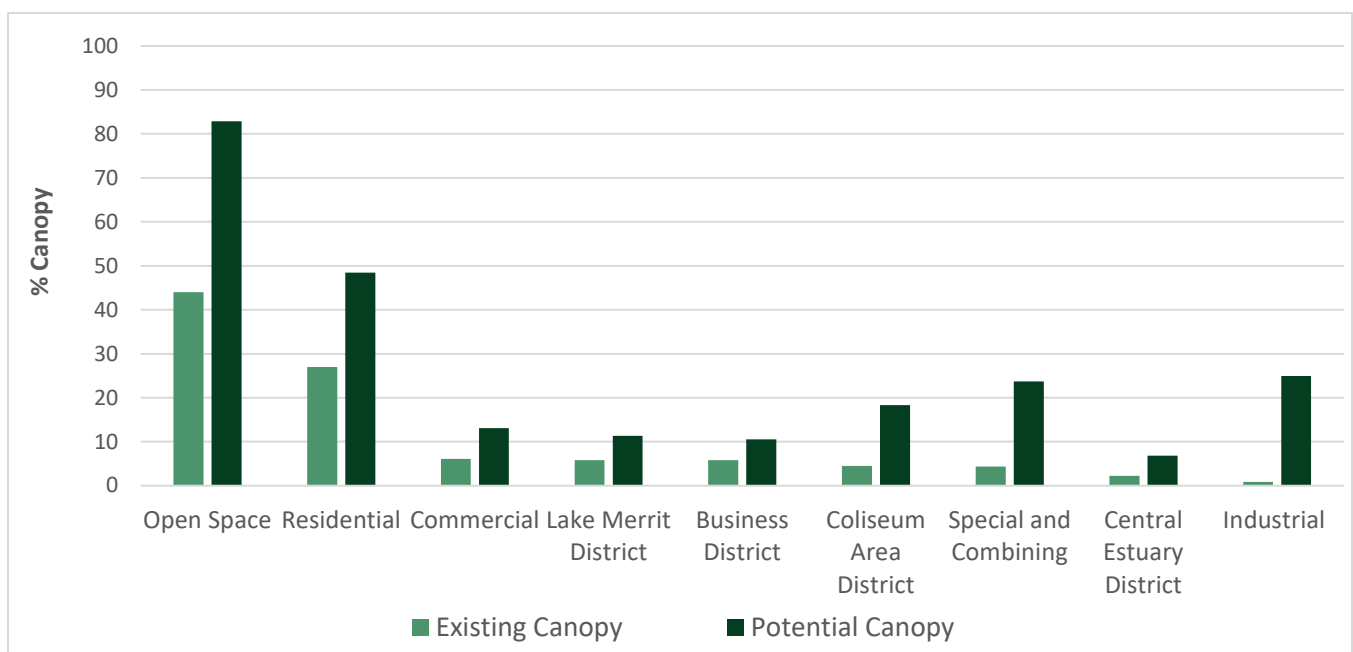


Figure 5: Existing and Potential Canopy Cover by Zoning Designation

The distribution of zoning within an individual Council District also has an impact on the canopy potential for each District (Figure 6, Table 1). For instance, Council District 4, where residential (85%) and open space zoning (12.5%) represent more than 97% of all area, has the highest overall potential for tree canopy (61.7%). Council District 3, which includes the Port of Oakland, has the highest percentage of industrial zoning (48%) and 21.3% residential zoning, and the lowest potential for tree canopy (15.4%).

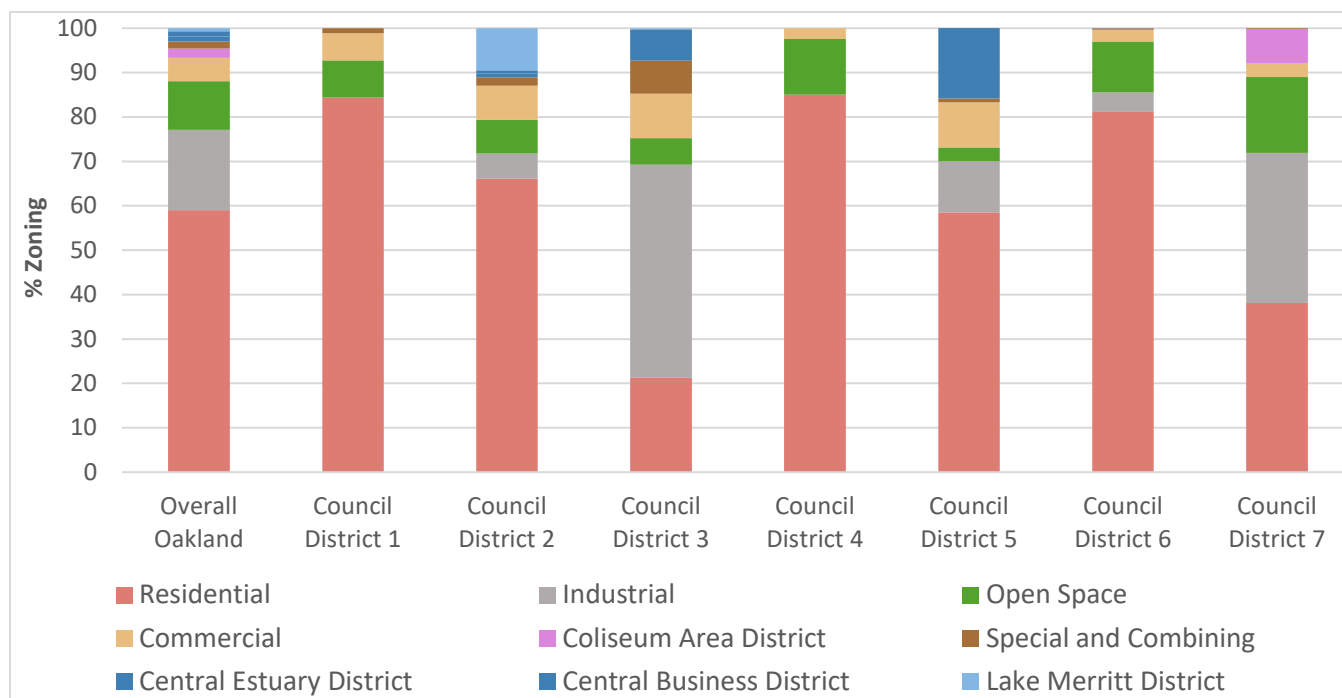


Figure 6: Distribution of Zoning by Council District

Residential zoned areas include neighborhoods and developments where much of Oakland's population make their homes. Considering only residential zoning, the average canopy cover for all of Oakland is 27% (Figure 7). District 4 has the highest canopy cover in residential zoned areas (39%) and Council District 5 has the lowest (12.6%).

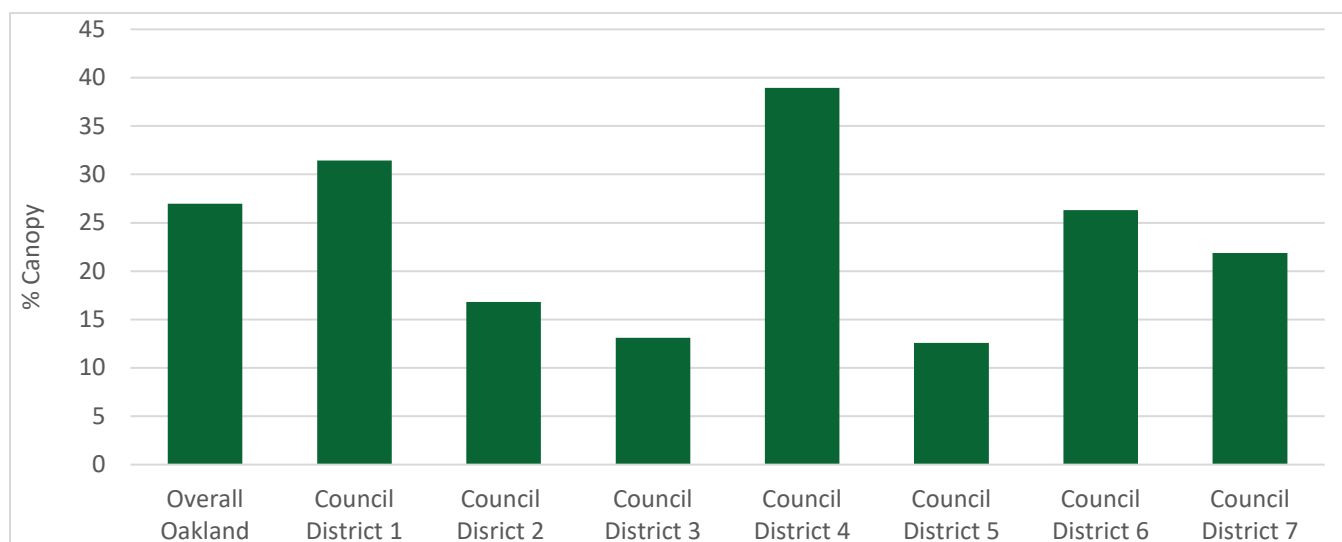


Figure 7: Canopy Cover in Residential Zoning by Council District

Pollution Burden and Vulnerability

The California Office of Environmental Health and Hazard Assessment (OEHHA) maps pollution and the potential vulnerability of populations to the effects of pollutants. CalEnviroScreen⁵ considers environmental conditions, health, and vulnerability through the following indicators:

Pollution Burden represents the potential exposures to pollutants and the adverse environmental conditions caused by pollution.

Asthma Score is based on the age-adjusted rate of emergency department visits for asthma per 10,000 people.

Poverty Score is based on the percent of the population with incomes less than two times the federal poverty level.

A higher
CalEnviroScreen Score
indicates a greater
pollution burden and
vulnerability by
population.

CalEnviroScreen scores range from 0 to 100. A census tract with a high CalEnviroScreen Score is one that experiences a higher pollution burden compared to a census tract with a lower score. DRG analyzed cumulative and component scores at the census tract level. Oakland includes 380 census tracts (Map 2).⁶

A comparison of cumulative scores to canopy cover in Oakland revealed that census tracts with higher CalEnviroScreen Scores were more likely to have lower canopy cover ($R^2=0.40$) (Figure 8). Canopy cover also tended to be lower in census tracts with higher poverty ($R^2=0.31$) and asthma scores ($R^2=0.30$).⁷ Census tracts with the highest scores in Oakland are proximate to Interstates 80, 880, and 980, and the Oakland International Airport.

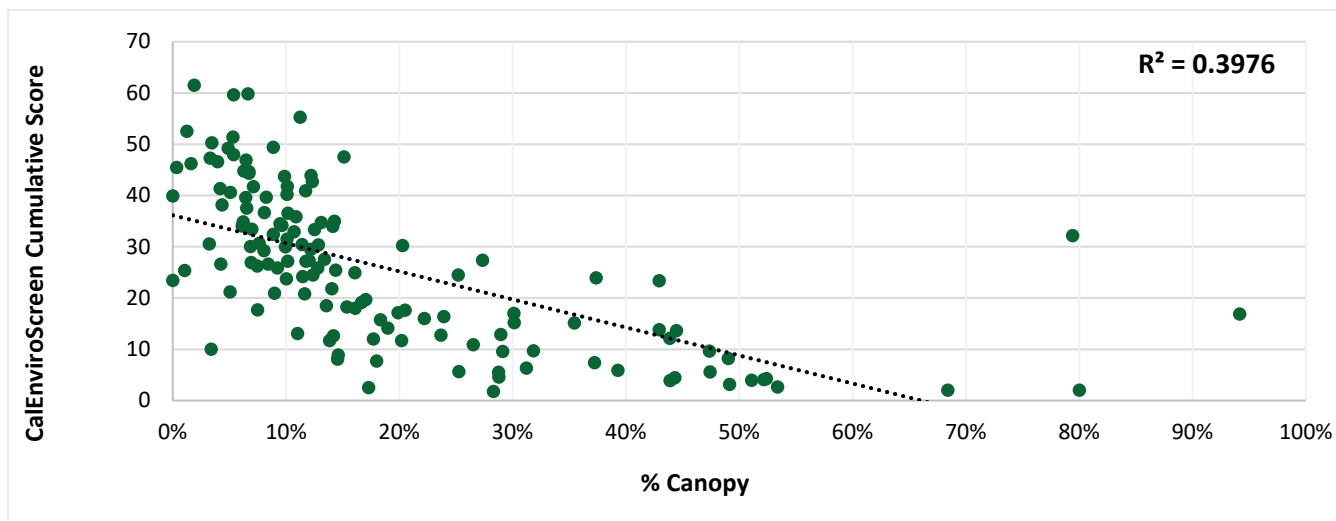
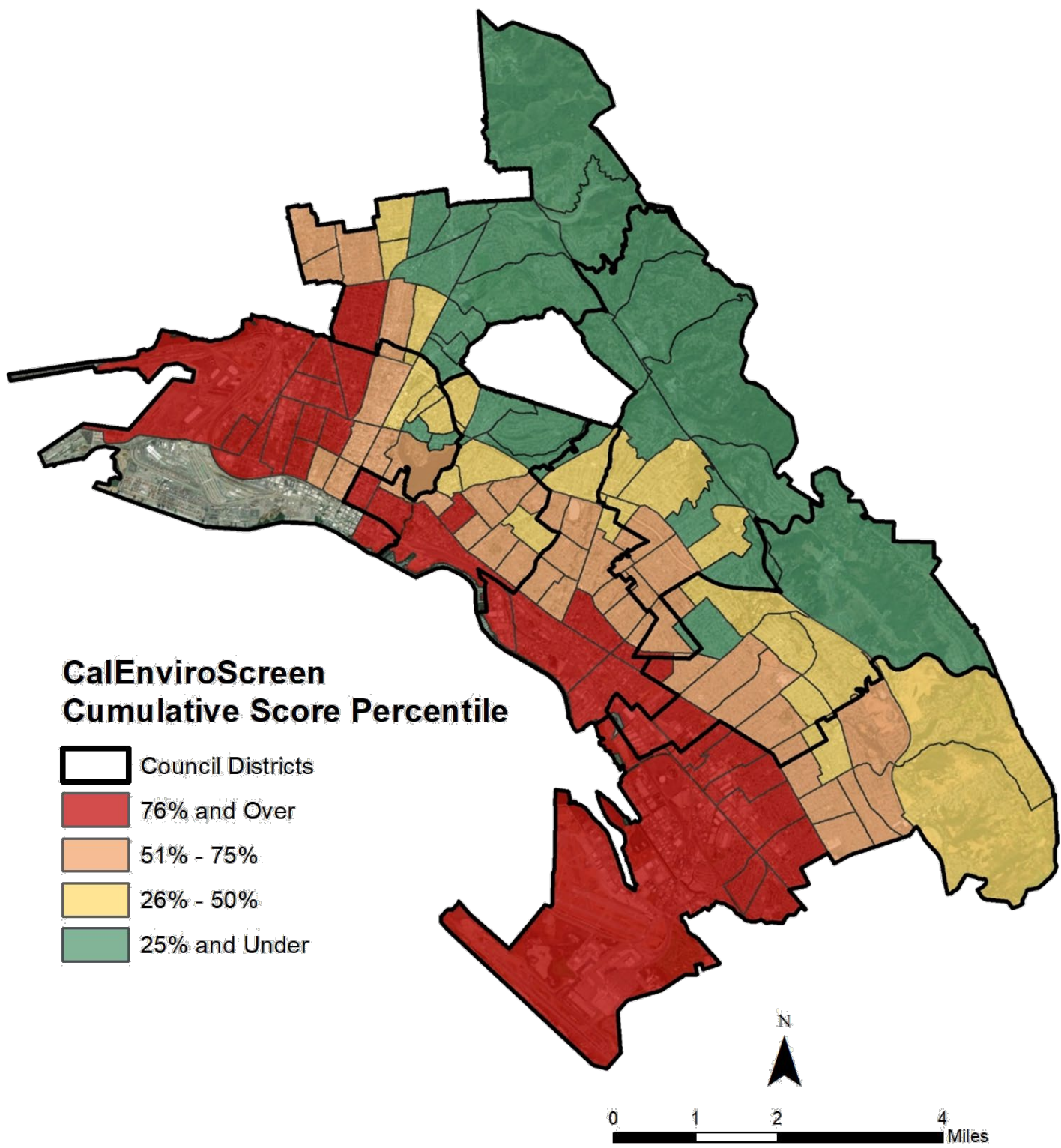


Figure 8: CalEnviroScreen Cumulative Score by Canopy Cover

⁵ This analysis used CalEnviroScreen 3.0, <https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30>

⁶ Four census tracts in Oakland do not have an associated cumulative score.

⁷ Poverty rates and asthma scores are components of the CalEnviroScreen Cumulative Score.



Map 2: CalEnviroScreen Scores by Census Tract

Redlining

Between 1935 and 1940, the federal government's Home Owner's Loan Corporation (HOLC), using data and the perceptions of local real estate professionals (e.g., developers, lenders, and appraisers), assigned grades of perceived "mortgage security" to neighborhoods in cities across the U.S., including Oakland. The highest grade, "A," was reserved for neighborhoods perceived to have minimal risks and to be "safe for investment" for banks and other mortgage lenders. Neighborhoods receiving the lowest grade, "D," were considered high risk and "hazardous" and were unlikely to receive home buying or improvement loans.⁸ This process, referred to as "redlining," resulted in maps that delineated the grades by color:

Red = Graded D or "hazardous." Residents were ineligible for FHA backing and unlikely to receive loans.

Yellow = Grade C, "definitely declining."

Blue = Grade B or "still desirable."

Green = Grade A or "best." Residents in green areas were most likely to receive loans and favorable terms.

Commercial = A Commercial grade meant the area was not eligible for home loans.

Factors in these ratings included quality of existing housing, history of sale/rent values, detrimental influences (e.g., odors, smoke, and grime), favorable influences (e.g., shopping and industry/labor opportunities), race/ethnicity and class of residents, and percent foreign-born. The assessments and terminology used to define neighborhoods was heavily biased by the perceptions and prejudicial misconceptions about race, ethnicity, and country of origin that were common during that period. This "redlining," or the drawing of boundaries around neighborhoods based heavily on race, deprived many residents of resources and opportunity. This effectively racialized poverty in cities across the U.S., including in Oakland (City of New York, 2019). The practice of redlining was banned in 1968, however its impacts are still seen in cities today.⁹ In fact, areas of Oakland graded D are also areas more burdened by pollution and with more vulnerable populations, according to CalEnviroScreen.

Within Oakland's current boundaries, 65.6% (23,852.5 acres) of land was redlined by HOLC (Map 3). Nearly 34% of redlined area received a grade of C (19.4%; 7,057 acres) or D (14.5%; 5,287 acres).

Considering the distribution of canopy in Oakland today, neighborhoods that were historically graded "A" tend to have higher canopy cover ($R^2=0.19$). However, areas that were graded "B" ($R^2=0.07$), "C" ($R^2=0.04$), and "D" ($R^2=0.13$) show less of a relationship to lower canopy cover.

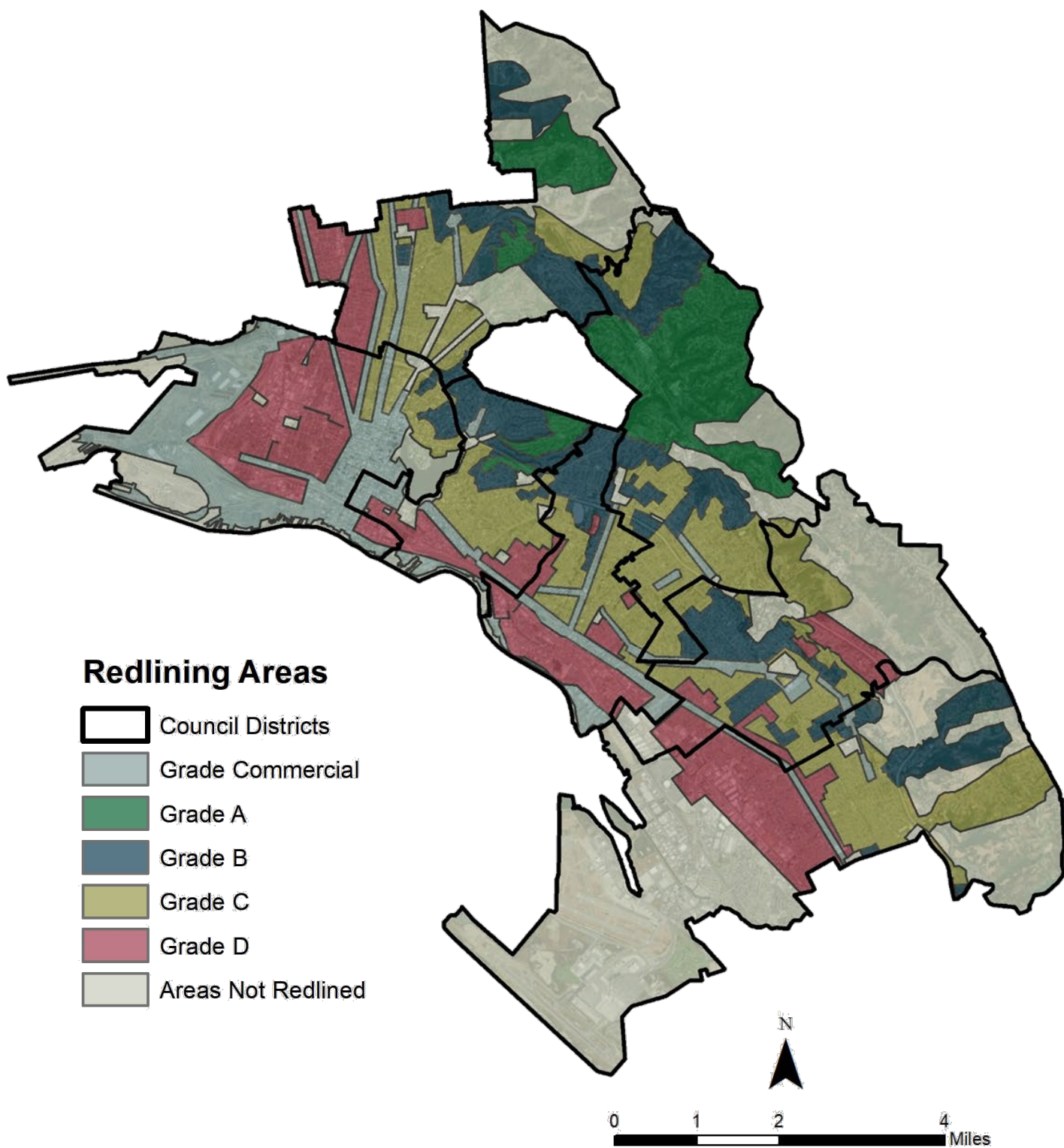
⁸ Mapping Inequality – Redlining in New Deal America.

<https://dsl.richmond.edu/panorama/redlining/#loc=12/37.81/-122.329&city=oakland-ca>

⁹ <https://www.cbsnews.com/news/redlining-what-is-history-mike-bloomberg-comments/>

<https://www.daytondailynews.com/local/legacy-of-redlining-homes-in-minority-neighborhoods-undervalued/IKO3MQFMHNA5HEYQ2UHN44HDYY/>

<https://www.washingtonpost.com/news/wonk/wp/2018/03/28/redlining-was-banned-50-years-ago-its-still-hurting-minorities-today/>



Map 3: Historic redlining grades within Oakland's current boundaries

Mental Health

The Centers for Disease Control and Prevention (CDC) 500 Cities Project¹⁰ provides city and census tract-level estimates for chronic disease risk factors, health outcomes, and clinical preventive services from 500 of the largest cities in the U.S. The Project includes data from respondents over 18 years old who reported poor mental health lasting longer than 14 days. Numerous studies suggest that exposure to nature, including trees, has a positive impact on mental health, including lower incidence of depressive symptoms (Kuo, 2001; Sherer, 2006; Jennings et al., 2016). In Oakland, the data reports poor mental health prevalence in 12.3% of census tracts¹¹. Census tracts where residents reported a higher prevalence of poor mental health also tend to have lower canopy cover ($R^2=0.20$) (Figure 9

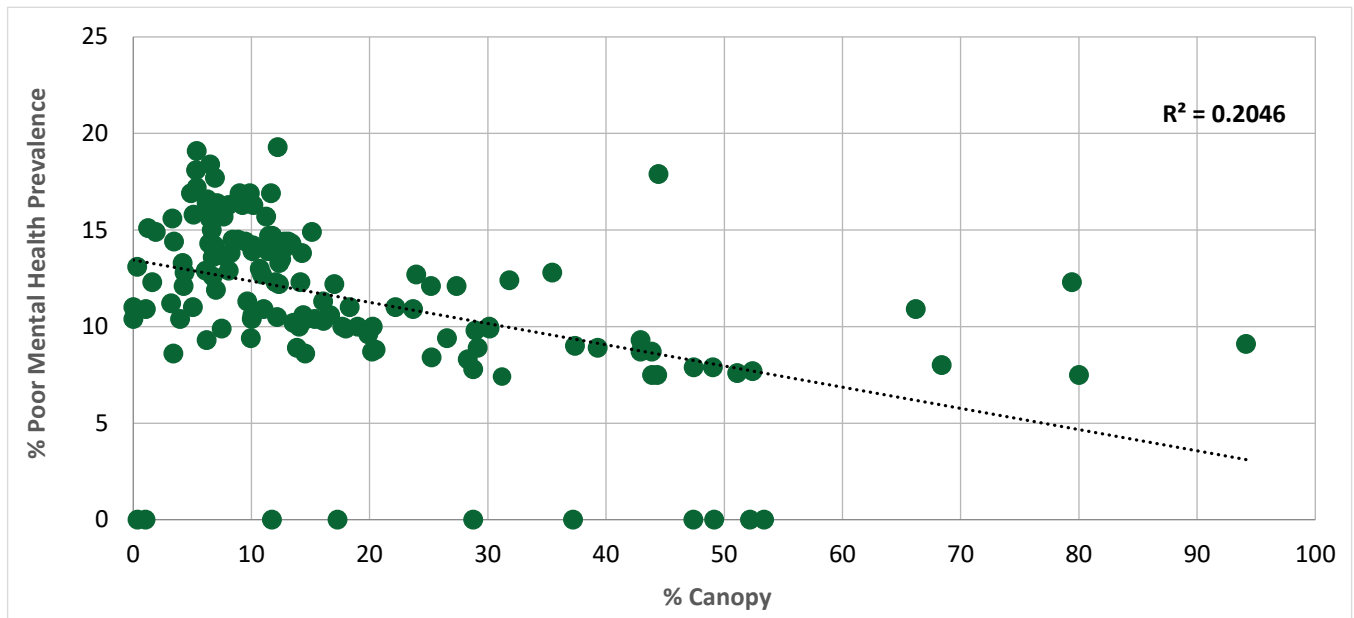


Figure 9: Poor Mental Health Prevalence by Canopy Cover

¹⁰ CDC 500 Cities Project: 2016 to 2019. <https://www.cdc.gov/places/about/500-cities-2016-2019/index.html>

¹¹ In Oakland, data on poor mental health prevalence was unavailable for four census tracts.

Public versus Private Canopy Distribution

Twenty-nine percent (29.1%) of tree canopy in Oakland is on public (city-owned) property (Figure 10). Trees growing on public property are considered community trees and include trees in rights-of-way, on streets and medians, in parks, and at city facilities. The remaining tree canopy (70.9%) in Oakland is on private property. While cities can influence tree canopy on private property through tree protection and preservation ordinance and tree planting incentives and initiatives, cities have the greatest control over the community trees on public lands.

The distribution of public land versus private land varies by Council District (Figure 10). Council District 3, which includes the Port of Oakland, has the highest percentage of public property at 53%. Council District 6, which has the highest percentage of residential zoning (85%), has the lowest percentage of public property at 17.7%.

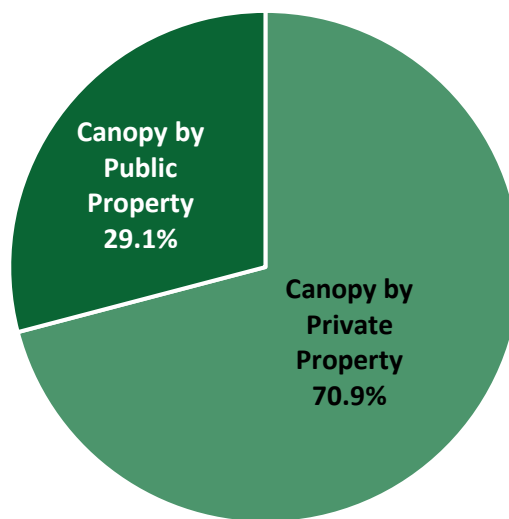


Figure 10: Distribution of Tree Canopy Public versus Private

While ordinances, incentives, and tree planting initiatives can influence trees and canopy on private property, *the City has the greatest control and responsibility over community trees* in the rights-of-way, parks, open space, and at city facilities.

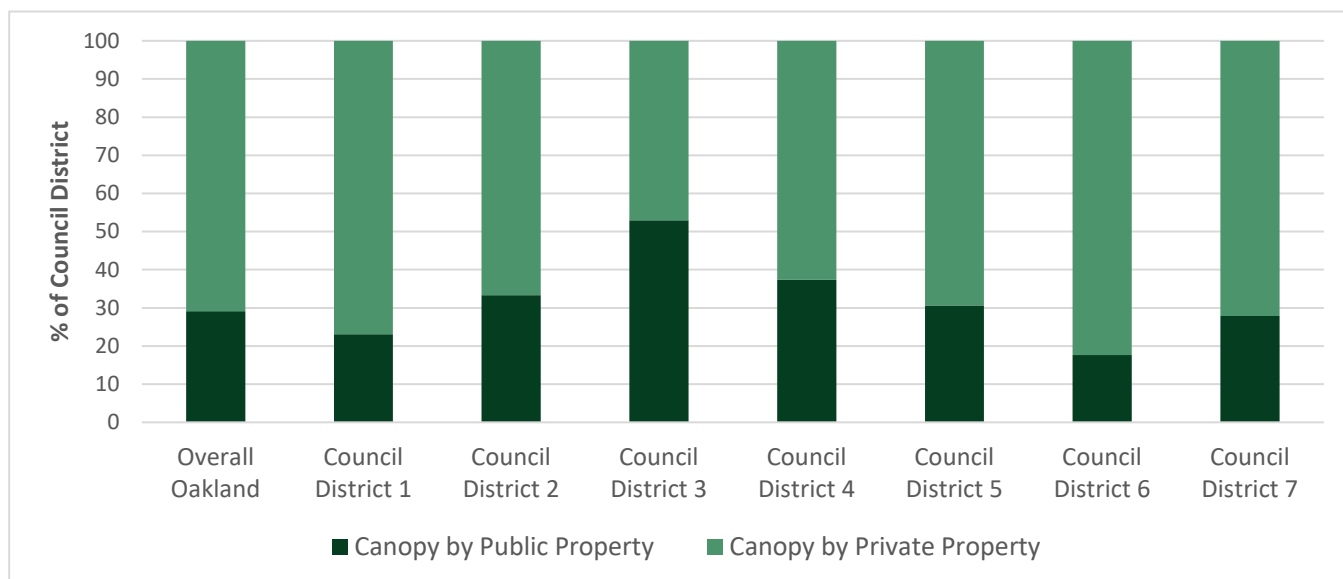


Figure 11: Public versus Private Land by Council District

Distribution of Community Urban Forest Assets

Community trees provide benefits to all residents in Oakland, including improvements to air quality, stormwater runoff reduction, carbon sequestration, and benefits to human health and welfare. Arguably, trees provide the greatest benefits and access to those who live closest. To better explore the distribution and accessibility of community forest assets in Oakland, it is helpful to also look at the distribution of residents along with some key demographic indicators.

Population density can have a direct relation to the number of trees and the amount of tree canopy that can be supported in a given area. As population density increases, the available space for trees decreases. Overall, Oakland has an average of 7,502 residents per square mile (Table 2). Council District 2 has the highest population density, with 15,827 residents per square mile, followed by Council District 5, with 13,816 residents per square mile. Council District 7, which includes the Oakland International Airport and 17% open space zoning, has the lowest population density, with 4,286 residents per square mile.

Table 2: Population Characteristics and Urban Forest Assets by Council District

	Overall Oakland	Council District 1	Council District 2	Council District 3	Council District 4	Council District 5	Council District 6	Council District 7
Total Acres	36,367.13	5,619.65	2,504.86	5,503.81	5,450.00	2,650.88	4,929.88	9,708.04
Population 2019	426,242	65,103	61,884	61,308	52,675	57,197	61,917	65,008
Population Density (Residents/mile ²)	7,502	7,415	15,827	7,129	6,185	13,816	8,041	4,286
Canopy Acres	1,484.76	1,745.16	327.11	288.80	2,350.18	238.70	1,382.92	1,484.76
Canopy Cover %	15.29	31.05	13.06	5.25	43.12	9.00	28.05	15.29
# Community Trees	68,664	12,805	9,192	13,422	9,496	6,930	7,067	9,752
Vacant planting sites ¹²	31,137	4,219	4,750	4,106	4,184	4,430	5,267	4,181
Community Trees per 1,000 Residents	161	197	149	219	180	121	114	150
# of Parks	380	42	75	99	47	39	28	50
Park Acres	2,277.70	134.65	96.51	386.62	640.26	45.65	143.63	830.38
Park Acres per 1,000 Residents	5.34	2.07	1.56	6.31	12.15	0.80	2.32	12.77

¹² Includes some sites where there is an existing tree stump

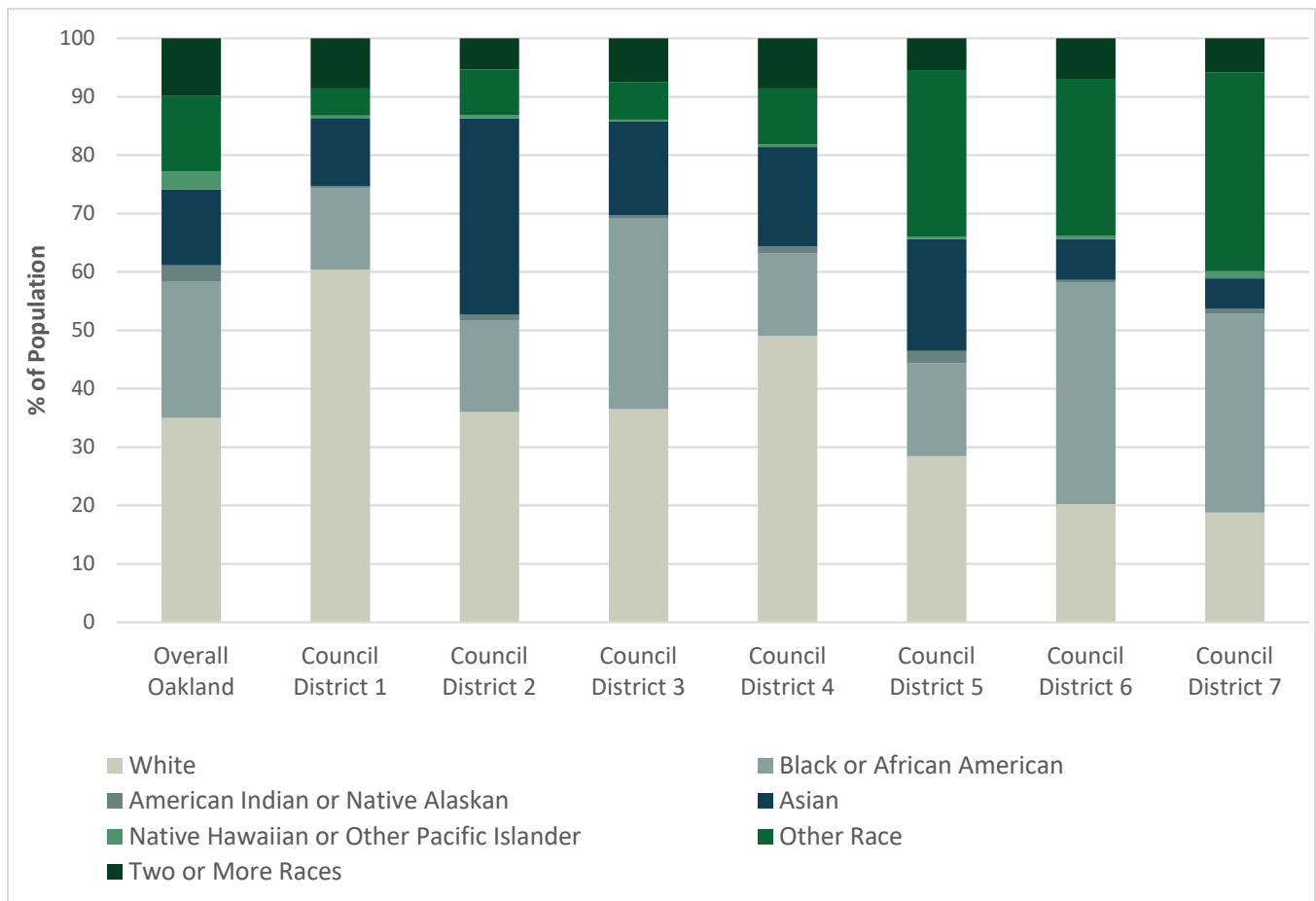


Figure 12: Distribution of Race by Council District¹³

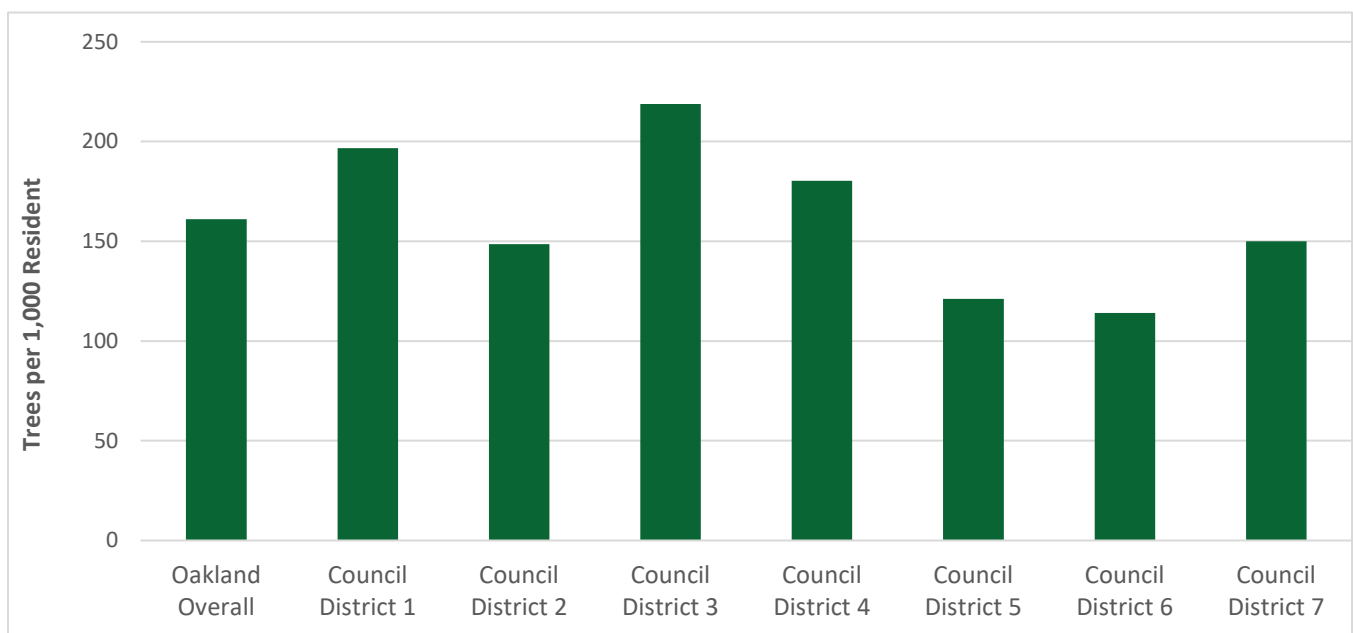


Figure 13: Number of Community Trees per 1,000 Residents

¹³ The U.S. Census does not currently include a race category for Latinx. As a result, individuals identifying as Latinx may self-identify as any available race category.

Community Trees per Resident

Oakland has 68,664 community trees (Table 2). Community trees are publicly owned trees in rights-of-way, streets, medians, parks, and at city facilities. On average, Oakland has 161 community trees for every 1,000 residents (Figure 13). Council District 3 has the highest number of community trees per resident (219 trees/1,000 residents), followed by Council District 1 (197 trees/1,000 residents), and Council District 4 (180 trees/1,000 residents). Council District 6 has the lowest number of community trees per resident (114 trees/1,000 residents).

The current stocking level for community trees is 69%, considering a total of 99,801 tree sites, including 68,664 existing sites and 31,137 vacant sites. Council District 6 has the highest number of vacant sites (5,267) followed by Council District 2 (4,750 vacant sites) and Council District 5 (4,430 vacant sites). Council District 3 has the lowest number of vacant planting sites (4,106).

Park Acres per Resident

Oakland has 380 parks, that cover a total of 2,278 acres (Table 2). Overall, Oakland has an average of 5.34 acres of park land for every 1,000 residents (Figure 14). Council District 7, which has the lowest population density (4,286 residents/mile²) and includes 17.1% open space zoning, has the greatest amount of park land per resident (12.8 acres/1,000 residents). Council District 4, which includes 85% residential zoning, and Joaquin Miller Park, has the second highest amount of park land per resident (12.2 acres/1,000 residents). Council District 5, which includes 37.5% zoning for Commercial, Industrial, and Central Estuary District and only 3.1% open space zoning, has the lowest amount of park land per resident (0.8 acres/1,000 residents).

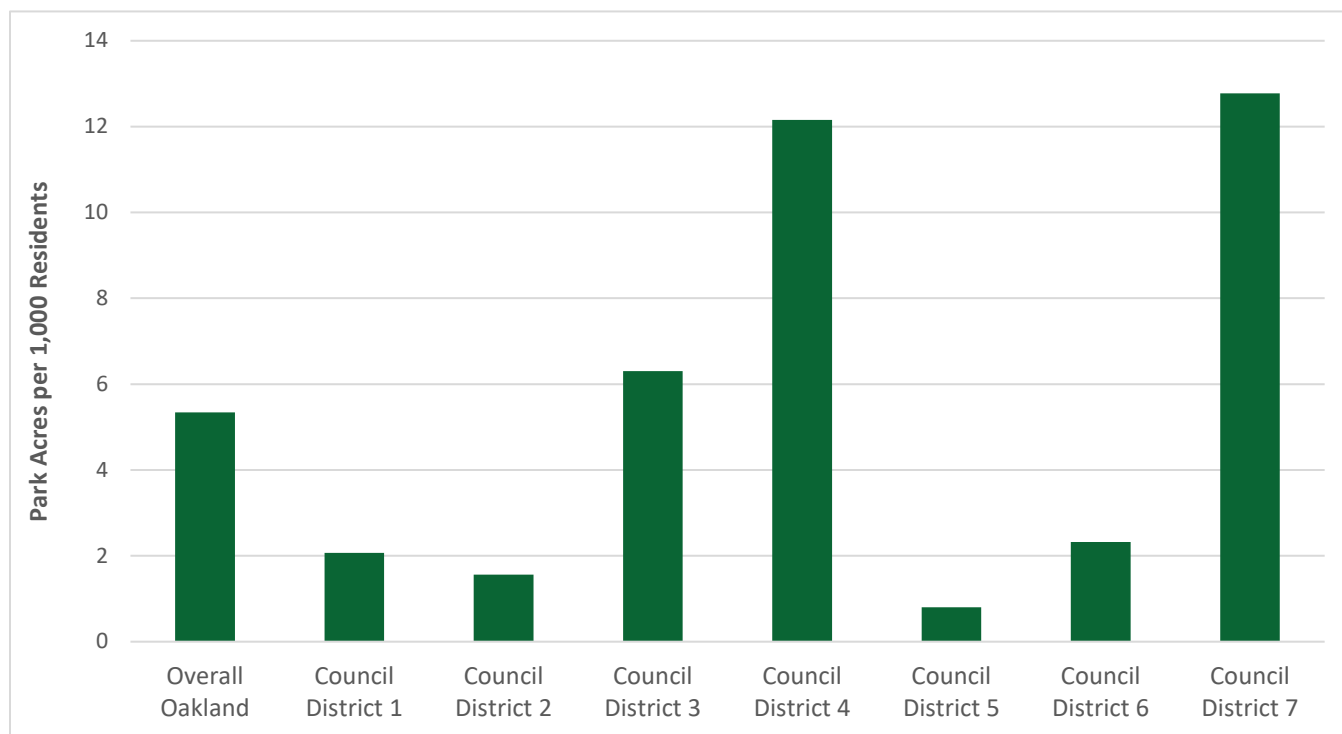


Figure 14: Park Acres per 1,000 Residents

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