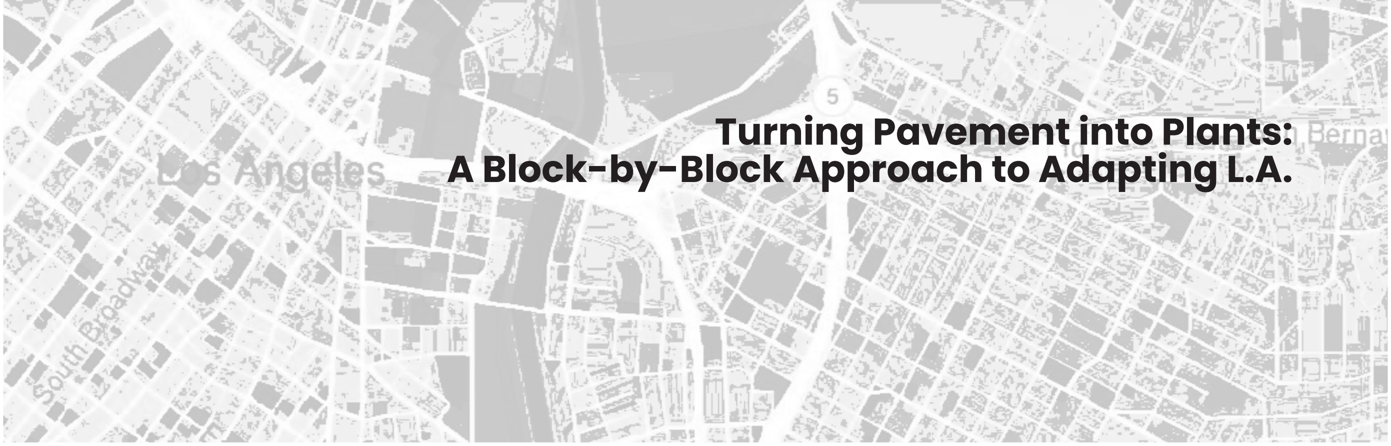

Turning Pavement into Plants: A Block-by-Block Approach to Adapting L.A.

DEPAVE**LA**

DEPAVE**LA**

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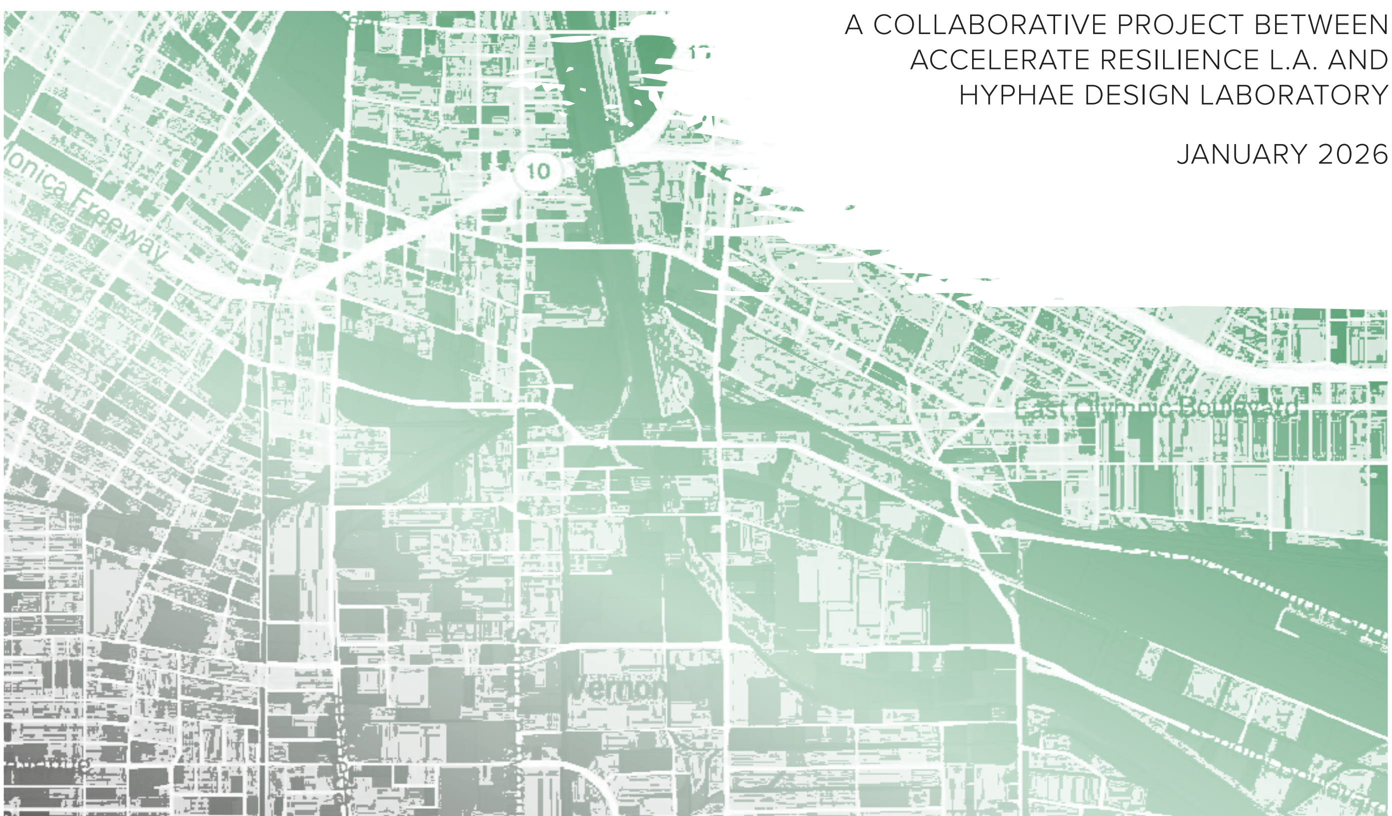
A COLLABORATIVE PROJECT BETWEEN
ACCELERATE RESILIENCE L.A. AND
HYPHAE DESIGN LABORATORY

JANUARY 2026



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This report was a collaborative partnership between Accelerate Resilience L.A. (ARLA) and Hyphae Design Laboratory from concept to completion.

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LA County Chief Sustainability Office
Environment · Economy · Equity

We would also like to thank diverse members of the following departments and organizations for their generous feedback: County of LA Department of Public Health, PLACE program, County of LA Department of Public Works, County of LA Second District, County of LA Tree Canopy Equity Group, LA Living Schoolyards Coalition, Conservation and Natural Resources Group, and the GreenLA Coalition.

Land Acknowledgement

Accelerate Resilience L.A. acknowledges that we live, work, and collected the data for this report on the ancestral lands of the Tongva, Tataviam, Serrano, Kizh, and Chumash Peoples. We honor their elders – past, present, and emerging – and recognize their ongoing stewardship of these lands and waters. We acknowledge that colonization has caused, and continues to cause, displacement, violence, and lasting trauma, and affirm our commitment to truth, healing, and strengthening relationships with Indigenous peoples and local tribal governments.

Reviews

Adam Millard-Ball, Professor of Urban Planning, UCLA
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Heidi Creighton, Senior Design Manager at the City of Santa Monica
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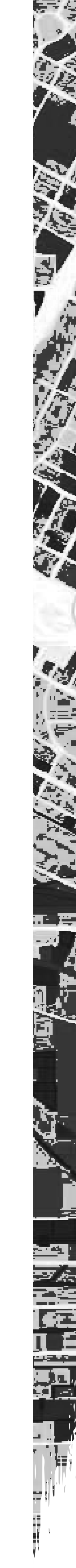
As climate adaptation accelerates in L.A. County, removing unnecessary pavement is no longer a fringe idea but an urgent need.



CHAPTER OVERVIEW

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EXECUTIVE SUMMARY

This report responds to a growing ecological crisis and policy consensus: the time has come to depave paradise.[1] If Los Angeles wants to reduce heat, manage water, expand tree canopy, and support public health and equity goals, it needs an actionable strategy for transforming pavement. The following report is a necessary step towards envisioning and quantifying that strategy.

PURPOSE AND CONTEXT

Los Angeles County is home to over 310,000 acres of pavement, an expanse so vast, it would form California's largest city if consolidated. This pavement burden is more than a visual or planning issue. It directly contributes to extreme heat, stormwater runoff, flooding, and ecological degradation, with disproportionately severe impacts on frontline communities. Schoolyards bake in the sun, sidewalks flood after storms, and tree planting opportunities are limited without first removing the asphalt that dominates so many of our shared spaces. Depaving requires a fundamental shift in how we value and design urban land. In a region where pavement has long been synonymous with progress, DepaveLA urges us to remove excess pavement and allow the land to breathe, recharge, and sustain healthier, more resilient communities.

This report provides the foundation for a first wave of depaving implementation. It provides a novel quantitative and geospatial dataset to understand the County's existing pavement distribution and narrow down locations where removal might be possible. It also highlights twenty-two practical design and depaving strategies, from planted bulbouts to parking lot reconfigurations, that local agencies and partners can use to remove unnecessary asphalt and regenerate urban land. Together, the dataset and depaving strategies offer a scalable approach to advance climate, health, and equity goals: one sidewalk, schoolyard, parking lot, and neighborhood block at a time.

SCOPE AND METHODOLOGY

DepaveLA presents the first countywide pavement analysis at both the parcel and right-of-way (ROW) level, distinguishing between roads, other paved surfaces, parking, and sidewalks using aerial imagery and land cover data.

Using high-resolution mapping and planning heuristics, the analysis categorizes pavement into two categories:

- Core pavement (needed for roads, sidewalks and required parking)
- Non-core pavement (not required for roads, sidewalks, and parking).

This technical assessment integrates parcel- and ROW-level pavement data with fine-scale metrics for heat, flood risk, canopy coverage, and pavement intensity, identifying "stacked needs" areas – places where top-quartile environmental burdens overlap – to guide equity-focused, multi-benefit, depaving interventions. It also offers a framework for public agencies to identify the scope of pavement removal opportunities and set quantifiable targets to guide pavement removal initiatives.

The scope of the analysis spans all of Los Angeles County, not just unincorporated areas. This assessment fills a critical data gap by providing the high-resolution depaving analysis that other plans call for, while also supporting implementation across public agencies, cities, school districts, community organizations, and private landowners.

SUMMARY OF KEY FINDINGS AND RECOMMENDATIONS

Scale of Opportunity

LA County has **312,453 acres** of pavement, or 488 square miles. This is an area so vast it would form California's largest city if consolidated.

An estimated **137,438 acres (44%)** of the existing pavement is what we call non-core pavement, meaning it is not thought to be required for roadways, sidewalks, or parking. This pavement should be further examined to determine how much of it might be potentially removable.

Hotspots of Intersecting Needs

In the most impacted areas of the County (the top 25% of communities showing overlapping pavement burden, heat, flood and canopy need), there are about 788 acres of pavement. 79% of these depaving hotspots with highest need are located in designated Disadvantaged Communities under SB 535.

Privately-Owned Parcels

Approximately 90% of non-core impervious surface lies within parcels, not in the public right-of-way. Of this parcel-based pavement, **nearly four times more acreage is privately owned than publicly owned**. This *4:1 ratio* underscores the need for strategies that extend beyond public land and engage private property owners in high-impact depaving efforts.

Residential Pavement Area

Amongst parcel types, residential parcels contain the largest amount of parcel pavement, with **74,685 acres**, which is 41% of the total pavement in all parcel types.

Within that residential area, **81% of the pavement is located on single-family parcels**, accounting for **58,936 acres** of total pavement.

Our pavement analysis estimates that of the total of 74,685 acres of pavement on residential parcels, approximately 26,587 acres is required for parking, with 4,204 acres reserved for roads. What remains is **43,894 acres** of pavement that is likely to be patios, walkways, and driveways.

If all residential properties were retrofitted to meet the County's current minimum landscape requirement of 20% of non-building parcel area, **571 acres** could be depaved. Currently 3.7% of residential parcels (68,013 parcels) do not meet this requirement.

LA County has 312,435 acres of pavement, or 488 square miles.

This is an area so vast it would form California's largest city if consolidated.

If each residential parcel cut a single 6'x6' tree well in their patio, it would amount to **1,530 acres** of pavement removed, while on average only reducing notional patio space by 3% (calculated by noting that, on average, residential parcels have 1,126 square feet of pavement that is not required for parking).

Vacant Lots

There are **14,862 acres** of pavement on vacant parcels throughout the County. This is pavement that is not being used, and could potentially be removed without compromising any activities.

While Residential and Industrial vacant parcels contain the most vacant parcel pavement overall, commercial vacant parcels tend to have more pavement per vacant parcel, with the average residential vacant parcel being 11% paved, the average industrial vacant parcel 37% paved, and the average commercial vacant parcel 46% paved.

Government Parcels

There are **30,649 acres** of pavement on parcels assessed for government use. Of this pavement, 17,023 acres (55%) are on parcels assessed for "Government owned - unspecified," suggesting that understanding and reclassifying these parcels more accurately can help surface hidden depaving opportunities on land already in public control.

Commercial and Industrial Parcels

Commercial non-core pavement (pavement not required for roadways, parking or sidewalks) makes up 22,857 acres countywide.

If all commercial properties were retrofitted to meet the **County's 10% minimum landscape requirement**, this would amount to **1,018 acres** of pavement removal.

Conservatively estimating that 50% of the 4 million required commercial and industrial parking spaces are already angled less than 90 degrees, switching the remaining spaces to angled parking could free up pavement equal to 1,259 football fields and create space to plant one small tree for each of the 2 million parking spaces.

There are 14,862 acres of pavement on vacant parcels throughout the County.

This is pavement that is not being used, and could potentially be removed without compromising any activities.

Right-of-Way

There are **15,418 acres** of pavement in the public right-of-way that are thought to not be in use as roads or sidewalks. Such pavement is likely to have wide shoulders, islands, and medians.

There are **102,933 acres** of pavement in the rights-of-way between parcels that **are in use as roadways**. This is around a third of all of the pavement in the County, and so future depaving strategies could include foci on road diets and other interventions for road pavement. The present study does not focus on road pavement but the category should be considered as a logical next step.

Supervisorial District Pavement

Each supervisorial district has unique pavement conditions. Districts 1, 2, and 4 have pavement as their largest landcover category, with District 2 further impacted by disproportionately low tree canopy. Districts 3 and 5 have relatively lower pavement coverage as a percent of their total area.

While all supervisorial districts show right-of-way and residential parcels as the largest pavement categories, the third-ranked pavement type varies for each district and might suggest different opportunities and solutions. For Districts 1, 2, and 4, it is industrial, for District 5 it is government, and for District 3, it is commercial.

The 3,179 school campuses in Los Angeles contain approximately 14,683 acres of pavement.

The average school campus is 40% covered in pavement.

Watershed Pavement

The South Santa Monica Bay, Lower San Gabriel River, and Lower Los Angeles River watersheds have relatively high road and non-road pavement in proportion to their size relative to the other watersheds, as well as relatively lower vegetation.

In all watersheds, rights-of-way and residential pavement were the largest pavement categories. However, the South Santa Monica Bay, Lower San Gabriel River and Lower Los Angeles River watersheds have the highest industrial pavement burden of the watersheds, with others showing more government and commercial pavement.

Schools Pavement

We calculated pavement coverage for all schools in the County, along with their extreme heat exposure, flood risk, and canopy coverage.

The 3,179 school campuses in Los Angeles County (including primary and secondary schools, adult education, as well as colleges and universities, including public, charter, and private schools) serve >2 million students, and contain approximately **15,240 acres** of pavement, with the average school campus being 40% covered in pavement. Many have a much higher pavement coverage.

If all of the school campuses with above average pavement coverage were brought down to the average, it would require removing **1,531 acres** of pavement.

Pavement Intensity versus Pavement Quantity

While single-family homes contain the **largest total area** of residential pavement, multi-family and industrial parcels are significantly more **pavement-intensive**, meaning there is a higher proportion of pavement on these parcels. This higher intensity is relevant when prioritizing where to address pavement burden.

RECOMMENDATIONS

1 **Recommendation 1:** Implement Depaving Projects in Hotspot Locations and on Vacant Parcels

2 **Recommendation 2:** Create a Depave Taskforce

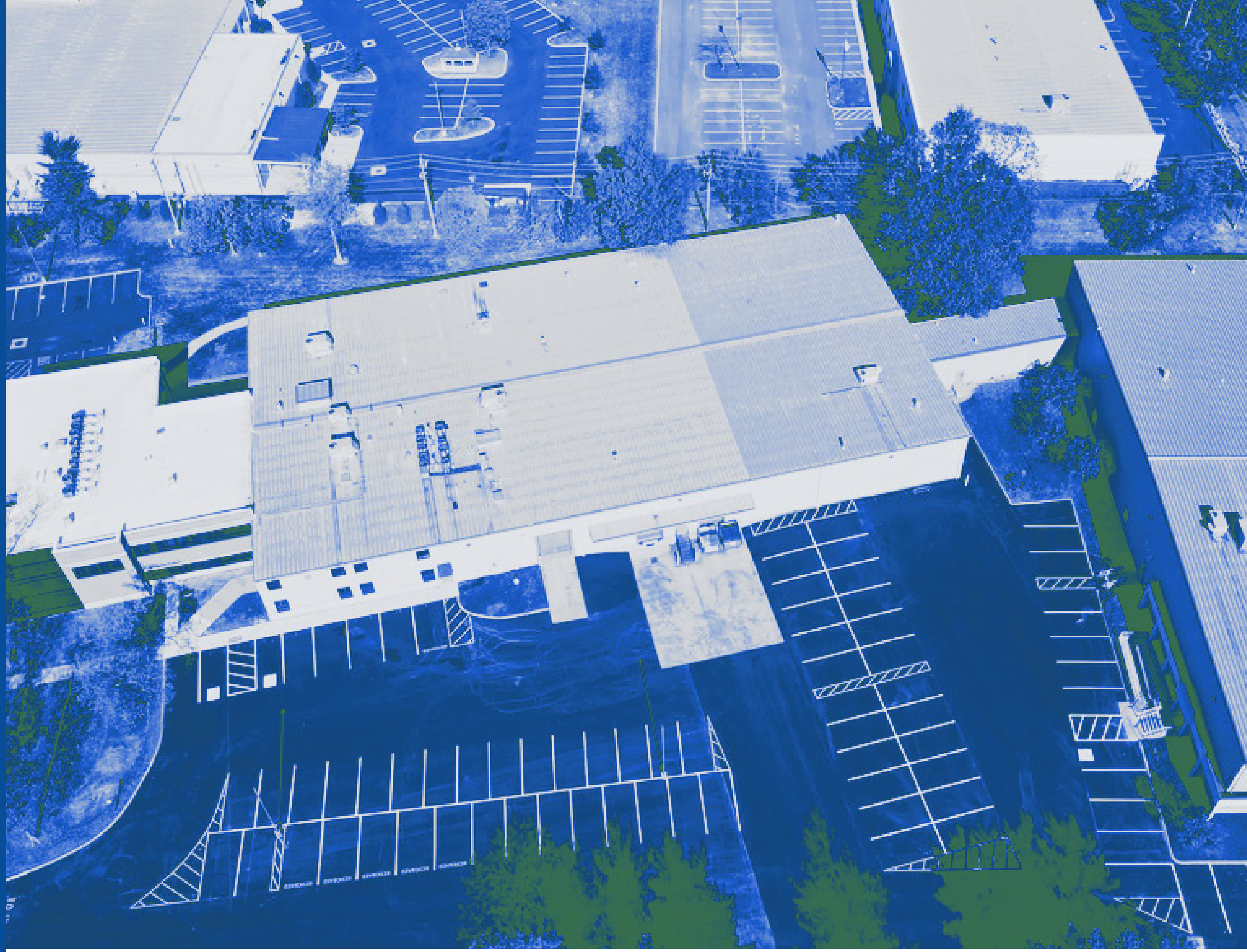
3 **Recommendation 3:** Use an Implementation Framework

4 **Recommendation 4:** Explore Incentive-Based Approaches for Depaving on Private Property

5 **Recommendation 5:** Promote Depaving of Schoolyards and Campuses

CHAPTER 1
INTRODUCTION

Pavement removal is critical to the success of several climate adaptation initiatives. To support greater implementation of depaving strategies, we developed a novel dataset that characterizes pavement across parcels, rights-of-way, and neighborhoods.



OVERVIEW

Pavement dominates the landscape of Los Angeles, far beyond what the region needs or can sustainably manage. Communities with high pavement burden and limited green infrastructure face higher temperatures that can cause heatstroke and exacerbate respiratory and cardiovascular illness.[2] Flooding from heavy rains overwhelms infrastructure, damaging property and spreading contaminants.

In many school districts, asphalt yards were installed decades ago as a low-maintenance cost-saving measure.[3] Today, those blacktop schoolyards are dangerously overheated and ecologically barren, conditions that directly affect student health, learning, and play. As these impacts intensify from climate change, there is an urgent need for strategies that address pavement directly. One such strategy is **depaving**: the removal of unnecessary hardscape to restore ecological function and protect public health. Replacing pavement with permeable surfaces can support groundwater recharge, promote vegetation growth, and create safer, cooler, more walkable environments.

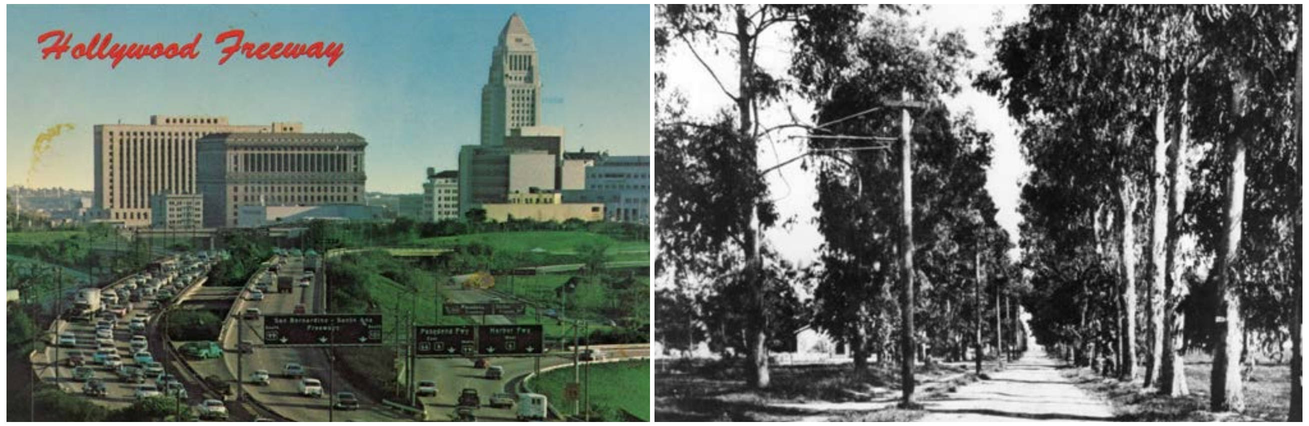


Figure 1.1: Left, postcard of L.A. mid-20th century. Right, Santa Monica Boulevard circa 1900 (Pierce, C. C. (1861-1946) / Security Pacific National Bank Collection / Los Angeles Public Library)[5]

This report identifies strategic depaving opportunities throughout Los Angeles County to support and accelerate ongoing efforts in watershed management, extreme heat mitigation, urban forestry, and transportation planning. Our assessment highlights where pavement could be removed to expand canopy cover, manage stormwater, and reduce heat while also delivering broader regional benefits of increased resilience and ecosystem restoration.

In the months and years ahead, we hope this report will guide strategic decision-making and serve as a resource for agencies, planners, and advocates. This assessment identifies where pavement is, how much of it there is, who controls it, and what can be done to remove it. This dataset provides a baseline resource for urban planners and other infrastructure partners to build upon and scale with further design, planning, geospatial analysis and implementation efforts.

A HISTORY OF HARDSCAPE

The freeways, wide streets, and parking lots of today are not inevitable features of the landscape. The over-pavement of Los Angeles stems from historical, economic, and political forces dating back to the early 20th century. Rapid urbanization, car-centric planning, and suburban expansion cemented the region's reliance on asphalt and concrete. Redlining and racially-restrictive covenants shaped where such investment and infrastructure funding was directed, deepening inequities in land use, mobility, and environmental quality. Redlined neighborhoods of Los Angeles were systematically denied public and private investment, leading to disinvestment in tree canopy and green space while enabling unchecked expansion of hardscape infrastructure. Prior to colonization, Indigenous communities managed these lands in ways that honored ecological balance and long-term stewardship, and local tribes continue to hold and exercise this knowledge today. As the climate crisis exposes the true costs of over-pavement, the need for sustainable land use has become more urgent than ever.

PRIOR PAVEMENT REMOVAL INITIATIVES

Previous pioneers of the depaving movement in Los Angeles include Dorothy Green, founder of the environmental group Heal the Bay. In the early 1990s, Green convened *Unpave L.A.*, an informal coalition of environmentally minded activists and academics committed to reversing impervious surface expansion.[5] Our work builds on that coalition's legacy of environmental imagination and urban water intervention. *Unpave L.A.* challenged entrenched systems such as the single-purpose flood control practices of the L.A. County Flood Control District and U.S. Army Corps of Engineers, the mismanagement of stormwater, and the degradation of water quality in local rivers and streams. The #UnpaveLA moniker has since been widely adopted across Los Angeles, referenced in NGO campaigns, planning reports, and even by the Director of Public Works.[6]

Since the 1990s, numerous studies have advocated for pavement reduction to mitigate urban heat, stormwater runoff, and water quality decline.[7] What was once a fringe concept has become a viable strategy embraced by planners, policymakers, and even segments of the Army Corps of Engineers. With pavement removal now a key metric of the Safe Clean Water Program and other programs, depaving has shifted from an aspirational idea to a necessary climate intervention.

In parallel to these developments, both the City and County of Los Angeles have explored reductions or removals of parking requirements. While this shift is primarily framed around development flexibility and housing affordability, it also presents an important opportunity to reduce impervious surface and unlock environmental co-benefits.

A 2015 study by Chester et al. documented an exponential increase in Los Angeles County's parking supply since the 1920s and 30s.[8] However, past studies were limited by reliance on census-tract-level analysis that lacked the spatial granularity needed to guide neighborhood-specific decisions. This report builds on that foundation by offering parcel- and right-of-way level opportunity analysis to inform more precise and locally responsive decision-making.

It is also important to acknowledge the influential work led by Depave Portland that has inspired a movement from Chicago to Nashville, across Canada and many other locations.[9] We are inspired by their leadership, and we believe Los Angeles communities can benefit from collaboration and knowledge sharing with these peers across the country.

A COMMUNITY APPROACH

There are many grassroots champions and organizers throughout Los Angeles' history who have led community-driven and culturally-informed initiatives to shape decisions about urban planning and the built environment. This report complements that legacy with a technical analysis, providing new data that can equip the next generation of leaders to support future depaving efforts.

This study is not a plan, nor does it propose any specific depaving projects. Instead, it identifies flexible depaving strategies that can be adapted to projects of any scale and should be tailored to the unique needs, aesthetics, and approaches of individual communities. Both large-scale, government-led infrastructure projects and smaller, grassroots or small business initiatives play important roles, as small projects can depave the way for larger ones.

Moving forward, a community-driven participatory design, planning and implementation approach will be essential to guide future phases of depaving across L.A.

REPORT STRUCTURE, KEY CONCEPTS, AND DEFINITIONS

The Report is divided into eight sections: **Introduction, Needs Assessment, Pavement Distribution Analysis, Pavement Necessity Analysis, Design and Planning, Recommendations**, and concludes with a **Methodology** chapter.

Below are some critical terms used throughout the report. These terms establish a shared language for interpreting our data, methodology, and recommendations, ensuring clarity across audiences, from planners and policymakers to community partners.

- **Pavement:** Impervious surfaces specifically designed for transportation (e.g., roads, alleys drive aisles), human activity (e.g., sidewalks, patios, parking lots), or other infrastructure (e.g., flood control channels). This definition excludes buildings but includes features such as medians and road shoulders that often present opportunities for depaving.
- **Parcel:** A legally defined area of land, typically privately or publicly owned, and zoned for residential, commercial, industrial, or institutional use. Pavement within parcels may include parking lots, private roads, driveways, and other hardscaped surfaces not used for through-traffic.
- **Right-of-Way (ROW):** Publicly controlled land located between parcels, generally used for streets, alleyways, sidewalks, medians, utility corridors, and transit infrastructure. ROW areas often include underutilized paved spaces, such as wide shoulders or oversized medians, that offer significant potential for depaving interventions.
- **Unincorporated Areas:** Parts of Los Angeles County that do not fall within the boundaries of an incorporated city and are therefore governed directly by the County. For the purposes of this report, we group these areas into 121 unincorporated communities to allow for more localized analysis. These communities sit alongside the County's eighty-eight incorporated cities, each with their own municipal governments and planning authorities. Together, the unincorporated areas and the cities make up the full jurisdictional landscape that this report seeks to survey, underscoring the importance of coordination across both County-led and City-led initiatives. Throughout this report we will sometimes describe data as pertaining to either unincorporated areas or countywide; the countywide designation in these cases includes both unincorporated and incorporated areas.
- **Countywide Statistical Area (CSA)**: Defined geographic units used to structure environmental, demographic, and governance analysis for depaving prioritization. This report uses the County's Countywide Statistical Areas (CSA) dataset to define the boundaries of communities. While CSAs do not always align perfectly with commonly recognized neighborhood or city boundaries, they provide complete, non-overlapping coverage of the County and are well-suited for geospatial analysis. These CSAs include the 121 unincorporated areas mentioned above, as well as the eighty-eight cities (divided into 226 neighborhoods) for a total of 347 named CSAs.
- **Core pavement:** Pavement that is currently in use as roadways or sidewalks, or reserved for parking spaces by planning codes.
- **Non-core pavement:** Pavement that exists but is not classified as core pavement. This pavement category merits further study, as closer inspection and full site assessment may determine it to be removable.
- **Porous Pavement:** Pavement that allows water to percolate through it while still providing structure for typical pavement uses like walking and driving. It can be used for depaving projects where core pavement function remains. A range of options exists from decomposed granite, to paving stones and porous concrete, which all have different infiltration and evaporation rates.
- **Pavement Amount vs Intensity:** In this assessment, we distinguish pavement amount, the total area (in square feet or acres) of pavement in a given place, from pavement intensity, which is the percentage of that place that is covered in pavement. This has implications for both pavement removal opportunities and pavement exposure burdens. A large parcel with a high pavement amount and low pavement intensity might have a high opportunity for pavement removal, but a lower pavement burden for people using the parcel, while a small parcel with high pavement intensity and low pavement amount might have high pavement exposure burden and low pavement removal opportunities.
- **Data Accuracy:** All of the data in this report is derived from data collected from numerous sources. Each source contributes errors and biases, and combining datasets can compound these errors and biases. For example, the landcover dataset used to account for how much pavement is in the county has been assessed with an overall accuracy of 83%, which means that the true quantities of pavement described in this report can be expected to diverge from the numbers reported here by at least plus or minus 17%.

CHAPTER 2

NEEDS ASSESSMENT

Across Los Angeles County, pavement burden, extreme heat, flooding risk and limited tree canopy afflict a diverse range of places, creating a broad spectrum of depaving needs. By using parcel- and corridor-scale indicators (ECOSTRESS surface temperature, UCI Flood Lab PRIMo high-confidence flood extents, land-cover–derived pavement share, and canopy coverage) and filtering results by where people live, this analysis moves beyond countywide generalities to pinpoint neighborhoods, schools, and street segments where interventions will matter most.

2.1 INTRODUCTION

Pavement has many essential uses. It facilitates travel by motor vehicle or bicycle. It provides a path for walking, a place to park, play basketball, or host a barbeque. Pavement also exacerbates several environmental risks, however. Each community within the County has different exposure to these risks, and consequently has different needs when it comes to depaving. This assessment thus focuses on three key risks that depaving can help mitigate: heat, flooding, and tree canopy access. We will first look at the distribution of pavement itself, which creates its own needs in addition to exacerbating those caused by heat, flooding, and low canopy. We will then focus on heat, flooding, and tree canopy needs across the County, in communities, and in supervisorial districts, to understand where depaving benefits might be most impactful. For each of these need categories we will also zoom into the most affected schools to help school initiatives prioritize depaving, and follow the same procedure for Vision Zero road segments. Schools, as well as other sensitive receptor sites, are a high priority. Vision Zero segments, where road, sidewalk, and pavement reconfiguration is already being considered throughout the County, are also natural candidates for depaving.

By mapping pavement burden, heat exposure, flood risk, and canopy gaps at a granular scale, and filtering by where people live, our analysis evaluates all of L.A. County, but highlights the top 25% of areas most affected by each risk factor. Within these we have then "stacked" where multiple hazards such as heat, flooding, and low canopy coincide, rendering such sites especially well-suited for multi-benefit interventions. Within this stacked need framework, we have also identified which School and Vision Zero road segments emerge as particularly high-leverage opportunities. Finally, our supervisorial district maps reveal within-district hotspots to support targeted capital planning at the district level.

The largest geometries within the County that we will use to aggregate pavement data are supervisorial districts, watersheds and CSAs, as outlined in figure 2.1. We also aggregate metrics into spatially consistent hexagonal grids for identifying hotspots, and later, in Chapter 3, into parcels and rights-of-way for identifying land-use.

What about census tracts?

Census tracts are valuable for providing social vulnerability information, such as the CDC Social Vulnerability Index (SVI), CalEnviroScreen indicators, California Heat Assessment Tool (CHAT), numerous EPA EnviroAtlas metrics, and CDC PLACES health metrics. This data is crucial for understanding the demographic and socioeconomic context of an area. Although census tracts are valuable for analyzing social and health vulnerabilities, they are less beneficial for identifying granular depaving opportunities or environmental hotspots. Their large, irregular boundaries blur important differences in land use, mask localized extremes through averaging, and make it difficult to align with parcels or rights-of-way. To capture smaller but critical areas where depaving would be most effective, finer-grained units like parcels, rights-of-way, or uniform hexagonal grids are more appropriate. In this chapter, we use hexagonal grids to locate hotspots and then examine which of these overlap with census tract–based SB 535 Disadvantaged Communities.

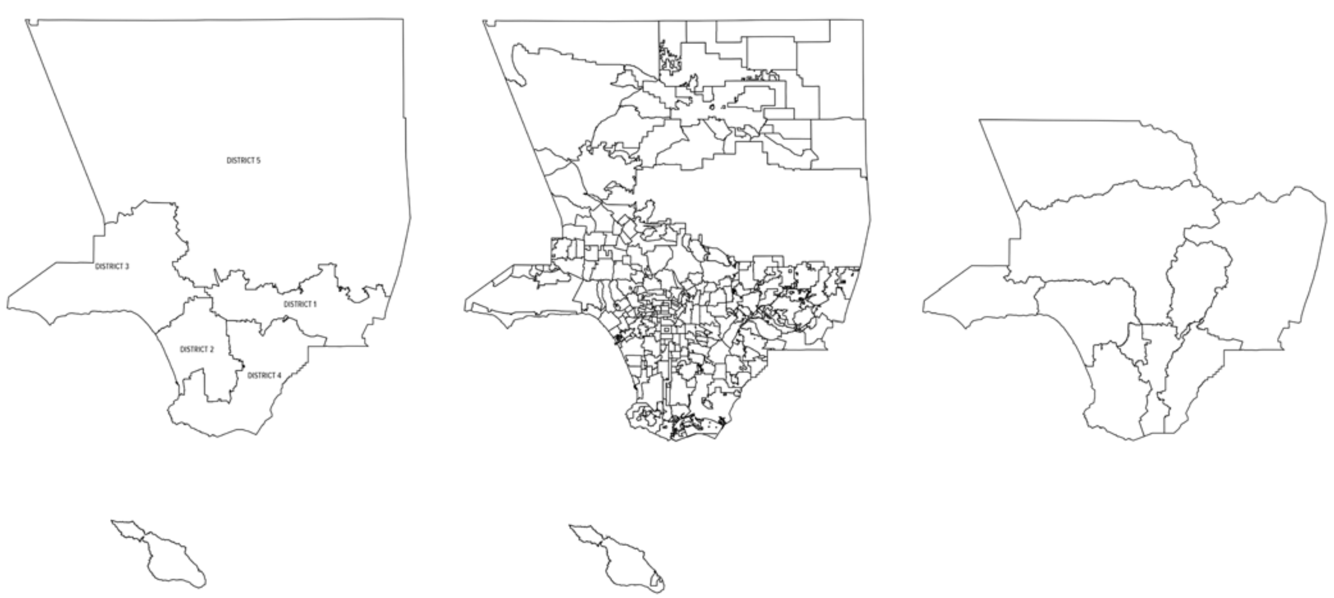


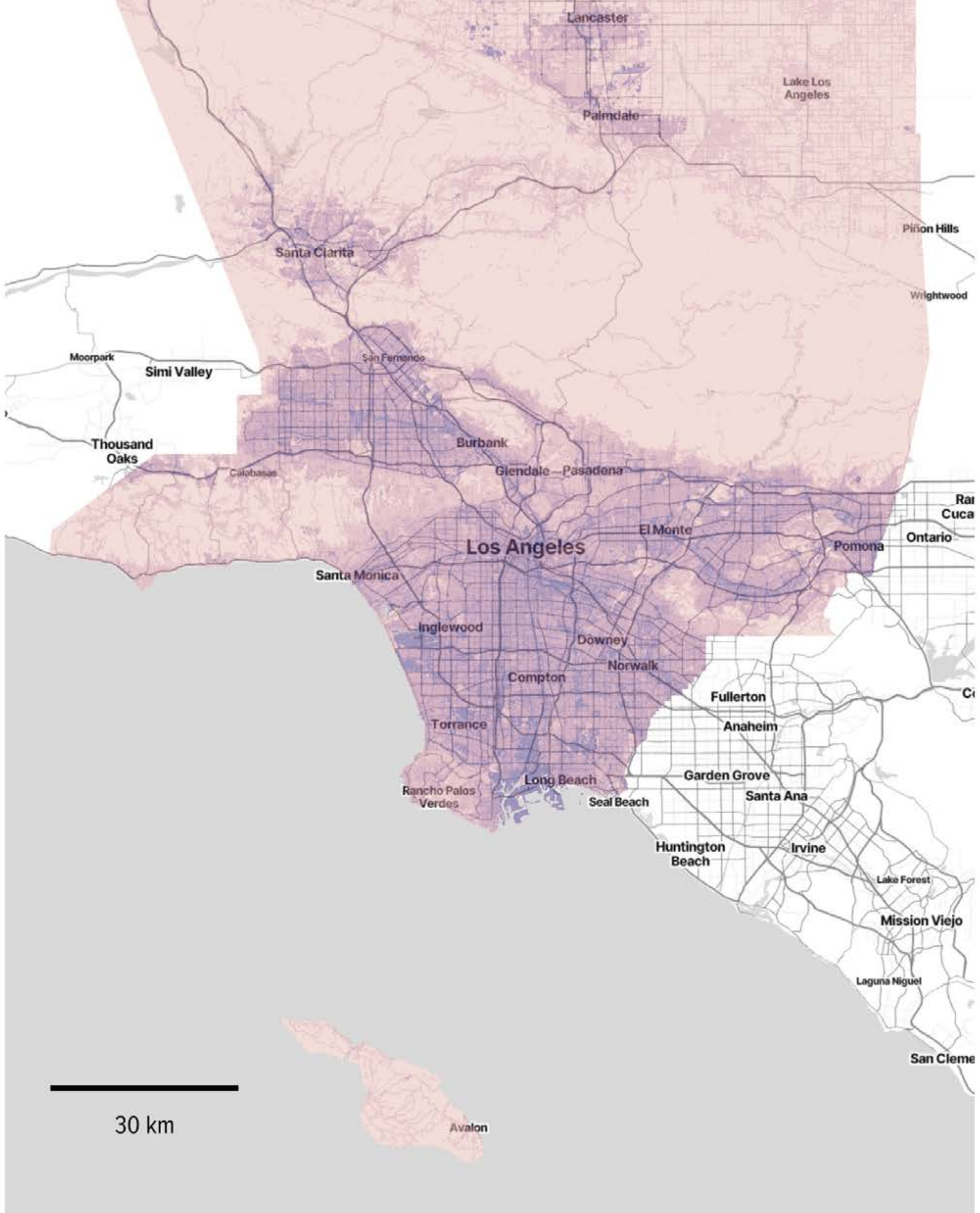
Figure 2.1: From left to right, supervisorial districts, CSAs, and SCWP watershed boundaries

2.2 PAVEMENT COVERAGE

Pavement exacerbates the above-mentioned risks of heat, flooding and tree equity. As such, we can also assert that one contributor to the depaving need of a community is the amount of pavement itself. Excess pavement can affect community identity,[10] mental health,[11,12] pollution exposure,[13] perceptions of safety[14] and social cohesion.[15] Therefore, pavement burden may be a meaningful metric in identifying where equitable depaving efforts should be prioritized. For this exercise we can approximate the pavement burden by looking at the total pavement area, or the percent of a subarea covered in pavement. In this context, pavement area is defined as road and non-road pavement areas as identified by the landcover dataset (discussed in Chapter 7 on methodology). While this method excludes buildings and other unpaved impervious surfaces, it does not account for pavement that is hidden beneath tree canopy in the aerial images used to generate the landcover dataset. Figure 2.2 shows the total pavement percent coverage in Los Angeles County aggregated over 1.5 hectare subareas. While the distribution of total pavement throughout the County may be helpful for orienting pavement policy spatially, we will dig a little deeper into what pavement might be used for in Chapter 3, and who controls it, while also analyzing different kinds of pavement.

As can be seen in Figure 2.2, pavement is most clearly concentrated in urban areas. The County of Los Angeles can be broken down into around 340 communities (CSAs). Some of these are neighborhoods or cities, while others are unincorporated places. The designations of these CSAs were created in 2014 and 2015 by The L.A. County Enterprise GIS team, working with the Unincorporated Area Deputies and Field Deputies of each Board of Supervisors office to establish names that reflect the desires of residents. Figure 2.3 shows the pavement percent of each CSA. By ranking these, we can see the communities with the highest proportion of paved area, as shown in Figure 2.3.

Excess pavement can affect community identity, mental health, pollution exposure, perceptions of safety and social cohesion.



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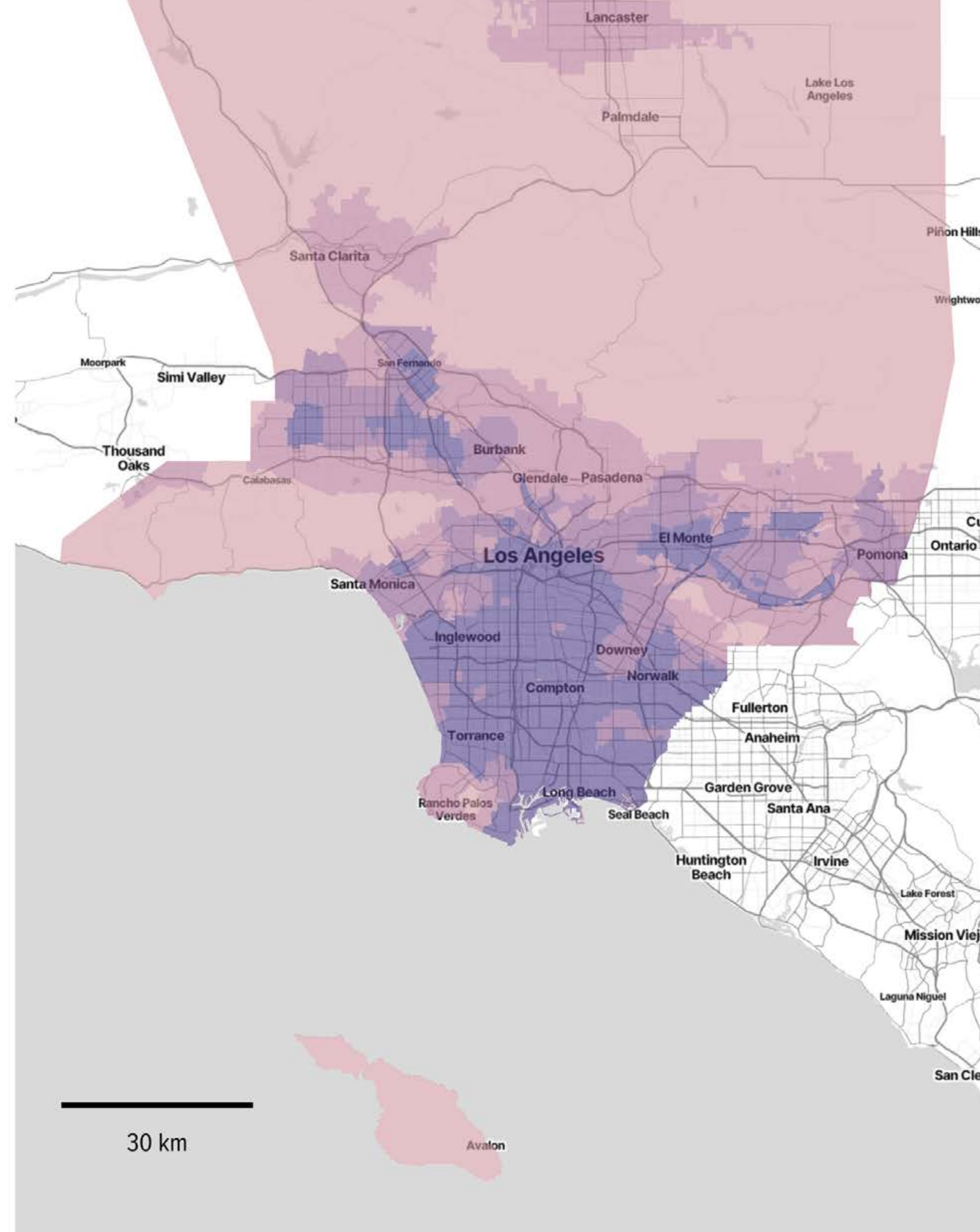
Total Pavement Percent

0 - 20 | 20 - 40 | 40 - 60 | 60 - 80 | 80 - 100

Figure 2.2: Total pavement area % per 1.5 hectares in Los Angeles County



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Total Pavement Percent

0 - 12 | 12 - 27 | 27 - 40 | 40 - 54 | 54 - 90

Figure 2.3: Countywide Statistical Areas (CSAs) by pavement percent

2.2.1 Pavement Coverage Ranking by Countywide Statistical Area (CSA)

As can be seen in Figure 2.4, the top 24 most heavily paved Countywide Statistical Areas (CSAs) include communities of diverse sizes and shapes. By aggregating the area covered by pavement into 3.7 acre hexagonal cells, and filtering out those cells with 0 population, we created a population-filtered pavement exposure map for each of the top 24 CSAs in Figure 2.6.

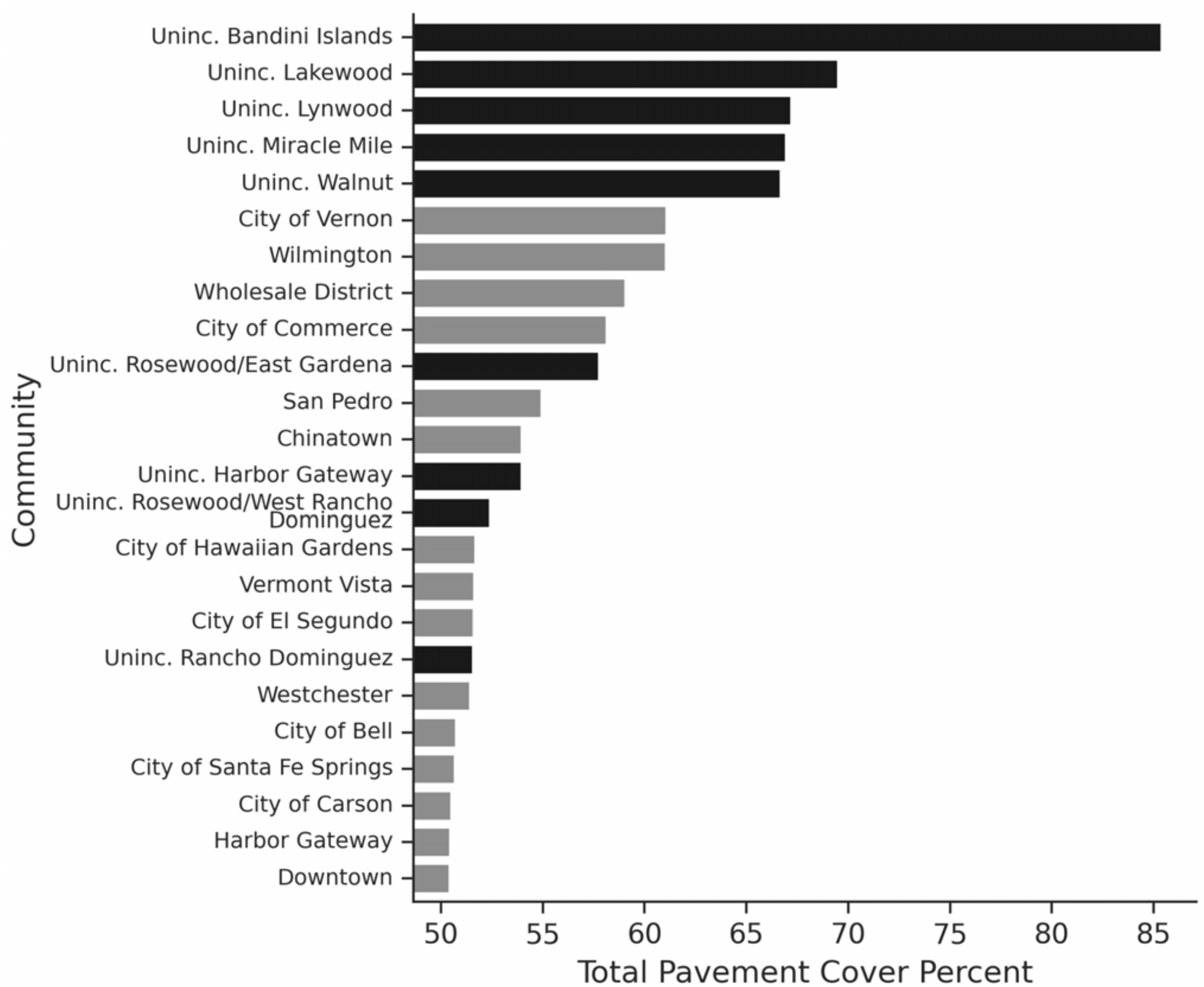

Figure 2.4: Top 24 CSAs ranked by area covered in pavement (darker colors are unincorporated, lighter colors are incorporated)

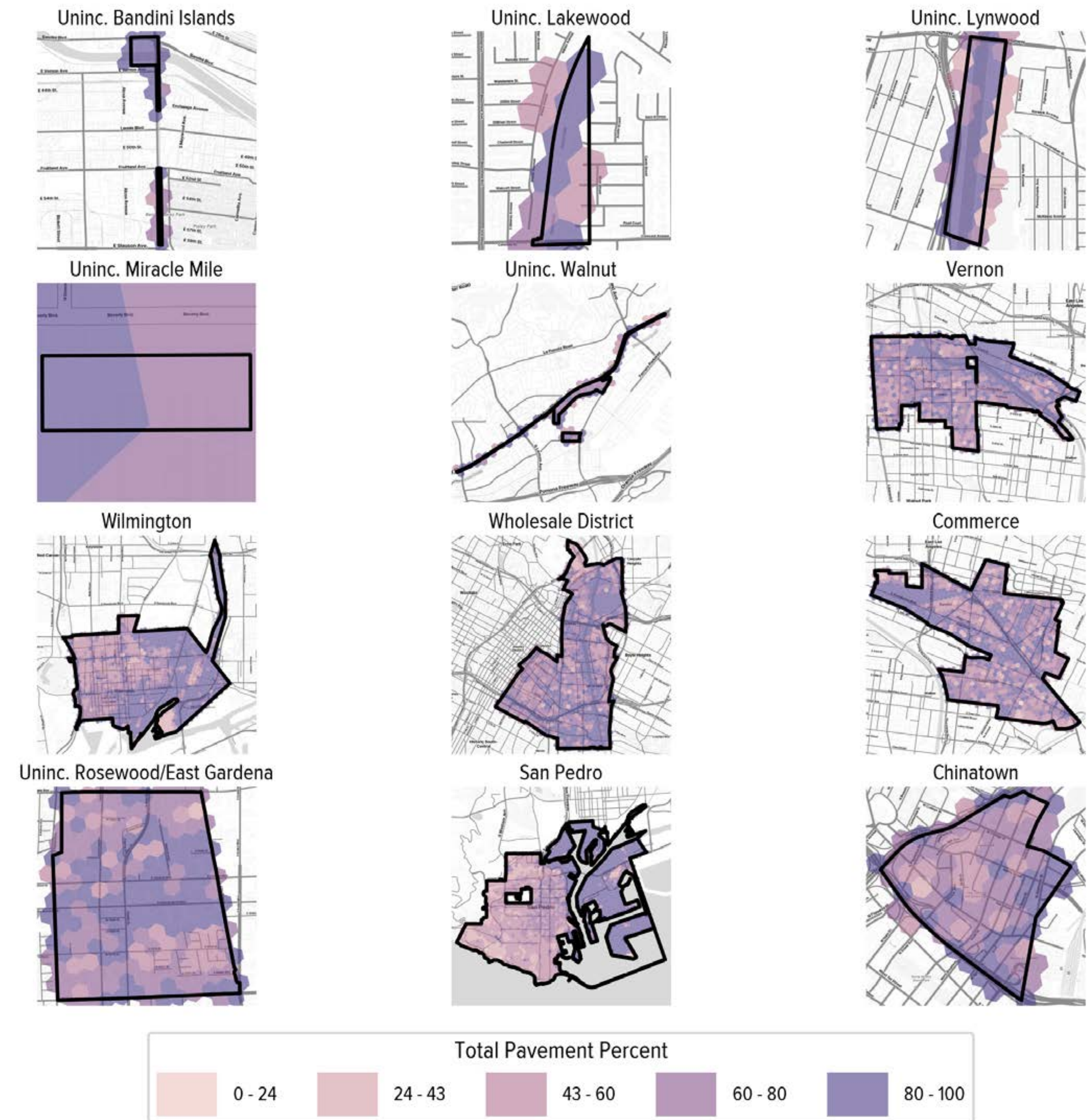

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Figure 2.5a: Top 24 CSAs by pavement percentage across 3.7 acre hexagons

Figure 2.5b: Top 24 CSAs by pavement percentage across 3.7 acre hexagons

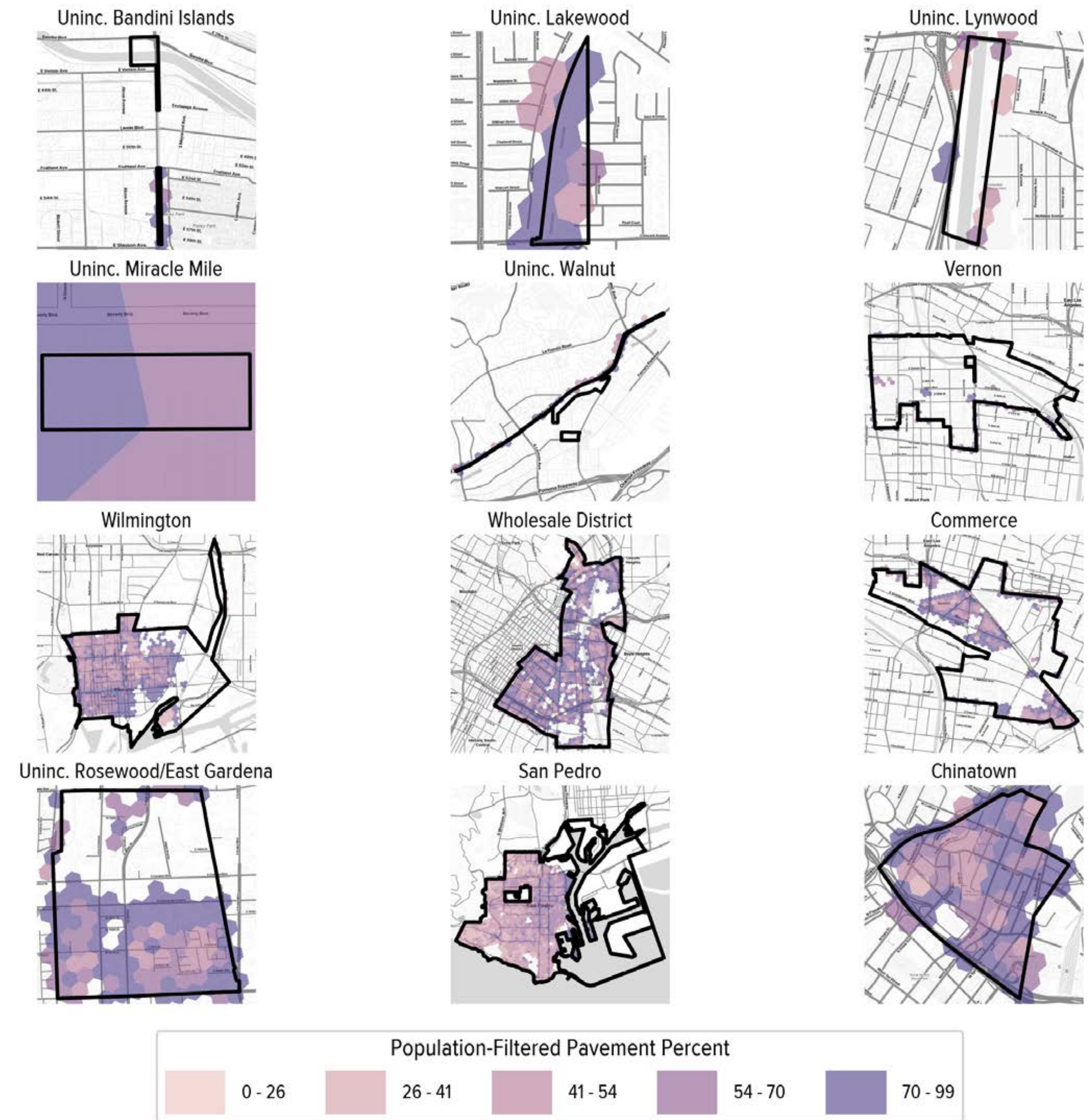
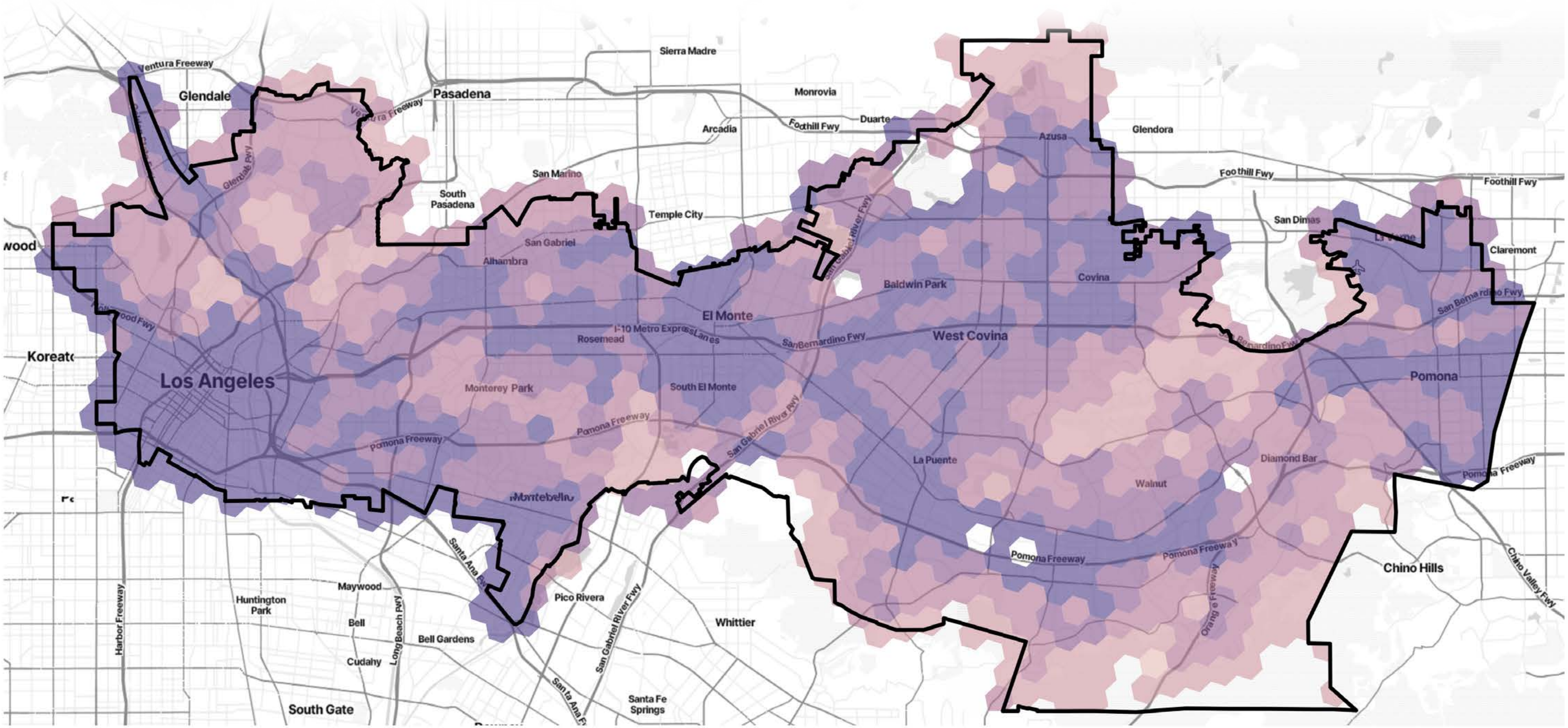


Figure 2.6a: Top 24 CSAs by population filtered pavement percent across 3.7 acre hexagons

Figure 2.6b: Top 24 CSAs by population filtered pavement percent across 3.7 acre hexagons

2.2.2 Pavement Exposure within Supervisorial Districts

For larger areas such as supervisorial districts, we can aggregate the area covered by pavement into 180 acre hexagonal cells, and filtering out those cells with 0 population, we can create a population-filtered pavement exposure map. This is mapped for each supervisorial district in Figures 2.7 through 2.11.



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Population-Filtered Pavement Percent

0 - 16 | 16 - 30 | 30 - 41 | 41 - 52 | 52 - 82

Figure 2.7: Supervisorial District 1 population filtered pavement percent coverage per 180 acres

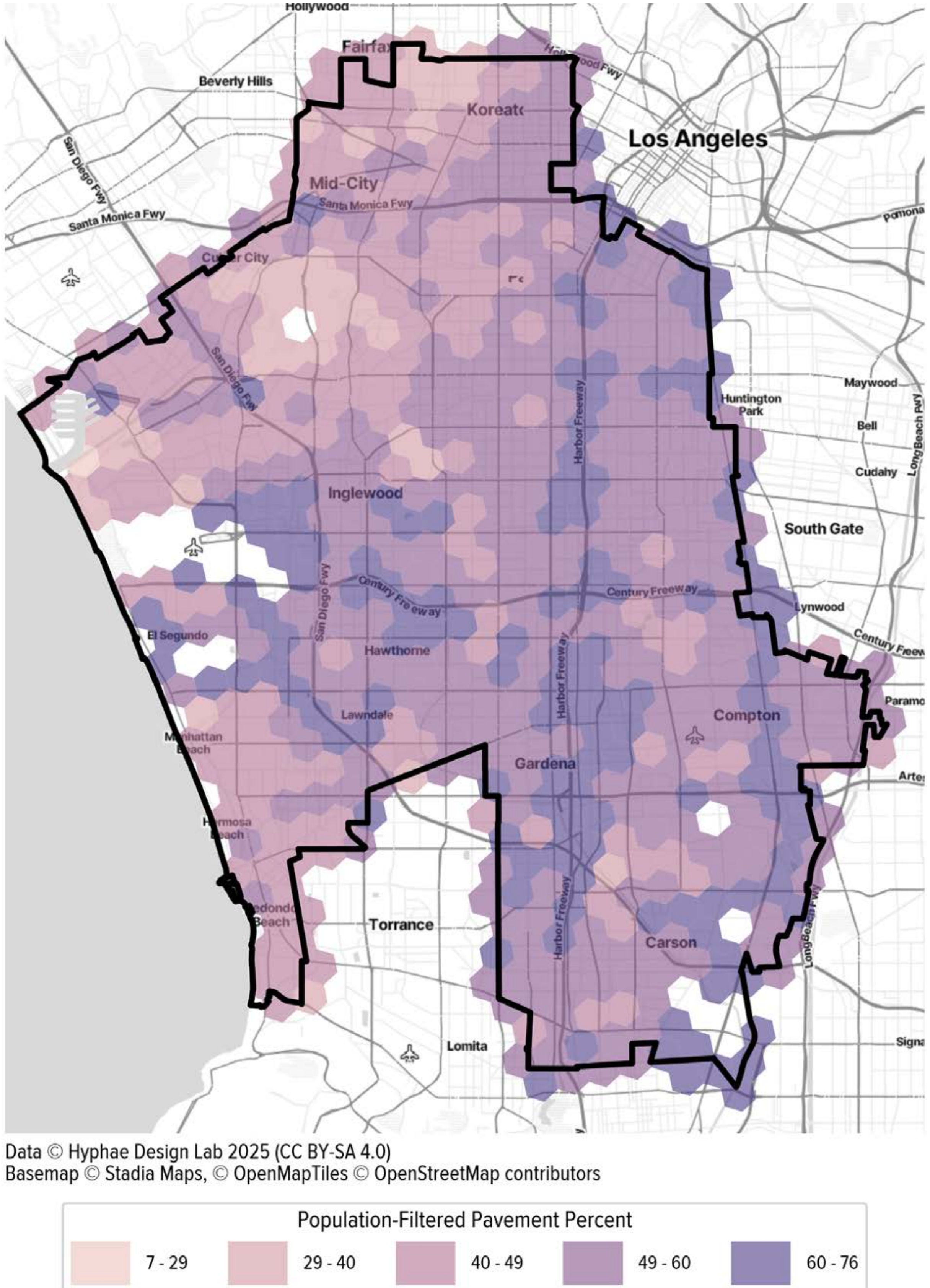
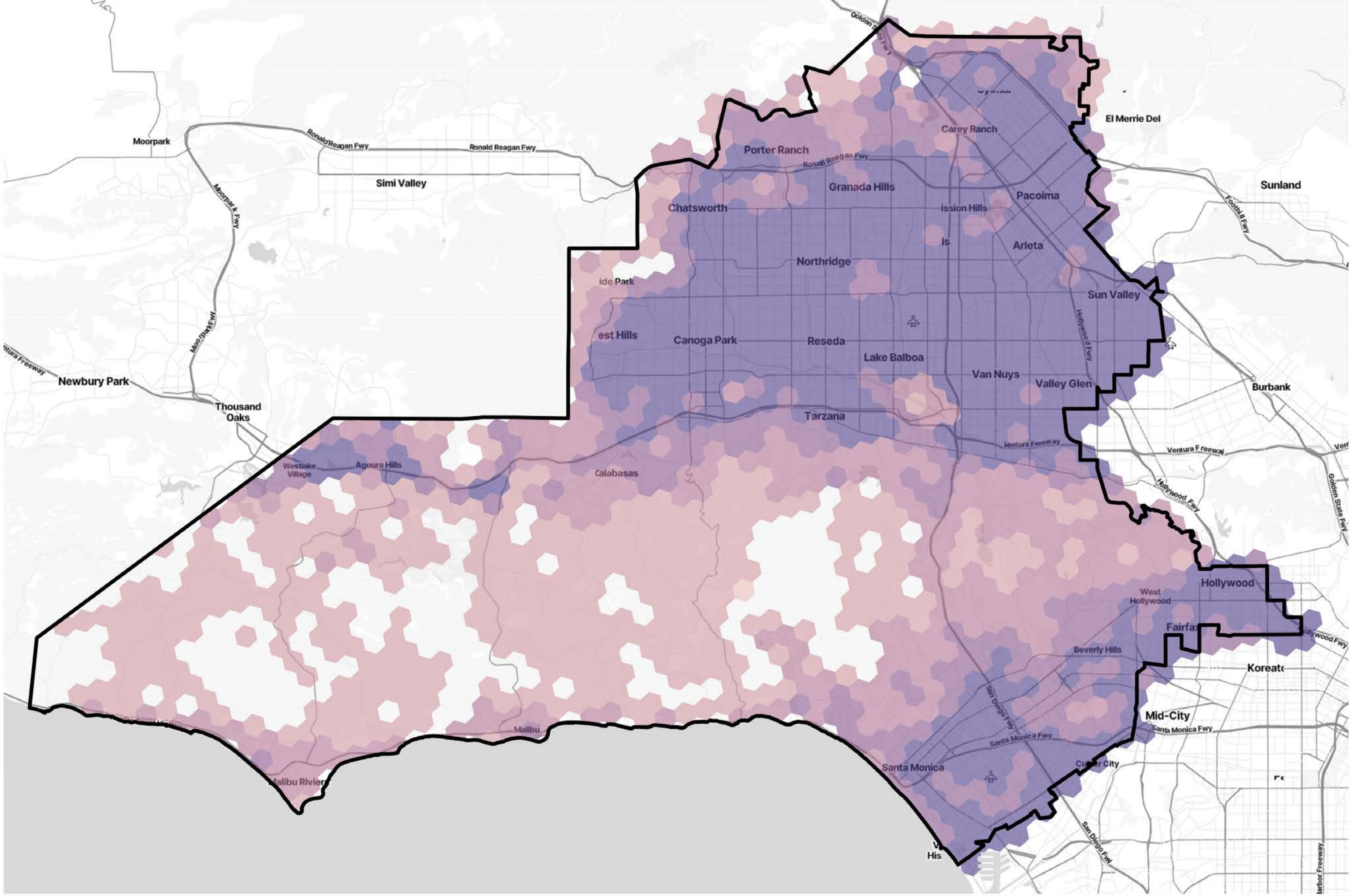


Figure 2.8: Supervisorial District 2 population filtered pavement percent coverage per 180 acres

Exposure to excess hardscape degrades thermal comfort, stormwater performance, air quality, and the overall livability of the built environment.



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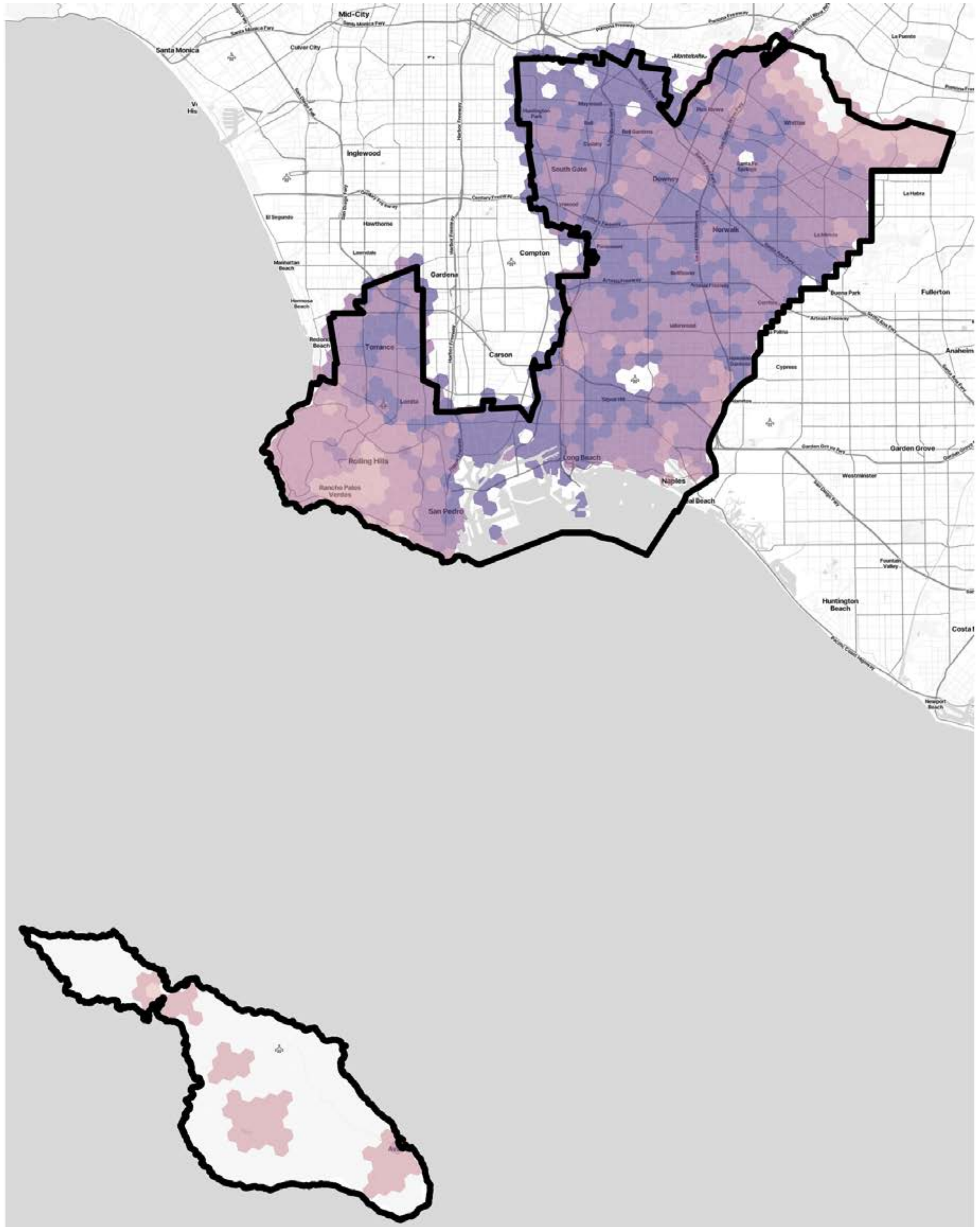
Population-Filtered Pavement Percent

0 - 7 | 7 - 18 | 18 - 30 | 30 - 41 | 41 - 64

Figure 2.9: Supervisorial District 3 population filtered pavement percent coverage per 180 acres



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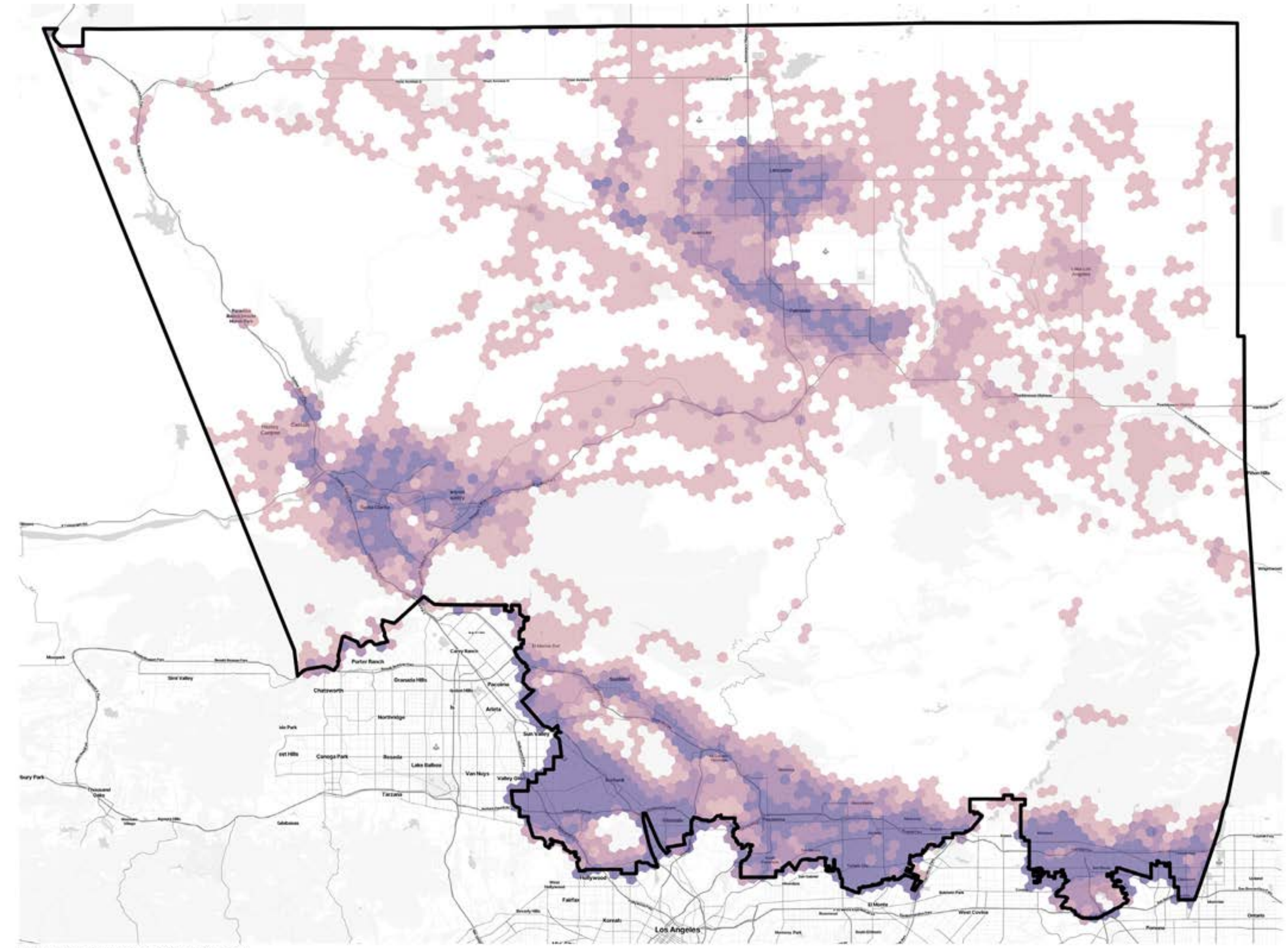
Population-Filtered Pavement Percent

0 - 12 | 12 - 29 | 29 - 43 | 43 - 60 | 60 - 92

Figure 2.10: Supervisorial District 4 population filtered pavement percent coverage per 180 acres



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Population-Filtered Pavement Percent

0 - 6 | 6 - 15 | 15 - 26 | 26 - 38 | 38 - 76

Figure 2.11: Supervisorial District 5 population filtered pavement percent coverage per 180 acres

2.2.3 Pavement at Schools

We have also mapped these metrics at a finer scale of detail for each of the 3,179 schools in the County. Together, these schools have an estimated total enrollment of 2,084,992 students, and their campuses occupy an estimated 41,508 acres of land.

Figure 2.12 shows the top 30 LAUSD elementary schools by pavement coverage. To see similar figures for other school districts in L.A., see the depave.la website. For a detailed study of the history of school pavement in LAUSD, as well as obstacles, opportunities and recommendations for school depaving, please refer to the UCLA Luskin Center for Innovation's Depaving California Schools for a Greener Future report.[16]

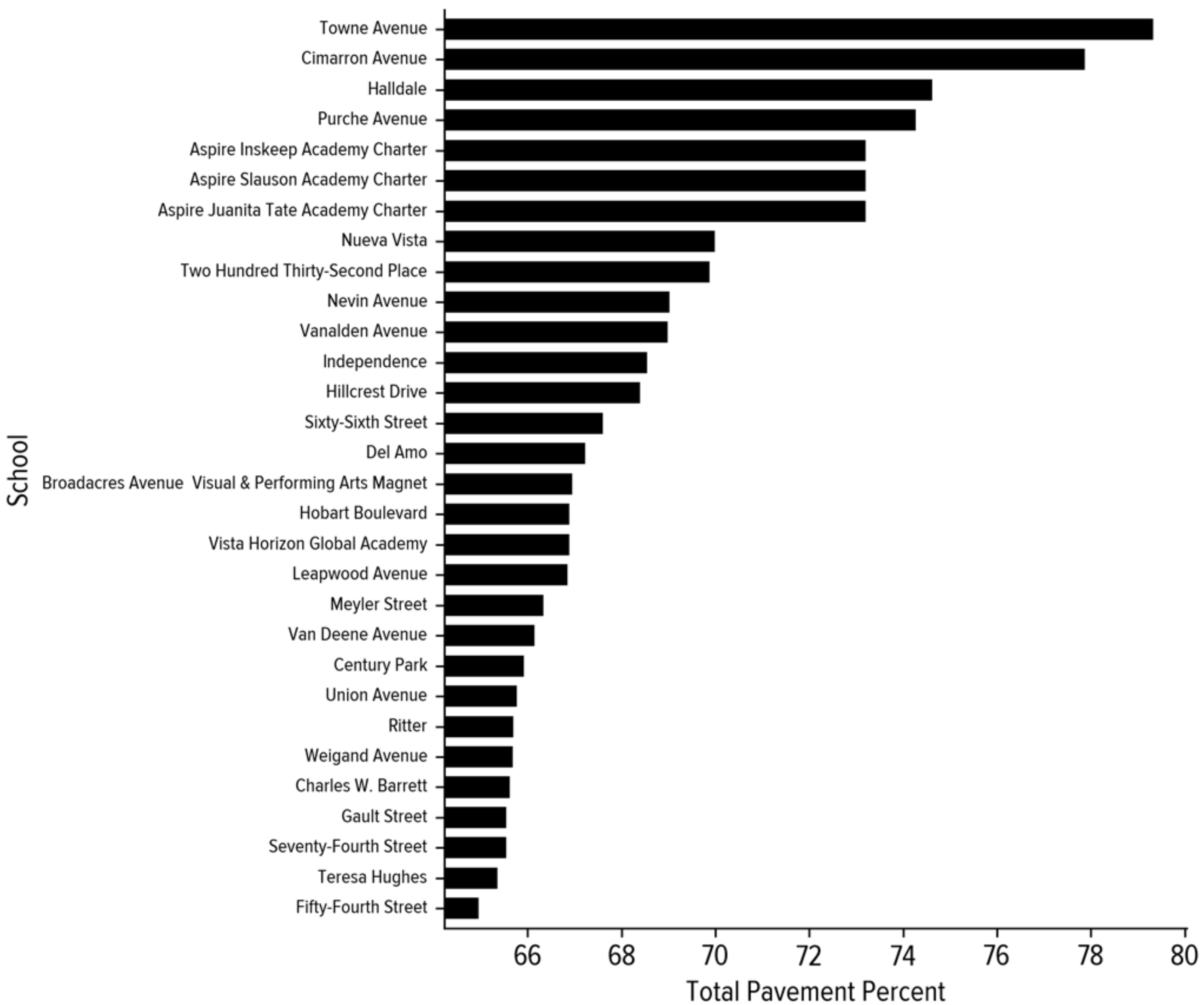


Figure 2.12: Top 30 LAUSD elementary schools by pavement coverage

2.2.4 Pavement in Vision Zero Road Segments

We have also mapped these metrics at a finer scale of detail for each of the County's 200 Vision Zero high collision road segments. For each segment, a 50 ft buffer is applied to each side of the road, to capture the context of roadside vegetation, pedestrian environment, and other features, enabling us to rank the streetscapes by how paved they are. While it may seem obvious that road segments are highly paved, the aerial imagery also captures trees, grass, soil, water, and buildings on a streetscape, so road segments with the highest pavement coverage are those with the least of these other land cover types. Figure 2.13 shows the top 30 Vision Zero segments by pavement coverage.

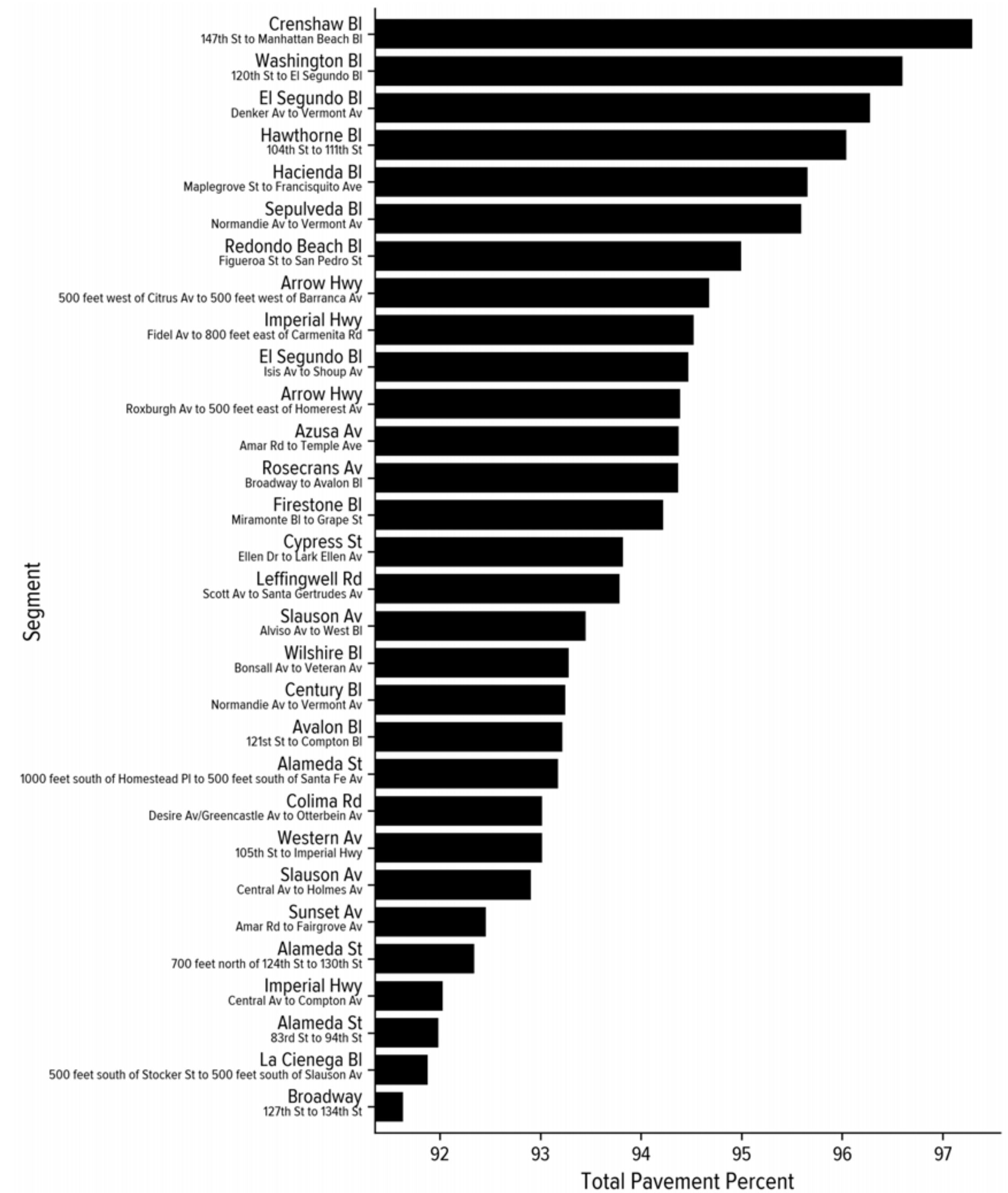


Figure 2.13: Vision Zero road segments ranked by pavement coverage

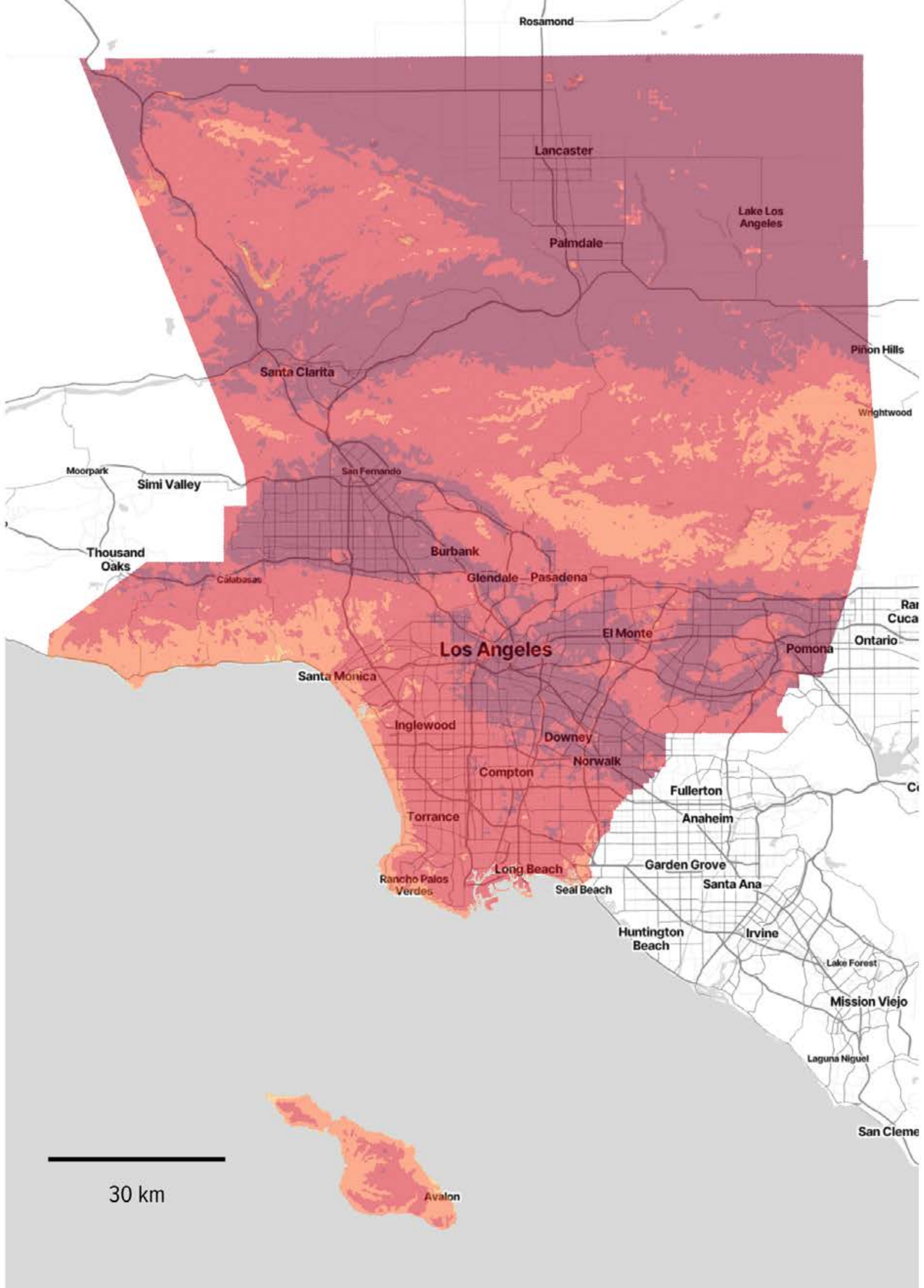
2.3 HEAT

Extreme heat is the number-one weather-related cause of death in the U.S. Most years, it kills more people than hurricanes, floods, and tornadoes combined.[17] Heat-health events are also consistently pushing up healthcare costs higher nationwide, with an estimated $100 billion annually in direct medical expenses attributed to heat-related illness. When including lost productivity and increased insurance burdens, experts predict this number to rise closer to the $500 billion-per-year mark by 2050.[18] Extreme heat events are becoming more frequent and severe. With urban heat islands expanding due to sprawl and shrinking green space, populations are increasingly vulnerable to heat stress, especially among children and the elderly.

The 2021 L.A. County Climate Vulnerability Assessment (CVA) predicted that “County-wide daily max temperature will increase by an average of 5.4 degrees fahrenheit to a mid-century average of 98.6 degrees fahrenheit.”[19] Santa Clarita, Reseda, Baldwin Park, East Los Angeles, and Lancaster are predicted to see the sharpest increases in extreme heat across L.A. County, with 95th-percentile daily maximum temperatures rising by over 6ºF by mid-century. Even coastal cities like Malibu and Venice, which historically have milder climates, are projected to see increases of 4–5ºF.[20] San Fernando, Mission Hills, and Encino have smaller populations but still face approximately 30 additional extreme heat days annually. Unincorporated North Lancaster and Del Sur have the highest baseline temperatures (≥100ºF) and will exceed 107ºF and 106.4ºF, respectively, on extreme heat days by 2050. District 3 (San Fernando Valley) is disproportionately represented, with nearly every community on the list falling within its boundaries. Additionally, Sylmar, Northridge, and Pacoima are projected to experience over 30 additional extreme heat days annually, among the highest increases in the country.[21]

The 2025 OurCounty Plan has established clear targets to reduce heat exposure and expand urban greenery, aiming to achieve 18% canopy coverage of all unincorporated areas by 2035, and 20% by 2045. This is intended to support a goal of reducing heat-stress emergency department visits by 20%, and 30%, respectively, over the same timeline.[22]

Heat can be measured in many different ways, by air temperature, surface temperature, or radiant temperature. Indices such as the Universal Thermal Comfort Index (UTCI) combine multiple metrics to reflect the human experience of heat. For this analysis, we will use the surface temperature recorded by NASA’s ECOSTRESS satellite that measures the temperature of Earth’s surfaces at a spatial resolution of 70 meters. Surface temperature is one of several key factors in the human experience of heat at ground level, and we are using it as our metric because it is available at a much higher spatial resolution than other temperature metrics, which enables us to use it for parcel-scale analysis. The ECOSTRESS satellite orbits over Los Angeles County roughly every 4 days. The figure below shows an example sample averaging three hot, summer afternoons in 2024 (Figure 2.14). Note that this method does not take into account additional vulnerability metrics or forecasts of future climate change as has been done in the previously-mentioned 2021 County Climate Vulnerability Assessment.[23]



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Summer Afternoon Surface Temperature °F

70 - 84 | 84 - 98 | 98 - 112 | 112 - 127 | 127 - 141

Figure 2.14: Ecostress surface temperature for Los Angeles County, average of 3 hot summer afternoons in 2024

As can be seen in Figure 2.14, the surface temperature in Los Angeles County on a hot summer afternoon varies considerably depending on location. The hottest northeast quadrant of the County stands in stark contrast to the southwest coast, for example, which is cooled by the ocean, and the mountainous east of the County, where high elevation also produces a more temperate climate.

In addition to natural factors such as elevation and distance to the coast, the presence or absence of pavement also influences temperature. In highly paved areas, pavement can store daytime heat and release it overnight. During multi-day heat events, this thermal memory can persist for multiple days,[24] compounding heat stress. The presence of pavement necessarily implies the absence of trees, grass, and other vegetation which would otherwise be cooling those areas through shade and evapotranspiration. Furthermore, given that combustion engines convert up to 80% of their fuel into heat instead of motion (or up to 40% for electric cars), paved roads also aggravate heat stress by facilitating motor vehicle traffic. In the following section, we compare how different communities compare in terms of their surface temperature.

2.3.1 Community Heat Burden

Figure 2.15 shows CSAs by their median surface temperature. This enables us to rank communities according to their heat exposure needs. Figure 2.16 shows the top 24 CSAs ranked by their median surface temperature. 11/24 are in unincorporated parts of the County.

In highly paved areas, pavement can store daytime heat and release it overnight. During multi-day heat events, this thermal memory can persist for multiple days, compounding heat stress.

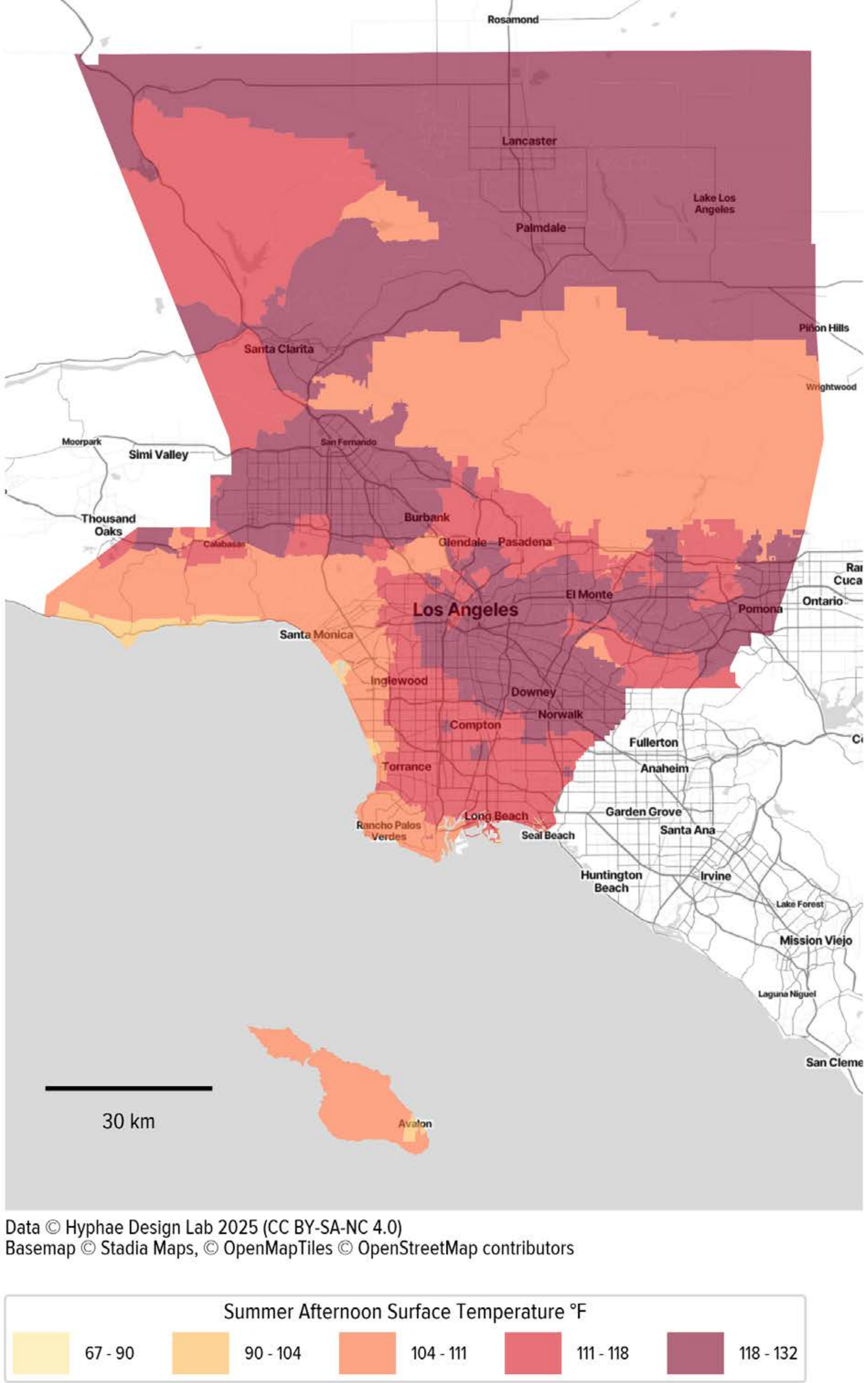

Figure 2.15: Median surface temperature of each CSA

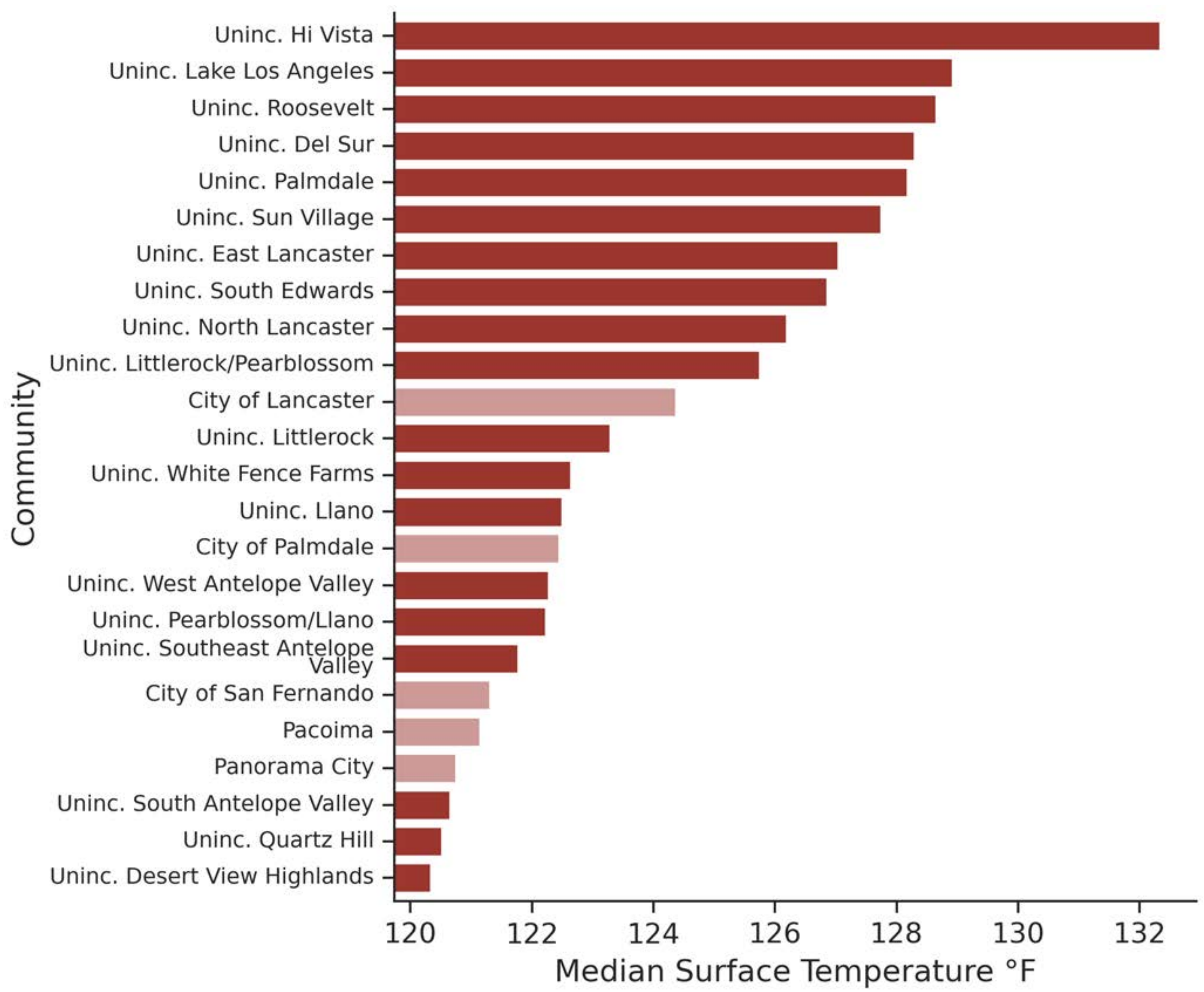

Figure 2.16: Top 24 communities ranked by median surface temperature (darker colors are unincorporated, lighter colors are incorporated)

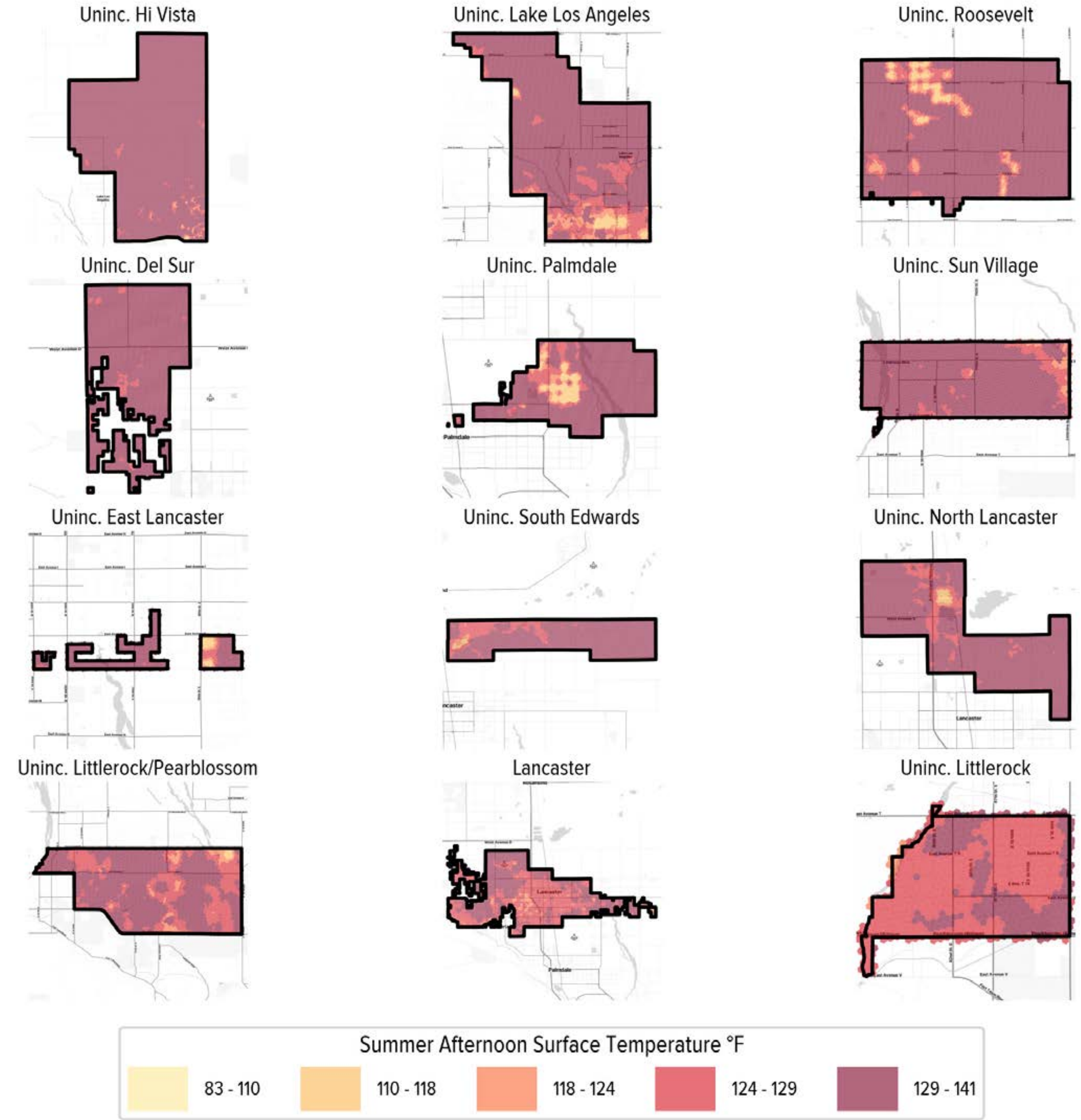

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Figure 2.17a: Top 24 communities ranked by median summer afternoon surface temperature mapped (ranked 1-12)

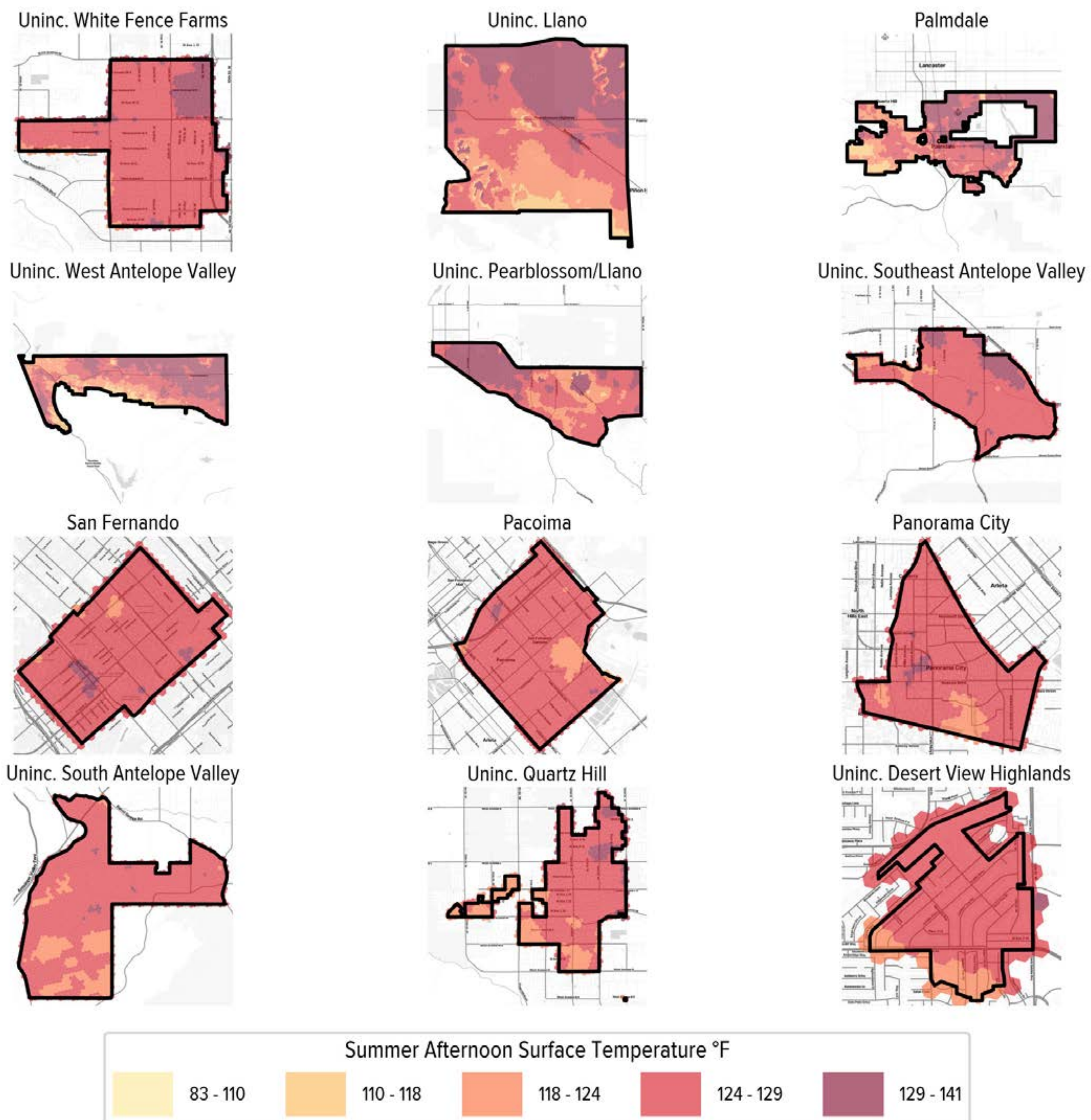

Figure 2.17b: Top 24 communities ranked by median summer afternoon surface temperature mapped (ranked 13-24)

As shown in Figure 2.17, the top 24 communities ranked by temperature include both sparsely and densely populated areas. To identify how temperature mitigation needs might intersect with population distribution, we aggregated temperature and population density metrics into a 3.7 acre hexagonal grid over each CSA and excluded those cells that have population equal to 0 to create a population-filtered temperature map, as shown for the top 24 CSAs in Figure 2.18.

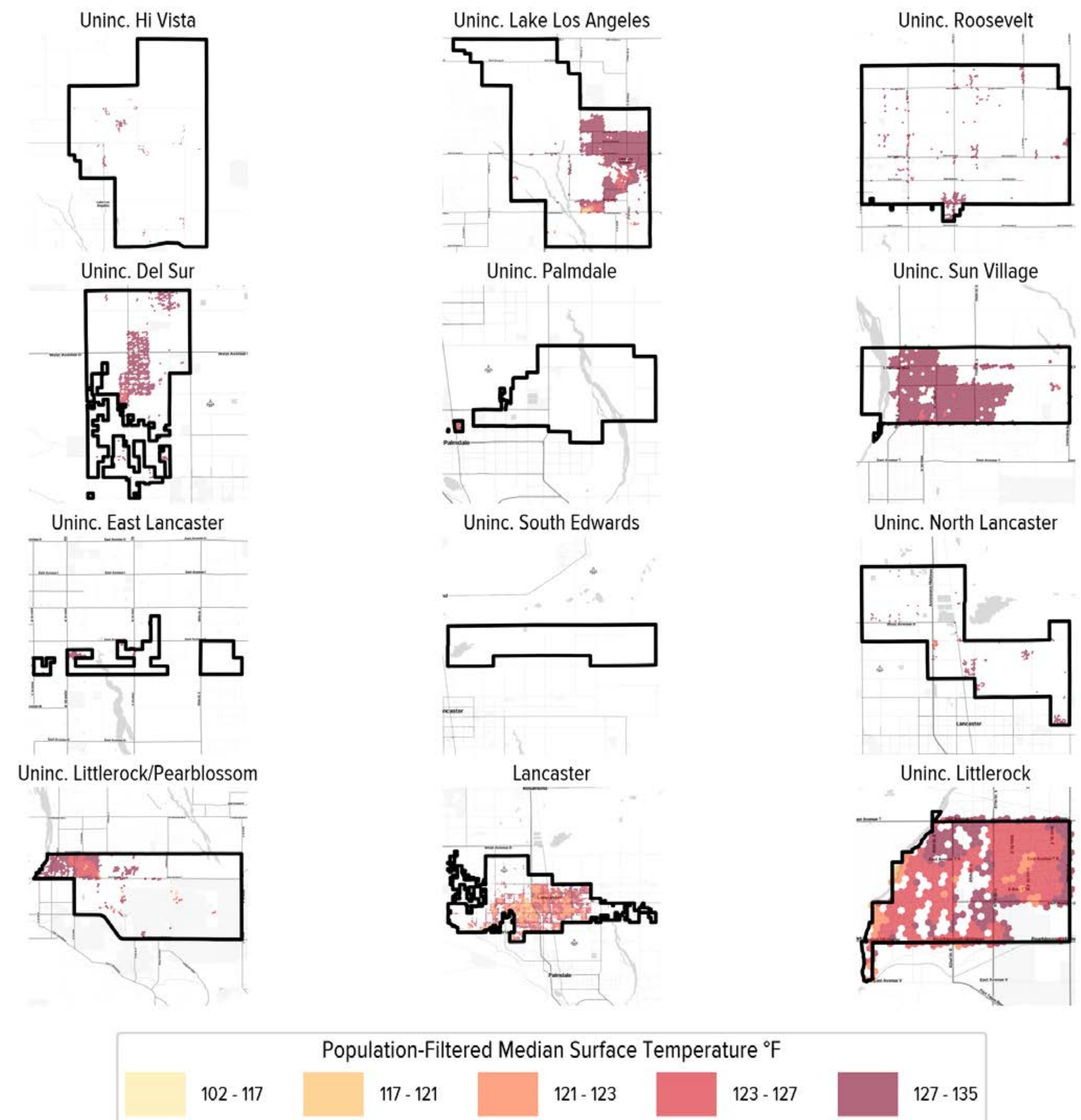

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Figure 2.18a: Top 24 heat CSAs with population filtered summer afternoon surface temperature (ranked 1-12)

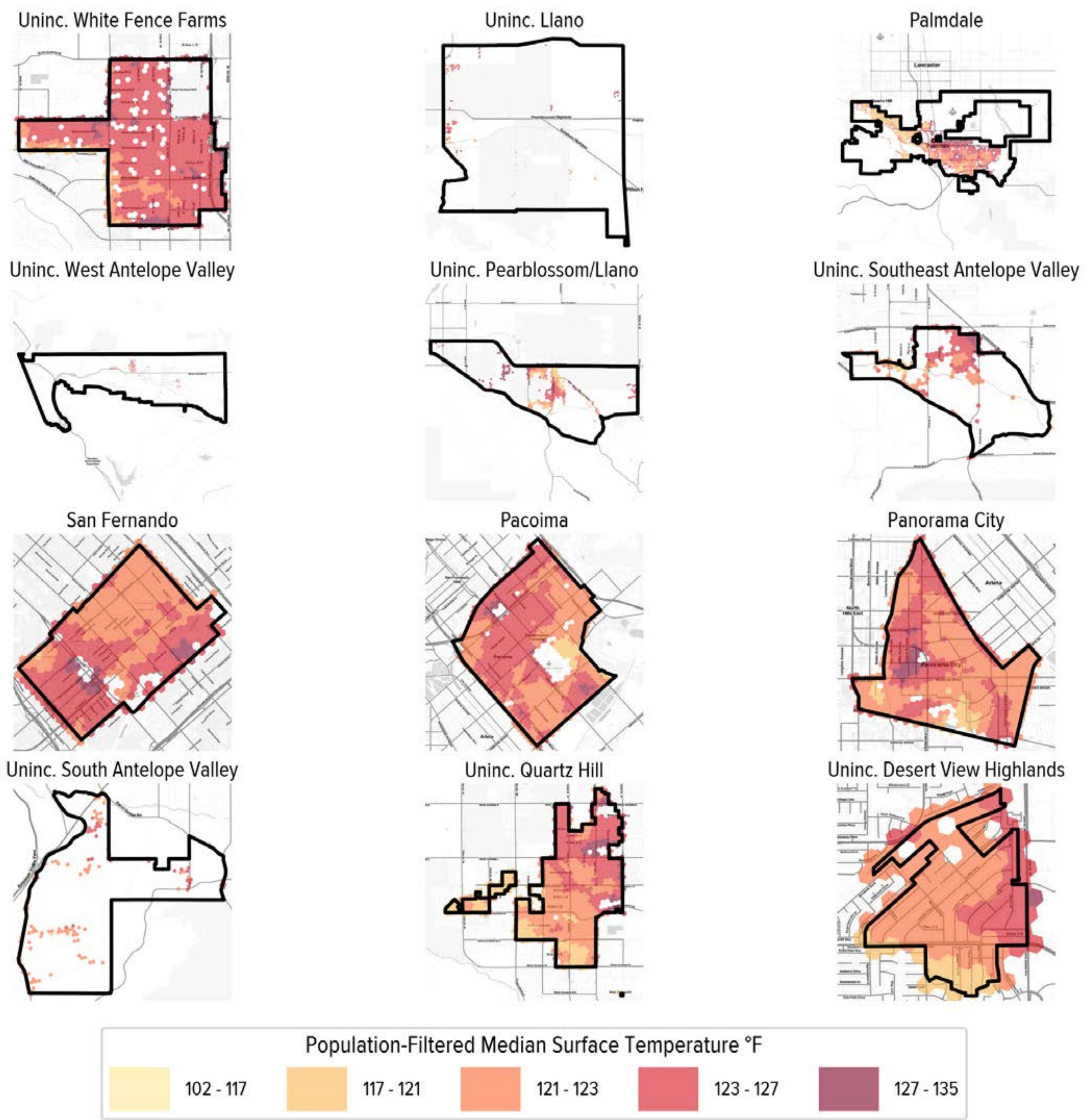


Figure 2.18b: Top 24 heat CSAs with population filtered summer afternoon surface temperature (ranked 13-24)

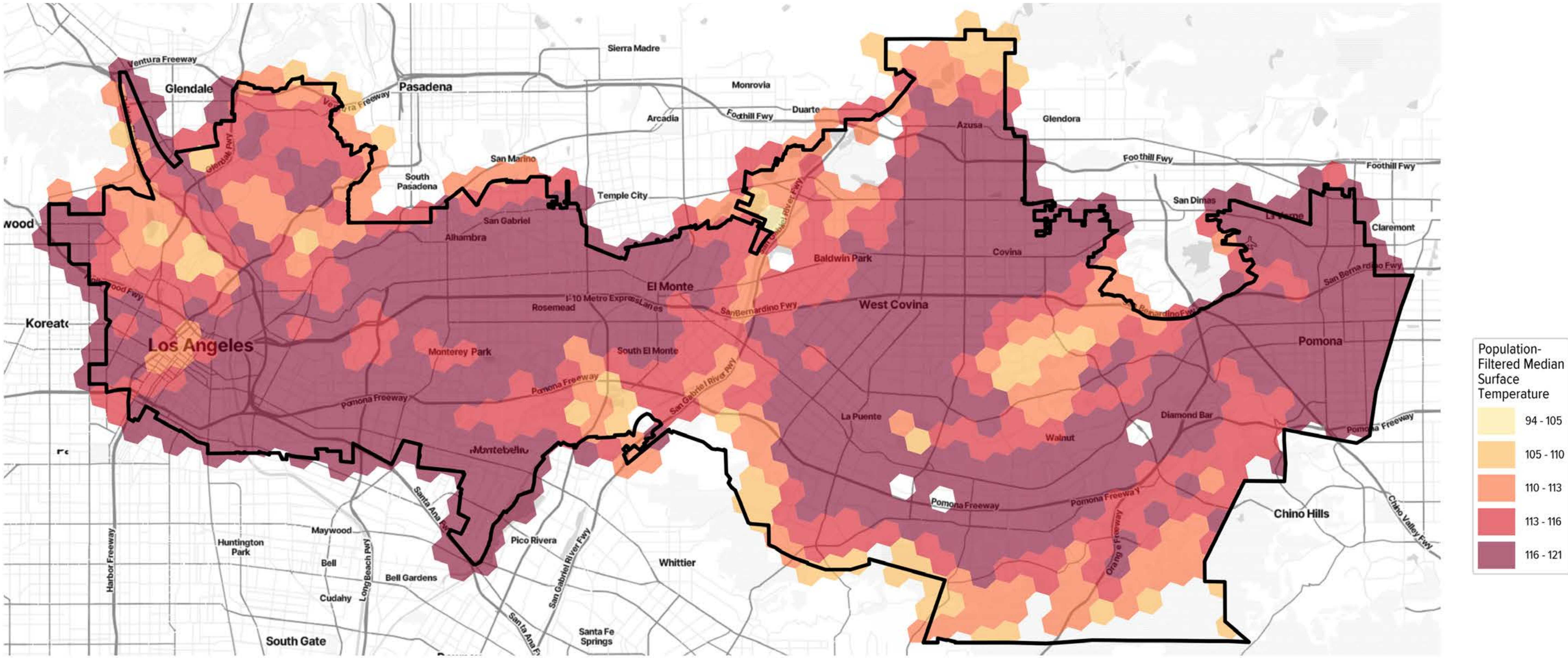
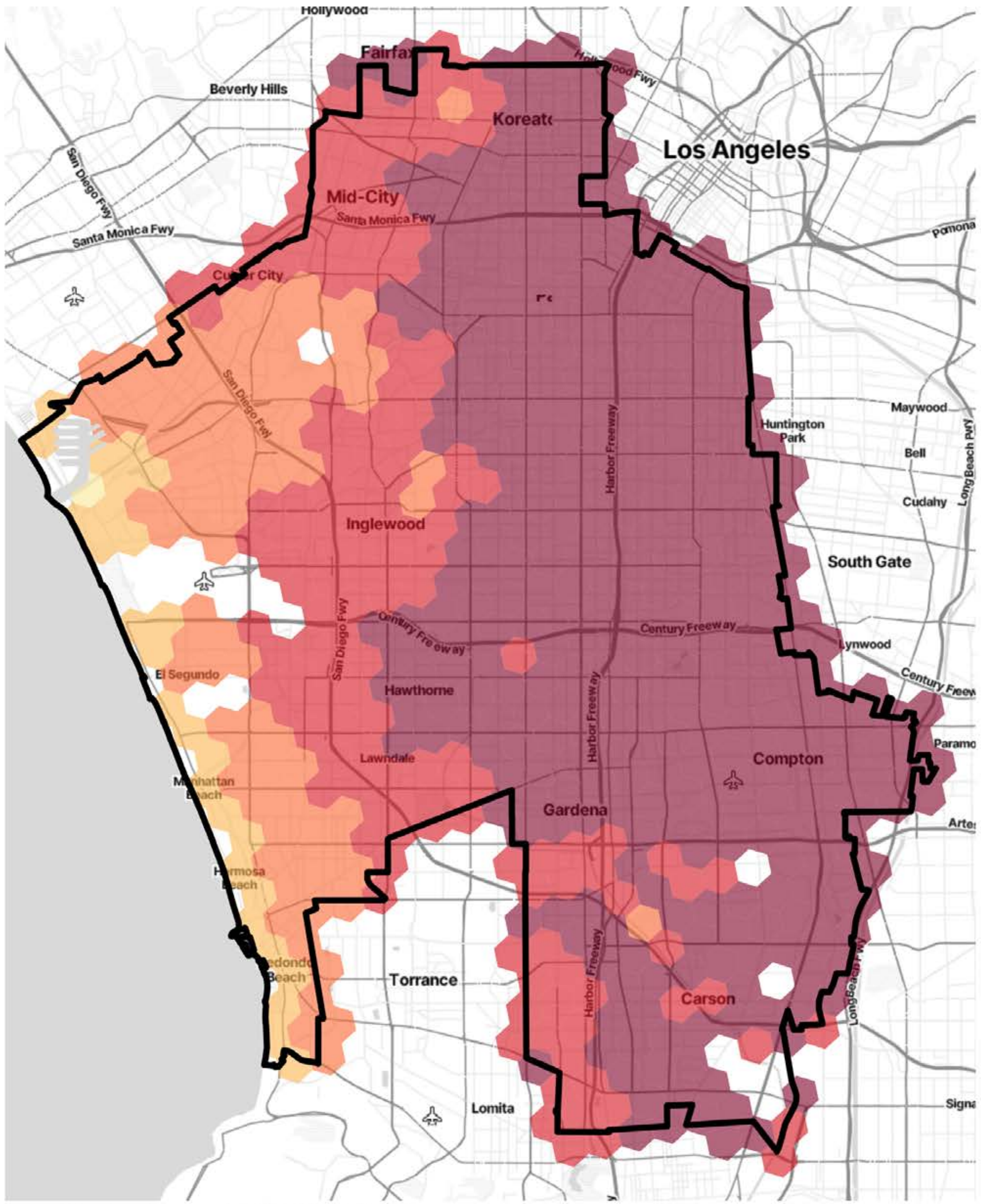


Figure 2.19: Supervisorial District 1 population filtered surface temperature

2.3.2 Heat Exposure within Supervisorial Districts

For larger areas such as supervisorial districts, we can aggregate temperature and population density metrics into a 180 acre hexagonal grid over each supervisorial district. By excluding those cells that have population equal to 0, we can create a population-filtered temperature map as shown in Figures 2.19 through 2.23. These maps include hotspots where there is a convergence of both heat and people, while de-emphasising places where temperatures might be high, but in which no people reside.



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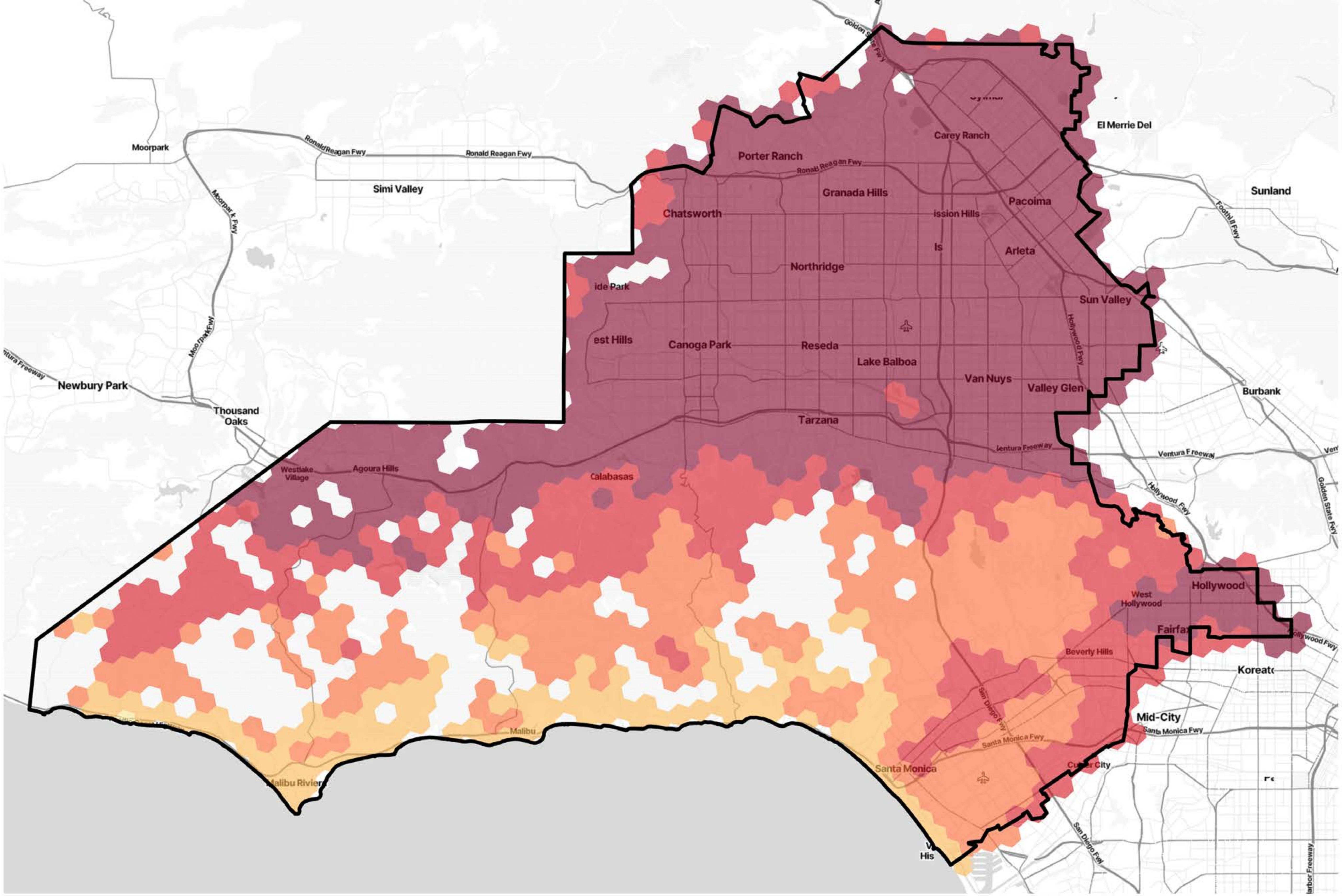
Population-Filtered Median Surface Temperature

84 - 94	94 - 103	103 - 108	108 - 111	111 - 118

Figure 2.20: Supervisorial District 2 population filtered surface temperature

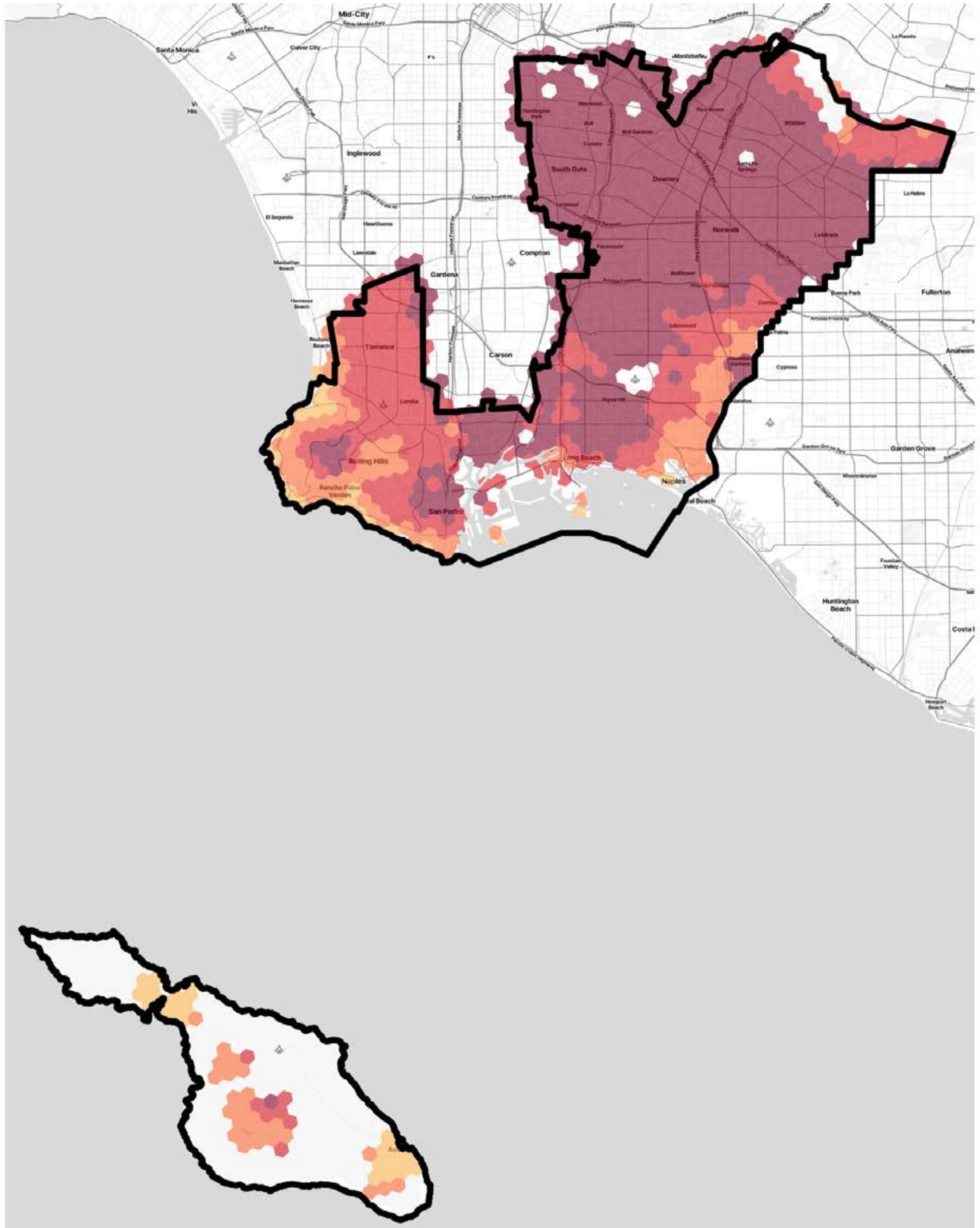
The presence of pavement necessarily implies the absence of trees, grass, and other vegetation which would otherwise be cooling those areas through shade and evapotranspiration.



Population-Filtered Median Surface Temperature

80 - 93 | 93 - 101 | 101 - 109 | 109 - 115 | 115 - 123

Figure 2.21: Supervisorial District 3 population filtered surface temperature



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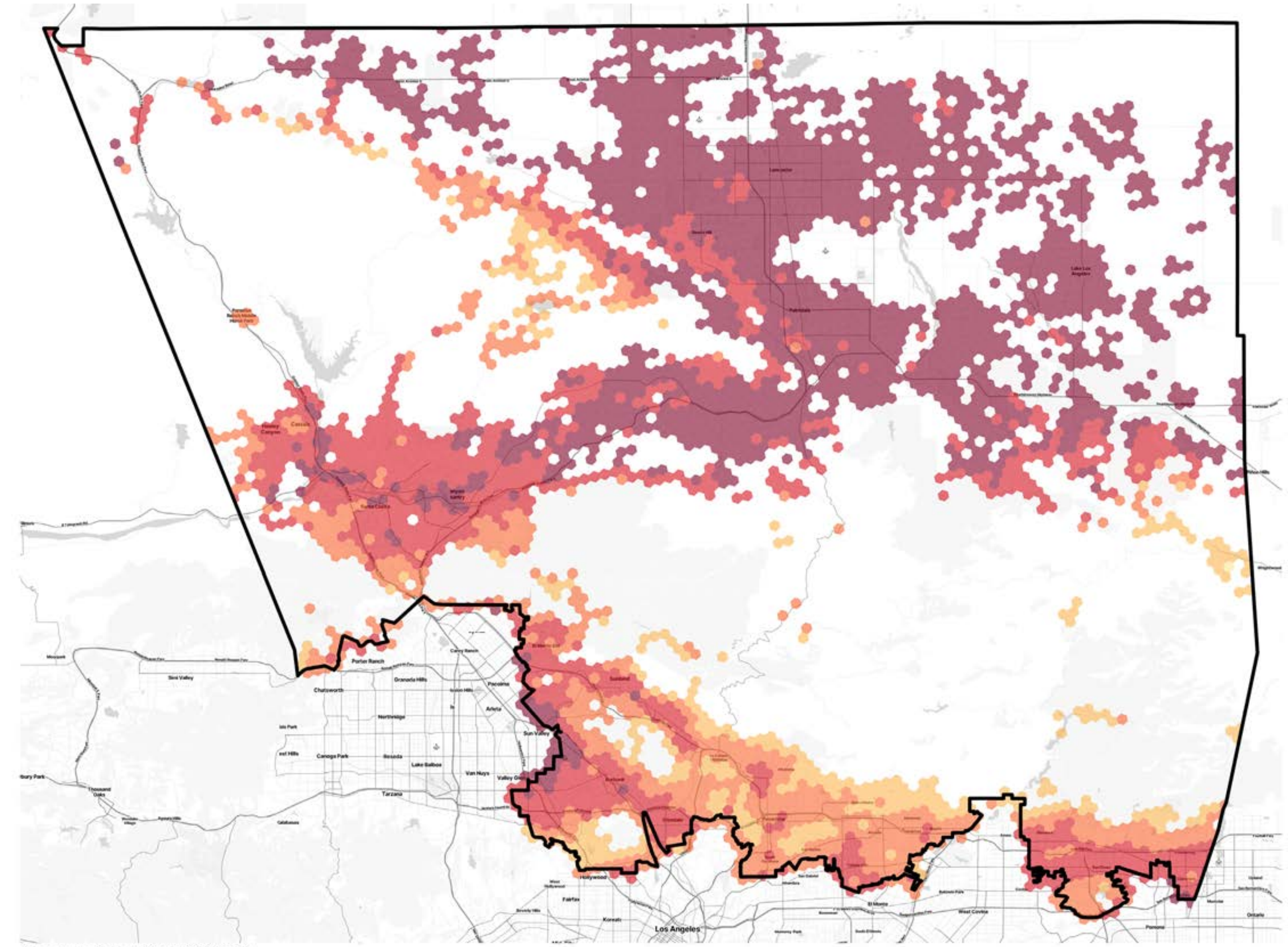
Population-Filtered Median Surface Temperature

73 - 93 | 93 - 101 | 101 - 107 | 107 - 112 | 112 - 119

Figure 2.22: Supervisorial District 4 population filtered surface temperature



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Population-Filtered Median Surface Temperature

91 - 105 | 105 - 112 | 112 - 118 | 118 - 125 | 125 - 134

Figure 2.23: Supervisorial District 5 population filtered surface temperature

2.3.3 Heat for Schools

We have also mapped this heat exposure metric at a finer scale of detail for each of the schools in the County. Figure 2.24 shows the top 30 LAUSD elementary schools by median surface temperature. For similar figures for other school types or districts see the depave.la website.

2.3.4 Heat in Vision Zero Road Segments

We have also mapped these metrics at a finer scale of detail for each of the 200 Vision Zero high collision concentration 1 mile road segments. Figure 2.25 shows the top 30 Vision Zero segments by median surface temperature in their immediate vicinity (a 50 ft buffer around the road segment was used for the analysis). These Vision Zero segments would benefit from streetscape interventions that produce cooling, including the planting of shade trees which can be facilitated by pavement removal.

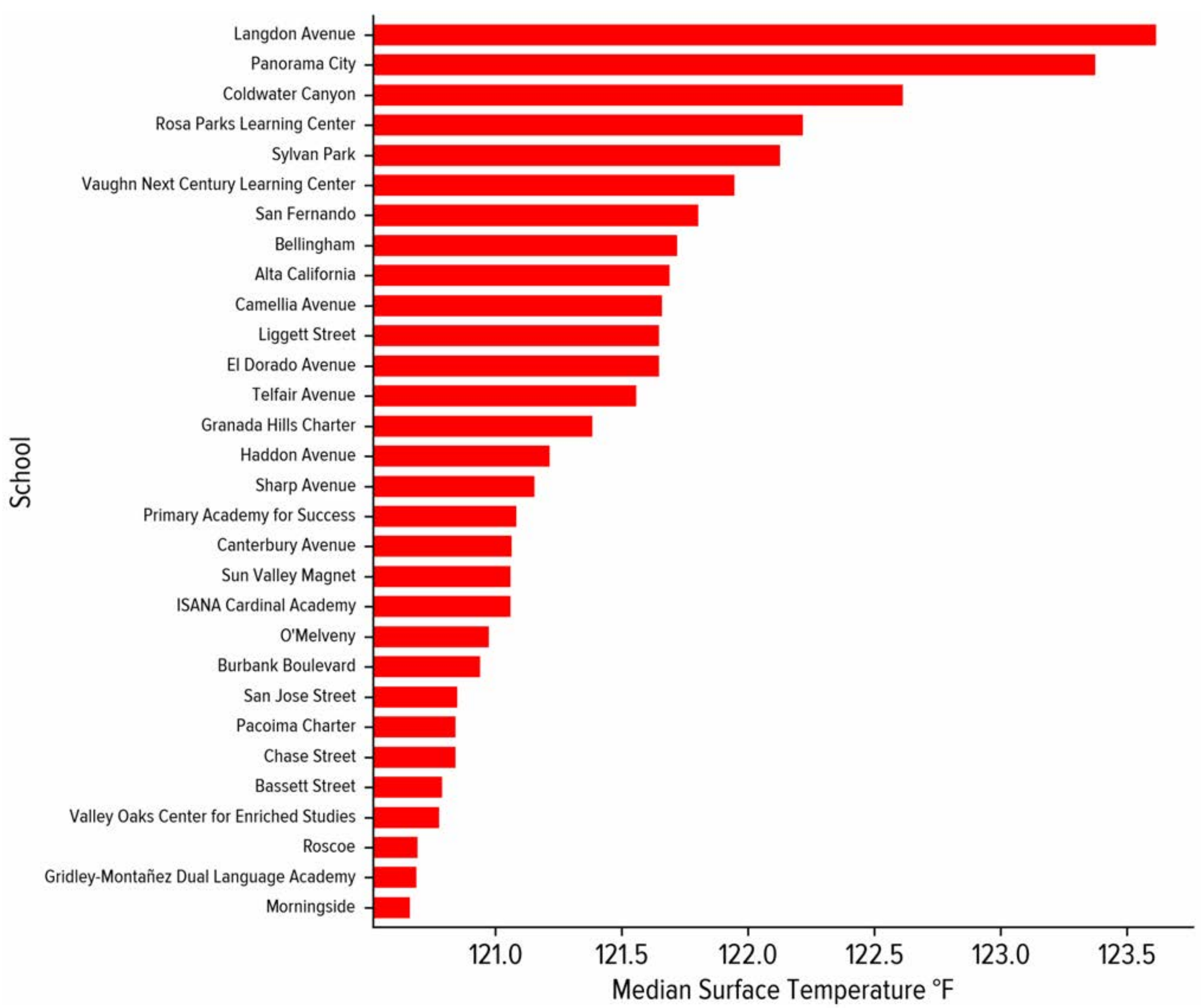


Figure 2.24: Top 30 LAUSD elementary schools ranked by median summer heat wave surface temperatures

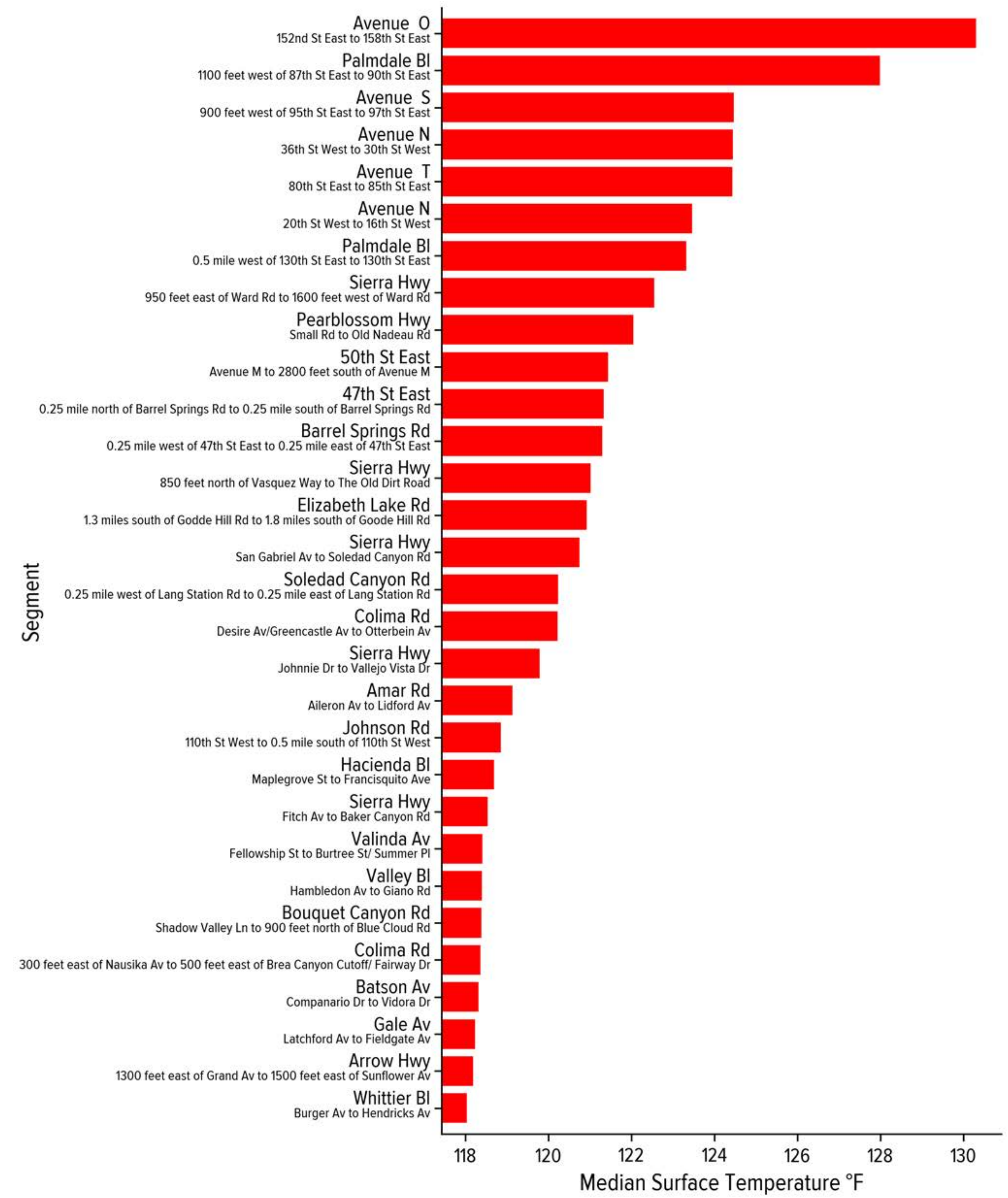


Figure 2.25: Top 30 Vision Zero road segments by median surface temperature

2.4 FLOODING AND GROUNDWATER

Removing pavement is one of many potential methods to both reduce flooding and increase stormwater capture and groundwater recharge. This assessment identifies where both flood risk and pavement removal opportunities exist. Future studies could focus on stormwater capture and groundwater recharge by looking more closely at soil infiltration rates, surface water and storm-drain dynamics, as well as groundwater basins. While this assessment did not specifically focus on that data, the focus on high-flood risk pavement is one piece of that puzzle, which can be integrated into other projects that are more directly focused on stormwater capture and groundwater recharge.

2.4.1 Stormwater Capture and Groundwater Recharge

To help Los Angeles County rely less on imported water, a series of interconnected plans and programs have set ambitious targets to increase local water supply. The OurCounty Plan calls for sourcing 80% of the County's water locally by 2045, while the County Water Plan identifies the need to boost local water sources by 580,000 acre-feet per year to meet that goal. The Regional Oversight Committee has assigned a portion of that total (300,000 acre-feet per year) to come specifically from stormwater capture.[25] The Safe Clean Water Program (SCWP), funded by Measure W, is now determining how much of that stormwater target it can achieve through Nature-Based Solutions (NBS) and other projects that could work hand-in-hand with County-wide depaving efforts.[26]

Notably, the SCWP Watershed Planning Framework calls for harnessing "the best available geospatial data" to identify "Opportunity Areas" where new projects could deliver the greatest stormwater benefits. DepaveLA datasets could help identify those areas where runoff and stormwater capture could advance watershed-scale strategies through depaving.[27]

For example, the SCWP Opportunity Maps for the Upper San Gabriel River (USGR) identify high-priority areas for stormwater capture and multi-benefit infrastructure investment, but they focus exclusively on where runoff can be managed rather than where it can be prevented through land use transformation. A forthcoming *Hardscape and Brownfield Transformation Opportunity Study* conducted by the San Gabriel Valley Council of Governments highlights this gap, noting that only six of 101 SCWP projects funded in Rounds 1–3 created new park space or greened schools, and that net impervious area actually increased during the same period.[28] The study aims to harness the DepaveLA report to first quantify where land transformation is feasible, particularly on schoolyards and underutilized parcels, then model the stormwater, water supply, and public health benefits of hardscape removal. Evaluating the underused SCWP Tax Credit Program as a potential incentive in this way can position depaving and brownfield projects as fundable and impactful within the SCWP framework.

2.4.2 Flooding

Flooding is a common and dangerous risk in Los Angeles County. Recent analysis suggests that up to 874,000 people in the County are at risk of greater than 30cm (~12 inch) 100 year floods, with potential for up to

$108 billion in property damage, making the Los Angeles flood hazard on par with well known hurricane risks on the Atlantic and Gulf coasts in terms of potential property damage.[29] Since 1975, Los Angeles County has been hit with 12 federally declared flood disasters.[30]

The 2021 L.A. County Climate Vulnerability Assessment names the communities of Westlake and Crenshaw (in Central and South Central Los Angeles) as particularly at risk for inland flooding, along with the smaller unincorporated communities of Roosevelt and Del Sur, among others. Other cities, including Long Beach and San Pedro, are listed as vulnerable to coastal flooding from both extreme precipitation and sea-level rise.[31] The Assessment also notes, however, that due to reliance on low-resolution FEMA maps, it may underestimate future risk, and calls for more precise, climate-informed modeling to better understand future flood impacts.[32] DepaveLA addresses these critical data gaps by utilizing higher-resolution, parcel-scale data (provided by UCI FloodLab) that captures localized flood risk. The results of our analysis thus diverge from those of the 2021 Vulnerability Assessment due to the known differences between the high-resolution methods that we used and the CVA's method.[33]

The causes of flooding can be broadly attributed both to the quantity of water and rate at which water is introduced to an area, as well as the speed at which water can leave the area. To understand the sources of floodwater, Figure 2.26 maps the primary contributing areas to flood-prone zones across Los Angeles County, based on modeling from the University of California Irvine (UCI) FloodLab's PRIMo model.[34]

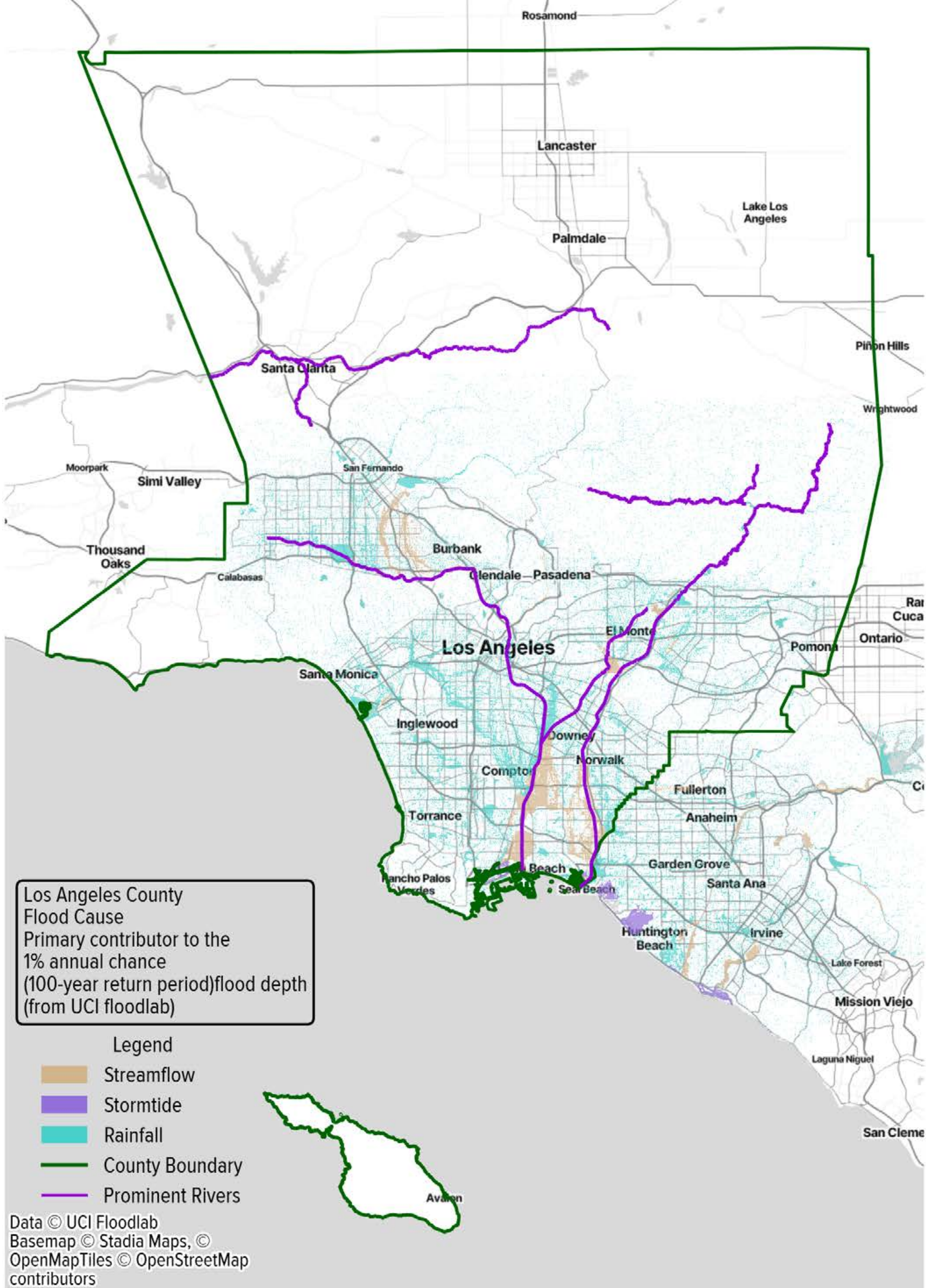


Figure 2.26: Flood cause apportionment for Los Angeles County (from University of California Irvine Flood Lab)

The three source categories are (1) streamflow, which is water conveyed from upstream through pipes, creeks, and river systems, (2) stormtide, which is coastal flooding driven by ocean tides and storm surge, and (3) rainfall, which can accumulate anywhere, but collects mostly in low-lying or poorly drained areas. As shown in Figure 2.26, streamflow hazards follow the Los Angeles River, Compton Creek, the Dominguez Channel, and the San Gabriel River. Stormtide hazards are limited mainly to the shoreline, while rainfall flooding is most acute where topography slows natural drainage.

Historically, pavement and channelization have been central to Los Angeles County's flood-control strategy. Concrete-lined rivers, storm drains, and extensive street networks were intentionally engineered to move water off parcels and out to the ocean quickly, dramatically reducing the catastrophic overbank flooding that plagued the region in the early 20th century.

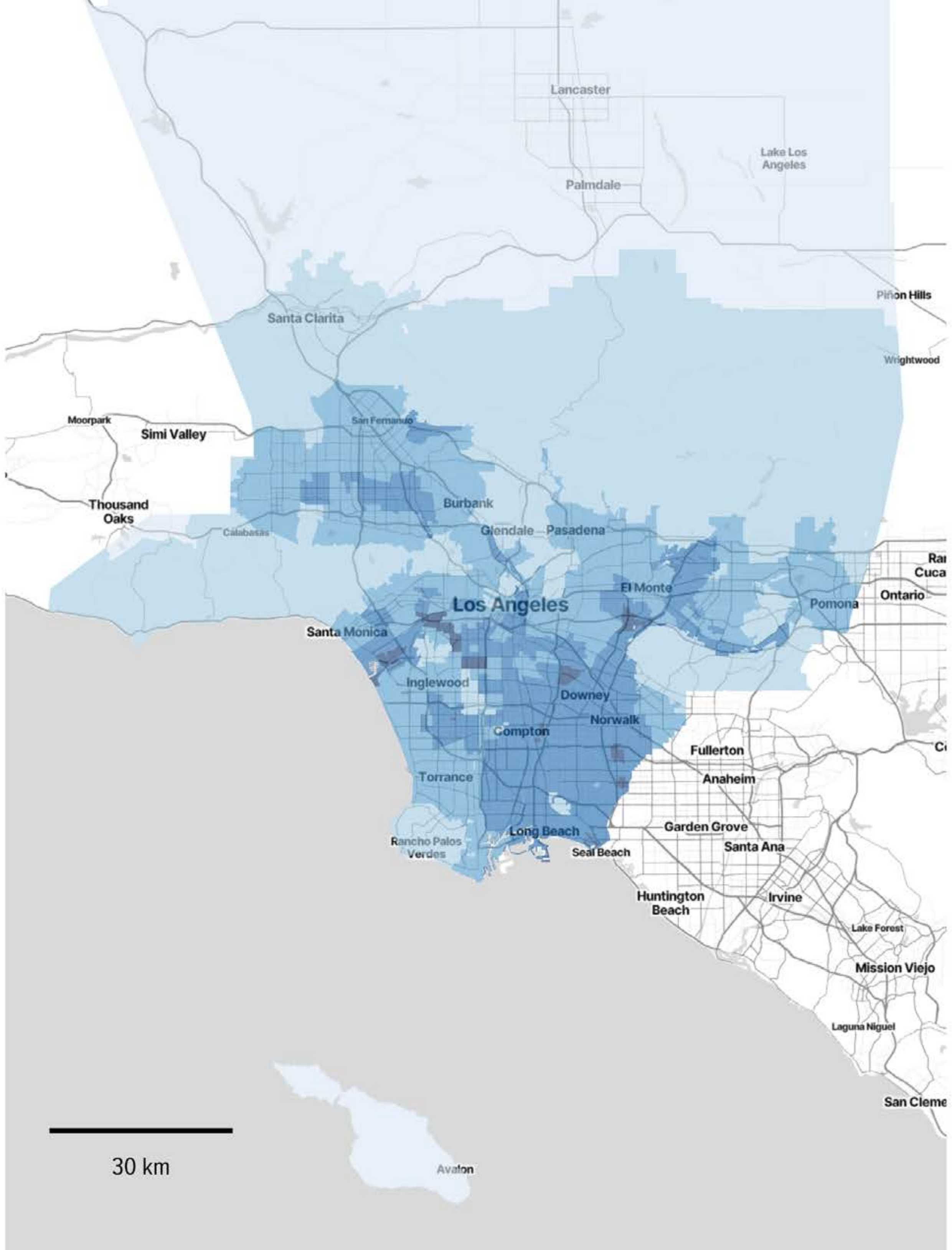
Yet these same impervious surfaces also limit infiltration, evapotranspiration, and groundwater recharge, which in turn magnify peak flows during intense rainfall, prolong inundation when river channels are overwhelmed, and allow stormtide waters to spread inland instead of dissipating into permeable soils. Furthermore, moving runoff rapidly downstream transfers flood risk and water-quality impacts to downstream communities and coastal ecosystems.

Strategic depaving seeks to complement effective flood-control infrastructure, not undo it. By replacing unnecessary or oversized pavement with permeable surfaces and vegetation, we can maintain essential conveyance along key flood-control channels and arterials while creating new areas that absorb, store, and evapotranspire stormwater, while also reducing heat. The following section compares how CSAs experience these overlapping flood risks and where targeted pavement removal could provide the greatest added value.

2.4.3 Community Flood Risk Burden

Figure 2.27 shows CSAs shaded by the percent of their total land area that falls within the "high-confidence" 1% annual-chance (100-year) flood zone identified in the UCI PRIMo model. The high-confidence area refers to land that floods in at least 95% of PRIMo's 100-year-storm simulations (the 5th-percentile flood extent).

This enables us to rank communities according to their potential flood risk. Figure 2.28 shows the top 24 CSAs ranked by their high confidence flood area. Note for a detailed treatment of the same source flood data using census tracts and vulnerability indicators see Sanders et al 2022.[35]



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High Flood Confidence Percent

0 - 7	7 - 19	19 - 38	38 - 66	66 - 100

Figure 2.27: CSAs by percent of area covered by high confidence of flooding in UCI PRIMo dataset

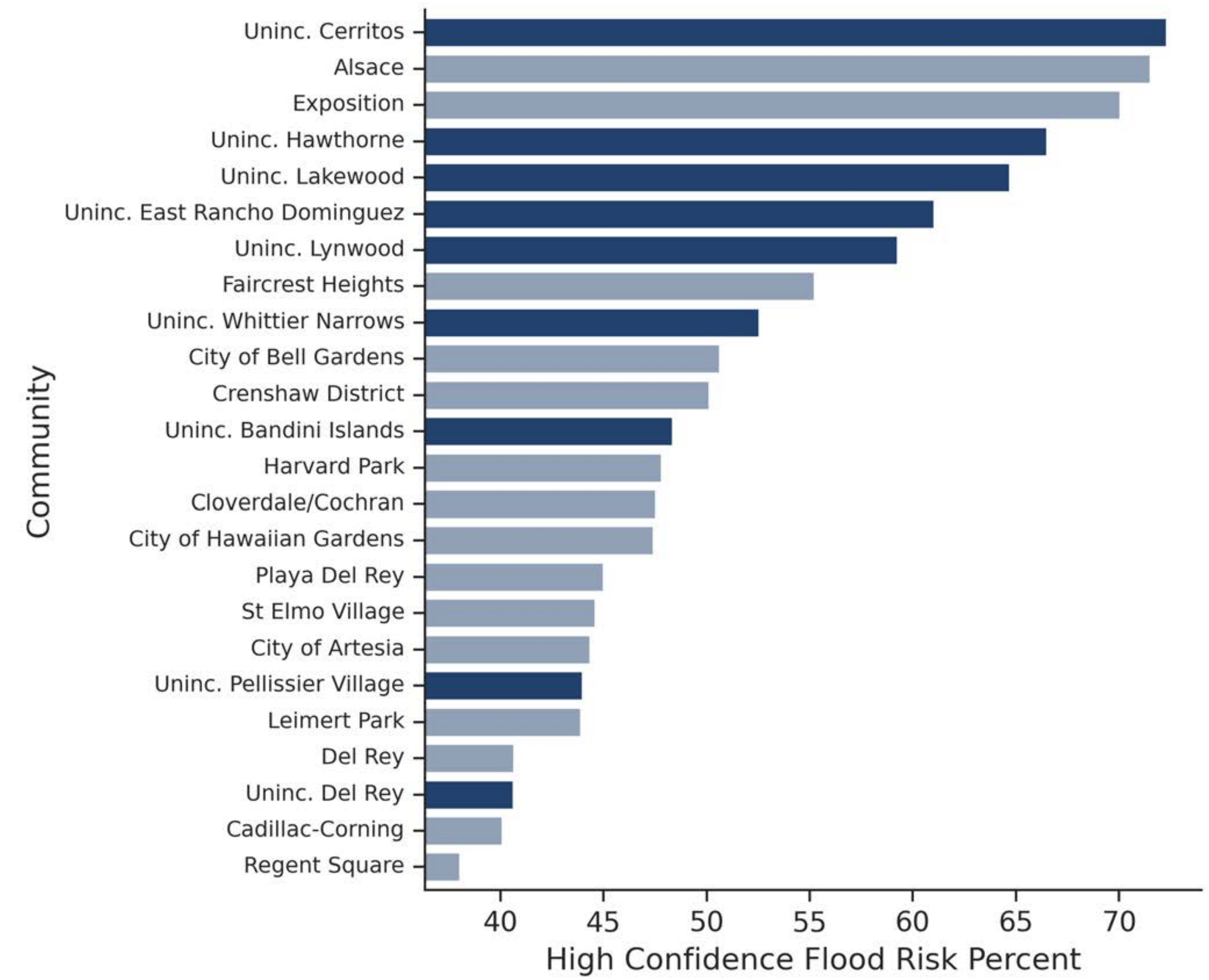

Figure 2.28: Top 24 communities ranked by percent of area with high flood confidence (darker colors are unincorporated, lighter colors are incorporated)

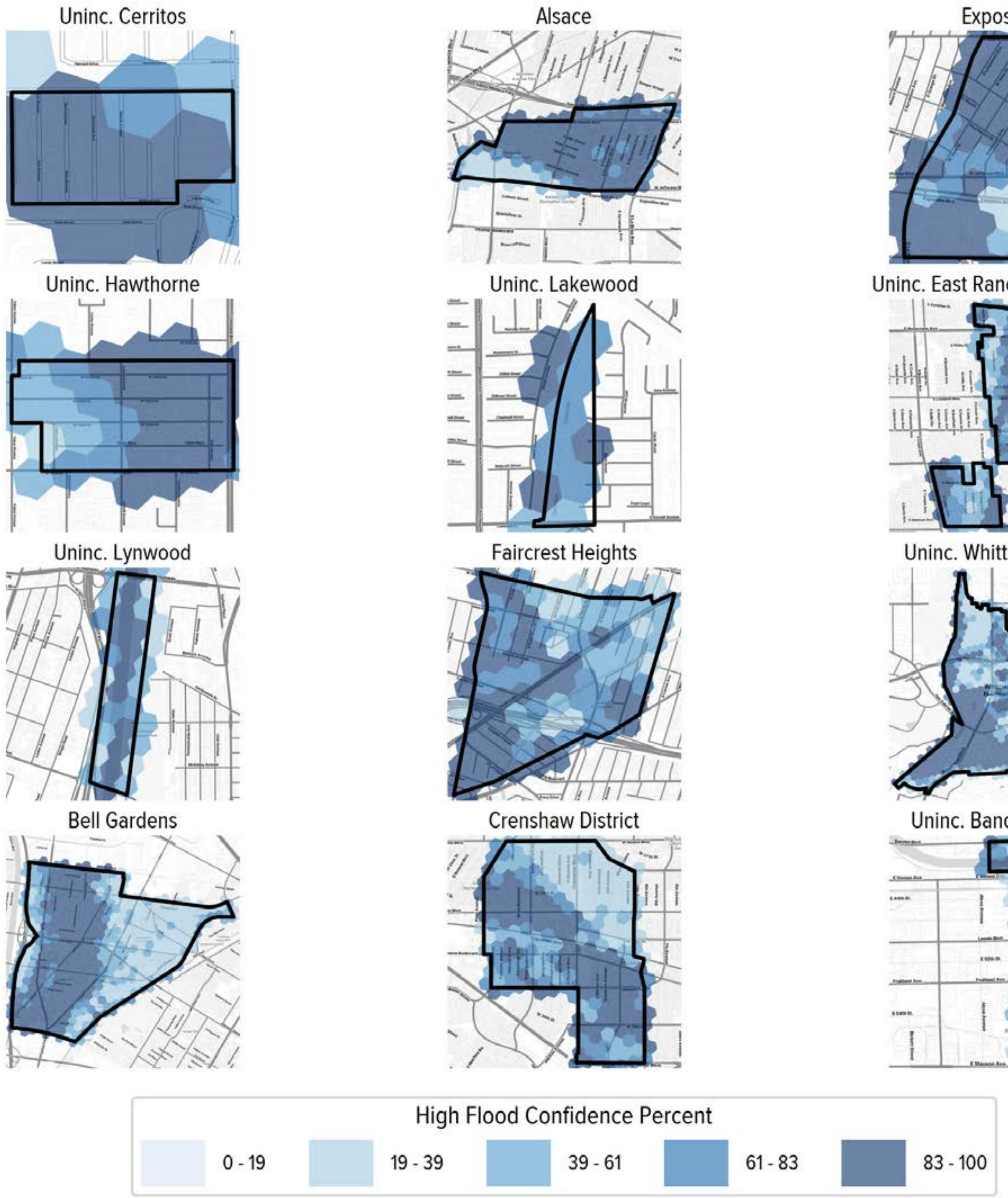

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Figure 2.29a: Top 25 flood risk CSAs mapped with high flood confidence area expressed over 3.7 acres hexagons (ranked 1-12)

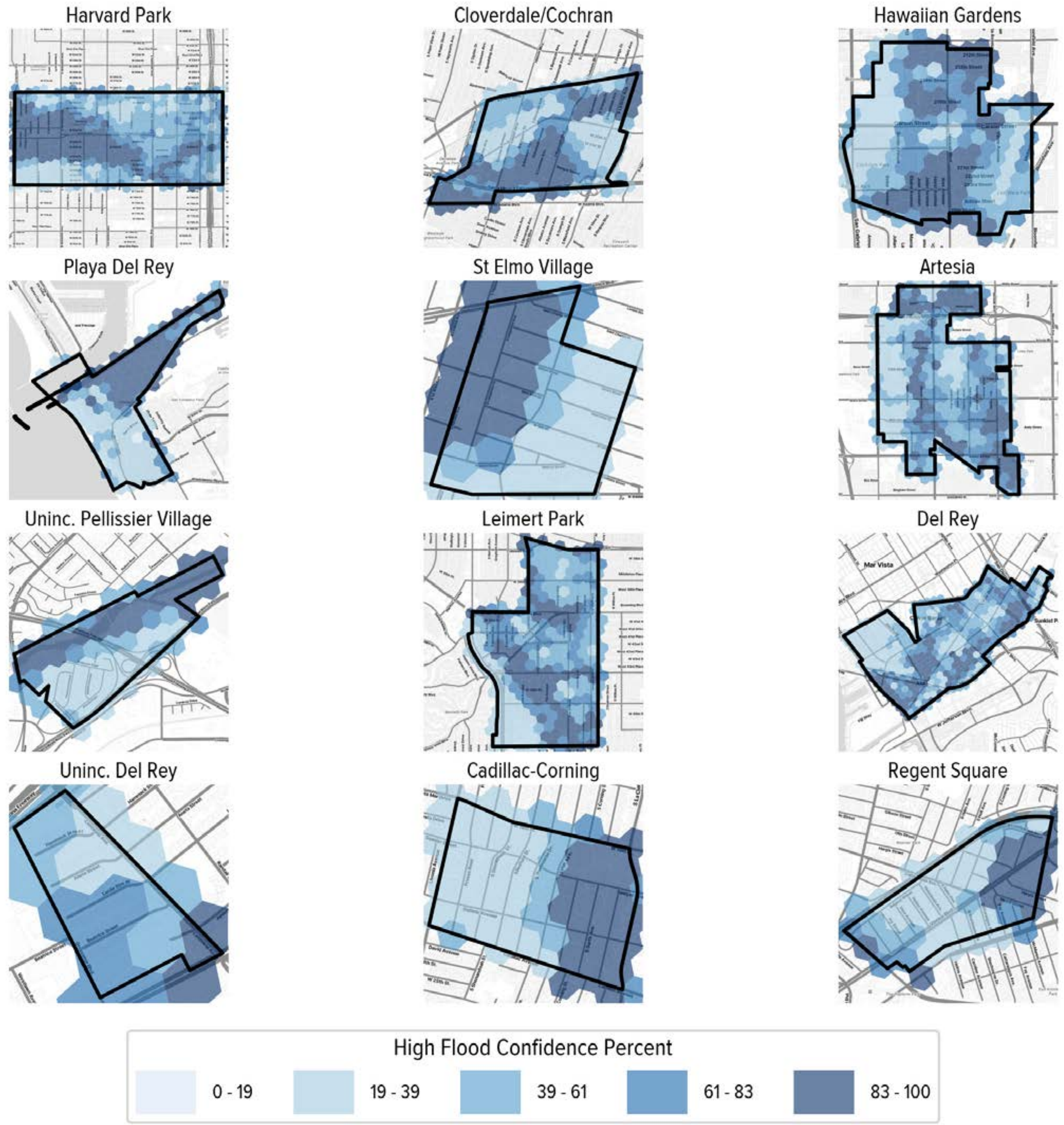
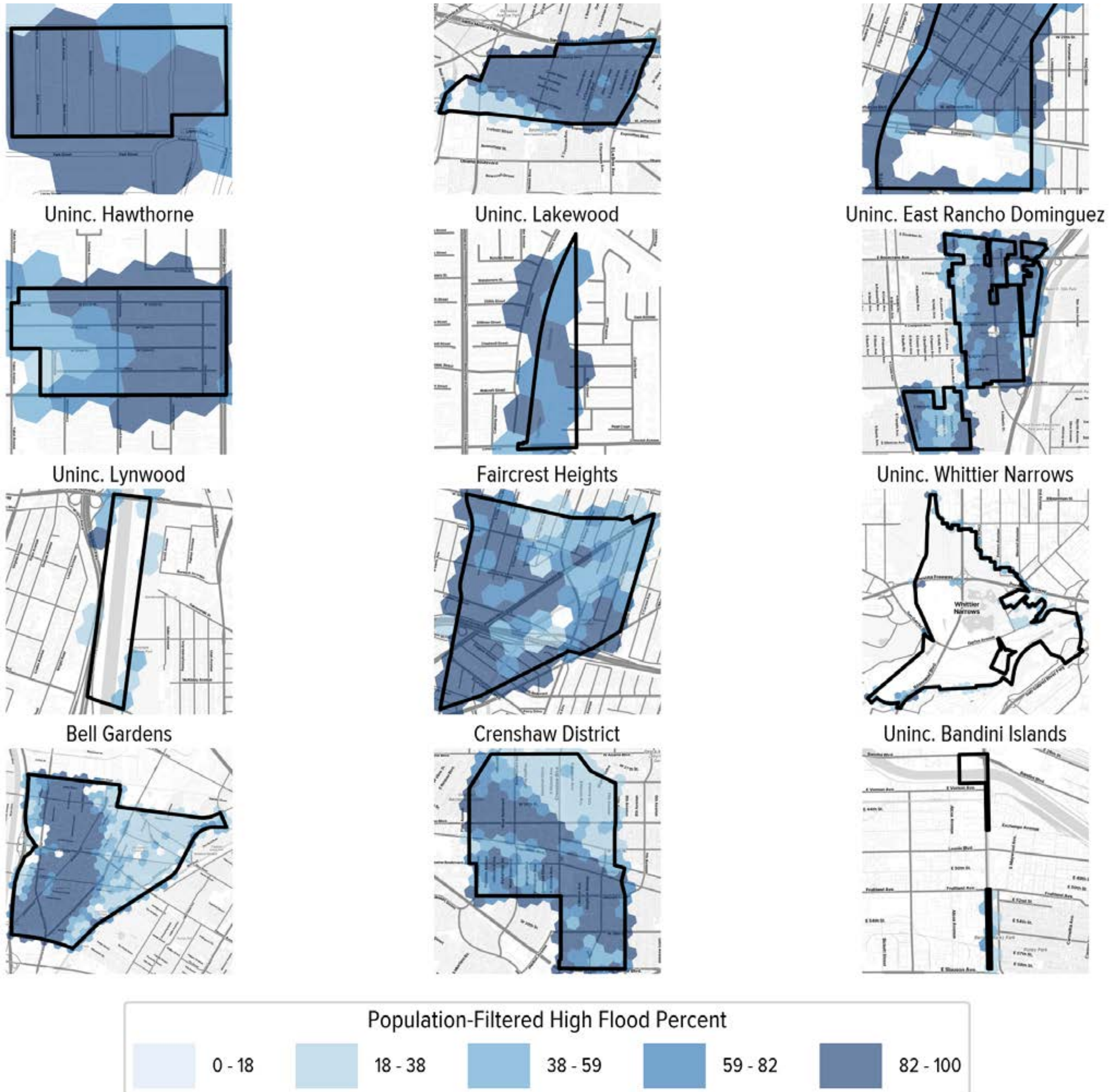


Figure 2.29b: Top 24 flood risk CSAs mapped with high flood confidence area expressed over 3.7 acres hexagons (ranked 13-24)

The rankings in Figure 2.29 express the flood risk in each community, but don't account for population size or distribution within the community. To discern the flood mitigation needs of people living in the space, we can aggregate the area of high flood confidence within a discrete grid of 3.7 acre hexagons. By then excluding cells with zero population, we created a population-filtered flood risk layer mapped for the top 25 flood CSAs as seen in figure 2.30.



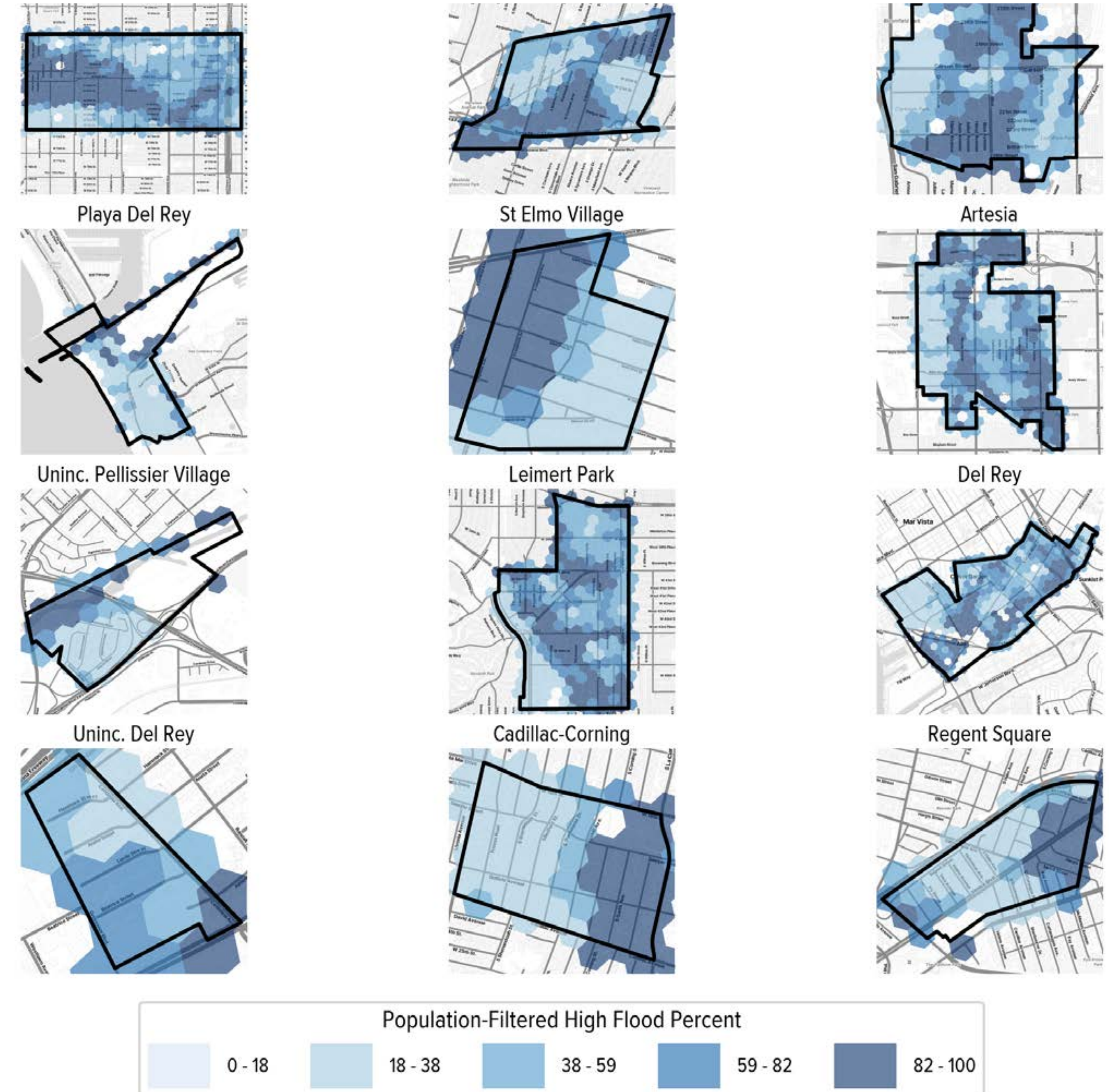


Figure 2.30a: Population filtered high flood confidence percent for top 24 flood CSAs (ranked 1-12)

Figure 2.30b: Population filtered high flood confidence percent for top 24 flood CSAs (ranked 13-24)

2.4.4 Supervisorial District Population Filtered Flood Risk

For larger areas such as supervisorial districts, we can aggregate the area of high flood confidence within a discrete 180 acre hexagon grid, and then exclude cells with zero population to create a population-filtered flood risk layer. To focus on need at this level, we can break the County down into supervisorial districts as shown in Figures 2.31 through 2.35.

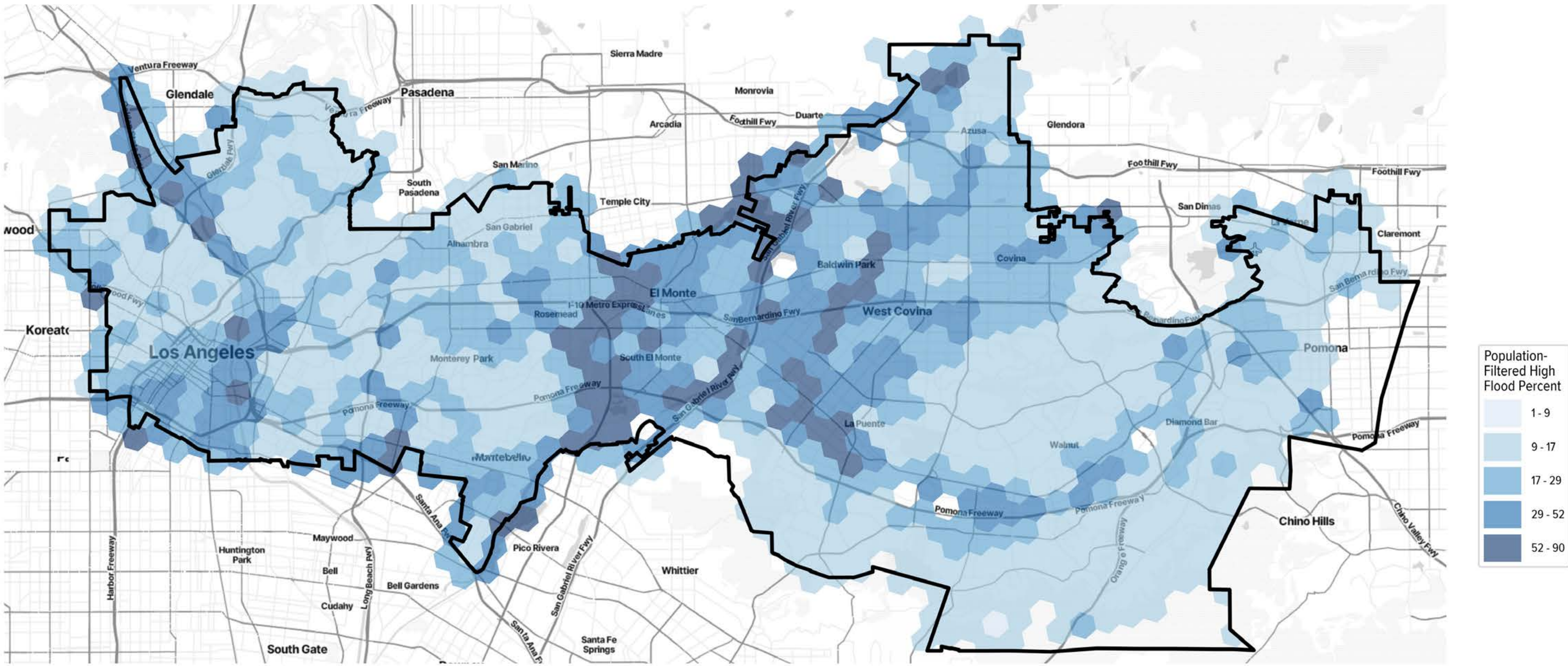


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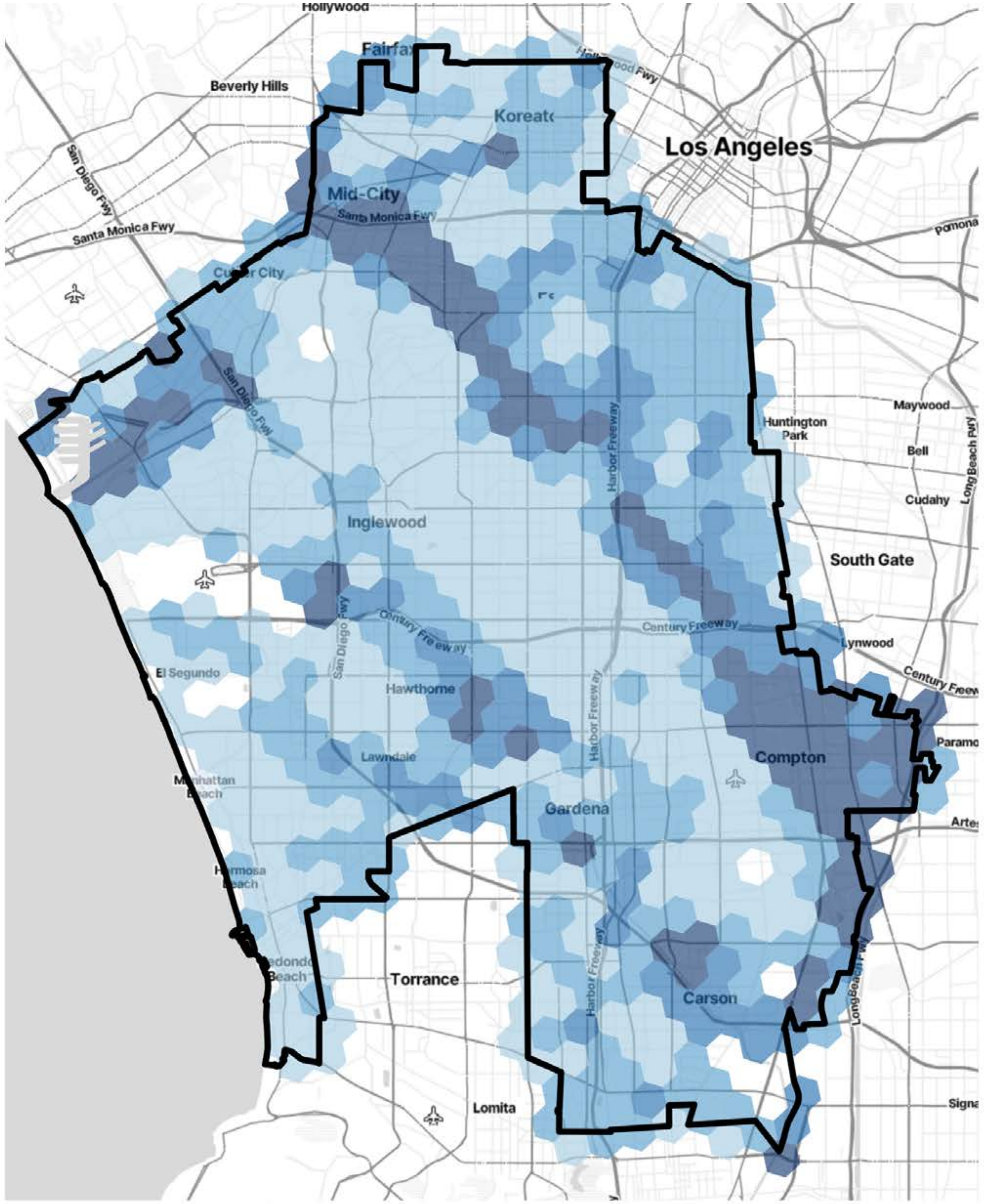
Figure 2.31: Supervisorial District 1 population filtered high flood percent per 180 acres



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Population-Filtered High Flood Percent

2 - 13	13 - 25	25 - 40	40 - 58	58 - 89

Figure 2.32: Supervisorial District 2 population filtered high flood percent per 180 acres

Each supervisorial district has unique pavement conditions. Districts 1, 2, and 4 have pavement as their largest landcover category, with District 2 further impacted by disproportionately low tree canopy. Districts 3 and 5 have relatively lower pavement coverage as a percent of their total area.

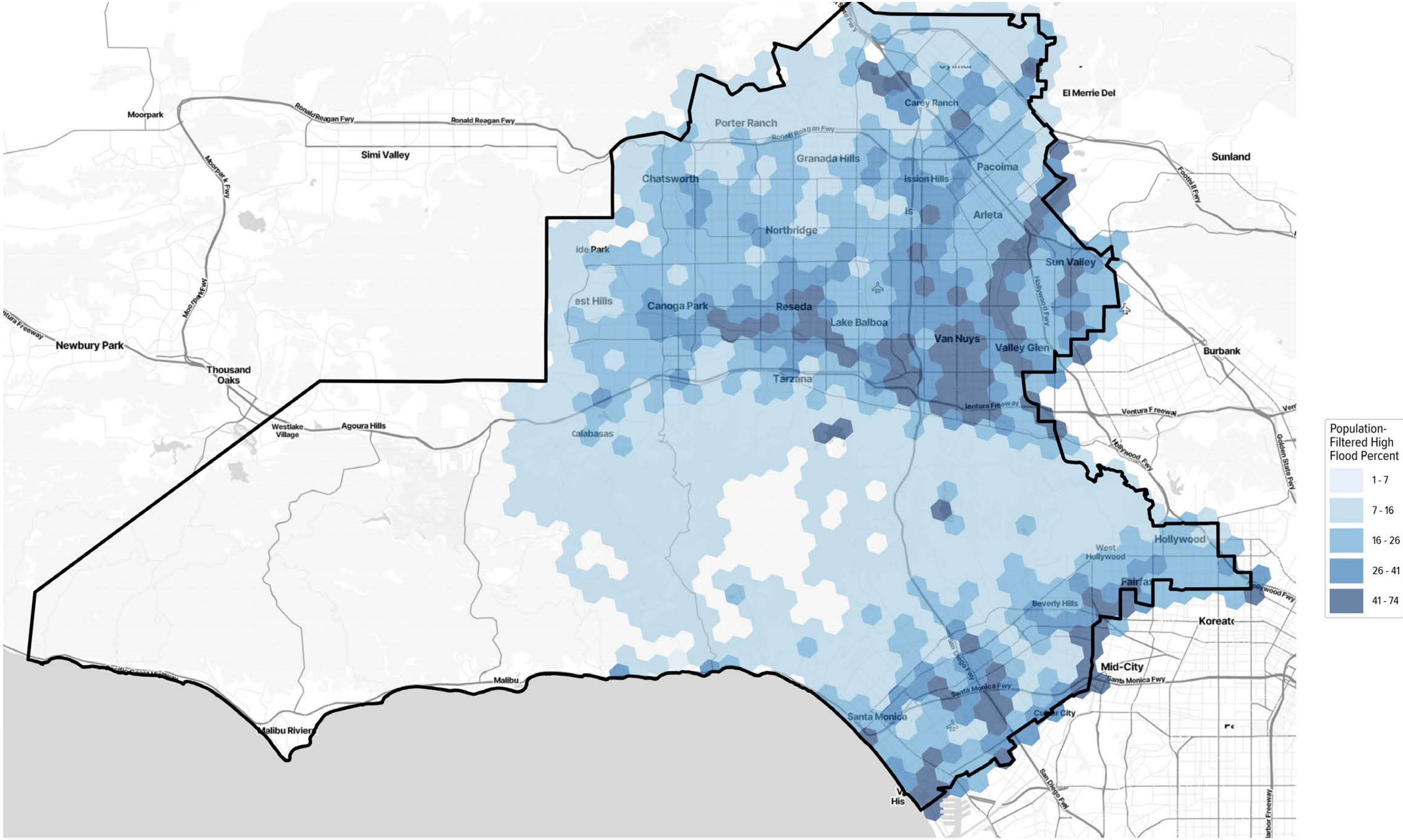

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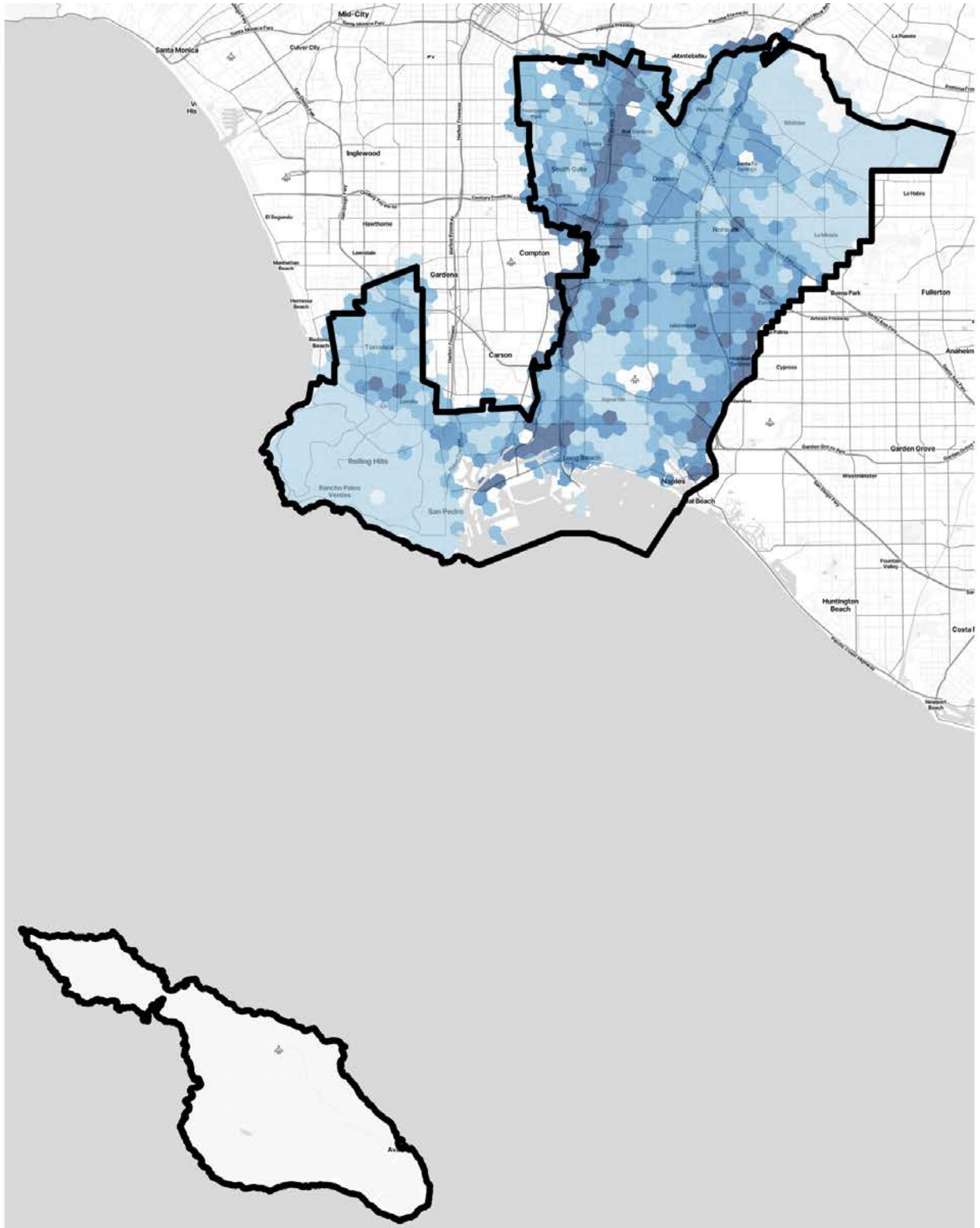
Figure 2.33: Supervisorial District 3 population filtered high flood percent per 180 acres



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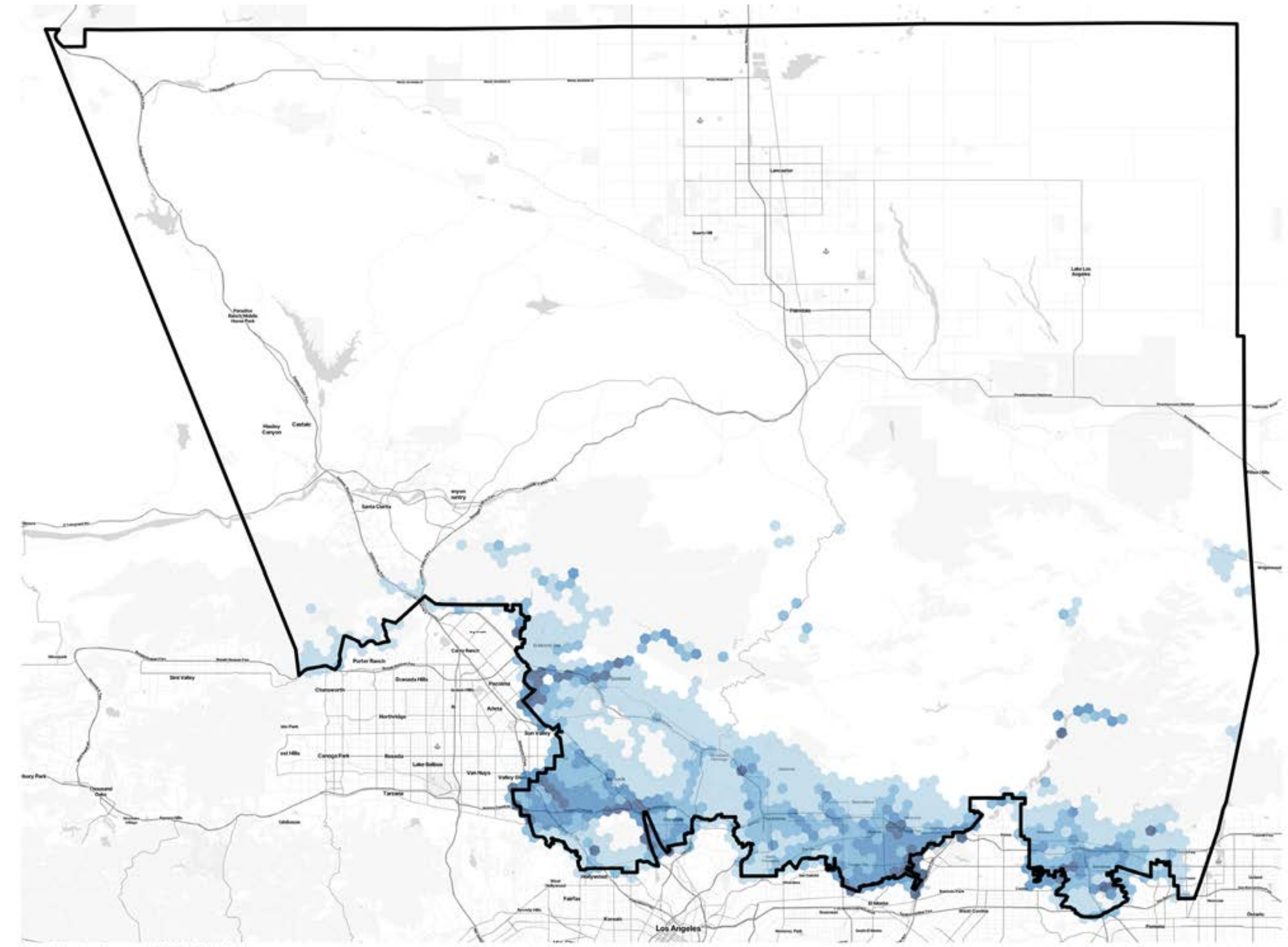
Population-Filtered High Flood Percent

0 - 11	11 - 24	24 - 41	41 - 62	62 - 93

Figure 2.34: Supervisorial District 4 population filtered high flood percent per 180 acres



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Population-Filtered High Flood Percent

0 - 6	6 - 13	13 - 24	24 - 43	43 - 90

Figure 2.35: Supervisorial District 5 population filtered high flood percent per 180 acres

2.4.5 Flooding Needs by School

We have also mapped these flood risk metrics at a finer scale of detail for each school in the County. Figure 2.36 shows the top 30 LAUSD Elementary schools by flood risk. For similar figures of other school types or districts see the depave.la website.

2.4.6 Flooding by Vision Zero Segments

We have also mapped these metrics at a finer scale of detail for each of the 200 Vision Zero high collision concentration 1 mile road segments. Figure 2.37 shows the top 30 Vision Zero segments by flood risk, based on the area with high flood confidence within a 50 ft buffer around each road segment. These segments can be targeted with streetscape initiatives that prioritize removing pavement to increase infiltration, and allow installation of bioswales, constructed wetlands, and other hydrological calming measures.

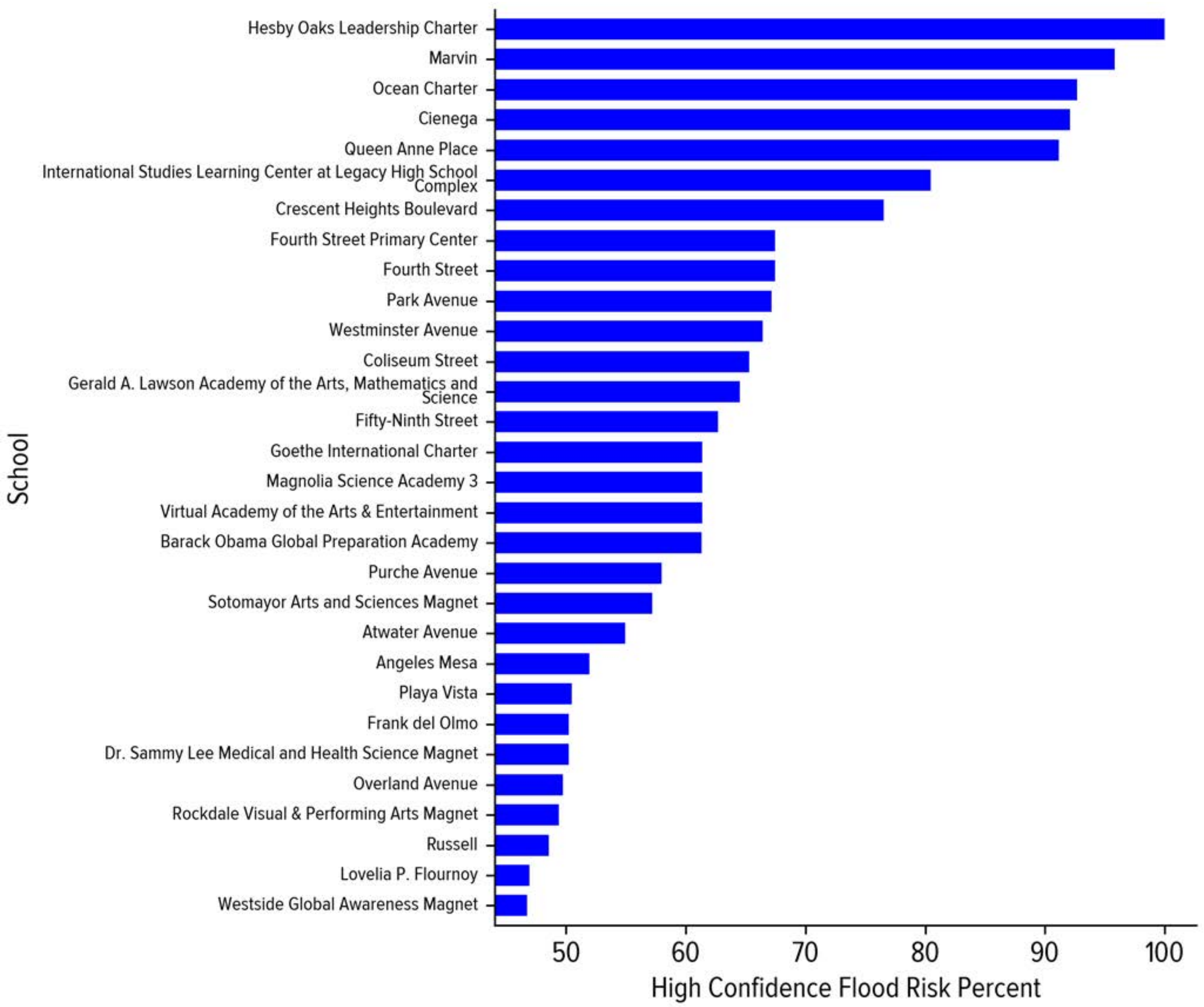

Figure 2.36: LAUSD elementary schools top 25 by high flood risk area

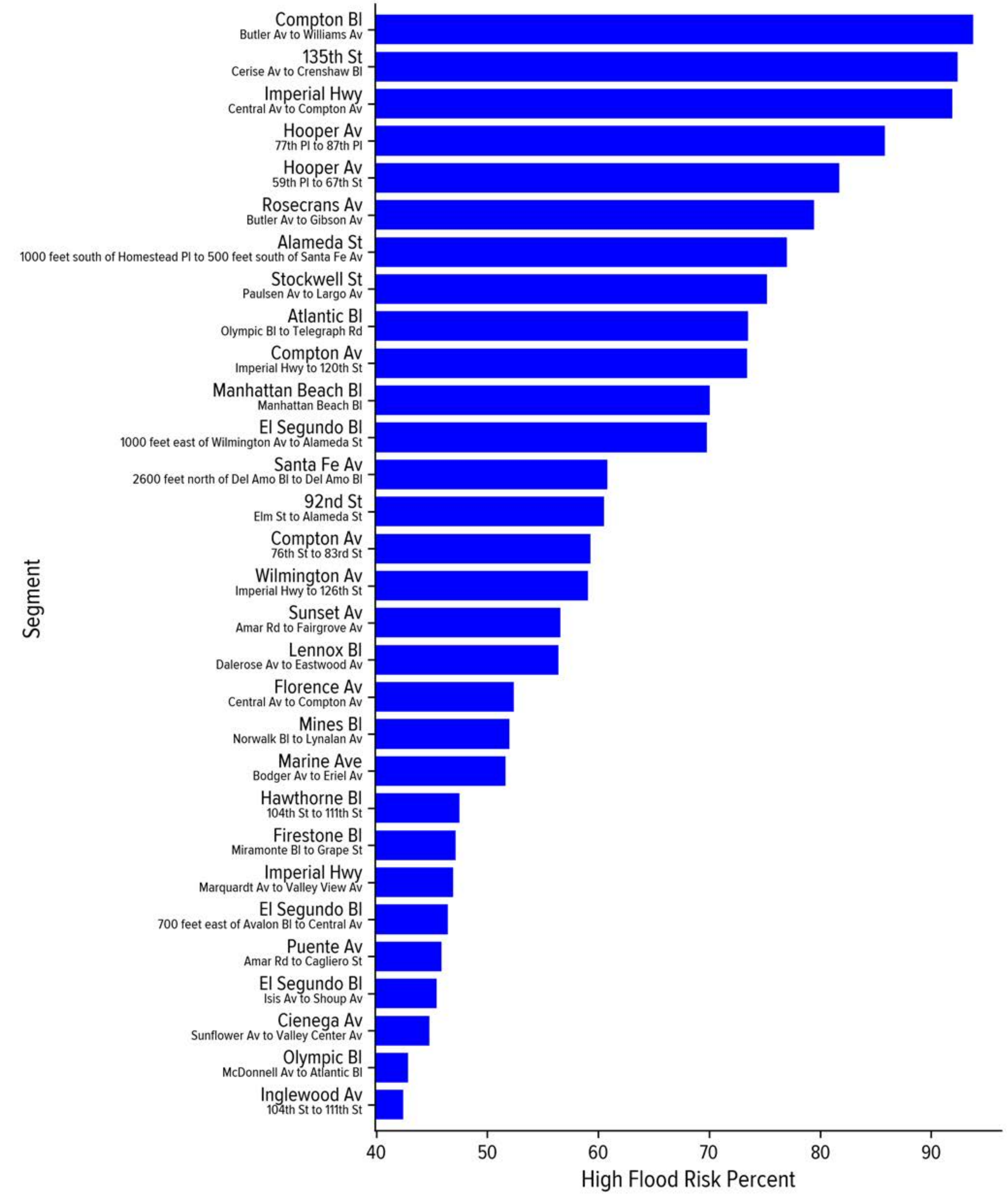

Figure 2.37: Top 30 vision zero segments by the high confidence flood area

2.5 TREE CANOPY

Los Angeles County has 450,802 acres (704 square miles) of tree canopy. However, this is not distributed equally across districts, communities, or population. Trees provide many benefits, including shade and evaporative cooling, flood mitigation, air quality improvement, enhanced biodiversity, and public health benefits. While planting trees is a great way to increase these benefits, depaving is often necessary before trees can be planted in places where a high pavement burden exists.

LA County's 2024 CFMP ranks communities by canopy need, and sets targets for tree planting. One consequence of this was the realization that there were not enough unpaved areas to plant the needed trees, which led to the present depaving assessment. Figure 2.38 shows the distribution of tree canopy throughout Los Angeles County.

As would be expected, we see high concentrations of tree canopy in parklands as well as mountainous, rural, and suburban areas. Lower canopy coverage can be found in dense urban areas and in the northeastern part of the County within the Mojave desert. By aggregating the canopy percentage over CSAs, as shown in Figure 2.39, we can create a ranking of communities by their tree canopy coverage as shown in Figure 2.40.

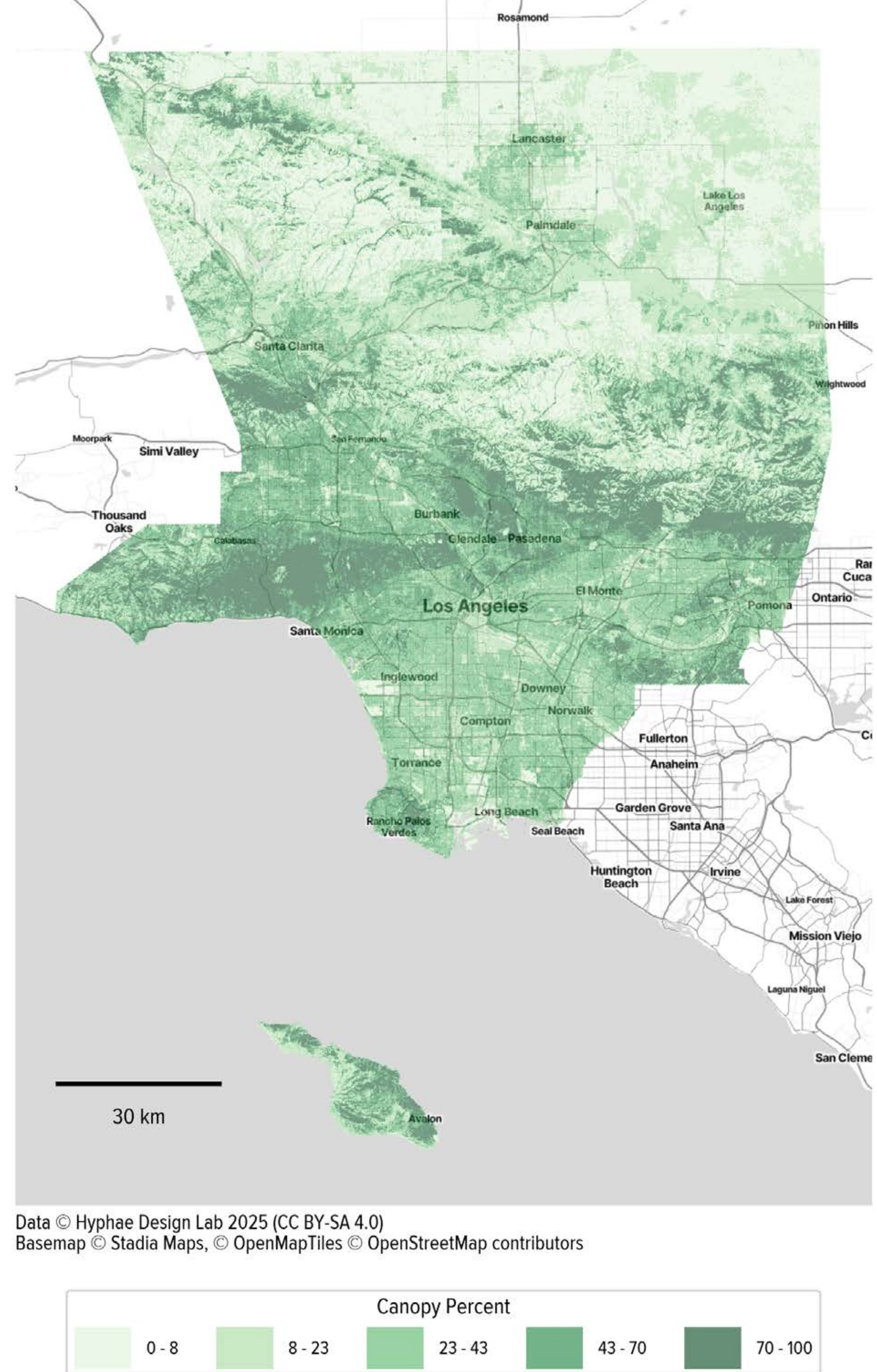

Figure 2.38: Tree canopy percent per 1.5 hectare in Los Angeles County

2.5.1 Community Tree Canopy Burden

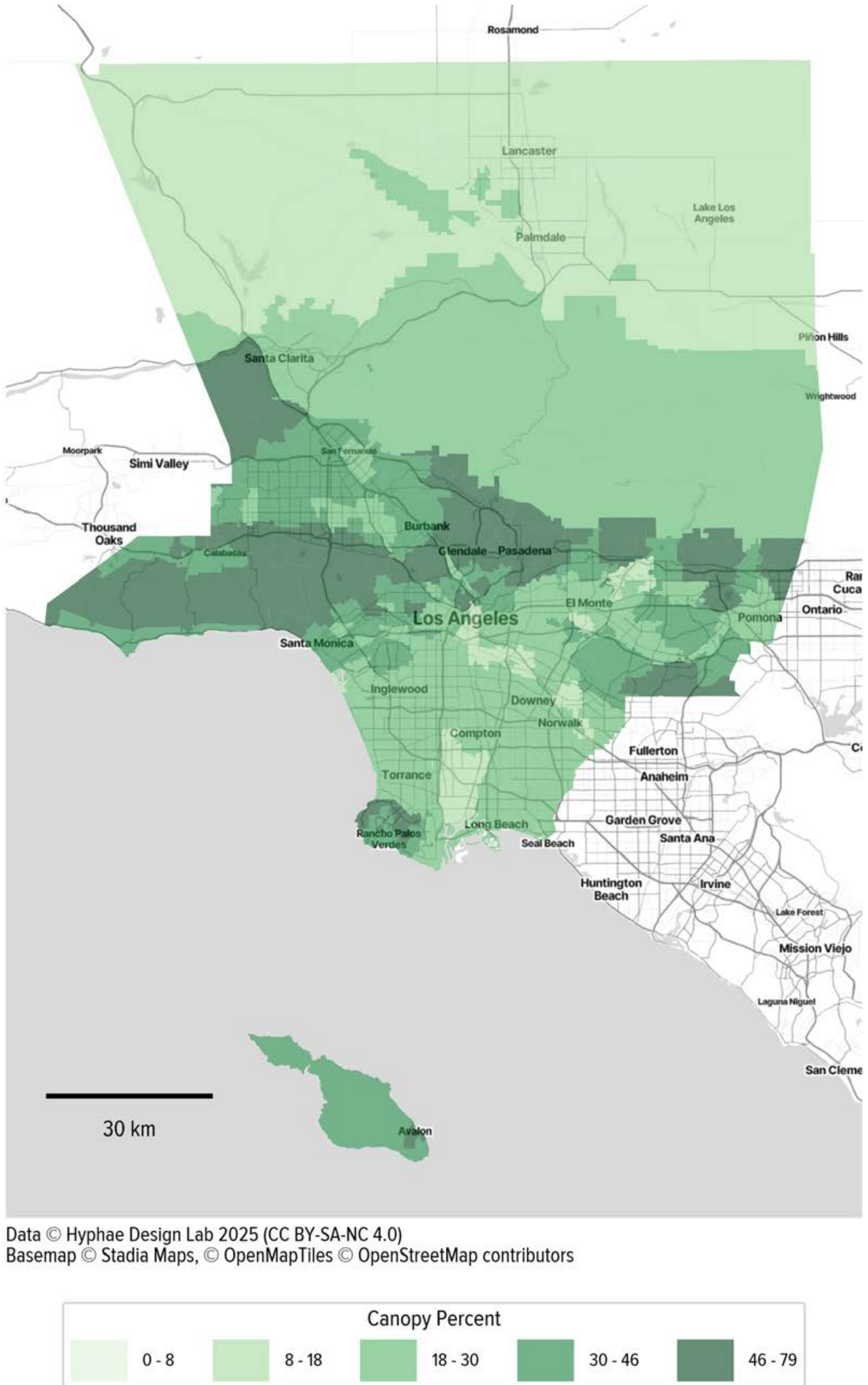

Figure 2.39: Tree canopy percentage of area for each CSA

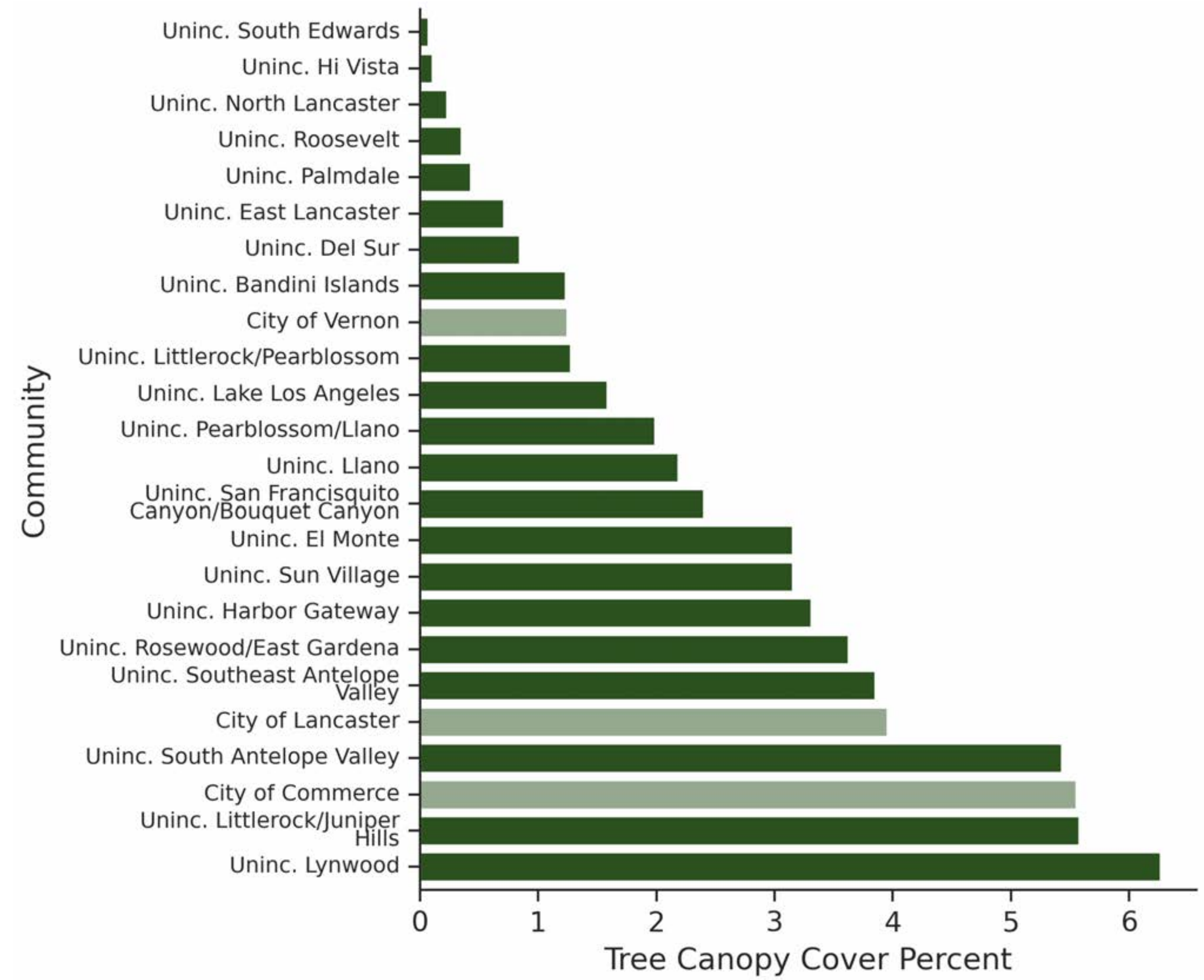

Figure 2.40: Ranking of communities by their tree canopy area (darker colors are unincorporated, lighter colors are incorporated)

2.5.2 Canopy Coverage within Supervisorial Districts

For an in-depth assessment of tree canopy within supervisorial districts, please refer to the Los Angeles County Community Forest Management Plan available at: https://cso.lacounty.gov/the-plan/cso-current-initiatives/community-forest-management-plan/

2.5.3 Canopy within Communities

For an in-depth assessment of tree canopy within the unincorporated area of the County of Los Angeles, please refer to the County's Community Forest Management Plan available at: https://cso.lacounty.gov/the-plan/cso-current-initiatives/community-forest-management-plan/

2.5.4 Canopy at Schools

For an in-depth assessment of tree canopy within schools, please refer to Green Schoolyards America's California Schoolyard Tree Canopy Equity Study.

2.5.5 Canopy in Vision Zero Road Segments

We have also mapped canopy metrics at a finer scale of detail for each of the 200 Vision Zero high collision concentration 1 mile road segments (with a 50 ft buffer on each side of the road centerline). Figure 2.41 shows the bottom 30 Vision Zero segments by canopy coverage. These segments are those with the least existing tree canopy coverage in their immediate vicinity (a 50 ft buffer around the road segment was used for the analysis). These can be prioritized for streetscape interventions that increase tree canopy, which can be made easier by depaving.

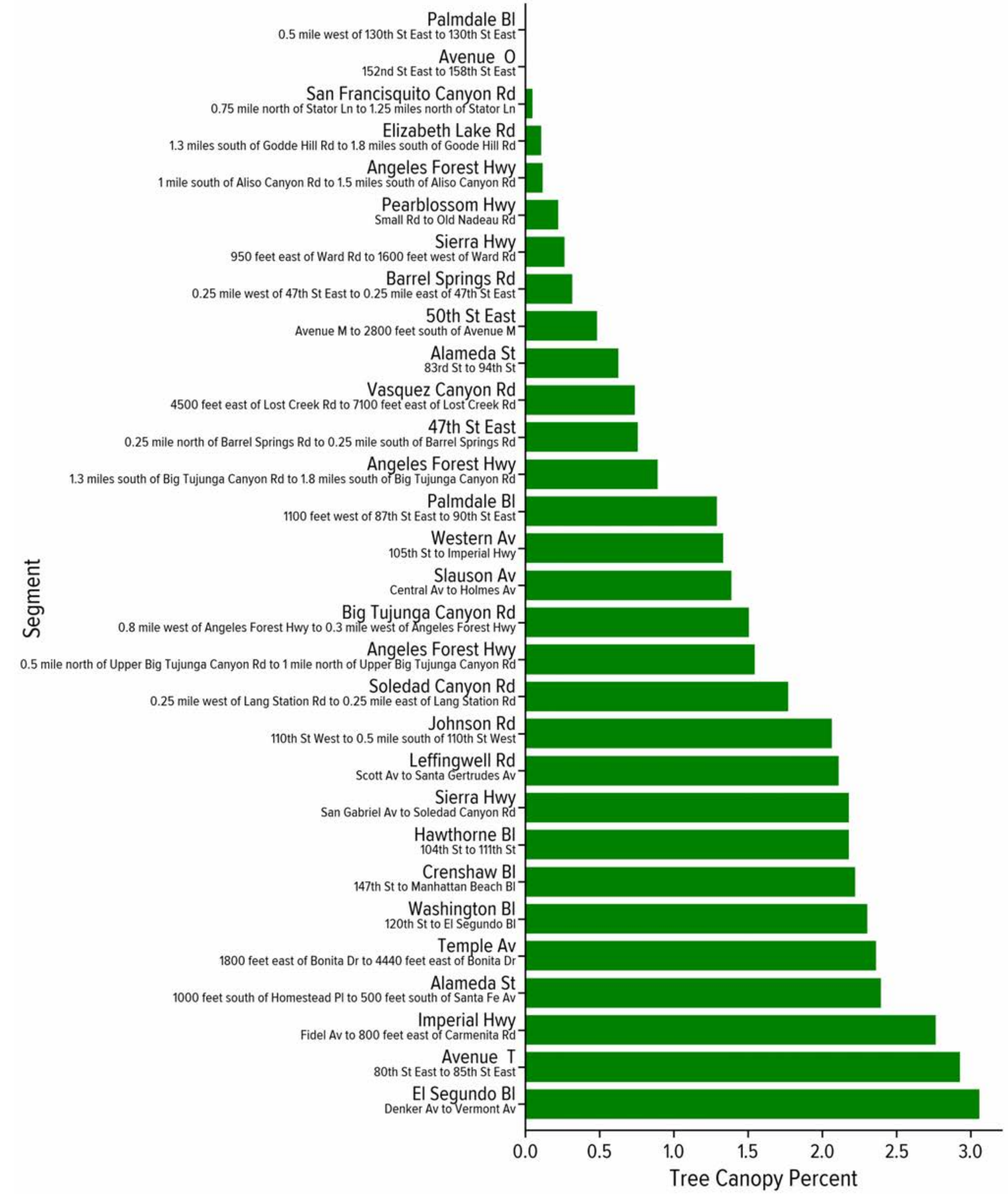

Figure 2.41: Bottom 30 vision zero segments by tree canopy percent

2.6 STACKED NEEDS – TOP QUANTILES

The previous sections provide ordinal ranking of community, school, and Vision Zero geographies by their total need metric burdens. In what follows, we will first look at the top quantiles of each need metric, filtered by population, then identify hotspots within communities where those needs overlap in order to determine where depaving interventions would have the most impact.

2.6.1 Each Need Separately

Examining Figure 2.42 closely, we can see that the high pavement areas and the high flood areas tend to be in the highly urbanized southern and western portions of the County, while the high heat and lowest canopy areas tend to be in the less developed (and less paved) northeastern parts of the County. That said, when we overlay these four maps and see where they converge, we can locate key hotspots that combine heat, flood, pavement, and low canopy needs.

By using parcel- and corridor-scale indicators and filtering results by where people live, this analysis moves beyond countywide generalities to pinpoint neighborhoods, schools, and street segments where interventions will matter most.

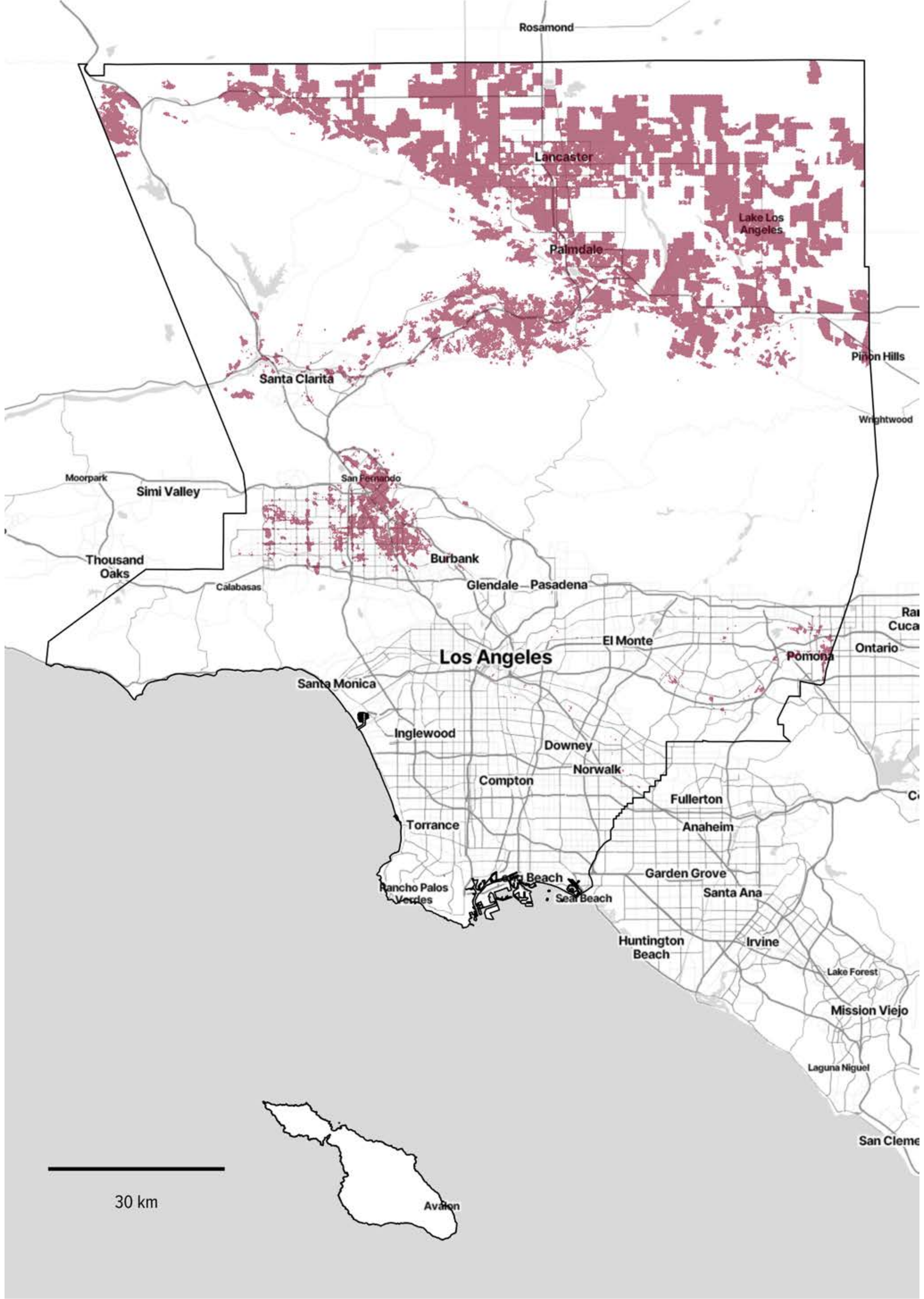

Figure 2.42a: Top quartiles of population filtered heat needs mapped using 70m hexgrid

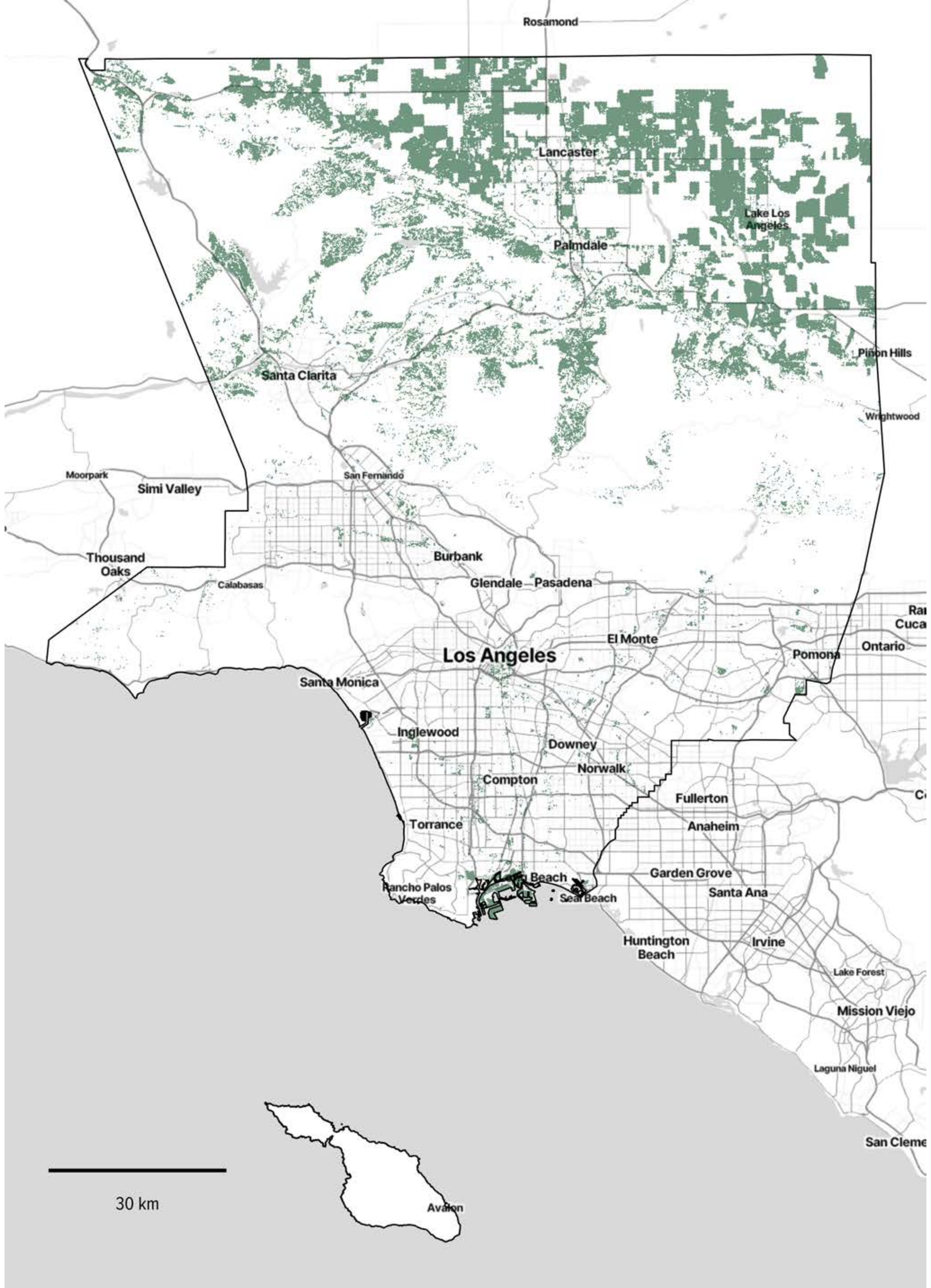

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Figure 2.42b: Top quartiles of population filtered canopy needs mapped using 70m hexgrid

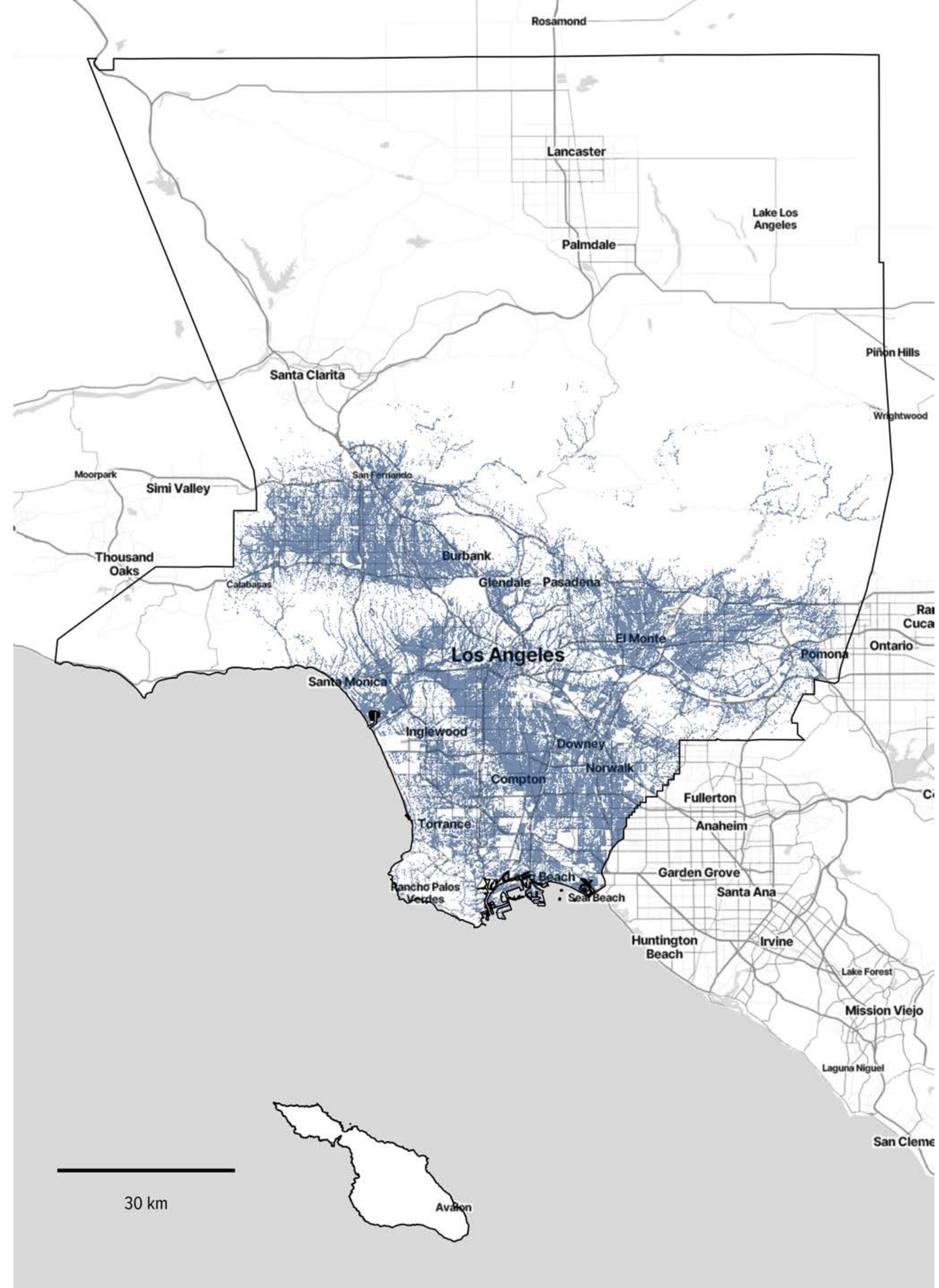

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Figure 2.42c: Top quartiles of population filtered flooding needs mapped using 70m hexgrid

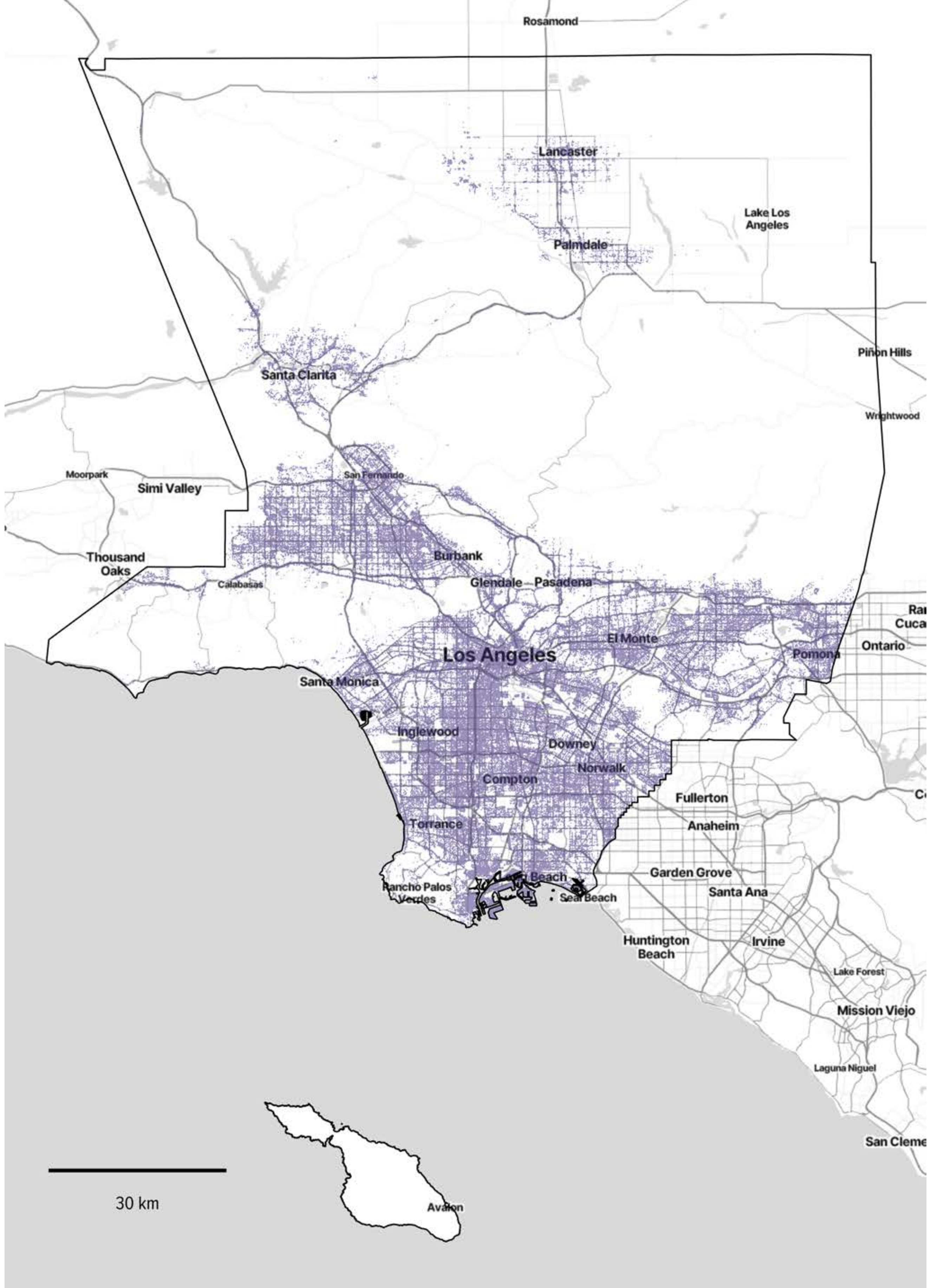

Figure 2.42d: Top quartiles of population filtered total pavement needs mapped using 70m hexgrid

2.6.2 Stacked Needs Pavement Analysis

2.6.2.1 Overlapping Quartiles

If we combine the population-filtered pavement, heat, flood, and canopy needs quartiles, and only keep those areas that fall within the top quartile of all 4 categories (when they are aggregated to 70 meter hexagons[36]), we get the map shown in figure 2.43.

As the four maps in Figure 2.42 suggest, there is considerable overlap between high heat and low canopy, as well as between high flood and high pavement, but less overlap between high heat and flood or pavement burden, as well as between low canopy and flood or pavement. If we map the actual overlapping 70 meter hexagons, as shown in Figure 2.43, we see several key hotspots that can be targeted.

2.6.2.2 Overlapping Quartiles per CSA

The 293 hexagons (70 meter) shown on the map in Figure 2.43 can be hard to see in context all at once. They fall into 29 CSAs, which are shown in Figures 2.44a-d.

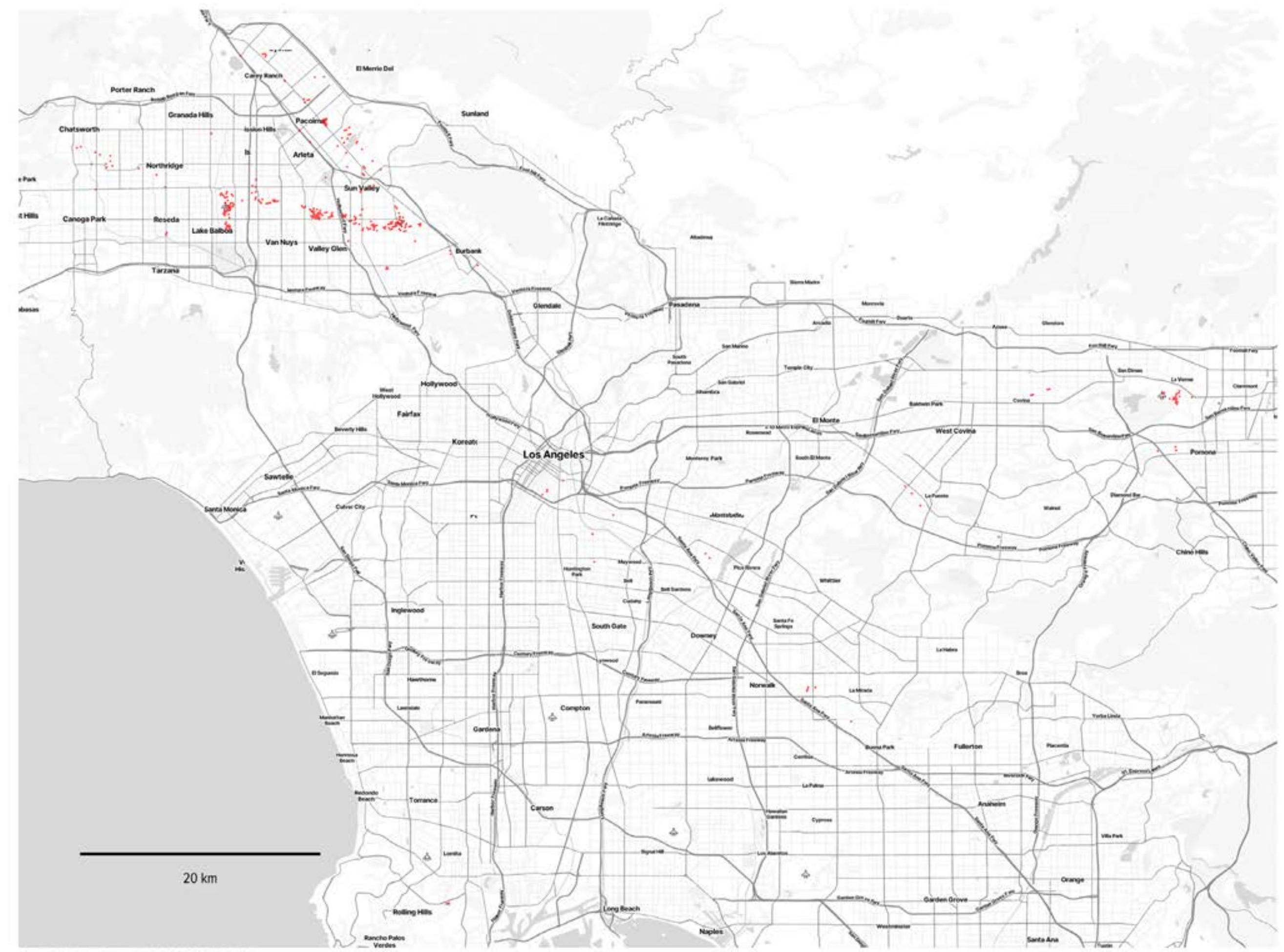

Figure 2.43: 70m overlap between top quartiles of population-filtered heat, flooding, pavement, and low canopy

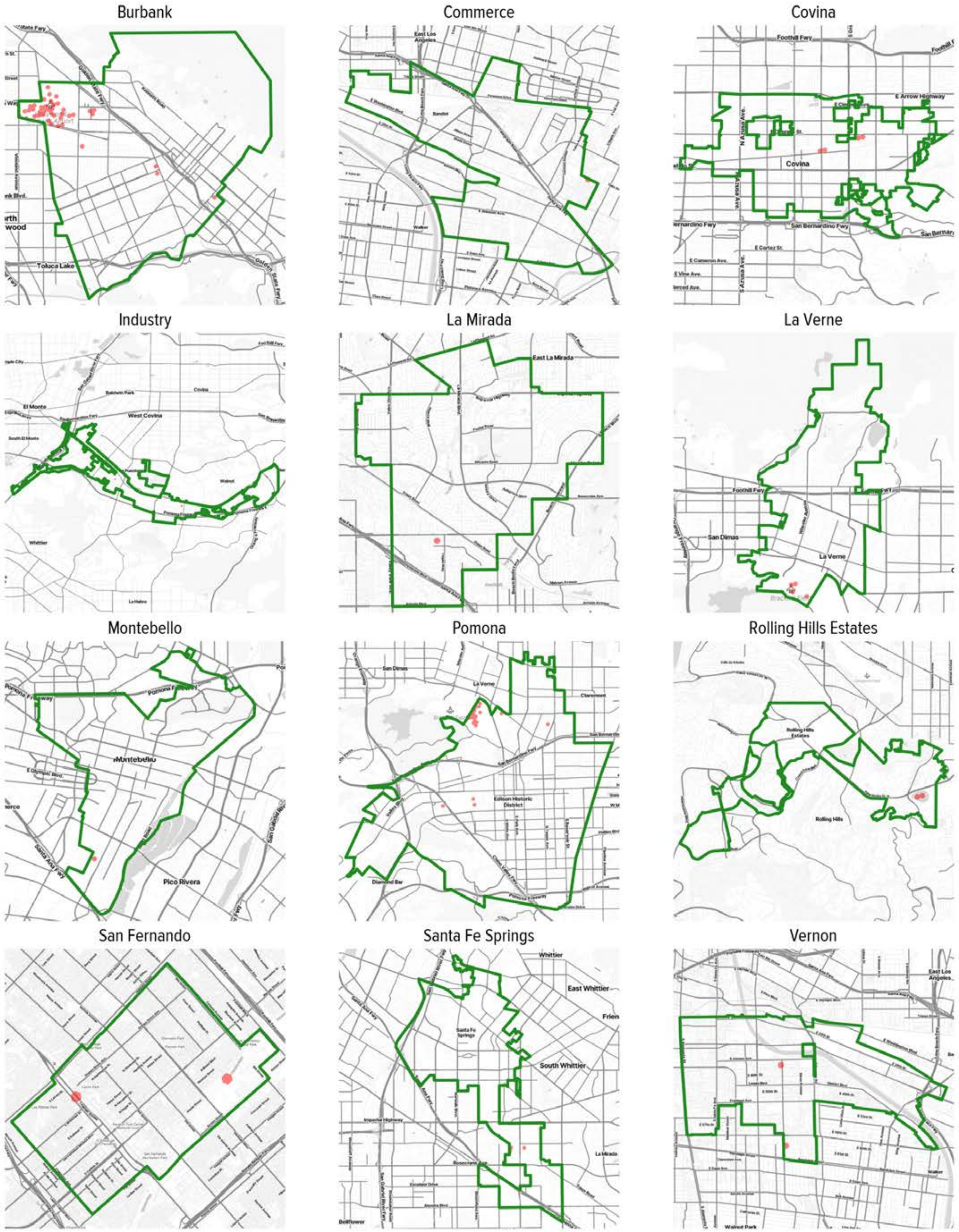

Figure 2.44a: Some of the CSAs contain areas that overlap the top quartile of population-filtered heat, flood, pavement, and the bottom quartile of canopy

Figure 2.44b: Some of the CSAs contain areas that overlap the top quartile of population-filtered heat, flood, pavement, and the bottom quartile of canopy

Figure 2.44c: Some of the CSAs contain areas that overlap the top quartile of population-filtered heat, flood, pavement, and the bottom quartile of canopy

2.6.2.3 Overlapping Quartiles per SB535 Disadvantaged Communities

Senate Bill (SB) 535 establishes requirements for minimum funding levels to "Disadvan-taged Communities" (DACs), requiring CalEPA to identify those communities based on "geographic, socioeconomic, public health, and environmental hazard criteria."

We used the 2022 update to these DAC geographies to filter our hotspots. Among the 293 hexagons that rank in the top quartile on all four high-resolution need metrics, 232 (79%) lie within SB 535-designated Disadvan-taged Communities.

The overlapping quartile hotspots that fall within SB535 areas fall into clusters shown in the maps in Figures 2.45, 2.46, and 2.47.

Population-filtered hex-grid maps reveal many overlapping hotspots across the County, where heat exposure, flood confidence and pavement coverage are highest and canopy is sparse.

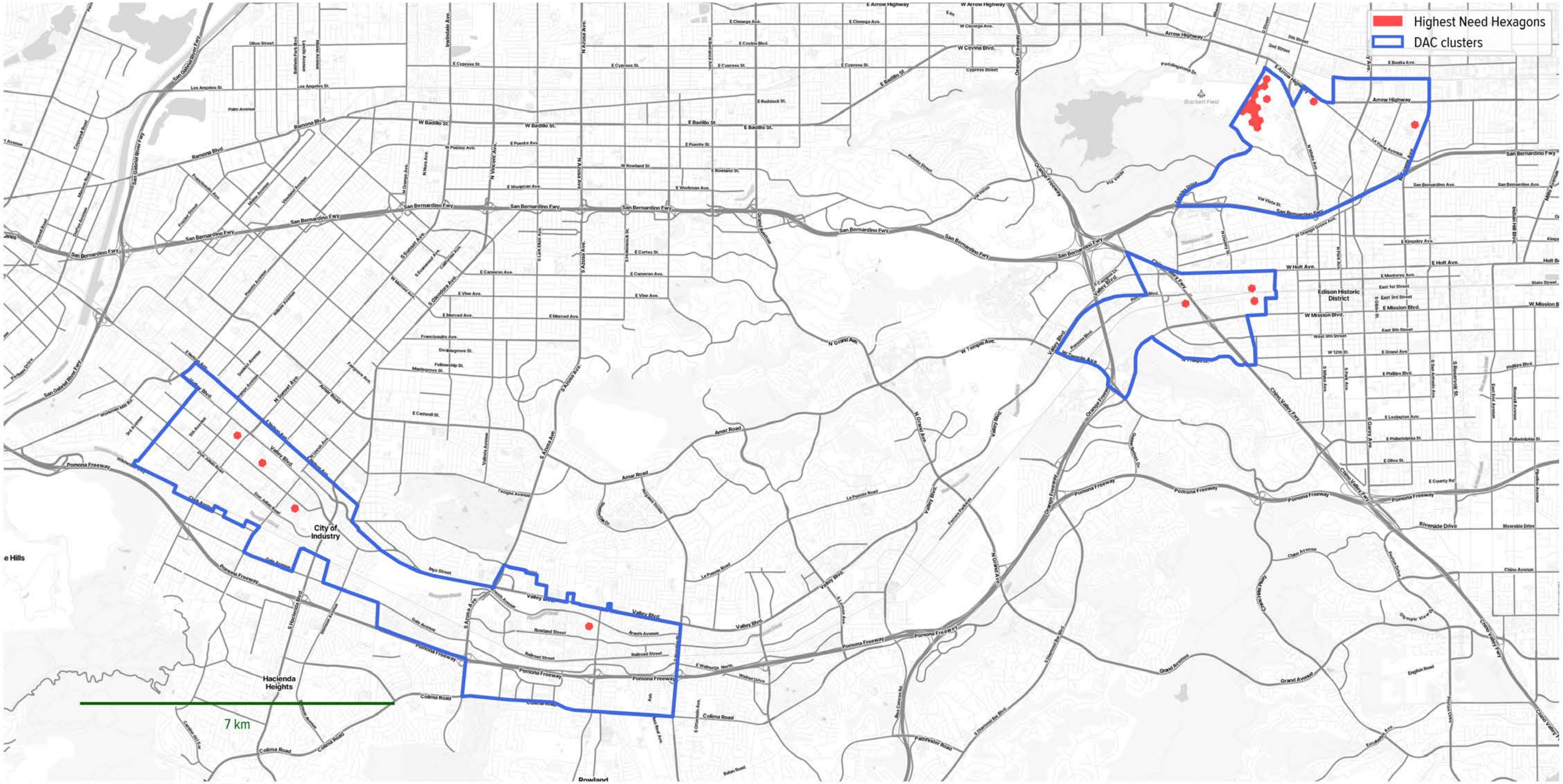

Figure 2.45: Cluster of SB535 hotspots in the San Fernando Valley region

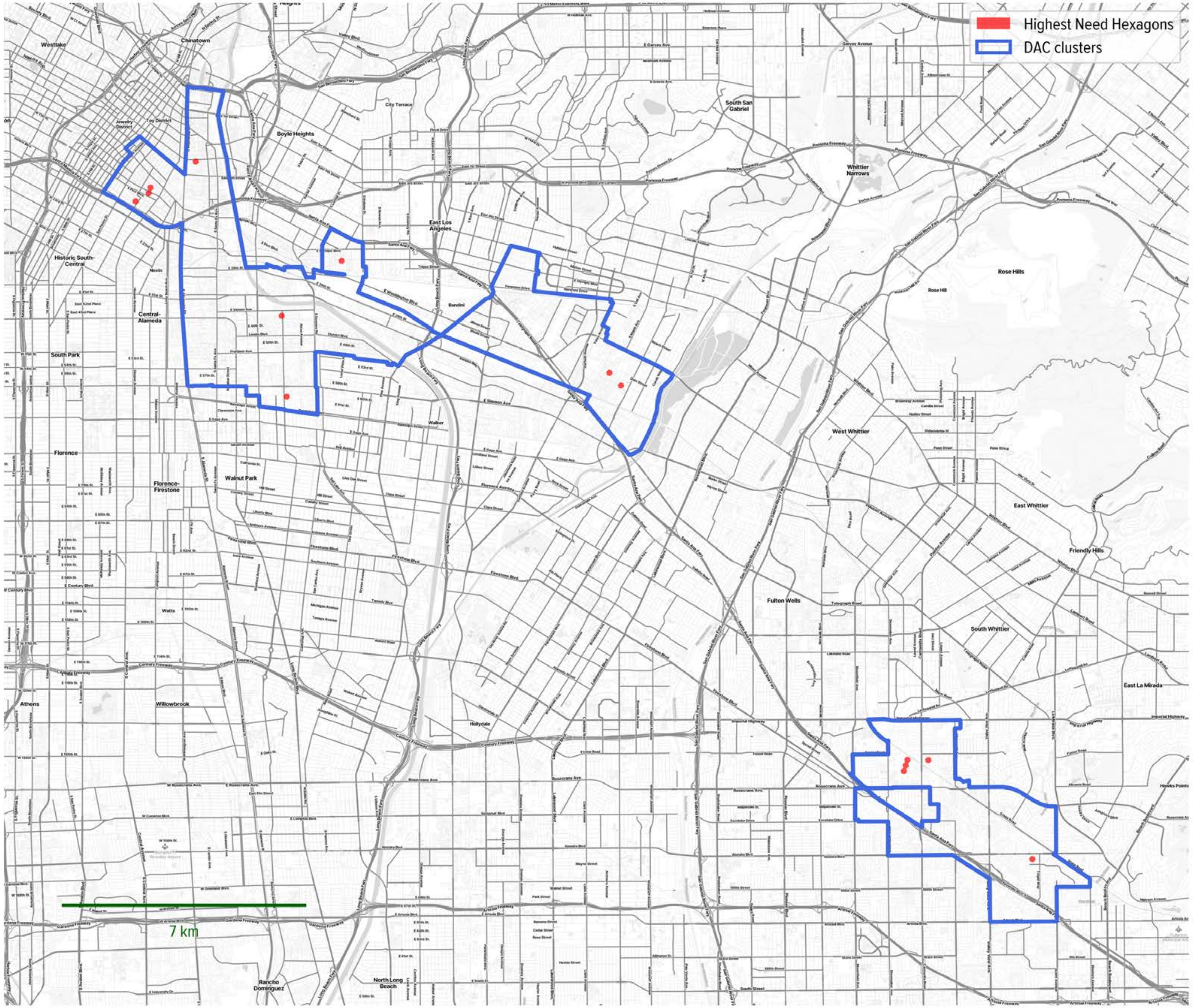

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Figure 2.46: Cluster of SB535 hotspots in Vernon, Maywood, and Commerce along the Lower Los Angeles River, and another near the San Gabriel River

Among the 293 hexagons that rank in the top quartile on all four high-resolution need metrics, 232 (79%) lie within SB 535-designated Disadvantaged Communities.

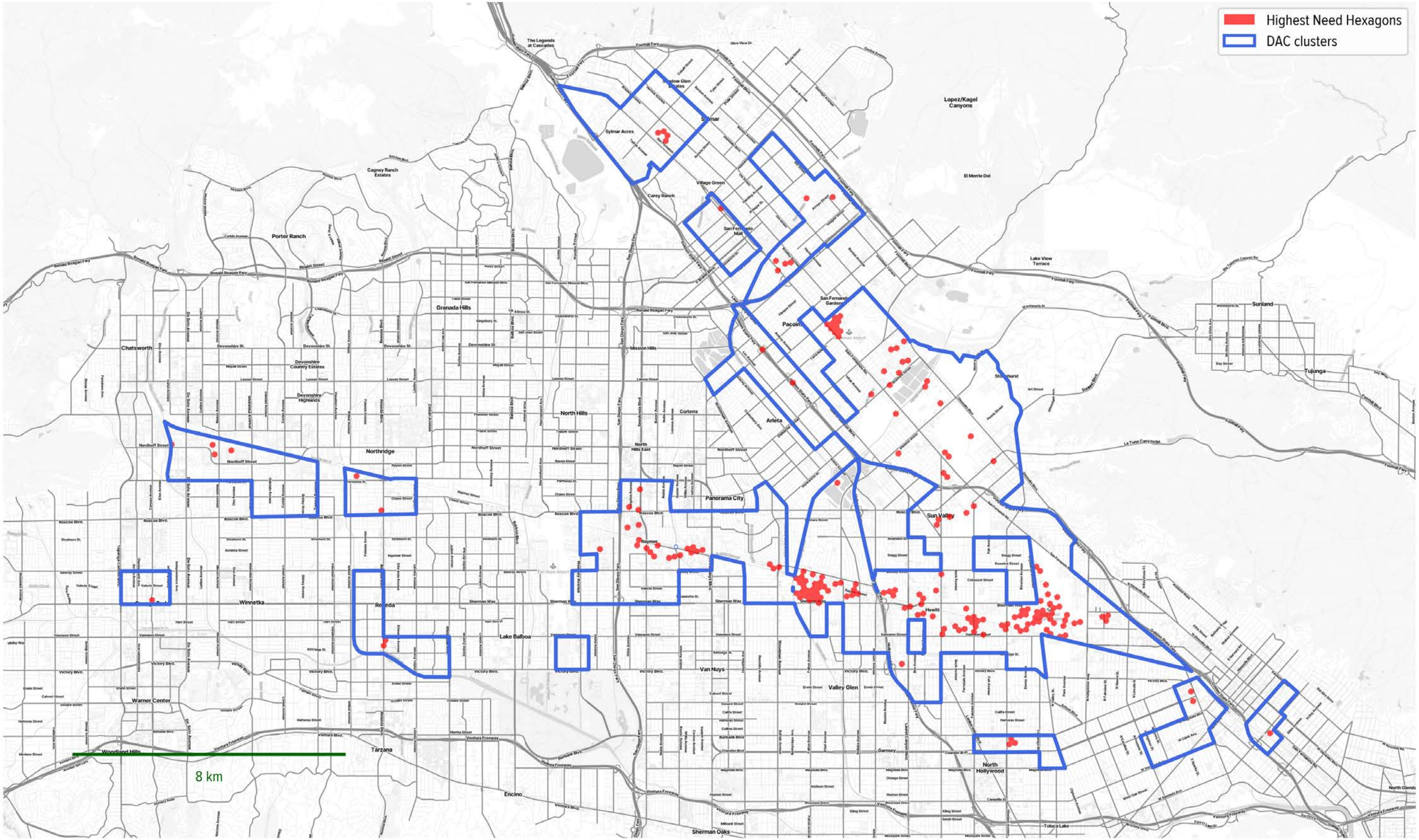

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Figure 2.47: Clusters of SB535 hotspots in the vicinity of San Jose Creek and the L.A. County Fairgrounds

2.6.2.4 Overlapping Quartile Tiers

These hotspots are very specific places where future depaving efforts can conduct more detailed site assessments to understand site conditions, the needs of site-specific partners, and the best strategies to remove pavement. Using these datasets, the hotspots could be expanded into tiers, for example:

TIER 1: CSAs and corridors where **pavement (top quartile)** co-occurs with **heat and flood (top quartile)** and l**ow canopy (bottom quartile).**

TIER 2: CSAs and corridors where **pavement (top quartile)** co-occurs with any **two** of the above other need indicators.

TIER 3: CSAs and corridors where **pavement (top quartile)** co-occurs with any **one** of the above other need indicators.

The map in Figure 2.48 shows this tiered system of overlapping needs metrics. Tier 1 encompasses all 4 top quartiles together, Tier 2 represents the top quartile of pavement overlapping with any 2 other needs top quartiles, and tier 3 shows the top quartile of pavement burden overlapping with any 1 other top quartile.

A breakdown of the distribution of these top quartile tiers within DACs and unincorporated CSAs can be found in Table 2.1.

Table 2.1: Distribution of stacked needs quartile hotspots in DACs and unincorporated CSAs

STACKED QUARTILE	# OF HEXAGONS	INCORPORATED	UNINCORPORATED	IN THE DACS	OUTSIDE DACS
tier 1	293	291	2	232	61
tier 2	6,014	5,681	333	4,750	1,264
tier 3	49,199	43,259	5,940	30,859	18,340

STACKED QUARTILE	ACRES OF PAVEMENT	INCORPORATED	UNINCORPORATED	IN THE DACS	OUTSIDE DACS
tier 1	788	783	5	620	168
tier 2	14,658	13,893	766	11,792	2,866
tier 3	100,468	88,311	12,157	64,837	35,631

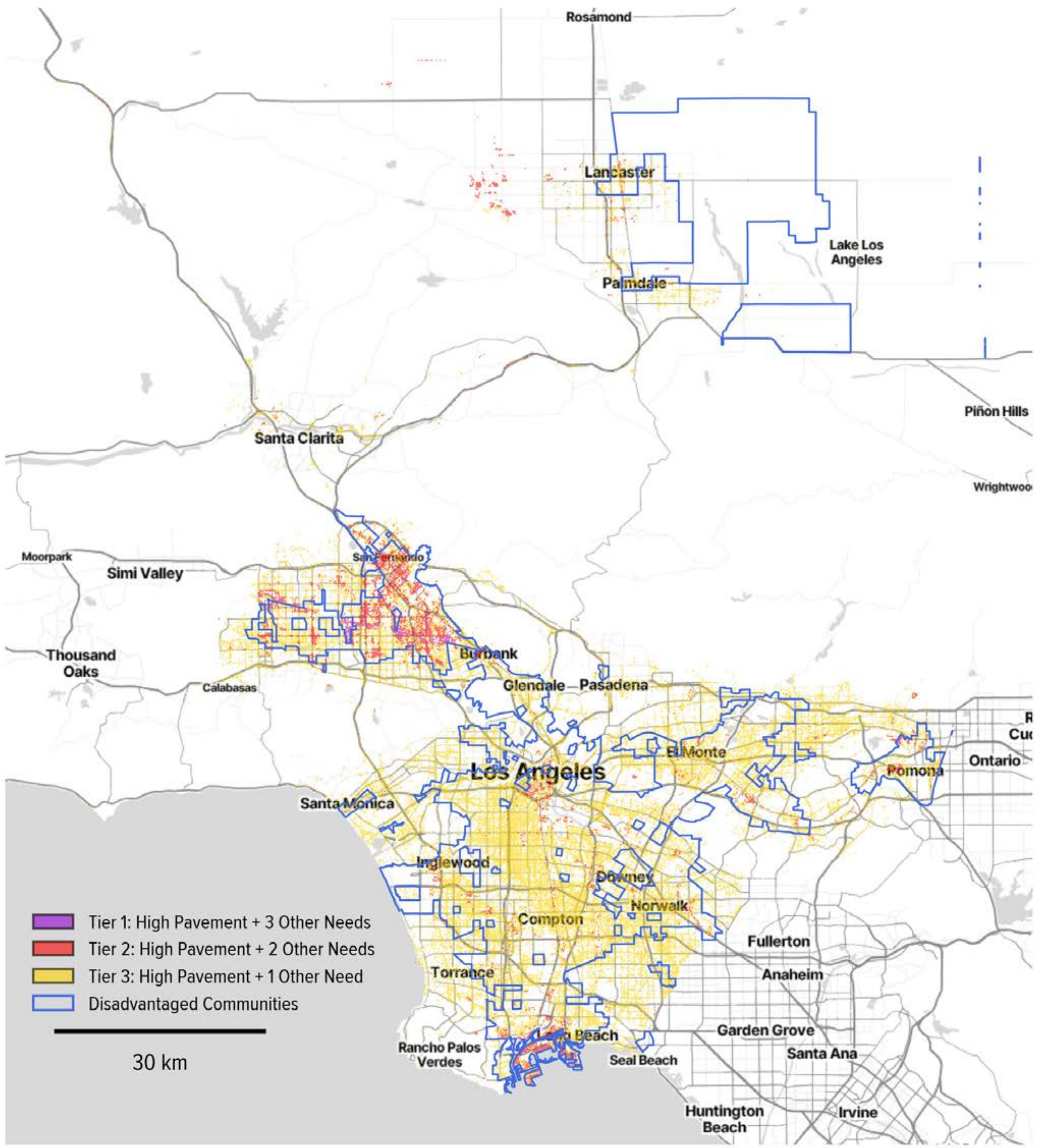


Figure 2.48: Tiered population filtered by top quartile needs overlap

2.7 COMPARISON WITH OTHER ASSESSMENTS

Various prior planning efforts led by the County have evaluated climate risks and needs. The previously-mentioned Los Angeles County Climate Vulnerability Assessment (CVA) identified key communities with elevated risk of temperature increase in the future. The Safe Clean Water Program (SCWP) identified key communities with elevated flood risk, while the Community Forest Management Plan (CFMP) identified communities with insufficient tree canopy.

Close examination of the methodologies used across these different planning efforts reveals differences and similarities between the geographic rankings from other assessments and the ones identified in this Depaving Assessment. For heat, the CVA categorized communities as high risk if they were projected to experience large increases above current air temperatures in the future. For example, even though Malibu and Venice are currently relatively low-temperature coastal communities, they were identified through the CVA as having high heat climate vulnerability because of the rate at which their air temperature is expected to sharply rise with the acceleration of climate change. In contrast, this assessment looked at surface temperature conditions on *recent* high heat days in order to rank the communities that *currently* experience the highest relative heat burden across space.

To assess flooding vulnerability, the CVA relied on FEMA's flood risk metrics, whereas this depaving assessment used more recent data from the UCI PRIMo model, which takes into account important details about stormwater infrastructure that are not captured by FEMA.

To evaluate tree canopy coverage, this study used a similar type of data as the County's CFMP, although the CFMP used canopy data from 2020 while this study used canopy data from 2023. Nevertheless, there is considerable agreement in most places about low canopy communities. However, the CFMP also considered additional vulnerability metrics and adjustments for land-use in their CSA rankings which result in some minor differences from our analysis.

2.8 NEEDS ASSESSMENT CONCLUSIONS

Across Los Angeles County, pavement burden, extreme heat, flooding risk, and limited tree canopy afflict a diverse range of places, creating a broad spectrum of depaving needs. By using parcel- and corridor-scale indicators (ECOSTRESS surface temperature, UCI Flood Lab PRIMo high-confidence flood extents, land-cover–derived pavement share, and canopy coverage) and filtering results by where people live, this analysis moves beyond countywide generalities to pinpoint neighborhoods, schools, and street segments where interventions will matter most.

Conclusions

- **Pavement burden is itself a risk factor.** Exposure to excess hardscape degrades thermal comfort, stormwater performance, air quality, and the overall livability of the built environment. Mapping total pavement share (roads + non-road pavement) identifies communities disproportionately exposed to asphalt and concrete.
- **Heat, flood risk, and low canopy have differing colocation with high pavement.** Population-filtered hex-grid maps reveal many overlapping hotspots across the County, where heat exposure, flood confidence, and pavement coverage are highest and canopy is sparse. The 293 70 meter hotspots fall into 29 CSAs, and 79% of them also fall into SB 535 DACs. These sites offer themselves as prime candidates for depaving-enabled cooling, flood mitigation, and greening. At the same time, there are large areas (53 CSAs) containing overlapping areas of high heat and low canopy coverage, but little pavement or flood risk.
- **Schools and Vision Zero corridors are high-leverage sites.** With *3,179 schools* (≈ *2.08 million students*) occupying ≈ 41,508 acres of total land; schoolyards are among the most scalable places to reduce heat, manage runoff, and add shade where sensitive receptors congregate. Likewise, *200 Vision Zero one-mile road segments* identified as high collision areas and slated for streetscape improvements offer an opportunity to integrate depaving and deliver safety, cooling, and hydrologic benefits simultaneously.
- **Upstream water strategy matters.** The PRIMo results underscore that rainfall-driven flooding is widespread beyond channel corridors. Depaving interventions ideally want to reframe the stormwater problem from "how can we capture water where there is flooding" to "*how to prevent flooding and infiltrate at the source*," preempting and complementing flood-control conveyance with distributed permeability and storage.
- **Supervisorial District patterns support targeted allocation.** Population-filtered 180-acre hexagonal grids identify local hotspots within-each supervisorial district.

With 3,179 schools occupying ≈ 41,508 acres of total land, schoolyards are among the most scalable places to reduce heat, manage runoff, and add shade.

- Our review of varying plans has concluded that, while different municipalities and departments have adopted climate and infrastructure goals that could be advanced through depaving strategies, **presently no coordinated initiative exists to guide and align depaving efforts.**

CHAPTER 3

PAVEMENT DISTRIBUTION ANALYSIS

This chapter does not estimate how much pavement is used for specific functions like parking or sidewalks, nor does it attempt to identify how much pavement could be removed. Instead, it focuses on mapping and quantifying the total extent of paved surfaces as a baseline for further analysis. This foundational layer alone offers a novel contribution: a disaggregated, countywide map of paved surfaces that was not previously available to planners.

3.1 INTRODUCTION

We proceed with a foundational spatial inventory of pavement across Los Angeles County, identifying the location, distribution, and classification of pavement within both parcels and rights-of-way (ROW). Pavement is further examined through multiple spatial and governance lenses, including land use categories such as residential, commercial, and industrial designations, parcel ownership distinctions between public and private entities organized by agency type, Supervisorial Districts, watershed boundaries, and community-level geographies based on Countywide Statistical Areas.

By separating descriptive spatial data from interpretive assumptions, Chapter 3 creates a neutral foundation onto which we layer heuristic or policy-oriented insights in later chapters. It establishes where pavement is located, who controls it, and how it is distributed across key geographic and administrative boundaries.

Chapter 4 (*Pavement Necessity Analysis*) builds on this foundation to estimate which pavement is needed for core services, and which might not be, enabling potential investigations to determine the pavement's use and potential for removability within its local context.

Our analysis of available landcover datasets indicates that Los Angeles County has around **312,453** acres of pavement, a total of **488 square miles. This total paved area exceeds the size of Los Angeles** (Los Angeles, the largest city in California, spans around 469 square miles). We estimate that at least **141,567 acres** of this pavement is located on **privately owned parcels, 42,505 acres** are on **publicly owned parcels**, and **128,381** acres are in **rights-of-way between parcels**. If we narrow the analysis to just **unincorporated parts of the County**, there are around **42,337 acres of pavement**, with **17,836 in private parcels, 5,544 in public parcels**, and **18,957 in rights-of-way between parcels**. Figure 3.1 shows this breakdown between incorporated and unincorporated parts of the County.

To arrive at these numbers, we took a landcover dataset that classifies the earth as seen from an airplane at a resolution of 0.75 feet into classifications of **tree canopy, buildings, water, bare earth, shrubs, grass, roads, and non-road pavement**. To get total pavement, we added roads and non-road pavement together. Overall, this is likely an underestimate of the total pavement as pavement that is underneath tree canopy is not counted.

We then took the landcover data and aggregated it into various spatial units such as parcels, rights-of-way (ROW), Countywide Statistical Areas (CSAs), supervisorial districts, and watersheds to provide perspectives on pavement throughout the County at different scales and in different contexts. For a detailed explanation of data sources and analytical methods, please see the Chapter 7 Methodology section.

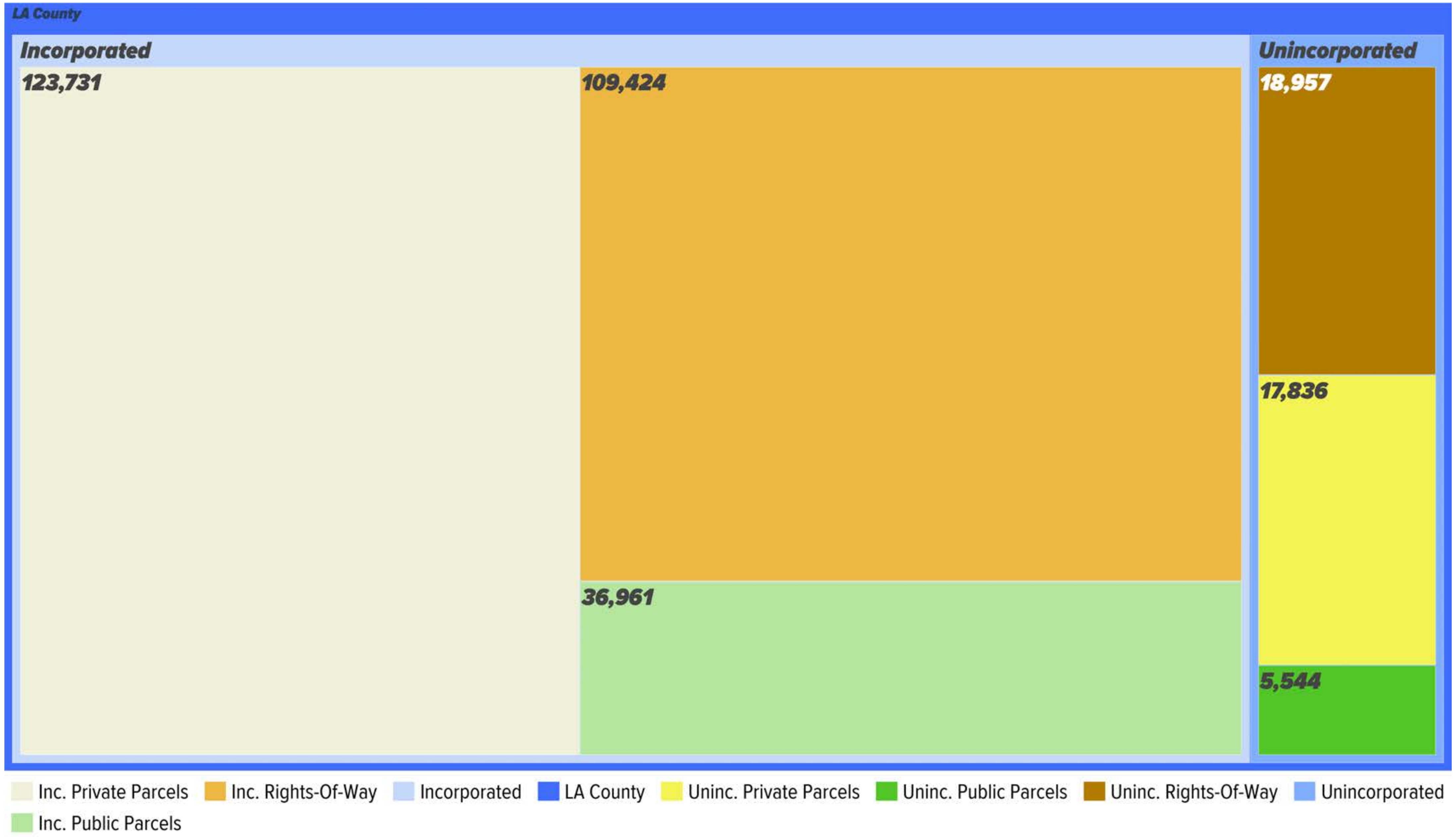


Figure 3.1: Total pavement acres in L.A. County

While single-family homes contain the vast majority of all residential pavement, multi-family properties are proportionally more paved.

3.2 PARCELS ANALYSIS

3.2.1 Summary of Parcels Analysis Findings

In our spatial analysis of over two million county parcels, we identified key distribution, intensity, and ownership patterns to guide pavement removal strategies. The largest total acreage of parcel pavement is concentrated in three land use categories: **Residential, Industrial, and Government**.

As previously mentioned, a critical distinction emerges between the total amount of pavement and its intensity. For instance, while single-family homes contain the vast majority of all residential pavement, multi-family properties are proportionally more paved. Similarly, industrial parking lots and trucking terminals are more pavement-intensive than the warehouses they serve. In the most impacted areas (top quartiles of intersecting heat, flooding, and canopy needs), industrial and roads present the highest pavement burden.

Furthermore, sorting parcels by public ownership reveals that certain entities such as school districts and the County control significantly more pavement than is immediately apparent from filtering for government land use codes more broadly. Finally, the existence of substantial pavement on "vacant" land, particularly in commercial and industrial zones, highlights a unique opportunity for depaving without impacting current land use activities. These findings provide a strategic roadmap for identifying both the largest areas of pavement and the most feasible opportunities for intervention.

3.2.2 Parcels Definition

All of the land in the County, both incorporated and unincorporated, falls either within parcels, or between them. The land within each parcel typically has an owner, which may be a private or public entity, and bears a land use code or zoning type that specifies what purpose the parcel can be used for, be it residential housing, industrial activities, or a range of other uses. The pavement within parcels is often used as parking, driveways, or patios, although some private roads, service roads, and drive-aisles may also exist within parcels.

We derived our parcel information from two datasets: 1) a set of all 2,098,519 parcels in the County, which records land use codes describing the allowed usage of the parcel (downloaded from the County's GIS portal September 24th 2024), and 2) A set of 49,807 public parcels, which are owned by federal, state, County, or City governments or some other public entities such as a school or park district. This latter public parcels dataset has more detailed information about which entity owns or controls each public parcel, and was downloaded from the County's GIS portal on September 24th, 2024.

3.2.3 Parcel Pavement per Land Use

Each parcel in the County has a "land use code" determining the land use that the County has assigned it. While there are hundreds of land use codes, they can be grouped broadly into nine land use categories: **Residential, Commercial, Industrial, Agricultural, Recreational, Institutional, Government and Miscellaneous**. These land use categories are based on function rather than ownership or control.

In a case where a government agency owns a residential house, for example, that parcel will likely have a residential land use code and not a government land use code. Later in this report, however, we will discuss another dataset focused specifically on public parcels, where ownership rather than use code determines classification.

Figure 3.2 shows the acres of total pavement in each of the nine parcel land use categories in the full parcel dataset (which includes both incorporated and unincorporated areas). The top 3 categories rank as residential, industrial and government, with commercial arriving at a close fourth place. Figure 3.3 shows the same breakdown but limited to parcels in unincorporated areas.

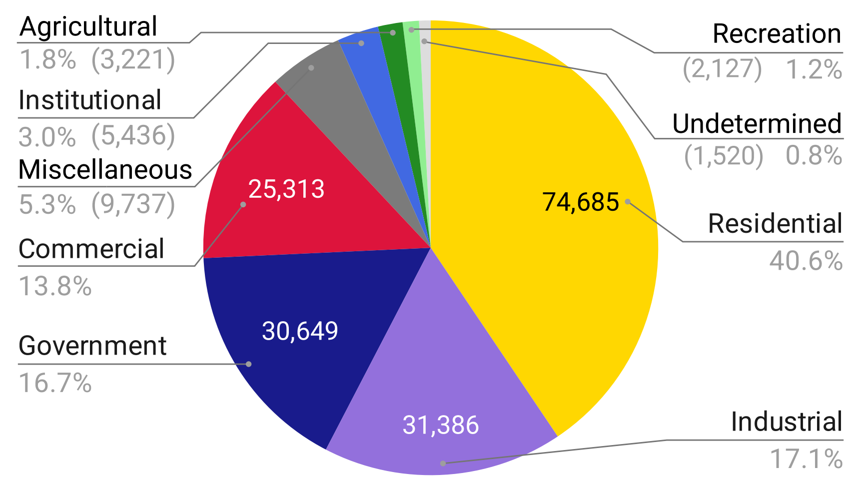


Figure 3.2: Countywide (incorporated and unincorporated) parcel pavement with respect to parcel land use categories

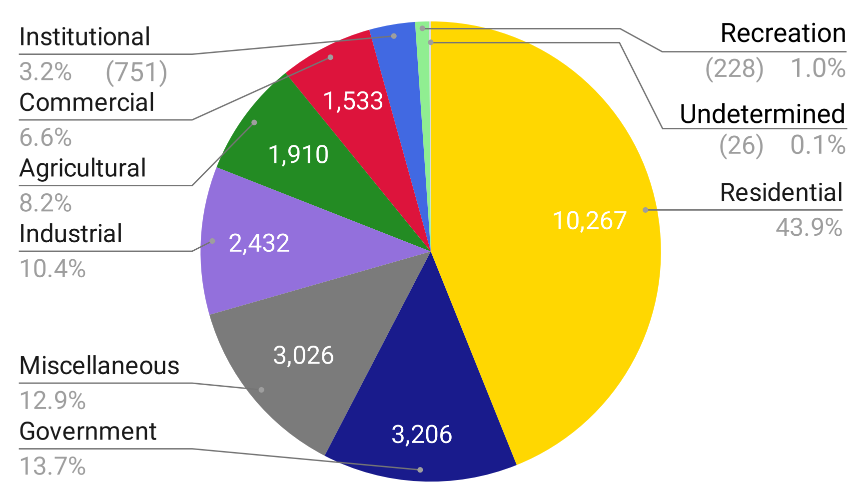


Figure 3.3: Parcel pavement with respect to parcel land use categories, but only in unincorporated parcels

3.2.3.1 Residential Parcel Pavement

The residential land use category can be further broken down into single- and multi-family categories. Figure 3.4 shows the pavement distribution within residential parcel types. **80% of the residential pavement is in single family parcels, accounting for 58,936 acres of total pavement**. Residential pavement on multi-family properties, mobile & modular home lots, as well as rooming houses amounts to an additional 15,749 acres of total pavement.

Although Figure 3.4 shows that **single-family lots contain 80.6% of all residential pavement county-wide, this dominance is driven by their sheer number**. When we shift from an **absolute** view (total paved acres) to a **relative** one (share of each parcel that is paved), multifamily parcels emerge as the more pavement-intensive land-use: on average, 24–28% of a multifamily lot is paved compared with 17% for single-family lots (Table 3.1). **This dual perspective – total versus intensity – helps identify both where the bulk of pavement lies and where residents experience the greatest pavement burden on a per-parcel basis.**

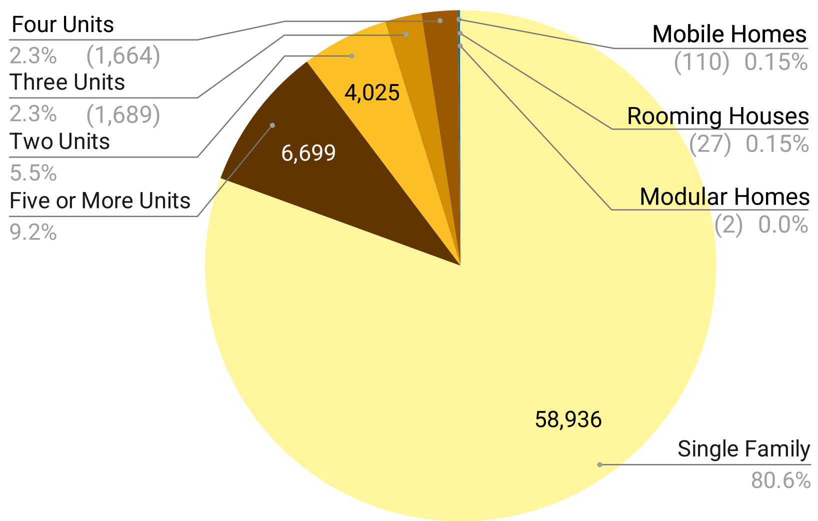


Figure 3.4: Breakdown of countywide (incorporated and unincorporated) residential parcel types by pavement acreage

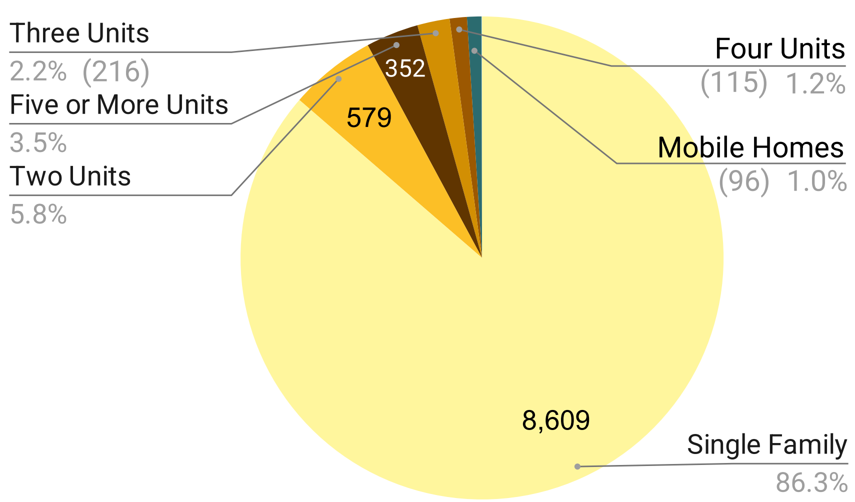


Figure 3.5: Breakdown of residential parcel types by pavement acreage just in unincorporated parcels only

Table 3.1: Average residential pavement percent by housing type countywide (incorporated and unincorporated)

RESIDENTIAL TYPE	AVERAGE PERCENT OF PARCEL AREA COVERED IN PAVEMENT	AVERAGE PERCENT OF PARCEL AREA COVERED IN BUILDINGS	AVERAGE PERCENT OF PARCEL AREA LANDSCAPED	TOTAL PARCEL COUNT
Four Units	28%	47%	24%	34,041
Three Units	26%	46%	28%	36,579
Rooming Houses	26%	44%	30%	427
Five or More Units	25%	57%	18%	68,825
Two Units	24%	43%	33%	107,685
Single Family	17%	34%	48%	1,601,581
Modular Homes	12%	21%	68%	23
Mobile Homes	6%	16%	78%	1,927

Table 3.2: Average residential pavement percent by housing type (unincorporated only)

RESIDENTIAL TYPE	AVERAGE PERCENT OF PARCEL AREA COVERED IN PAVEMENT	AVERAGE PERCENT OF PARCEL AREA COVERED IN BUILDINGS	AVERAGE PERCENT OF PARCEL AREA LANDSCAPED	TOTAL PARCEL COUNT
Four Units	30%	46%	20%	1,943
Five or More Units	30%	50%	24%	2,326
Three Units	28%	45%	27%	4,081
Two Units	25%	42%	33%	13,117
Rooming Houses	23%	35%	41%	14
Single Family	15%	27%	58%	223,279
Modular Homes	7%	10%	82%	16
Mobile Homes	3%	6%	91%	1,386

3.2.3.2 Industrial Parcels Pavement

Of the 31,386 acres of pavement on industrial parcels, the two largest portions stem from Warehouse parcels (9,928 acres) and Light Manufacturing parcels (9,217 acres), as shown in Figure 3.6. While the Warehouses and Light Manufacturing land use categories make up the majority of pavement in industrial parcels, this does not mean that those categories typically contain the most pavement per parcel or per unit of area. Table 3.3 shows the average percent of parcel area covered by pavement for each Industrial subcategory, indicating that parcels devoted to parking lots and trucking terminals/storage yards tend to be more paved.

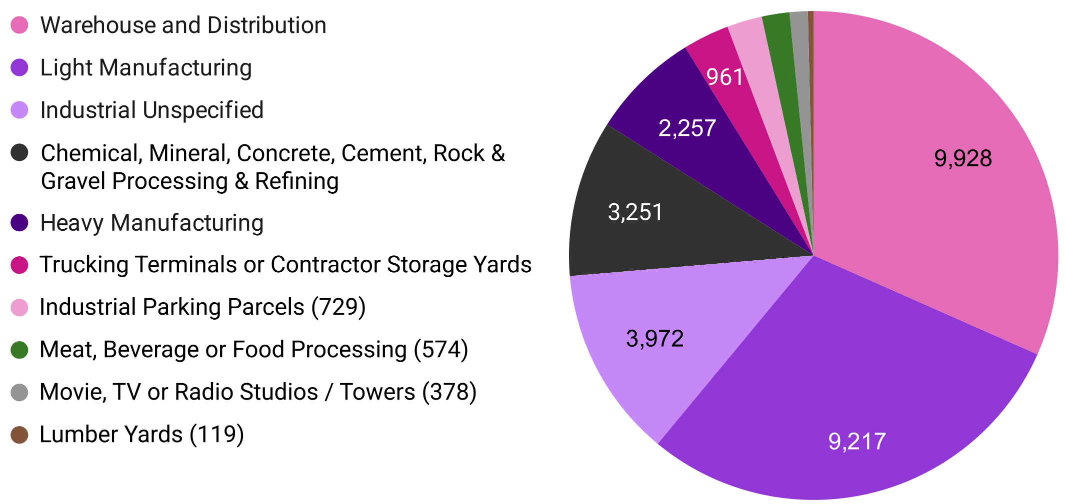


Figure 3.6: Breakdown of pavement by industrial parcel subcategories countywide (incorporated and unincorporated)

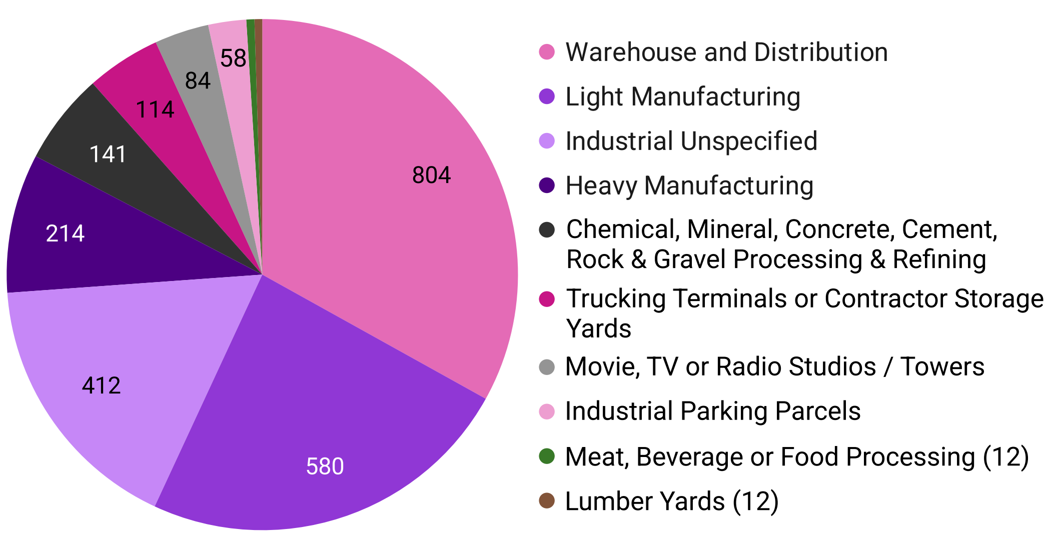


Figure 3.7: Breakdown of pavement by industrial parcel subcategories just in unincorporated areas

Table 3.3: Percent pavement coverage, on average of industrial parcels by subcategory

INDUSTRIAL TYPE	AVERAGE PERCENT OF PARCEL AREA COVERED IN PAVEMENT	TOTAL PARCEL COUNT
Industrial Parking Parcels	81%	1,634
Trucking Terminals or Contractor Storage Yards	74%	747
Lumber Yards	57%	126
Heavy Manufacturing	43%	1,228
Warehouse and Distribution	41%	12,301
Industrial Unspecified	40%	12,743
Light Manufacturing	39%	19,943
Chemical, Mineral, Concrete, Cement, Rock & Gravel Processing & Refining	37%	507
Meat, Beverage or Food Processing	37%	600
Movie, TV or Radio Studios / Towers	33%	392

Table 3.4: Percent pavement coverage, on average of industrial parcels by subcategory just in unincorporated parcels

INDUSTRIAL TYPE	MEAN TOTAL PAVEMENT PERCENTAGE	PARCEL COUNT
Industrial Parking Parcels	83%	106
Trucking Terminals or Contractor Storage Yards	69%	107
Lumber Yards	49%	13
Warehouse and Distribution	42%	992
Light Manufacturing	41%	1,191
Heavy Manufacturing	40%	85
Industrial Unspecified	39%	1,201
Meat, Beverage or Food Processing	35%	26
Movie, TV or Radio Studios / Towers	30%	52
Chemical, Mineral, Concrete, Cement, Rock & Gravel Processing & Refining	18%	52

3.2.3.3 Government Parcels Pavement

Our countywide parcels dataset includes a land use code for parcels with government functions. Note that this 'government use' classification is distinct from government ownership. Government agencies can own parcels that serve commercial, residential, industrial, or agricultural purposes, and these parcels receive land use codes corresponding to their actual function, not their government ownership. The government land use codes in our dataset specifically identify parcels used for government operations, which are broken down into the subcategories used in Table 3.5.

At the top of the list is the land use code description "Government owned - unspecified" with 16,359 parcels containing 17,023 acres of pavement. These parcels actually serve diverse functions. For example, a closer investigation of these unspecified parcels reveals that there are parks, flood control areas, government service buildings, transportation corridors, parking lots, plazas, and museums in these parcels, but without being assigned the corresponding parcel use code. This discrepancy likely reflects limitations in administrative processes for assigning parcel use codes rather than accurate descriptions of actual land use. Since government parcels are often more accessible for depaving initiatives, mislabeling their land uses as 'unspecified' risks overlooking high-potential sites. Understanding and accurately reclassifying these parcels can help identify promising depaving opportunities on land already under public control.

Table 3.6 shows the government land use code parcel pavement broken down by land use subcategories, but only for unincorporated areas.

Table 3.5: Government land use code parcels by land use subcategory countywide (incorporated and unincorporated)

GOVERNMENT USE DESCRIPTION	TOTAL PAVEMENT ACRES	PARCEL COUNTY
Government-owned – unspecified	17,023	16,359
Airports	3,687	166
College, High School, Elementary School and other Public School	2,774	911
Harbor and Related	2,048	60
Vacant Land, Government-owned	1,226	4,149
Pier, Wharf	844	8
Parks, Recreation, Horses, Ball Fields, Pools, Amusement Rides, Stadiums, Scouts, Beaches	837	577
Flood Control Drainage	641	630
Dump Sites	624	250
City Hall, Central Government Services, Police, Fire, Court, Jail, Postal	300	195
Dam, Reservoir, Tank, Sewer Utilities, Water-related, Utility	294	236
Transportation and Rapid Transit	115	66
Libraries, Museums	91	107
Public Housing, Social Services, Community Redevelopment	66	123
Right-of-Way Parcels (not Right-of-Way between parcels), Parcels that Overlap Streets, Roads, Future Streets, Power Transmission, Parking Leases	47	99
Military Post	31	8

Table 3.6: Government land use code parcels by land use subcategory in unincorporated areas

GOVERNMENT USE DESCRIPTION	TOTAL PAVEMENT ACRES	PARCEL COUNTY
Government-owned – unspecified	2,131	2,385
College, High School, Elementary School and other Public School	461	141
Vacant Land, Government-owned	230	1,750
Dump Sites	199	34
Parks, Recreation, Horses, Ball Fields, Pools, Amusement Rides, Stadiums, Scouts, Beaches	81	70
Flood Control Drainage	71	87
Dam, Reservoir, Tank, Sewer Utilities, Water-related, Utility	11	26
Central Government Services, Police, Fire, Court, Jail, Postal	8	18
Military Post	4	3
Right-of-Way Parcels (not Right-of-Way between parcels), Parcels that Overlap Streets, Roads, Future Streets, Power Transmission, Parking Leases	3	8
Libraries, Museums	3	3
Transportation and Rapid Transit	3	9
Public Housing, Social Services, Community Redevelopment	2	1

3.2.3.4 Vacant Parcels

One of the attributes in the parcel land use codes is a flag for vacant parcels. Although these parcels still carry land use code information about their allowed or proposed uses, they are flagged as vacant because they are, in one way or another, unused or unoccupied. Across Los Angeles County, **168,967 vacant parcels** contain over **14,000 acres** of potentially unused pavement—a striking figure that raises the question of why so much pavement exists on land designated as vacant. This represents a major opportunity for removal, especially since **7,034** of these acres fall within the **23,729 vacant parcels located in populated hotspots,** defined as the top quartile of either heat or flood risk, or the bottom quartile of tree canopy coverage. The distribution of pavement in vacant parcels by use code is shown in Figure 3.8, which begins to shed light on the underlying patterns. While Figure 3.8 shows that most of the pavement in vacant parcels is categorized as residential or industrial, this does not mean that vacant residential and industrial parcels tend to have more of their area covered in pavement. Table 3.7 shows the average vacant parcel area covered by pavement by land use category, indicating that generally commercial vacant parcels are more paved, while residential vacant parcels tend to have lower pavement coverage per parcel.

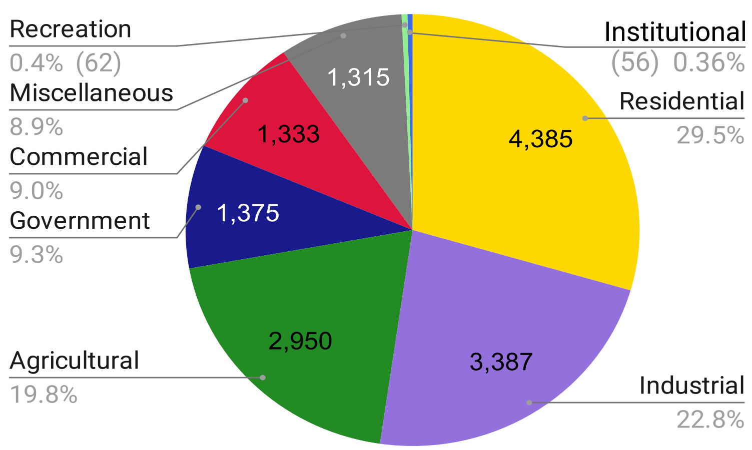


Figure 3.8: Pavement acreage in vacant parcels according to parcel land use category countywide (incorporated and unincorporated)

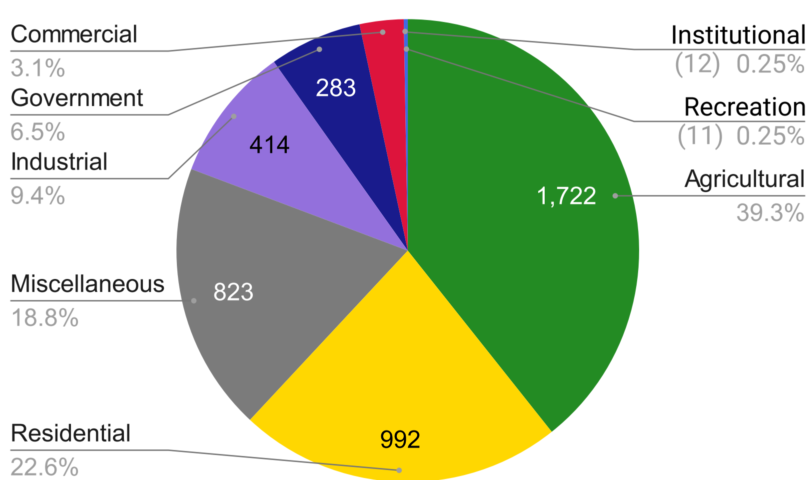


Figure 3.9: Pavement acreage in vacant parcels according to parcel land use code (unincorporated)

Table 3.7: Average pavement percent of vacant parcel area by land use code subcategory countywide (incorporated and unincorporated)

AGGREGATED LAND USE VACANT	AVERAGE PAVEMENT PERCENT OF PARCEL AREA	PARCEL COUNT
Commercial Vacant	46%	8,829
Industrial Vacant	37%	11,744
Institutional Vacant	32%	167
Recreation Vacant	24%	216
Government Vacant	21%	4,281
Miscellaneous Vacant	12%	2,581
Residential Vacant	11%	89,948
Agricultural Vacant	1%	51,200

Table 3.8: Average pavement percent of vacant parcel area by land use code subcategory in unincorporated parcels only

AGGREGATED LAND USE VACANT	AVERAGE PAVEMENT PERCENT OF PARCEL AREA	PARCEL COUNT
Industrial Vacant	35%	1,124
Commercial Vacant	28%	1,270
Institutional Vacant	21%	33
Government Vacant	4%	1,761
Residential Vacant	4%	35,610
Recreation Vacant	6%	43
Miscellaneous Vacant	3%	1,704
Agricultural Vacant	0.5%	46,085

3.2.4 Public Parcel Pavement by Ownership

In addition to land-use codes, we analysed 49,807 publicly owned parcels using the owner's name to create owner categories such as "Cities," "School Districts," and "County." Figure 3.10 shows how pavement area is distributed across these eight public-ownership categories.

Some may have noticed that while Table 3.5 shows 2,774 acres of pavement with school land use codes, Figure 3.10 identifies 9,542 acres of pavement owned by school districts. This is likely because school districts can own parcels with non-educational land use codes. For example, a school district may own a storage yard, or a bus transit parcel, or a piece of vacant land, while the owner in the public parcels dataset will be the school district, the land use code will reflect those uses. (Note that in either case, this does not include private schools, which together with public school campuses contain 15,240 acres of pavement, much of which is on parcels not having school land use codes). Similarly, Figure 3.10 identifies 1,104 acres of pavement on parcels owned by park districts. This reflects just pavement in the public parcels dataset where the owner's name includes keywords like "PARKS" or "RECREATION." When we take a separate parks and open space dataset,[37] we find that parks and open spaces by this definition contain 7,233 acres of pavement, much of which is likely included in Figure 3.10 under Cities, County-Controlled, Federal, and State Owned parcels.

Figure 3.11 shows the public parcel pavement by ownership category but just for unincorporated parcels. Here, as expected the cities become least represented, and County-controlled pavement emerges as the top ownership category.

In summary, the parcels analysis provides a detailed understanding of pavement distribution and potential depaving opportunities within privately- and publicly-owned land. This granular view of individual properties lays a foundation for identifying specific areas where targeted interventions can yield substantial environmental and social benefits. Building upon this parcel-level understanding, the next section will shift focus to right-of-way areas, the publicly-controlled spaces between parcels, to examine the unique challenges and opportunities for pavement removal within these essential connective corridors.

ROW locations are publicly controlled, and hence might provide opportunity for depaving.

3.3 ROW ANALYSIS

3.3.1 Summary of ROW Analysis Findings

The land between parcels is called the right-of-way (ROW) for this analysis. By far the dominant pavement type within the ROW is roads, although most sidewalks are suspected to fall within the ROW. The remaining pavement within rights-of-way that is not roads or sidewalks is typically median strips, wide shoulders, virtual gores[38] and street parking. For this study we identified pavement areas that are used as roadways to distinguish them from other types of pavement. The total acres of these types of pavement in the ROW are shown in Figure 3.12, along with the areas of other land cover classes such as tree canopy, bare ground (which can be pervious like soil, or impervious like rock), grass, shrubs, and buildings. Roads and non-road pavement combined to a total pavement area in the ROW of 128,381 acres.

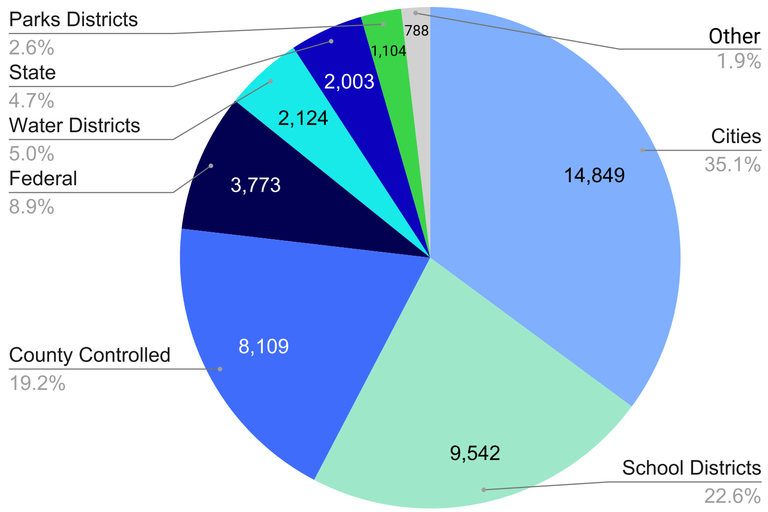


Figure 3.10: Total pavement in publicly-owned parcels by parcel ownership category (including in incorporated and unincorporated areas)

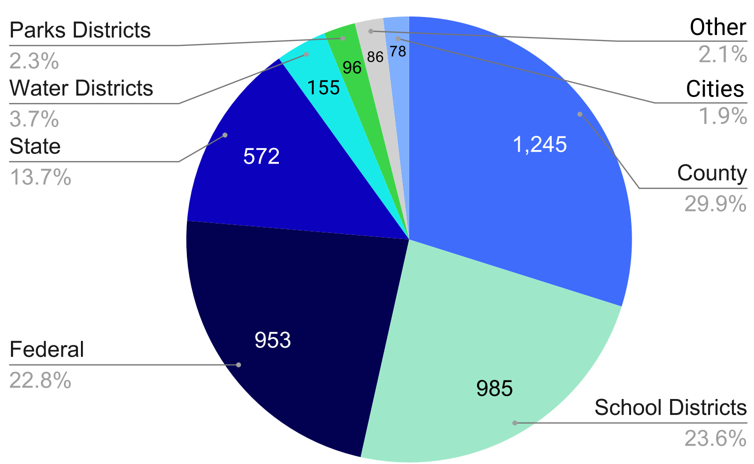


Figure 3.11: Total pavement in publicly-owned parcels by parcel ownership category just in unincorporated parcels

This ROW analysis was conducted to provide clearer insights into street pavement conditions. **Like the publicly-owned parcels mentioned in Section 3.2.3.3, ROW locations are publicly controlled, and hence might provide opportunity for depaving**. Depaveable area within the ROW is also important because it allows tree well planting along residential and commercial streets to increase shade cover along active transportation routes. Larger, freeway-associated ROW spaces, could also allow for vegetated air barrier planting, which the US EPA recommends as a strategy for improving air quality.[39]

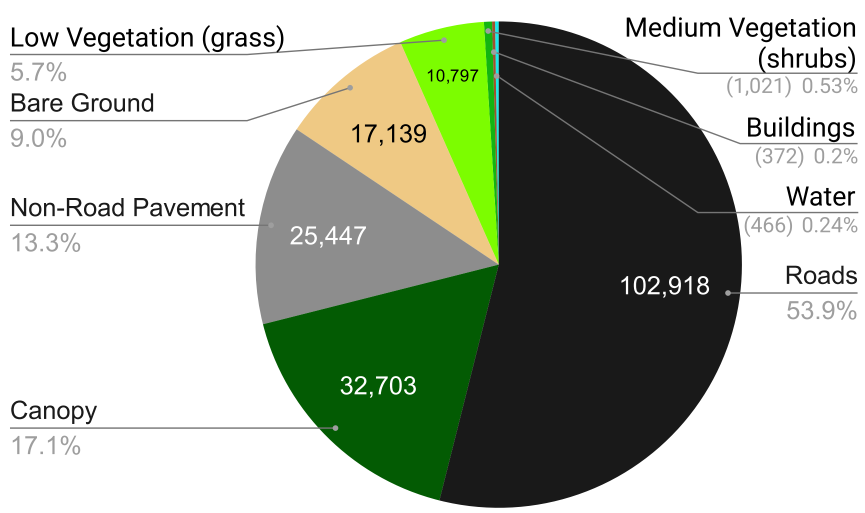


Figure 3.12: Acreage of right-of-way land cover classes countywide (incorporated and unincorporated)

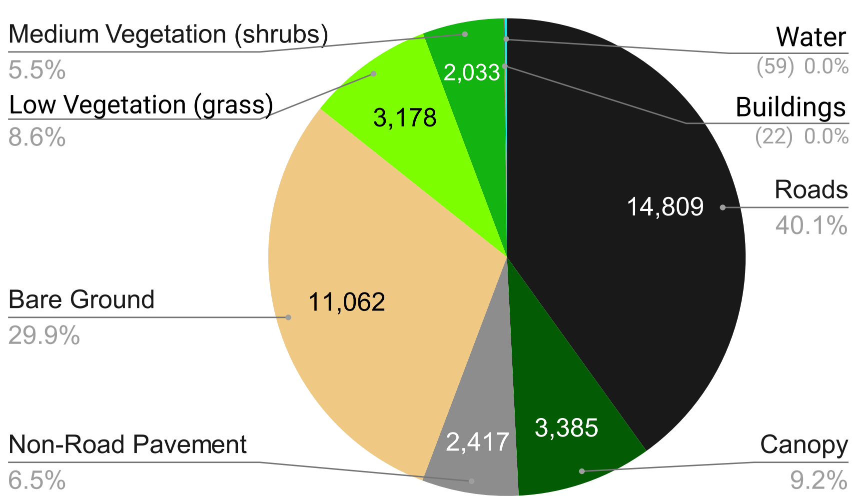


Figure 3.13: Acreage of right-of-way land cover classes in unincorporated ROW

3.4 SUPERVISORIAL DISTRICT ANALYSIS

As Figure 3.14 shows, supervisorial districts vary greatly in their landcover composition. Districts 1, 2, and 4 have pavement as their largest category, with District 2 showing both the highest pavement percentage and being among the lowest tree canopy percentages. Districts 3 and 5 have relatively lower pavement coverage as a percentage of their total area, with District 3 having the highest tree canopy coverage (due to its location in the Santa Monica Mountains), and District 5 having the most prominent presentation of bare ground.

We can take the pavement component of this figure by summing the road and non-road pavement, and further classifying it by land use category as shown in Figure 3.15.

As Figure 3.15 shows, for all of the supervisorial districts, the largest categories of total pavement are rights of way followed by residential. However, the third ranked pavement type is industrial for Districts 1, 2, and 4, government for District 5, and commercial for District 3.

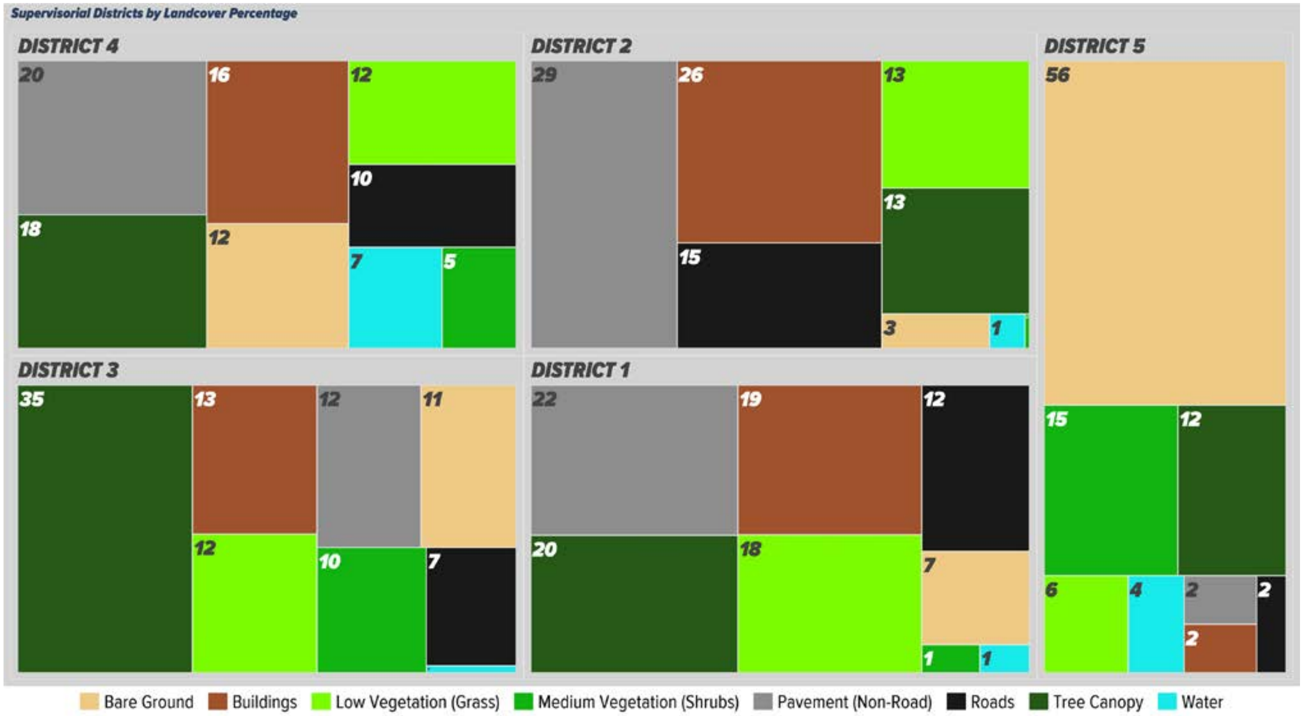


Figure 3.14: Landcover percentage distribution by Supervisorial District

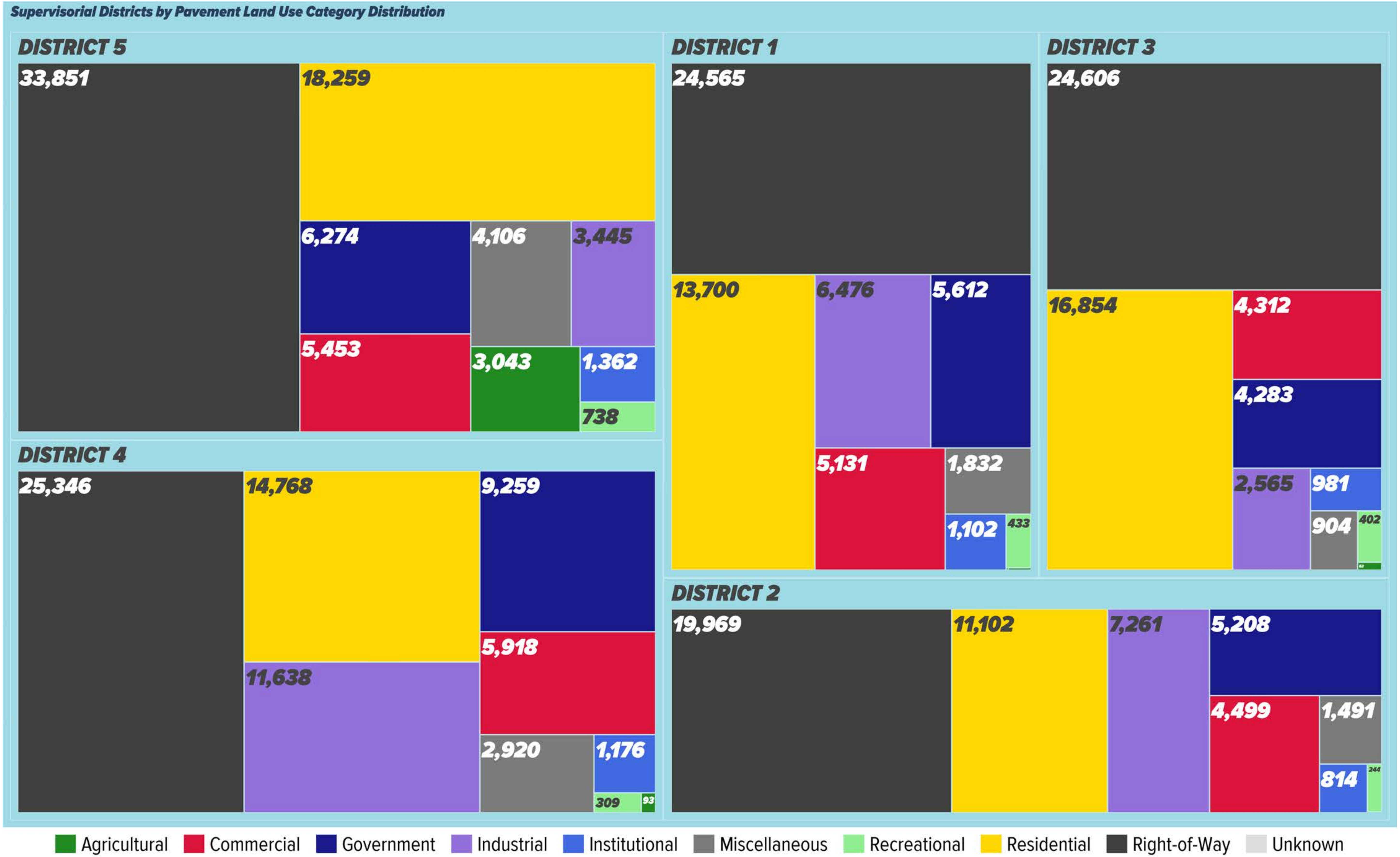


Figure 3.15: Supervisorial Districts by pavement land use category distribution

3.5 WATERSHED ANALYSIS

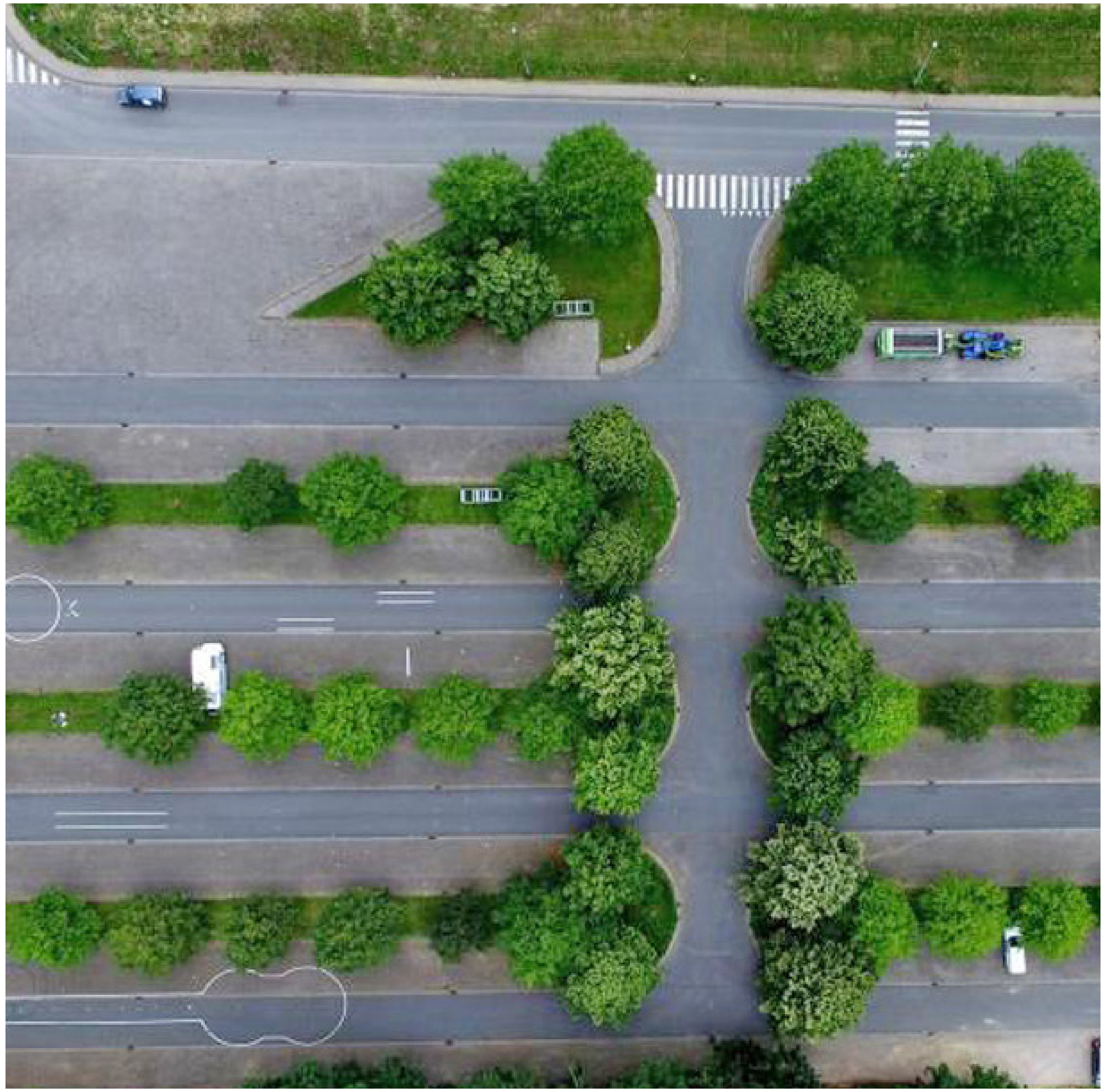
Understanding the amounts of total pavement, road pavement, and non-road pavement within Los Angeles County watersheds, both within parcels and inter-parcel rights-of-way, is crucial for initiating targeted depaving projects. This data provides a baseline for assessing each watershed's current impervious surface coverage, which directly impacts stormwater runoff, water quality, and groundwater recharge.

By quantifying these distinct pavement types in various locations, we can identify high-priority areas for intervention, such as excessive non-road pavement in parcels contributing to localized flooding, or extensive road pavement in rights-of-way hindering infiltration. This granular information allows for the development of watershed-specific strategies that maximize the benefits of depaving for improved water management, reduced pollution, and enhanced ecological health within Los Angeles County. Analyzing watersheds side by side reveals great variance in land cover and land uses, and thus require different solutions and attention.

Figure 3.16 highlights pavement distribution by watershed area. Certain watersheds such as the Santa Clara River and North Santa Monica Bay have relatively lower pavement. By contrast, watersheds like South Santa Monica Bay, Lower San Gabriel River, and Lower Los Angeles River have high levels of non-road pavement (shown in gray) suggesting greater need for depaving.

Further breaking down the pavement by land use categories as in Figure 3.17 shows that while all of the watersheds except Lower San Gabriel River have rights-of-way as their top ranked land use category, they differ substantially in other pavement uses. For the Upper Los Angeles River watershed, for example, as well as the Upper San Gabriel River, Central Santa Monica Bay, Rio Hondo, Santa Clara, and North Santa Monica Bay watersheds, the second-ranked land use category is residential, while for the South Santa Monica Bay, Lower Los Angeles River, and Lower San Gabriel River, industrial is

This data provides a baseline for assessing each watershed's current impervious surface coverage, which directly impacts stormwater runoff, water quality, and groundwater recharge.



ranked second. The third-ranked land use category is government for the Upper Los Angeles Riverand Central Santa Monica Bay, industrial for Upper & Lower San Gabriel River and Santa Clara River, and commercial for Rio Hondo and North Santa Monica Bay.

By focusing on parcel pavement only, we can see which types of parcels have the highest percentage of high flood confidence area as shown in Figure 3.18.

In Figure 3.18, the Upper Los Angeles River, Upper San Gabriel River, and Rio Hondo show higher flood risks on government and miscellaneous parcels. The Lower Los Angeles River, however, as well as the Central Santa Monica Bay watersheds show residential pavement as having high flood risk. Lower Los Angeles River and Upper San Gabriel River also see high flood risk on industrial pavement.

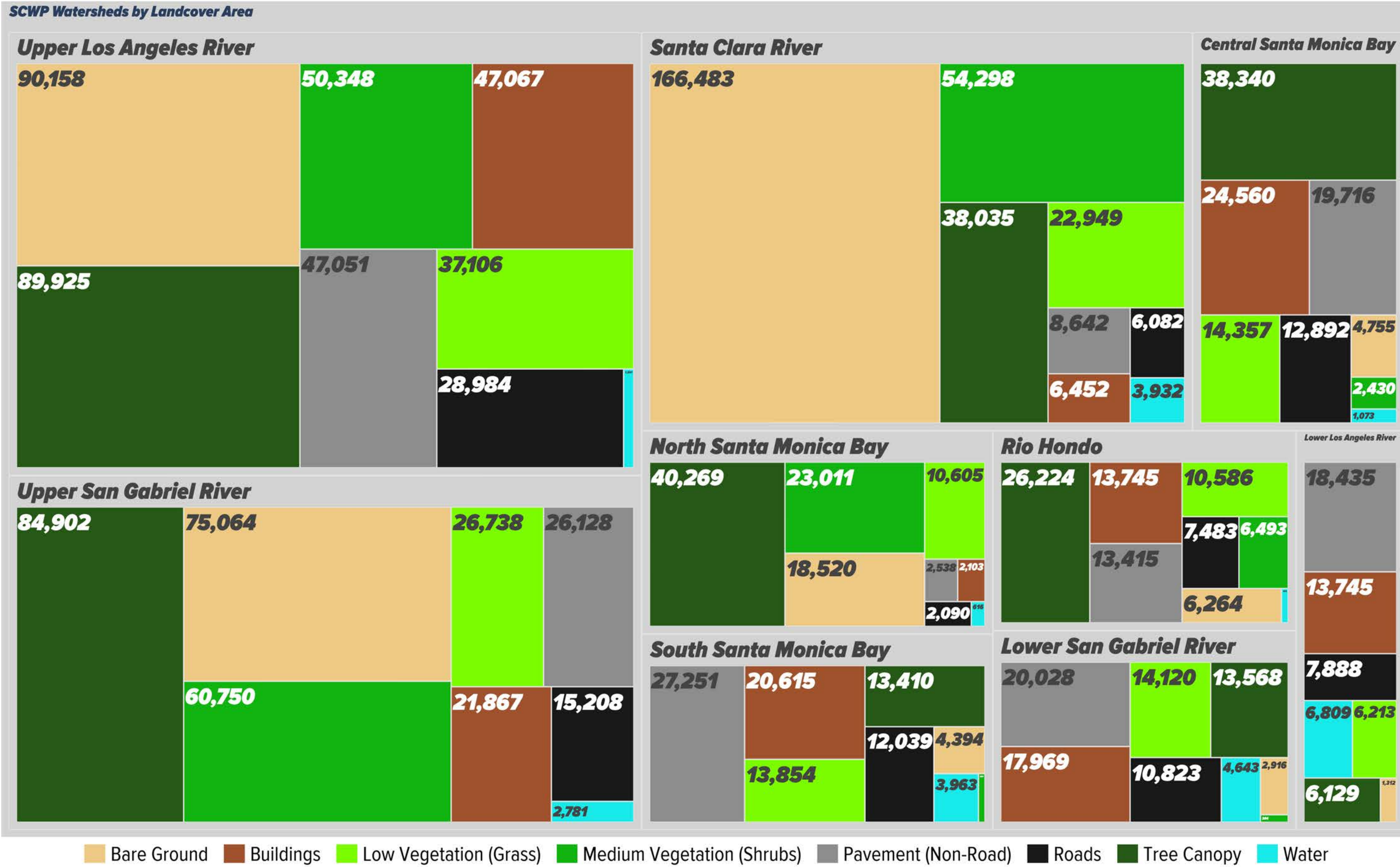


Figure 3.16: Watershed landcover area distribution

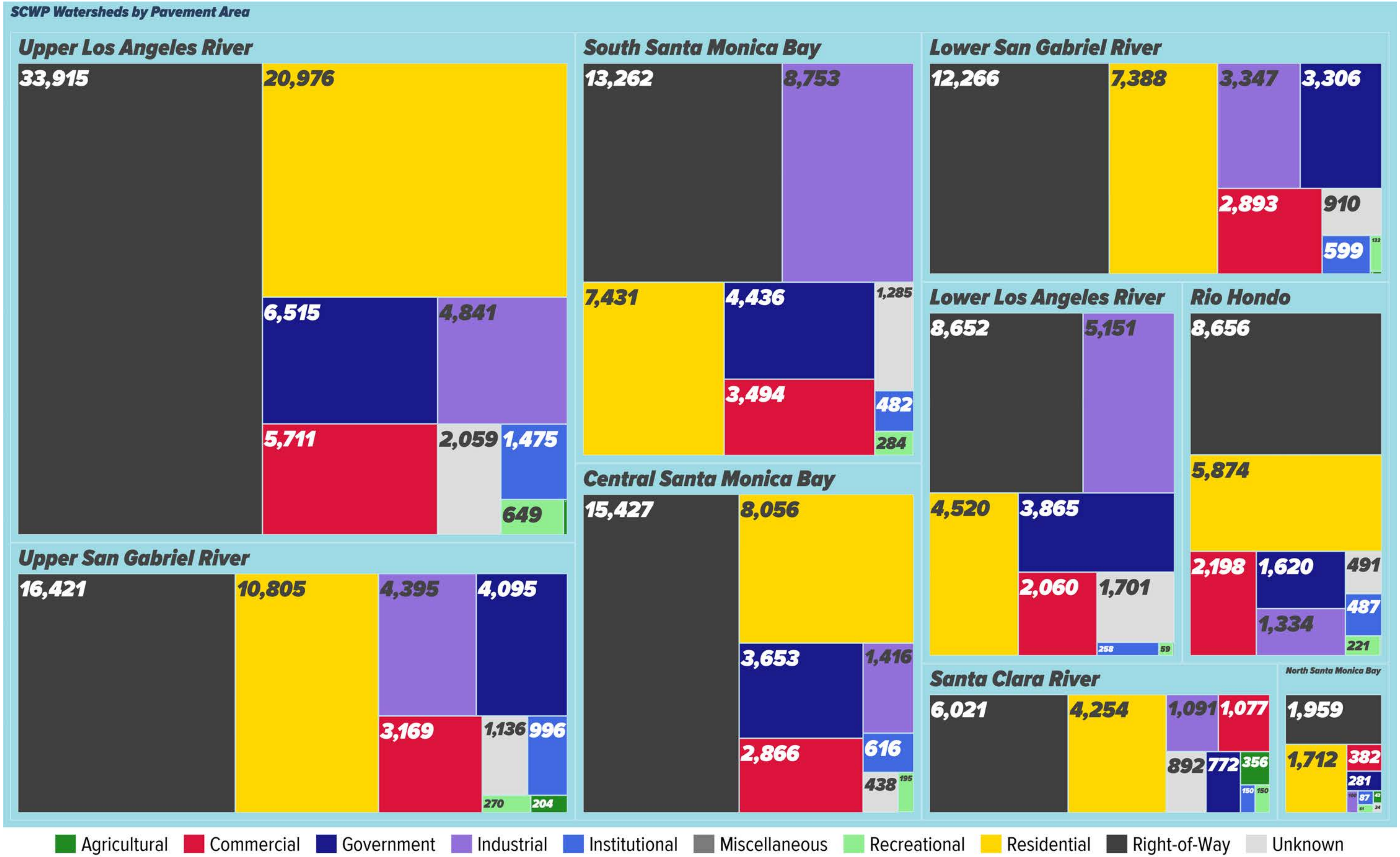


Figure 3.17: Watershed pavement by use category distribution

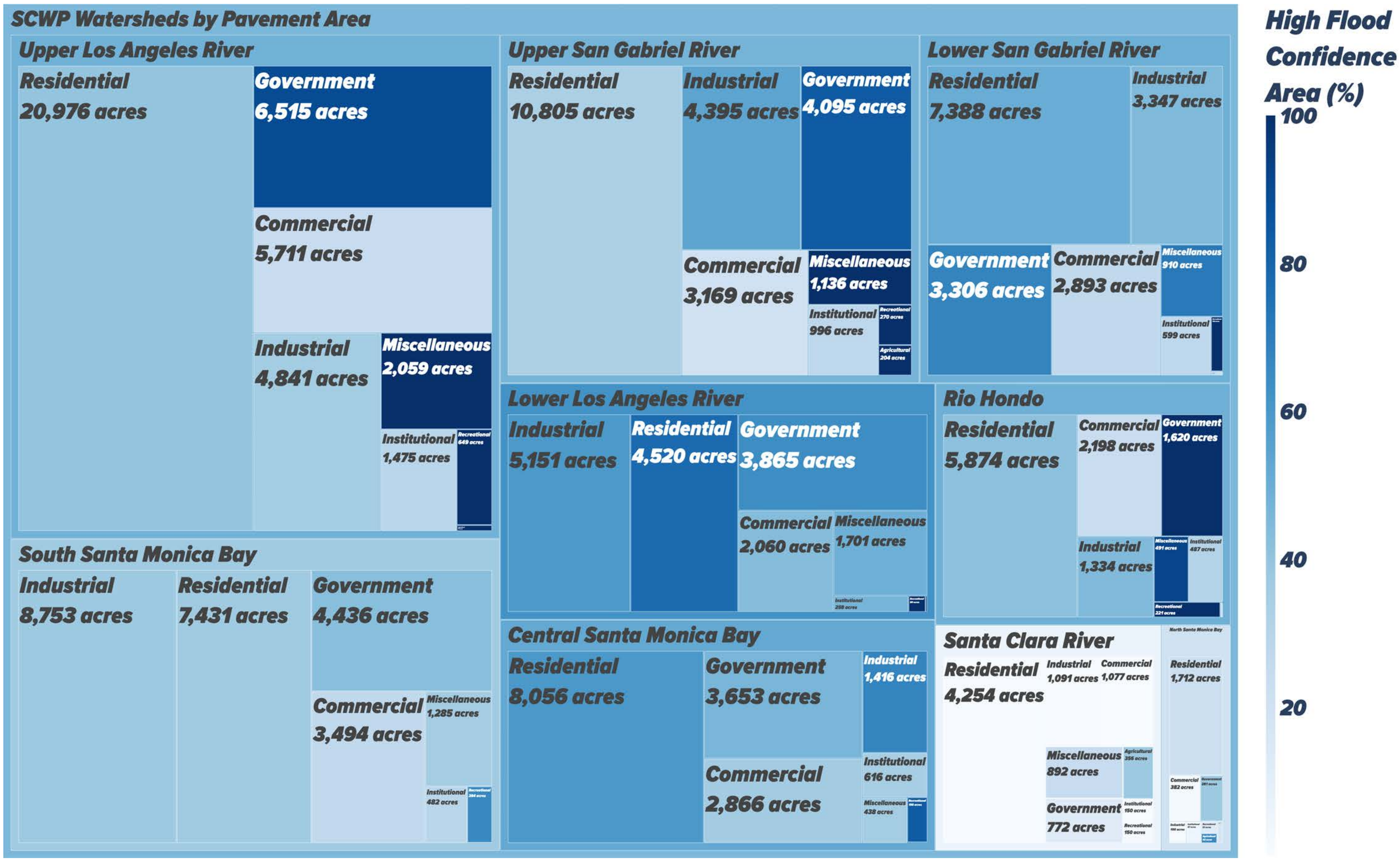


Figure 3.18: Watershed pavement by use category area colored by parcel high flood confidence area percent

3.6 COMMUNITY ANALYSIS

The distribution of pavement across right-of-way and parcel use categories has been calculated for all of the CSAs in the County. For details on additional ranking and specific communities, please see the depave.la website.

The top 25 CSAs by pavement coverage are shown in Figure 3.19. In most cases, rights-of-way make up the largest single category of paved surfaces. However, industrial land is more predominant in Carson, San Pedro, and the City of Industry. A small community such as Westchester, home to the LAX airport, is notable for a high percentage of paved government-owned land compared to its rights-of-way. These variations in pavement distribution across land use types provide insight into which depaving strategies may be best suited to each area.

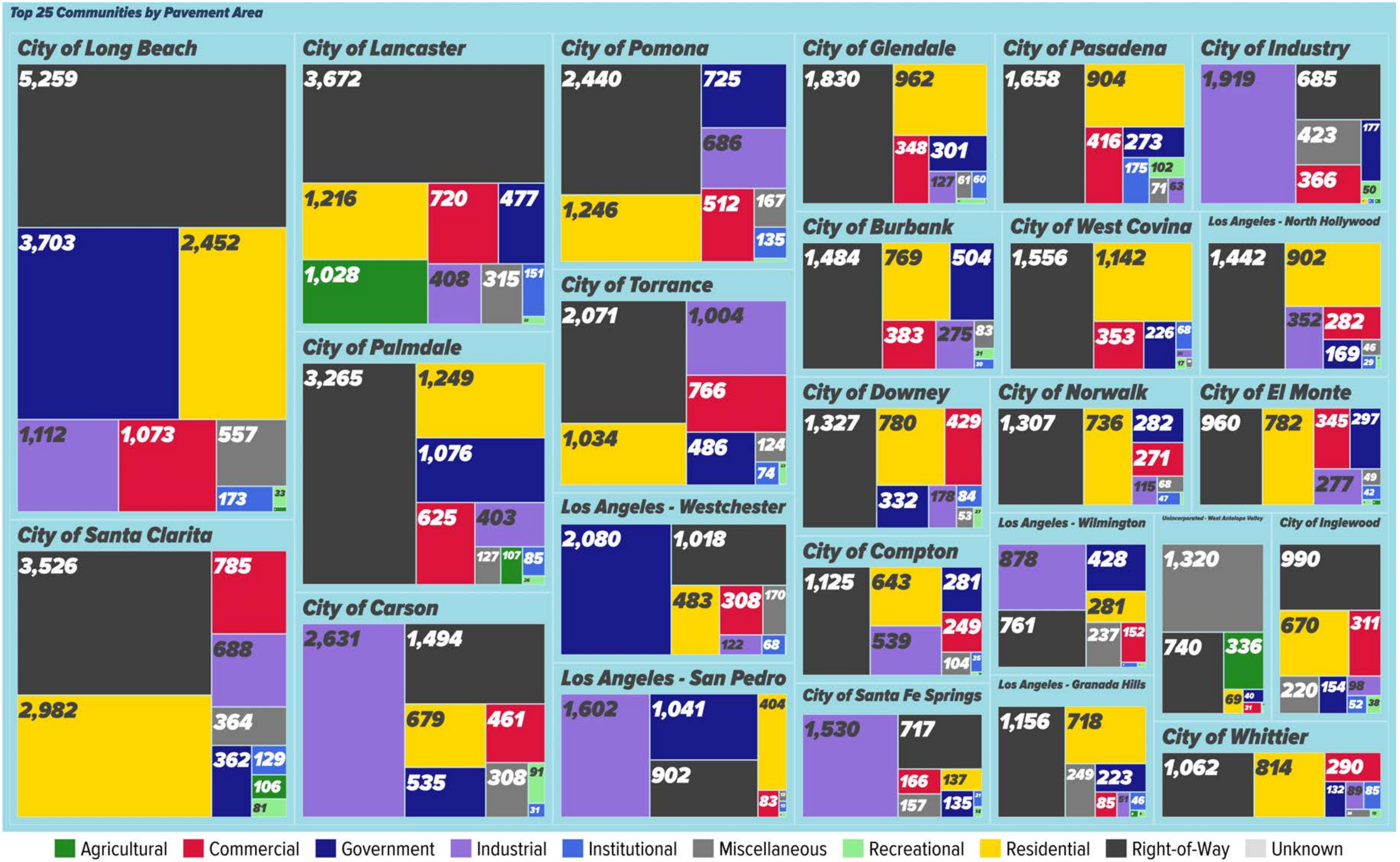


Figure 3.19: Pavement use category distribution for top 25 CSAs by pavement area

3.7 SCHOOLS ANALYSIS

We have also estimated the pavement coverage in each of the 3,179 school parcels. These schools together have an estimated total enrollment of 2,084,992 students, and at least **15,240 acres** of pavement, which is roughly **137 square feet of pavement per student**.[40] For each school campus, we have calculated the total pavement coverage, flood risk statistics, and median hot summer afternoon surface temperature. See, for example, the case of Fifty-Fourth Street Elementary in Figure 3.20. To see similar figures for other schools, please visit the depave.la website.

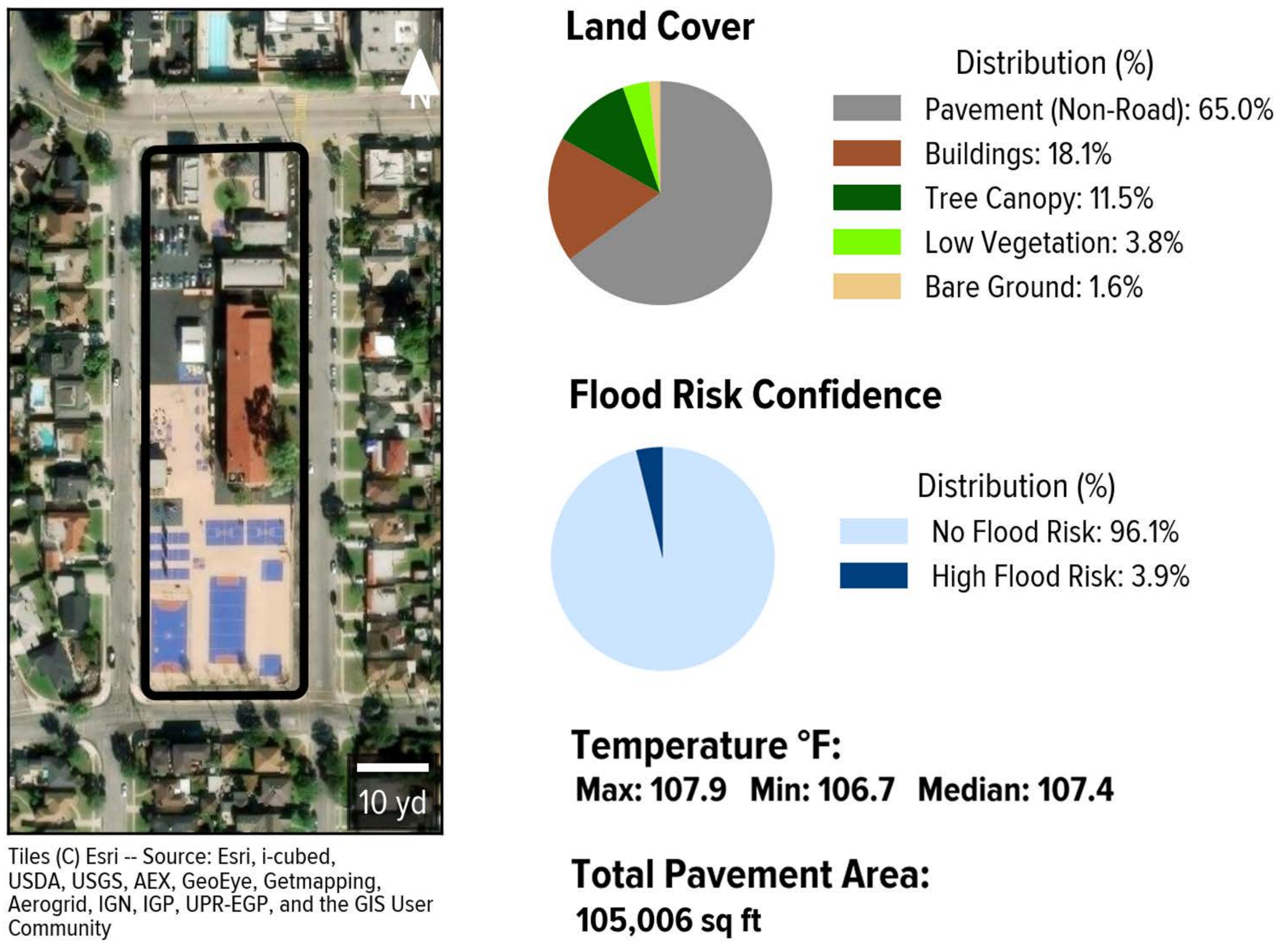


Figure 3.20: Land cover distribution for Towne Avenue Elementary School

3.8 VISION ZERO PAVEMENT ANALYSIS

We have also estimated the pavement coverage in each Vision Zero road segment. Figure 3.21 highlights Crenshaw Blvd between 147th street and Manhattan Beach Blvd as an example, with flood risk, temperature and total pavement area also shown. To see similar figures for other Vision Zero segments, please visit the depave.la website.

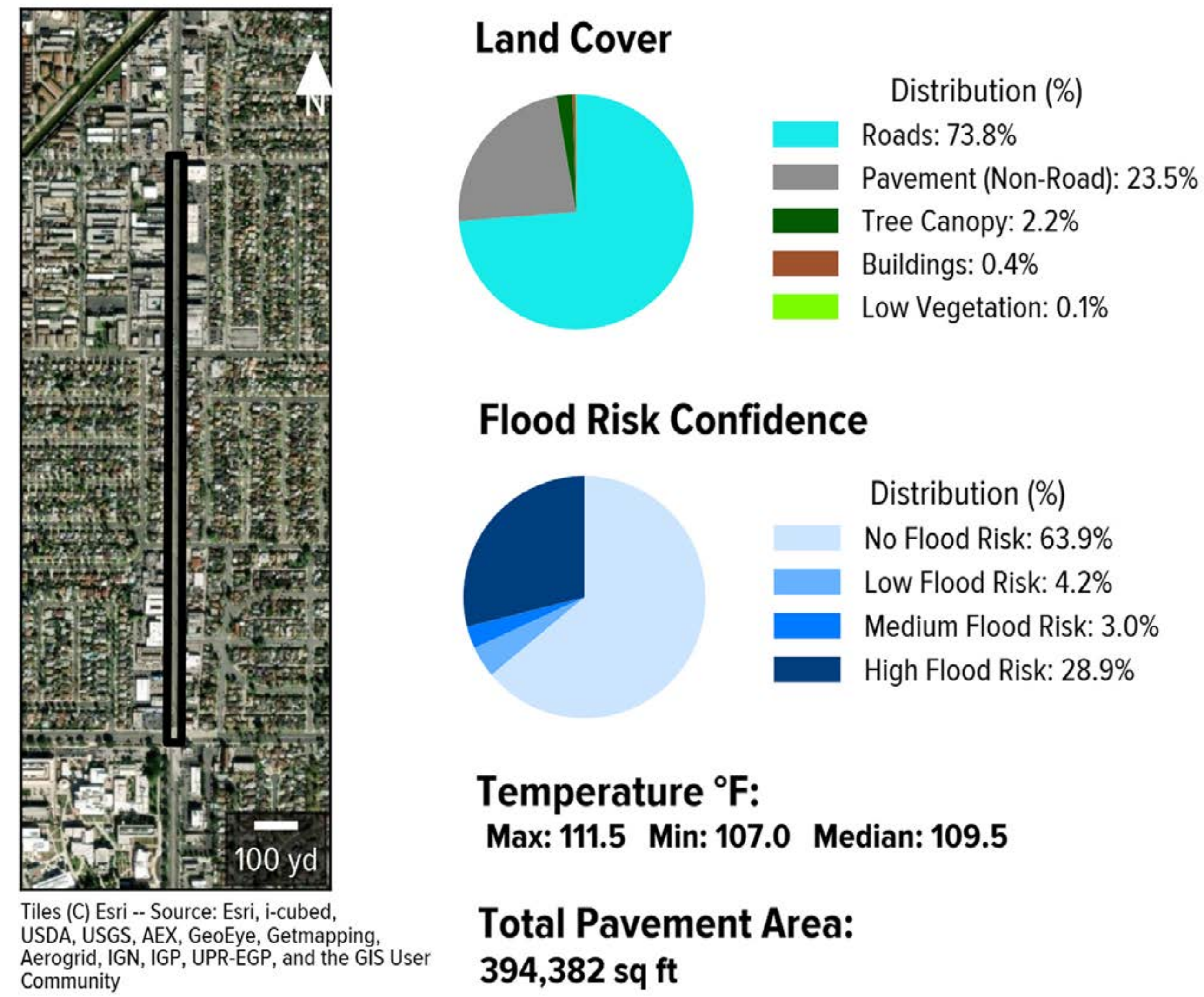


Figure 3.21: Land cover distribution of Crenshaw Blvd from 147th street to Manhattan Beach Blvd.

3.9 TOP NEEDS QUANTILE ANALYSIS

3.9.1 Each Need Separately

Figure 3.22 shows the distribution of land use categories within the top quartiles of population-filtered heat, flood, and low canopy coverage. The total pavement in the top quartile of high flood risk zones is **135,070 acres**, in high heat zones **27,331** acres, and in low canopy areas **16,617** acres. The maps in Figure 2.42 (Chapter 2) give some clues as to why. The high pavement areas and the high flood areas tend to be in the highly urbanized southern and western portions of the County, while the high heat and low canopy areas tend to be in the less developed (and less paved) northeastern parts of the County. In most high-need areas, right-of-way accounts for the largest single category of pavement, followed by residential and industrial uses. The areas with the lowest canopy have unusually high industrial pavement area, and relatively low residential and commercial. This analysis used 70 meter hexagons to aggregate pavement to need quartiles. As shown in the next section, this aggregation method allows us to also look at combinations of needs.

3.9.2 Stacked Needs Pavement Analysis

If we combine the population-filtered pavement, heat, flood, and canopy needs quartiles and only keep those areas that fall within the top quartile of **all 4 categories** (when they are aggregated to 70 meter hexagons[41]), we arrive at **788 acres** of pavement. The distribution of this pavement is shown in Figure 3.23:

This distribution points to government and industrial pavement as the largest categories in the highest risk areas. **Although residential parcels have the majority of parcel pavement countywide, in the highest combined risk areas (with overlapping heat, flooding, pavement, and canopy problems) government and industrial parcels are the largest contributors to parcel pavement.**

We can broaden our definition of high risk to include the top half of each need category while still requiring an area to fall into all categories. This results in **37,765 acres** of high need pavement, with the distribution shown in Figure 3.24.

In this scenario, **ROW** becomes the top land use category, with **14,302 acres,** while **industrial, commercial, and residential** are all very similar around **6,000 acres each**.

Although residential parcels have the majority of parcel pavement Countywide, in the highest combined risk areas government and industrial parcels are the largest contributors to parcel pavement.

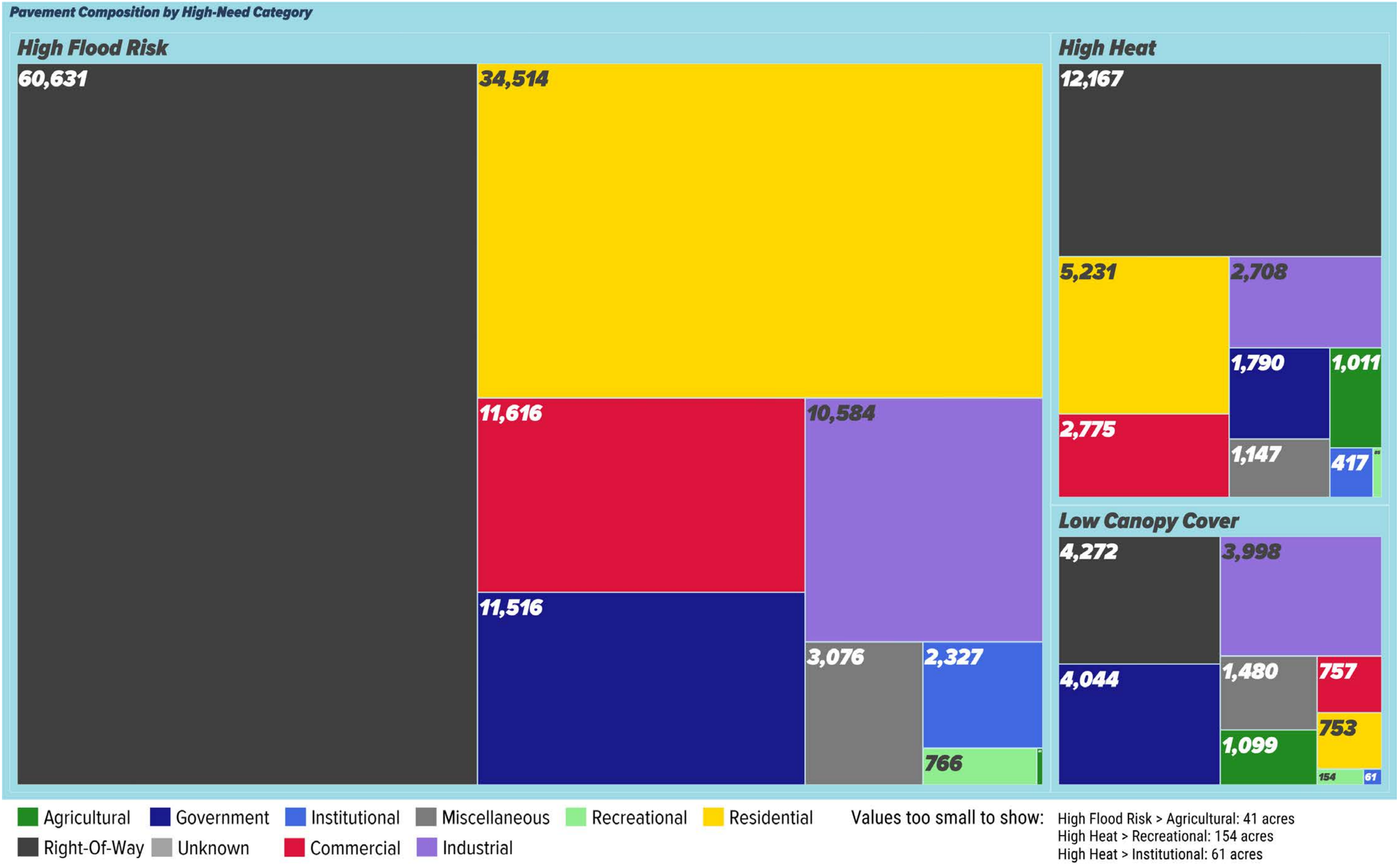


Figure 3.22: Pavement area by parcel use categories in top quartiles of population filtered extreme heat, high flood risk, and low canopy areas

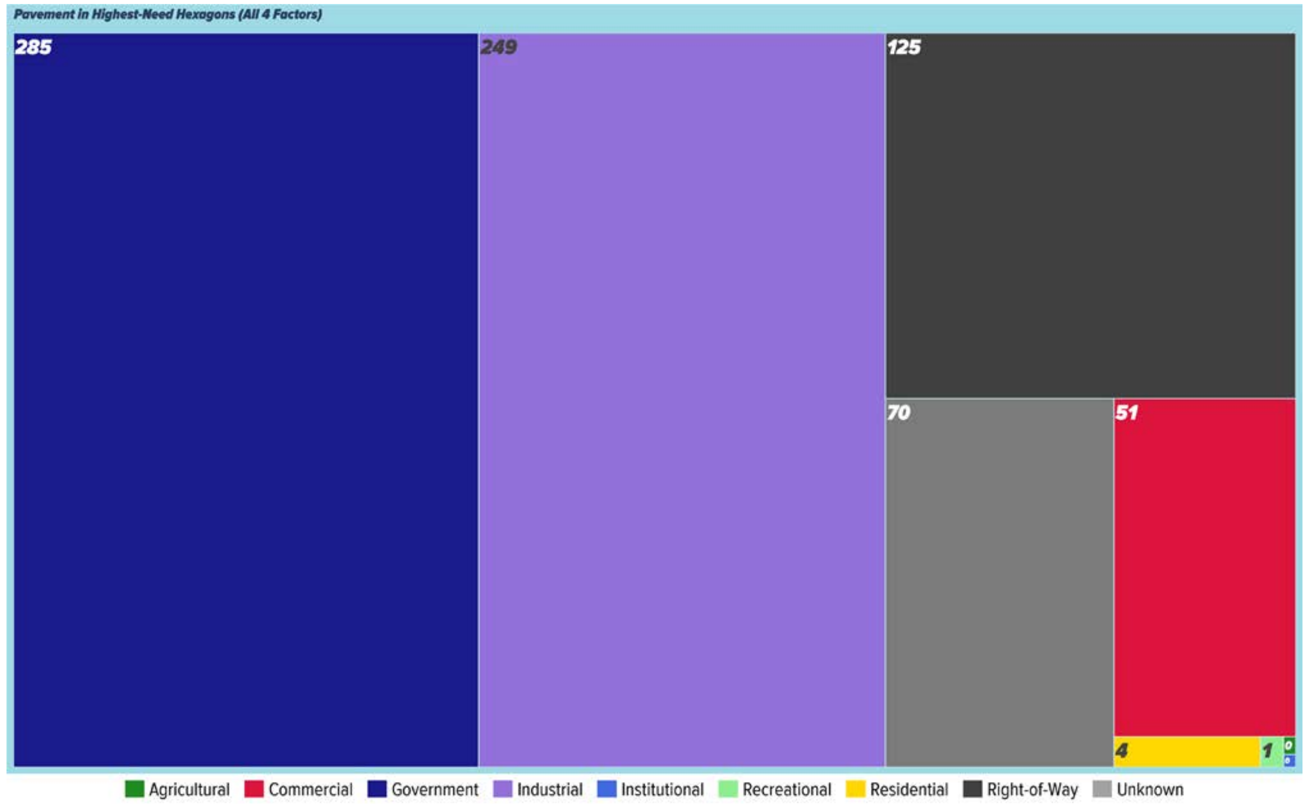


Figure 3.23: Pavement distribution per land use category in areas that fall within the top quartiles of all of population-filtered heat, flooding, canopy, and pavement

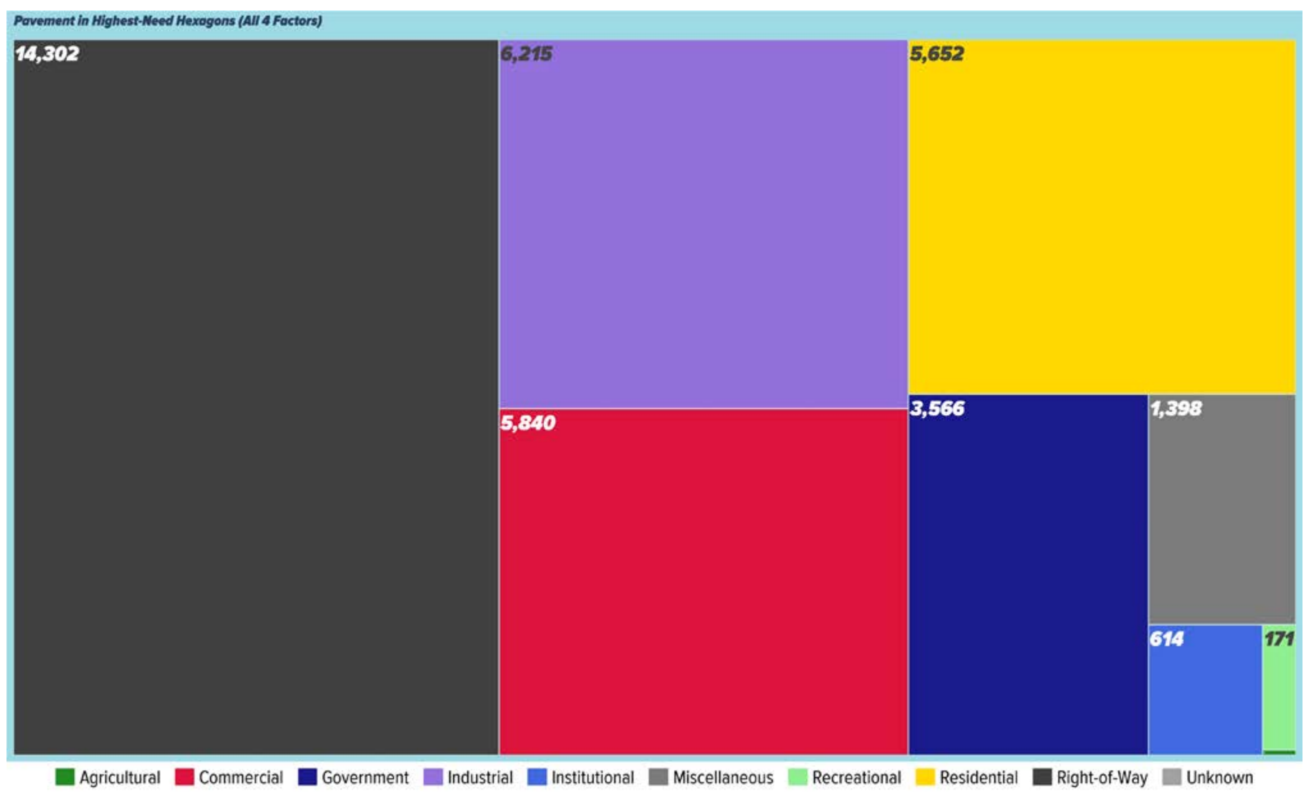


Figure 3.24: Pavement distribution in the 50th percentile of population filtered pavement, heat, flood, and low canopy areas

3.10 CHAPTER 3 CONCLUSIONS

This chapter has provided a foundational spatial analysis of pavement distribution across Los Angeles County, revealing that the County contains **~312,453 acres (≈488 sq mi) of pavement, with ~141,567 acres on private parcels, ~42,505 acres on public parcels, >14,000 acres on vacant parcels, and ~128,381 acres in ROW.**

While single-family parcels contribute the largest share of pavement on residential land by sheer acreage, multi-family parcels, industrial yards, and parking areas are far more pavement-intensive. Hotspot analysis revealed a mismatch between locations with the highest pavement and locations with the greatest need. Industrial parcels account for the most pavement in high-risk areas, but ROW becomes the largest contributor under broader needs assessment criteria. ROW corridors with wide medians and oversized lanes offer retrofit potential. Publicly-controlled land, such as schools and government facilities, also stand out as strategic opportunity sites for depaving, alongside vacant commercial and industrial sites.

Together, these results provide the foundation for a multidimensional framework for prioritizing interventions and designing equitable, impactful depaving programs. Chapter 3 provides a clear, multi-scale map of the pavement problem, by acres, intensity, geography, and spaces within public control. In the next chapters, we will determine **how much** of that hardscape is *non-core* and **how** to remove it where benefits are greatest.

Los Angeles County contains ~312,453 acres (≈488 sq mi) of pavement, with ~141,567 acres on private parcels, ~42,505 acres on public parcels, >14,000 acres on vacant parcels, and ~128,381 acres in ROW.

CHAPTER 4

PAVEMENT NECESSITY ANALYSIS

This chapter uses transparent, rule-of-thumb heuristics to separate core pavement (roads, minimum off-street parking, and sidewalks) from a residual category we call non-core pavement, an *upper-bound* for what might be removed under ideal conditions. The result is a refined understanding of where pavement removal should be pursued to maximize benefits (such as cooling, stormwater management, tree canopy, and street safety) while minimizing impacts on core pavement functions.

4.1 INTRODUCTION

Chapter 3 of this assessment discussed the distribution of pavement across parcel uses, owner categories, rights of way, watersheds, and the like, without attempting to discern how much of that pavement needs to remain, and how much could potentially be removed. This chapter builds upon that analysis by exploring ways of conceptualizing and quantifying pavement "need" through land use codes and zoning laws. We do this by employing heuristics to classify pavement quantities as core pavement; what is left is termed non-core pavement.

What is a heuristic? In this context, we are using the term heuristic in the sense well described by the following quote from wikipedia:

> **A *heuristic* or *heuristic technique*** *(problem solving, mental shortcut, rule of thumb) is any approach to problem solving that employs a pragmatic method that is not fully optimized, perfected, or rationalized, but is nevertheless "good enough" as an approximation or attribute substitution. Where finding an optimal solution is impossible or impractical, heuristic methods can be used to speed up the process of finding a satisfactory solution."*[42]

The numbers in Chapter 3 were derived from deterministic calculations of remote sensing and other vetted data sources such as visible landcover categories summed across parcel boundaries. The heuristics outlined in the following Chapter 4, however, may include more approximate calculations, taking the County requirement for parking space area on a few parcel types, for example, and then extrapolating across all of the cities and parcels to get an estimate of the Countywide parking area requirement. Keeping in mind the heuristic nature of such a calculation becomes especially important when we combine the results with the data from Chapter 3.

While the total non-road pavement was measured with aerial imaging, the parking area was not measured, but rather guessed at from how much parking is required (in some cases) and how much pavement is present. This is useful for filling gaps in remote sensing data. While in the future it may be practical to properly measure all of the sidewalks and parking lots in the entire County, for now, we can use heuristics not only to estimate the quantities of these things, but also to **extrapolate** their relevance to the **Design & Planning strategies** outlined in Chapter 5, and to **create benchmarks** for assessing depaving progress in the future.

The utility of such heuristics also lies in our need for estimates of **depaving opportunity**. Now that we know how much pavement exists and where it exists (from Chapter 3), how much of that pavement do we estimate can be removed without interfering with critical infrastructure (such as roads for driving, sidewalks for walking, and spots for parking)?

To narrow the potential for pavement removability, we focus on three assumptions:

1. Roads are needed for transport and so any pavement used in roads was conservatively considered to be core pavement in this heuristic.
2. A certain amount of pavement is needed for parking, so we estimated how much parking is required, and considered that pavement to be core pavement.
3. A certain amount of pavement is required for sidewalks, and so we estimated how much and included it in our core pavement category.

What remains after applying these heuristics is a great deal of pavement, much of which is still core pavement. There are many patios, walkways, ball-courts, courtyards, plazas, skateparks, loading areas, and storage pads, for example, that must remain in place to serve their function. However, this exercise is meant to set an optimistic ceiling, not a prescription.

After applying the three heuristics, whatever pavement remains we have labeled “non-core pavement,” while remaining fully aware that many of these remaining hardscapes often serve valid functions and may stay in place. Because those site-specific uses are too varied to inventory at scale, we treat them collectively as a single unknown. The resulting total therefore represents an upper-bound estimate[43] of how much pavement *could* come out, not a realistic forecast of what *will* or even *should* be removed.

Terminology

There are many terms like *core, essential, prescribed*, and *allocated* used across the planning, engineering, and design fields that sound similar, but carry different implications. In response, and to reduce the risk of misinterpretation, we adopt the more conservative, two-bucket nomenclature used throughout this report: **core pavement** and **non-core pavement**.

Core pavement refers to pavement likely required to meet basic mobility and access needs under current codes and practices. At this countywide scale of analysis, this includes roads, a code-informed estimate of minimum parking requirements, and standard sidewalk infrastructure. **Non-core pavement** is simply the remainder after those core needs are accounted for. This framing clarifies our stance: we are not certifying that specific pavement can or should be removed; we are identifying a theoretical upper bound on what might warrant closer evaluation.

Caveats to the Chosen Terms

Heuristics and countywide approximations should not be treated as prescriptive, legal, or design-level findings. First, codes vary by jurisdiction and change over time: what is “prescribed” in one city may be optional or differently calculated in another. This is important to remember for this assessment, as we just used County codes for reference, and did not evaluate different code requirements across the eighty-eight cities. Second, code minima do not equal operational need. Actual demand, site circulation, ADA access, emergency response, loading, utilities, drainage, and frontage conditions can increase (or occasionally decrease) what is *functionally* essential on a specific site. Third, our land-cover–based “road” versus “non-road pavement” distinction inherits classification and boundary uncertainties (e.g., medians, alleys, private drives near ROW lines). Finally, labeling the residual as “non-core” is not a claim of removability. Many patios, courts, service areas, and walkways serve important functions that were not inventoried at scale.

Consistent with that, the report does **not** target roads or required parking for removal. Rather, it highlights the substantial quantity of **other** paved surfaces as the primary arena for near-term depaving opportunity, while still offering some depaving strategies for roads and parking in Chapter 5. Readers should interpret the Chapter 4 estimates as a planning screen to prioritize inquiry, not as a substitute for site-specific analysis, stakeholder engagement, or permitting.

Conversely, pavement that we classify as core is not necessarily non-removable! The massive amount of land dedicated to roads and parking is clearly significant. This report does not consider road and parking pavement because there is such a vast amount of other pavement that could be removed.

4.2 HEURISTIC ANALYSIS OF PAVEMENT NECESSITY

Introduction to Findings

The heuristic analysis of depaving opportunities in Los Angeles County reveals immense potential: of the 312,435 acres of total pavement assessed, approximately 137,438 acres is thought to be non-core pavement, which is to say pavement not in use as roads or thought to be required for parking or sidewalks.

Pavement Necessity Analysis

For this heuristic analysis, we took the total pavement area and removed the road pavement. From what remained, we estimated parking requirements within parcels and removed that amount of pavement from each parcel. We found that the required off-street parking amounted to 28% of pavement for residential parcels, 23% for commercial, and 16% for industrial. We then estimated the required sidewalk area and removed that from the remaining pavement in the ROW. See Chapter 7: Methodology for details of the off-street parking and sidewalk estimation methods.

In Figure 4.1, the black color indicates the percent of total pavement that is used for roads, service roads and some larger driveways. The gray color indicates the percentage of total pavement needed for off-street parking. Yellow indicates sidewalks, while the green color represents the remainder of the pavement, which is non-core pavement, some of which may be potentially removable, and a further subset of that is actually removable. Figure 4.1 on the right also shows the same analysis but just for unincorporated parts of the County. Table 4.1 shows the same breakdown by acreage. Within the countywide right-of-way, we see 15,418 acres of pavement that is non-core as it is not in use for roads or sidewalks. Within parcels, we see 122,020 acres of pavement not in use as roads or off-street parking or sidewalks. If we parse these parcels into private and public parcels, we find around 27,292 acres in public parcels, and around 94,728 in private parcels.

Table 4.2 provides insights from the analysis of pavement not required for roads, parking or sidewalks ("non-core" pavement) in unincorporated parcels and ROW spaces. Within unincorporated areas, there are 23,380 acres of potentially non-core pavement within parcels. In the Right-of-Way (between parcels) we found 1,305 acres of potentially non-core pavement. The majority of potential non-core pavement is in parcels but there is still a significant amount in the right-of-way. This data is further explored and broken down in following sections.

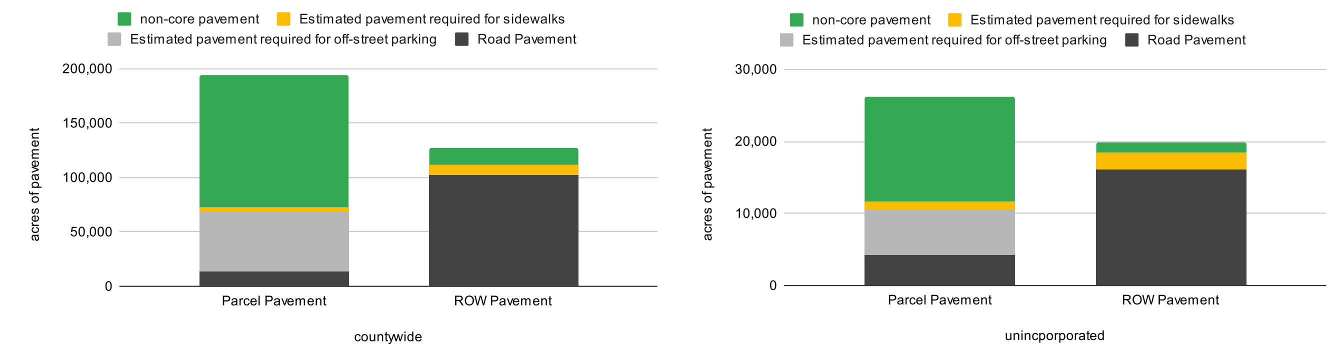


Figure 4.1: Parcel Pavement and ROW Pavement, Core and Non-Core. Left) Countywide (incorporated and unincorporated). Right) Just unincorporated

Table 4.1: Total County-wide (incorporated and unincorporated) parcel and ROW pavement, non-road pavement, road pavement, non-core pavement, and pavement needed for parking

COUNTYWIDE	TOTAL PAVEMENT ACRES	ROAD-PAVEMENT ACRES	NON-ROAD PAVEMENT (NRP) ACRES	ESTIMATED NRP REQUIRED FOR OFF-STREET PARKING (ACRES)	ESTIMATED NRP REQUIRED FOR SIDEWALKS (ACRES)	NRP NOT REQUIRED FOR OFF-STREET PARKING OR SIDE-WALKS (NON-CORE PAVEMENT) ACRES
Total Pavement	312,453	117,208	195,244	54,488	11,956	137,438
Parcel Pavement	184,072	14,275	169,797	54,492	3,587	122,020
Private Parcels	141,567	8,176	133,391	44,518	2,608	94,728
Public Parcels	42,505	6,099	36,406	9,974	979	27,292
ROW Pavement	128,381	102,933	25,447	0	8,369	15,418

Table 4.2: Unincorporated parcel and ROW pavement, non-road pavement, road pavement, non-core pavement, and pavement needed for parking

UNINCORPORATED	TOTAL PAVEMENT ACRES	ROAD-PAVEMENT ACRES	NON-ROAD PAVEMENT (NRP) ACRES	ESTIMATED NRP REQUIRED FOR OFF-STREET PARKING (ACRES)	ESTIMATED NRP REQUIRED FOR SIDEWALKS (ACRES)	NRP NOT REQUIRED FOR OFF-STREET PARKING OR SIDE-WALKS (NON-CORE PAVEMENT) ACRES
Total Pavement	42,337	20,331	22,005	6,358	3,404	15,703
Parcel Pavement	23,380	4,221	19,158	6,358	1,021	14,398
Private Parcels	17,836	2,797	15,039	4,972	742	10,918
Public Parcels	5,544	1,424	4,119	1,386	280	3,480
ROW Pavement	18,957	16,110	2,847	0	2,383	1,305

Total potentially non-core pavement:

If we take the high needs areas defined in Chapter 2, Section 6 (Stacked Needs - Top Quantiles), and apply the heuristic calculations to them, we find that for the **25% of fully overlapping needs**, there is 788 acres of total pavement, with 174 acres reserved for roads, 157 acres reserved for off-street parking, 5 acres reserved for sidewalks, leaving **452 acres** of potentially non-core pavement. If we look at the tiers of overlapping needs discussed in Chapter 2, Section 6, we see that considering 3 and 2 overlapping needs reveals an estimate of **8,509** and **42,149** acres of non-core pavement respectively.

Expanding the scope of the needs aggregation to the **50% percentile of fully overlapping (tier 1) needs**, there is 37,765 acres of total pavement, with 12,036 acres in use as roads, 6,683 acres reserved for off-street parking, 891 acres reserved for sidewalks, leaving **18,155 acres** of potentially **non-core pavement**.

We can also look at the SB5353 disadvantaged communities (DACs), where we see 151,842 acres of total pavement, of which 51,128 acres are in use as roads, 26,503 acres are thought to be required for parking, and 4,251 acres are thought to be in use as sidewalks. This leaves **69,960 acres** of non-core pavement in DACs. If we overlap the tiered hotspots with the DACs, we get the distribution shown in Table 4.4.

Table 4.3: Stacked needs quartile tiers pavement amounts by pavement types

STACKED QUARTILE	ACRES OF TOTAL PAVEMENT	ROAD PAVEMENT (ACRES)	NON-ROAD PAVEMENT (ACRES)	REQUIRED OFF-STREET PARKING (ACRES)	ESTIMATED SIDEWALK REQUIREMENT (ACRES)	ESTIMATED NON-CORE PAVEMENT (ACRES)
Tier 1	788	174	614	157	5	452
Tier 2	14,658	3,521	11,138	2,402	227	8,509
Tier 3	100,468	38,826	61,642	16,393	3,100	42,149

Table 4.4: Calculation of non-core pavement in tiered needs hotspots within Disadvantaged Communities (DACs)

STACKED QUARTILE	ACRES OF TOTAL PAVEMENT IN DACS	ROAD PAVEMENT IN DACS (ACRES)	NON-ROAD PAVEMENT IN DACS (ACRES)	REQUIRED OFF-STREET PARKING IN DACS (ACRES)	ESTIMATED SIDEWALK REQUIRED IN DACS (ACRES)	ESTIMATED NON-CORE PAVEMENT IN DACS (ACRES)
Tier 1	620	127	492	123	4	365
Tier 2	11,792	2,857	8,935	1,933	183	6,818
Tier 3	64,837	24,167	40,670	10,738	1,947	27,985

4.3 CONCLUSIONS AND KEY INSIGHTS

Building on the pavement map-first inventory done in Chapter 3, this chapter uses transparent, rule-of-thumb heuristics to separate core pavement (roads, minimum off-street parking, and sidewalks) from a residual category we call non-core pavement, an *upper-bound* for what might be removed under ideal conditions. The result is a refined understanding of where pavement removal should be pursued to maximize benefits (such as cooling, stormwater management, tree canopy, and street safety) while minimizing impacts on core pavement functions.

4.3.1 Key Insights

A large pavement removal opportunity exists.

Of **~312,453 acres** of pavement countywide, **≈137,438 acres** fall in the non-core category by this heuristic; **about 4 in 10 acres** of all pavement. This is not a removal target; it is a **ceiling** against which to stage feasibility studies, design, and funding.

Most non-core acres are inside parcels, not in the ROW.

Roughly **122,030 acres (≈90%)** of the non-core total sit **on parcels**, vs. **15,418 acres (≈10%)** in the **right-of-way (ROW)**. Within parcels, **private ownership dominates** (≈94,728 acres) relative to **public parcels** (≈27,292 acres), about a **4:1 ratio**.

Unincorporated areas contain a significant share of non-core pavement.

The heuristic identified **≈15,703 acres** of non-core pavement in **unincorporated** L.A. County, mostly on parcels (**≈14,398 acres**) with an additional **≈1,305 acres** in the ROW, prime candidates for pilots and cross-department coordination.

Where needs overlap, opportunity concentrates.

In places where pavement burden, heat, flood risk, and low canopy coincide (the stacked-needs tier 1 hotspots defined in Chapter 2), our model still finds **≈452 acres** of non-core pavement in the top-quartile of overlap, and **≈18,155 acres** in the top half. If we consider tier 2 and 3 hotspots with top-quartile overlap, we find **8,509** and **42,149 acres** respectively. This suggests a target-the-hotspots strategy will potentially have many acres of pavement to choose from.

Important Caveats Remain.

The approach used in this chapter warrants several caveats. Parking and sidewalk quantities are **estimated** from representative codes/assumptions, not measured everywhere. The outputs are therefore **approximations** that can be used to guide screening and scoping, not entitlements or mandates. While we use high-level Countywide data to estimate non-core pavement, many "non-core" surfaces (courts, pads, loading areas) serve real community or operational needs, requiring **site-specific due diligence** to determine **actual removability**. Also, the heuristics themselves could be subject to further refinement, and parking and sidewalk standards vary by city, corridor type, and era. The model's **countywide heuristics** should thus be **refined locally** during design phases.

CHAPTER 5

DESIGN AND PLANNING

This chapter offers a scalable toolkit of 22 depaving strategies, from simple residential patio cutouts to complex parking-lot reconfigurations, priced by local contractors and designed to mix and match across residential, commercial, and public sites. It shows that depaving need not be a full-site overhaul: many small, repeatable interventions can amount to a large Countywide impact.

5.1 INTRODUCTION

This chapter provides guidance for design and implementation of depaving projects. We review existing pavement design standards and their implications for depaving, then offer a toolkit of "depaving strategies" for tailoring depaving to various site conditions found throughout the County. We combine these strategies with pavement analysis data to extrapolate potential quantities of pavement that could be removed using selected strategies. We conclude by offering depaving targets for municipal agencies and a framework for setting them.

5.1.1 Design Standards & Guidelines

Green Infrastructure Design Standards

We reviewed the County of Los Angeles' Green Infrastructure Guidelines.[44] While permeable paving, bulb outs, and bioswales are included as optional best management practices (BMP), net depaving is not mentioned, and certainly not required or even incentivized by the County's Green Infrastructure design standards. The guidelines mandate, for example, that "30 percent of… design storm runoff volume [is] to be mitigated for all County road and flood infrastructure projects. Designers should pursue greater volume mitigation at project sites where it is practical."[45] Although this sets a runoff mitigation requirement, engineers are directed to achieve it within the smallest possible footprint, typically through deep retention areas, rather than through expanding total permeable surface area. This could be revised to prioritize net pavement reduction wherever feasible.

Similarly, CALGreen voluntary tiers (e.g., A5.106.3 and A5.106.11.1) encourage permeable paving and stormwater mitigation strategies but stop short of requiring a formal analysis of pavement removal. In practice, Los Angeles County's prevailing design standards, particularly those governing parking lot layout and right-of-way (ROW) dimensions, often constrain the integration of stormwater capture and greening strategies such as planters, bioswales, and tree wells.

Pavement Management System

Los Angeles County, like most jurisdictions, utilizes a Pavement Management System to assess pavement condition and prioritize road repair and investment. However, the current evaluation process does not include depaving as a standard consideration. The system's evaluation criteria focus on traditional maintenance and repair metrics, but notably absent are questions about whether pavement could be decommissioned or whether the same functional purposes could be served with less pavement. Integrating depaving assessment into the existing Pavement Management System workflow could systematically identify opportunities to remove unnecessary pavement during routine project planning and design phases.

5.1.2 Planned Projects

CFMP Projects

An October 2024 motion to implement the CFMP included a directive to "Direct the CSO, in collaboration with the Directors of DPW, Parks and Recreation (DPR), and other relevant Departments to seek funding for and implement pilot depaving projects on County property, including the right-of-way, in high canopy need communities, and consider opportunities to integrate trees into conceptual project designs associated with Vision Zero and other community improvement initiatives."[46]

SCWP Projects

LA Waterkeeper conducted an analysis of over 100 projects funded through the Safe Clean Water Program. They found that "hardscape removal is not occurring as intended… Only 30.3 acres of hardscape have been removed by construction projects over Rounds 1-3 (while 27.5 acres of hardscape have been added)."[47]

These findings were a motivating driver behind this depaving study. More detailed evaluation of the plans and built projects may help clarify why more pavement wasn't removed. This report documents a range of depaving strategies and data analyses relevant to pavement reduction in Los Angeles County.

Draft SCWP Watershed Plans released in August 2025 provide a set of project opportunity areas, seemingly based on census tracts. The depaving data in this report can complement those efforts by providing higher-resolution hotspots within the opportunity areas identified by the SCWP. Additionally, low participation by private property owners in existing SCWP tools such as the SCWP Tax Credit and Credit Trading Programs suggests the current mechanisms may be insufficient to drive meaningful investment in pavement removal on private properties.

Infrastructure L.A. Projects

We evaluated projects in the Infrastructure L.A. database, some of which overlapped with the SCWP projects. Only 25 projects were specifically labeled "pavement" projects, all of which were Caltrans, but many included paving. Projects that are already in the procurement and construction phase are likely too far developed for depaving to be integrated, but these only accounted for 31 of the total projects on the list. There are many projects in the feasibility (50+) and design stages (400+). Many of the projects directly involve pavement such as complete streets projects, as well as bus shelter improvements. These projects should be evaluated to understand how they can maximize total net removal. As evidenced by the current state of infrastructure in Los Angeles, when depaving is not set as a project goal, the status quo is often to pave everything.

5.2 DEPAVING STRATEGIES

5.2.1 Depaving Strategies Overview

The following set of depaving strategies equips partners to transform paved urban areas into greener, more resilient spaces. We offer an initial framework for identifying representative sites, assessing the financial and environmental impacts of depaving efforts, and implementing strategies. By integrating top-down geospatial analysis with bottom-up logistical planning, we developed strategies tailored to specific urban conditions. Readers will learn about the methodology for site selection, and innovative solutions such as parking lot conversions.

While this report identifies opportunities to reduce pavement and increase green space, it does not assess soil contamination risks or evaluate potential remediation requirements. Many sites, particularly in historically industrial or high-traffic areas, may have underlying soil contaminants that must be addressed in order for depaving and greening to occur. This is particularly important for sensitive uses such as schools. Potential projects should include thorough environmental assessments, and any design or implementation plans should incorporate appropriate remediation and health safety measures in coordination with regulatory agencies.

Strategy Development

We studied the built environment throughout the County to develop a set of typologies that are representative of common conditions where depaving is possible. 22 existing conditions were identified from these studies and then grouped into the following 4 categories: sidewalks, parking lots, roadways, and activity pavements. From these conditions, specific depaving strategies were identified to depave a given site, add vegetation and capture or infiltrate stormwater flows.

Information for each adaptation strategy was drawn from successful installations implemented across the country and internationally. Our methodology was guided by green infrastructure publications and manuals from governments and non-profit organizations working toward greening, depaving, and sustainable stormwater management. We compiled cut sheets using standardized dimensions and materials, drawing on previous Hyphae projects, government agency resources, and manufacturer specifications. Importantly, these cut sheets were used to request real-world bids from local contractors, ensuring that our strategies are grounded in practical cost estimates and ready for implementation.

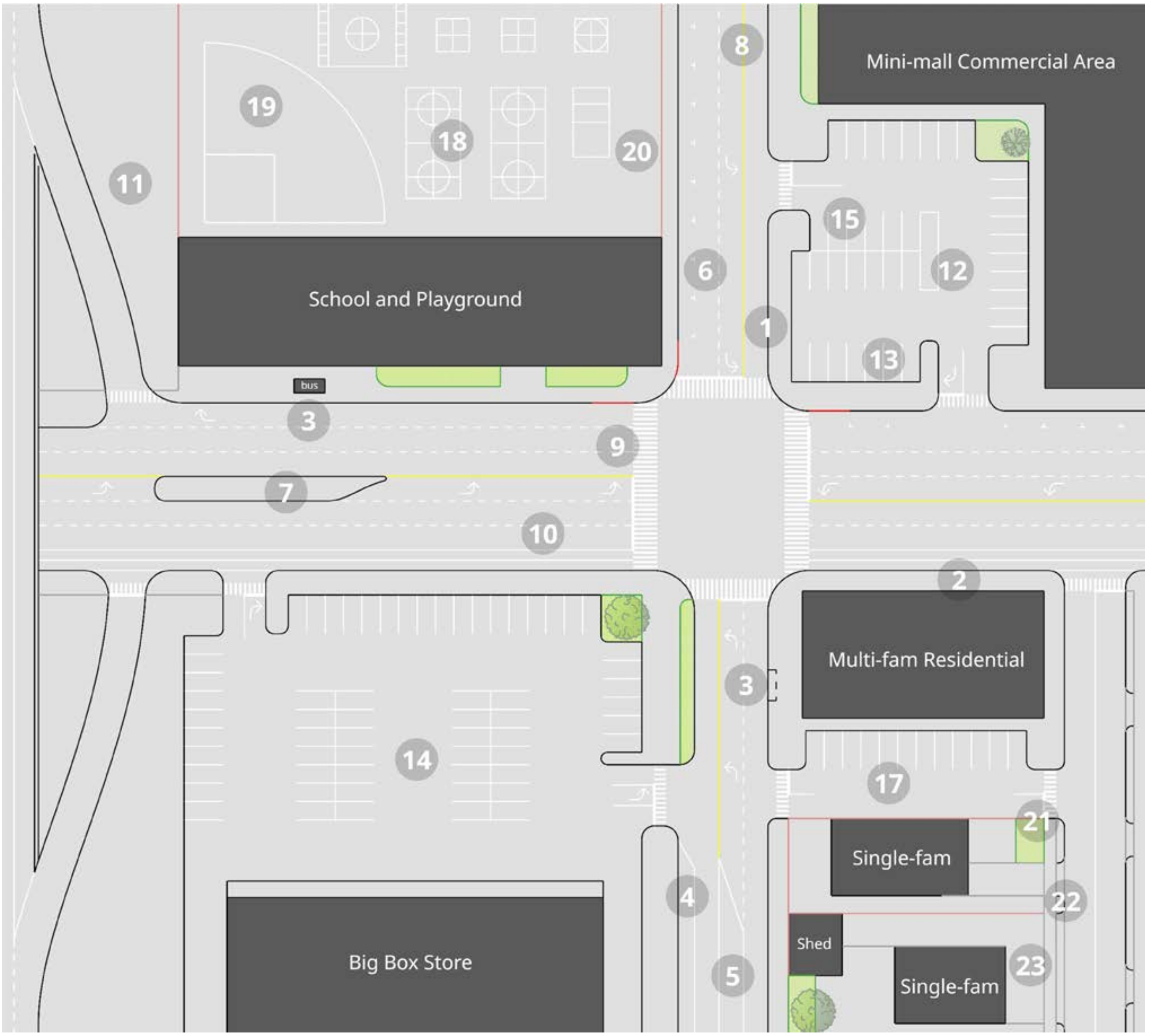


Figure 5.1: Typical street and block layout before depaving interventions applied

Figure 5.2: Typical street and block layout after depaving strategies applied. See Table 5.1 for legend of numbered intervention strategies

Model Depaved Block

A representative block is used here for visualization and educational purposes to show a range of possible depaving strategies. In practice, real projects would likely include one or a few of these interventions rather than all at once.

- **Central north-south street:** Illustrates a "road diet" conversion from four lanes to two, creating space for added vegetation. Angled parking is shown in the lower block, and parallel parking in the upper block.[48]
- **East-west boulevard:** Typically features paved medians, which here have been converted to planted medians. A separate bike path has been added in the lower right section.
- **Mini-mall commercial area (upper right corner):** Traditional parking lot is redesigned in a one-way traffic flow format to reduce pavement, increase parking density, and improve layout.
- **Residential area (lower right corner):** Includes hedgerows along the boulevard to reduce noise and air pollution by removing pavement in strips along the boulevard, new tree wells cut into patios, and trellises added where only small amounts of pavement can be removed.
- **Big box store (lower left corner):** Parking lot retrofitted with tree wells, bioswales, hedgerows, and a planted buffer separating it from the freeway.
- **School and playground (upper left corner):** Grass and trees added, with hedgerows along playground edges for privacy and a planted buffer by the freeway to reduce noise and filter air.

Existing Conditions & Proposed Depaving Strategies

A complete list of depaving strategies is shown in Table 5.1.

Table 5.1: Depaving strategies, their descriptions, benefits, and land uses

	Existing Conditions	Depaving Strategies	Description	Benefits (Heat =H, Flooding = F, Canopy = C)	Land Uses												Heuristic Depaving Potential Acres
					Caltrans ROW	Collector/ Arterial Road ROW	Local Street ROW	Rail ROW	Port	Schools	Municipal facilities	Parks	Resi-dential Property	Indus-trial & Warehouse	Shopping Center	Large Commer-cial	
SIDEWALK																	
1	Wide Sidewalk	Concrete removal & planting	For sidewalks that are greater than 6' wide (4' min for ADA), plan for a 2' minimum for planter to be effective. For areas in heavy traffic (Caltrans/collectors), include buffer planting. Where size permits, this can include tree planting and water capture.	H,F,C	●	●	●	●						●	●	●	
2	Narrow Sidewalk	Treewell with Structural Soils & Permeable Pavers	Remove pavement, install structural soil, or geotextile alternative, install a tree in treewell, repave with permeable pavers or grates, maintain a min 4'x4' opening.	H,F,C		●	●			●	●	●					
3	Bus Stops	Pavement Removal & planting	Strategic tree planting around bus stops, on sides, and behind stop where there is space. Where conditions allow, orient planting area to provide maximum shade.	H,C													9
ROADWAYS																	
4	Transverse Striped Shoulder	Planting Islands	In wide ROW setbacks (sides of roads) that are not sidewalks, remove striped yellow hatched in no-drive areas, and plant. Can have flush or raised curb condition, and can include swale where hydrologically beneficial.	H, F, C	●	●	●	●						●	●	●	
5	Transverse Striped Median	Asphalt removal & planted median	Remove striped hatched in no-drive areas, and plant. Can have flush or raised curb condition and/or bollards depending on traffic engineering. Can include swale where hydrologically beneficial.	H,F,C	●	●				●		●		●	●	●	
6	Narrow Streets	Planted Bulbouts	For conditions where both the sidewalk and/or the street are narrow, you can cut bulbouts with or without curbs to add planters between every 1 or 2 parallel parking spaces. First, saw cut asphalt between parallel parking spaces, install planters or trees. Options also include installing bollards or bike racks to protect planters.	H,F,C			●			●							552
7	Paved Median w/ Curb	Planted Median	Remove pavement & plant median with curb. Curb cuts, linear drains, and swales can be included where hydrologically beneficial.	H,F,C		●											
8	Streets, w/ Drivable Medians and Turn Lane	Raised Median Planter	Remove pavement, install curb & plant, higher vegetation in middle of blocks, lower vegetation at intersections. Curb cuts, trench drains, and swales can be included where hydrologically beneficial.	H,F,C	●	●	●	●		●	●	●		●	●	●	
9	Intersections at Wide Street with No-Parking Zone	Planted Bulbout	In conjunction with Vision Zero Traffic Safety, but rather than paving bulbouts, plant them with low vegetation for pedestrian visibility and curb-cuts for stormwater.	H, F		●											54
10	Wide Roads w/ no Turn Lane	Restripe and plant in extra space	Reduce lane width, restripe, remove asphalt and plant at sidewalk or between bike lane (min 2' per side of street). May be associated with Vision Zero Projects.	H,F,C		●	●										
11	Freeways & Arterial without Sidewalks	Vegetated Buffers	In right-of-way areas along freeways and busy roads there are often unused paved medians and verges. As these do not have sidewalks or pedestrians, they do not require pavement. In such locations, vegetated buffers with dense trees and shrubs could be planted. That vegetation could also mitigate stormwater runoff from roads and freeways.	H,F,C													
																Possible Acres:	**615**

	EXISTING CONDITIONS	DEPAVING STRATEGIES	DESCRIPTION	BENEFITS (HEAT =H, FLOODING = F, CANOPY = C)	LAND USES												HEURISTIC DEPAVING POTENTIAL ACRES
					Caltrans ROW	Collector/ Arterial Road ROW	Local Street ROW	Rail ROW	Port	Schools	Municipal facilities	Parks	Resi-dential Property	Industrial & Ware-house	Shopping Center	Large Commer-cial	
PARKING LOTS																	
12	No-drive Zone	Asphalt removal & planted median	Remove striped yellow hatched in no-drive areas and plant. Can have flush or raised curb condition.	H,F,C						●	●	●		●	●	●	
13	Parking Lot Edge	Saw cut border hedgerow	Move spaces forward min 2' and plant with columnar hedges in, planted along property borders.	H,F,C				●		●	●		●	●	●	●	
14	90 Degree Parking	1-way conversion with angled parking	Convert 90 degree parking to angled reduces some spaces, but allows narrower drive aisle and triangular planting spaces in front of cars and at end of aisle.	H,F,C				●	●					●	●	●	**3,330**
15	Perpendicular Park Spaces	Diamond Treewells	For lots that can't be further optimized and are small. Diamond Tree Wells (square tree wells placed on 45 degree angles), can be installed between spaces while not impacting parking layout. Remove pavement, then install structural soil or geotextile alternative in as large as possible area, repave with permeable pavers, maintain a min 3'x3' opening.	H,F,C						●	●	●		●	●	●	**574**
16	Perpendicular Facing Spaces	Restripe and interplant between perpendicular parking areas	For lots whose drive aisles are larger than necessary.	1,2,4,U				●			●			●	●	●	
17	Normal/Over-sized Parking Spaces	Compact Space Conversion	Convert 25% of standard parking spaces (8.5x19') to compact spaces (7.5x16'). Implement a 3' strip of veg at end of new parking spaces and collect offset width into a larger planted space at the end of the parking aisle.	H,F,C				●			●			●	●	●	**791**
ACTIVITY PAVEMENT																	
18	Paved Plaza	Tree wells	Plant canopy trees or trellises to maximize shade cast on ground. Include permeable pavers.	H,F,C		●				●	●	●					
19	Paved Playground	Remove pavement, replace with vegetation	Remove pavement, add trees for shading, replace pavement with sand or woodchips, add rain gardens.	H,F,C						●		●					
20	Paved Sports Spaces	Strategic Border Planting for shade	Plant trees, hedgerows, or shrubs along border of pavement, using existing green school design plans for compatability with schoolyard activities.	H,F,C						●	●	●	●				
21	Paved Yards & Patios	Core-Drill/ Saw Cut Opening and Plant Tree	For residential and commercial spaces that are heavily paved, suggest strategic removal for shade tree and native rain-garden planting, bioswales, and/or permeable pavers.	H,F,C						●			●				**1,530**
22	Narrow Drive-ways, Yards, & Patios	Core-Drill/ Saw Cut Opening and Build a Trellis	For driveways, sidewalks, or other active places, core drill or saw-cut pavement, remove and amend soil, add topsoil, irrigation, vine planting, and cable trellis. Could also be over outdoor lunch areas at schools.	H,F,C									●				
23	Driveways	Pervious Pavers w/ vegetation between	Pervious pavers are installed with space between for groundcover to grow. Pavers can be absent in middle for vehicle tires to straddle.	H,F,C									●				
																POSSIBLE ACRES:	**6,225**

5.2.2 Depaving Strategy Heuristics

5.2.2.1 Introduction

This section provides additional detail about each of the depaving strategies, including sizing assumptions. Using the geospatial analysis from chapters 1 and 2, we then extrapolate these strategies to estimate the total potential pavement removal opportunity for each intervention. Using representative design drawings for each strategy, we then calculated the pavement removed per each repeatable unit. For example, if a design drawing shows how many square feet can be removed per commercial parking space, we can multiply that by the total number of eligible spaces countywide to estimate the maximum removal potential. Using this method for the shortlist of strategies that were more easily quantifiable with heuristics, we found over 6,000 acres of removable pavement at scale. With refined methods, future analyses could expand this estimate significantly.

Some of the depaving strategies (shown in yellow in Table 5.2) are unable to be calculated with heuristics extrapolation at this time due to insufficient data availability. However, for the strategies that we can extrapolate (shown in green in table 5.2) we have described the heuristics below.

Table 5.2: Extrapolation of strategies to total heuristic pavement removal

	EXISTING CONDITIONS	DEPAVING STRATEGIES	HEURISTIC METHOD	HEURISTIC DEPAVING POTENTIAL ACRES
SIDEWALK				
1	Wide Sidewalk	Concrete removal & planting	For this heuristic, future analyses should use advanced remote-sensing techniques to measure sidewalk widths.	
2	Narrow Sidewalk	Treewell with Structural Soils & Permeable Pavers	For this heuristic, future analyses should use advanced remote-sensing techniques to measure sidewalk widths.	
3	Bus stops	Pavement Removal & planting	Los Angeles County has 12,025 bus stops. For each of them, remove pavement for 2 treewells, 4"x4".	**9**
ROADWAYS				
4	Transverse Striped Shoulder	Planting Islands	For this heuristic, future analyses should use advanced remote-sensing techniques to identify all striped shoulders.	
5	Transverse Striped Median	Asphalt removal & planted median	For this heuristic, future analyses should use advanced remote-sensing techniques to identify all striped shoulders.	
6	Narrow Streets	Planted Bulbouts	Los Angeles County has ~4,811,467 stalls of on-road parking. Taking 25% of these, and adding a 6'x8' tree-well between pairs of spaces, liberates around 20 feet of pavement per space on average.	**552**
7	Paved Median w/ Curb	Planted Median	For this heuristic, future analyses should use advanced remote-sensing techniques to identify all striped shoulders.	
8	Streets, w/ drivable medians and turn lane	Raised Median Planter	For this heuristic, future analyses should use advanced remote-sensing techniques to identify all striped shoulders.	
9	Intersections at Wide Street with No-Parking Zone	Planted Bulbout	Los Angeles County has 174,633 drivable intersections, and of these we calculate that 772 are "wide." For each wide intersection, remove 250sqft bulbout on each corner.	**54**
10	Wide Roads w/ no turn lane	Restripe and plant in extra space	For this heuristic, future analyses should use advanced remote-sensing techniques to identify all medians and turn lanes.	
11	Freeways & Arterial without sidewalks	Vegetated Buffers	For this heuristic, future analyses should use advanced remote-sensing techniques to identify all paved shoulders and low berms.	
PARKING LOTS				
12	No-drive Zone	Asphalt removal & planted median	For this heuristic, future analyses should use advanced remote-sensing techniques to identify all no-drive zones in parking lots.	
13	Parking Lot Edge	Saw cut border hedgerow	For this heuristic, future analyses should use advanced remote-sensing techniques to identify and characterize all parking lot edges.	
14	90 degree parking	1-way conversion with angled parking	Conservatively estimating that 50% of the 4 million required commercial and industrial parking spaces are already angled less than 90 degrees, switching the remaining spaces to angled parking could free up pavement.	**3,330**
15	Perpendicular Park Spaces	Diamond Treewells	For every 4 perpendicular facing parking lots, remove a 25 sqft diamond.	**574**
16	Perpendicular Facing Spaces	Restripe and interplant between perpendicular parking areas	In future analyses, a more detailed accounting of parking inventory could be used to establish the potential of this strategy.	
17	Normal/Oversized Parking Spaces	Compact Space Conversion	County land use code 22.112.070, Subsection E, stipulates that up to 40% of required parking spaces may be designated for "Compact Cars." Convert 25% of commercial and industrial spaces to compact.	**791**
ACTIVITY PAVEMENT				
18	Paved Plaza	Tree wells	For this heuristic, future analyses should use advanced remote-sensing techniques to identify all plazas.	
19	Paved Playground	Remove pavement, replace with vegetation	For this heuristic, future analyses should use advanced remote-sensing techniques to identify all playgrounds.	
20	Paved Sports Spaces	Strategic Border Planting for shade	For this heuristic, future analyses should use advanced remote-sensing techniques to identify all basketball courts.	
21	Paved Yards & Patios	Core-Drill/ Saw Cut Opening and Plant Tree	In residential parcels, 44,097 acres of pavement is likely to be patios, walkways, and driveways. On average that amounts to ~1000 sqft per residence. For each residence, cut a 6x6 treewell.	**1,530**
22	Narrow Drive-ways, Yards, & Patios	Core-Drill/ Saw Cut Opening and Build a Trellis	In future analysis, for this heuristic we should use advanced remote sensing techniques to identify all driveways.	
23	Driveways	Pervious Pavers w/ vegetation between	For this heuristic, future analyses should use advanced remote-sensing techniques to identify all driveways.	
			POTENTIAL ACRES:	**6,840**

5.2.2.2 Parking Lot Strategies:

Commercial and industrial parking spaces account for a large share of total overall pavement in L.A. County, but a number of common design changes could result in large-scale depaving without necessarily reducing the amount of available parking spaces. In one approach, we convert a permissible number of parking spaces from full-sized to compact, and in the other, we change the angle of the parking spots, which frees up room between spots and allows for narrower drive aisles.

Conversion from standard to compact parking

County land use code 22.112.070, subsection E, stipulates that up to 40% of required parking spaces may be designated for "Compact Cars." Standard parking spaces in Los Angeles are generally 8.5' wide by 18' long, while compact parking spaces are 8' wide by 15' long. Converting just 25% of all parking spaces on commercial & industrial lots from regular spaces to compact spaces would recover 3' of space for a planting strip at the back of every parking space. This would allow for a 3' planting strip on lots with single-sided parking and 6-foot planting strips on lots with double-sided parking. With an estimated 4,015,930 commercial and industrial parking spaces in the County, this amounts to 761 acres of pavement that could be removed at scale. Note that in 2024, 34% of new car sales were compact or subcompact[49], and while the County planning code only requires no more than 40% of the required parking spaces to be compact, there are no such limits applied to parking that exceeds total required parking.

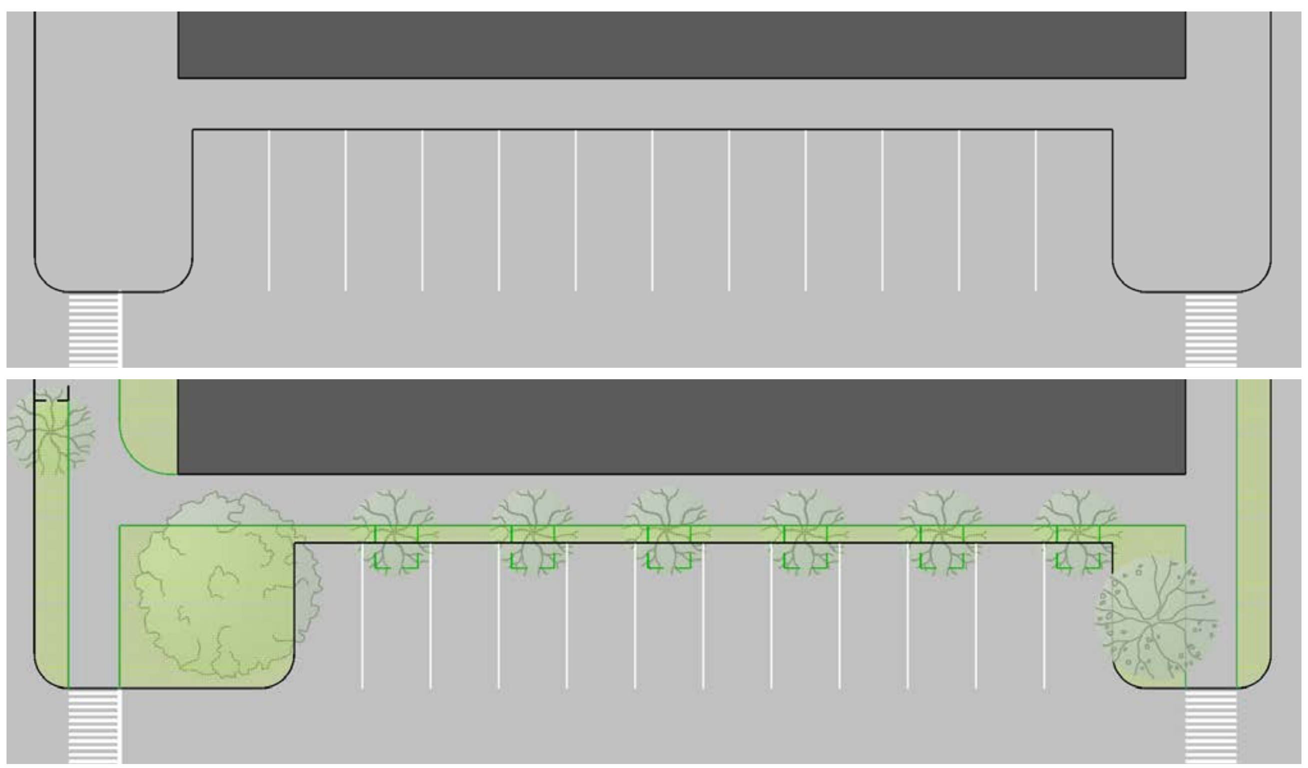


Figure 5.3: Compact parking space conversion before/after diagram

Figure 5.4: Compact space converstion precedent (Generated with Gemini)

Converting 25% of the 4 million commercial and industrial parking spaces in L.A. County to compact size could free up pavement equal to 575 football fields.

Conversion from standard to angled parking

Independently of the conversions to compact parking mentioned above, we can also consider the potential for converting 90 degree parking lot spaces to smaller angles. Conservatively estimating that 50% of the 4 million required commercial and industrial parking spaces are already angled less than 90 degrees, switching the remaining spaces to angled parking could free up pavement equal to 1,259 football fields and create space to plant one small tree for each of the 2 million parking spaces.

There are several reasons why most lots use 90 degree stalls; they are easier to design and build, especially on rectangular lots, as they can be laid out in a grid, and there are no complicated one-way drive aisles needed. However, while not all parking lot configurations are the same, angled parking is often more space efficient. Drive aisles can be narrower because people don't need as much space to back out. It is also easier to back out, as the driver does not need to make a 90 degree turn. While there are different dimensions and requirements for different angles of parking (45°, 60°, 90°), for this exercise we assume all sites are converted to 45° parking.

In smaller lots with only one drive aisle, this layout doesn't work as well because you lose space at either end. However, in larger lots that have more than one drive aisle, the narrower layout usually creates room to accommodate extra rows of parking. Conversion to angled parking creates a triangle of space at the end of each parking stall as well as a larger triangle of parking at the ends of each row of parking. The small triangle is 36 square feet and the large triangle is 90 square feet.

Angled parking spaces need to be 1' deeper than standard spaces (19' rather than 18'), but angled parking also allows for more narrow drive aisles. Drive aisles can generally be 18' (as little as 12') wide rather than 24'. Conversion to angled parking then allows a 5' wide walkway or planter strip to be added behind every row of parking. This small leftover triangle of space alone would amount to up to 3,330 acres (2,519 football fields worth) of pavement removal and allow 1 small tree to be planted for each of the rotated spaces.

Where additional trees would not be desired, the small triangle could be planted with native grasses, shrubs, or forbs, or left unplanted, which would still potentially reduce flooding, improve water storage and reduce heat islands. These cutouts could also be configured specifically to collect and direct water flows from parking runoff. While ongoing irrigation and maintenance are critical to long-term success, detailed O&M planning falls outside the scope of this report.

Figure 5.6: Angled parking precedent (Generated with Gemini)

Figure 5.5: One-way conversion diagram - before/after. As the angle of parking gets smaller, the aisle width can shrink with the... triangles between spaces reaching maximum area at 45 degrees.

Perpendicular-Facing Space Diamonds

Removing the diamonds as shown in Figure 5.7 results in approximately 25 square feet of pavement removed per 8 parking stalls in large parking lots. The 2014 LARIAC dataset of commercial, industrial, and government parking lots over 5,000 sqft covers over 100 square miles. If we assume half of this is drive aisles, and half of the stalls are around the edges, this leaves around 4 million stalls potentially in perpendicular facing configuration which could support removing **287 acres** of pavement.

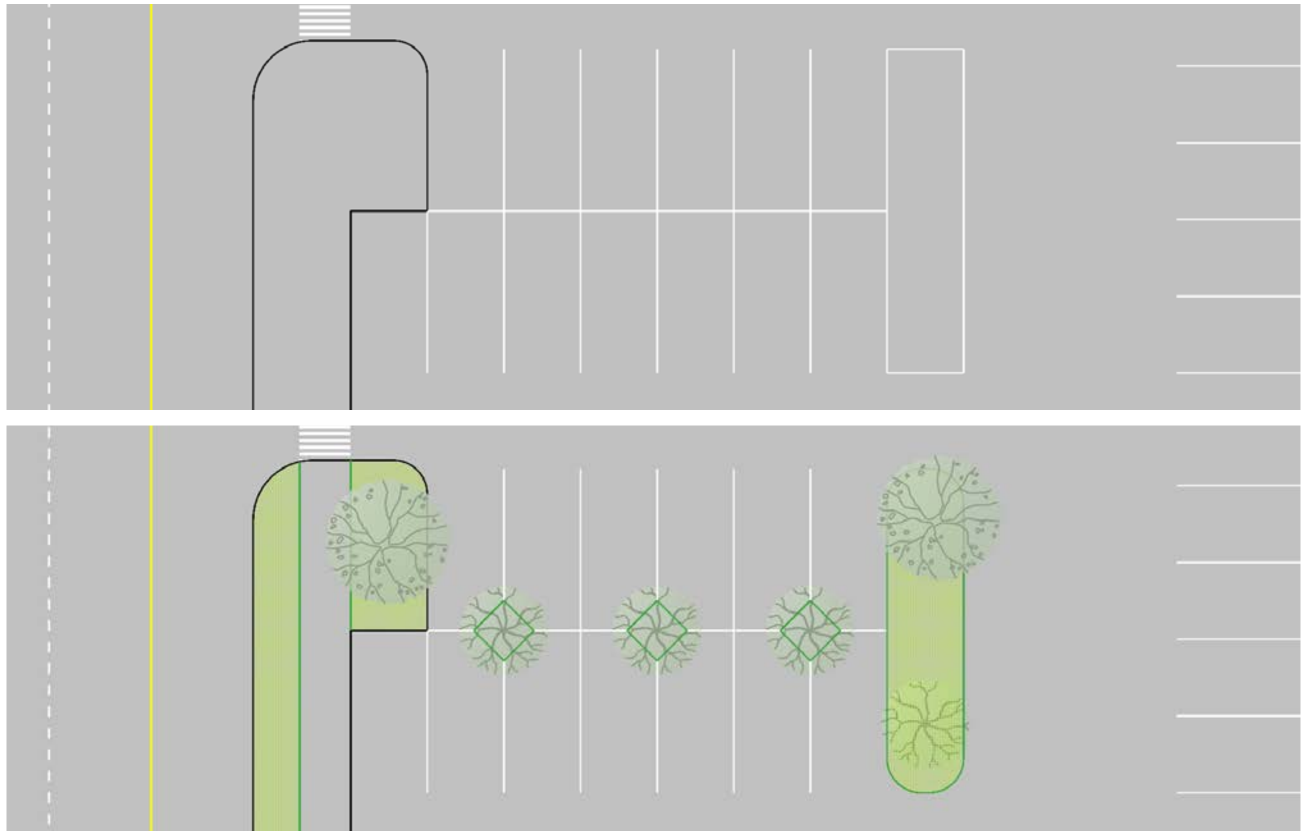


Figure 5.7: Perpendicular facing space diamond diagram - before/after

Figure 5.8: Tree diamond precedent (Generated with

Figure 5.9: Parking typology collage render (Generated with Gemini)

Converting to angled parking could free up pavement equal to 2,519 football fields, enough room to plant one small tree for each of the 4 million required commercial and industrial parking spaces.

5.2.2.3 Sidewalk Strategies

Bus Stop Strategies

Los Angeles County has 12,025 bus stops listed in L.A. Metro's bus stops dataset.[50] If each of these had two 4'x4' portions of pavement removed to create a pair of tree wells that could provide shade for each bus stop, then it would result in around **8.8 acres** of pavement removal.

5.2.2.4 Roadway Strategies

While our proposed goals and preliminary targets exclude roadway pavement, future iterations of this assessment should consider feasible strategies and heuristic estimates for adapting select segments of the roadway network, offering optional pathways for agencies seeking to pursue right-of-way depaving.

Periodic Bulbouts on Roadways

Los Angeles County has ~4,811,467 stalls of on-road parking. Taking 25% of these and adding a 6'x8' tree-well between pairs of spaces liberates around 20 feet of pavement per space for a total **552 acres**.

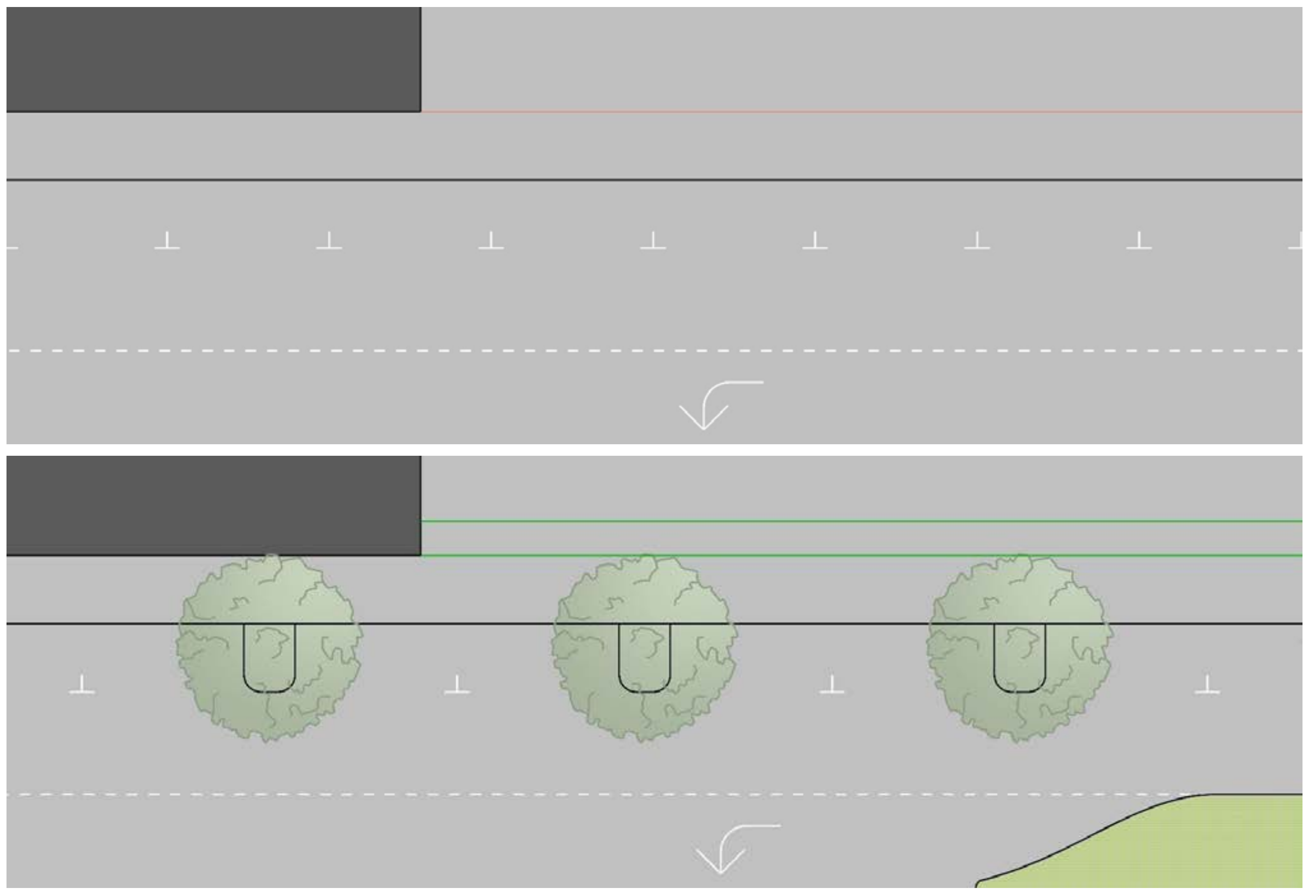


Figure 5.10: Bulbouts on roadways - before/after

Figure 5.11: Bulbouts on roadways precedent

Wide Intersection Planted Bulbouts

Los Angeles County has 174,633 drivable intersections, and of these we calculate that 772 are "wide," having at least 3 lanes per connected street and at least 3 connected streets. These intersections may be wide enough to accommodate a bulb out within an 8' width of no-parking shoulder on both sides of each corner with 20' of no-parking length from crosswalks. This amounts to 250 square feet per corner for these wide inter-sections. Extrapolating this results in **54 acres** of pavement removed across the county for this depaving strategy.

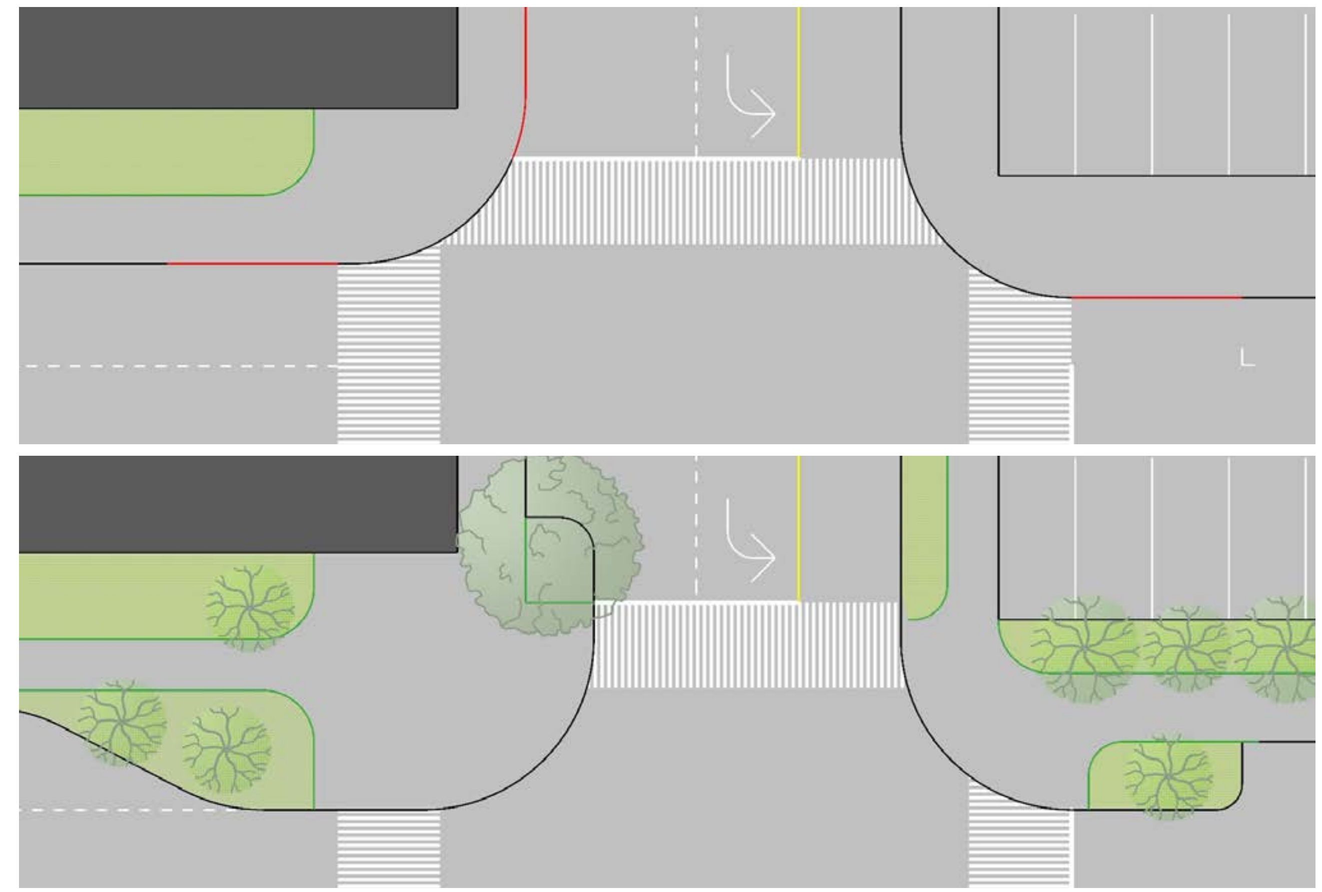


Figure 5.12: Wide intersections - before/after

Figure 5.13: Wide intersection precedent

Tree Wells in the Right-of-Way

There are 15,418 acres (24 square miles) of pavement (not including roads and side-walks) in the right-of-way (ROW) areas between parcels. This is mainly in medians, bulbouts, virtual gores, and wide shoulders.

Converting 3% of this space (462 acres) into 6'x6' tree wells (which would, on average, amount to planting a tree every 40' along 10% of the roads in the county) could create over 550,000 new tree wells in these areas.

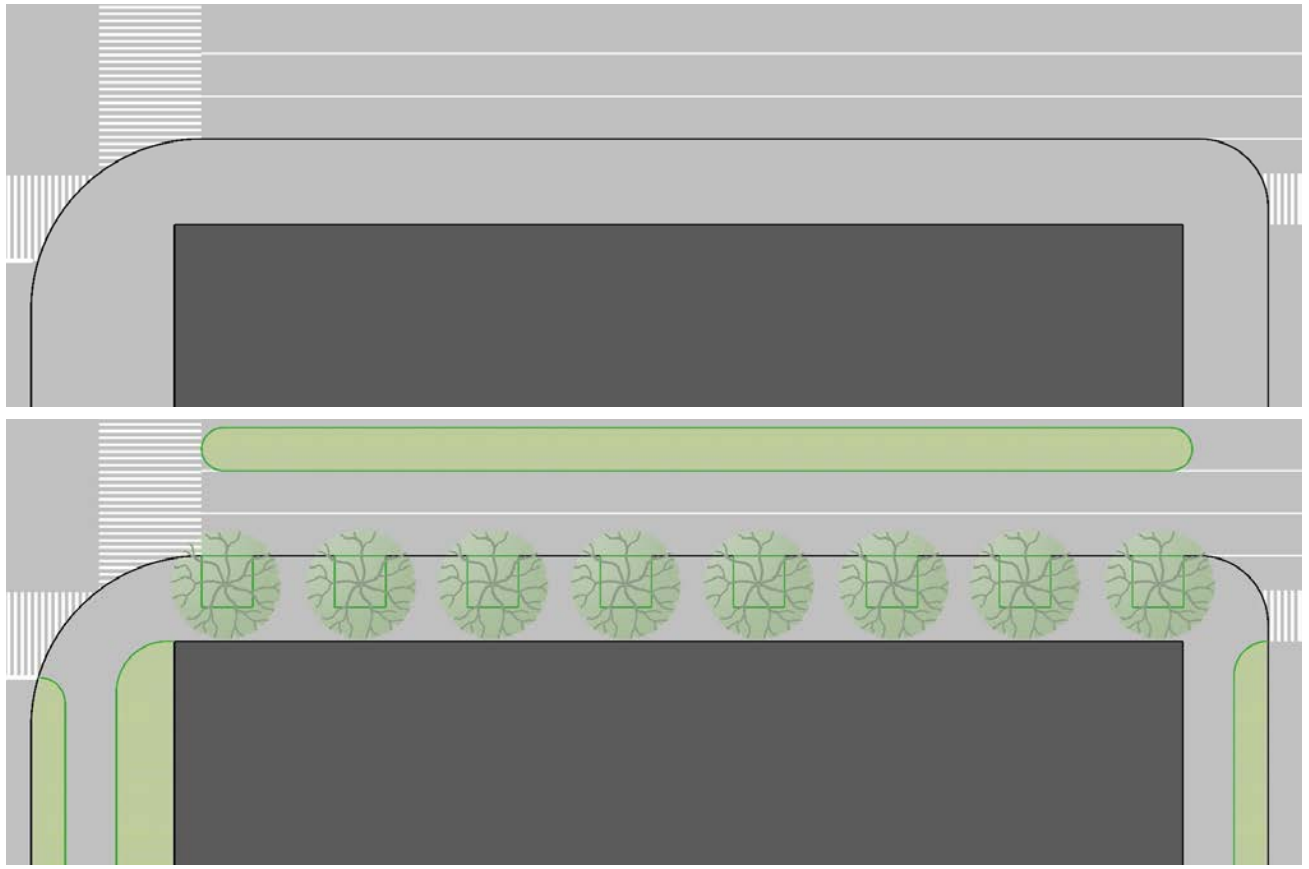


Figure 5.14: Narrow sidewalk diagram - before/after

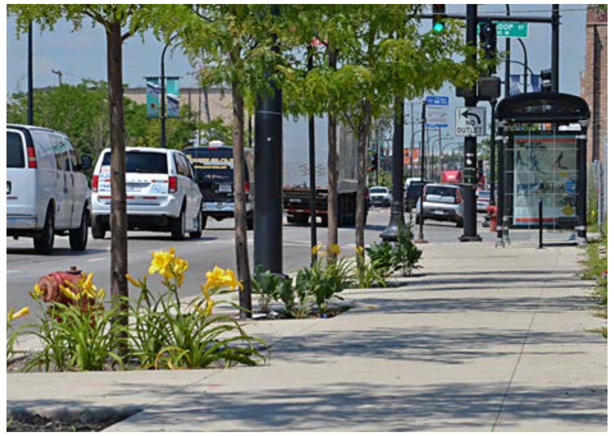


Figure 5.15: Narrow sidewalk precedent - tree wells in right-of-way

Figure 5.16: Roadway typology collage render (Generated with Gemini)

5.2.2.4 Activity Space Strategies

Patio Conversion

Our pavement analysis indicates that of the total of 74,684 acres of pavement on residential parcels, we estimate that approx-imately 26,587 acres is required for parking, and 4,204 is in use as roads. What remains is 43,894 acres of pavement that is likely to be patios, walkways, and driveways. On average, there is 1,126 square feet of this non-parking pavement on each of the 1,851,856 residential parcels, and so if we cut a single 6 foot by 6 foot tree well in each of these (amounting to around 3% of the total average patio area) in each of these patios, it would result in a total of **1,530 acres** of depaving.

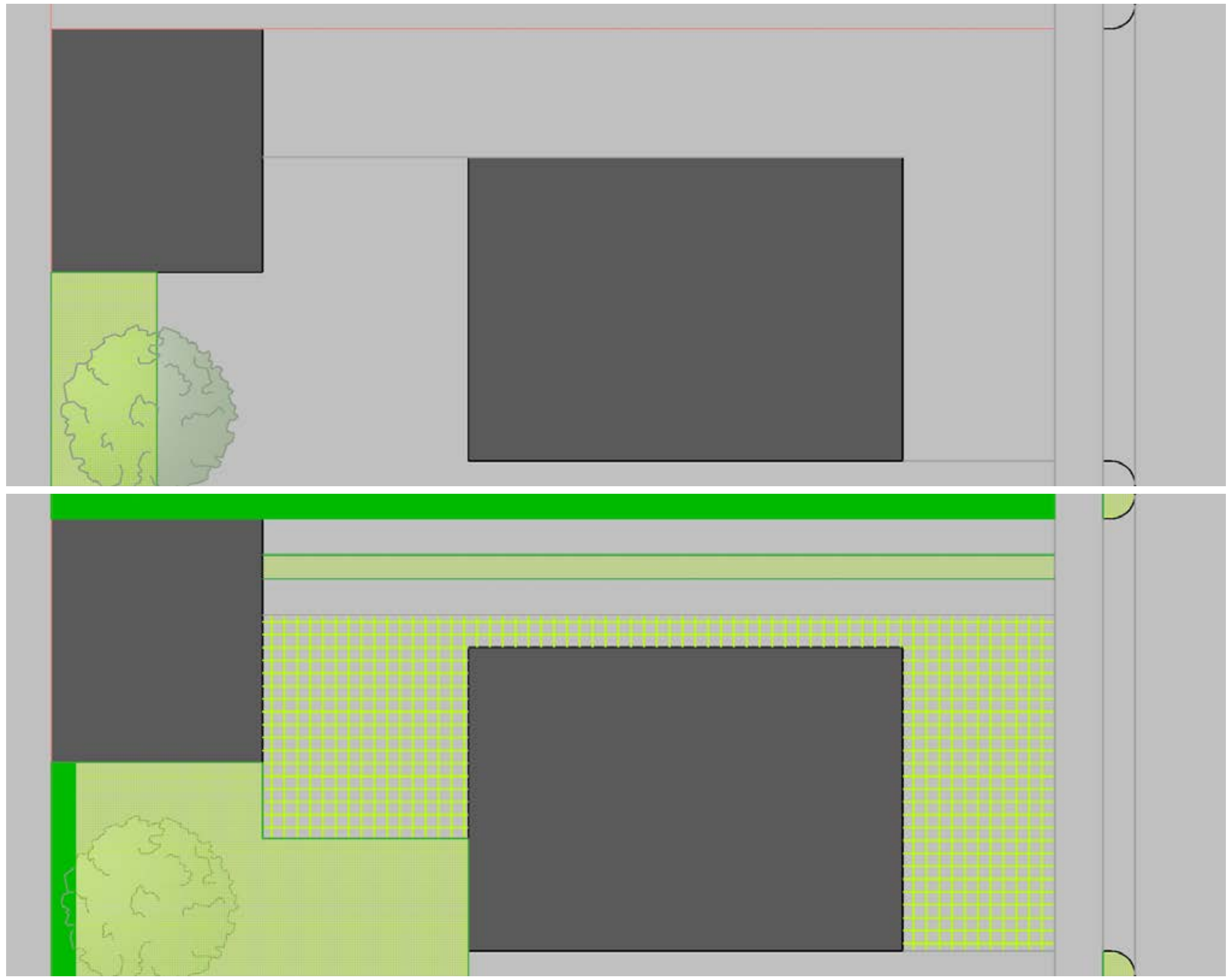


Figure 5.17: Patio conversion - before/after

Figure 5.18: Patio conversion precedent (Generated with Gemini)

Figure 5.19: Residential typology collage perspective (Generated with Gemini)

5.3 COST ANALYSIS

5.3.1 Approach

This study did not attempt to calculate the costs of every possible pavement removal method across all site types and scales. In practice, conducting real-world pilot projects and compiling their cost data into a depaving information hub would likely provide useful information. Rather than present a cost for a few specific strategies, this study offers a broad estimate range meant to cover all types of depaving strategies. It does not dive into maintenance costs, since removing concrete itself requires little upkeep. However, long-term care is essential for any green infrastructure project that might be installed in the place of concrete.

Project teams responsible for overseeing these projects should factor in funding for ongoing stewardship to keep them both functional and ecologically successful.

Costs for the depaving strategies were researched using several methods and then compiled and compared. Comprehensive cost estimates were collected from a number of small, local Los Angeles contractors. L.A. County Public Works shared typical cost information from similar projects, which we reviewed to find examples comparable in scale to the depaving strategies discussed in this report. In addition, commercial contractors costing databases and software programs were consulted to establish typical rates. Several published studies with actual installed cost data, produced by green infrastructure nonprofits such as TreePeople, were also reviewed. All these data sources were combined into a comprehensive cost analysis spreadsheet.

5.3.1.1 Contractor Outreach & Collaboration

Qualified contractors were vetted based on experience with projects of different scales, including residential, commercial, and municipal. Preference was given to small local contractors and those with CBE, DBE, MBE, or WBE status. Selected contractors were interviewed and asked to provide cost data for the elements for which they had relevant and recent pricing experience. To improve accuracy, contractors were given scale scenarios ranging from 100 to 1,000 square feet. All participating contractors were compensated for their time and expertise.

5.3.1.2 Design Elements

All of the depaving strategies can be broken down into **design elements**, which can be brought together in various combinations under diverse site conditions to implement the strategy.

- The design elements that were identified and priced by contractors include:
- Pavement cutting and debris removal
- Sidewalk features such as permeable pavements and tree wells
- Stormwater detention elements including stormwater planters and Silva Cells
- Parking area strategies such as restriping and cool pavement
- Living systems including hedgerows, bioswales, and ground cover
- Irrigation systems, including connections to recycled water

The per square foot cost of pavement removal was calculated at roughly $9 for residential projects, $12 for commercial projects, and $15 for municipal projects.

5.3.2 Cost Analysis Findings

5.3.2.1 Costs of Pavement Removal Alone

We evaluated the cost of depaving a 200 square foot project, without any additional work or planting included, in order to establish a baseline cost of pavement removal. Factors included locating utilities and sawcutting pavement, as well as excavation and debris removal, but did not include traffic control. The per square foot cost of pavement removal was calculated at roughly **$9 for residential projects, $12 for commercial, and $15 for municipal**. While many existing programs fund nature-based solutions, few cover the actual cost of pavement removal, thus creating an opportunity to stack funding by treating depaving as a distinct, preparatory phase.

While this estimate includes the cost of hauling materials off-site, better coordination and creative strategies for onsite material reuse could reduce the cost and environmental burden of moving material. To achieve depaving at scale, public-private partnerships with material handling, processing and recycling and reuse facilities would need to be expanded and become more coordinated. This work should be scoped into a depaving plan.

5.3.2.2 Costs of Pavement Removal with Planting Strategies

Estimated costs for depaving strategies, **including planting in the depaved areas, ranged from a $100 per-square-foot cost for residential projects, $130 for commercial, and $160 for municipal projects.**

Each design typology was assigned a specific area for a cost estimation basis. These baseline areas ranged from 100 square feet up to 4,000 square feet based on areas typical for each type of project. For example, we assumed a baseline area of 100 square feet to remove pavement, add curb cuts and plant a transverse striped shoulder. For a bus stop, we estimated a depaved area for planting would be approximately 200 square feet (20'x10'). For installing a planted median in a street, the assumed size was 4,000 square feet (400' x 10'). Estimates were calculated at these scales to generate a cost per square foot number per typology.

This report only evaluated capital and installation costs, but it is important to note that long-term maintenance, including irrigation and staff resources, will be critical to the success and durability of planted strategies. Detailed O&M planning falls outside the scope of this analysis but should be considered in future depaving planning efforts.

5.3.2.3 Construction Cost Factors

Removing pavement on private property can be significantly more affordable per acre than in the public right-of-way. Work in the right-of-way is costly because of spatial constraints, the need for traffic safety measures, additional mobilization requirements, and difficulties working with underground and overhead utilities. By contrast, both residential and commercial private property offer fewer barriers, making cost reductions more feasible. Scaling incentive programs, and promoting do-it-yourself approaches for residential projects, could further drive down costs of pavement removal.

5.3.2.4 O&M

While this report focuses on capital and installation costs, it is important to note that long-term maintenance, including irrigation, staff resources, and operational oversight will be critical to the success and durability of these strategies. Detailed O&M planning and reprioritization of existing resources fall outside the scope of this analysis but represent essential future considerations.

5.4 LANDSCAPE BENCHMARKS

5.4.1 Landscape Requirements

5.4.1.1 Commercial Landscape Requirements

Commercial parcels contain 22,857 acres of potentially non-core pavement (pavement thought to be above and beyond the required parking or sidewalk area). According to Los Angeles County Planning and Zoning Code 22.20.040, commercial parcels in unincorporated areas developed after 2019 are required to have at least 10% landscaped area. Retrofitting all commercial properties to meet this requirement would depave **1,018 acres**. Currently 64% of commercial parcels do not meet this requirement. This code (updated in 2019) does not apply to existing grandfathered land uses and only applies in unincorporated areas of the County. However, because it is an established code requirement, it provides a useful benchmark to evaluate pavement removal opportunities. The benchmarks can potentially be used to guide incentives to land owners or to evaluate future land use regulations updates.

5.4.1.2 Residential Landscape Requirements

The August 2024 amendment to Title 22 – Planning and Zoning of the Los Angeles County Code includes design standards for residential development. One of the included requirements is that 20% of the area not in use for buildings in residential parcels be landscaped, up to 5,000 square feet. While

The average school campus is 40% covered in pavement, and some have much higher coverage.

this only applies to new developments in unincorporated areas, we can use this as a benchmark for residential landscape area requirements. Retrofitting all residential properties to meet this standard would require depaving **571 acres**. Currently **3.7%** of residential parcels do not meet this standard.

5.4.2 Bringing Above Average Pavement Down to Average

5.4.2.1 Parks Heuristic

The Open Space Dataset[51] says that there are 3,012 parks in the County. Together, these have 7,223 acres of pavement, and are on average 15% covered in pavement, however, some parks have a much higher percentage of their area covered with pavement, and indeed there are 1,153 parks that have more than 15% pavement coverage. If we removed enough pavement to get all of those down to 15%, it would require removing **1,408 acres** of pavement.

5.4.2.2 Schools Heuristic

- We calculated pavement coverage for all schools in the County, along with their extreme heat exposure, flood risk, and canopy coverage, and will make this data available for school partners.
- The 3,179 school campuses in Los Angeles County, which serve >2 million students, contain approximately **15,240 acres** of pavement, with the average school campus being 40% covered in pavement. However, some have much higher pavement coverage.
- If all of the school campuses with above average pavement coverage were brought down to the average, it would require removing **1,531 acres** of pavement.

5.5 TARGETS

5.5.1 Introduction to Depaving Targets

Targets can include both depaving targets and targets for downstream indicators (heat, flooding etc.) Depaving targets will include an amount of pavement, location of pavement removal, and timelines for that removal, for example "10,000 square feet of pavement removed from the top extreme heat exposure areas by 2040." Because of the diversity of land-use conditions, site specific obstacles, and depaving strategies, we can consider several targets for different occasions.

5.5.1.2 Baseline

The present assessment presents a new pavement dataset created for research, planning, and implementation which can serve as a baseline for future evaluation of depaving progress and impacts. This dataset should be updated as more pilot projects are implemented, and revised remote sensing and analytical products become available. In this context, the results presented in **Chapter 2** of this report can be seen as the baseline for environmental needs metrics. As future depaving efforts reduce surface temperatures, flood risk, increase tree canopy, and consequently improve public health, repeating measurements of these factors as time progresses will enable us to evaluate our impact. The results in **Chapter 3** can be seen as the baseline for the pavement distribution and its relationship with the distribution of environmental needs. Ideally, pavement will be decreased in the areas where needs are greatest. By repeating this analysis in the future, we can gauge the efficacy of pavement removal initiatives on reducing pavement. The results in **Chapter 4** offer a baseline for the upper limit of the total depaving opportunity considering prescribed limits on how much pavement needs to remain in the County. These limits are expected to soften as policies improve and planning codes are updated to support less pavement-intensive designs of the built environment.

5.5.1.3 Benchmarks

Scaling the depaving strategies described in **Chapter 5, Section2** adds up to **6,443 acres** of pavement that may potentially be removed. The landscape requirements discussed in Section 5.4.1 add another **1,589 acres** that could be removed by aspiring to retrofit properties to new requirements. Striving to bring parks and schools that are over the mean pavement coverage (Chapter 5, Section4.2) adds another **1,408 and 1,531 acres** respectively. This leads to a total calculation of **10,753 acres** of pavement, or **~8%** of the **137,438 acres** of non-core pavement identified in Chapter 4. These 10,753 acres are just those that we have calculated potential for based on a small selection of possible depaving strategies, targets, indicators, and benchmarks. As mentioned in Chapter 4, Section 3.1, in places that simultaneously score high for pavement burden, heat, flood risk, and low canopy (the stacked-needs hotspots defined in Chapter 2), our modeling finds **≈452 acres** of non-core pavement in the top-quartile (tier 1) overlap, and **≈18,155 acres** when the threshold expands to the top half. Considering the tier 2 and 3 hotspots finds **8,509** and **42,149** acres of non-core pavement respectively. Thus, agencies with different mandates can formulate depaving targets based on the indicators most relevant to their priorities. For example, the County CFMP includes targets related to their canopy goals, and the SCWP Watershed Plans include targets related to their water goals. As more detailed studies are conducted to ascertain site specific details, these benchmarks can be refined and augmented to improve depaving outcomes.

5.5.2 Depaving Targets

A depaving target could refer to an amount of pavement to be removed by a certain time, or a target location for pavement removal.

5.5.2.1 Potential Target Setting Framework

In this section we propose a *framework* agencies can use to turn today's baselines and strategy benchmarks into future depaving targets, without locking in prescriptive numbers now. Chapters 2–4 establish where need is greatest (heat, flood risk, low canopy, high pavement), where non-core pavement exists and who controls it, and a putative opportunity ceiling of ~137,000 acres countywide. Section 5.5.1.3 translates those conditions into strategy-scaled benchmarks totaling ~10,000 acres under optimistic near-term uptake. In this proposed framework, those figures serve as baselines and benchmarks: reference points for setting targets in subsequent plans and budget cycles.

The proposed framework defines a clear scope and unit of measure: acres of pavement removed, disaggregated by ownership (public parcels, private parcels, ROW), land use, Supervisorial District, watershed, and CSA. Co-metrics can be used to track co-benefits such as new tree wells, green surface conversions, modeled stormwater infiltration/storage, and measured heat, canopy cover and pavement coverage, so future targets can be expressed as both acreage and outcomes. Prioritization is need-first: the framework can be implemented to steer most annual acreage removal to stacked-need CSAs (e.g., ≥70% in ≥80th-percentile areas), include a district guardrail (e.g., a 12% floor), and ensure an unincorporated share (e.g., 10–15%), with site selection further filtered by hydrologic value (infiltration and flood benefits), delivery readiness (program alignment, capital cycles), and ownership/control (public first; private via incentives and standard plans).

Implementation can be staged across three time horizons: short (1–3 years pilots and early wins), mid (4–10 years scaling to meet policy timelines, using the 10,000 acre benchmark as a planning reference), and long (10–20 years to embed in codes/standards).

Strategy "unit rates" from Section 5.2 (e.g., compact stall conversions, ROW tree-well retrofits, bus-stop tree wells, median conversions, residential cuts, intersection bulb-outs) allow agencies to convert program choices into count- and acre-based targets and then aggregate them into district and watershed workplans. Illustrative domain totals provide context for future target-setting and stress-testing. For example, ROW non-core contains ~13,000 acres (with example mid-range removals on the order of ~10% or ~1,360 acres). Public parcels total ~23,000 acres (~15% or ~3,500 acres mid-range), while private parcels encompass ~88,000 acres (~9% or ~7,800 acres mid-range).

In short, the proposed framework uses today's data-driven baselines and the ~10,000 acre benchmark to guide future target formulation, ensuring equity, hydrologic sense, and delivery realism. The hope is that this will be firm enough to steer near-term planning while being flexible enough to evolve as evidence and capacity grow.

5.5.3 Monitoring, Evaluation, and Adaptive Management

In order to determine the efficacy of depaving initiatives and to guide their implementation as real-world conditions continue to evolve, a monitoring, evaluation, and adaptation framework is necessary.

5.5.3.1 Change Analysis Against Baseline Assessments

The assessments in chapters 2, 3, and 4, which used 2020 data, should be repeated using equivalent data from 2016 and 2023. This would establish trends in pavement coverage, needs metrics, usage patterns, and ownership over time, and how these relate to historical or ongoing policy changes. The same should be done in 2026, 2029, and every 3 years hence to determine the impact of depaving initiatives as they progress.

5.6 DESIGN AND PLANNING CONCLUSIONS

This chapter has offered a scalable toolkit of 22 depaving strategies, from simple residential patio cutouts to complex parking-lot reconfigurations, priced by local contractors and designed to mix and match across residential, commercial, and public sites. It shows that depaving need not be a full-site overhaul: many small, repeatable interventions can amount to large Countywide impact. Applying these strategies to County codes and land-use patterns quantifies a substantial, achievable opportunity: around 10,000 acres of non-core pavement might be removable by extrapolating the identified strategies. A clear near-term objective, 11,126 acres, focuses on high-need communities and schools, converting abstract potential into program-ready targets for planning and investment.

The cost of depaving projects is a crucial constraint. Pavement removal alone costs about $9–$15/sqft, while comprehensive projects with planting and green infrastructure run ~$100–$160/sqft. The chapter therefore proposes a path forward, using baseline data, land-use benchmarks, equity filters (heat, flood, low canopy), and ongoing monitoring and evaluation, to prioritize where benefits are greatest and ensure investments advance climate justice while adapting as evidence accumulates.

CHAPTER 6

RECOMMENDATIONS

This chapter proposes recommendations derived from the key findings of the preceding chapters, offering guidance for future policy and implementation.

1 **Recommendation 1:** Implement Depaving Projects in Hotspot Locations and on Vacant Parcels

Relevant Findings

The 168,967 vacant parcels in Los Angeles County contain over 14,000 acres of potentially unused pavement, representing a major opportunity for removal. 7,034 of these pavement acres fall within the 23,739 vacant parcels that are in populated hotspots representing the top quartile of either heat, flood risk, or the bottom quartile of tree canopy coverage.

More than **788** acres of pavement are located in areas simultaneously experiencing extreme heat, flood risk, pavement burden, and low tree canopy. **79%** of these depaving hotspots with highest need are located in designated Disadvantaged Communities under SB 535.

RECOMMENDATIONS

- Jurisdictions interested in depaving should start by prioritizing projects on publicly owned land based on the priority hotspots identified in this analysis. Those sites present an opportunity to experiment with the range of depaving strategies outlined in this report. Potential locations could include rights-of-way managed by public works agencies, as well as facilities operated by departments such as parks, libraries, animal services, and public safety.

- Because vacant parcels can be depaved without disrupting ongoing activities, we also recommend exploring temporary management agreements, such as low-cost leases or easements, that would allow public agencies or community partners to depave and activate vacant parcels, especially in hotspot areas. Incorporating vacant sites into the pilot initiative would not only expand the range of tested design strategies but also demonstrate how underutilized land can be quickly transformed into climate-resilient, community-serving spaces.

2 **Recommendation 2:** Create a Depave Taskforce

Relevant Findings

Municipalities throughout the County have adopted a range of climate and infrastructure goals that could be advanced through depaving strategies. However, presently, there is no coordinated initiative to guide and align depaving efforts.

RECOMMENDATIONS

- We recommend creating a Depave Taskforce to oversee depaving efforts and facilitate regional coordination across jurisdictions. The Taskforce should include participants from public agencies, local governments and community stakeholders.

- The Taskforce's responsibilities could include setting depaving priorities and targets, developing guidelines and standards for project design and implementation, and tracking progress toward environmental, equity, and public health outcomes. It should serve as a central hub for technical assistance, offering guidance to agencies, municipalities, and community groups on identifying depaving opportunities, evaluating feasibility, and implementing projects.

3 **Recommendation 3:** Use an Implementation Framework

Relevant Findings

An estimated **44%** of the existing pavement in Los Angeles County is not required for roadways, sidewalks, or parking.

Many of the County's Vision Zero priority corridors are afflicted with extreme heat, high risk of flooding, low canopy area, and high pavement burden. Furthermore, 58% of Vision Zero corridors fall within SB 535 Disadvantaged Communities.

Watershed-scale analysis reveals significant depaving opportunities where impermeable surface areas intersect with flood risk, especially in industrial zones.

A significant number of government-owned parcels are mislabeled as "unspecified" in existing land use datasets. School districts and the County control far more pavement than government land use codes suggest.

Depaving is not currently a required component of the County's green infrastructure design standards or RFPs. While CALGreen voluntary tiers (e.g., A5.106.3 and A5.106.11.1) encourage permeable paving and stormwater mitigation strategies, they stop short of requiring a formal analysis of pavement removal. Furthermore, Los Angeles County's prevailing design standards, particularly those governing parking lot layout and right-of-way (ROW) dimensions, often limit or complicate the integration of stormwater capture and greening strategies such as planters, bioswales, and tree wells.

The current County code requirements for residential landscape area dictate that 20% of non-building area must be landscaped. Our calculations show that implementing this goal across all residential parcels would only reduce pavement cover by 571 acres, while residential parcels overall contribute ~74,000 acres of pavement burden countywide.

RECOMMENDATIONS

- We recommend jurisdictions develop an implementation framework to guide and coordinate depaving efforts. The framework should establish clear goals, policies, standards, and metrics, and ensure depaving is consistently integrated into capital projects, planning processes, and funding programs.

- An effective implementation framework could include:
  - **Creating a "Depaving First" standard** for capital infrastructure and public realm projects, including a required *Depaving Evaluation* in early design stages of project design.
  - **Adopting measurable depaving targets** with both cumulative acreage goals and sub-goals by land use type, aligned with canopy equity, stormwater, and public health objectives.
  - Prioritizing depaving in **hotspot communities** with the highest needs and providing direction for municipalities and departments to incorporate depaving strategies into future Specific Plans, Neighborhood Plans, and other place-based planning processes developed with community input.
  - **Auditing and adapting existing zoning and design standards** to reduce the proliferation of unnecessary new pavement and encourage nature-based alternatives, such as bioswales, tree trenches, and permeable pedestrian paths, supported by performance metrics. In addition, consider increasing residential landscape coverage requirements to increase vegetation cover and reduce pavement.
  - **Developing right-of-way depaving strategies** to transform over-paved corridors, medians, and sidewalks, prioritizing disadvantaged communities and aligning with Vision Zero projects wherever possible.
  - **Integrating depaving into existing and future programs** by revising relevant scoring criteria to reward projects that incorporate depaving and embedding depaving opportunity maps into project planning and design processes.

4 **Recommendation 4:** Explore Incentive-Based Approaches for Depaving on Private Property

Relevant Findings

Residential and commercial properties together account for the majority of pavement in Los Angeles County, with residential parcels alone comprising 40.6% and commercial parcels 13.8% of total parcel-based pavement area.

Pavement burden can be understood in two ways: total coverage and intensity. Single-family residential parcels make up the largest share of pavement overall, but multifamily and commercial parcels often carry a heavier burden based on the pavement intensity. On average, up to 28% of multifamily lots are paved, compared with 17% of single-family lots. Looking at both total and proportional coverage helps show not just where most pavement exists, but also which residents are most affected by high levels of paved surfaces on their properties.

If all residential properties were retrofitted to meet the County's current minimum landscape requirement of 20% of non-building parcel area, **571 acres** of pavement would need to be removed.

If all commercial properties were retrofitted to meet the **County's 10% minimum landscape requirement**, this would amount to **1,018 acres** of pavement removal.

In areas where high heat, low canopy, high pavement and high flooding overlap, industrial pavement is the single largest category of parcel pavement. Industrial parcels used for parking, trucking terminals, and storage yards have the highest average pavement intensity of any land use in Los Angeles County. These high-intensity sites contribute disproportionately to stormwater runoff, urban heat, and flood vulnerability, especially in communities already facing stacked environmental burdens. Although these parcels are typically in active use, their intensity makes them strategic long-term targets for depaving, particularly in freight corridors and legacy industrial zones.

RECOMMENDATIONS

- Public agencies should explore incentive-based approaches to encourage private property owners to remove pavement on residential, commercial, and industrial properties outside public control. Potential strategies could include offering rebates, grants, and streamlined permitting for projects that replace impervious surfaces with nature-based alternatives. Agencies can leverage existing funding sources, such as regional rebate programs, state and local funding measures, and other grants to scale and support these efforts.
- The program should include the following considerations:
  - **Residential** incentives could focus on large-scale depaving for multifamily complexes and smaller-scale improvements, such as tree wells or DIY projects, for single-family homes.
  - **Commercial and Industrial** property incentives could target parking lots, warehouses and trucking terminals with retrofits by promoting compact or angled parking, alongside other strategies outlined in Chapter 5 of this report, to enable pavement removal and green infrastructure integration with minimal disruption.

5 **Recommendation 5:** Promote Depaving of Schoolyards and Campuses

Relevant Findings

Schools represent a major opportunity for pavement removal, with 9,542 acres of paved area across public school districts and University owned parcels in Los Angeles County. This is approximately **22%** of all pavement on public parcels in Los Angeles County. Across all school campus parcels, public and private, there are 15,240 acres of pavement.

This assessment calculated the total pavement on school properties but did not attempt to discern how much of that pavement was necessary for ball courts and other school specific pavement needs. There is a need to preserve pavement for essential activities while expanding opportunities for nature-based amenities, shade and recreation.

RECOMMENDATIONS

- The aforementioned Depave Taskforce should organize and convene a cross-jurisdictional School Greening Roundtable, inviting local school districts, and other relevant County and municipal agencies to coordinate and incentivize implementation of school depaving strategies. Through the roundtable, participants could identify priorities and coordinate next steps such as: allocating bond-funded resources toward depaving and nature-based play areas; and developing model site plans and design guidelines that integrate stormwater, shade, and physical activity benefits.
- Future depaving assessments should investigate the specific uses of pavement on school parcels in greater detail to obtain an estimate of how much pavement could be removed.

CHAPTER 7

METHODOLOGY

This section details the methodology we used to estimate how much pavement exists under different uses across Los Angeles County. We leverage high-resolution datasets and spatial classification techniques to identify how much pavement exists and where it is located, disaggregate it by land use, and then estimate its purpose, thus providing a trailblazing framework for evaluating and prioritizing depaving potential.

The methodology is organized into the following key components:

- **pavement classification**
- **aggregation methods**
- **heuristic methods for estimating non-core pavement**

Additionally, the section addresses **limitations of the current datasets** and explores **opportunities for refinement**, so as to better inform future urban planning and environmental justice efforts.

7.1 PAVEMENT CLASSIFICATIONS

7.1.1 Source Imagery

For this analysis, the Los Angeles Regional Imagery Acquisition Consortium (LARIAC) provided aerial imagery gathered across the County in winter 2023-2024. This imagery has a ground surface resolution of 4 inches across most areas, and 9 inches across national park and national forest areas.

7.1.2 Pavement Classification

We used the landcover classification model provided by ESRI for use with ArcGIS software.[52] This model is thought to be trained on landcover classification data developed by Los Angeles County in 2016 using a U-Net classifier with a resnet34 backbone. It produces land cover classes from 3-band aerial imagery, including canopy, bare ground, water, roads, pavement (non-road), low vegetation (like grass), medium vegetation (like shrubs) and buildings.

We applied this model to the 2023-2024 4-inch LARIAC aerial imagery using a padding setting of 100, and a tile size of 400 to yield a countywide 8 class landcover dataset of 0.333 foot resolution. We resampled this (by nearest neighbor) to 0.75 foot resolution for further analysis to make data processing faster. The results included around 700 acres of pavement (non-road) that was clearly misclassified snow in the high mountain regions. We filtered this out of subsequent datasets using an elevation cutoff of 2,000 meters with all non-road pavement above 2,000 meters in elevation was removed from the analysis.

7.1.3 Pavement Class Evaluation

These pavement classification rasters are generated by computer algorithms based on algorithmic interpretation of aerial imagery, and these algorithms are not expected to be 100% accurate. We thus chose to quantify the accuracy of the classification. We randomly sampled 50 points from each of the 8 land cover classes in the 2023 dataset. We then overlaid these upon the original 4 and 9 inch LARIAC images, and asked a human to estimate which of the 8 classes the points fell into. The resulting confusion matrix is shown in figure 7.1, and the accuracy per class shown in table 7.1. We evaluate map accuracy with four metrics: **overall accuracy, producer's accuracy, user's accuracy, and Cohen's Kappa**.

Overall accuracy is the percentage of all reference samples that are classified correctly. **Producer's accuracy** is, for each class, the proportion of ground-truth samples that the map labels correctly. **User's accuracy** is, for each class, the proportion of map-labeled samples that truly belong to that class on the ground. **Cohen's Kappa** summarizes the agreement between the map and the reference data while adjusting for the agreement that could occur by chance: it ranges from -1 (complete disagreement) to 1 (perfect agreement), with 0 indicating chance-level agreement. The overall accuracy was 83%, with a Cohen's Kappa of 0.809.

The evaluation samples were randomly distributed throughout the whole County to include both rural and urban points. In rural areas especially, the distinction between bare ground and low vegetation is ambiguous in winter imagery for southern California, since dead or brown grass can appear similar to bare soil or dusty rocks. Water and bare earth are often confused by the model. Some dry lakebeds were classified as water (the model was trained on 2016 imagery) when they were clearly bare earth in 2023. Pavement (non-road) and roads have acceptable accuracy, with producer's accuracy of 96% and 88% respectively, and user's accuracy of 92% and 80% respectively.

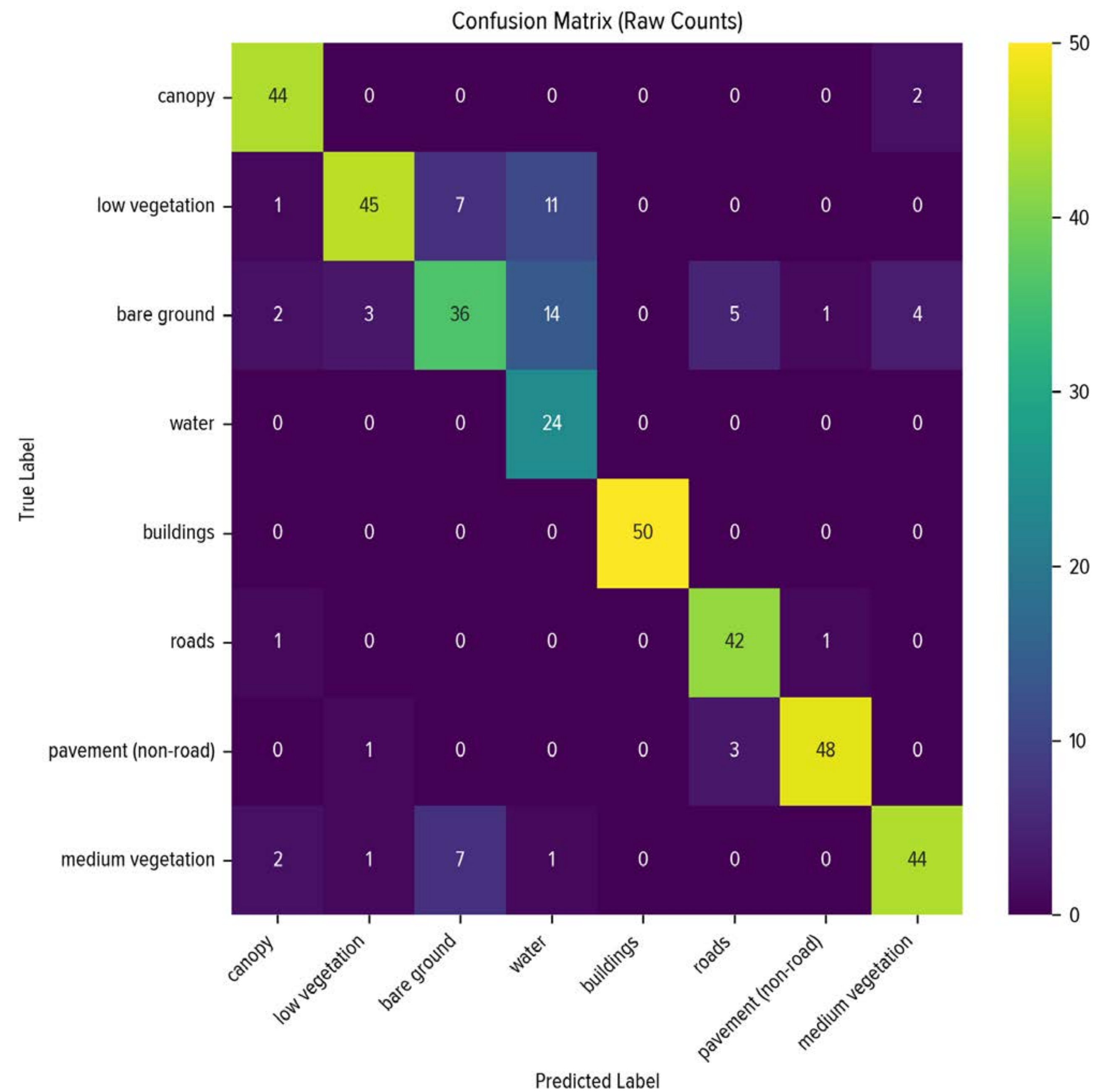


Figure 7.1: Confusion matrix of validation for landcover dataset. Rows are true interpreted values (according to the human evaluators looking at the images), and columns are mapped values

Table 7.1: Accuracy assessment by class of the landcover dataset

	USER'S ACCURACY (OF COMMISSION)	PRODUCER'S ACCURACY (OF OMISSION)
Canopy	95%	88%
Low Vegetation	70%	90%
Bare Ground	55%	72%
Water	100%	48%
Buildings	100%	100%
Roads	95%	84%
Pavement (non-road)	92%	96%
Medium Vegetation	80%	88%

7.2 AGGREGATION METHODS

7.2.1 Raster Aggregation Methods

We aggregated statistics of raster datasets within polygons to produce many of the analytical results in this assessment. The raster datasets include the landcover dataset discussed above, as well as temperature, flooding, population, and elevation rasters. The polygons that we used for statistical aggregation of the raster datasets include parcels, Countywide Statistical Areas, census tracts, supervisorial districts, watersheds, subwatersheds, and several levels of H3 hexagons. Table 7.1 shows all of the raster datasets used, and which statistics were generated of them for each polygon.

Table 7.3 shows the polygon datasets used for the aggregation of the raster data and which attributes were used to associate with pavement statistics.

For each polygon in each dataset, the raster statistics were gathered as described in Table 7.2, so that we could associate them with polygon attributes described in Table 7.3. This allowed for example square footage of road pavement and non-road pavement to be summarized for residential parcels or the right-of-way in a particular Countywide Statistical Area separately.

To generate school polygons, we began with a dataset of school location points, including school names, and spatially joined it to the parcel polygons dataset. However, many schools are actually built on multiple parcels, sometimes spanning several city blocks. To address this, we buffered the initial "seed" polygon (where the school point landed) by 100 feet to capture parcels that might lie just across a historical street right-of-way, and included any parcels within that buffer owned by a school district. We then iterated this process to ensure all school parcels in a group would be counted for that school.

This method has limitations. For example, two adjacent schools in the same district (such as a high school and an elementary school that are within 100 feet of each other) will both include each other's pavement.

This method also excludes landcover data from ROW areas that lie between the original parcels where multi-parcel schools were constructed. Many schools span multiple historical parcels that were never combined into one. We tested methods to account for this, such as building a convex hull around groups of parcels, but this leads to overestimating pavement, so we opted to exclude those interparcel regions to take a more conservative approach.

Table 7.2: Raster datasets used in this depaving assessment

RASTER DATASET NAME	DESCRIPTION	RESOLUTION	DATA YEAR	SOURCE	RASTER STATS GENERATED PER POLYGON
Combined Landcover	8 class land cover from winter 2023-2024: canopy, medium vegetation, low vegetation, bare-earth, water, roads, non-road pavement, buildings	0.75 feet	Winter 2023-2024	Hyphae inference from LARIAC imagery	Percent coverage and square footage of each class
Flood Confidence	Confidence in the 1% annual chance (100- yr return period) flood extent. Low confidence is associated with 100-yr events at the 95th percentile, medium confidence is associated with 100-yr events at the 50th percentile, and high confidence is associated with 100-yr events at the 5th percentile	9.75 feet	PRIMo modeling in 2019, based on DEM from 2006	University of California Irvine Flood Lab	Percent coverage and square footage of each class
Surface Temperature	Surface temperature from ECOSTRESS satellite sensor averaged from 3 acquisitions of 07/20/24 4:55pm, 08/04/2024 11:15pm and 08/21/2024 12:07pm	230 feet	2024	USGS EarthExplorer / NASA Jet Propulsion Laboratory	Median, mean, stdev, min, max, variance, count
Dasymetric Population	This dasymetric population map intelligently reallocates 2020 population from census blocks to 30 meter pixels based on land cover types and uses and slope. It is used for metrics that require population to be spatially allocated at a pixel level, primarily in the urban section of the atlas	99 feet	2020	US EPA EnviroAtlas	Sum, mean, min, max, median, stdev, variance, count.
Elevation	Land surface elevation	32 feet	Mix of 2013, 2019, 2022, and 2024	USGS National Map	Mean, median, stdev, min, max, variance, count

Table 7.3: Polygon datasets used for aggregation of raster data

POLYGON DATASET	DESCRIPTION	SOURCE	POLYGON DATATYPES ASSOCIATED WITH RASTER DATA
Parcels	One polygon for each of the 2,098,519 tax parcels in the County (with duplicate geometries removed)	Los Angeles County Enterprise GIS Hub	UseCodes' per parcel were used to allocate pavement to various uses. The same analysis was also done after filtering parcels by their 'TaxRateCit' attribute to just look at parcels in unincorporated areas.
Public Parcels	One polygon for each of the 49,807 publicly-owned parcels in the County (with duplicate geometries removed)	Los Angeles County Enterprise GIS Hub	OwnerFullName was used to associate types of owners, or classes of public agencies with pavement quantities.
Right-of-Way (ROW)	All of the space between parcels	Derived from parcel data by aggregating all of the area outside of the polygons within the County	The right-of-way polygon was analyzed as a whole, but also broken into pieces using the CSAs, watershed, supervisorial districts polygons to get the ROW stats for each of those geographies.
H3 Hexagons	Hexagonal grids at levels 10, 9, 8, 7, and 6 (roughly with hexagon edge lengths of 0.75, 0.2, 0.53, 1.4 and 3.7 km respectively)	Generated with the H3 python library	H3 index associated with raster stats.
Countywide Statistical Areas (CSAs)	One polygon for each of the 365 CSAs in the County	Los Angeles County Enterprise GIS Hub	'LABEL' attribute was used to associate pavement stats with community names. 'CITY_TYPE' was used to look at just unincorporated CSAs. The CSA polygons were also used to segment the ROW polygon to get ROW stats within each CSA.
Schools	One or more polygons for each of the 3172 schools in L.A. County	Los Angeles County Enterprise GIS Hub	'school_name' was associated with raster stats within each parcel owned by a school district within 100 feet of the school point, or any school district owned parcels adjacent to any of those, or 100 feet from adjacent ones.
Vision Zero Road Segments	One polygon for each of the 200 road segments with high collision concentration	Los Angeles County Enterprise GIS Hub	'STREET' and 'LIMITS' were concatenated to make a label designating the road segments, each of which was associated with raster stats. The line geometry was buffered by 50ft to make the polygons (so 100ft wide rectangles).
Supervisorial Districts	One polygon for each of the 5 supervisorial districts in the County	Los Angeles County Enterprise GIS Hub	'LABEL' attribute was used to associate pavement stats with District names. The District polygons were also used to segment the ROW polygon to get ROW stats within each District.
Watersheds	One polygon for each of the 9 watersheds identified by the Safe Clean Water Program		'Watershed' attribute used to associate pavement stats with watershed names. The watershed polygons were also used to segment the ROW polygon to get ROW stats within each watershed.

For Vision Zero Road segments, we buffered each 1 mile line by 50 ft, to yield a 1 mile by 100 foot rectangle for each segment. These segments include an area that approximates the "streetscape" of that segment, which includes the adjacent sidewalks, street trees and other landscape features that belong to the human experience of traversing said segments.

The aggregation of raster-based geospatial data (including temperature, landcover classifications, flood risk categories, dasymetric population and elevation) to polygon features was performed using a suite of custom Python scripts. These scripts leveraged several core libraries: **GeoPandas** for managing vector polygon data, **Rasterio** for raster data input/output and spatial operations, and **NumPy** for numerical computations.

The general workflow for each polygon dataset involved the following key steps:

1. **Data Ingestion and Preparation:** Input polygon layers (in GeoPackage format) were loaded. An initial check ensured each polygon layer was projected to a consistent Coordinate ReferenceSystem (EPSG:6424) to align with the raster datasets.
2. **Iterative Polygon Processing:** Each polygon was processed iteratively. For every individual polygon feature:
   - **Raster-Polygon Intersection:** The Rasterio's "rasterio.mask.mask" function was utilized to extract only the raster pixel values that fell within the boundaries of the current polygon. This created a masked subset of the raster data specific to that polygon's geometry. An initial check for spatial disjointedness between the polygon and raster extents was performed to skip unnecessary processing.
   - **Statistical Summarization:**

     For continuous raster data (e.g., temperature, elevation, dasymetric population), NumPy functions were applied to the extracted pixel values to calculate descriptive statistics. These included the count of valid pixels, mean, median, minimum, maximum, standard deviation, and variance (and sum for population) of the raster values within the polygon.

     For categorical raster data (e.g., landcover classes, flood risk categories), the scripts would similarly extract pixel values. Then, pixel counts for each unique category within the polygon were determined. These counts were converted into percentages of the polygon's total area covered by each category, and absolute areas (e.g., square footage) after accounting for pixel resolution.
3. **Attribute Appending:** The derived statistics (e.g., ECOSTRESS surface temperature mean, canopy percent, high flood risk square feet) were appended as new attributes to the corresponding polygon feature in the GeoDataFrame.
4. **Output Generation:** Once all polygons were processed, the updated GeoDataFrame, now enriched with the aggregated raster statistics, was saved as a new GeoPackage file.

This systematic approach ensured that each polygon feature was accurately attributed with summary statistics derived from the overlapping raster data, providing a quantitative basis for subsequent spatial analysis, map and chart generation, and reporting.

7.2.2 Polygon Aggregation Methods

In order to obtain metrics that combine attributes calculated at the parcel level with larger geometries (such as, for example, "square feet of residential pavement per watershed"), this study employs an areal interpolation methodology to aggregate polygon-specific attributes from a detailed parcel dataset to sets of larger, summarizing polygons such as h3 hexagons, CSAs, supervisorial districts and watersheds. This process allows for the estimation of values for a target set of polygons based on data from a source set of polygons where the boundaries do not perfectly align. The core of this analysis is performed using the GeoPandas library in Python, leveraging its spatial overlay and data manipulation capabilities.

The primary steps of the methodology are as follows:

1. **Data Ingestion and Preparation:** Two distinct polygon layers are read into GeoPandas GeoDataFrames: a detailed "parcels" layer containing various land use and development-related attributes, and a larger polygon layer representing the larger geographic units into which the parcel data will be aggregated.
2. **Areal Weighting through Spatial Overlay:** A spatial intersection overlay is performed between the parcels and the big polygons. This operation clips the parcels to the boundaries of the larger polygons, creating a new layer of intersection polygons. For each resulting intersection, the area is calculated. This intersection area is then used to determine a weight, which represents the proportion of each original parcel that falls within a given larger polygon.

3. **Weighted Value Calculation:** The numeric attributes of interest from the original parcels are then weighted by this calculated proportion. This is achieved by multiplying the attribute value by the ratio of the intersection area to the original parcel's area. This step ensures that the contribution of each parcel's attributes to the larger polygon is proportional to its spatial extent within that polygon. This includes the aggregation of various pavement and landscape requirement metrics.
4. **Categorical Data Aggregation:** For categorical attributes, such as land use descriptions, a different approach is taken. The weighted pavement area is calculated for each land use category within the intersection polygons. A pivot table is then created to transform the data, resulting in separate columns for the total weighted pavement area for each unique land use category within each large polygon.
5. **Aggregation and Data Merging:** The weighted numeric attributes and the pivoted categorical data are then grouped by the unique identifier of the larger polygons and summed. This yields the total aggregated values for each larger polygon. These aggregated sums are subsequently joined back to the original larger polygons GeoDataFrame, effectively adding the newly calculated summary statistics as new columns.

7.3 HEURISTIC METHODS

7.3.1 Parking Requirements Method

The parking requirements for residential, commercial and industrial parcels were derived from Title 22 of the County code (referenced online in late 2024). These parking assumptions are shown in table 7.4.[53] For residential we overstate the requirement by assuming generous 12'x24' spaces for residents with full-size pickup trucks (the actual County code requirement is for spaces to be around 8'6"x18').

When we added up the total parking requirements for each of these three use categories using these assumptions, we found that the required parking amounted to 28% of non-road pavement for residential parcels, 23% for commercial, and 16% for industrial. We thus conservatively assumed that for all other parcel types (agricultural, institutional, recreational, government and miscellaneous), that the parking requirements were 30% of the non-road pavement, which, being based on our aerial imagery, does not account for subsurface, multilevel, or indoor parking. We used this conservative approach (rather than, for example, assuming 23%) so as not to exaggerate the amount of pavement that might be potentially non-core.

This could be refined by more detailed correspondence of parcel land use codes with the Title 22 specifications, but this rough method did allow an overall order-of-magnitude estimation of the parking requirements for all parcels in the county, which could be subtracted from the parcel non-road pavement to yield a crude estimate of non-core pavement.

Table 7.4: Assumptions for residential parking requirements

RESIDENTIAL DEFINITION	PARKING AREA REQUIRED (SQFT PER PARCEL)
Single Family	576
Two Units	864
Three Units	864
Four Units	864
Five or More Units	1,152
Modular Home	576
Mobile Home	576
Rooming House	576
Mobile Home Park	1,152

This also enabled us to estimate the total number of commercial and industrial parking spaces required in the County by summing the required area per parcel (which comes to 4,015,930). A 2015 Chester et al study[54] estimated that in 2010 there were 12,303,349 total off street spaces, while our estimate is 7% lower at 11,433,288. The same group estimated in 2010 that, nationwide, the ratio of surface parking to structured parking (multilevel, subsurface etc) may range from 1:1 (in dense urban cores) to 7:1.[55] Thus the 4,015,930 is still a conservative estimate of the total number of surface parking spaces available for heuristic estimates on the impact of parking lot depaving strategies discussed in Chapter 4.

Table 7.5: Assumptions for parking requirements for commercial and industrial parcels

PARCEL	BUILDING SQFT PER REQUIRED 152 SQFT PARKING SPACE
INDUSTRIAL	
Warehouse	1000
Industrial	500
Offices (within industrial building)	400
COMMERCIAL	
Restaurants, Bars, Theaters, Health Clubs, etc.	10
Retail Commercial, Medical Office Building	250
Business Professional Office (other than medical)	400

7.3.2 Sidewalks Requirements Method

To estimate the contribution of sidewalks to the interpretations of our dataset, we used the following method:

We employed the “tile2net” algorithm[56] to estimate sidewalk polygons from high-resolution aerial imagery (provided by LARIAC) for three sample areas of the county. These sample areas included East LA, Boyle Heights, and Carson. This algorithm produces polygons around sidewalk areas in an aerial image, but because it is trained on networks of paths rather than strictly as image segmentation, it can extend sidewalk polygon estimations underneath tree canopy and building shadows. Figure 7.2 shows an example of the tile2net segmentation of an aerial image in the Carson neighborhood.

Figure 7.3 shows a more zoomed-in example of the tile2net sidewalk polygons compared to our pavement classification.

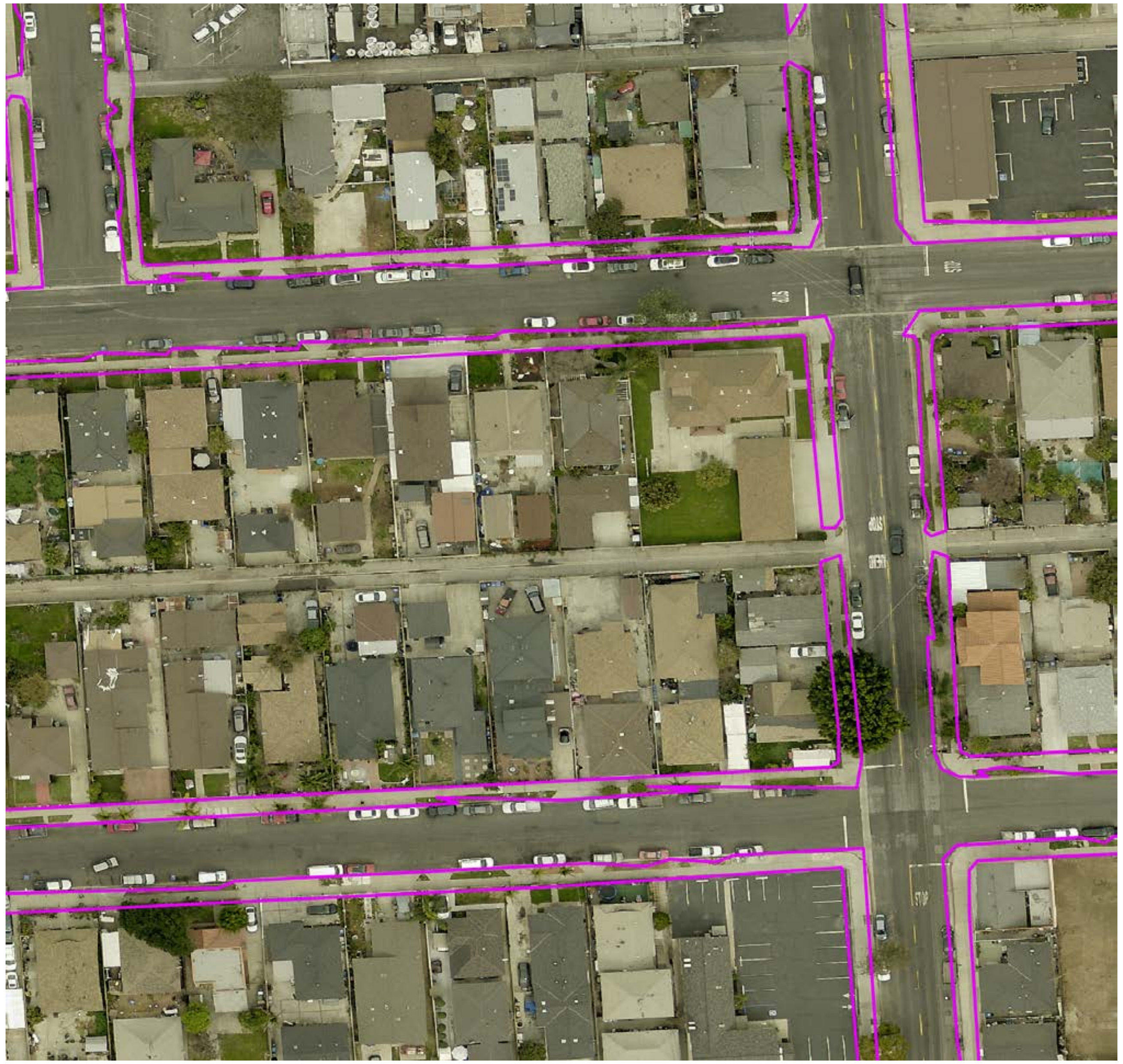


Figure 7.2: An aerial image from Carson showing a purple outline where tile2net classifies sidewalk pixels

Figure 7.3: a) shows the tile2net sidewalk polygons as purple outlines over the aerial image. b) are the same sidewalk outlines in purple over the land classification

As can be seen in Figure 7.3a, the tile2net algorithm, while not perfect, is largely effective at identifying where sidewalks are located and then separating them from roads and crosswalks, even when they run underneath tree canopy. As can be seen in Figure 7.3b, the sidewalks often appear to cover road pixels rather than non-road pavement pixels.

To estimate sidewalk locations across the County, we started by running tile2net on a 6,651 acre sample area in the vicinity of Boyle Heights. Tile2net also provides line geometry for all sidewalks in the sample area, and we calculated the total length of these to be 321 miles. We then used the OSM overpass API to collect all of the road lines (using network_type='drive' to exclude service roads, parking aisles, and alleys) from the same sample area. We calculated these to be 461 miles long. Thus the average ratio of sidewalks to road lengths is around 0.7. We then calculated the entire length of all roads in the County (42,835 miles), and multiplied this by 0.7 to estimate the total length of sidewalks in the County (29,984 miles). We then multiplied this by 4 feet to get a total square footage of sidewalks that might be considered core (14,538 acres). To relate this to the pavement classification pixels, we focused on the inter-parcel space, or right-of-way (ROW), which is where most sidewalks appear when overlaying the ROW boundary with aerial imagery, and where 70% of the tile2net sidewalk polygon area in our sample datasets fell.

Using a sample of 1,884 acres of sidewalk from a tile2net test in a section of Boyle Heights, we found that overall around 15% of the pixels in the sidewalk polygons were road pixels, while 53% were NRP pixels. We also found that of the sidewalk area, 70% was in the right-of-way rather than inside parcels. Of the sidewalks in the right-of-way, we found that 20% of the pixels were road pixels, and 52% were NRP pixels.

These figures derived from this rubric were used to dial in estimates of how much ROW NRP is sidewalks, and how much pavement classified as road in the ROW is actually potentially sidewalk. Thus the NRP data is considered a high level estimate for gauging "order-of-magnitude" opportunities and priorities for depaving. Additional geospatial analysis and machine learning can be done to further specify in greater details the distribution of sidewalks in future study phases.

These are very rough estimates and could be refined further by more detailed surveys of the sidewalk to pavement pixel class apportionment, and by deep learning analysis targeting sidewalks specifically.

7.3.3 Landscape Potential Heuristics

Commercial Landscape Potential

The Los Angeles County Planning and Zoning Code 22.20.040 stipulates that commercial parcels permitted after 2019 must be at least 10% landscaped. While this requirement only applies to newer commercial parcels in unincorporated areas, it represents a heuristic target that we can apply to all commercial parcels for the purposes of defining aspirational depaving targets.

Residential Landscape Potential

The August 2024 amendment to Title 22—Planning and Zoning of the Los Angeles County Code—includes design standards for residential development. One of the included requirements is that 20% of the area not in use for buildings in residential parcels be landscaped, up to 5,000 square feet.[57] While this only technically would apply to new developments in unincorporated areas, we can use this figure as a benchmark for residential landscape area requirements. Each parcel's landscape area was calculated from the landcover statistics by summing the tree canopy, low vegetation, medium vegetation, bare earth, and water square footage. We then divided this by the total parcel area (after first subtracting building area from it) to get the existing landscaped area percentage for each parcel. These per parcel landscape area calculations were used to develop the depaving targets discussed in section 7.3.4.

7.3.4 Public Parcel Ownership Category

We analysed 49,807 publicly owned parcels using the "Owner Full Name" field (e.g., "AGOURA HILLS CITY CLERK"). By scanning that text for diagnostic keywords we assigned every parcel to one and only one of eight ownership classes, as shown in table 7.6.

Table 7.6: Ownership categories and keyword rules used for public parcel ownership analysis

<table>
<tr><th>CATEGORY</th><th>KEYWORD RULE</th></tr>
<tr><td>County</td><td>"LA COUNTY|LA CO |CO SAN|LACMTA|LOS ANGELES COUNTY|COUNTY SAN|COUNTY OF LOS|L A COUNTY|L A CO "</td></tr>
<tr><td>School</td><td>"SCHOOL|COLLEGE|UNIVERSITY"</td></tr>
<tr><td>Parks</td><td>"PARK|REC|CONSERV|GARDEN"</td></tr>
<tr><td>Water</td><td>"WATER|IRRIG|HYDRO|SANIT"</td></tr>
<tr><td>City</td><td>"CITY"</td></tr>
<tr><td>State</td><td>"STATE OF CA"</td></tr>
<tr><td>Federal</td><td>"U S GOVT|U S GOV'T|US GOV|UNITED STATE|POSTAL"</td></tr>
<tr><td>Other</td><td>(records not caught by the rules above).</td></tr>
</table>

To avoid double-counting, the rules are applied hierarchically: for instance, a parcel named "LOS ANGELES CITY WATER DISTRICT" is counted in Water / Sanitation, not in City, and a state-owned park appears in Parks & Recreation, not in State. Figure 3.10 shows how pavement area is distributed across these eight public-ownership categories.

7.3.5 Intersections

We used the python OSMNX library to download all of the drivable roads as edges and their intersections as nodes for graph analysis. Some edges have user-provided lane counts. We summed the number of lane counts per intersection and divided it by the number of streets connected to the node to get the average number of lanes per connected street. We removed nodes with average lanes per street less than 3 to get "wide" intersections. Of 174,633 intersections, only 74,751 (43%) had lane information, and of those, 332 were considered "wide." For each street connected to each node we assumed 2 corners, each of which could have the 250 square feet of pavement removed according to the adaptation strategy. We then divided by 43% to extrapolate across the nodes missing lane information, to get 54 acres of pavement that could be removed from wide intersections.

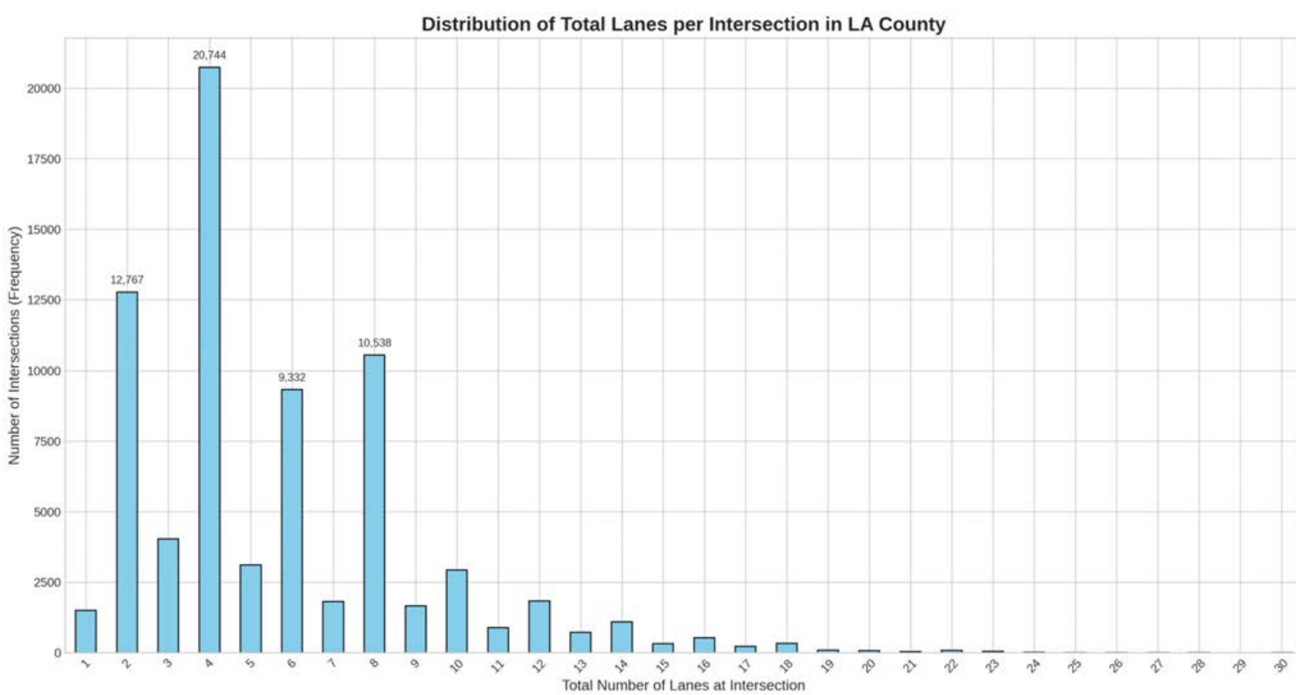


Figure 7.4: Distribution of total lanes per intersection in LA County

7.4 LIMITATIONS OF THESE METHODS

Conducting a wall-to-wall depaving assessment for all 4,000 + square miles of Los Angeles County is necessarily an exercise in balancing breadth and depth. The limitations in table 7.7 should be kept in mind whenever countywide results are interpreted or applied to site-scale decisions.

Many of these limitations point towards the necessity of site-scale follow-up when moving beyond the county-scale. For example:

1. **Granular design constraints:** Driveway throat widths, utility clearances, ADA turning radii, and emergency vehicle easements are all sub-pixel features invisible to this study.
2. **Contextual land-use nuance:** A 20,000 ft² "industrial" parcel in Vernon may host a parking-intensive logistics yard, whereas the same UseCode in Pasadena could be a multi-story light-manufacturing building with negligible surface parking; the county-wide heuristics average these extremes.
3. **Partner and equity considerations:** Ownership patterns, community priorities, and planned capital projects determine whether an area's theoretical depaving potential is socially and politically feasible. These factors require qualitative engagement beyond the raster analytics used for this assessment.

These countywide datasets can be a powerful screening tool; they can highlight hotspots, rank jurisdictions, and gauge order-of-magnitude benefits. **Yet any move from *potential* to action should trigger a sequence of more specific assessments: higher-resolution data, field checks, and partner dialogue tailored to the unique spatial, regulatory, and social context of each prospective depaving site.**

Table 7.7: Selected limitations of the methods used for this assessment

CATEGORY	KEY SOURCES OF UNCERTAINTY	PRACTICAL IMPLICATION
Spatial Resolution	• 0.75 ft (≈23 cm) pixels are coarse relative to many real-world features (planter strips, narrow medians, curbs, lane markings)	Fine-grained elements of the public realm, such as "tenths" of a parking stall, micro-swales, or thin sidewalk buffers, are often omitted or mis-classified, leading to conservative (under-counted) pavement totals.
Mutually Exclusive Land Cover Classes	• Single-class assignment per pixel masks mixed surfaces (e.g., asphalt under tree canopy)	Conservative (under-counted) pavement
Temporal Mismatch	• Land classification sourced from 2023-2024 imagery, ECOSTRESS surface temperature from 2024, flood confidence model from 2006 DEM, parcels from 2025	Any location that changed appreciably between vintages will carry mixed or outdated attributes, introducing temporal bias into aggregate statistics.
Classification Error	• Landcover classification has assessed overall accuracy of 83%, which means all pavement amounts may be + or - 17%	This baseline might not allow change detection over time for changes <17% with much confidence.

CATEGORY	KEY SOURCES OF UNCERTAINTY	PRACTICAL IMPLICATION
Polygon Aggregation	• Parcels and ROW derived from assessor geometry; internal lot lines inside campuses and shopping centers introduce slivers of ROW that are not functionally roadway • Parcel data aggregated to other geometries was "weighted" • School buffering heuristic merges adjacent parcels but ignores inter-parcel ROW	Pavement attributed to "ROW" may include drive aisles or parking lots that function as private space; conversely, contiguous school grounds may be split, understating on-site imperviousness. Parcel level data aggregated into other small geometries is approximate.
Parcel Use Code Ambiguity	• Parcel use codes may not be updated or accurate	For example, "government use - unspecified" use code includes parcels across diverse uses that may have varying opportunity
Heuristic Methods	• Title 22 parking rules applied at broad UseCode groupings; multilevel or subsurface parking not captured • Parking heuristic based on County code and not on the 88 cities • Sidewalk length extrapolated from one Boyle Heights sample using tile2net and OSM road ratio	Parking requirements likely over-state necessity on small residential parcels and under-state supply at large commercial centers. Sidewalk square footage requirement likely overestimated overall, and may vary significantly in hillside or industrial districts.
Model Generalization	• Flood confidence, temperature exposure, and population density raster layers each carry their own modeling assumptions • H3 hexagon, watershed, and CSA boundaries impose arbitrary cut-offs that may bisect real-world systems	Risk-oriented prioritization (e.g., heat + population + pavement) inherits compound uncertainty; cross-boundary projects (e.g., river corridors) may require custom aggregation.

7.5 OPPORTUNITIES FOR REFINEMENT

The methods used in this assessment could be improved upon for future assessments. The following methodological improvements can be leveraged for future depaving assessments to track progress of ongoing depaving efforts:

1. **Landcover rasters should be generated with a purpose-built model (fine-tuned for pavement specific assessment using 4 inch imagery).** This would improve the accuracy of the data.

2. **Tile2net should be run for the whole County to get a specific measurement of actual sidewalks.** This would provide a much more accurate baseline for sidewalk square footage than the current estimation method, which relies on a single sample area.

3. **The parking heuristic should be exhaustively derived from each of the city codes in addition to the County code, with the resulting requirements applied to City-specific parcels.** This would create a more accurate and spatially refined estimation of required parking across the entire county. Future research could also incorporate more dynamic parking demand models that consider factors like time of day, day of the week, and local events to move beyond static, requirements-based estimations.

4. **Advanced remote sensing methods for measuring parking spaces should be used to ascertain how many stalls are 90 degrees vs other angles.** This would enable quantification of potential benefits of scaling parking lot depaving strategies.

5. **Integrate qualitative and community-based data.** To better understand the social and political feasibility of depaving projects, future assessments should incorporate qualitative data. This could include data from community meetings, surveys, and interviews to capture local knowledge, priorities, and concerns. Combining this qualitative data with the quantitative geospatial analysis will provide a more holistic understanding of depaving opportunities and challenges.

6. **Develop a more nuanced understanding of public parcel use.** While the current study categorizes public parcels by owner, future analyses could further disaggregate these categories to better understand the specific uses of public land. For instance, "City" owned parcels could be further classified into functional categories like "municipal buildings," "public works yards," and "community centers" to better identify specific depaving opportunities.

7. **Include infiltration and surface flow data in prioritization.** The SSURGO data and recent developments in surface flow modeling can be used to prioritize depaving based on where infiltration will be most beneficial for both flood mitigation and groundwater recharge.

8. **Model UTCI at high resolution for heat assessments.** New methods for physical modeling enable countywide estimation of thermal comfort metrics taking into account the shade of trees and buildings, and the impact of wind. These simulations would afford a more specific estimate of heat stress than surface temperature.

9. **Needs assessment should include vulnerability metrics.** The needs assessment should be expanded to include vulnerability metrics such as the CDC/ATSDR Social Vulnerability Index, the EPA Community Health Vulnerability Index (CHVI), the EDF Climate Vulnerability Index (CVI) and similar indicators to include the consideration of receptor sensitivity with the physical measurements and models for the evaluation of pavement removal needs. Because such metrics are often limited in spatial resolution to the census block geometry, dasymetric methods can be used to harmonize them with the hex grids used in this study.

ENDNOTES

[1] The reference is to Joni Mitchell's 1970 hit song, "Big Yellow Taxi." "I wrote 'Big Yellow Taxi' on my first trip to Hawaii," long-time LA resident Mitchell recounted in a 1996 interview. "I took a taxi to the hotel and when I woke up the next morning, I threw back the curtains and saw these beautiful green mountains in the distance. Then, I looked down and there was a parking lot as far as the eye could see, and it broke my heart . . . this blight on paradise." Hillburn, R. (1996, December 8) Both Sides, Later. *Los Angeles Times*. https://www.latimes.com/archives.

[2] Brum, R. de Lima, Penteado, J. O., Tavella, R. A., Nadaleti, W. C., Brum, A. N., They, N. H., Coronas, M. V., Klein, R. D., Pereira, N., & Rodrigues da Silva Júnior, F. M. (2025). Effects of increased temperature on atmospheric pollutant levels and human health in small and medium-sized cities in southern Brazil. Case Studies in Chemical and Environmental Engineering, 11, 101170. https://doi.org/10.1016/j.cscee.2025.101170.

[3] Ng, M., and Coffelt, J. (2024). Depaving California Schools for a Greener Future. Key barriers and policy recommendations. UCLA Luskin Center for Innovation, 22-28. escholarship.org/uc/item/89t9q2sq.

[4] Pierce, C. C. (1861-1946) / Security Pacific National Bank Collection / Los Angeles Public Library.

[5] Green, D. (1993, August 15). Unpave L.A. *Los Angeles Times*. https://www.latimes.com/archives.

[6] E.g. Bluesky. (n.d.). #UnpaveLA [Hashtag page]. Bluesky. https://bsky.app/hashtag/unpaveLA.

[7] Van Buren, M. A., Watt, W. E., Marsalek, J., & Anderson, B. C. (2000). Thermal enhancement of stormwater runoff by paved surfaces. *Water Research*, 34(4), 1359–1371; Brabec, E., Schulte, S., & Richards, P. (2002). Impervious surfaces and water quality: A review of current literature and its implications for watershed planning. *Journal of Planning Literature*, 16(4), 499–514; Chithra, S. V., Harindranathan Nair, M. V., Amarnath, A., & Anjana, N. S. (2015). Impacts of impervious surfaces on the environment. *International Journal of Engineering Science Invention*, 4(5), 27–31.

[8] Chester, M., Fraser, A., Matute, J., Flower, C., & Pendyala, R. (2015). Parking Infrastructure: A Constraint on or Opportunity for Urban Redevelopment? A Study of Los Angeles County Parking Supply and Growth. Journal of the American Planning Association, 81(4), 268–286. https://doi.org/10.1080/01944363.2015.1092879.

[9] www.depave.org.

[10] Osman, Dalia Abdel Moneim. (2018). The Potential of Pavements in the Identity Conflict of a City. in Cities' Identity Through Architecture and Arts. ISBN: 9781315166551.

[11] Lan Luo, Bin Jiang, From oppressiveness to stress: A development of Stress Reduction Theory in the context of contemporary high-density city, Journal of Environmental Psychology, Volume 84, 2022, 101883, ISSN 0272-4944, https://doi.org/10.1016/j.jenvp.2022.101883.

[12] Ning Chen, Xiaodong Chen, Pengyu Zhu, From a visual standpoint: Exploring the influence of the built environment, especially road ratio, on mental wellbeing before and after the COVID-19 outbreak in Hong Kong, Journal of Urban Management, Volume 14, Issue 2, 2025, Pages 325-341, ISSN 2226-5856, https://doi.org/10.1016/j.jum.2024.09.004. (https://www.sciencedirect.com/science/article/pii/S2226585624001158).

[13] Mousavi, M., Emrani, J., Teleha, J. C., Jiang, G., Johnson, B. D., Shamshiripour, A., & Fini, E. H. (2024). Health risks of asphalt emission: State-of-the-art advances and research gaps. *Journal of Hazardous Materials*, 480, 136048. https://doi.org/10.1016/j.jhazmat.2024.136048.

[14] Yao, S., Wang, N., & Wu, J. (2025). How does the built environment affect pedestrian perception of road safety on sidewalks? Evidence from eye-tracking experiments. *Transportation Research Part F: Traffic Psychology and Behaviour*, 110, 57-73. https://doi.org/10.1016/j.trf.2025.02.005.

[15] Appleyard, D., & Lintell, M. (1972). The Environmental Quality of City Streets: The Residents' Viewpoint. *Journal of the American Institute of Planners*, 38(2), 84–101. https://doi:10.1080/01944367208977410.

[16] Ng, M., & Coffelt, J. (2024). *Depaving California schools for a greener future: Key barriers and policy recommendations*. UCLA Luskin Center for Innovation. https://escholarship.org/uc/item/89t9q2sq.

[17] Adams-Fuller, T. (2023, August). Extreme heat is deadlier than hurricanes, floods and tornadoes combined. *Scientific American*. https://www.scientificamerican.com/article/extreme-heat-is-deadlier-than-hurricanes-floods-and-tornadoes-combined/.

[18] Atlantic Council. (2021, August). *Extreme heat: The economic and social consequences for the United States*. Adrienne Arsht-Rockefeller Foundation Resilience Center, p. 3. https://www.atlanticcouncil.org/wp-content/uploads/2021/08/Extreme-Heat-Report-2021.pdf.

[19] Los Angeles County Chief Sustainability Office. (2021, October). *LA County climate vulnerability assessment*, p. 23. https://preview-assets-us-01.kc-usercontent.com/0234f496-d2b7-00b6-17a4-b43e949b70a2/5a0e0a91-02b5-4e90-995f-c47440c73001/LA-County-Climate-Vulnerability-Assessment-1.pdf. Additionally, the 2019 OurCounty Sustainability Plan predict that, by mid century, air temperatures will increase by 1.8°F to 7.2°F across the region, with the greatest increases in average temperatures and high-heat days (> 95°F) occurring in Palmdale, Lancaster, and the San Gabriel Valley. Los Angeles County Chief Sustainability Office. (2019, July). *OurCounty: Los Angeles Countywide Sustainability Plan*, p. 49. https://ourcountyla.lacounty.gov/wp-content/uploads/2019/07/OurCounty-Final-Plan.pdf.

[20] LA County Climate Vulnerability Assessment (2021), 26.

[21] LA County Climate Vulnerability Assessment (2021), 44.

[22] Los Angeles County Chief Sustainability Office. (2025, draft). *2025 OurCounty plan*.

[23] Los Angeles County. (n.d.). *LA County GIS mapping application* [Interactive map]. ArcGIS Web Application. https://lacounty.maps.arcgis.com/apps/webappviewer/index.html?id=c78e929d004846bb993958b49c8e8e65.

[24] Li, D., Wang, L., Liao, W., Sun, T., Katul, G., Bou-Zeid, E., & Maronga, B. (2024). Persistent urban heat. *Science Advances*, 10(15), eadj7398. https://doi.org/10.1126/sciadv.adj7398.

[25] Safe Clean Water Program. (2024, November). *Framework for Safe, Clean Water Program watershed planning*. Los Angeles County Public Works, p. 20 https://safecleanwaterla.org/content/uploads/2024/11/Watershed-Planning-Framework.pdf.

[26] Safe Clean Water Program. (2024, November). *Framework for Safe, Clean Water Program watershed planning*. Los Angeles County Public Works, p. 2.

[27] Safe Clean Water Program. (2024, November). *Framework for Safe, Clean Water Program watershed planning*. Los Angeles County Public Works, p. 24-25.

[28] Los Angeles Waterkeeper. (2023, February). *Changing the course: What's worked, what hasn't, and what's next for the SCWP*, p. 2.

[29] Sanders, B. F., Schubert, J. E., Kahl, D. T., Luke, A., Karoly, K., Hua, Q., Crawford, M., Gidaris, I., Kenney, S., Basolo, V., Hsu, A., Matthew, R. A., Bouton, S., & Brand, E. (2023). Large and inequitable flood risks in Los Angeles, California. *Nature Sustainability* 6, 47-57. https://doi.org/10.1038/s41893-022-00977-7.

[30] Los Angeles County Public Works. (n.d.). *Are you prepared for a flood?* Los Angeles County. https://pw.lacounty.gov/wmd/nfip/documents/AreYouPreparedforaFlood.pdf.

[31] LA County Climate Vulnerability Assessment (October 2021), pp. 7, 64.

[32] LA County Climate Vulnerability Assessment (October 2021), p. 18.

[33] Schubert, J. E., Mach, K. J., & Sanders, B. F. (2024). National-scale flood hazard data unfit for urban risk management. *Earth's Future*, 12(7), e2024EF004549. https://doi.org/10.1029/2024EF004549.

[34] Sanders, B. F., & Schubert, J. E. (2019). PRIMo: Parallel raster inundation model. *Advances in Water Resources* 126, 79-95.

[35] Sanders, B. F., Schubert, J. E., & Kahl, D. T. (2023). Large and inequitable flood risks in Los Angeles, California. Nature Sustainability, 6, 47-57. https://doi.org/10.1038/s41893-022-00977-7.

[36] As the spatial resolution of our pavement and canopy source metrics are ~24cm, our flood source metric ~3 meters, and our heat metric 70 meters, the smallest spatial unit to which we can meaningfully aggregate these combined needs is 70 meters.

[37] Los Angeles County, *Countywide Parks and Open Space* Public - Hosted), LA City GeoHub, https://geohub.lacity.org/datasets/840b3da17e844486b3bafaae6eda87d4_0/explore.

[38] Gores are the triangular pieces of land created where roads or lanes merge, fork, or intersect, and are called virtual gores when that area is paved.

[39] Baldauf, R. (2016). *Recommendations for constructing roadside vegetation barriers to improve near-road air quality* (EPA/600/R-16/072). U.S. Environmental Protection Agency.

[40] For a detailed discussion of the history and rationale for putting so much pavement on schoolyards, please see Ng and Coffelt's 2024 report "Depaving California Schools for a Greener Future."

[41] As the spatial resolution of our pavement and canopy source metrics are ~24cm, our flood source metric ~3 meters, and our heat metric 70 meters, the smallest spatial unit we can meaningfully aggregate these combined metrics is 70 meters.

[42] "Heuristic," *Wikipedia*, last modified January 13, 2025, https://en.wikipedia.org/wiki/Heuristic. Article cites Gigerenzer, G.; Gaissmaier, W. (2011). "Heuristic Decision Making." Annual Review of Psychology. 62: 451–482.

[43] It should be noted that while this assessment seeks to identify an upper bound of potentially non-core pavement, the actual amount may be higher. Our pavement counts are conservative (see Chapter 7). For example, pavement hidden beneath tree canopy was not captured in aerial photography and therefore excluded, though it could potentially be removed. In addition, road pavement is treated as "core" in this analysis, but future efforts may consider opportunities for road removal where feasible.

[44] Los Angeles County Department of Public Works. (2011, June). *Green infrastructure guidelines: Low impact development and other sustainable practices for public works projects*. Los Angeles County. https://dpw.lacounty.gov/adm/sustainability/docs/GreenInfrastructureGuideline06092011.pdf.

[45] Los Angeles County Department of Public Works. (2011, June). *Green infrastructure guidelines: Low impact development and other sustainable practices for public works projects*. Los Angeles County.

[46] Holly J. Mitchell and Lindsey P. Horvath, "Adoption and Equitable Implementation of the Los Angeles County Community Forest Management Plan," Motion, Los Angeles County Board of Supervisors, October 8, 2024.

[47] Los Angeles Waterkeeper. (2023, February). *Changing the course: What's worked, what hasn't, and what's next for the SCWP.*

[48] This report does not include road diets in our assessment of depaving opportunity, however we have included this common adaptation strategy in this diagram for reference purposes.

[49] Krisher, T. (2024, October 22). Lower-priced new cars are gaining popularity, and not just for cash-poor buyers. *Associated Press*. https://apnews.com/article/cars-vehicles-autos-affordable-suvs-compact-price-a9547c1d9a52199a492676f8ef2d5891.

[50] Los Angeles County Metropolitan Transportation Authority. (2025, June). *Metro bus stops* [Dataset]. ArcGIS Online. https://lametro.maps.arcgis.com/apps/mapviewer/index.html?layers=d837b1e9ec0a4f9abb43dfcb2bd5322a.

[51] Los Angeles County. (n.d.). *Countywide parks and open space* (public - hosted) [Dataset]. LA City GeoHub. https://geohub.lacity.org/datasets/840b3da17e844486b3bafaae6eda87d4_0/explore.

[52] Esri. (n.d.). *Using land cover classification (aerial imagery)*. ArcGIS Pro Documentation. https://doc.arcgis.com/en/pretrained-models/latest/imagery/using-land-cover-classification-aerial-imagery-.htm.

[53] Chester et al. (2015) used a more comprehensive method based on checking 19 city codes throughout the county, but the original focus of the present analysis was on unincorporated parcels primarily, so we used the county code requirements to calculate the parking requirements for all parcels. These tend to be within 25% of the median presented by Chester et al. 2015.

[54] Chester, M., Fraser, A., Matute, J., Flower, C., & Pendyala, R. (2015). Parking infrastructure: A constraint on or opportunity for urban redevelopment? A study of Los Angeles County parking supply and growth. *Journal of the American Planning Association*, 81(4), 268-286. https://doi.org/10.1080/01944363.2015.1092879.

[55] Chester, M., Horvath, A. & Madanat, S. (2010), "Parking Infrastructure: Energy, Emissions, and Automobile Life-Cycle Environmental Accounting," Environmental Research Letters, Vo. 5, No. 3 (http://dx.doi.org/10.1088/1748-9326/5/3/034001).

[56] Hosseini, M., Sevtsuk, A., Miranda, F., Cesar, R. M., & Silva, C. T. (2023). Mapping the walk: A scalable computer vision approach for generating sidewalk network datasets from aerial imagery. *Computers, Environment and Urban Systems*, 101, 101950. https://doi.org/10.1016/j.compenvurbsys.2023.101950.

[57] Los Angeles County. (2024). *An ordinance amending Title 22 – Planning and Zoning of the Los Angeles County Code to implement design standards for residential development* (Ordinance No. 2024-0049). Los Angeles County Board of Supervisors. https://file.lacounty.gov/SDSInter/bos/supdocs/195356.pdf.

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