Heat Island Reduction Toolkit

Cooling Long Beach

Urban Heat Island Reductions Strategies

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CHAPTER 1

Introduction

Purpose

This document identifies a wide range of methods and strategies to address extreme heat and to cool the City's public streets, sidewalks, and alleyways. This toolkit is a resource for community members, as well as City staff, consultants, and developers in the planning, design, and implementation of streetscape projects. The Cooling Long Beach project identified sustainable design strategies to cool temperatures; improve walking, biking, connections to transit, and key community destinations; and increase the climate resiliency and well-being of the Washington Neighborhood (Figure 1). While the focus of this project is on one specific area of the City, the tools and strategies found in this document can be applied broadly throughout the City and elsewhere in California and the southwest.

This project was funded by SCAG as part of regional and local on-going efforts to address climate change and build more sustainable communities. This project provided an opportunity to develop innovative strategies that can serve as a model for other cities throughout the SCAG region while addressing the specific wants and needs unique to the communities within each study area.

SCAG has been a leader in developing regional strategies to address climate impacts. Its Connect SoCal Plan identifies Sustainable Communities Strategies to achieve state-mandated GHG emissions reductions. Strategies from this plan include:

- Improve mobility, accessibility, reliability, and travel safety for people and goods.
- Reduce greenhouse gas emissions and improve air quality.
- Support healthy and equitable communities.
- Adapt to a changing climate and support an integrated regional development pattern and transportation network.

This toolkit is organized into five chapters: Introduction, Community Engagement & Local Context, Cooling Toolkit, Cooling Strategies, and Implementation & Funding. Chapter 1: Introduction includes the purpose of this project and the impacts of climate change and urban heat island effect. Chapter 2: Community Engagement & Local Context includes summaries on the planning process and community engagement strategy with study area descriptions. Chapter 3: The Cooling Toolkit includes the cool tool benefits, applications, and design considerations. Chapter 4: The Cooling Strategies more thoroughly considers the cooling strategies. Chapter 5: Funding & Implementation provides example applications and funding opportunities. The Appendix includes: Existing Conditions & Opportunities, Existing Document Review, Potential Funding Sources, Cost Estimate, and a Maintenance Matrix.

The Cooling Long Beach Toolkit provides cooling strategies for city streets that:

- Address extreme heat issues.
- Reflect community needs and desires.
- Are functional for city departments and developers.
- Target heat issues in specific neighborhoods, but can be applied elsewhere in the City and SCAG region.

Study Area

The Washington Neighborhood Study Area in Long Beach is one of several Urban Heat Islands in the city—areas where there is a significant temperature increase between it and the surrounding context. This report details key existing conditions and characteristics of the neighborhood, bordered by Pacific Coast Highway to the north, Anaheim Street to the south, Magnolia Avenue to the west, and Long Beach Boulevard to the east - encompassing a quarter of a square mile. This year-long Urban Cooling Strategies project, funded by a grant from Southern California Association of Governments (SCAG), will identify sustainable design strategies to cool temperatures; improve walking, biking, connections to transit, and key community destinations; and increase the climate resiliency and well-being of the Washington Neighborhood.

To facilitate these goals, the project team reviewed three key factors in the study area: equity and demographics; heat-related information; and active transportation information. What follows is a summary of these findings, and is complemented by a review of regional and local plans that will inform this work.

Figure 1. Washington Neighborhood Study Area.

Climate Change and the Urban Heat Island Effect

Data tells us that the global climate is changing. This is due in part, to increases in emissions of greenhouse gases (GHGs), like carbon dioxide, that are produced from burning materials like wood, coal, and fossil fuels that we use to power our cities and cars. These greenhouse gasses trap heat within the earth's atmosphere, resulting in changes to our climate and weather. Some of these changes include increased droughts, intensified rains and wildfires, and more frequent and severe heat waves. This project will focus on issues related to heat.

Urban heat islands are areas that experience higher temperatures than nearby less developed areas because they have more paved surfaces and buildings, and less vegetation. Urban heat islands occur when buildings and pavements absorb heat during the day and radiate the heat at night, leading to poor air quality and health problems. The urban heat island effect, made worse by climate change, disproportionately impacts communities of color and low-income communities.

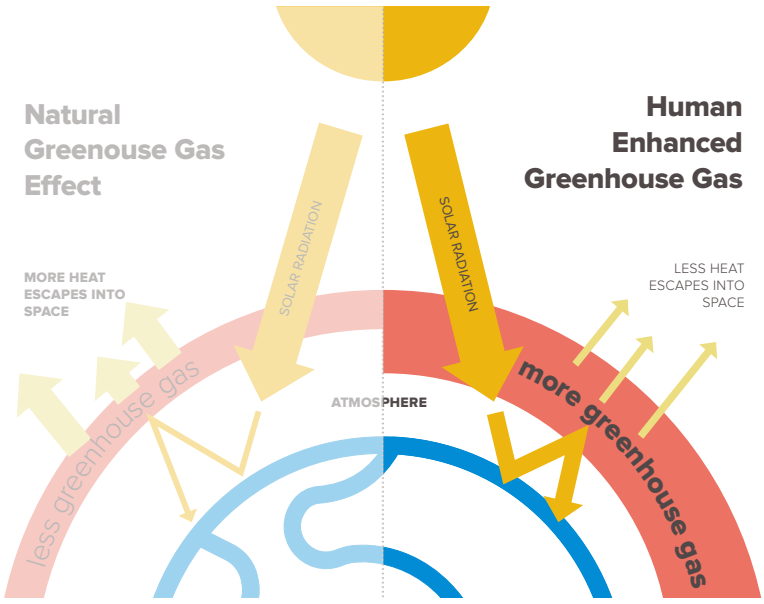

Figure 2. Climate change and the greenhouse gas effect

Impacts of Climate Change

The planet is getting hotter, resulting in more frequent and more destructive floods, extreme heat and wildfires, severe storms, and sea-level rise.

These in turn threaten aging transportation infrastructure (roads, bridges, and trails) and the safety and comfort of people who use them in Long Beach and around the world. Transportation is intimately connected to climate change. Both the operation and construction of the transportation system result in greenhouse gas emissions that cause the atmosphere to trap too much heat.

Temperature

People living and working in the Washington Neighborhood are already feeling the effects of climate change, with increasing periods of extreme heat compounded by the urban heat island effect.

The urban heat island effect causes urban areas—replete with impermeable, dark-colored surfaces like parking lots, roads, and roofs—to experience higher surface temperatures throughout the day, and to retain heat into the night. While it may not receive as much news coverage as other dangerous weather phenomena like floods, fires, hurricanes, or tornadoes, extreme heat kills more Americans every year than any other weather-related disaster.

Communities in Southern California already experience multiple heat health events (periods when high levels of heat impact public health) annually, and the number, duration, and intensity of heat health events is projected to continue increasing due to climate change.

Figure 2 shows surface temperatures taken within the study areas on October 2nd and November 24th, 2020 during the hottest part of the day (2-4pm) using an infrared thermometer. These readings indicate the dramatic surface temperature differences between the asphalt of the roadway, at 127 degrees farenheit, to the lawn, at 73 degrees farenheit.

Figure 3. Surface temperatures taken within the study area.

Wildfires

2020 was an unprecedented year for wildfires in California. The air quality for much of the state was so poor it could cause "serious health problems, aggravate lung disease, cause asthma attacks and acute bronchitis, and increased risk of respiratory infections." There were periods in Summer 2020 that California air quality was the among the worst in the world.[1] Researchers also fear the smoke can act more deeply to hamper the body's ability to fend off infection.[2]

The Labor Day weekend heat wave of 2020 shattered previous records, with high temperatures reaching 121 degrees Fahrenheit in Los Angeles County. The heat and high winds fueled wildfires, and air pollution reached unhealthy levels. Due to overheated and overburdened electrical equipment, thousands of Southern California residents lost power and were forced to combat triple-digit temperatures without air conditioning, fans, or refrigerators.

Monitoring equipment at Long Beach Airport, about 3 miles northeast of the Washington Neighborhood, recorded 104 degrees Fahrenheit on September 6, 2020. Such conditions can be fatal, particularly for individuals under 18 and over 65 years of age, and especially in areas where shade coverage is lacking.

Extreme heat kills more Americans every year than any other weather-related disaster.

The Labor Day weekend heat wave, scientists predict, is the "new normal." A study published in 2015 forecasted that the number of days of extreme heat will continue to increase and highlighted reducing carbon emissions as a way to curtail these estimates by as much as half.[3]

Disease & Air Pollution

Studies have found increased rates of COVID-19 in areas of elevated air pollution, disproportionately impacting poor communities. Someone living in an area of high particulate pollution like Long Beach is 15% more likely to die from COVID-19 than someone living in an area with only slightly less air pollution. Minority populations, particularly Black communities, are more vulnerable to COVID-19 for many reasons, including their long-term exposure to elevated air pollution.[4]

1. https://www.washingtonpost.com/weather/2020/08/20/california-fires-air-quality/

2. https://www.theguardian.com/world/2020/sep/04/what-is-californias-wildfire-smoke-doing-to-our-health-scientists-paint-a-bleak-picture?utm_term=2c76aabaa38d82f6219f0177066f717e&utm_campaign=GuardianTodayUS&utm_source=esp&utm_medium=Email&CMP=GTUS_email

3. Rong-Gong Lin II, "L.A. Will Keep Getting Hotter, Scientists Say—A Lot Hotter," Los Angeles Times, June 21, 2016, https://www.latimes.com/local/california/la-me-ln-extreme-heat-la-20160620-snap-story.html.

4. https://woods.stanford.edu/news/linking-air-pollution-and-covid-19

In addition to air pollution causing health problems, extreme heat events come with an increase in "stagnation events" - stationary domes of hot air that can cause air pollutants to get trapped and persist in the lower atmosphere. Stagnation events are becoming more prevalent, and set up the perfect conditions for ground-level ozone, a dangerous air pollutant, to develop. Emissions from chemical and industrial plants, electric utilities, refineries, exhaust from vehicles, and increasingly wildfire smoke and oil and gas extraction are sources of these pollutants. Los Angeles experienced 103 unhealthy days per year on average from 2000-2014, but recently saw unhealthy days happen even more frequently, with 107 days in 2015 and 104 days in 2017. Overall, these ozone levels are typically elevated in urban areas, partly due the urban heat island effect.

The urban cooling strategies highlighted in this Study aim to break this cycle. These strategies include: ***street trees, green infrastructure, shade structures, cool pavement & hardscape, and cool amenities.***

Solutions

Trees help reduce extreme heat and improve air quality. Mature trees can cool surface temperatures by as much as 45 degrees Fahrenheit. These valuable assets are unequally distributed throughout the region, with many wealthier neighborhoods enjoying higher concentrations of trees than lower-income communities. Tree canopy density is also incredibly dependent on landowners: 90% of the urban forest in the adjacent City of Los Angeles is on private land—leaving only 10% within public control. Furthermore, the U.S. Forest Service estimates 129 million trees have died in California since 2010 due to conditions caused by climate change, drought, and pests.[5]

One of the most effective measures for reducing emissions is to drive less. Making it easier for people to walk, bike, and utilize transit helps encourage mode shift towards more environmentally-friendly travel options and therefore mitigates climate impacts. However, when temperatures reach "extreme" levels, outdoor activities become dangerous. Waiting for the A Line, biking to Seaside Park, or walking down Anaheim Street in 110-degree weather is not only uncomfortable—it could be deadly. Pollution-caused heat may even push residents to drive more, further escalating the problem and necessitating additional adaptation strategies.

5. https://www.climatecentral.org/news/climate-change-is-threatening-air-quality-across-the-country-2019

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Wide streets and long pedestrian crossings, like on Long Beach Blvd, were identified by the community as hot and uncomfortable places.

CHAPTER 2

Community Engagement & Local Context

Planning Process

This project is divided into three phases: exploration, generation of ideas, and refinement. Beginning in fall 2020, the exploration phase involved project area site visits which included temperature readings and the production of the existing conditions assessment. A deep dive into the Washington Neighborhood Study Area included assessment of: existing context, existing shade, and heat vulnerability and mobility. Additionally, there was a review of numerous City plans, guidelines, and documents related to this project. In winter 2020-2021, from the existing conditions assessment, initial cooling strategies were generated in order to receive feedback from the public during the first community workshop. Phase three included refinement of the initial strategies into five cooling strategies and the development of the overall toolkit for each study area. In summer 2021, the final report, including sections on each phase of the project, was delivered to the City of Long Beach. See Chapter 3: Cooling Toolkit and Chapter 4: Cooling Strategies for the final developed Cooling Strategies. See Appendix A for the complete Existing Conditions report.

Community Engagement Process

The project was driven by an inclusive community engagement process that built upon work the City is doing as part of the Climate Action & Adaptation Plan and other aligned planning efforts. Habitat for Humanity of Greater Los Angeles (Habitat LA) and the Washington Neighborhood Association were critical partners in this process as they provided local expertise and drew on their deep-rooted relationships within the community.

Engagement activities were driven by three key goals, which helped ensure the outreach process was equitable and provided important input for the evaluation and design of the project. These goals include:

- **Gather input on community needs and priorities.** This project incorporated community feedback into the toolkit regarding recommendation locations and specific strategy solutions.
- **Develop partnerships.** Habitat LA and the Washington Neighborhood Association built on the existing relationships with local schools and organizations.
- **Address the needs of disadvantaged communities.** The project community online events were all bilingual and provided multiple opportunities for the community to provide input.

Engagement activities and events included:

- The City and Habitat LA distributed social media posts and event fliers prior to each virtual open house event.
- Community Navigators promoted events with email, text, and social media posts.
- Community event caravan completed by Habitat LA.
- Online community survey that confirms goals and values of the project.
- Standalone website to introduce community members to the project, invite the public to share their perspective and priorities on existing challenges related to changes in climate as it relates to increased temperatures in their community, and provide feedback on the preliminary project vision and goals and toolkit.
- Two virtual open house events. Event #1 was held on March 2nd, 2021 and was attended by 74 people. The focus of the event was to introduce the project, promote the community survey, and collect feedback about where cooling strategies are most needed and additional ideas from the community. Event #2 was held on June 2nd, 2021 and was attended by 46 people. The focus of the event was to educate the public on the cooling solutions and collect feedback on these solutions.

With the community engagement, this project reached 120 people from the events and 127 people from the online survey. Key feedback received from the engagement included:

- 40% experienced negative health symptoms on hot days
- 79% of participants said heat changes how I travel
- 70% of participants said hot days are more frequent

Feedback from the community members informed the development of this toolkit. See community voices callouts throughout the report and the following Community Priorities section for more details about where in Long Beach community members indicated cooling is most needed, and what specific tools and strategies are of greatest community interest.

From the public online survey and two virtual community events, the project team gathered critical information from the community that shaped the development of the cool tools and strategies.

Community Priorities

The online survey, which received 127 responses, provided this project with helpful information about where in their neighborhood the community experiences conditions that are especially hot, sunny, or lack shade. Common responses included:

- Avoiding streets without trees or tall buildings that create shade, and heavy traffic corridors.
- Pacific Avenue, Long Beach Blvd, Anaheim Street, and Pacific Coast Highway were reported as particularly hot and lacking any shade for pedestrians within the Washington Neighborhood Study Area.
- Bus stops, particularly on the north side of streets, are incredibly hot.
- Community members change their direction of travel and avoid these hot areas.

The survey also asked if there are cooling strategies that they would support in the community. Commonly supported strategies included:

- Street trees and added landscaping.
- Shade structures and benches, particularly at bus stops.
- Permeable paving, bioswales, and green infrastructure.
- Outdoor water features, like splash pads in the park and water fountains.
- More shaded areas in the park.

In addition to written responses, the project received verbal responses during the second virtual community event that were sketched live onto an image from a specific location within the community. A total of three locations were identified and sketched upon. Figure 4 provides a visual of some of the cool tools that community members want to see within alleys, specifically the alleyway between Cedar Avenue and Chestnut Avenue.

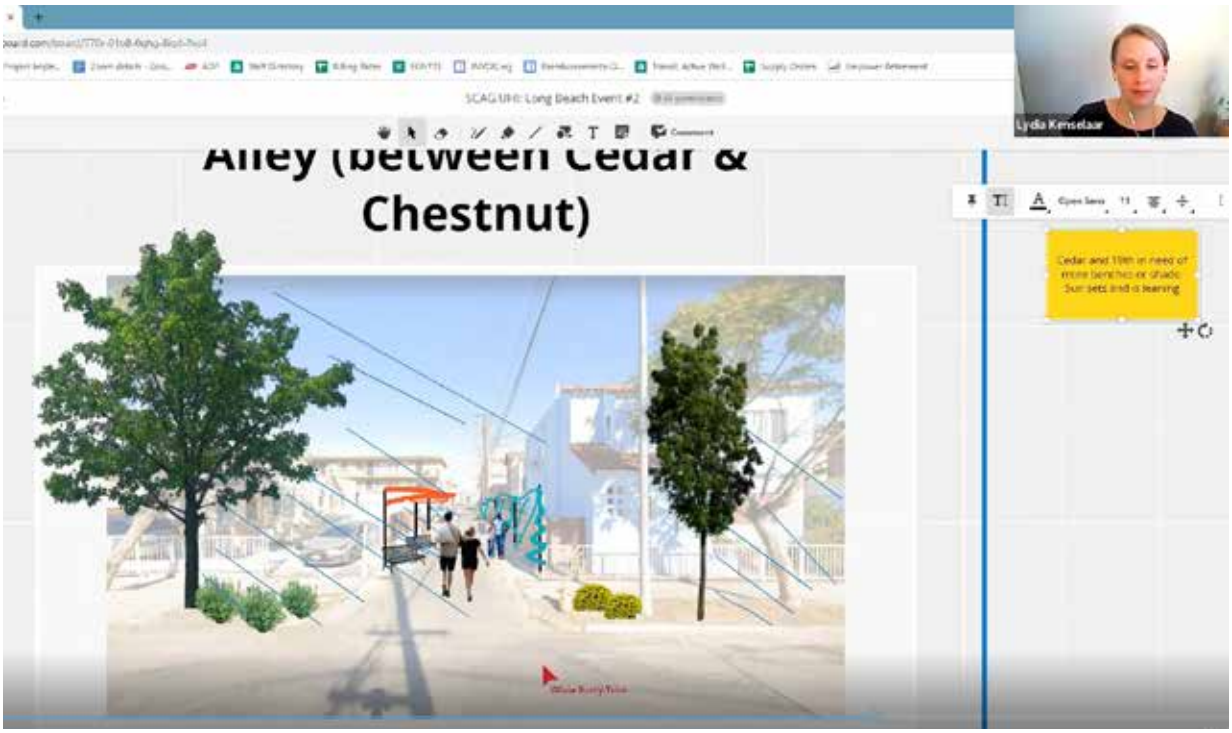


Figure 4. Community Event #2 provided an opportunity for the community to verbally provide input while their responses for sketched live during the event.

Community members expressed support for cool strategies to be considered on these streets and elsewhere in Long Beach.

The two online public events together reached 120 community members and provided robust insight into the needs and desires of the community as it relates to hot and uncomfortable places in Long Beach. The community was again asked what they think would help cool the streets and where the streets need cooling. Common input received included:

- Shaded bus stops with more benches..
- Splash pads in parks, and misters near buildings and storefronts.
- Safety is important. Provide tools to more easily and safely cross the street, especially on large and wide streets that are extra hot.
- Planted medians with shade trees on wider streets.
- Alleyways would be more enjoyable if they had more greenery.

Community Navigators

The Community Navigators is a pilot program initially designed to provide outreach training and skills building to residents and others associated with the Washington Neighborhood. As collaborative partners, the Washington Neighborhood Association and Habitat for Humanity of Greater Los Angeles identified resident leaders, neighbors and others who demonstrated a general understanding about outreach, had a network in the community, and who were interested in expanding their capacity.

This pilot program not only helped a broader group of residents attend the virtual events and participate in the survey, but it also has left 6 residents with more skills, expanded networks in their community, and facilitated relationship building that has the potential to yield positive outcomes in the future. This program was a more focused effort, therefore there was more reliance on referrals from Washington Neighborhood Association and Habitat LA staff who work alongside the community.

To build the pilot program, Habitat LA staff consulted with other affiliates across the country who use this model to engage residents, build skills, and capacity in communities. Through this guidance and previous experience of Habitat LA staff, an outreach based curriculum was designed that included technology training, one on one meetings, group check in meetings, templates and tools, and other supports needed to help the Community Navigators successfully conduct outreach and grow their knowledge.

The 6 Community Navigators involved in this project were provided with template texts, email, talking points, electronic fliers, and an initial list of residents to contact using whichever means worked for the person. This list of contacts grew as the Community Navigators established a relationship with people on their call list and they would connect them to other community members. These relationships were made possible because the Community Navigators not only invited residents to the Urban Cooling meetings, but also served as a resource to the community by sharing fliers for other events and resources. The Community Navigators called their assigned lists, sent text messages, posted on social media, and spoke to a total of 480 residents.

There are several models for Community Navigators programs in other cities throughout the US. Habitat LA researched these models to inform the development of this pilot. If beginning a similar pilot program with another nonprofit community organization, recommend a minimum of 3 month time to research precedent models, develop a local model, and market the opportunity to participants.

Local Context

The Washington Neighborhood is located in the City of Long Beach, in the southern portion of Los Angeles County. It is a mostly residential area bounded by the industrial Magnolia District Neighborhood to the east (Map 1). The Washington Neighborhood is located in Council District 1 (Map 2).Wide roadways run on the perimeter of the neighborhood and bisect the neighborhood at Pacific Ave. The tree canopy is sparse and the groundcover is largely impermeable.

There are many community destinations in the neighborhood, including three schools, two parks, six health and service providers, and 16 stores that sell food (Map 1). Street parking is perceived to be in high-demand. The community is served by the Los Angeles County Metropolitan Transportation Authority's (Metro) A Line (formerly known as the Blue Line), which runs along Long Beach Blvd and connects the neighborhood to Downtown Los Angeles. Approximately 9,000 people live in the Washington Neighborhood in 2,200 households. Approximately 400 of those households have no access to a vehicle.

EQUITY AND DEMOGRAPHICS

This project responds to the goals of Long Beach's Racial Equity and Reconciliation Initiative, especially the Initiative's goal to improve health and wellness in the City by eliminating social and economic disparities in the community most impacted by racism. The project aligns with the identified potential actions for this goal:

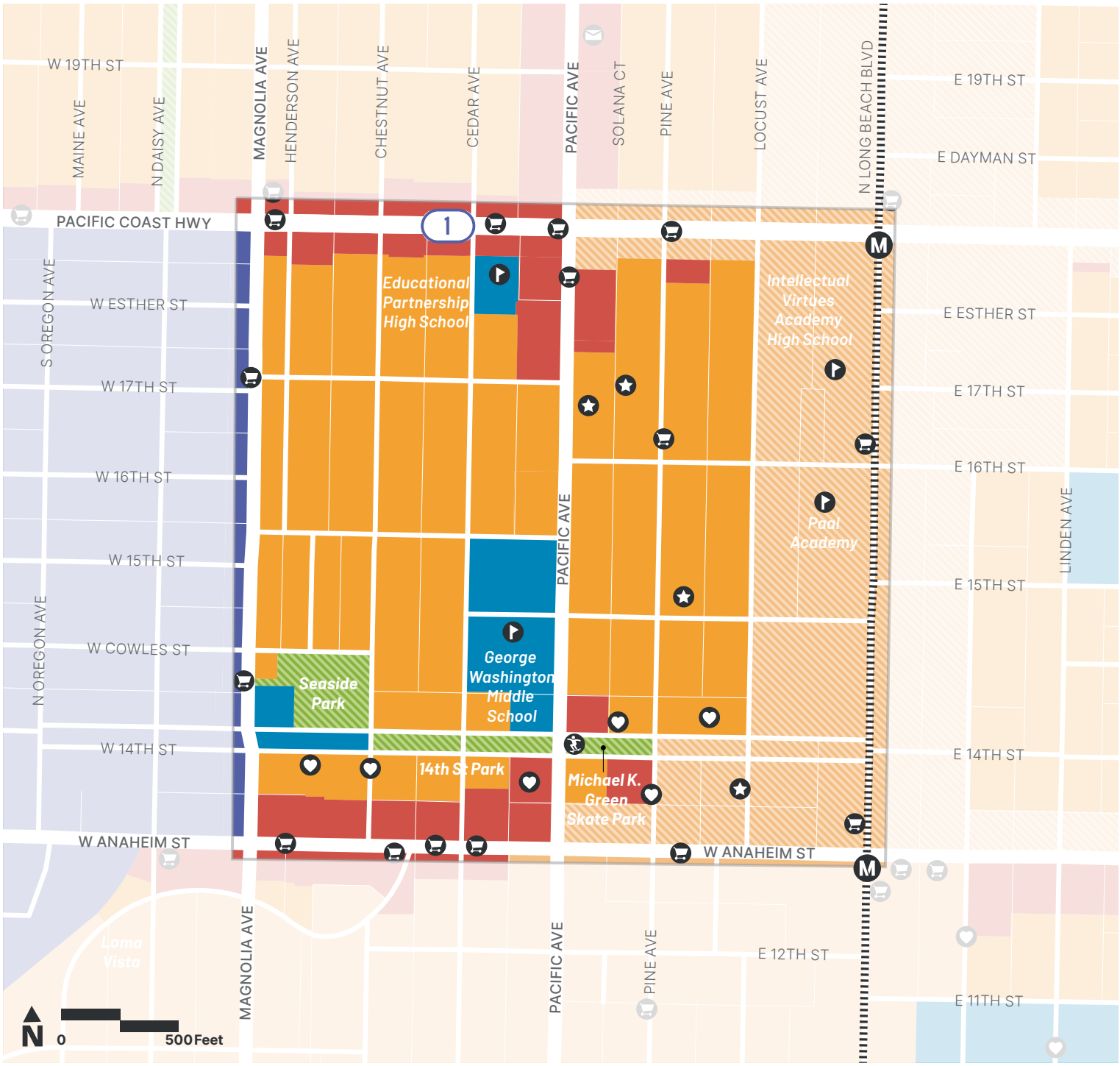
- Increase access to park space and recreation programming to foster physical activity, community connections, and safe places for children and families to play
- Equitably increase access to safe green space and urban nature
- Increase efforts to grow, preserve, and protect Long Beach's urban forest in areas of high pollution and extreme heat
- Explore enhanced infrastructure financing district to provide funding for environmentally sustainable infrastructure
- Identify sustainable funding to implement the City's Climate Action and Adaptation Plan and prioritize actions that address the negative impacts of climate change for Black communities and communities of color

Table 1. Demographic Characteristics of Long Beach

DEMOGRAPHIC CHARACTERISTIC	WESTERN HALF OF NEIGHBORHOOD	EASTERN HALF OF NEIGHBORHOOD	CITY OF LONG BEACH
% of households who are renters	96%	86%	61%
Median household income	$32,000	$46,000	$61,000
% Non-Hispanic White	4.1%	4.5%	28.4%
% Hispanic or Latino	82%	84%	45%
% of households that speak a language other than English at home	80%	85%	46%
% of households with limited English proficiency	49%	50%	36%
% under age 18	31%	34%	22%
% over age 65	4%	5%	13%
% of households with no access to a vehicle	18%	17%	10%

Compared to the residents of Long Beach as a whole, residents generally have lower incomes; are more likely to be renters, non-White, Spanish speaking, and younger than age 18; and are less likely to have access to a vehicle. These demographic factors point to a high reliance on walking, biking, and transit. Coupled with projections for increased days with extreme heat, these factors suggest that Washington Neighborhood residents are highly vulnerable to the effects of climate change.

Given that the vast majority of residents of the Washington Neighborhood are renters and the median income is low, it is essential that the project team recognizes the potential that improvements to the public realm can increase risks of displacement of existing residents and works to support the existing residents' right to remain in their community. As housing costs continue to rise across Southern California, existing households (especially renters and working-class families) face the very real threats of unaffordable housing options, which could lead to losing contact with the community they depend on. As this project moves forward, the project team must work to identify potential threats to community cohesion and seek a wide array of opinions on any recommendations or concepts in this project. With more than four out of every five residents speaking a language other than English at home, multilingual outreach and communication of project information will be crucial for equitable participation of community members.



Map 1.

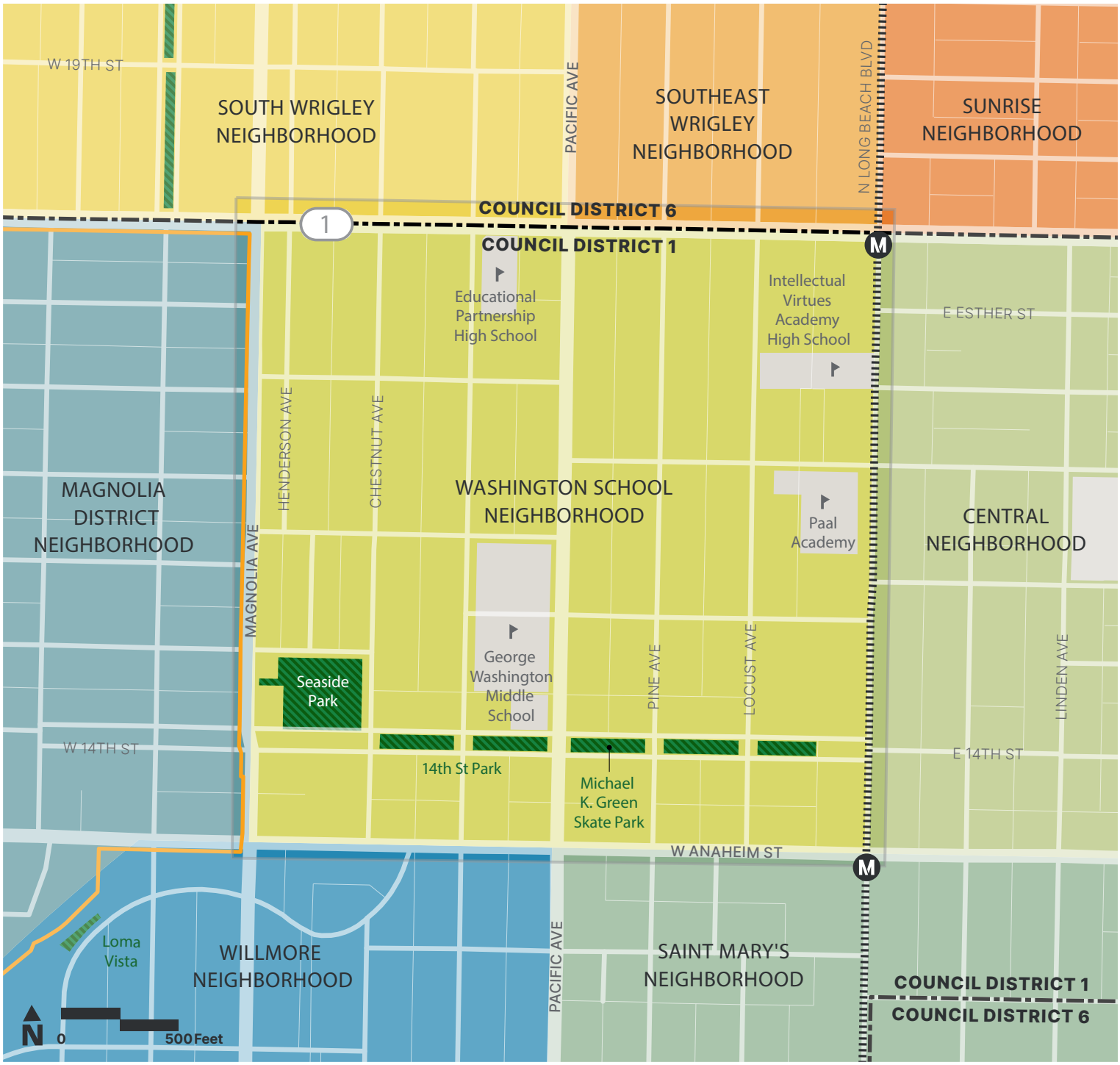
LAND USE & DESTINATIONS

ZONING

- Commercial
- Industrial
- Institutional
- Parks
- Planned Development
- Residential
- Specific Plan
- Study Area

COMMUNITY DESTINATIONS

- Post Offices
- Schools
- Farmers Markets
- SNAP Stores
- Skate Park
- Cultural Institutions
- Shopping Centers
- Health & Service Providers
- Metro Blue Line and Stations



Map 2.

STAKEHOLDERS

- Council Districts
- Property and Business Improvement District
- Study Area

COMMUNITY DESTINATIONS

- Schools
- School Grounds
- Parks
- Metro Blue Line and Stations

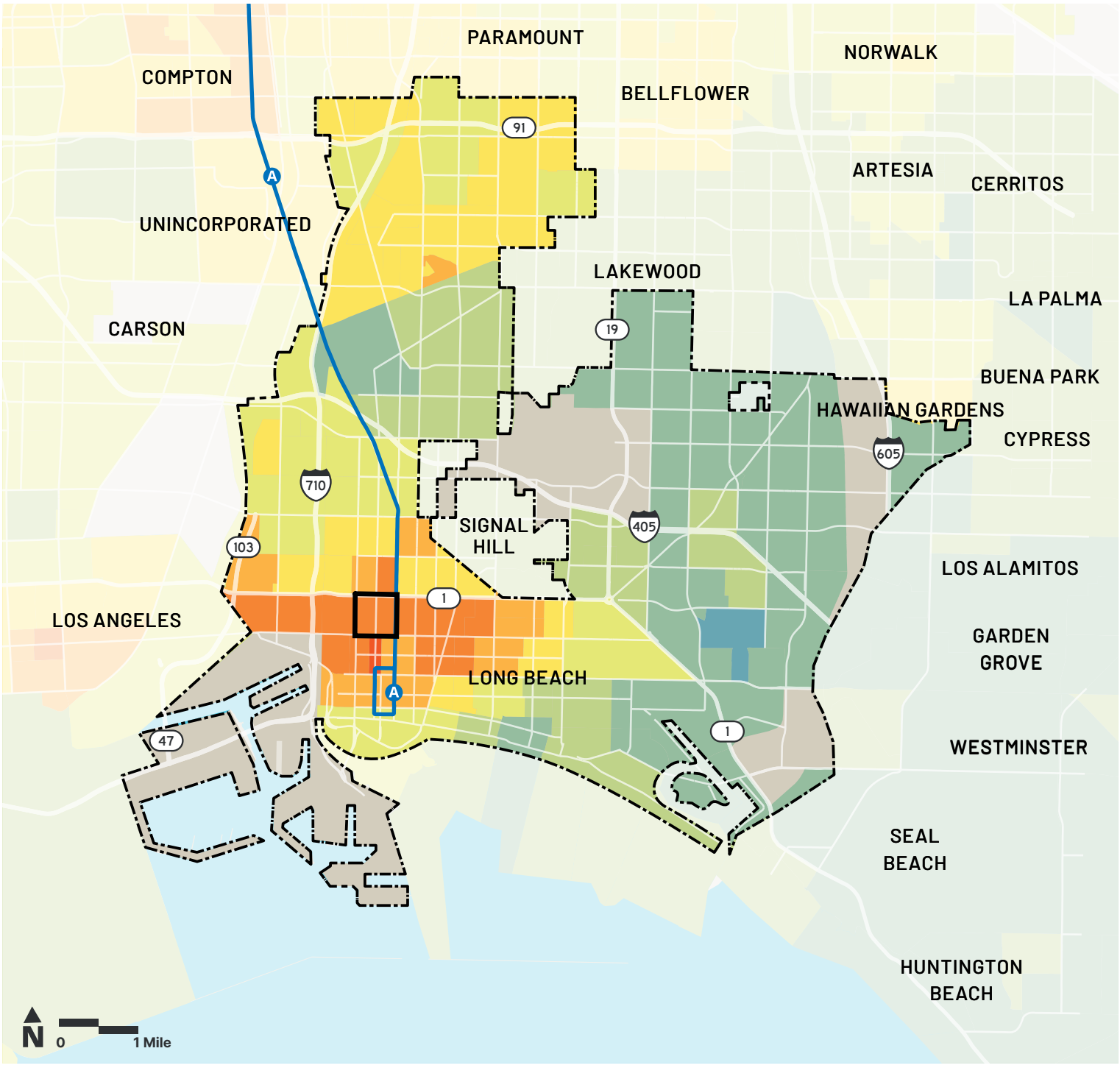
Heat and Pollution Vulnerability

According to the California Heat Assessment Tool, the study area is located in an area of high heat vulnerability (Map 3). Heat vulnerability is determined by a combination of social vulnerability, health, and environmental factors. Social factors include the percent of people with no high school diploma, the percent doing outdoor work, the percent living in poverty, the percent with no vehicle access, and the percent of households with no adult who is fluent in English. Health factors include the rate of asthma, percent of babies with low birth weights, and rate of cardiovascular disease. Environmental factors include high pollution levels (measured as PM2.5 concentration), ozone levels above state standards, percent of land that is impermeable, projected increase in paved land area by 2050, percent of land with no tree canopy, and temperature difference from nearby rural areas.

The area also ranks among the highest census tracts in the state for pollution burden and environmental justice concern, with a CalEnviroScreen percentile of 99 out of 100 in the western part of the study area, and a percentile of 94 in the eastern part of the study area. Map 4 shows the CalEnviroScreen scores for census tracts in Long Beach.

The roots of the area's high heat vulnerability and pollution burden can be traced back to the era of red-lining that began in the 1930s. The Home Owners Loan Corporation disincentivized investment in areas with high numbers of people of color. As shown in Map 5, HOLC gave the western part of the study area a grade of C (declining) and the eastern part a grade of D (hazardous). Across the country, red-lined areas have been shown to be significantly hotter than areas that were not red-lined.[1] People with low incomes who live in these formally redlined areas may have less ability to move to escape the high levels of heat due to lack of resources.

1. https://www.mdpi.com/2225-1154/8/1/12/htm



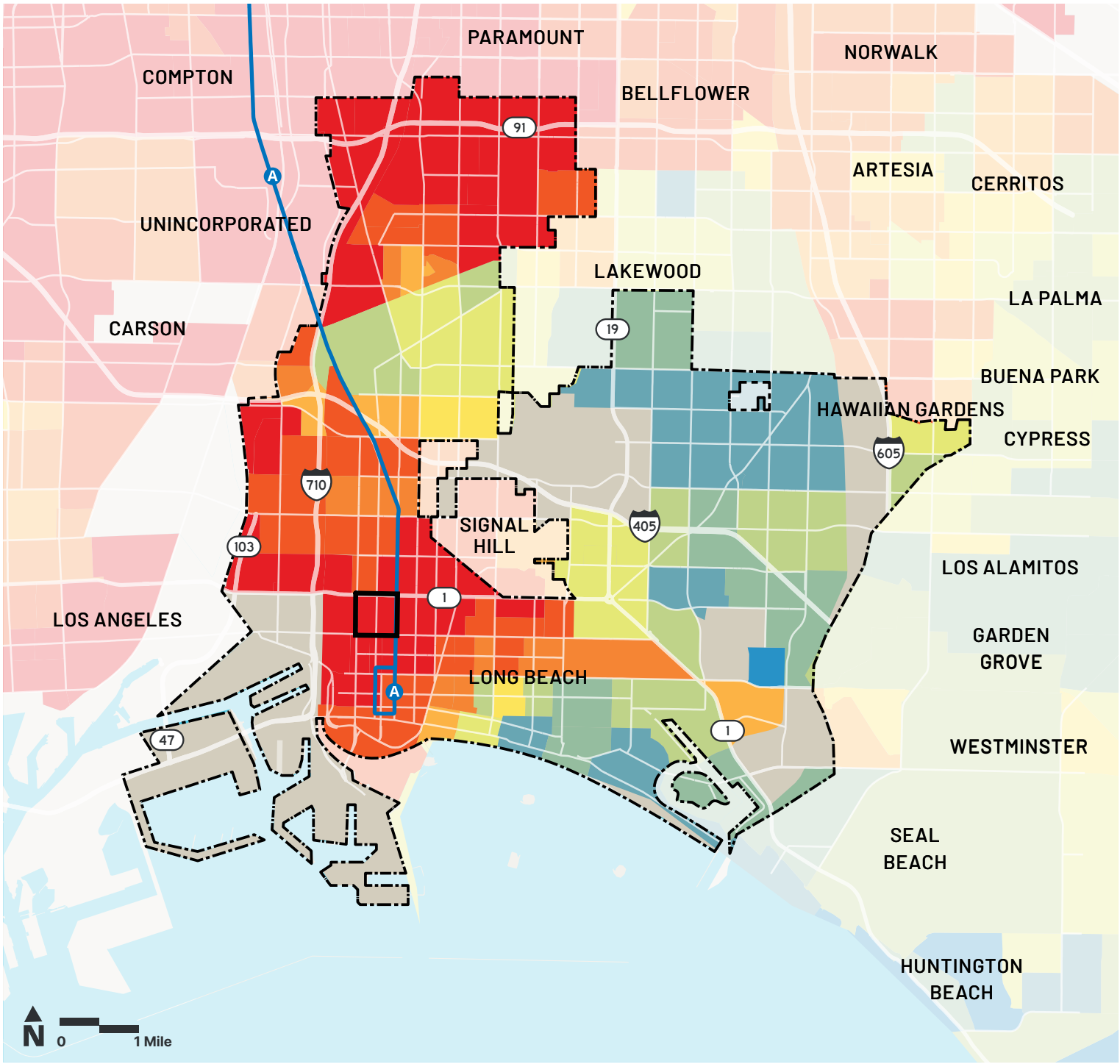
Map 3.

HEAT VULNERABILITY

- Study Area
- City of Long Beach Boundaries
- Metro A/Blue Line

HEAT HEALTH ACTION INDEX

- 0 - 9
- 10 - 19
- 20 - 29
- 30 - 39
- 40 - 49
- 50 - 59
- 60 - 69
- 70 - 79
- 80 - 89
- 90 - 100



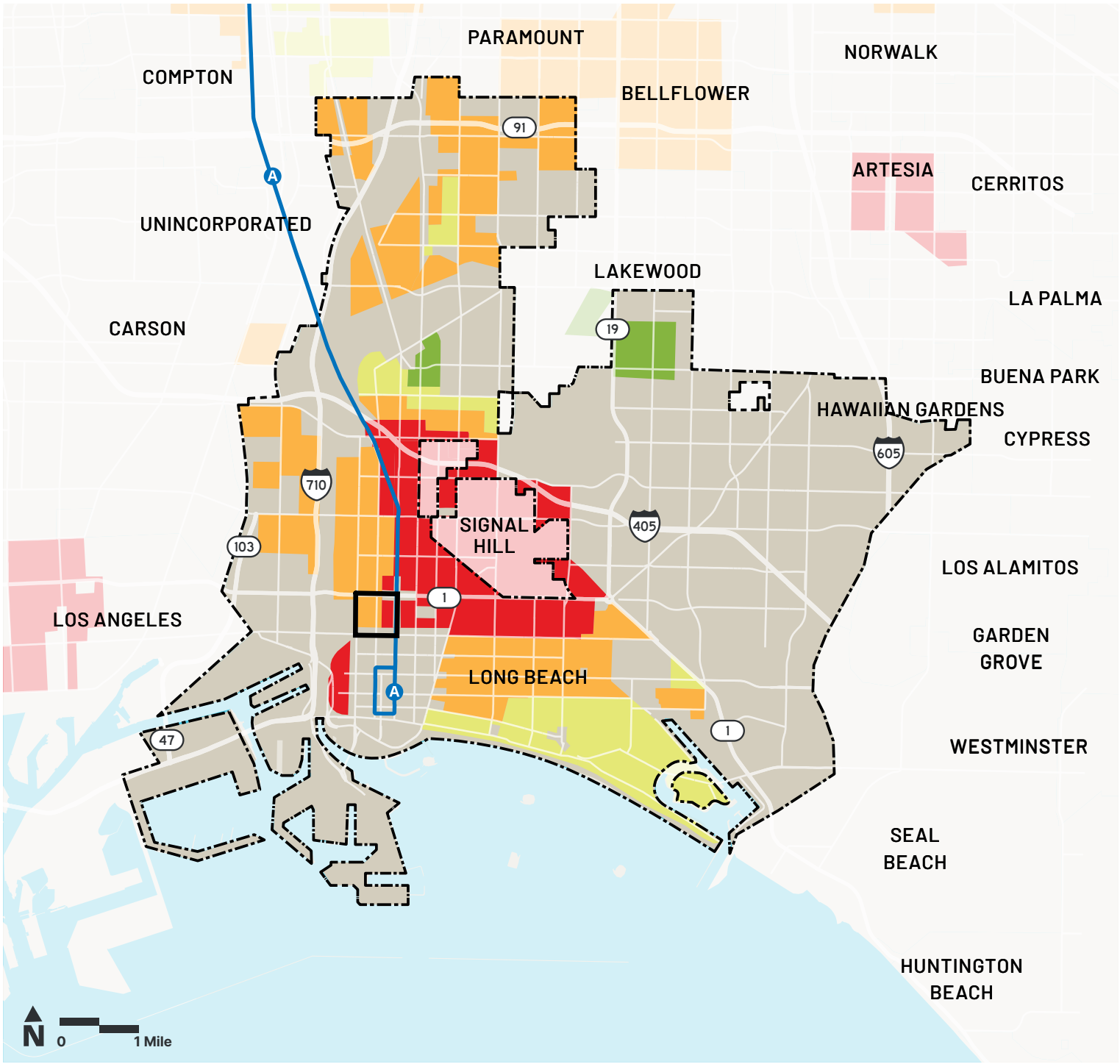
Map 4.

POLLUTION BURDEN & POPULATION CHARACTERISTICS

- Study Area
- City of Long Beach Boundaries
- Metro A/Blue Line

CALENVIROSCREEN 3.0 PERCENTILE

- 0 - 9 (Lowest Scores)
- 10 - 19
- 20 - 29
- 30 - 39
- 40 - 49
- 50 - 59
- 60 - 69
- 70 - 79
- 80 - 89
- 90 - 100 (Highest Scores)



Map 5.

HISTORIC DISINVESTMENT

- Study Area
- City of Long Beach Boundaries
- Metro A/Blue Line

HOLC NEIGHBORHOOD REDLINING GRADE

- A (Best)
- B (Still Desirable)
- C (Declining)
- D (Hazardous)

CHAPTER 3

Cooling Toolkit

Approach

This chapter outlines strategies to combat the urban heat island effect and protect people from extreme heat as they travel along Long Beach's streets, sidewalks and alleys. This chapter is organized into two sections:

- **Cool Tools** describe the benefits, range of material options, and maintenance principles of the five Cool Tools.
- **Cooling Strategies** identifies ways to apply cool tools in different zones of the street: Behind the Curb (pedestrian + transit stops), Between the Curbs (bikes + traffic calming), and Alleyways.

Cool Tools (P. 30)

Describes the benefits, range of material options, and maintenance principles of the five types of Cool Tools.

STREET TREES (P. 34)

GREEN INFRASTRUCTURE (P. 48)

SHADE STRUCTURES (P. 59)

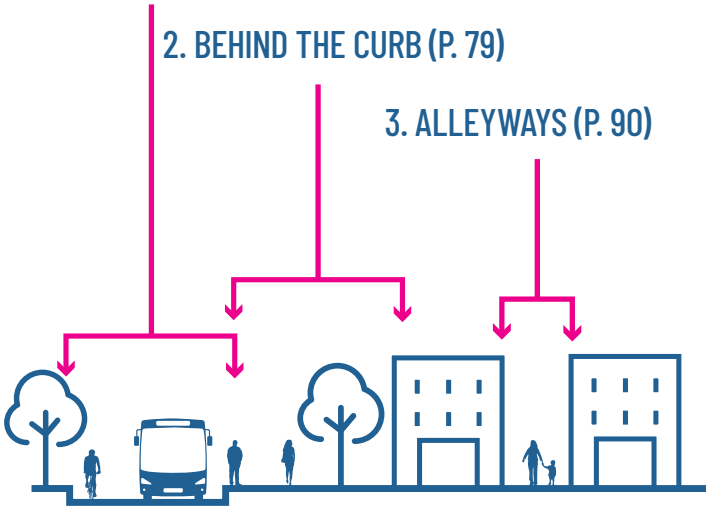
COOL PAVEMENT + HARDSCAPE (P. 66)

COOLING AMENITIES (P. 72)

Cooling Strategies (P. 78)

Identifies ways to apply cool tools in different zones of the street: Behind the Curb (pedestrian + transit stops), Between the Curbs (bikes + traffic calming), and Alleyways.

1. BETWEEN THE CURBS (P. 83)
2. BEHIND THE CURB (P. 79)
3. ALLEYWAYS (P. 90)



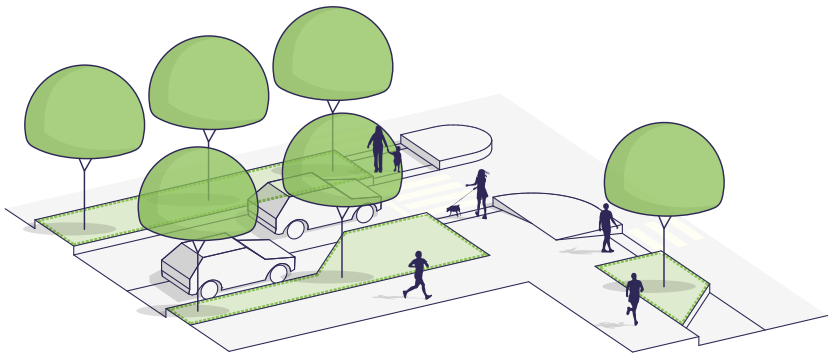
Cool Tools

Streets that are highly impermeable and auto-oriented contribute to the urban heat island effect by reducing evapotranspiration, absorbing heat, and facilitating the use of vehicles that release waste heat and pollution. Cooler streets combat the urban heat island effect by increasing the proportion of the street dedicated to vegetation and permeable surfaces, reducing heat absorption, and facilitating walking, biking, and transit. Cool tools, including street trees, green infrastructure, shade structures, cool pavement and hardscape, and cool amenities, are elements of cooler streets. This section describes the benefits, design principles and tools, materials, and maintenance principles of each cool tool.

This section of the document is divided into subsections that provide information about the benefits, design principles, define the range of design tools, and describe maintenance strategies for each of the cool tools categories:

Street Trees

Street trees are located in the public right-of-way and require adequate space and maintenance in order to thrive.



Green Infrastructure

Green infrastructure tools include shrubs and understory plantings, bioswales, rain gardens, flow-through planters, permeable paving, and green roofs and walls.

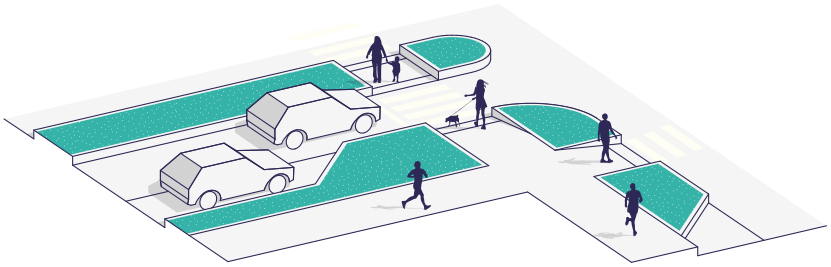
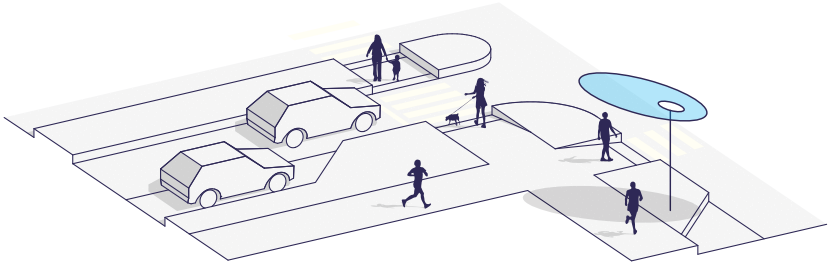


Figure 5. Cool Tools are defined in this document as street trees, green infrastructure, shade structures, cool pavement + hardscape, and cooling amenities, as shown across these two spreads.

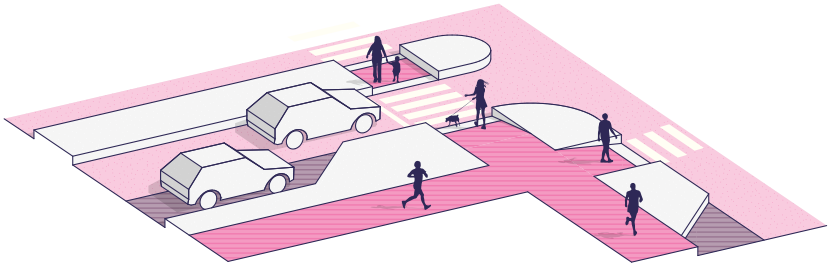
Shade Structures

Types of shade structures include transit shelters, building awnings, free standing canopies, and multi-functional structures such as green roofs or art.



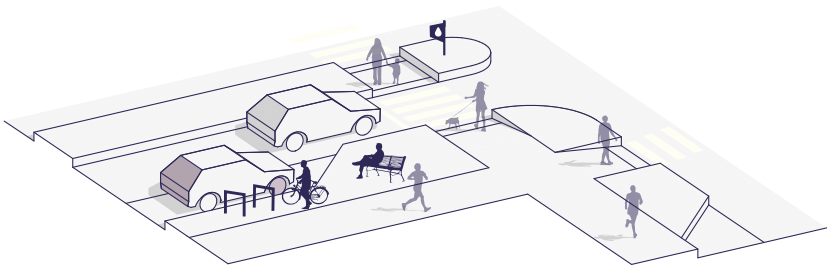
Cool Pavement + Hardscape

Cool pavements and hardscapes are reflective, helping to lower surface temperatures and reduce the amount of heat absorbed and retained on a street.



Cooling Amenities

Elements like benches, drinking fountains, electric vehicles charging stations, and bicycle/scooter parking do not directly lower ambient temperatures, but encourage use of cooler transportation modes.



Cool Tools Benefits

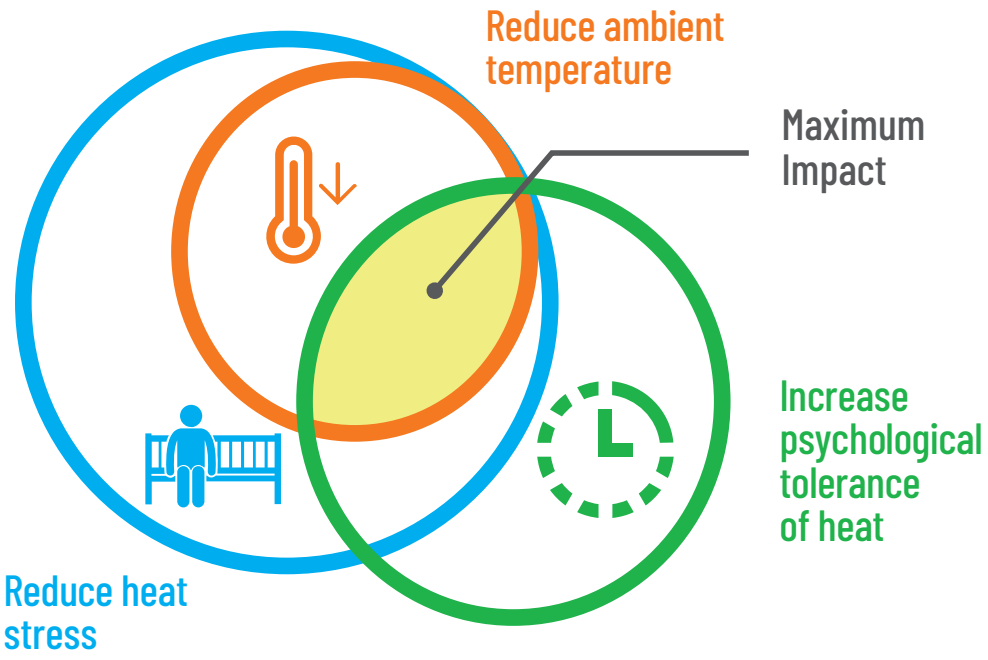


Figure 6. Cooling Benefits diagram

COOLING BENEFITS

The cool tools work in multiple ways: by reducing the risk of heat illness for people traveling along Long Beach's streets, increasing their psychological tolerance of heat, and reducing the ambient temperature they experience. Street trees, green infrastructure, and shade structures work in all three ways. Cool pavement and hardscape reduce the heat absorption of the street, reducing ambient temperatures and thus the risk of heat illness. Cooling amenities, like benches and hydration stations, and operational changes, detailed in the user-focused cooling strategies section, will not reduce ambient temperatures, but will make it possible for people to withstand hot conditions for longer periods without becoming ill or uncomfortable.

ENVIRONMENTAL AND COMMUNITY BENEFITS

The benefits of the cool tools extend well beyond cooling. Street trees and green infrastructure can help to improve water and quality, conserve water, and reduce energy use. Cool hardscape and pavement can also reduce energy use and reduce the temperature of stormwater runoff, improving water quality. All of the cool tools encourage walking, biking and transit. All of the tools have the potential to enhance community vitality and safety, as they make the public realm more comfortable, facilitating social interaction and community building.

These benefits align with the Long Beach Climate Action and Adaptation Plan, which includes strategies and goals for residents and businesses to adapt to climate changes focusing on extreme heat, air quality, drought, and flooding.

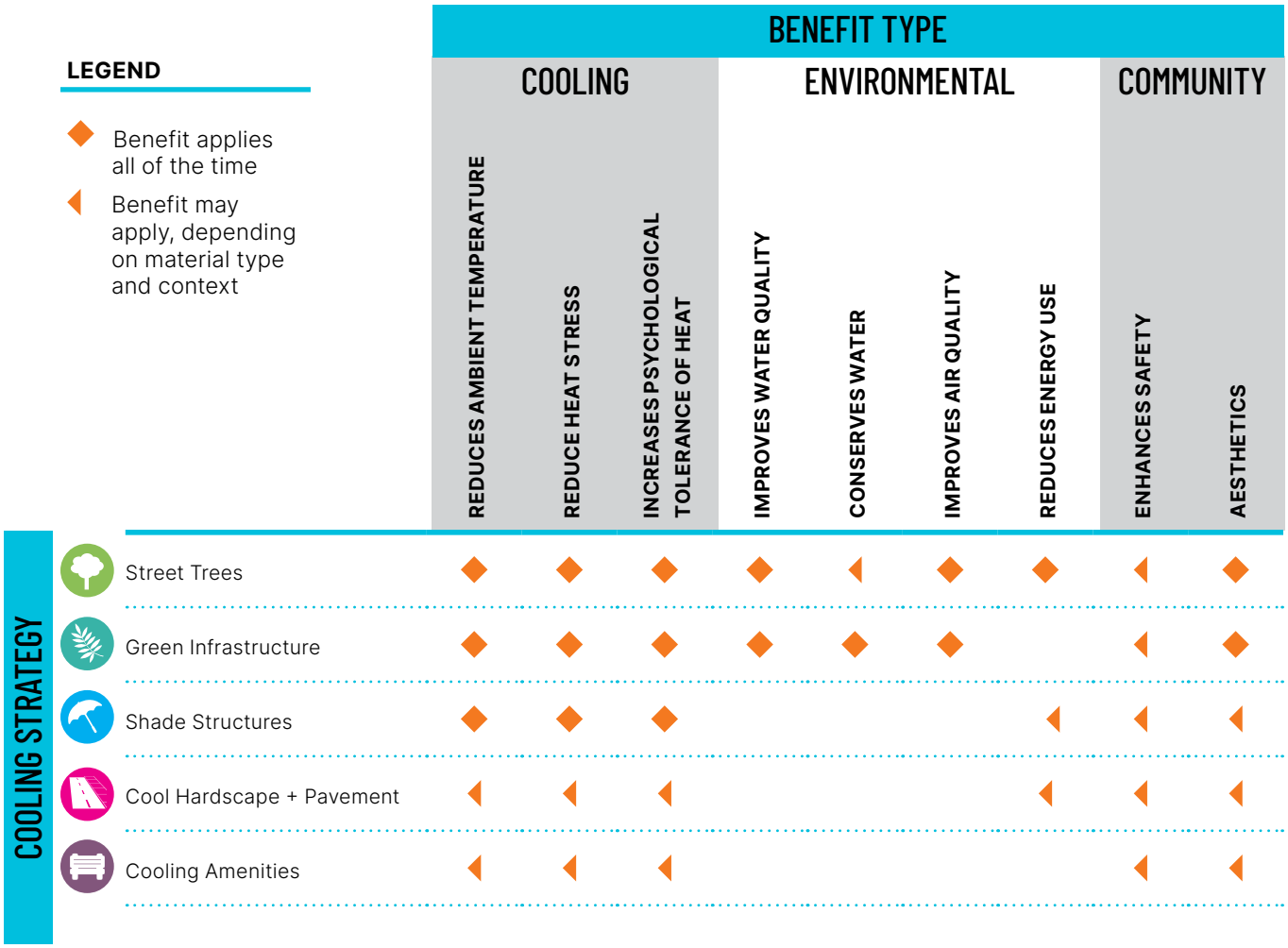


Figure 7. Cooling Benefits table

COMMUNITY VOICES

"Evito caminar por calles donde no hay tanta sombra (I avoid walking through streets where there is not much shade)"

-Workshop participant

Street Trees

BENEFITS: STREET TREES

Trees provide more than just beauty and shade, trees also can provide numerous ecosystem services. Benefits of trees include three categories: cooling benefits, environmental benefits, and community benefits.

Cooling Benefits

Street trees that provide shade can increase comfort for pedestrians and bicyclists by lowering temperatures, filtering air and water, and improving the quality of both. According to temperature readings taken on a typical streetscape in Long Beach, shade trees can reduce concrete surface temperature up to 42 degrees Fahrenheit - and studies have found trees can provide as much as 45 degrees of cooling benefits. Comparisons of the surface temperature on exposed concrete sidewalk compared to a shaded concrete sidewalk can be seen in the Existing Conditions Chapter.

These cooler temperatures can also reduce the risk of heat stress and increase psychological tolerance of heat.

Environmental Benefits

Street trees provide numerous environmental benefits. Trees improve the air we breathe by reducing particulate matter and other forms of air pollution. In the United States alone, urban trees remove 822,000 metric tons of pollution per year.[1] Trees also improve water quality. Their root systems can collect contaminants and some trees can uptake contaminants and store it. Trees can also slow down the flow of water and absorb water borne toxins and then filter the toxins.

Additionally, tree roots are able to help handle storm runoff and reduce flooding by soaking up and filtering stormwater during large storm events. Tree leaves collect raindrops and contribute to water evaporation which greatly reduces the amount of water that enters sewers, thereby reducing the risk of flooding and the amount of sewage-polluted stormwater that cities must treat.[2]

1. The Morten Arboretum, https://www.mortonarb.org/trees-plants/benefits-trees/helping-our-environment

2. The Morten Arboretum, https://www.mortonarb.org/trees-plants/benefits-trees/helping-our-environment

Community Benefits

There are numerous benefits a tree can provide to a community beyond cooling and environmental benefits. The presence of trees that provide shade can make walking and biking facilities feel more comfortable and appealing, contributing to mode shift and reducing greenhouse gas emissions. On tree-lined streets people tend to drive more slowly, reducing the risk of collisions.[3]

Studies have shown that trees contribute to a greater sense of safety, fewer property crimes, and fewer violent crimes are reported in neighborhoods with significant tree canopies.[4] Additionally, the sight of trees reduces blood pressure and increases worker productivity.[5] Like the Jacaranda Tree, individual tree species can contribute to creation of a unique identity for a community.

3. http://www.actrees.org/files/Research/benefits_of_trees.pdf

4. https://nph.onlinelibrary.wiley.com/doi/full/10.1002/ppp3.39

5. https://www.vibrantcitieslab.com/

COOL TOOLS: STREET TREES

The ultimate goal of planting street trees in the context of urban cooling is to grow large, healthy trees that are capable of providing ample shade to a hot urban environment. Street trees are an essential tool to combat the urban heat island effect and should be considered early in the design process of a project. Street trees are a valuable asset that can play huge role in mitigating the effect of climate change and the urban heat island. The design tools below represent a suite of approaches to consider when adding trees to city streets.

Design Principles

The following principles should guide the approach to tree planting.

- Increase city's tree canopy coverage
- Provide continuous shade, were feasible, along bicycle and pedestrian routes
- Provide as much soil volume as feasible to extend the life and increase the health of street trees.
- Align tree planting with placemaking initiatives
- Capture stormwater where feasible
- Choose an appropriate species for the context; 'right tree right place'
- Future proof tree planting by selecting species tolerant of warming temperatures
- Irrigate whenever feasible help trees survive periods of drought or extreme heat stress.

Rootable Soil Volume

Providing a large enough rootable soil volume is one way to ensure street trees are able to grow large, remain healthy, and live longer than a typical street tree in a 4'x4' treewell. Studies have shown that trees grown in large volumes of rootable soil grow faster, develop larger canopies, and outlive those grown in smaller volumes of compacted soil. Based on available information derived from several studies and extrapolated to a 30-foot canopy street tree, the approximate recommended soil volume for a healthy street tree is 1,500 cubic feet.

Some cities have begun enacting minimum soil volume policies for new tree plantings. For example the City of Emeryville, CA requires minimum soil volumes of 600, 900, and 1200 cubic feet for small, medium, and large trees respectively for all new development sites.

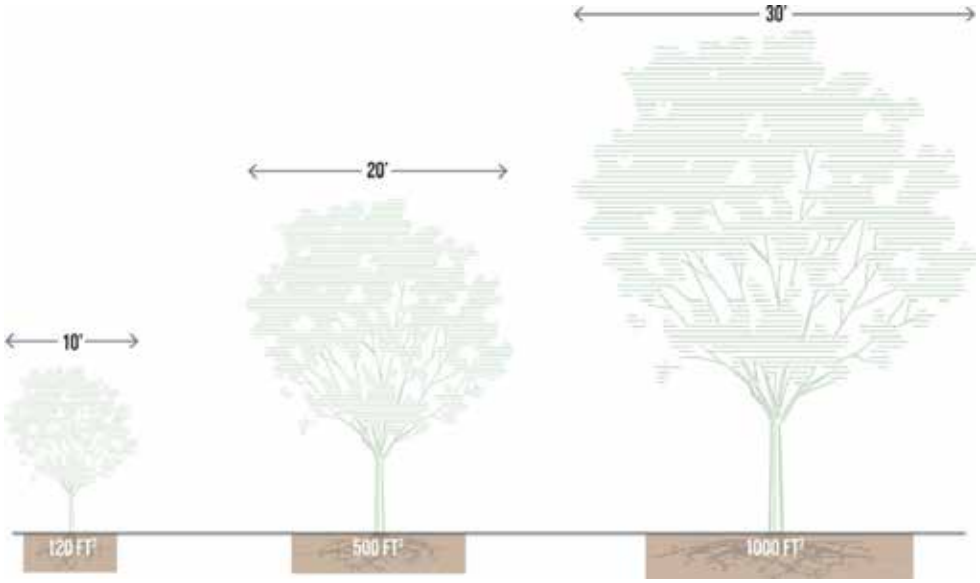


Table 2. Larger trees that provide the greatest shade and cooling benefits require greater volumes of uncompacted soil space to allow roots to grow. For example, a tree with a 30-foot wide canopy needs approximately 1,000 cubic feet of root space to thrive. (Source: NACTO)

Irrigation: Standard Practice

The majority of street trees are non-irrigated, relying instead on moisture from precipitation and urban runoff to meet their water needs. Prolonged drought and heat stress brought on by climate change is leading to increased vulnerability and it is predicted that not all species typically planted as street trees in Southern California will survive by the end of this century.

Irrigation: Establishment

When new street trees are planted an 'establishment' period is typically put into place where the tree will receive supplemental water for a period of time, typically 1 to 3 years. Most often cities rely on a watering truck to water trees on a regular schedule during the establishment period, and this may be performed by city staff or an outside contractor. Once the establishment period is finished, trees are left unirrigated with the hope of surviving on available precipitation. Another method of providing establishment irrigation that is gaining in popularity is the use of watering bags that must be refilled regularly and provide water slowly between refillings.

Irrigation Types

Street trees may be permanently irrigated using a variety of methodologies with the most typical configurations being surface bubblers, root watering systems, and subsurface drip irrigation. Bubblers and root watering systems are more durable than standard drip irrigation, as they are constructed with all rigid parts as opposed to flexible tubing which is more easily damaged. Root watering systems are the most costly to install, but they have the advantage of delivering water directly to a tree's root system. Installation of street tree irrigation can be included in roadway or streetscape capital improvement projects and can also be folded into requirements for private development. Maintenance of street tree irrigation systems can be conducted by city maintenance crews, but is sometimes coordinated through a BID and contracted out.

COOL TOOLS: STREET TREES

Tree Wells

Tree wells are areas designated for tree planting surrounded by pavement; typically found along sidewalks or in parking lots.

Tree wells should be used in constrained areas.

Trees grow best when they have plenty of soil volume to develop strong, healthy roots.

City Standard Tree Well Detail

Typical city-standard tree wells do not allow for nearly enough rootable soil (non-compacted, moisture retaining) for street trees to grow large with a dense shade giving canopy. Most tree roots occur in the top 24 inches of soil, so a typical 4-foot by 4-foot square tree well provides just 32 cubic feet of rootable soil. This severe lack of soil leads to stunted growth and a short life span compared to trees grown in large volumes of rootable soil. It is recommended that city-standard tree well sizes be increased as much as possible given the physical constraints of various planting contexts.

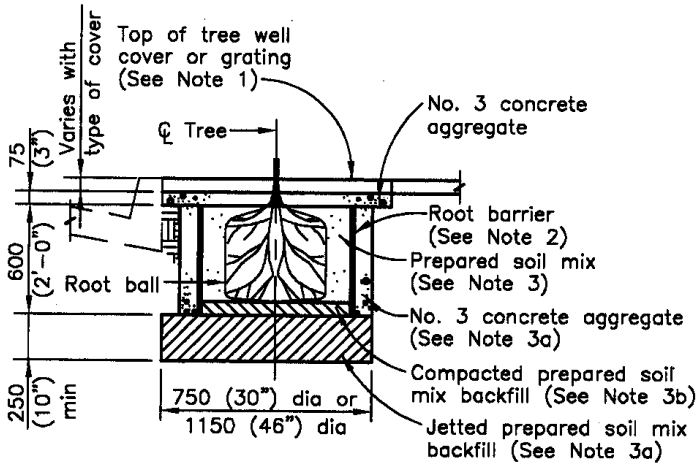


Figure 8. City of Long Beach Tree Root Barrier Detail (Source: Long Beach Department of Public Works)

Preferred Tree Well Detail

A preferred design detail for a city standard tree well detail is one that goes beyond a typical 4'x4' dimension with the goal of providing as much rootable soil as possible and a larger area of open soil for gas exchange and stormwater infiltration. For example, the City of Los Angeles now has standard tree well details in categories of 'small', 'medium', and 'large' based on available sidewalk width, with the largest being 8'x8'.

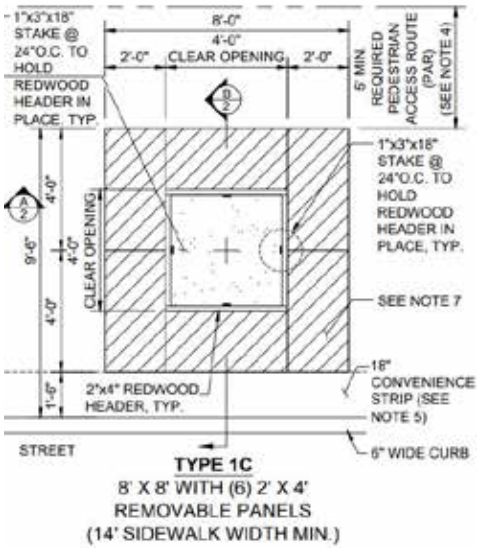


Figure 9. City of Los Angeles Large Tree Well Detail (Source: Los Angeles Bureau of Engineering)

Treelets

A treelet is a curbed tree well that is extended into the parking lane and typically occurs between on-street parking spaces. Treelets are used as an alternative to planting strips in business districts where the existing sidewalk width is narrow and it is important to maintain the maximum width to accommodate pedestrian volumes. Treelets can be accommodated between existing parking spaces and typically do not impact the number of parking spaces along the street. A tree pit is sawcut out of the street and a curb extension is built outside the gutter dimensions to prevent conflicts with existing drainage infrastructure. A treelet can be combined with a suspended pavement system to provide additional rootable soil volume for the tree below grade under elements such as the parking lane or sidewalk area. See the Cool Paving & Hardscape of this section for more detail on suspended pavement.

COOL TOOLS: STREET TREES

Continuous Planting Area

A continuous planting area can be defined as a planting area that goes beyond the square-foot area of the current city standard or preferred tree well sizes. They can be extended tree wells, or continuous parkway planting areas for example. There are multiple benefits derived from continuous planting areas that contribute to the growth of larger street trees with dense shade providing canopies, such as increased available soil volume, moisture holding capacity,a larger soil surface area for gas exchange, and the ability to capture and store more stormwater. Expanding planting areas also decreases hardscape in the pedestrian realm and can create cooler microclimatic conditions while shrub or grass planting in larger planting areas can help buffer pedestrians from roadway traffic. A linear parkway condition can also be created below ground by linking new or existing treewells with each other via root corridors created by structural soil or suspended pavement systems installed between treewells.

Case Study: A streetscape enhancement project on Sherman Way for the City of Los Angeles in which existing tree wells were expanded to create larger planting areas for existing and new trees. New expanded tree wells and street trees were also added where space was feasible with the goal of increasing the tree canopy coverage along this vibrant commercial corridor.

Suspended Pavement Systems

Suspended Pavement Systems increase the amount of rootable soil available for street trees. They do this by utilizing a sub-grade structural system to support paving such as sidewalks and roadway instead of relying on a traditional compacted sub-grade and base course. This allows for a non-compacted loamy soil mix to be incorporated into the matrix of the structural system, greatly increasing the volume of available soil for street trees compared to a tree well alone. Trees grown with the addition of soil volume created from Suspended Pavement Systems have been shown to grow faster and ultimately larger compared to trees planted in standard tree wells with compacted soil

Suspended Pavement System soil-planted trees have also been shown to cause much less potential damage to adjacent hardscape or sub-surface utilities.

Suspended Pavement Systems have been used in many different contexts from urban plazas, to sidewalks, to bicycle facilities, as well as under portions of roadway. They are a very effective way of adding tree soil volume without the need for a large open soil area at surface level, making them very effective for tight urban conditions.

COMMUNITY VOICES

What kind of plants do community members want to see?

"Los arboles que tienen hojas en abundancia (Trees that have abundant leaves)."

-Workshop participant

MATERIALS PALETTE STREET TREES

Relationship to Approved Street Tree List

The City of Long Beach has an approved street tree list. The goal of the list is to contribute to a diverse and vital urban forest while providing block by block uniformity and identity. Species diversity is important to protect the urban forest against any catastrophic failure caused by a species or genus specific pathogen or disease.

With the increasing threat of persistent drought and extreme high temperatures associated with climate change, it will be important for the city to adapt its street tree list to meet these challenges. Some trees currently part of the list may not be able to survive by the end of the century without supplemental irrigation and should be phased out and replaced with species more tolerant of drought and extreme heat.

Species should be regularly evaluated for future planting based on current population levels, performance, and climate change. A strategy that is currently being advocated through research being done at University of California Division of Agriculture and Natural Resources is to begin 'future proofing' cities street tree palettes by pulling successful species from warmer cities who's current climate is roughly equivalent to that of Long Beach's by the end of this century.

Relationship to Green Infrastructure

Trees can be planted in bioswales if they are planted on the upslope portion of the swale. Tree species should be tolerant of periodic inundation and drought conditions if no supplemental irrigation is provided.

Street Trees can also be planted adjacent to more intensive green infrastructure BMPs such as flow through planters which are usually constructed with vertical concrete sides and bottom, and subject to full inundation, if the tree is planted in a separate dedicated soil volume.

Approach to Tree Selection - Spatial

When applying 'spatial' selection criteria to choosing tree species for street trees, it is crucial to evaluate the spatial context both above and below ground. It has been common practice to evaluate above-ground space looking at values such as distance to building facades or other architectural projections, sidewalk width, distance to travel lanes, distance from overhead power lines or street lamps. However, not as much attention has been paid to below ground spatial conditions other than potential conflicts with underground utilities. Studies have shown that available soil volume is just as important to a tree's success and longevity as are above ground conditions. In fact, trees should be selected for by above ground conditions and how much available soil will be provided at the planting location. As a rough guide, a small tree (20-30ft), medium tree (30-60'), and large tree (60'+), should be provided a minimum of 600, 900, and 1200 cubic feet respectively of high-quality rootable soil.

Approach to Tree Selection - Solar Orientation

When choosing street tree species it is important to investigate seasonal changes to the solar orientation at the planting location. Some locations can be mostly shaded during the winter months if there are taller buildings adjacent to the sidewalk as is often the case in commercial and business districts. For trees that require full sun, spending a winter season in the shade can lead to poor form and a looser canopy as the tree searches for light. For this reason it is useful to consider choosing deciduous species in locations that experience winter shade such as the south side of east-west running streets.

Approach to Tree Selection - Climate Change

Street tree species should be selected based on projected average maximum temperature increases in city through end of this century. This can be done by using species that are currently successful in locations where the present climate matches the projected future climate of Long Beach.

According to climate projections obtained from Cal-Adapt (California Energy Commission and California Strategic Growth Council), Long Beach's average annual maximum temperature will increase up to 4.2 degrees Fahrenheit by mid-century and up to 7.3 degrees Fahrenheit by the end of the century with an a 1 percent to 25 percent increase in average annual precipitation by the end of the century. This increase in temperature will mean Long Beach's end of century climate will be more like the current climate in Riverside, California which has a 30-year annual average maximum temperature of 78.2 degrees Fahrenheit. Long Beach can begin to 'future proof' its street trees by including species that thrive in present day Riverside.

Street Trees for Climate Resilience

The tree species included in the adjacent chart represent species that will provide cooling benefits and that are best suited to projected changes to Long Beach's climate, as well resistant to known diseases and pests, and have good seaside tolerance. Species with an asterisk next to them are not currently included in the city's approved street tree list.

Quercus canbyi (Mexican Red Oak) is a medium size tree, very drought and heat tolerant, and has good seaside tolerance.

BOTANICAL/COMMON NAME	HEIGHT	CANOPY WIDTH	CANOPY SHAPE	CALIFORNIA NATIVE	DROUGHT TOLERANT	WATER INTENSITY	ROOT DAMAGE	MAINTENANCE	CARBON SEQUESTRATION CAPACITY	DISEASE SUSCEPTIBILITY	FRUITING BEARING	MINIMUM SIZE REQUIREMENTS
Acacia farneseiana 'Sweet Sierra'/Podless Sweet Acacia*	25'	25'	Spread		◆	L	L	L	L	M		4
Acacia anuera/Mulga*	15-20'	15-20'	Round		◆	L	L	L	L	M		3
Fraxinus velutina/ Arizona Ash*	30-50'	30-40'	Spread	◆	◆	M	H	M	M	M		6
Geijera parviflora/ Australian Willow	25-35'	20'	Round		◆	L	L	M	H	L		5
Lagerstroemia indica/ Crape Myrtle	25'	25'	Round		◆	M	L	L	L	L	◆	4
Quercus canbyi/ Mexican Red Oak*	40-50'	30-50'	Spread		◆	L	L	M	H	L	◆	6
Quercus virginiana/ Southern Live Oak	40-80'	60-100'	Spread			M	M	M	M	M	◆	8+
Rhus lancea/ African Sumac	20-30'	20-35'	Spread		◆	L	L	M	H	L	◆	4

LEGEND

VL	Very Low
L	Low
M	Medium
H	High
◆	Yes/Selection

Figure 10. Street tree matrix

MAINTENANCE: STREET TREES

Routine Maintenance

Street trees are a fantastic capital investment for the City, though for trees to survive and thrive for many years to come they require the best practice maintenance as described below. Routine maintenance includes things like leaf litter removal, replenishing mulch, use of fertilizer, and irrigation.

General Care

- Leaf litter shall be removed from all paved areas, site furnishings, plaques, and from the tops of plants.
- Do NOT use “weed eater” or other string trimmer type tools in planting areas.
- If mulch/wood chips are used, replace on a regular basis to maintain soil moisture and control weed growth. Mulch should not extend to be flush with tree trunks, refer to plans for minimum distance specified from tree trunks.
- For new trees: Note watering schedule per specifications.
- For transplanted trees: water deeply twice per week for their first two years on-site. OR Note watering schedule per project specifications.
- Do NOT allow irrigation to overspray on to the trunks of the trees or on to any hardscape.
- Do NOT hand water or use hose to water trees if automatic irrigation provided.
- Minimum 1x per week: test irrigation systems for any leaks, clogs, or flow issues. This includes inspection of heads, valves, emitters, etc.
- Confirm tree trunks and hardscape are not in the path of overhead spray. Remedial maintenance

Remedial Maintenance

includes things like tree pruning, pest inspection, etc.

General Care

- Any tree pruning required shall be completed by a certified arborist.
- Trees shall be pruned once annually, sprayed, removed, and replaced as needed in a manner satisfactory to the Public Works Department.
- Only prune branches identified by a certified arborist as dead, damaged, or infested, or those causing an immediate threat to public safety.
- Pruning of trees should be minimal and mainly consist of removal of dead, weakened, diseased, or dangerous branches.
- Some pruning may be required to remove crossing or rubbing structural branches.
- Some trimming may be necessary to remove twigs and branches in the path of bike/pedestrian travel along the corridors within the project area.
- Refer to ANSI A300 Pruning Standards and companion “Best Management Practices - Tree Pruning” for acceptable practices.
- Under no circumstance shall a tree be topped.

Green Infrastructure

BENEFITS: GREEN INFRASTRUCTURE

Green infrastructure is a design approach to managing stormwater, the urban heat island effect, air and water quality. Green infrastructure includes streetscape elements such as: bioswales, infiltration planters, permeable paving, and green walls. These elements intercept stormwater before it reaches the gray water infrastructure systems, or sewers. Through these different systems some water infiltrates into ground thereby recharging the groundwater and aquifers, some evaporates into the air, and some is temporarily stored before it is slowly released back into the sewer system.

By incorporating these elements as well as native plantings and trees in curb extensions, planted medians and pedestrian refuge islands roadway runoff is slowed, water quality is improved, paving is reduced, improve habitat connectivity, and reduce the urban heat island effect.

Cooling Benefits

Green infrastructure elements incorporated into the streetscape design creates a more enjoyable bicycle and pedestrian experience by reducing the ambient and surface temperatures of the adjacent areas. When designed as a system, vegetated green infrastructure planters contribute not only to the cooling of an urban area, but also reduce the heat stress of pedestrians and cyclists as they navigate an urban street as well as improve the psychological tolerance of heat. Many kinds of permeable pavements, including pervious concrete, porous asphalt, and reinforced grass pavements, are also considered cool because they can cool a pavement surface through the evaporation of moisture stored in the pavement. Permeable pavements have the added benefit of providing storm-water management.[6]

6. https://www.coolrooftoolkit.org/wp-content/pdfs/CoolRoofToolkit_Full.pdf

COMMUNITY VOICES

What kind of plants do community members want to see?

"Flores de diferentes colores que sean nativas de la zona (Flowers of different colors that are native to the area)."

-Workshop participant

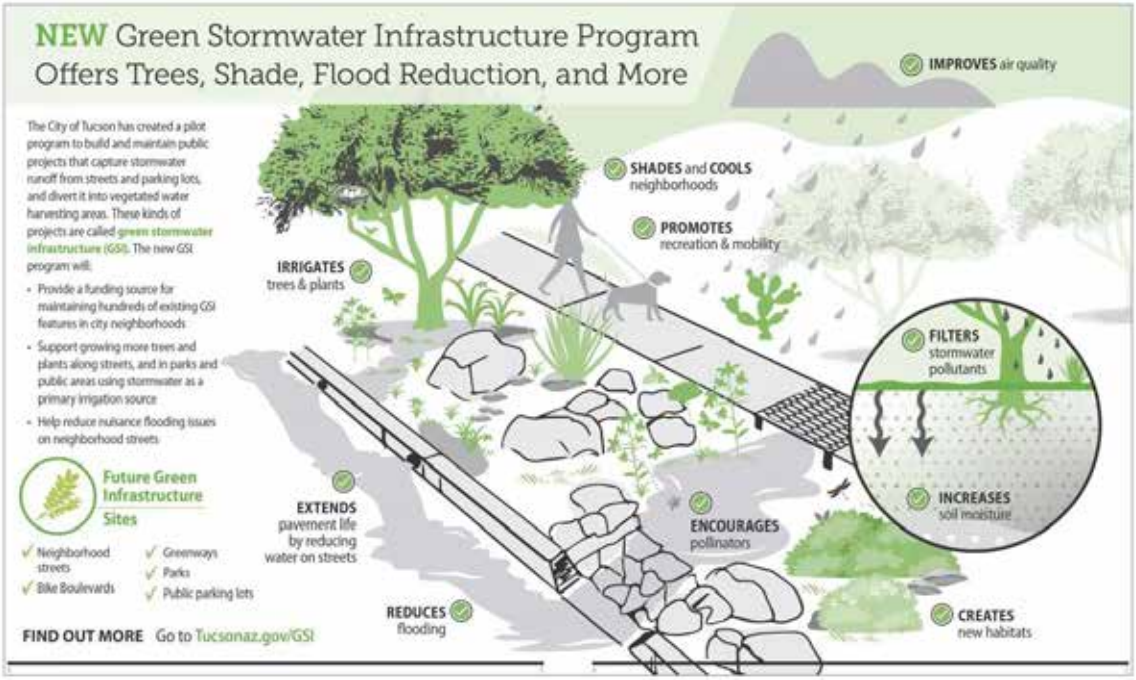


Figure 11. Benefits of green infrastructure (Source: https://www.tucsonaz.gov/gsi)

Environmental Benefits

Water that falls on impermeable surfaces like roofs, parking lots, and streets can not infiltrate into the ground so it becomes stormwater runoff collecting pollutants like oil, grease, heavy metals, and bacteria before flowing through gutters and storm drains, and eventually discharging into local water bodies. A well designed green infrastructure network can capture and filter this polluted runoff before it is returned back into the urban ecosystem. This process can conserve and improve water quality, improve air quality, and reduce energy use. Trees and vegetated stormwater facilities in an urban environment can also provide habitat and connect wildlife populations for birds, mammals, amphibians, reptiles, and insects. Even small patches of vegetation like green roofs can provide habitat for a variety of insects and birds. By reducing erosion and sedimentation, green infrastructure also improves habitat in local watersheds.[7]

Community Benefits

High quality public spaces, like those that include green infrastructure, improve mental health and create opportunities for community gatherings and development. Green infrastructure can be incorporated into existing transit facilities, including within medians and bulb outs, and thereby improve the experience and safety of the transit user. Green infrastructure can also be incorporated into bicycle facilities, within buffers, to improve drainage and user safety. Green infrastructure can reduce vehicle speed and vehicle volumes along a corridor when used as curb extensions, medians, pedestrian refuge islands, and diverters.[8] Incorporating green infrastructure elements into streetscapes improves mental and physical health through better air quality, shade and cooler temperatures, and beautification and contact with nature in areas where access to larger green space is limited.

7.https://www.epa.gov/green-infrastructure/benefits-green-infrastructure

8.https://nacto.org/publication/urban-bikeway-design-guide/bicycle-boulevards/green-infrastructure/

COOL TOOLS: GREEN INFRASTRUCTURE

Many of these green infrastructure elements can be designed and incorporated into what the City of Long Beach Low Impact Development (LID) Best Management Practice (BMP) Design Manual requires when designing a stormwater facility, standards for catchment, mitigation, infiltration, conservation, and education. The manual is a good reference for stormwater system type selection, feasibility, design criteria, and requirements.

The design tools below represent a suite of approaches to consider when adding green infrastructure to city streets.

Design Principles

- Maximize existing green space
- Expand green space in combination with bike/ped/roadway improvements
- Capture water where feasible
- Follow the City of Long Beach Development Services Low Impact Development Best Management Practices Design Manual requirements for area of impervious surface
- Placemaking initiatives eg. green alleys, enhanced pedestrian environment on sidewalks

Shrubs & Understory Planting

Shrub and understory planting is an integral component of green infrastructure. Including shrubs and other understory plants in treatments such as bioswales, flow through planters, and rain gardens helps to filter and slow stormwater runoff so it can infiltrate into surrounding soil or be cleaned before entering the storm drain system. Green infrastructure plantings are most successful using a palette of native plants that can tolerate periods of drought and inundation.

Many cities in the region defer to the Los Angeles green infrastructure standard details when constructing green infrastructure projects.

Bioswales

In the public realm, bioswales are typically located between the back of curb and sidewalk in the parkway area. They are usually designed to both infiltrate and clean stormwater runoff, and often have an inlet in the curb at the upstream end and an outlet in the curb at the downstream end. Any stormwater not infiltrated exits via the outlet and then goes into the municipal storm drain system after an initial 'cleaning' by the bioswale. Bioswales are often sized to treat the initial volume of water from a 'first flush' storm event. The shallow 'V'-shaped cross section of bioswales means that there is some variability in the types of plants that can be included in the design of the swale. Species more tolerant of inundation are planted near the bottom of the swale, while those less tolerant of inundation, including trees, may be planted on the upslope or sides of the swale.

Rain Gardens

In the public realm, rain gardens are often referred to as 'Parkway Basins'. They are designed to capture, clean, and infiltrate stormwater from municipal runoff. As the name suggests, these basins are constructed in the parkway area between the back of curb and pedestrian sidewalk. They are usually about 1-foot deep and the slopes are reinforced with rock. A curb inlet diverts stormwater into the basin during times of precipitation, and when the basin is full, the stormwater bypasses the inlet and continues down the gutter. Planting should be included in the design and construction of a parkway basin and the plants should be native when possible and have the ability to tolerate both periods of dryness and periods of inundation. Trees may be planted adjacent to parkways basins, but are not meant to be planted directly in a basin.

COOL TOOLS: GREEN INFRASTRUCTURE

Flow-through Planters

Flow through planters treat and clean stormwater before returning it to the municipal storm drain system. They do not infiltrate any stormwater, being hard-sided and hard-bottomed. They typically contain a lightweight soil mix formulated specifically for the purpose they serve and utilize similar plant materials to those used in bioswales, rain gardens, and other stormwater infrastructure. Flow through planters are useful in areas where stormwater infiltration is not possible due to soil conditions or dense urban areas where soil saturation could cause issue with roadway infrastructure or building foundations.

Figure 12. Stormwater Planter

Permeable Paving

Permeable, or pervious, paving comes in two basic forms: modular such as permeable concrete pavers, or pour-in-place such as permeable asphalt or concrete. Permeable paving reduces stormwater runoff by lessening the amount of non-porous surface area. Instead, stormwater is routed down through the paving system to an aggregate base where it is infiltrated or stored temporarily before going into the storm drain system.

Permeable paving can be combined with suspended pavement systems to be used as passive irrigation for trees. Permeable paving systems can be used in a variety of contexts such as bicycle lanes, parking lanes, sidewalks, parking lots, alleys, or roadway gutters. Installing permeable pavement systems requires a site soil survey to determine if the soil infiltration rate is high enough to accommodate infiltration. Otherwise intercepted stormwater runoff must be conveyed via subdrainage infrastructure to the storm drainage system.

PHOTO: https://www.estormwater.com

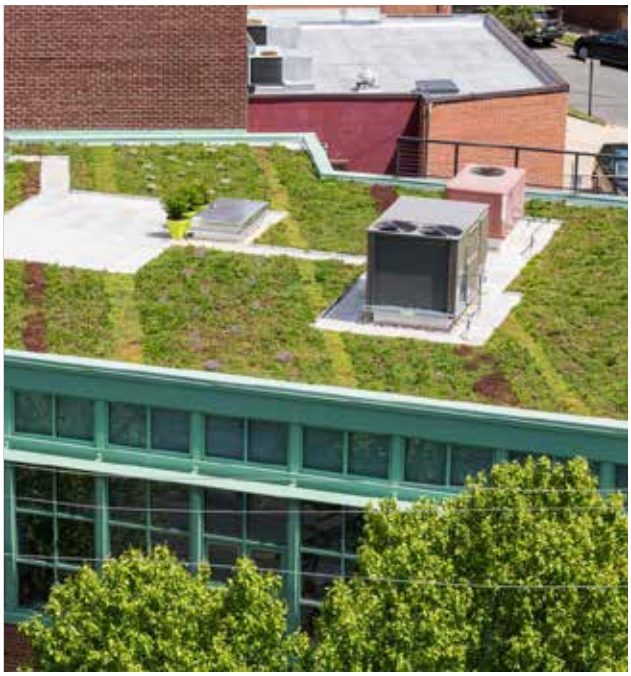
COOL TOOLS: GREEN INFRASTRUCTURE

Green Roofs

A Green Roof is a vegetated roof covering with a system of growing media and plants taking the place of standard exterior facing roof materials. They consist of a waterproof membrane layer on the bottom, followed by a drainage layer, media layer, and then the plant material on top. In warm dry climates an irrigation system is often included in the green roof system to help the plants survive during periods of drought and high heat. Green roofs have been shown to help mitigate heat island effect while also lessening heating and cooling expenses of the buildings they are on. A study conducted at the University of Central Florida found the maximum average day temperatures for conventional roof surface was 130°F, while the maximum average for green roof was 91°F, which is 39°F lower than the conventional roof.

The plant material used on green roofs depends on the ultimate depth of grow media provided by the particular system and local climatic conditions, however all plants selected for green roofs should be drought tolerant and have generally small root systems. In Southern California many green roof plant palettes include a mix of small succulents and native perennial plants and grasses.

Because they are associated with buildings, opportunities to build green roofs that interface with the public right of way, by for example by capturing stormwater to use for irrigation, must be coordinated with development projects.



Vertical Greenery Systems

Vertical Greenery Systems (VGSs), also known as 'Green Walls', 'Living Walls', or 'Green Facades' are methods of affixing living plants to the exterior walls of buildings or other structures. Studies have shown that VGSs can be used to help mitigate urban heat island effect, reducing the ambient air temperature and moderating extreme temperatures in their vicinity. Because the plants transpire water through their leaves, they are able to create a localized area of evaporative cooling around them. There are a number of methods for installing VGSs and their associated growing media and irrigation systems. Cities can incorporate VGSs on public buildings or parking structures and may partner with Business Improvement Districts (BID) or other community organizations to facilitate VGSs on other non-publicly owned buildings. VGSs may be coupled with other building systems such as the drainage or Heating, Ventilation, and Air Conditioning system both of which may be able to contribute water to the VGS irrigation system.

MATERIALS PALETTE GREEN INFRASTRUCTURE

Relationship to Green Infrastructure Types and Street Trees

Green infrastructure treatments that include planting can be coordinated with street tree planting. The species included in the plant palette indicate species that tolerate periods of inundation and are therefore compatible with stormwater-receptive green infrastructure treatments: bioswales, rain gardens, and flow-through planters.

PHOTO: https://www.ioes.ucla.edu

PHOTO: https://www.designworkshop.com

BOTANICAL/COMMON NAME	PLANT TYPE/FORM	CALIFORNIA NATIVE	DROUGHT TOLERANT	WATER INTENSITY	TOLERATES INUNDATION	SIDE SLOPE PLANTING
Achillea millefolium/Common Yarrow	P	◆	◆	L		◆
Carex pansa/Dune Sedge	G	◆	◆	M	◆	◆
Carex praegacilis/ Clustered Field Sedge	G	◆	◆	M	◆	
Chilopsis linearis/Desert Willow	T	◆	◆	L		◆
Chondropetalum tectorum/ Small Cape Rush	G		◆	M	◆	◆
Iris douglasiana/Douglas Iris	P	◆	◆	M		◆
Juncus patens/Common Rush	G	◆	◆	L	◆	
Leymus condensatus/Giant Wild Rye	G	◆	◆	L		◆
Muhlenbergia rigens/Deer Grass	G	◆	◆	L		◆
Platanus racemosa/Western Sycamore	T	◆	◆	N		◆
Salvia spathacea/Hummingbird Sage	P	◆	◆	M		◆
Sisyrinchium bellum/Blue-eyed Grass	P	◆	◆	L		◆

LEGEND

P	Perennial
G	Groundcover
T	Tree
N	Not Tolerant
L	Low
M	Medium
◆	Yes/Selection

Figure 13. Green Infrastructure-Appropriate Plantings

MAINTENANCE: GREEN INFRASTRUCTURE

Routine Maintenance

Green infrastructure helps to reduce grey water infrastructure costs for the City by helping to manage stormwater, therefore it is important they receive regular maintenance. Routine maintenance includes things like debris removal, ensuring water infiltrates at the required rate, inspecting and replacing any damaged plant material, inspecting for and repairing any erosion damage, weeding, accumulated sediment removal, and cleanout of inlets and outlets.

General Care

Maintenance should include:

- Regular cleaning of litter and debris both in the green infrastructure and at the inlet and outlet channels.
- Inspect all grates and filters for blockage.
- Periodic maintenance to avoid overwatering and prevent potential discharges via underdrains.
- Replace plants as needed.
- Inspect system after each rain event.

Mulch

- Replenish mulch regularly to maintain depth specified in project plans.
- Use only non-floating mulch in bioretention areas.

Subgrade Stormwater Storage Systems (if present)

- All stormwater pretreatment features incorporated into your site must be inspected regularly. Inspection frequency for the system will be determined by project documents , but should never exceed one year between inspections (six months during the first year of operation).

Remedial Maintenance

Remedial maintenance includes things major repairs due to storm or other damage.

General Care

- Annual visual inspection and clean out before rainy season
- Repair any storm damage after rainy season

Shade Structures

COMMUNITY VOICES

"All of Anaheim Street is completely in the sun at all times. With all the businesses on that street it should be a major walkable corridor, but because of the heat and the dangerous traffic it's unlivable."

-Workshop participant

BENEFITS: SHADE STRUCTURES

While trees provide the greatest measurable cooling benefits, shade structures are a great tool to use when planting trees is infeasible in a particular location.

According to temperature readings taken in Long Beach in 2020, there can be a 15 degree Fahrenheit difference in surface temperature of a bench exposed to full sun and a bench under a shade structure. In addition to reducing surface temperatures, shade structures can protect against ultraviolet radiation, and reduce air temperature.

Shade structures not only can contribute to urban cooling by providing shade, but they can also contribute to enjoyable public spaces. In locations where shade trees will not work due to limited size of planting area, shade structures can provide a year around solution by functioning as a freestanding structure or affixed to existing buildings. Examples of spaces like this are along sidewalk zones, adjacent to commercial frontages where ROW is limited.

Shade structures are also an opportunity to incorporate public art into the streetscape.

Figure 14. Shade structures are used in this alley to provide shade in a constrained area where tree planting is not feasible.

Figure 15. Shade structures can be an opportunity to incorporate public art.

COOL TOOLS: SHADE STRUCTURES

Shade structures can be incorporated into a wide variety of spaces within the public realm. These include transit stops, alleyways, parks and playgrounds, and along commercial corridors. Shade structures come as pre-fabricated materials available from a wide array of manufacturers. They can also be custom designed to incorporate public art.

The design tools below represent a suite of approaches to consider when adding shade structures to city streets.

Design Principles

- Use shade structures in constrained areas where trees are infeasible to provide continuous shade on corridors or at transit stops
- Materials should be durable to weather and vandalism
- Tie to placemaking initiatives
- Reference any applicable city design guidelines when designing or selecting shade structures

Freestanding Shade Structures

Shade structures affixed to posts, either cantilevered (supported on one side) or supported by multiple posts can be incorporated into a wide variety of street contexts.

The shading element can be constructed of a wide range of materials, from canvas or other tightly woven cloths, to louvered panels, to solar arrays or green roofs. They can be incorporated in business districts, parking lots, plazas, transit stops, and rest areas.

Possible locations for use include: Business districts, parking lots, plazas, and bus stops.

Building-Supported Shade Structures

Some shade structures are designed to work in conjunction with architecture. These include awnings and shade sails. Building-supported shade structures that provide shade benefits to the public right of way need to be designed and installed in cooperation and with the permission by the property owner.

MATERIALS PALETTE SHADE STRUCTURES

Shade Sails

Shade sails are created by running a wire rope around the perimeter of a sail and stretching a high tensile shade cloth between 3 - 5 support structures, attaching it at each corner. They are available in a range of sizes from 15-40’ in length and width to heights of 8 to 16 feet. The shade sail is constructed of canvas or other tightly woven cloths including knitted polyethylene or woven PVC. Shade sails may be utilized at entrances to buildings, plazas, transit stops, parks, playgrounds, rest areas, and pedestrian alleys.

Bus Shelters

Bus shelters are structures located at a bus stop that provide seating and protection from the weather for waiting passengers. In warm, arid climates they also provide protection from the sun, although they are not 100% effective due to the movement and seasonal angle of the sun. Whether a bus stop is installed, and the ultimate design is usually dictated by the City in coordination with the transit provider. Design standards established by the city and service provider should be consulted.

When installing a bus shelter it is important to maintain a minimum distance of 4’ clear for pedestrians to pass either in front or behind the shelter.

Cantilever Shade Structures

Cantilever shade structures are built to require structural support on only one side. Their frames are designed to contain their own loads and avoid impacts to adjacent buildings or other structures.

Hip Shade Structures

Hip shade structures are square or rectangular free-standing shade structures that have options for two, four, six, or eight columns for support. They are usually mounted in-ground with concrete footings and are available in many sizes and heights. Potential locations for use include playgrounds, parks, and plazas or other large seating areas.

Awnings

An awning is an architectural fabric projection that provides weather protection, shade, identity or decoration and is wholly supported by the building to which it is attached. They are comprised of a lightweight frame structure over which a cover is attached and can be stationary or retractable. Awnings can provide a shaded environment for pedestrians and are typically incorporated into commercial districts are often an identifying feature of a particular district or neighborhood.

MAINTENANCE: SHADE STRUCTURES

Routine Maintenance

Routine maintenance includes things like cleaning, lubricating, and replacing any damaged parts.

General Care

Shade structures should be inspected on a regular basis to confirm:

- Operability of any mechanical parts are present, lubricate annually after rainy season.
- Condition of materials and parts, including but not limited to posts, fasteners, shade sails, or solar panels.

Keep free of stickers, grime and dirt per manufacturer. Clean per manufacturer specifications if vandalized.

Bus Shelters

- Bus shelters are typically operated and maintained by city contractors. For outside vendors, contact City.

Remedial Maintenance

Routine maintenance includes things like cleaning, lubricating, and replacing any damaged parts.

General Care

- Annual inspections for structural integrity
- Replace per manufactures specifications

COMMUNITY VOICES

"Pacific Coast Highway is a sunbaked nightmare!"

-Workshop participant

Cool Paving + Hardscape

BENEFITS: COOL PAVING + HARDSCAPE

Cool pavements have no standard or official definition, though the concept mainly refers to reflective pavements that help lower surface temperatures and reduce the amount of heat absorbed into the pavement.[9] Hot dark pavements not only contribute to the urban heat island effect, but they can also increase the temperature of stormwater runoff. Streetscape surfaces like pavement are dark and typically absorb over 80 percent of sunlight that contacts them and convert that solar energy into heat. During the daytime, conventional asphalt concrete pavement absorbs the vast majority of solar energy it is exposed to (~85-95%) and reflects only a small portion upwards back into the atmosphere, causing it to be 68-86°F hotter than surrounding surface temperatures.[10] These pavements then transfer heat downward to be stored in the pavement subsurface, and re-release this heat to the atmosphere at night - contributing to the urban heat island and increasing ambient air temperatures, at all hours of the day.

Replacing and upgrading pavements with more reflective materials could reverse this warming, turning urban surfaces into contributors to reducing the urban heat island effect.[11] There are many kinds of paving options that are lighter in color and create more reflective paved surfaces. Shade structures are also an opportunity to incorporate public art into the streetscape.

Studies in several cities in the U.S. have shown that city-wide installations of highly reflective roofs and pavements, along with planting shade trees will, on average, reduce a city's ambient air temperature by 4 to 9 degrees Fahrenheit in summer months.[12] Paired with shade trees, cool pavement can provide improved comfort for pedestrians in an urban environment by reducing surface and near-surface air temperatures. Cool

9. https://www.epa.gov/sites/production/files/2017-05/documents/reducing_urban_heat_islands_ch_5.pdf

10. Ongel, A., & Harvey, J. (2004). Analysis of 30 years of pavement temperatures using the enhanced integrated climate model (EICM). Pavement Research Centre.

11. https://www.coolrooftoolkit.org/wp-content/pdfs/CoolRoofToolkit_Full.pdf

12. https://www.coolrooftoolkit.org/wp-content/pdfs/CoolRoofToolkit_Full.pdf

Pavement is capable of reflecting solar energy, reducing the temperature of stormwater runoff resulting in less thermal shock to local waterways. Cool pavement has potential to lower tire noise from two to 8 decibels and keep noise levels below 75.[13] Such pavement can improve nighttime visibility by enhancing visibility with the light color and potentially requiring less lighting, thereby saving energy and costs. Cool pavement projects have been tested and implemented in numerous locations throughout Los Angeles and these projects have showcased the benefits of this urban heat island effect mitigation strategy. Specifically, in June 2017, the City applied a reflective cool pavement seal on 15 city street segments. The cool seal test results read more than a 10 degree surface temperature difference between the light gray pavement and nearby black asphalt.[14]

Cool paving is an emerging technology and studies on its efficacy are not all consistent. A 2019 study found that on a typical Los Angeles summer day, with a high of 88 degrees, they found a person could feel more than 7 degrees warmer on a "cool pavement", as opposed to a normal asphalt road. This was mostly attributed to solar radiation reflected off the lighter colored cool pavement, which was also visible as glare. The cool pavement was causing more uncomfortable conditions for pedestrians.

As cities continue throughout the region and country continue to test and pilot cool paving, the latest research should be consulted before considering its use. The performance and longevity of Cool Paving is also tied to an array of factors, including volume of traffic, which creates wear and tear on the surface, sun exposure, and weather.

13. https://www.epa.gov/heatislands/using-cool-pavements-reduce-heat-islands

14. Dana Bartholomew, "'Cool Pavement' to Cut Urban Street Heat Gets First California Tryout in Canoga Park," Los Angeles Daily News, May 20, 2017, https://www.dailynews.com/2017/05/20/cool-pavement-tocut-urban-street-heat-gets-first-california-tryout-incanoga-park/

COOL TOOLS: COOL PAVING + HARDSCAPE

Cool paving areas can be incorporated on surfaces in a variety of public spaces including residential roads, parking lots, plazas, and playgrounds. Cool paving will have more significant impacts on lowering temperatures when paired with other cool tools such as street trees, green infrastructure, and cool amenities. Cool paving comes as integral concrete, a seal, coating, or overlay.

The design tools below represent a suite of approaches to consider when adding cool paving to city streets.

Design Principles

- When feasible, choose light colored pavement
- Consider the potential for glare and impacts of reflectivity
- Tie to placemaking initiatives
- Reference any applicable city design guidelines when applying or selecting cool pavements or hardscape

Concrete

Portland cement concrete is the familiar concrete pavement commonly used for infrastructure such as sidewalks, bridges, buildings, etc. Concrete is formed when Portland cement creates a paste with water that binds with sand and rock to harden.

Cool Paving - Seal

Seal coats are asphalt-based treatments that are applied on top of new or existing pavement that cap aggregate in place and enhances pavement protection from the elements.

- A successful case study of this product can be found in the pilot program started by StreetsLA in the City of Los Angeles. Los Angeles was the first city in California to test cool pavement on public streets. This pilot study installed the cool pavement on 10-12 residential streets in three different neighborhoods in 2019. The projects combined installing cool pavement, street trees, and shade structures. The outcome of these projects saw surface temperatures decrease by 9-11 degrees farenheit.[15]

15. https://www.irf.global/information-on-cool-pavement-pilot-program-city-of-los-angeles/

Cool Paving - Coating

Cool coating pavement treatments are similar to seal coats, but are not asphalt based and have been modified to have cooling properties.

Cool Paving - Overlay

An overlay consists of installing new pavement over an existing pavement structure and is typically done to repair damage. When installing an overlay, the old surface is usually milled (ground) off, any structural damage is repaired, and then a new surface is applied.[16]

16. *Pavement Tools Consortium. (n.d.). Overlay. Retrieved July 11, 2019, from https://www.pavementinteractive.org/reference-desk/maintenance-and-rehabilitation/rehabilitation/overlay/*

MATERIALS PALETTE: COOL PAVING + HARDSCAPE

There are specific products that can be used for each cool pavement type. The chosen materials depend on the needs and context of the specific project, therefore specific product information will not be shared here.

MAINTENANCE: COOL PAVING + HARDSCAPE

Routine Maintenance

Routine maintenance includes things like street sweeping, pressure washing, and minor repairs.

General Best Practices for Surface Coating

Keep the surface clean

- Complete regular street sweeping per City schedule to keep surface clean. Buildup of dirt and debris can result in premature wear of the coating.
- Refer to manufacturer specifications for detailed cleaning and maintenance practices.

Portland Cement Concrete

- Follow City-standard sidewalk cleaning and maintenance procedures.

Remedial Maintenance

Remedial maintenance includes things like recoating or replacing

Recoating

- When cleaning is unable to restore the project appearance, the project should be recoated. Cool paving applications can last for as many as five years, but vary depending on several factors. These include the volume of vehicular traffic, amount of sun exposure, and precipitation. Consult manufacturer specifications for specific long-term maintenance and frequency needed for re-application

Cooling Amenities

COMMUNITY VOICES

"Crear un parque en donde hay fuentes y chorritos de agua, en donde las familias se pueden refrescar cuando hace calor, como fuentes de agua. (Create a park where there are fountains and streams of water, where families can cool off in hot weather, such as water fountains) "

-Workshop participant

BENEFITS: COOLING AMENITIES

Cooling amenities encourage people to walk, bike, and take transit and make it more comfortable to do so. When paired with other cooling strategies, cooling amenities such as drinking fountains, shaded benches, and bike racks can significantly influence both cooling and community benefits. These amenities may not directly mitigate the urban heat island effect, but they do provide comfort and necessary tools for adaptation.

Hydration and shade is critical when moving in a hot urban environment. Factors that contribute to heat illness include physical activity, extended exposure to high air temperatures, direct and indirect solar radiation on the body, wind speed, and humidity. Exposure to these conditions can result in dehydration, heat exhaustion, or heat stroke.[17] Individual vulnerability to heat illness also depends on clothing type, acclimatization, coping ability, age, gender, physical appearance, subcutaneous fat, fitness, diet, and skin color.[18] Children and older adults, women, people with chronic medical conditions, and people with darker skin colors tend to be more vulnerable to heat illness.

Providing public drinking fountains and shaded places to rest can reduce instances of heat-related illness. Public drinking fountains help people walking, bicycling, and using transit avoid dehydration, which is especially important for vulnerable populations including children, elderly people, and people experiencing homelessness. These hydration stations not only provide free water for the public but can reduce waste by reducing the need to purchase single-use plastic bottles or cups.

Shaded benches can provide relief from extreme heat by not only sheltering people from solar radiation, but also providing a place to rest, lowering their metabolic

17. http://documents1.worldbank.org/curated/en/605601595393390081/pdf/Primer-for-Cool-Cities-Reducing-Excessive-Urban-Heat-with-a-Focus-on-Passive-Measures.pdf http://documents1.worldbank.org/curated/en/605601595393390081/pdf/Primer-for-Cool-Cities-Reducing-Excessive-Urban-Heat-with-a-Focus-on-Passive-Measures.pdf

18. Aram, F., Solgi, E., Garcia, E.H. et al. Urban heat resilience at the time of global warming: evaluating the impact of the urban parks on outdoor thermal comfort. Environ Sci Eur 32, 117 (2020). https://doi.org/10.1186/s12302-020-00393-8

rate. Bench design that allows a person to elevate their feet may be most effective in lowering their metabolic rate.[19]

19. https://www.nia.nih.gov/health/hot-weather-safety-older-adults

Incorporating additional amenities, such as shaded places to drink water and sit and relax, can improve quality of life. These amenities provide physical as well as psychological relief from hot temperatures and create a more comfortable, enjoyable, and low stress environment that encourages community building and social interaction.

COOL TOOLS: COOLING AMENITIES

Cooling amenities can be incorporated into a wide variety of spaces within the public realm and work most effectively when paired with other cool tools. The amenities that are covered in this document include benches, bicycle racks, hydration stations, splash pads, and misters.

The design tools below represent a suite of approaches to consider when adding cooling amenities to city streets.

Design Cooling Amenities

- Add cooling amenities wherever feasible to enhance overall comfort and encourage mode shift
- In constrained contexts where other cool tools are not feasible, prioritize cooling amenities
- Tie to placemaking initiatives
- Reference any applicable city design guidelines when selecting cooling amenities

Benches

Benches should be co-located with shade elements such as street trees or shade structures wherever possible.

According to the Downtown Long Beach Pedestrian Plan (2016) "providing street furniture on sidewalks acts as a buffer between pedestrians and vehicular traffic." It is recommended that street furniture is placed outside of the walking zone to avoid hazards to pedestrians. Additionally, the Plan states that benches should be provided at all transit stops and stations, and under the provided shelter if feasible.

Bicycle Racks

Bicycle racks should be co-located with shade elements whenever possible and provided near points of interest, workplaces, and transit stops in order to encourage a mode shift from driving to bicycling.

Hydration Stations

Stainless steel hydration stations that are resistant to vandalism are suited for urban environments and bring down maintenance costs. Specifications include powder-coated exterior, heavy-gauge construction with tamper-resistant hardware, and vandal resistant bubbler hood guard. Types of hydration stations include standard, bottle-filling, or combination.

Splash Pads

Located within parks or playgrounds, splash pads provide varying interactive water features. Splash pads can vary in size and layout, and can be custom designed to fit the needs of the site.

Misters

Misters can be located within public parks, plazas, or within transit corridors. Misters cool through evaporative cooling - the natural cooling effect that happens when water evaporates in warm air. As droplets of water evaporate they cool the air immediately around them. The finer the mist the more thoroughly it evaporates and the more thoroughly it cools the air. Misters can provide brief moments of cool air with a single installation or more robust systems and cool a larger area such as a seating area or transit station or alley.

MAINTENANCE: COOLING AMENITIES

Routine Maintenance

Routine maintenance will be different for the various cooling amenities. Refer to manufacturers maintenance specifications for maintenance schedules and details.

Street Furnishings (Benches & Bike Racks)

General Care

- Remove graffiti
- Periodically inspect for damage
- Remove objects, like bicycles, that have been abandoned

Water Features (Hydration Stations & Misters)

General Care

- Ensure stations and plumbing are properly maintained can help avoid unsafe drinking water.
- Refer to guidance from the City of Long Beach's Public Works Department and manufacturer recommendations regarding cleaning protocols, including:
    - Cleaning frequency
    - Flushing schedule to remove sediments or stagnant water
    - Water pressure checks
    - Repair protocol

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COMMUNITY VOICES

"Mi opinión es que en las paradas de bus no hay protección de sol. (My opinion is that there is no sun protection at bus stops)."

-Workshop participant

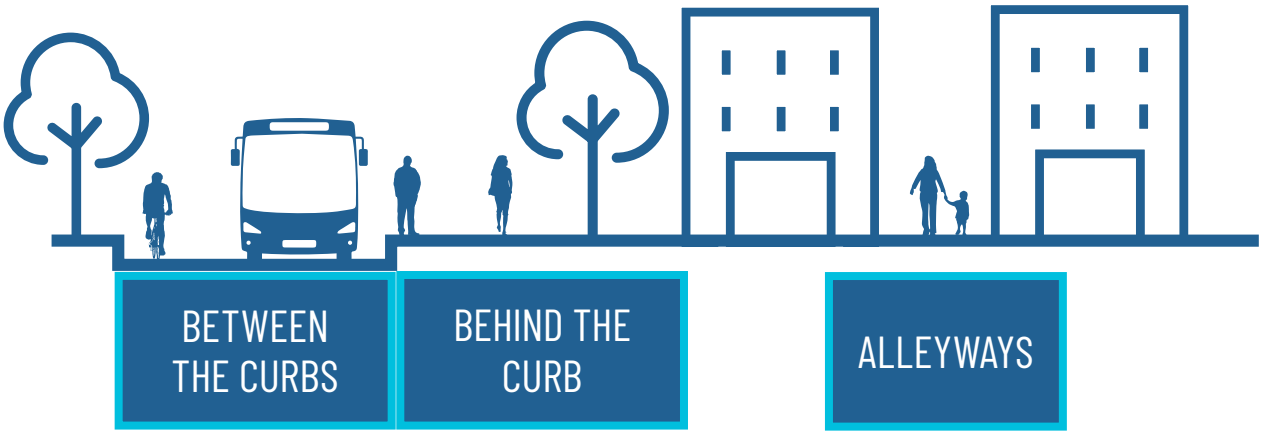


Figure 16. Zones of the street include pedestrian and transit stops (Behind the Curb), bike and traffic calming (Between the Curbs), and Alleyways.

CHAPTER 4

Cooling Strategies

Streets designed to maximize functionality for all users become cooler streets by definition: they give people the option to travel by walking, biking, and transit, reducing the heat and pollution released by motor vehicles that contributes to the urban heat island effect. But whether or not people feel comfortable actually using those facilities has a lot to do with how they are designed. Integrating cool tools to increase shade, lower temperatures, and increase the psychological tolerance of heat can play a significant role in encouraging the use of those facilities which leads to mode shift and benefit community health and safety.

To maximize cooling benefits in the public right of way, prioritize the incorporation of cool tools as follows:

1. Shade Trees: plant closely together to create continuous shade (provide up to 45 degrees cooling benefit)
2. Green Infrastructure: reduce pervious surfaces and maximize planting areas (up to 25 degrees cooling benefit)
3. Shade Structures: add when tree planting is infeasible (up to 15 degrees cooling benefit)
4. Cool Paving + Hardscape: use light colored surfaces (up to 9 degrees cooling benefit)
5. Cooling Amenities: these include elements that increase the psychological tolerance of heat, but don't provide direct cooling benefits; they can augment other cool tools or be applied in constrained areas where other cool tools are infeasible

This section of the Plan shares ways to apply the cool tools outlined in the first part of this chapter into these different areas of public sidewalks, streets and alleys. Figure 16 illustrates how the elements within each zone relate to the broad categories below:

- Behind the Curb: cool strategies that can be applied to the building frontage, walk zone, and amenity/curb zones, or access zones of a street. This typically includes pedestrian-oriented treatments, as well as transit stop amenities that may be included in the access zone.
- Between the Curbs: cool strategies that can be applied to the access zone and vehicle zone of the street. This typically includes bicycle facilities and traffic calming treatments.
- Alleys: cooling strategies that are appropriate for alleys or paseos.

The matrix shown in Figure 16 is an index to this section that illustrates which cool tools are appropriate for the streetscape design contexts described in each column.

Additionally, a range of operational changes are described. This includes things like adjusting speed limits and signalization, which can improve the psychological tolerance of heat often without changing the cross section of the street.

	BEHIND THE CURB			BETWEEN THE CURBS				ALLEY
Cool Tool	**Constrained**	**Exceeds Minimums**	**Transit Corridor Compatible***	**Separated Bike Facility**	**Bicycle Boulevard**	**Median**	**Traffic Calming treatments**	**Alley**
STREET TREES								
Tree Wells	◆	◆	◆	◆		◆	◆	◆
Treelets			◆		◆		◆	
Street tree + continuous parkway	◆	◆	◆	◆		◆		◆
Suspended Pavement System	◆	◆	◆	◆				◆
GREEN INFRASTRUCTURE								
Shrubs & Understory Planting	◆	◆	◆	◆	◆	◆	◆	◆
Bioswales		◆	◆	◆	◆	◆	◆	◆
Rain Garden		◆	◆	◆	◆	◆	◆	◆
Flow-through Planters	◆	◆	◆	◆	◆	◆	◆	◆
Permeable Paving	◆	◆	◆	◆	◆	◆	◆	◆
Green Roofs		◆	◆					◆
Vertical Greening Systems	◆	◆	◆					◆
Planter Pots/ Boxes	◆	◆	◆	◆	◆		◆	◆
SHADE STRUCTURE								
Freestanding	◆	◆	◆			◆		◆
Building - supported	◆	◆	◆					◆
COOL PAVING + HARDSCAPE								
Concrete	◆	◆	◆	◆	◆			◆
Seal Coat				◆	◆			◆
Cool Coat				◆	◆			◆
Overlay				◆	◆			◆
COOLING AMENITIES								
Benches	◆	◆	◆			◆		◆
Bicycle Racks	◆	◆	◆			◆		◆
Hydration Stations		◆	◆			◆		◆
Splash Pads		◆	◆			◆		
Misters	◆	◆	◆					◆

This matrix represents the full range of cool tools that may be considered based in different public right of way contexts. The feasibility of implementing these cool tools in any given streetscape context will need to be determined through a detailed design process. Some treatments may require more space than is available in a given context.

** This matrix represents treatments that are compatible with linear transit corridor treatments. At transit stops, clear space must be provided for riders to wait and board. For example, a bioswale may be installed along a transit corridor, provided a clear area is provided at transit stops.*

Figure 17. Matrix of Cool Tools

Behind the Curb

USE OF SPACE

As shown in Figure 16, this zone of the street may contain:

- Building frontage: door zone, sidewalk cafes, bicycle parking.
- Walk Zone: sidewalk space for the exclusive use of pedestrians, or a shared-use (Class I) path for use by people walking or biking.
- Amenity/Curb Zone: street trees and parkways, street furnishings.
- Access Zone: Curb extensions, parklets, and bus bulbs.

The amount of space allocated for each of these uses will vary from street to street.

CONSTRAINED

Many existing sidewalks along streets are narrow, typically between 5 and 8 feet wide, and if street trees are present, they are usually installed in small tree wells. This is a tough environment with underground utilities and compacted sub-base and base materials necessary to support sidewalks and roadways. The amount of 'rootable' (loose, aerated, water storing) soil is minimal which results in stunted tree growth and shorter street tree life span.

When space in this zone is constrained, consider the following cool strategies to create conditions for trees to thrive and incorporate more cool tools:

- Trees: plant trees wherever feasible using continuous parkway planting or widening tree wells; in especially constrained areas, use tree grates or suspended paving systems that allow space for both tree roots to thrive beneath pavement and accessible walk zone space. Treelets, which extend into the roadway between parking spaces, may also be considered.
- Green Infrastructure: install a continuous parkway strip if feasible to reduce impervious surfaces; flow-through planters can be incorporated into curb extensions. Permeable paving may also be used. Vertical greening, may also be considered and may require approval/ coordination with private building owners.
- Shade Structures: add shade structures at transit stops. Shade structures may also be used adjacent to the walk zone if tree planting is infeasible - either free-standing or mounted to adjacent buildings.
- Cool Paving + Hardscape: sidewalks are typically made of concrete, which is a cool paving surface; if decorative pavers are used, select lighter colors to reduce heat gain.
- Cooling Amenities: locate cooling amenities, like benches, bike racks, or planter boxes, at transit stops or near community destinations.

Streets that contain a constrained Behind the Curb space include:

- Magnolia Ave, Henderson Ave, 15th St, and a part of Chestnut Ave.

These constrained conditions may be altered if road space currently dedicated to street parking or travel lanes are reallocated to Behind the Curb uses.

EXCEEDS MINIMUM

When space in this zone is not constrained and exceeds minimum space requirements, in addition to each of the strategies noted in the Constrained section, consider the following cool strategies:

- Trees: plant trees wherever feasible using either continuous parkway planting, or a suspended pavement system to further maximize soil volumes. If space permits, consider a double row of trees.
- Green Infrastructure: if parkway areas are ample bioswales or rain gardens can be incorporated.
- Shade Structures: shade structures may incorporate elements like green roofs or solar panels.
- Cool Paving + Hardscape: sidewalks are typically made of concrete, which is a cool paving surface; if decorative pavers are used, select lighter colors to reduce heat gain.
- Cooling Amenities: locate cooling amenities, like benches, bike racks, or planter boxes, at transit stops or near community destinations.

Streets that currently exceed the minimum Behind the Curb space include:

- Locust Ave, Pine Ave, Pacific Ave, Cedar Ave, Chestnut Ave, 17th St, 16th St, and Cowles St.

These constrained conditions may be altered if road space currently dedicated to street parking or travel lanes are reallocated to Behind the Curb uses.

On streets with wider existing sidewalks (averaging 15' wide) such as Long Beach Blvd and Pacific Coast Highway, it is generally possible to install larger treewells or continuous planting areas despite the constraints such as above and below ground utilities that exist in areas with more narrow sidewalks. More horizontal space between treewells and existing buildings and a larger soil volume allows for larger species to be planted, thereby increasing the potential for shade.

NEW DEVELOPMENT

It is important to note that Back of Curb improvements can often be funded and implemented through private projects that construct new housing, mixed-use, or retail buildings. This is an opportunity for cooling strategies:

- Design the ideal, not the minimum: while an existing back of curb space may be constrained, new development presents an opportunity to increase a building's setback from the street, creating more space to apply cooling strategies within the public right of way.
- Irrigation and Green Infrastructure: Irrigation can be challenging to retrofit into an existing streetscape, but its presence makes a big difference in the health and longevity of trees and plants. Developer-driven projects may fund the installation and maintenance of irrigation within the public right of way. Additionally, green infrastructure treatments, like green roofs, bioswales, or rain gardens may be designed in concert with new architecture to take advantage of gray water from buildings.

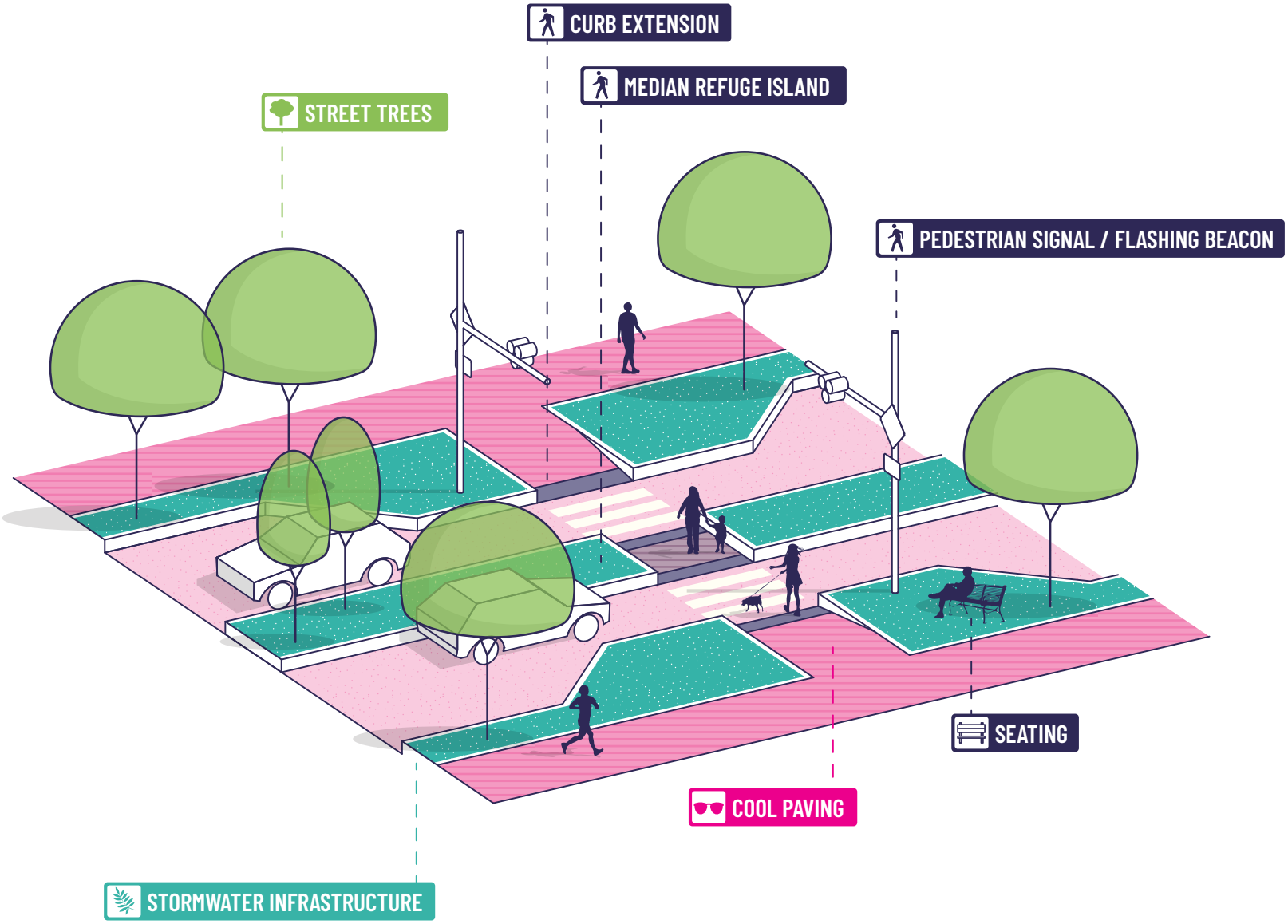


Figure 18. Pedestrian-focused cooling strategies behind the curb

BEHIND THE CURB: PEDESTRIANS AND BIKES

Pedestrian facilities adjacent to streets, as shown in Figure 18, typically include a concrete sidewalk (which is a type of cool paving), planting/amenity areas, and treatments to facilitate crossing, like curb extensions or planted medians.

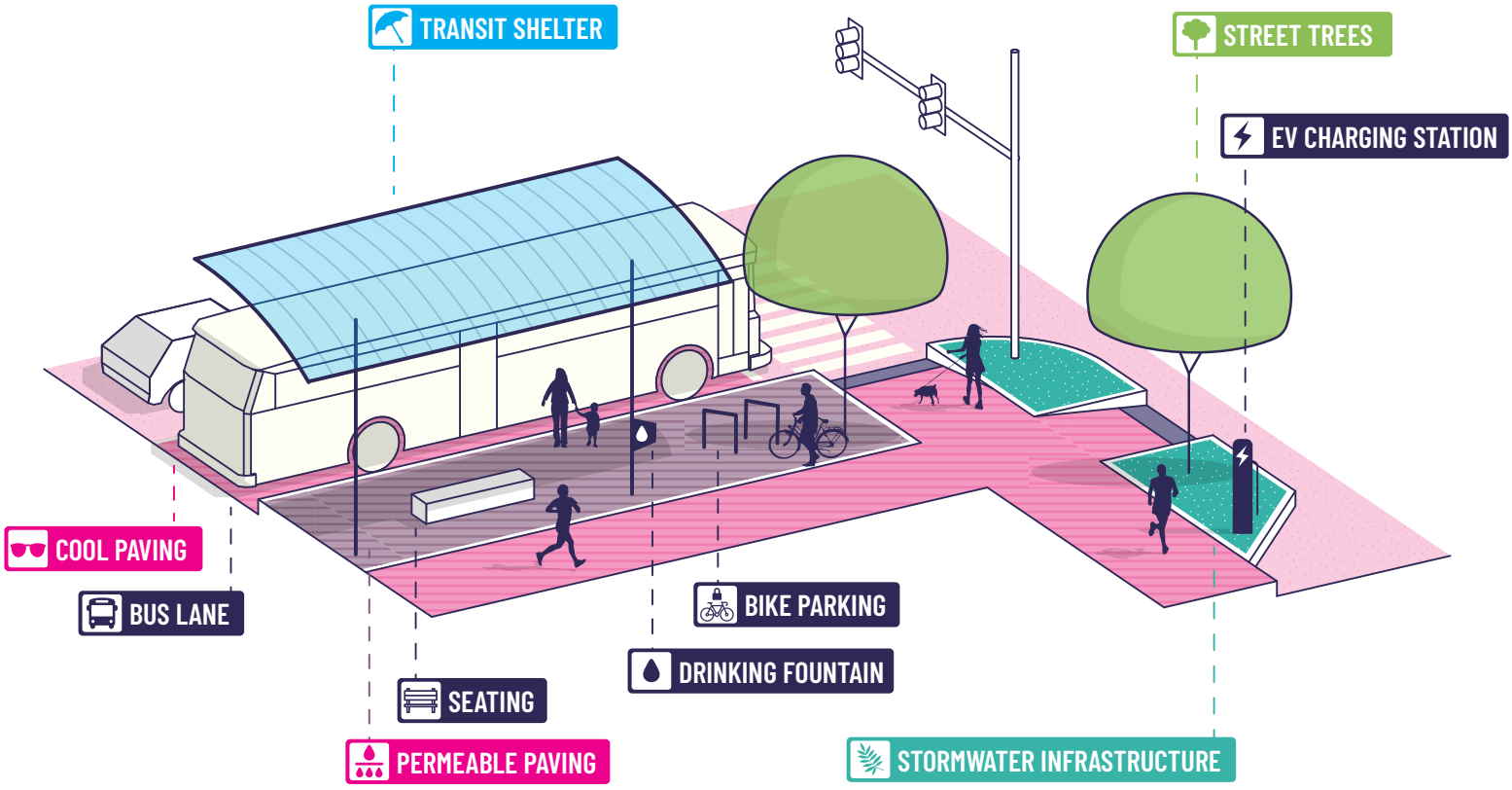


Figure 19. Cooling strategies at transit facilities

BEHIND THE CURB: TRANSIT AND BIKE AMENITIES

Transit stops are located across a wide variety of contexts throughout the city. Each of these contexts requires a different approach to transit stop design. The minimum desired cooling infrastructure at transit stops include a bench and shade provided by a shade structure or tree. On streets with lower traffic volumes, cool paving may be considered. Transit stops sited in locations with ample space or that serve higher volumes of riders or act as a hub for multiple service providers may be designed to include a wider range of cooling amenities, as shown in Figure 19, such as drinking fountains, bike racks, bike share, e-charging for scooters, bikes, or electric vehicles. Transit operators, including Metro, have established design standards that should be consulted when designing a transit stop.

Between the Curbs

USE OF SPACE

As shown in Figure 16, this zone of the street may contain:

- Vehicle Zone: Vehicle lanes, transit lanes, bike facilities, or medians.
- Access Zone: On-street parking or bus bulbs.

The amount of space allocated for each of these uses will vary from street to street. Within these zones, three main types of design treatments present opportunities to incorporate cool tools: Vehicle Lanes, Traffic Calming Treatments and Bicycle Facilities.

Vehicle Zone: Cool Paving & Permeable Paving

Cool paving and permeable paving are the two types of cool tools that can be applied without altering how space is used. The full range of cool paving types can be applied to vehicle lanes. Concrete is recommended for high volume roadways, while lower volume roadways, like residential streets, are good candidates for seal coat, cool coat, and overlay cool paving treatments. Consult the Cool Paving + Hardscape section of this document for additional details and design consideration. Permeable paving may also be appropriate to use in parking lanes or in bike facilities.

Traffic Calming Treatments

CURB EXTENSIONS: These treatments extend the curb into the street, so the distance to cross is shorter and people are more visible to drivers. They also narrow the street, which helps to reduce vehicle speeds.

Curb extensions can incorporate:

- Green Infrastructure: Flow-through planters, rain gardens or bioswales.
- Cooling Amenities: benches, bike racks, or EV charging stations.

MEDIANS : Medians are typically installed when a continuous center turn lane is not needed. In addition to calming traffic and presenting an opportunity to incorporate cool tools, medians can help reduce crossing distances at crosswalks.

Medians can incorporate:

- Street Trees: continuous parkway, tree wells.
- Green Infrastructure: Shrubs and understory planting, bioswales, rain gardens, flow-through planters.
- Shade Structures: sometimes medians may function as wide linear parks, which may include shade structures

CHICANES: Chicaines, as shown in Figure 20, are a series of raised or delineated curb extensions, edge islands, or parking bays on alternating sides of a street which reduce vehicle speeds.

Chicaines can incorporate:

- Street Trees: Treelets, tree wells.
- Green Infrastructure: Flow-through planters, or rain gardens.

MINI-ROUNDABOUT/TRAFFIC CIRCLE: Traffic circles are raised or delineated islands placed at intersections that reduce vehicle speeds by narrowing turning radii and the travel lane. Smaller scale traffic circles are called min-roundabouts.

This treatment can incorporate:

- Street Trees: Tree wells.
- Green infrastructure: Shrubs and understory planting, rain garden, flow-through planters, and permeable paving.

Bicycle Facilities:

Bicycle facilities in California are classified into four different categories. There are three main types of bike facilities that can incorporate the widest range of cool tools: Separated Bike Facilities (Class I and IV) and Bicycle Boulevards (Class III). Standard Bike Lanes (Class II) provide more limited cool tool application possibilities.

SEPARATED BIKE FACILITIES: CLASS I SHARED-USE PATH:

These bike facilities are off-street, completely separate from the roadway and may be used by both people walking and biking. In some cases they may replace a standard sidewalk in the public right of way along a street. Some facilities allow people walking and biking to use the same path, while others separate users. This user separation can be delineated by a paving change, curb, or planted area that can incorporate trees or green infrastructure.

Class I Shared Use Path may include:

- Street Trees: Continuous parkway, tree wells, or suspended pavement.
- Green Infrastructure: Shrubs and understory planting, rain garden, flow-through planters, and permeable paving.
- Shade Structures: Freestanding or building supported.
- Cool Paving: The surface of the shared-use path may be concrete.
- Cooling Amenities: Benches, bike racks, hydration stations.

SEPARATED BIKE FACILITIES: CLASS IV SEPARATED BIKEWAY

This on-street bike lane is physically separated from motor vehicle traffic through bollards, planters, or other vertical delineation that can include trees and planted areas.

This facility type can include:

- Street Trees: Tree wells, continuous parkway, or suspended pavement can all be incorporated into the buffer between this facility and moving vehicles.
- Green Infrastructure: Shrubs and understory planting, rain garden, flow-through planters, and permeable paving.
- Cool Paving: The surface of the shared-use path may be concrete.

Refer to Figure 21 for additional treatment ideas that incorporate cool tools.

CLASS III BIKE LANE/BICYCLE BOULEVARD

These are designated routes on streets, marked at minimum through signage that often include "sharrow" markings, that people riding bikes share with vehicles. Cool paving treatments may be used on the shared roadway surface.

Class III facilities are designed to incorporate traffic calming facilities, such as curb extensions, chicanes, and mini roundabouts. Refer to the Traffic Calming descriptions on page 85 for additional details about which cool tools are most applicable, and refer to Figure 20 for additional treatment ideas that incorporate cool tools on Bicycle boulevards.

CLASS II BIKE LANE

These are on-street, striped lanes that are typically adjacent to vehicle traffic traveling in the same direction. Sometimes they may include an additional buffer between either the bike lane and the travel lane, or the bike lane and the parking lane (or both). Bike lanes may include:

- Green Infrastructure: if buffered areas are wide enough, shrubs and understory planting or flow-through planters, or permeable paving may be used.
- Cool Paving: all types may be used.

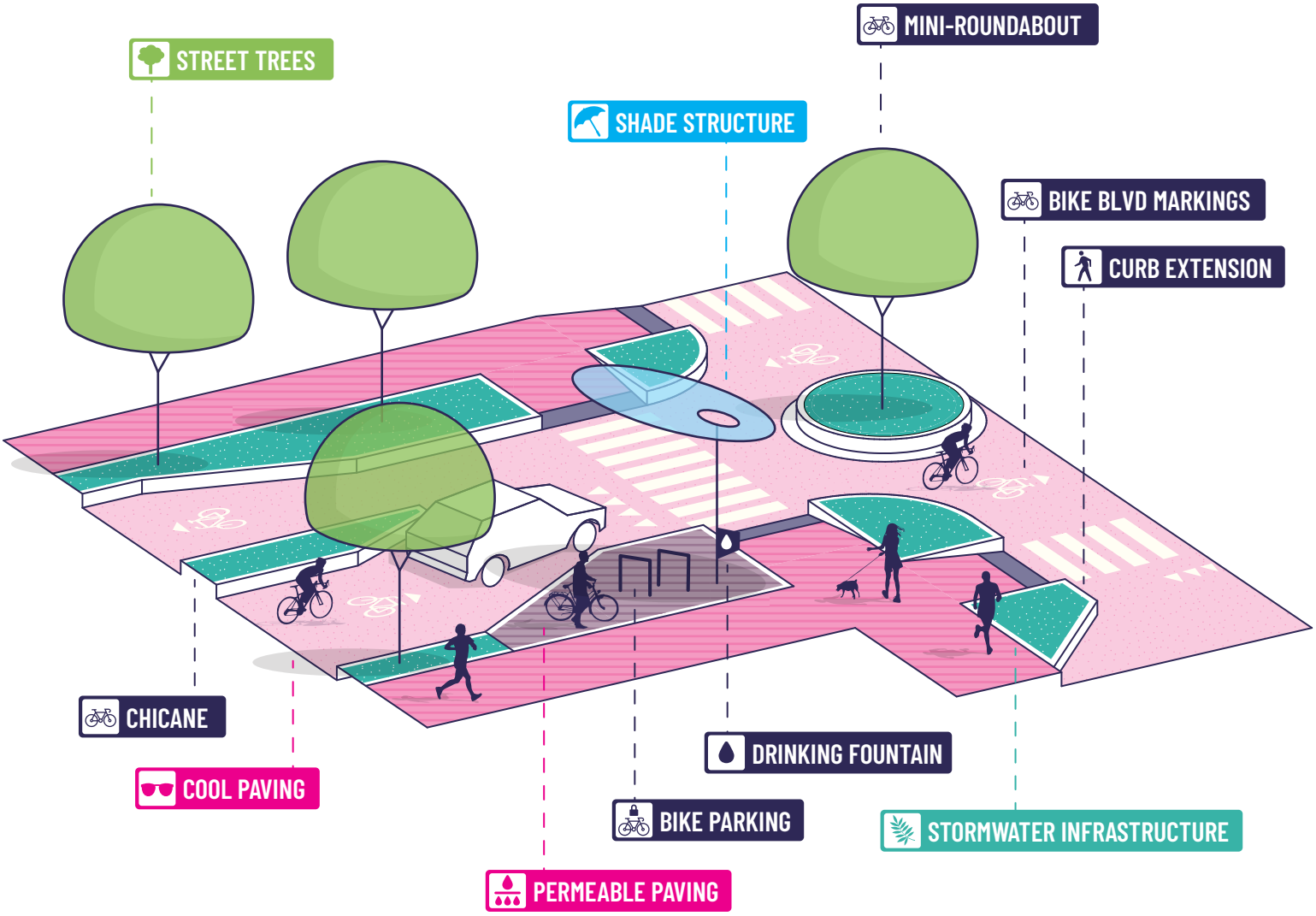


Figure 20. Bike-focused cooling strategies along bicycle boulevards

BETWEEN THE CURBS: BICYCLE BOULEVARD + TRAFFIC CALMING

Bicycle Boulevards are a type of Class III bikeway, as shown in Figure 20, which often include traffic calming features like curb extensions, chicanes, or mini-roundabouts—all of which present opportunities to incorporate plantings and/or capture stormwater. Permeable paving or "green gutters" can work well in parking lanes, and because streets with bicycle boulevards often have lower traffic volumes, cool paving can be considered for the roadway surface.

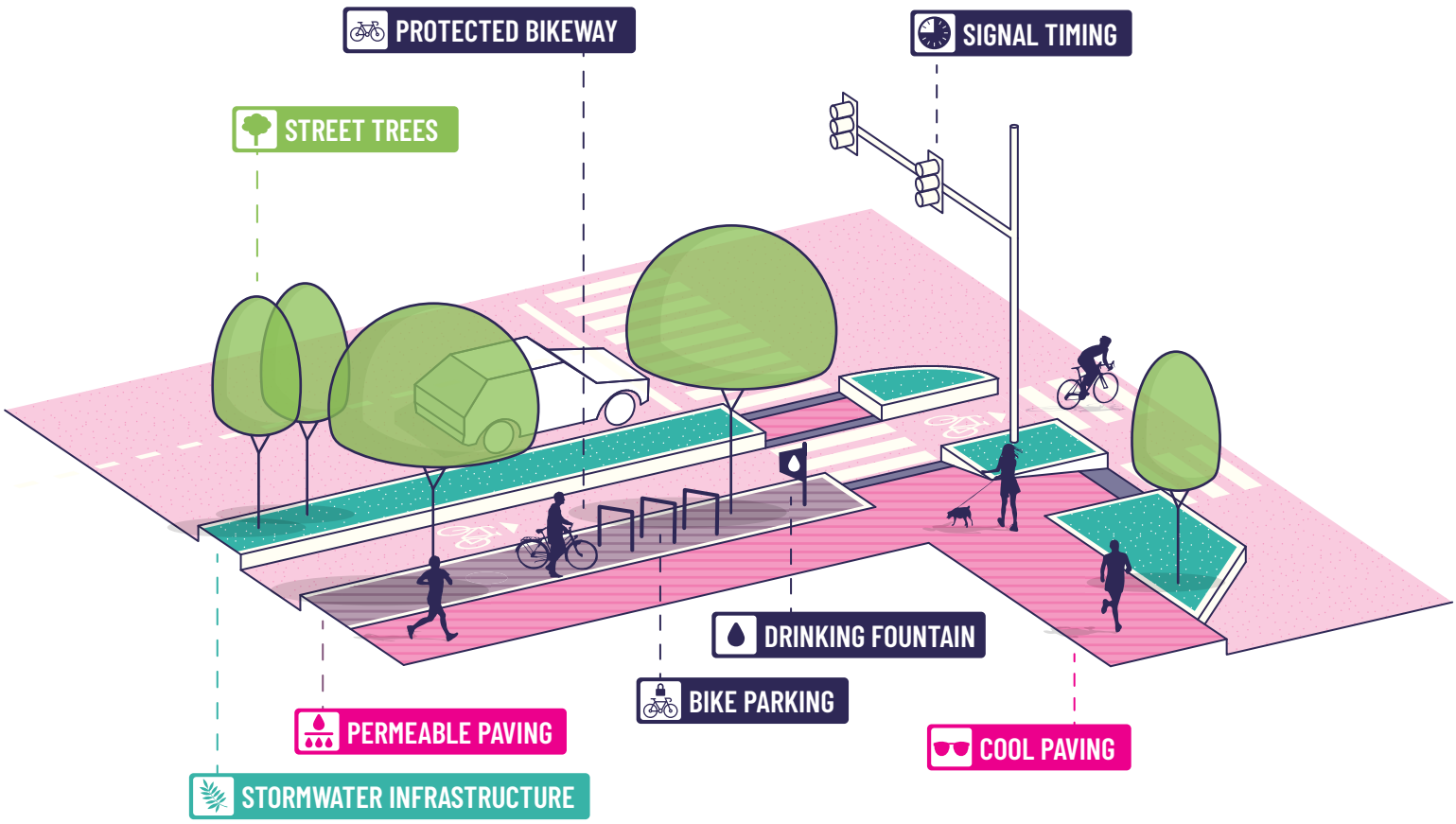


Figure 21. Bike-focused cooling strategies are ample along Class IV Separated Bikeways

BETWEEN THE CURBS: SEPARATED BIKE FACILITY

There are a wide range of bicycle facility types, each of which presents opportunities to incorporate cooling strategies. On city streets, Class IV separated bikeways present one of the greatest opportunities to increase cooling by incorporating trees, planting, or stormwater-receptive green infrastructure into the buffer zone the separates the bike facility from vehicles, as shown in Figure 21. Treatments like cool and permeable paving can be used in the bike lane or adjacent sidewalk areas.

Operational Changes

In addition to cool tools that provide direct cooling benefits, operational changes should be considered as another way to minimize heat exposure for those walking, biking, or waiting for transit and to increase the psychological tolerance of heat.

The following are examples of pedestrian-focused operational changes that reduce the amount of time pedestrians spend waiting to cross the street. These strategies should be used in conjunction with cooling strategies that limit exposure to sun and heat and improve the psychological tolerance of heat. These may be incorporated in addition to other cool tools, or in constrained conditions where it is infeasible to implement other cool tools that provide direct cooling benefits.

PEDESTRIAN SIGNAL INDICATORS

Demonstrate to pedestrians when to cross at a signalized crosswalk. Equip all traffic signals with pedestrian signals except where a pedestrian crossing is prohibited. Countdown pedestrian signals are particularly valuable for pedestrians, as they indicate whether a pedestrian has time to cross the street before the signal phase ends. Use countdown signals at all signalized intersections when possible.

SIGNAL TIMING

Keep Cycles Short: Keep signal cycle length low to reduce wait time and promote pedestrian and vehicle compliance.

Use Fixed Timing: Use pre-timed rather than actuated signals in an urban environment to create a predictable pedestrian intersection.

Prioritize pedestrians, transit, and bicycles: Signals set the tempo of the entire street. Transit signal priority is useful, as is bike-speed progression. But pedestrian safety and accessibility is the key priority.

Consider the use of a Leading Pedestrian Indication (LPI) to provide additional traffic protected crossing time to pedestrians: Pedestrian WALK signal is displayed 2-4 seconds before the vehicular green indication to allow pedestrians time to establish a presence in the intersection before vehicles start turning.

Consider exclusive pedestrian phasing: With an exclusive pedestrian phase, WALK signals are provided without green indications for any conflicting vehicle movements. Scramble pedestrian phasing is one type of exclusive phase during which pedestrians may walk in all directions, including diagonal. Exclusive pedestrian phasing and scramble pedestrian phasing should always include audible information, because pedestrians with vision impairments cannot rely on the sound of vehicular traffic to identify the start of the WALK phase.

Minimize the number of phases: Like the cycle length, the number of phases will influence strongly the rate of compliance by pedestrians, bicyclists, and drivers.

BICYCLE SIGNALS

Bicycle signals can facilitate safer and more convenient bicyclist crossings at intersections along Class I, IV, or II facilities by providing a bicycle signal phase, which minimizes bicycle-vehicle conflicts.

An intersection with bicycle signals may reduce heat stress and delays for a crossing bicyclist, and discourage illegal and unsafe crossing maneuvers. Bicyclists typically need more time to travel through an intersection than motor vehicles. Green light times for bicycle signals should be determined using the bicycle crossing time for standing bicycles.

Further, push buttons, signage, and pavement markings may be used to highlight these facilities for both bicyclists and motorists. At unsignalized intersection crossings flashing amber warning beacons and signals, such as Pedestrian Hybrid Beacon or Toucan signals, are often used to assist bicyclists crossing.

Determining which type of signal or beacon to use depends on vehicle speed limits, vehicle traffic volumes, anticipated bicycle crossing traffic, and the configuration of planned or existing bicycle facilities.

Traffic signal detection should be provided with sensors that are smart enough to distinguish bicycles from vehicles, so that green times can be extended for safe passage of bicycles when they are present and green time can be reallocated to more congested approaches when they are not present. Detection with sensors that distinguish bicycles from vehicles can alert the signal controller of bicyclists waiting to cross the street.

Supplemental bike indicators are available to communicate to waiting bicyclists that the signal knows they are waiting on red, and a green light will be provided long enough to safely clear them. A supplemental pavement marking may be used to instruct bicyclists where to position themselves to trigger the signal, although this is not necessary with video detection. For non-video detection the type of detection must be adjusted for bicycle metallic mass, and non-metallic bikes are not detected.

All existing and new traffic signals should be timed for bicyclist speeds so that people on bikes can clear the intersection before the next signal phase begins, which minimizes vehicle bicycle conflicts.

BUS ONLY LANES

Dedicated bus lanes are exclusive lanes allowing transit use only during all times of day. Dedicated lanes improve reliability and reduce travel time by providing separated space for buses, allowing free flow through otherwise congested traffic conditions

Key Features

- All-day separation from mixed through traffic (physical barriers or pavement markings).
- May require or be accompanied by dedicated signal(s)/phases.

BUS BOARDING ISLANDS/CURB EXTENSIONS

Also known as “bus bulbs,” these sidewalk curb extensions provide a larger passenger waiting area and allow buses to stop in lane. They help minimize bus delay, reducing time spent waiting for gaps in traffic to re-enter the travel lane. Curb extensions provide other benefits, as well: they can improve pedestrian safety by shortening crossing distance at intersections, and minimize parking removal by reducing the transition area needed for a bus to reach the curb.

BIKE-SUPPORTIVE BUS DESIGN

Dedicated bike lanes running on the left side of one-way streets can minimize or eliminate bus/bike conflicts for right-side boarding buses, improving safety and allowing for more efficient transit operation.

Dedicated bike signal phasing near a transit stop – or at intersections where the bus turns – can improve multi -modal integration and reduce conflicts by clarifying the interaction among bicycle riders, pedestrians, and transit vehicles and users.

Bikes behind stations, often called “island” stations, are side-boarding bus platforms which feature a channelized bike “wrap-around” behind the station area. This allows for continuous bicycle separation from general traffic and transitways, minimizing conflicts between buses, passengers, and bicycles at stations.

FAR-SIDE BUS STOP PLACEMENT

In general, buses move more efficiently through signalized intersections when a stop is placed on the far side of the intersection. This enables the bus to clear an intersection before stopping, minimizing delay at traffic signals. In addition, it allows the bus to pull back into the travel lane by moving into the gap created by a signal phase. Bus stops can occupy less space since the transition to curbside is partially accommodated within the intersection. In addition to minimizing transit delay, far-side stops minimize conflicts with right-turning vehicles and can make pedestrians safer, since pedestrians are crossing behind the bus (rather than in front of it) and are visible to other roadway users.

BUS STOP CONSOLIDATION

Consolidating stops can improve bus travel time by reducing delay associated with deceleration to, acceleration from, and dwell time at bus stops.

Key Features

• Creating “super stops” at major transfer points can provide rider amenities in addition to improving bus travel time.

• Consolidating stops and removing underutilized stops requires public outreach and education.

• Different types of service (e.g. local, limited, express) can exist in the same corridor, utilizing a different subset of stops.

Alleys or Paseos

USE OF SPACE

Alleys or paseos are narrow paths or passageways that are often reserved for the use of pedestrians. Some alleys are also accessible to vehicles in addition to pedestrians, providing either emergency vehicle access, or passage to "back of house" uses like garage entry or trash and recycling areas. These spaces offer a potential cooling location for pedestrians, and a way to access various points of interest without having to walk along a busy roadway.

The types of cool tools that can be applied to alleys or paseos depends upon if vehicles use the space. If an alley is used for emergency vehicle access or personal vehicles, the appropriate amount of space will need to be left clear of obstacles. This limits the types of cool tools that can be applied due to space constraints. If the alley is for exclusive use by pedestrians, the clear space required for the walk zone will be narrower than vehicle widths.

Alleys that have existing freestanding structures, like fences or privacy walls, could include a wider range of treatments. These structures could be used as supports for shade structures or shade sails, climbing vines, narrow planter boxes, or lighting. Including permeable paving, or cool paving, and planting areas are options for most alleyways and the adjacent sidewalk areas near the alley street entrance. Refer to Figure 22 for additional treatment ideas.

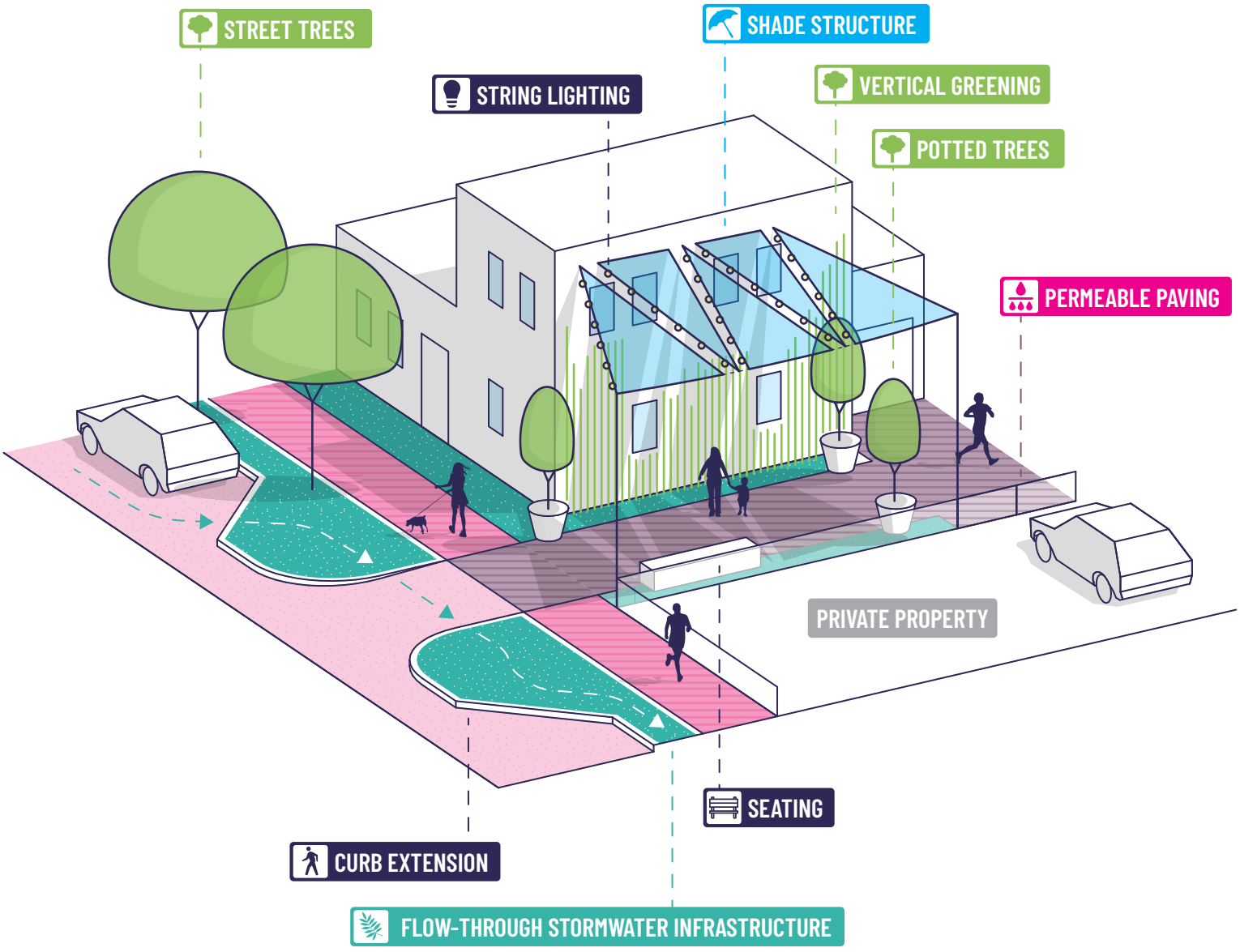


Figure 22. Pedestrian-focused cooling strategies along alleyways/paseos

ALLEYWAYS/PASEOS

Alleyways throughout the city are variable: some are pedestrian only routes, and others are used by vehicles as well as pedestrians and bikes. Pedestrian safety enhancements, like curb extensions, create space for green infrastructure, as shown in Figure 22. The context of each alley is unique, consult the Cool Tools section of this document and the Cool Tools Matrix for ideas to integrate green infrastructure and paving treatments, like cool or permeable paving, into alleyways.

Some bus stops along Long Beach Blvd have shade structures and seating.

CHAPTER 5

Implementation & Funding

Putting Community Priorities into Action

Feedback from community workshops and the online survey indicated strong support for implementing the cool tools and cooling strategies in the Washington Neighborhood Study Area, as described in Chapter 2.

There are a wide range of ways that the cool tools can be applied in the right-of-way. Below are three examples of how the tools can be integrated into commercial corridors, residential streets, and within alleyways of the Washington Neighborhood Study Area.

Commercial Corridors:

Anaheim Street was identified as one of the hottest and most uncomfortable streets by community members. Anaheim Street is a commercial corridor with bus service and planned bike facilities. Without altering the roadway, cooling gains can be accomplished through widening tree wells and adding street trees, and adding transit shelters. To make more significant cooling gains, a wide range of design treatments can be considered. This corridor, and others like it, such as Long Beach Blvd, Pacific Avenue, and Pacific Coast Highway are strong candidates for competitive grant funding to fully explore the range of cool strategies that are appropriate for this context. The photosimulation in Figure 23 shows how Anaheim Street may be re-imagined as a cool street.

Most of the restaurants and retail on Anaheim Street have their own parking lots. Therefore, it would be possible to remove parking to accomodate one-way protected bikeways, as shown in the rendering. It may be feasible to have parking on one side of the street to create a 2-way separated bikeway on one side of the street. Other improvements could include:

- Bioswale separated bikeway buffers.
- Stormwater infrastructure in the access or amenity zone.
- Building-supported shade structures along existing commercial frontages.

As noted in the Cool Tools chapter, each tool provides varying levels of cooling benefits therefore a more detailed study of the specific location and associated community and cooling needs would need to be completed.

Figure 23. Pedestrian and bicycle-focused cooling strategies along the sidewalks and within the roadway of Anaheim Street, between Pacific Avenue and Pine Avenue.

Local Roads:

Pine Avenue was identified as another hot and uncomfortable street by community members. Pine Avenue is a typical Washington Neighborhood Study Area residential corridor, running north and south. Pine Avenue has a proposed bikeway (Bike Blvd/Class III). While prioritizing the existing bikeway, cooling gains can be made through flow-through stormwater infrastructure curb extensions at intersections and cool paving. To make more significant cooling gains, a wide range of design treatments can be considered including adding street trees within existing planting strips. This corridor, and others like it, such as Locust Avenue and Cedar Avenue, are strong candidates for competitive grant funding to fully explore the range of cool strategies that are appropriate for this context. The photosimulation in Figure 24 shows how Pine Avenue may be re-imagined as a cool street.

Most of Pine Avenue has 6-8'' of planting/amenity space allowing plenty of space for added street trees and possible green infrastructure. Other improvements could include:

- Mini-Roundabouts at intersections for cooling benefits and traffic calming.
- Stormwater infrastructure in the access or amenity zone where space allows.
- Bikeway sharrow striping at intersections.

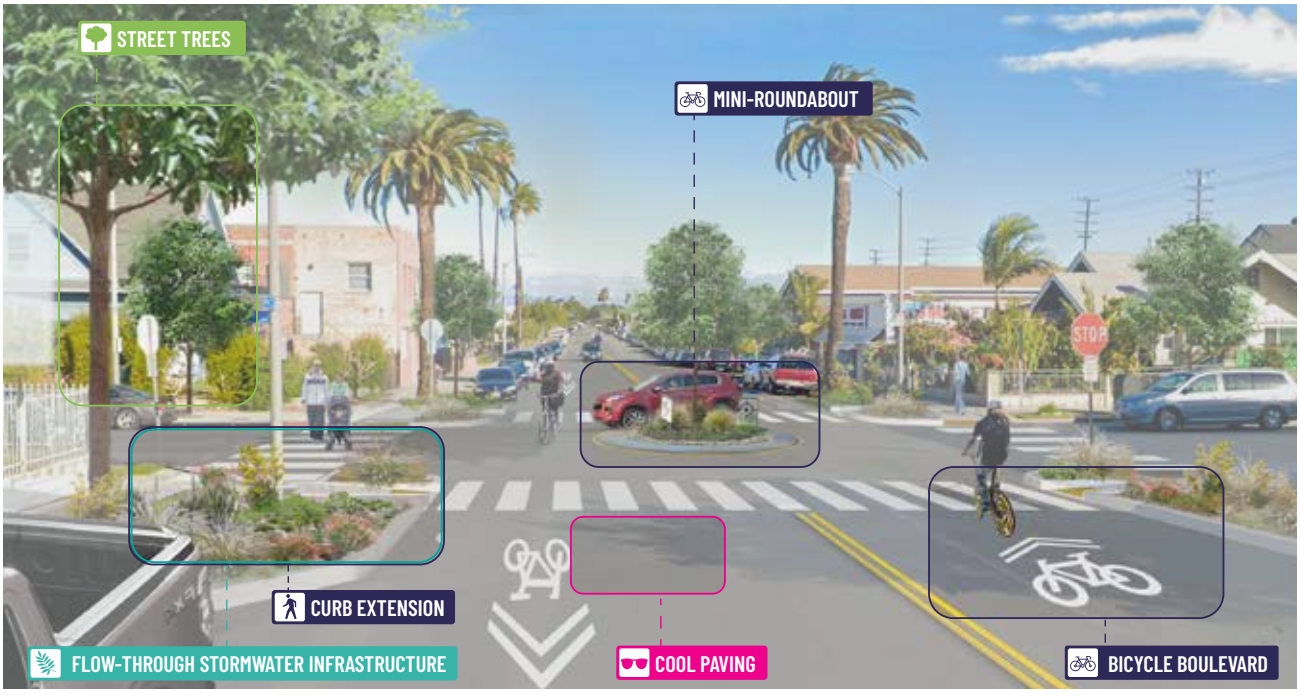


Figure 24. Bicycle and pedestrian-focused cooling strategies along Pine Avenue at 16th Street.

Alleys:

Residential alleyways were identified as an important outdoor space that could be more comfortable on hot days by the community. Alleyways are regular north to south corridors within the Washington Neighborhood Study Area's city grid, and present an ideal condition for cooling strategies. A centrally located alley, between Cedar Avenue and Chestnut Avenue, provides a protected space away from fast-moving vehicle traffic. While prioritizing the pedestrian experience, cooling gains can be made by providing freestanding shade sails and cool amenities such as vertical-growing vines. To make more significant cooling gains, and if existing structures and space allows, a wide range of design treatments can be considered including adding flow-through stormwater infrastructure on the street at the alley entrance and cool paving throughout the space. This alley, and others like it, like Tribune Court, and are strong candidates for competitive grant funding to fully explore the range of cool strategies that are appropriate for this context. The photosimulation in Figure 25 shows how a typical residential alleyway may be re-imagined as a cool alley.

Residential alleyways commonly provide enough space for multiple cooling strategies, with a focus on shade, either freestanding or utilizing existing structures like fences and privacy walls for building-supported shade structures. Other improvements could include:

- Cool paving throughout.
- Cool amenities including planter boxes for smaller vegetation and climbing vines.
- Street trees within existing planting strips at the alley entrances.

Figure 25. Improvements within the alleyway between Cedar Avenue and Chestnut Avenue.

Funding Opportunities

To fund the design and implementation of projects that will cool Long Beach's sidewalks, streets, and alleys, a variety of strategies should be applied. The cool tools and strategies included in this Plan include a wide range of multi-benefit elements spanning from active transportation, transit, landscape, stormwater management, and more. They may require multiple funding sources to ensure each recommended type of improvement can be built and maintained. Each cooling strategy project type noted below shares a construction cost range per mile; this, in conjunction with the unit costs included in Appendix D of this document, can be used to help estimate grant request amounts. In addition to construction costs, design and engineering support should be added at approximately 10% of the total construction cost.

The following benchmarks may be used to estimate cost per mile of cool project type:

Major Street: Class IV Separated Bikeway, Transit, and Green Infrastructure Enhancements:

Construction cost: $8-15M per mile

- Bioswales
- Street Trees + Suspended paving
- Shade structures
- Flow-through curb extensions

Major Street: Pedestrian, Transit, and Green Infrastructure Enhancements:

Construction cost: $8-12M per mile

- Street Trees
- Flow through curb extensions
- Planted Center Median with bioswales or rain gardens
- Shade structures
- Permeable Paving

Local Street: Bike and Pedestrian Enhancements

Construction cost: $0.75-2M per mile

- Street Trees
- Cool Paving
- Traffic Calming with Green Infrastructure

Alley: Pedestrian and Green Infrastructure Enhancements

Construction cost: $0.5-2M per mile

- Cool Paving
- Vertical Greening
- Flow-through curb extensions
- Street Furnishings

CONTINUED COMMUNITY INVOLVEMENT

The design concepts presented in this Study involve substantial changes to existing conditions including closing streets to vehicular traffic, altering the design of neighborhood roadways, and planting new trees and vegetation. Transformative projects of this scale require thorough, sustained community involvement in the planning process. If the City secures funding for detailed design and implementation of these or similar concepts, additional public outreach will be conducted to ensure the community has opportunities to review and further refine specific project elements, and to ensure that the project addresses the needs and desires of the community.

HARNESS CITY INTERNAL RESOURCES

Capital Improvement Program

Funding cooling projects via the City's CIP process provides the greatest flexibility. Unlike externally managed grant funds, there are no ineligible expenses. Balancing CIP funds with external grant funds can be a great way to cover project costs that may be ineligible under some funding programs. For example, if the City receives a grant through a transportation funding source to install a separated bikeway, the City's CIP budget could be used to pay for cool tools or cooling amenities that are not permitted under that funding source.

Roadway Resurfacing, Utility Repair, and Sidewalk Replacement

Digging up the street for underground utility repair, resurfacing the roadway, and replacing sidewalks are major opportunities to incorporate green infrastructure and cool tools into the public right of way. Green infrastructure treatments that capture and treat stormwater often require the roadway surface to be re-graded and often also require subgrade excavation for treatments.

EXTERNAL GRANT FUNDS

Storytelling

Grantmaking agencies review large volumes of funding requests. Storytelling, making the case for why a project is the most deserving, is one strategy to make an application stand out among other submissions. Centering storytelling around urban cooling in a grant narrative can be a great way to illustrate the broad range of ways a project will have a positive impact on the community and can make a funding request more competitive.

Coordinate across departments on grant requests

The "best fit" funding sources for cooling strategies are highlighted in this document. Different departments within the City are responsible for crafting and submitting these funding requests. Annual grant planning meetings may be helpful to ensure that cooling strategies are being incorporated wherever feasible into external grant requests.

Seek funds from multiple sources

The "best fit" funding sources the City will explore are listed in this section; a full list of additional funding sources can be found in the Appendix. The descriptions are intended to provide an overview of available options and do not represent a comprehensive list. Each of these funding sources can be leveraged against others. It is important to note that many traditional Active Transportation funding streams, like the Caltrans ATP program, do allow trees and plantings as allowable expenses. Similarly, green infrastructure-focused funding programs like Urban Greening or Green Infrastructure grants from the CNRA sometimes allow transportation-associated costs (like bike and pedestrian facilities).

Maintenance

Any funding requests should, if possible, include a commitment to maintain the facilities. Not all funding streams include maintenance as an allowable expense, Measure W funding is one notable exception.

The following funding programs are the best fit to design and implement cooling project. Additional funding sources can be found in the appendix of this document.

SECURE FUNDING

The urban cooling strategies presented in this Study call for improvements related to transportation, landscape, water management, and more, and may require multiple funding sources to ensure each recommended type of improvement can be built and maintained. Throughout this Study, community members expressed support for the designs presented, but a desire that the City commit to regular maintenance. Therefore, any funding requests should include a commitment to maintain the facilities, if allowable.

The "best fit" funding sources the City can explore are listed in this section; a full list of additional funding sources can be found in the Appendix. The descriptions are intended to provide an overview of available options and do not represent a comprehensive list. This section reflects the funding available at the time of writing. The funding amounts, fund cycles, and even the programs themselves are susceptible to change without notice.

SAFE AND CLEAN WATER PROGRAM: MEASURE W

Approved by Los Angeles County voters in 2018, The Safe and Clean Water Program which generates up to $285 million per year from a special parcel tax of 2.5 cents a square foot of "impermeable space" will help cities around the county meet their obligations under the federal Clean Water Act. This program funds projects and programs that focus on stormwater and water quality benefits. Eligible project types that can be supported through this funding stream include feasibility studies, pilot projects, detailed design and construction, and ongoing operations and maintenance costs.

CNRA URBAN GREENING & GREEN INFRASTRUCTURE GRANTS (CNRA)

The California Natural Resource Agency (CNRA) appropriated $18.5 million for competitive grants for multi-benefit green infrastructure investments in or benefiting disadvantaged communities. Applicants can be awarded between $50,000-$3 million. Applicants must show that their projects will achieve measurable benefits by, acquiring, creating, enhancing or expanding community parks and green spaces or use natural systems, or systems that mimic natural systems to achieve multiple benefits to create sustainable and vibrant communities.

CALTRANS' ACTIVE TRANSPORTATION PROGRAM

The California State Legislature created the Active Transportation Program to encourage active modes of transportation. Senate Bill 1 (SB 1) stipulates that $100,000,000 of revenues from the Road Maintenance and Rehabilitation Account will be available annually to the ATP. The ATP consolidates existing federal and state transportation programs, including the Transportation Alternatives Program (TAP), Bicycle Transportation Account (BTA), and State Safe Routes to School (SR2S), into a single program with a focus to make California a national leader in active transportation. Applications are to be submitted typically in July.

CONGESTION MITIGATION AND AIR QUALITY IMPROVEMENT PROGRAM (CMAQ)

CMAQ provides funding to state and local agencies for transportation projects that help meet Clean Air Act objectives. Funded projects must work to reduce congestion and improve area quality in nonattainment or maintenance zones for ozone, carbon monoxide or particulate matter. CMAQ funds can be used for bicycle and pedestrian projects that are included in the metropolitan planning organization (MPO) current transportation plan and transportation improvement program (TIP). Projects can include bicycle and pedestrian facilities that are not exclusively recreational and for outreach related to safe bicycle use. Studies that are part of the project development pipeline (e.g., preliminary engineering) are also eligible for funding. Approximately $138.5 million is available in Los Angeles County for fiscal years 2016 to 2020. LA Metro offers CMAQ funding to other agencies through the Metro Call for Projects or other Metro Board action.

FULL LIST OF FUNDING SOURCES

Below is a complete list of available funding sources. Reference Appendix C: Potential Funding Sources for additional details.

FEDERAL FUNDING SOURCES

- Federal Highway Administration Fixing America's Surface Transportation Act (FAST Act)
- Federal Highway Administration Surface Transportation Block Grant
- Federal Highway Administration Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Federal Transit Administration Bus and Bus Facilities Program
- Our Town (National Endowment for the Arts)
- Federal Transit Administration Urbanized Area Formula Program
- Federal Highway Administration The Better Utilization Investments to Leverage Development Discretionary Grant (BUILD)
- Environmental Protection Agency Brownfield Assessment Grant Program
- Federal Highway Administration Highway Safety Improvement Program (HSIP)

STATE FUNDING SOURCES

- Caltrans Active Transportation Program (ATP)
- Caltrans Sustainable Transportation Planning Grant Program
- California Natural Resource Agency Environmental Enhancement and Mitigation Funds
- California Natural Resource Agency Urban Greening Grant Program
- California Natural Resource Agency Green Infrastructure Program
- California Department of Parks and Recreation Regional Park Program
- California Department of Parks and Recreation Statewide Park Development and community Revitalization Program
- California Department of Resources Recycling and Recovery Rubberized Pavement Grant Program
- California Strategic Growth Council Transformative Climate Communities Program
- California Strategic Growth Council Affordable Housing and Sustainable Communities
- California Strategic Growth Council Sustainable Communities Program
- Caltrans State Transportation Improvement Program

- California Department of Parks and Recreation Habitat Conservation Fund – Trails
- Coastal Conservancy Proposition 1 Grant
- California Transportation Commission Local Partnership Program
- Caltrans Transportation Development Act
- California Resilience Challenge

PRIVATE FUNDING SOURCES

- Conservation Fund- The KODAK American Greenways Program
- PeopleForBikes Community Grant Program
- Robert Wood Johnson Foundation
- The Kresge Foundation
- The Bloomberg American Cities Initiative
- Bloomberg Philanthropies Asphalt Art Initiative

Appendix A: Existing Conditions & Opportunities

Introduction

This appendix summarizes existing conditions findings and opportunities that informed the development of this Plan. This includes: a summary of the Built and Natural Environmental conditions and Mobility Assessment. This information was gathered through both a desktop assessment and through field visits.

Mobility Assessment

Understanding how people use the streets will help us identify the appropriate cooling strategies for the Washington Neighborhood. The streets in the study area are laid out in a grid, with narrow public alleyways running through most blocks. The study area is bounded by major streets (Pacific Coast Highway, Long Beach Blvd, Anaheim St, and Magnolia St) and bisected by a major street (Pacific Ave).

All of the streets in the study area have sidewalks on both sides of the street, but not all sidewalks are accessible. For example, on Pacific Coast Highway, sidewalks are as narrow as 4ft with no buffer space from the roadway or from building facades, and are frequently blocked by utility poles.

Map 6 shows the transit stops and existing and planned bicycle facilities in the Washington Neighborhood. There are currently no painted bike lanes, physically separated bike lanes, or shared use paths in the study area. Pacific Coast Highway, a seven-lane roadway with over 30,000 ADT, is designated as a Class III bicycle route. Pacific Ave, a five-lane roadway with an ADT of 12,000, is designated a Class III bicycle route with sharrows and is planned to receive an upgrade to a protected bike lane. Class II bike lanes are planned for Anaheim St and Long Beach Blvd. Class III bicycle boulevards are planned for 14th S, Pine Ave, Magnolia Ave, as well as Cowles St and Chestnut Ave near Seaside Park.

Map 6.

MULTIMODAL TRANSPORTATION NETWORK

PROPOSED BIKEWAYS

- Class II Bike Lane
- Class III Bike Boulevards/Routes
- To Be Determined

EXISTING BIKEWAYS

- Class II Bike Lane
- Class III Bike Boulevards/Routes

- Transit Stops
- Study Area

COMMUNITY DESTINATIONS

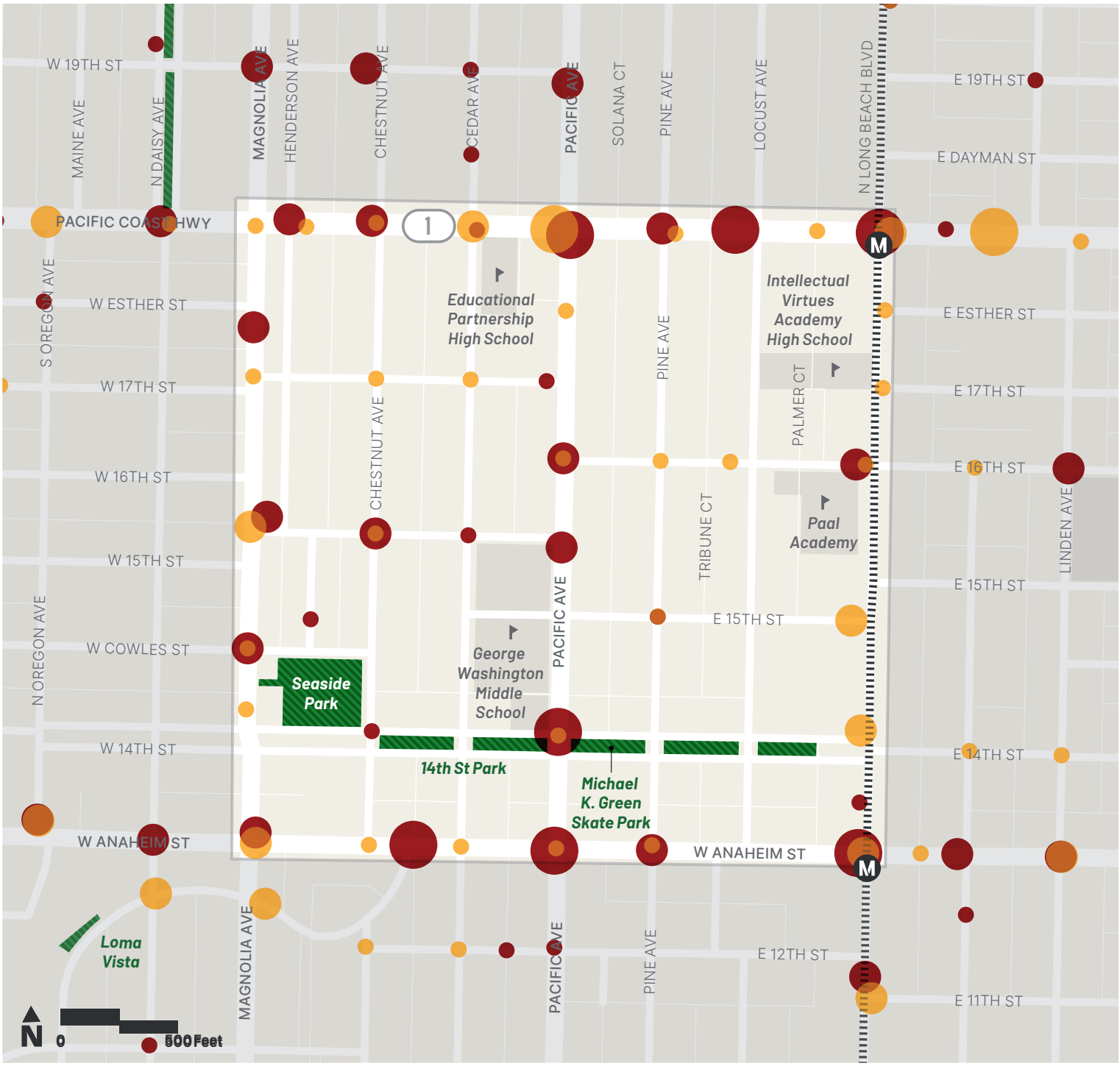
- Schools
- School Grounds
- Parks
- Metro Blue Line and Stations

Buses run along the major streets. Ten of the 37 bus stops in the study area have shelters. The A-line light rail runs along Long Beach Blvd, with a station south of Pacific Coast Highway.

To access transit stops and most community destinations in the study area, people walking and biking must move along or across the streets with the highest traffic volumes, highest speeds, and highest number of lanes. Anaheim Street, Pacific Avenue, and Pacific Coast Highway in the Washington neighborhood are listed as high-injury corridors in the 2020 Safe Streets Long Beach Action Plan.

Map 7 shows the locations of the 131 vehicle collisions with people walking and bicycling that occurred in the study area from 2015-2019. 81 collisions involved people walking and 50 involved people bicycling.

While major streets make up 37% of the roadway miles in the study area, they account for 90% of the collisions. 118 collisions occurred on or at intersections with the major streets in the study area. Pacific Coast Highway is the most dangerous street in the study area for people walking and biking; it makes up only 7% of the roadway miles while accounting for 26% of the collisions. Anaheim St and Pacific Ave tie for second-most dangerous, each accounting for 20% of the collisions.



Map 7.

COLLISIONS

BICYCLE/VEHICLE COLLISIONS
WITHIN 100 FT

- 1
- 2 - 4
- 5

PEDESTRIAN/VEHICLE COLLISIONS
WITHIN 100FT

- 1
- 2 - 4
- 5 - 8

COMMUNITY DESTINATIONS

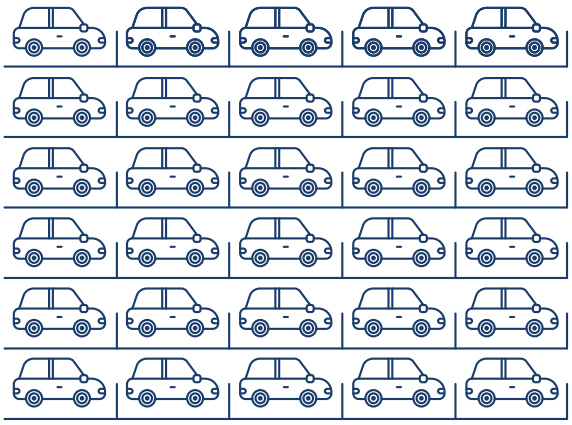
- Schools
- School Grounds
- Parks
- Metro Blue Line and Stations
- Study Area

Built + Natural Environment Conditions

EXISTING COOLING ELEMENTS

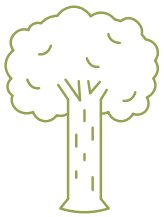
Public space in the study area largely prioritizes the movement and storage of vehicles, and parking is perceived to be in high demand. There are approximately 2,500 on-street parking spaces in the public right-of-way (parking lots not included), meaning that there is about one on-street parking space available per household in the area. There are 768 trees in the public right-of-way, meaning parking spaces outnumber trees by more than 3 to 1. There are 80 high-quality shade trees in the study area, for a ratio of parking spaces to high quality trees of more than 30 to 1.

The existing tree canopy along major streets is sparse. 90% of the 80 high quality shade trees in the study area are located on minor streets where there are no bus stops and few community destinations.



30 PARKING SPACES

- to -

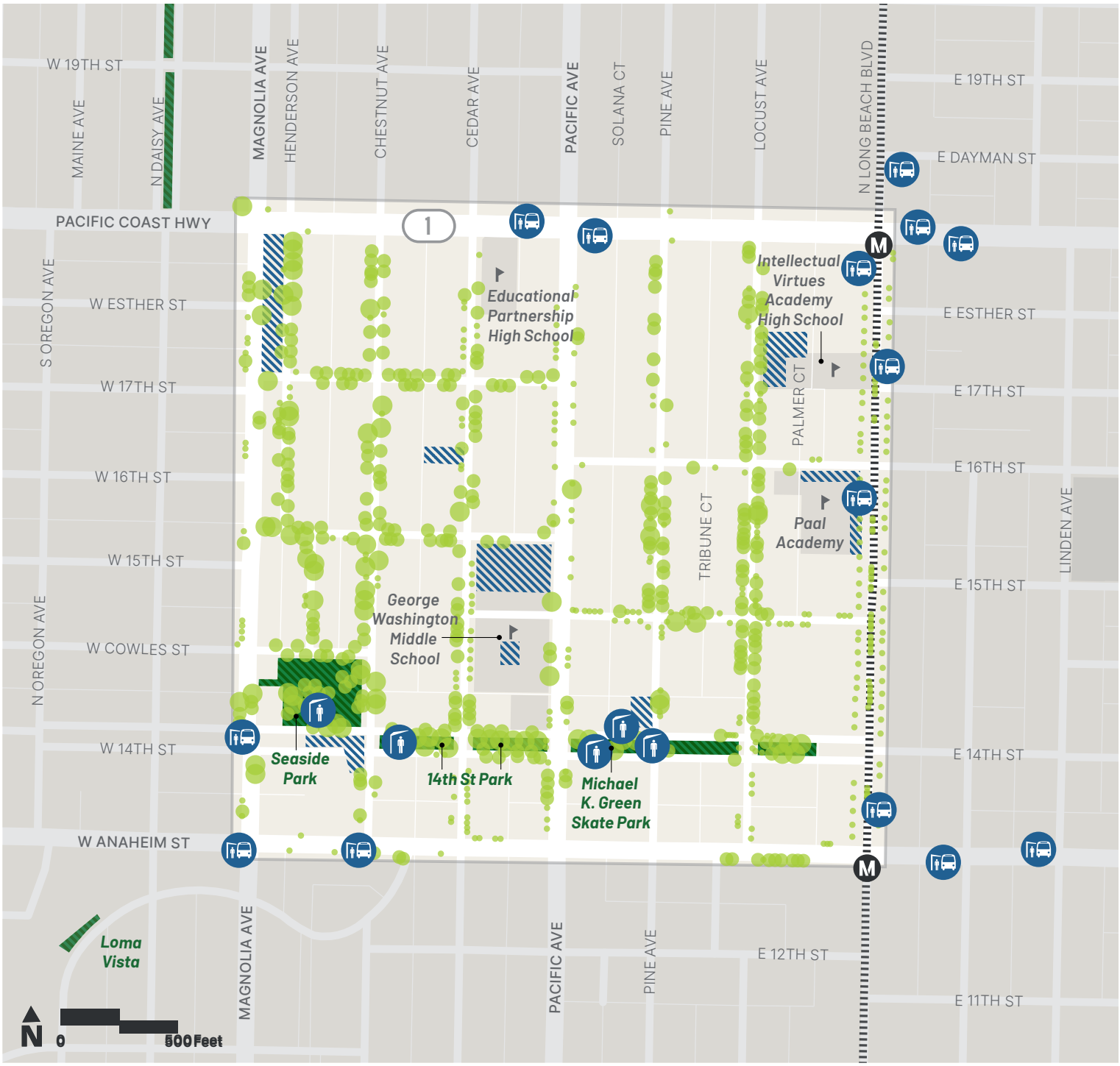


1 HIGH QUALITY TREE

Site visits confirmed that nearly all the trees along Long Beach Boulevard are Mexican Fan Palms (*Washingtonia robusta*), which provide minimal shade. Tree species within the residential area along 14th Street park include Indian Laurel Fig (*Ficus microcarpa*), Palo Verde (*Cercidium 'Desert Museum'*), and Jacaranda Tree (*Jacaranda mimosifolia*). Indian Laurel Fig provides high shade, Palo Verde provides light to medium shade, and Jacaranda Tree provides medium to high shade. Even with varying degrees of shade, each of these species provides significantly more shade than the Mexican Fan Palm. The Mexican Fan Palm, Jacaranda Tree and Palo verde are in the City of Long Beach's approved tree list.

Map 8 shows the elements that create a cooler environment for walking, biking, and waiting for transit, including the tree canopy, shade canopies, shelters, and unpaved spaces in the area. There are five shade canopies in the study area, one at Seaside Park, one at the playground on 14th St and Chestnut Ave, and three at the skate park on 14th St and Pacific Ave. The only free-standing shade structures on major streets are bus shelters. Only about a quarter of the 37 bus stops in the study area have shelters.

There are very few large unpaved spaces in the study area, and they are all bordered by fences. Except for Seaside Park, the 14th Street Linear Park, and a playing field at Washington Middle School, the large unpaved spaces are undeveloped private land.



Map 8.

EXISTING COOLING FACTORS

Shade Structures

Shaded Bus Stops

Semi-public Green Spaces

STREET TREES

- 5-10ft canopy
- 10-20ft canopy
- 20-45ft canopy

Study Area

COMMUNITY DESTINATIONS

Schools

School Grounds

Parks

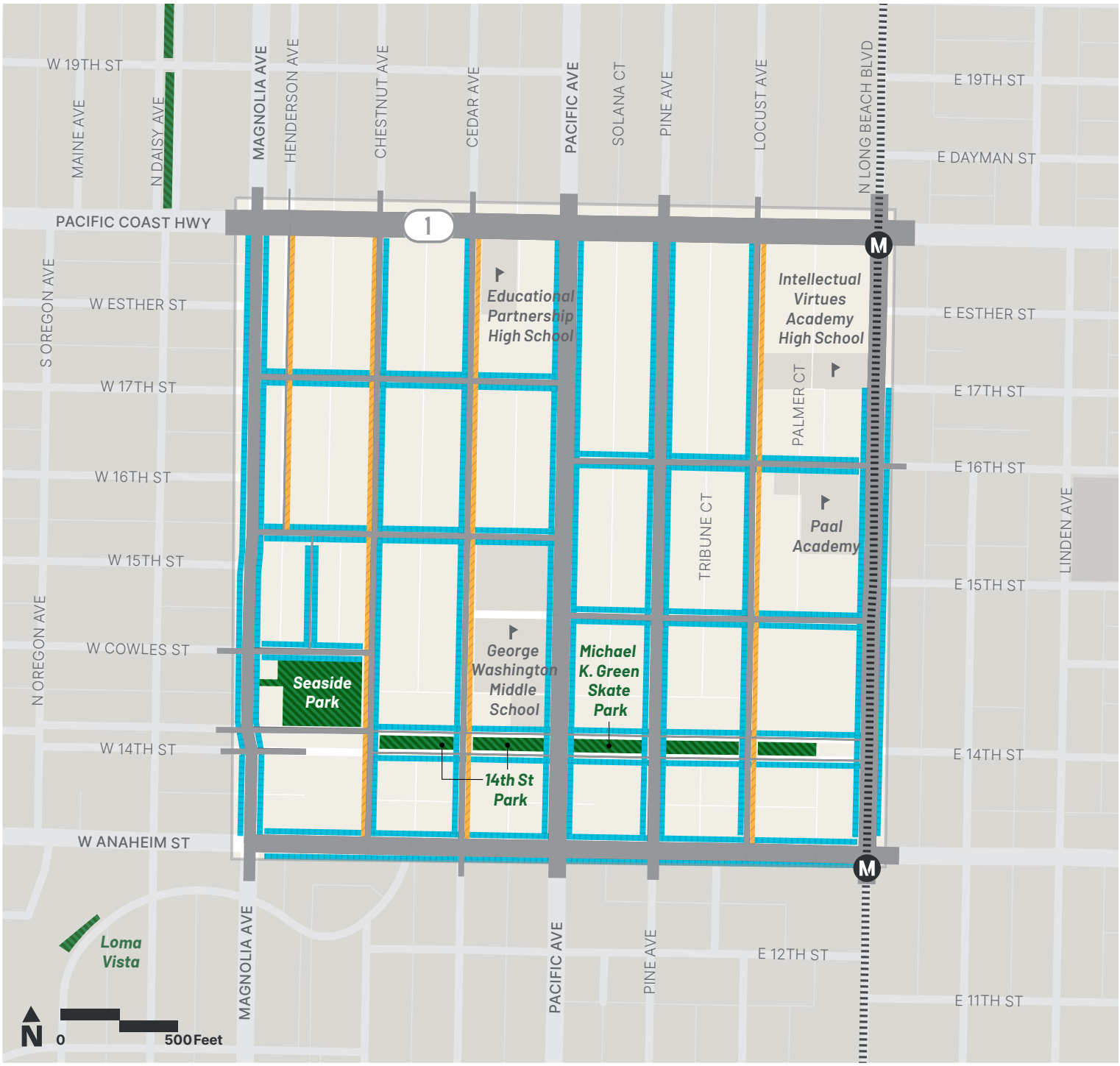
Metro Blue Line and Stations

Planting Opportunity Areas

There are many opportunities to create additional shaded areas by developing alternate roadway conditions. Map 9 shows the current number of parking and travel lanes on streets in the study area. Of the five major streets in the study area, Pacific Ave presents the most feasible opportunity for improving safety and comfort for people bicycling, walking, and accessing transit by reconfiguring parking.

Traffic volumes on this five-lane roadway are at 12,000 vehicles daily. FHWA identifies roadways between 10,000 and 15,000 ADT as likely to be good candidates for conversion to three lane roadways. Three-lane Magnolia Ave carries only 7,000 vehicles per day; converting the center turn-lane to a planted median could be a potential strategy for increasing green space without significantly impacting vehicle traffic. A center turn-lane to planted median conversion may similarly be possible on Pine Ave. Reconfiguring travel lanes on the remaining multi-lane roadways, Long Beach Blvd, Anaheim St, and Pacific Coast Highway, may be more difficult due to high traffic volumes, though on larger streets there is more pavement therefore a larger potential impact for shade without altering parking needs or roadway use needs.

Table 3 below summarizes potential strategies to expand on shaded areas with the right-of-way. This table represents a range of possible options, these are not definite solutions. Any potential changes would need to be weighed against community preferences, demand and value. Community members have expressed that parking is in short supply. The City will need to balance cooling strategies to make sure residents parking needs are appropriately considered. This study has identified candidate locations where parking reconfiguration is feasible however additional feasibility study and outreach should be conducted to determine appropriate locations and extents. Considering the high residential nature of this neighborhood the priority should be to utilize existing parkway space before considering any changes that would impact roadway reconfiguration. On streets that are really narrow, sometimes the only way to add shade is to expand the sidewalk space. In those cases you would need to have an engaged discussion with community members about trade-offs in regards to location specific priorities between providing additional shade and parking. The Cool Tools and Benefits chapter should be referenced for a range of options in constrained locations and for ideas about balancing the needs of the community and the City.



Map 9.

EXISTING ROADWAY CONFIGURATION

TRAVEL LANES

- 1
- 2
- 3
- 5
- 7

PARKING LANES

- Parallel Parking
- Angled Parking

- Study Area

COMMUNITY DESTINATIONS

- Schools
- School Grounds
- Parks
- Metro Blue Line and Stations

STREET	CURRENT CONFIGURATION	TRAVEL LANE	PARALLEL PARKING	ANGLED PARKING
14th St	One-way pair of residential streets with parallel parking		●	
15th St	Two-way residential street with parallel parking on both sides		●	
16th St	Two-way residential street with parallel parking on both sides		●	
17th St	Two-way residential street with parallel parking on both sides		●	
Anaheim St	Four travel lanes with center turn lane, some parallel parking on both sides (29,500 AADT)	●	●	
Cedar Ave	Two-way residential street with parallel parking on one side and angled parking on one side		●	●
Chestnut Ave	Two-way residential street with parallel parking on one side and angled parking on one side		●	●
Cowles St	Two-way residential street with parallel parking on both sides		●	●
Henderson Ave	One-way residential street with parallel parking on both sides (south of 15th St) and angled parking on one side (north of 15th St)		●	
Long Beach Blvd	Four travel lanes with turn lane at intersections, some parallel parking on both sides (18,100 AADT)	●	●	
Locust Ave	Two-way residential street with parallel parking on one side and angled parking on one side		●	●
Magnolia Ave	Two travel lanes with center turn lane, parallel parking on both sides (7,000 AADT)	●	●	
Pacific Av	Four travel lanes with center turn lane, parallel parking on both sides (11,800 AADT)	●	●	
Pacific Coast Hwy	Six travel lanes with center turn lane (32,500 AADT)	●		
Pine Ave	Two travel lanes with center turn lane, parallel parking on both sides	●	●	

Table 3. Candidate Shade Expansion Areas

When the current streetscape configuration does not have space for new trees or planting, another strategy that may be considered is reallocating parking or travel lanes.

To determine whether or not reallocating roadway space is the right fit, a more detailed traffic analysis or parking demand assessment would need to be completed.

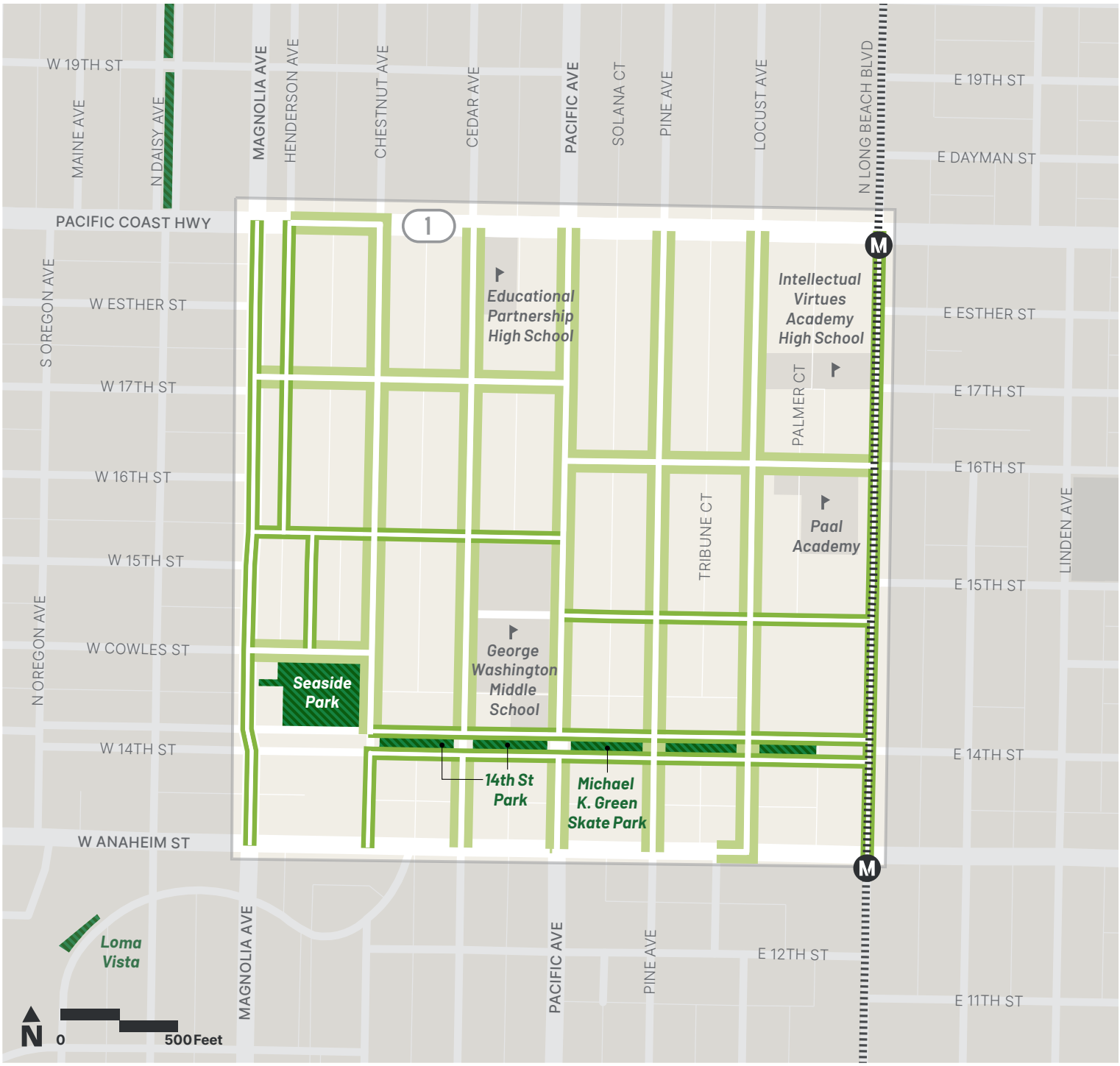
Table 3 identifies for the Washington Neighborhood Study Area:

- Streets with parallel parking: if parking demand is low, potential for reallocation
- Streets with angled parking: angled parking takes up more physical space than parallel parking, converting to parallel parking frees up space for other uses
- Travel Lanes: streets whose vehicular traffic volumes may be able to be accommodate using fewer lanes of travel

To determine whether or not reallocating roadway space is the right fit, a more detailed traffic analysis or parking demand assessment would need to be completed.

Any potential changes to the roadway would need to be weighed against demand of each mode that uses the street the and value this reallocation will bring. For example, while parking removal is an effective strategy for adding space for shade tree planting, it may not be feasible to do so in some areas due to high parking demand.

Planting opportunities in existing planted buffer space between the sidewalk and the roadway are greatest along the north-south minor roadways, Pacific Ave, and 16th and 17th St (Map 10). Planted parkway areas along these streets measure roughly six to eight feet from the edge of the sidewalk to the curb. Parkway planting opportunities are most constrained along Pacific Coast Highway and Anaheim Street.



Map 10.

PLANTING/AMENITY SPACE

PLANTING/ AMENITY SPACE

- 3-5 ft
- 6-8 ft
- Study Area

COMMUNITY DESTINATIONS

- Schools
- School Grounds
- Parks
- Metro Blue Line and Stations

Microclimate Conditions

Trees and green space dramatically impact temperatures along streets. Studies have found that mature shade trees can create as much as a 45 degree cooling difference in surface temperatures,[1] and site visits to the project area to collect heat readings confirm the vast difference in surface temperatures that can be found.

According to a median radiant temperature study completed in Tempe, Arizona, of the three shade types, lightweight structures (umbrellas, pergolas, shade sails, canopies), urban form (overhangs of buildings, tunnels, arcades), and trees, urban form shade performs the best and trees perform the second best. Additionally, non-native trees were found to be more effective in the performance of shade as compared to native trees like Mesquite and Palo Verde.[2]

The color of surface materials is also linked to differences in temperature. Darker colored surfaces, like asphalt, absorb and retain heat. Lighter colored surfaces, like concrete or the shiny surface of a tree leaf, reflect heat and are cooler. This is known as the albedo effect. Heat readings of different materials (asphalt, concrete, grass, and benches) were collected on October 2nd and November 24th, 2020 using an infrared thermometer. Readings were taken in both full sun and shade of various elements (buildings, shade structures, and trees).

1. Shooshtarian, S., Rajagopalan, P., & Sagoo, A. (2018). A comprehensive review of thermal adaptative strategies in outdoor spaces. Sustainable Cities and Society. 41, 647-665.

2. Middel, Ariane (2020). Heat Exposure in the SW: Exploring Mitigation Strategies from a Pedestrian Perspective. Arizona State University.

Table 4. Heat Reading Results

	FULL SUN	TRANSIT SHELTER	BUILDING SHADE	DECIDUOUS SHADE TREE	POOR SHADE TREE
Grass	97.70	-	-	-	73.80
Bench	113.93	98.70	-	-	88.05
Asphalt	127.05	-	-	82.40	105.05
Concrete - Roadway	119.50	-	-	-	-
Concrete - Sidewalk	119.40	94.25 (↓25.15)	94.63 (↓24.77)	77.40 (↓41.00)	100.83 (↓18.57)

Heat readings conducted along the 14th St Linear park showed that, in unshaded areas, temperatures on paved surfaces were 20°F to 30°F hotter than on grass (118-127°F on paved surfaces vs. 98°F on grass). Temperatures on paved surfaces in full sun were about 25°F hotter than temperatures on paved surfaces under poor shade trees, and a full 41°F hotter than temperatures on paved surfaces under high quality shade trees. The hottest spot along 14th St (asphalt pavement in full sun) was 53°F hotter than the coolest spot (grass under a poor shade tree).

Heat readings on benches varied significantly with shade conditions. In full sun, bench surface temperatures ranged from 107°F to 119°F. Under bus shelters, temperatures dropped to between 92°F and 105°F (a cooling difference of between 27°F and 14°F). Under low-quality shade trees, temperatures on benches dropped further to between 86°F and 90°F (a cooling difference of between 33°F and 17°F).

Shade from buildings also lowers surface temperatures. Temperatures on concrete sidewalks in full sun ranged from 112°F to 125°F. Temperatures on concrete sidewalks under building shade dropped to between 90°F and 98°F (a cooling difference of between 35°F and 14°F).

Concrete sidewalks had the most diverse range of heat readings. Heat readings found that deciduous shade trees provide the greatest cooling benefit by a large margin (41°F). Transit shelters and building shade provided similar levels of cooling benefits (an average of 25 and 24°F respectively), followed by poor shade canopy trees (such as Jacarandas or Palm Trees) providing the least amount of cooling benefit (an average of 18.5°F).

In full sun the hottest temperatures were recorded on asphalt, followed by concrete sidewalks; grassy areas were the coolest. This reinforces what we know from research about the urban heat island effect: paved surfaces are hottest and landscaped areas are coolest, and shade from trees provides the greatest cooling benefit to all surfaces.

Summary

The major streets in the study area are hot, uncomfortable, and dangerous for people walking, biking, and accessing transit. The major streets have all of the transit stops, most of the community destinations, most of the collisions, and few of the trees in the study area. Reallocating roadway space for walking, biking, and green space and creating shade with buildings, bus stop shelters, shade sails, and expanded tree wells will significantly improve safety and comfort for people as they move through the area, access transit, and meet their daily needs.

Appendix B: Existing Document Review

This project will be informed by previous planning efforts and wherever possible will reinforce broader regional and city goals related to both sustainability and active transportation. The following are the most critical documents.

BLUE LINE FIRST/LAST MILE: A COMMUNITY-BASED PROCESS AND PLAN

METRO, MARCH 2018

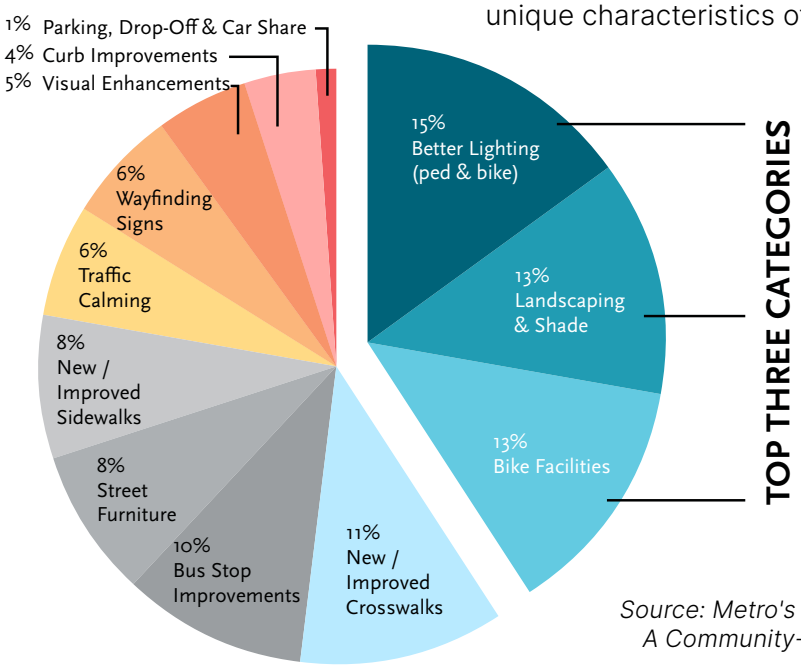
Innovative report with its inclusive, equity-focused community engagement process. Key improvements that surfaced in nearly every station area include:

- More lighting for people on foot and bike
- Sidewalk widening, sidewalk repair, or installation of new sidewalks

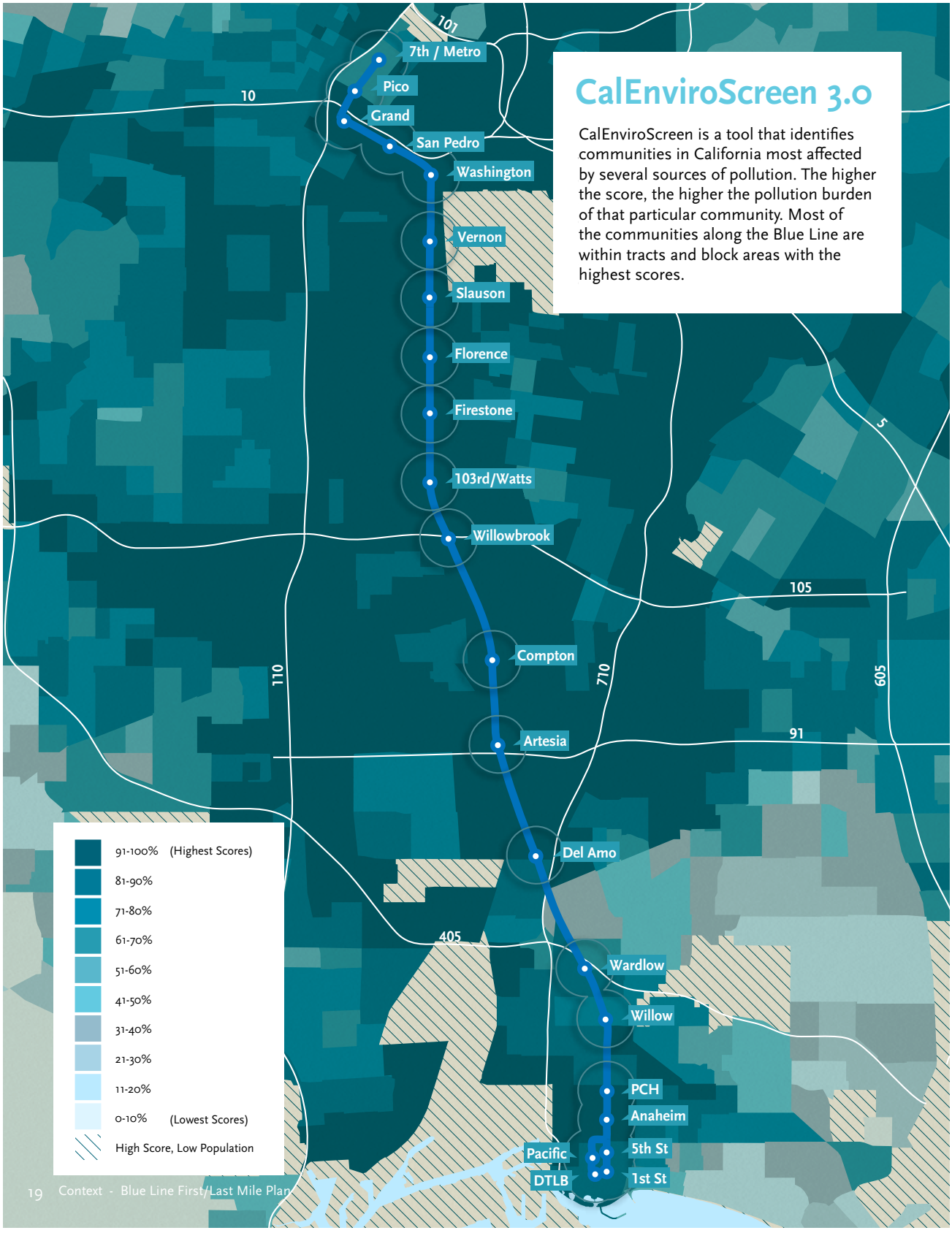

Long blocks and trucks on Alameda Corridor

- Crosswalk improvements, including high visibility striping, curb ramps with tactile warning pads, pedestrian beacons or rectangular rapid flashing beacons
- More high-quality, low-stress bicycle facilities
- Wayfinding and signs that direct people to the Metro station and to key locations
- Streetscaping, landscaping, street trees, and installation of shade structures
- Visual enhancements that reflects the unique characteristics of each community

First/Last Mile Comments - Topics



Source: Metro's Blue Line First/Last Mile: A Community-Based Process and Plan



Source: Blue Line First/Last Mile: A Community-Based Process and Plan, Metro

RACIAL EQUITY AND RECONCILIATION INITIATIVE

2020

The Framework for Reconciliation had two distinct community engagement mandates: community listening session and stakeholder convenings. “The basic principle underlying community engagement and listening is that the belief that systemic racism is best addressed by the people most impacted by the systems of exploitation, and therefore, these communities must be at the forefront of policy and systems to address change.” Virtually hosted listening sessions and town halls are frameworks to follow for this project. 560 total community members engaged in the listening sessions and town halls.

Key findings from these listening sessions and town halls that this project can address include:

- More funding for schools, parks, and libraries (especially in areas of need)
- Improve neglected urban neighborhoods and address environmental justice

The 4th equity goal of the Initiative is to improve health and wellness in the City by eliminating social and economic disparities in the community most impacted by racism. Identified potential actions for this goal include:

- Increase access to park space and recreation programming to foster physical activity, community connections, and safe places for children and families to play
- Equitably increase access to safe green space and urban nature
- Increase efforts to grow, preserve, and protect Long Beach’s urban forest in areas of high pollution and extreme heat
- Explore enhanced infrastructure financing district to provide funding for environmentally sustainable infrastructure
- Identify sustainable funding to implement the City’s Climate Action and Adaptation Plan and prioritize actions that address the negative impacts of climate change for Black communities and communities of color

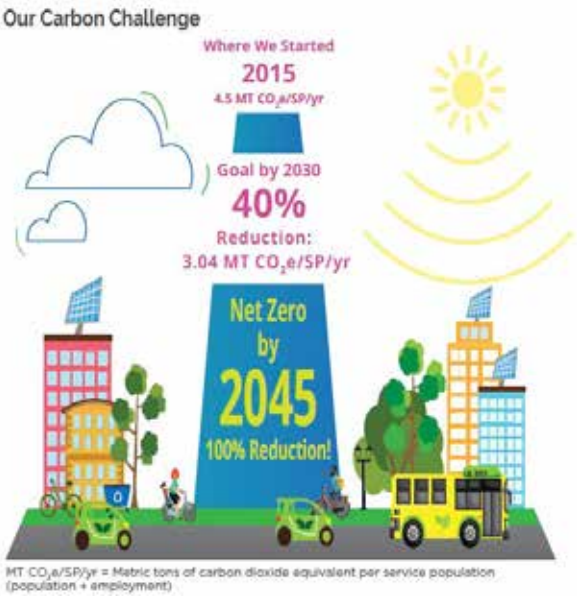
LONG BEACH CLIMATE ACTION AND ADAPTATION PLAN (CAAP)

NOVEMBER 2020

"The vision of the Plan is to create a more sustainable, resilient and equitable city by addressing climate change in a way that remedies existing environmental health disparities while also improving health, quality of life, and enhancing economic vitality." Examples of actions identified by this Plan that relate to our project include:

Extreme Heat Goals

- Increase presence of: cool roofs and cool walls, reflective and shade canopies, public access to water
- Expand implementation of the Urban Forest Management Plan
- Provide bus shelter amenities
- Expand accessibility of cooling centers



Drought Goals

- Implement additional water conservation programs
- Continue outreach and education related to water conservation
- Encourage urban agriculture practices that promote drought resilience

Emissions Reductions Goals

- Increase frequency, connectivity and safety of transit options
- Increase bikeway infrastructure
- Expand/improve pedestrian infrastructure citywide

Additional CAAP Mitigation Actions listed as non-priority include improvising transit stop/station environments by evaluating the network of transit stops/stations to determine improvements for rider comfort, safety, and convenience, include provision of shade/shelter, seating, on-time arrival information, lighting etc.

Figure 26. 2045 Reduction Goal

From Long Beach Cliimate Action and Adaptation Plan

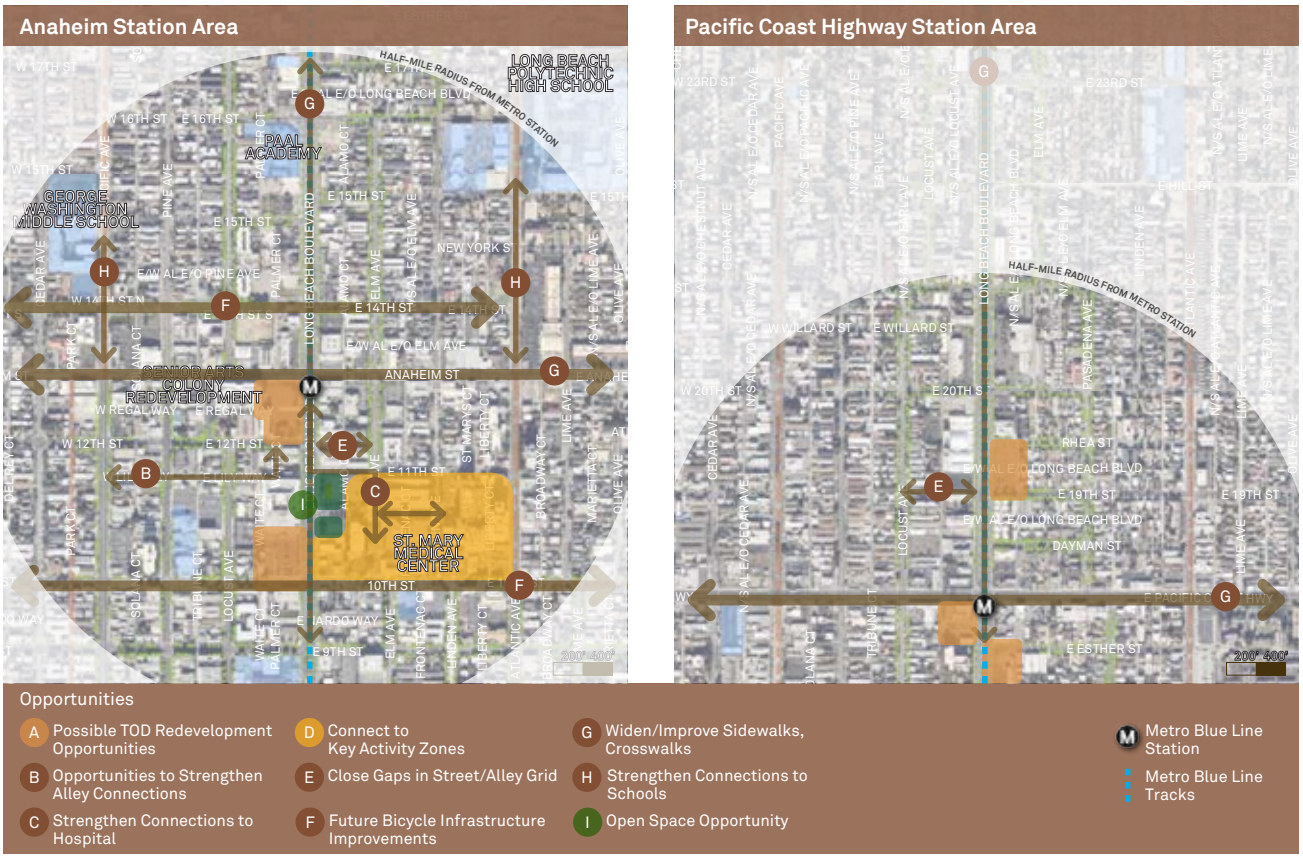


Figure 27. Midtown Opportunities Map

From Long Beach Downtown and TOD Pedestrian Master Plan

LONG BEACH DOWNTOWN AND TOD PEDESTRIAN MASTER PLAN

Plan identifies a number of issues related to safety, barriers to accessing transit, and opportunities for enhancing connections to the Blue Line. Plan identifies Midtown esp Anaheim Street and PCH, where our focus area is located between, have high levels of traffic and a high incidence of pedestrian collisions. Intersection corridors of the blue line and Anaheim and PCH are most dangerous for pedestrians. There are no traffic calming devices resulting in higher speeds and dangerous conditions. Between 2008-2012 there were 10 pedestrians collisions at the intersection of Anaheim and Long Beach Blvd. Almost 40% of all pedestrian collisions occur in Midtown. Midtown has relatively few public spaces near Blue Line stations. Problems include narrow sidewalks, wide lanes, and no barriers between moving traffic and pedestrians. The Long beach Senior Arts Colony was identified as a possible location for immediate improvements including landscaping with their 8' setback.

Opportunities identified include:

- Widen/Improve sidewalks and crosswalks on Anaheim Street and Long Beach Blvd
- E 14th St as a future bicycle infrastructure improvements
- Pacific Ave strengthen connections to schools

The Pedestrian Toolkit in Chapter 4 provides good direction for pedestrian improvements.

Priority projects in our study area include:

- PCH Station Transit Access Project
- 15th Street West Streetlet and Stitch Street
- Anaheim Stitch Street Phase 2

CITY OF LONG BEACH BICYCLE MASTER PLAN 2040

FEBRUARY 2017

The plan envisions a Long Beach 25 years into the future where bicycling is the easiest and most convenient way to travel for work, errands, and recreation. The three goals of the plan include:

• Design bicycle facilities that are accessible and comfortable for people of all ages and abilities

• Increase awareness and support of bicycling through programs and social equity

• Identify, develop, and maintain a complete and convenient bicycle facility network.

Extensive community input was collected through the Master Plan process, with public feedback especially solicited to inform policy and infrastructure recommendations. The plan takes a thorough approach to reach parts of the city and population groups that are often absent from the planning process.

SAFE STREETS LONG BEACH, A VISION ZERO ACTION PLAN

JULY 2020

This plan is an initiative to reduce traffic-related fatalities and serious injuries to zero by 2026 that is guided by Vision Zero. Driving too fast for conditions is the most frequent violation by motorists contributing to fatal and serious injury collisions in Long Beach. Included in the list of high-injury corridors for pedestrians and bicyclists is Anaheim Street, Long Beach Boulevard, Pacific Avenue, and Magnolia Avenue.

"When asked what should be done to make our streets safer, community members most frequently mentioned improved street design, less distracted driving, slowing down vehicles, and more education for all roadway users."

Some identified strategies for a safer street include:

• Narrowing travel lane widths

• Including protected bike lanes on both sides of the street

• Improving visibility and reducing vehicle speeds with corner bulbouts.

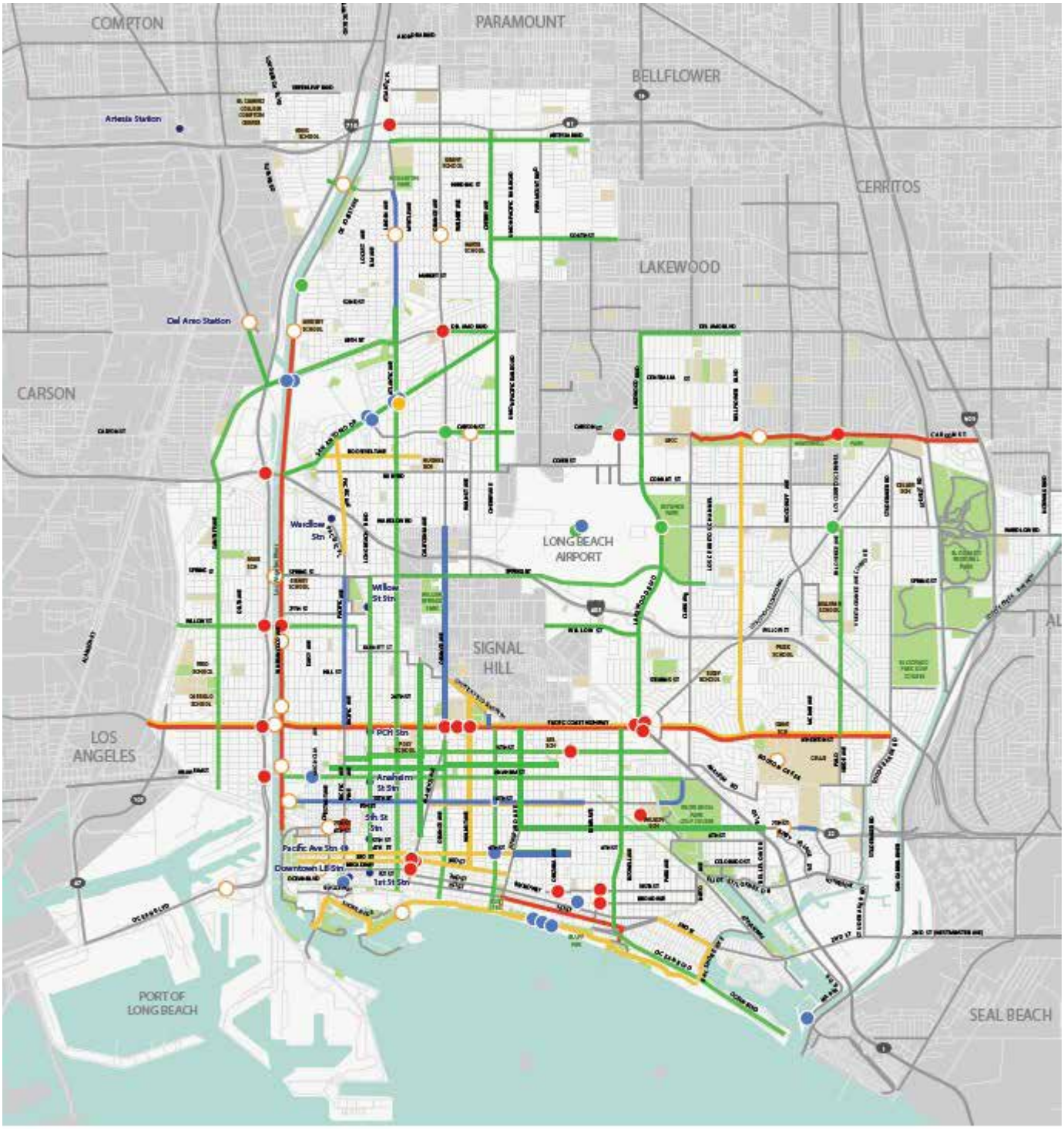


Figure 28. Workshop Feedback Map

From City of Long Beach Bicycle Master Plan

LONG BEACH LOW IMPACT DEVELOPMENT (LID) BEST MANAGEMENT PRACTICE (BMP) DESIGN MANUAL

DECEMBER 2013

Manual describes the requirements for designing a stormwater facility, standards for catchment, mitigation, infiltration, conservation, and education. This manual is a good reference for stormwater system type selection, feasibility, design criteria and requirements.

LONG BEACH URBAN FOREST MANAGEMENT PLAN

Long-term management plan. Some of the goals of the Plan overlap with our project, specifically: Provide fair distribution of urban forest services in all parts of the City; expand the urban forest in the public right of way; protect, preserve and enhance the existing urban forest; enhance the social, economic, environmental, and public health benefits to the entire community through a sustainable urban forest. Also included in the plan is the 2012 approved street tree list that will be closely referenced for this project.

Summary of urban forest benefits:

- Wildlife habitat
- Water quality and erosion control
- Temperature control
- Air quality
- Sound control
- Psychological benefits
- Public Safety benefits
- Economic values

Appendix C: Potential Funding Sources

The concepts described in the “Cooling Long Beach: Urban Heat Island Reduction Strategies” project can be applied to nearly every community in Los Angeles, bringing opportunities for improving traffic safety and climate adaptation to millions of Angelenos. This Funding Sources Report identifies more than 40 sources for funding the work described in the Adaptation Concepts and community meetings, including federal, state, regional, and private funding sources. Research for this document was prepared in November of 2019 and is accurate as of this time, but it is important to acknowledge that these funding sources could change without notice.

While the transportation components, such as bikeways, crosswalks and traffic signals are easily funded under Active Transportation sources, other components such as plantings, shade structures, cool pavement materials, and hydration stations are often excluded from many funding sources because they are perceived as ‘beautification efforts’ or additional amenities. For this reason, the project team has worked to expand this list to include health, environmental, creative placemaking, and climate change funding sources, as well.

The document is structured as follows:

1) Federal Sources

2) State Sources

3) Regional and Local Sources

4) Private Sources

A chart summarizing the materials is also included.

A. FEDERAL SOURCES

Fixing America's Surface Transportation Act (FAST Act)

The FAST Act, which replaced Moving Ahead for Progress in the 21st Century Act (MAP-21) in 2015, provides long-term funding certainty for surface transportation projects, which allows states and local governments to move forward with critical transportation projects. The FAST Act authorizes $305 billion over fiscal years 2016 through 2020 for highway, highway and motor vehicle safety, public transportation, motor carrier safety, hazardous materials safety, rail, and research, technology, and statistics programs. The FAST Act maintains its focus on safety, keeps intact the established structure of highway-related programs, continues efforts to streamline project delivery and provide funding for freight projects as well. This funding opportunity comes out on a yearly basis and could potentially fund numerous transportation projects. $2.9 million was accumulated for use between FY 2016-2020 for Los Angeles County.

Federal Highway Administration Surface Transportation Block Grant (STBGP)

The FAST Act expanded the existing Surface Transportation Program (STP) into the Surface Transportation Block Grant Program (STBGP), which places more decision-making power in the hands of state and local governments. The FAST Act simplifies the list of uses eligible for program funds and increases the ways that funds can be used for local roads and rural minor collectors. Eligible projects for this funding are; Highways, bridges, and tunnels, transit capital projects, truck parking facilities, pedestrian and bicycle improvements. Projects must be identified in the STP/TIP and be consistent with the long-range statewide transportation plan and metropolitan transportation plan.

The Transportation Alternatives Program (TAP) is a set-aside program of this block grant. The new program requires 55 percent of program funds be distributed within each state on the basis of population, compared to 50 percent under STP. In California, STBGP is allocated through the Regional Surface Transportation Program (RSTP). The TAP program is allocated through the Active Transportation Program (ATP). $31.7 million was accumulated for use between FY 2016-2020 for Los Angeles County.

Congestion Mitigation and Air Quality Improvement Program (CMAQ)

CMAQ provides funding to state and local agencies for transportation projects that help meet Clean Air Act objectives. Funded projects must work to reduce congestion and improve area quality in nonattainment or maintenance zones for ozone, carbon monoxide or particulate matter. CMAQ funds can be used for bicycle and pedestrian projects that are included in the metropolitan planning organization (MPO) current transportation plan and transportation improvement program (TIP). Projects can include bicycle and pedestrian facilities that are not exclusively recreational and for outreach related to safe bicycle use. Studies that are part of the project development pipeline (e.g., preliminary engineering) are also eligible for funding.

While CMAQ is a federal funding source, the program is administered at the local level through the Metropolitan Transit Authority and sub allocated though Caltrans. These funds are eligible for transportation projects that contribute to the attainment or maintenance of National Ambient Air Quality Standards in non-attainment or air quality maintenance areas. Examples of eligible projects include enhancements to existing transit services, rideshare and vanpool programs, projects that encourage bicycle transportation options, traffic light synchronization projects that improve air quality, grade separation projects, and construction of high-occupancy vehicle (HOV) lanes. Projects that apply for this program are required to develop reliable air quality estimates using the CMAQ Emissions Calculator Toolkit. Projects that are proven to reduce direct PM2.5 emissions are to be given priority.

Federal High Administration Bus and Bus Facilities Grants Program

The Bus and Bus Facilities Grant Program makes federal resources available to states and direct recipients to replace, rehabilitate, and purchase buses and related equipment and to construct bus-related facilities including technological changes or innovations to modify low or no emission vehicles or facilities. On November 25, 2019, FTA announced $423 million to improve the safety and reliability of America's bus systems and enhance mobility for transit riders. The federal share of eligible costs is 80% of the net capital project cost. This program occurs on a yearly basis and typically opens in May and the grant deadline is typically around June.

National Endowment for the Arts Our Town

The Our Town grant program supports creative placemaking projects that help to transform communities into lively, beautiful, and resilient places – achieving these community goals through strategies that incorporate arts, culture, and/or design. Creative placemaking is when art is deliberately integrated into community revitalization work - placing arts at the table with land-use, transportation, economic development, education, housing, infrastructure, and public safety strategies. Grant applicants require partnerships between arts organizations and government, other nonprofit organizations, and private entities. Funding ranges from $25,000-$200,000 per project with a minimum cost share/match equal to the grant amount. This program occurs on a yearly basis and the application deadline typically falls in August.

Federal Transit Administration Urbanized Area Formula Program

This program makes federal resources available to urbanized areas for transit capital and transit-related planning. An urbanized area is an incorporated area with a population of 50,000 or more. A 20% match is required; however, bicycle facilities, including routes to transit, bike racks, shelters and equipment and can receive a 95% federal share for the first 1% of program funds.

The Better Utilization Investments to Leverage Development Discretionary Grant (BUILD)

The BUILD (formerly TIGER) reimbursement grant, available through the U.S. Department of Transportation, allows sponsors at the State and local levels to obtain funding for multi-modal, multi-jurisdictional projects that are more difficult to support through traditional funding initiatives. Eligible projects include: recreational trails, road diets, separated bike lanes, shared use paths, sidewalks, signal improvements, signed pedestrian or bicycle routes, traffic calming, trailside and trailhead facilities, bicycle parking, racks, repair stations, storage, and bike share programs. A program of projects can be assembled and should demonstrate significant regional impacts and be construction-ready. The minimum grant request in rural areas is $1 million and in urban areas it is $5 million.

Environmental Protection Agency Brownfield Assessment Grant Program

Assessment grants provide funding for a grant recipient to inventory, characterize, assess, and conduct planning and community involvement related to brownfield sites. Revolving Loan Fund (RLF) grants provide funding for a grant recipient to capitalize a revolving loan fund and to provide sub-grants to carry out cleanup activities at brownfield sites, a property. The EPA defines a brownfield property as the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. A grant applicant applying for a community-wide assessment may request up to $300,000 and applicants applying for a site-specific assessment may request up to $200,000. Application deadlines typically are in December.

Highway Safety Improvement Program (HSIP)

The Federal Highway Administration provides funding to states for projects that help communities achieve significant reductions in traffic fatalities and serious injuries on all public roads, bikeways, and walkways. Eligible projects include pedestrian safety improvements, enforcement activities, traffic calming projects, and crossing treatments in school zones. Non-infrastructure projects are not eligible. All HSIP projects must be consistent with the state's Strategic Highway Safety Plan. Funding is available up to $10 million and requires a 10% match.

B. STATE FUNDING

Active Transportation Program (ATP)

The California State Legislature created the Active Transportation Program to encourage active modes of transportation. Senate Bill 1 (SB 1) stipulates that $100,000,000 of revenues from the Road Maintenance and Rehabilitation Account will be available annually to the ATP. The ATP consolidates existing federal and state transportation programs, including the Transportation Alternatives Program (TAP), Bicycle Transportation Account (BTA), and State Safe Routes to School (SR2S), into a single program with a focus to make California a national leader in active transportation. Applications are to be submitted typically in July.

Funding Sources:

- State and Federal Funding
    - $34 million in State Highway Account (per-year)
    - $88.5 million In Federal (per-year)
- $10 million (California Climate Investments)-Cycle 3 one-time program
- $100 million (SB1 State Funds per-year)

Goals of the ATP are currently defined as the following:

- Increasing the proportion of trips accomplished by walking;
- Increasing safety and mobility for active transportation users;
- Advancing active transportation efforts of regional agencies to achieve the greenhouse gas reduction goals;
- Enhancing public health;
- Ensuring that disadvantaged communities fully share in the benefit of the program; and,
- Providing a broad spectrum of projects to benefit many types of active transportation users.

Caltrans Sustainable Transportation Planning Grant Program

The Sustainable Transportation Planning Grant Program supports transportation planning processes which address local and regional transportation needs and issues. The program offers two types of grants: Strategic Partnerships and Sustainable Communities. The Sustainable Communities Grants has about $29.5 million in funding to encourage local and regional planning that furthers state goals. The Strategic Partnership Grant has about $4.5 million to identify and address statewide or regional deficiencies on the State highway system in partnership with Caltrans. Eligible planning projects must directly benefit the multi-modal transportation system, improve public health, social equity, environmental justice, the overall environment, and other community benefits. Applications are to be submitted typically in October.

Environmental Enhancement and Mitigation Funds

The California Natural Resources Agency provides grants to projects that indirectly mitigate the environmental impacts of new transportation facilities. Funds are available for land acquisition and construction and should fall into one of the following three categories: urban forestry projects, resource lands projects, or mitigation projects beyond the scope of the lead agency. The local Caltrans district must support the project. The maximum award amount is $500,000. The application deadline usually falls in June.

Urban Greening Program

The California Natural Resource Agency provides grants through this program to projects that reduce greenhouse gases by sequestering carbon, decreasing energy consumption, and reducing vehicle miles travelled, while also transforming the built environment into places that are more sustainable, enjoyable, and effective in creating healthy and vibrant communities. These projects will establish and enhance parks and open space, using natural solutions to improving air and water quality and reducing energy consumption, and creating more walkable and bike-able trails. Approximately $19 million is available for urban greening projects, and there are no maximum or minimum grant amounts.

Green Infrastructure Program

The California Natural Resource Agency appropriated $18.5 million for competitive grants for multi benefit green infrastructure investments in or benefiting disadvantaged communities. Applicants can be awarded between$50,000-$3 million. Applicants must show that their projects will achieve measurable benefits by, acquiring, creating, enhancing or expanding community parks and green spaces or use natural systems, or systems that mimic natural systems to achieve multiple benefits to create sustainable and vibrant communities.

Regional Park Program

The California Department of Parks and Recreation provides a Regional Parks Program which provides competitive grants that will create, expand, and improve regional parks. Projects will create at least one new creation feature that attracts visitors from at least a 20-mile radius or county-wide population to a regional park. The program has approximately $23,125,000 in funds available. Applicants can receive funding between $200,00-$3 million. Projects eligible for this grant include, new recreation features, non-motorized trail, equestrian center, aquatic feature, regional sports complex, playground, plaza, public art, etc. There is no match required.

Statewide Park Development and Community Revitalization Program (SPP)

The California Department of Parks and Recreated provides a competitive grant program that will create new parks and new recreation opportunities in critically underserved communities. The types of projects that are eligible for funding include, new parks, expanding an existing park, and renovating an existing park. Applicants can receive funding between $200,00 and $8,500,000. There is no match required. Application deadlines usually fall in August.

Rubberized Pavement Grant Program

The California Department of Resources Recycling and Recovery (Cal Recycle) provides the Rubberized Pavement Grant Program, formerly called the Rubberized Asphalt Concrete (RAC) Grant Program, to promote markets for recycled-content surfacing products derived from waste tires generated in California and decrease the adverse environmental impacts created by unlawful disposal and stockpiling of waste tires. There is approximately $7,750,000 available funding. $350,000 maximum for individual application. If applying for a regional application, the maximum is $500,000.

The program will award ten cities grants of up to $25,000 annually.

Transformative Climate Communities

The California Strategic Growth Council funds community-led development and infrastructure projects that achieve major environmental, health, and economic benefits in California's most disadvantaged communities. Funded by California's Cap-and-Trade Program, TCC empowers the communities most impacted by pollution to choose their community vision, strategies, and projects to enact transformational change – all with data-driven milestones and measurable outcomes. In its first round, and through a competitive process, the California Strategic Growth Council (SGC) awarded TCC grants to three recipients in three locations: including $66.5 million to the City of Fresno, $33 million to the Watts neighborhood of Los Angeles, and $33 million to the City of Ontario.

Affordable Housing and Sustainable Communities

The California Strategic Growth Council funds healthier communities and protects the environment by increasing the supply of affordable places to live near jobs, stores, transit, and other daily needs. The most successful applications include affordable housing sites as well as funds to build or improve walkways, bikeways, transit amenities, and urban greening. Funded by auction proceeds from California's Cap-and-Trade emissions reduction program, AHSC is administered by the Strategic Growth Council and implemented by the California Department of Housing and Community Development. AHSC reduces emissions by funding projects that make it easier for residents to get out of their cars and walk, bike, or take public transit. The City of Los Angeles was highly successful in Cycle IV, winning all five of their applications, bringing nearly $100 million in housing, transportation, and urban greening.

Strategic Growth Council Sustainable Communities Program

The program provides technical assistance and a variety of grants to SCAG member jurisdictions. Grants are available in three categories: Integrated Land Use (Sustainable Land Use Planning, Transit Oriented Development (TOD) and Land Use & Transportation Integration); Active Transportation (Bicycle, Pedestrian and Safe Routes to School Plans); and Green Region (Natural Resource Plans, Climate Action Plans (CAPs) and Greenhouse Gas (GHG) Reduction programs). SCAG has awarded approximately $22.3 million in total funding to many local sustainability and active transportation planning projects

Caltrans State Transportation Improvement Program

STIP funds are available for new construction projects that add capacity to the transportation network. Funding is a mix of state, federal, and local taxes and fees; and consists of two components: Caltrans' Interregional Transportation Improvement Program (ITIP) and regional transportation planning agencies' Regional Transportation Improvement Program (RTIP). Pedestrian and bicycle projects may be programmed under ITIP and RTIP. The funds are announced during the month of June every other year and there is a minimum 11.5% match.

California Department of Parks and Recreation Habitat Conservation Fund

This fund allocates approximately $2 million each year to cities, counties, and districts for nature interpretation programs to bring urban residents into park and wildlife areas, protection of various plant and animal species, and the acquisition and development of wildlife corridors and trails. Funds are available for trail maintenance, interpretive signage, lighting and waysides. The program requires a 50% match.

Coastal Conservancy Proposition 1 Grants

These grants fund ecosystem and watershed protection and restoration projects focused on water sustainability, wetland restoration and urban greening. These grants can be used for the urban greening

or water sustainability elements incorporated in bikeway, walkway and trail projects and funding can be used for planning, land acquisition, and construction though there is a focus on supporting projects that will be quickly built. The total amount of funding for this grant is approximately $100.5 million with about a 25%-50% match requirement.

California Transportation Commission Local Partnership Program

This program provides local and regional transportation agencies that have passed sales tax measures, developer fees, or other imposed transportation fees with a continuous appropriation of $200 million annually to fund transportation improvement projects including biking, walking, safety and health-related projects. Projects are given funding priority that can show that they are planning on implementing their project through construction and demonstrate their project will improve air quality.

Caltrans Transportation Development Act (TDA)

The Transportation Development Act (TDA) provides funding annually to be allocated to transit and non-transit related purposes that comply with regional transportation plans. Funding is based on sales tax collected in each county, but has generated approximately $1.9 million. The TDA funds a wide variety of transportation programs, including planning and program activities, pedestrian and bicycle facilities, community transit services, public transportation, and bus and rail projects.

California Resilience Challenge

The California Resilience Challenge is an initiative of the Bay Area Council Foundation, a nonprofit corporation, qualified as a tax-exempt organization under section 501(c)(3) of the Internal Revenue Code. The Challenge is administered by the Bay Area Council, a business sponsored public policy advocacy organization for the nine-county Bay Area that was founded in 1945. The California Resilience Challenge is a statewide effort, led by businesses, utilities, and a diverse range of partners, to build local and regional climate resilience and to support a shared vision for a resilient California in the face of increasing climate threats. The Challenge is providing grants for diverse, replicable and innovative climate change adaptation planning projects across California. These projects will reflect California's diverse geography and showcase leadership in climate change adaptation.

C. REGIONAL AND LOCAL FUNDING

Metro Local Return Programs

Proposition A, Proposition C, Measure R, and Measure M Local Return programs are each one-half cent sales taxes that finance countywide transit development. Metro is responsible for distributing a certain proportion of the tax revenues to cities and counties to develop and improve public transit, paratransit, and related transportation infrastructure. Funds from Propositions C, R, and M can be used for bicycle-related uses such as infrastructure, signage, bicycle sharing, and education efforts. These Local Return Funds are distributed monthly to jurisdictions on a per capita basis. Metro's local return program has generated approximately $500 million and distributes them to cities monthly on a per capita basis.

Safe and Clean Water Program: Measure W

Approved by voters in 2018, The Safe and Clean Water Program generates up to $285 million per year from a special parcel tax of 2.5 cents a square foot of "impermeable space" will help cities around the county meet their obligations under the federal Clean Water Act and associated permits given out by the state. The revenue that will be generated from this measure will be used to pay for regional and municipal projects that improve water quality and that may also increase water supply including parks and wetlands, which will also benefit communities.

LADOT People Street Program

The Los Angeles Department of Transportation provides an application-based program that builds partnerships with community groups and the City to transform LA streets into active and accessible places for community members. Types of project could include; Parklets, Plazas, Bicycle Corrals, Intersection Murals, and Decorative Crosswalks.

City of Los Angeles Great Streets Initiative

The Great Streets Challenge is a program of Los Angeles Mayor Eric Garcetti's Great Streets Initiative to envision, collaborate on, and build transformative street infrastructure projects. The Great Streets Challenge aims to:

Build strong partnerships between communities and the City of Los Angeles.
Empower communities to develop a vision to transform their corridors.
Design streets with a community's vision of how to improve our neighborhoods for all people.
Implement projects that transform our streets into safe, accessible, and vibrant public spaces in alignment with adopted City policies.

Non-Profit Organization may apply for this competitive funding opportunity to transform their communities. Projects could include, bicycle and pedestrian improvements, park improvements, parklets, community murals, sculptures, etc.

Metro Active Transport Program (MAT)

The MAT Program encourages increased use of active modes of transportation, such as biking and walking, and enhance pedestrian and bicycle safety. The goals on the MAT Program is to advance the Active Transportation Strategic Plan, First/Last Mile policy, and the Equity Platform Network. Within the MAT Program there are two programmatic categories you can apply for which are, the First/Last Mile Priority Network around major transit stations and the Active Transportation Corridor Priority Network countywide. There is approximately $37.7 million in funding available between the fiscal years 2021-2025 for each category. For the First/Last Mile Priority Network category, projects can receive between

$500,000-$5 million in funding annually or the Active Transportation Corridor Priority Network category, projects can receive between $7 million-$8 million annually.

Metro Open Streets Program

This competitive grant program funds a series of regional car-free events. The goals of the Open Streets Grant Program are to provide opportunities for, riding transit, walking and riding a bike, encourage future mode shifts to more sustainable transportation modes and for civic engagement to foster the development of multi-modal policies and infrastructure. For the FY 2020 cycle, there over $1 million in funds available and project can receive up to $500,000 in funding. There is a minimum 20% match requirement and the grant is administered annually.

Metro Transit Oriented Development (TOD) Planning Grant Program

This $5 million fund is intended to spur the adoption of transit-supportive land use and other regulatory plans around station areas in order to increase access to and utilization of public transit. Eligibility is for Los Angeles County jurisdictions with land use authority within one-half mile of existing, planned, or proposed transit stations.

Metro ExpressLanes Net Toll Revenue Reinvestment Grant Program

State law requires the net toll revenues generated from the Metro ExpressLanes be reinvested in the corridor from which they were derived, pursuant to an approved expenditure plan. Gross toll revenues from the ExpressLanes program are first used to cover the direct expenses related to the maintenance, administration and operation, including marketing, toll collection, and enforcement activities related to the ExpressLanes. Any remaining revenue produced is used in the corridor for which it was generated through the Net Toll Revenue Reinvestment Grant Program. Grant funds were reinvested in projects that provide direct mobility benefits. Funds were made available into three categories, Transit use, Systems Connectivity/Active Transportation, and Roadway Improvements/Highway Improvements. There is approximately $22 million-$28 million in funding available

City of Los Angeles Neighborhood Purpose Grant (NPG)

The Neighborhood Purpose Grant provides funding to benefit communities while supporting and building partnerships with local organizations. Canoga Park Neighborhood Council has the opportunity to apply for grant. All funds must go to a public resource. Applicants can receive up to $5,000 in grant funding.

D. Private Sources

Conservation Fund-The KODAK American Greenways Program

The Conservation Fund's American Greenways Program has teamed with the Eastman Kodak Corporation and the National Geographic Society to award small grants ($500 to $2,500) to stimulate the planning, design, and development of greenways. These grants can be used for activities such as mapping, conducting ecological assessments, surveying land, holding conferences, developing brochures, producing interpretive displays, incorporating land trusts, and building trails. Grants cannot be used for academic research, institutional support, lobbying, or political activities.

PeopleForBikes Community Grant Program

PeopleForBikes is a coalition of bicycle suppliers and retailers that has awarded $2.9 million in community grants and leveraged an additional $670 million since 1999. The grant program funds bicycle paths and rail trails, as well as mountain bicycle trails, bicycle parks, BMX facilities, and large-scale bicycle advocacy initiatives. Grants awarded have ranged between $800 and $10,000.

The Robert Wood Johnson Foundation

The Robert Wood Johnson Foundation was established as a national philanthropy in 1972, and today, it is the largest U.S. foundation devoted to improving the health and health care of all Americans. Grant making is concentrated in four areas:

- To assure that all Americans have access to basic health care at a reasonable cost
- To improve care and support for people with chronic health conditions
- To promote healthy communities and lifestyles
- To reduce the personal, social and economic harm caused by substance abuse: tobacco, alcohol, and illicit drugs

The Robert Wood Johnson Foundation has numerous grant program to apply to and funding is based on those grant opportunities.

The Kresge Foundation

The Kresge Foundation is a private, national foundation that works to expand opportunities in America's cities through grantmaking and social investing in arts and culture, education, environment, health, human services, and community development. The foundation awards operating support and project and planning grants through their six programs. One of their six programs include Environment, where they offer grant funding in order to help cities implement comprehensive climate-resilience approaches grounded in equity. Approximate funding is shown on the application when grant application is open.

Bloomberg American Cities Initiative

The Bloomberg Philanthropies supports U.S. city leaders to address climate change, combat obesity and gun violence, and catalyze new opportunities for artists and volunteers to work within their communities to solve problems. The Initiative includes a number of sub-categories including American Cities Climate Challenge, Partnership for Healthy Cities, and What Works in Cities. Grant funding is made available for the multiple categories they invest in, including climate change, road safety, research for health, public art, and sustainable cities.

Bloomberg Philanthropies Asphalt Art Initiative

Bloomberg Philanthropies' Asphalt Art Initiative responds to the growing number of cities around the world embracing art as an effective and relative low-cost strategy to activate their streets. The focus of this initiative is to create art on roadways (intersections and crosswalks), pedestrian spaces (plazas and sidewalks), and vertical infrastructure (utility boxes, traffic barriers, and underpasses). The overall goal of the program is:

- Improving street and pedestrian safety
- Revitalizing and beautifying underutilized public space
- Promoting collaboration and civic engagement in local communities

Applicants can receive up to $25,000 each to implement their own arts-driven transportation projects. Cities who apply must have populations of 30,000-500,000.

FEDERAL FUNDING SOURCES						
Name	**Amount Available**	**Types of Eligible Projects**	**Key Eligibility Factors**	**Frequency**	**Local Matches**	**Priority Assessment**
Federal Highway Administration Fixing America's Surface Transportation Act (FAST Act)	$2.9 million between FY2016-2020 in Los Angeles County	▪ Public transportation ▪ Hazardous materials safety ▪ Motor carrier safety ▪ Rail ▪ Research ▪ Technology ▪ Statistics	The application will fund eligible projects that best achieve program goals and meet program requirements	Annually from FY 2016-FY 2020	N/A	High
Federal Highway Administration Surface Transportation Block Grant	$ 31.7 million between FY2016-2020 in Los Angeles County	▪ Federal aid highway improvements ▪ Bridge and tunnel projects ▪ Pedestrian and Bicycle infrastructure ▪ Transit capital projects	Projects must be identified in the STP*/TIP* and be consistent with the Long-Range Statewide Transportation Plan and Metropolitan Transportation Plan.	Annually from FY 2016-FY 2020	N/A	High
Federal Highway Administration Congestion Mitigation and Air Quality Improvement Program (CMAQ)	$138.5 million between FY16-2020 2020 in Los Angeles County	▪ Transportation projects or programs ▪ Hazardous materials safety ▪ Motor carrier safety ▪ Rail ▪ Research ▪ Technology ▪ Statistics	A project or program that is likely to contribute to the attainment or maintenance of a national ambient air quality standard	Annually from FY 2016-FY 2020	N/A	High
Federal Transit Administration Bus and Bus Facilities Program	$423 million nationally	▪ Bus facility rehabilitation ▪ Bus facility construction ▪ Technology improvements ▪ Bus purchases	To program provides funds to designated recipients that allocate funds to fixed route bus operators, states, or local governmental authorities that operate fixed route bus services	Annually	Federal share of eligible costs: 80% of net capital of project cost	Medium
Our Town (National Endowment for the Arts)	$25,000-$200,000	▪ Artist residency ▪ Arts festivals ▪ Public art ▪ Artist/designer-facilitated community planning ▪ Public space design ▪ Design of cultural facilities ▪ Etc.	Required partnership between local government and nonprofit organization	Annually	Cost share/match equal to the grant amount	Medium
Federal Transit Administration Urbanized Area Formula Program	N/A	▪ Planning ▪ Engineering ▪ Design and evaluation of transit projects ▪ Capital investments in bus and bus-related activities ▪ Crime prevention ▪ Etc.	The program is available for urbanized areas for transit capital and transit-related planning.	Annually	20% however bicycle facilities, bike racks, shelters, etc. can receive 95% federal share for the first 1% of program funds	High
Federal Highway Administration The Better Utilization Investments to Leverage Development Discretionary Grant (BUILD)	$1 million-$5 million	▪ Recreation trails ▪ Road diets ▪ Separated bike lanes ▪ Shared-use paths ▪ Sidewalks ▪ Signal improvements ▪ Bicycle parking, racks, repair stations, storage ▪ Bike share programs	Projects should demonstrate significant regional impacts and be construction-ready	Annually	Funding may be used for up to 80% of the costs of the project in urban areas, 100% in rural areas	High
Environmental Protection Agency Brownfield Assessment Grant Program	$200,000-$300,000	▪ Brownfield site assessments ▪ Public outreach ▪ Groundwater monitoring ▪ Site surveying ▪ Creation of parks, greenways, other types of recreation properties	Grants should be used to protect human health and the environment, promote economic development, and the creating or addition of parks, greenways, underdeveloped properties.	Annually	N/A	Medium
Federal Highway Administration Highway Safety Improvement Program (HSIP)	$10 million	▪ Pedestrian safety improvements ▪ Enforcement Activities ▪ Traffic Calming ▪ Crossing enhancements at schools	Non-infrastructure projects are not eligible and must be consistent with the State's Strategic Highway Safety Plan	Annually	10%	High

STATE FUNDING SOURCES						
Name	**Amount Available**	**Types of Eligible Projects**	**Key Eligibility Factors**	**Frequency**	**Local Matches**	**Priority Assessment**
Caltrans Active Transportation Program (ATP)	$400 million	▪ Infrastructure projects ▪ Plans – community wide bicycle, pedestrian, SR2S, or active transportation plans ▪ Non-infrastructure projects – education, encouragement, enforcement activities ▪ Combination Projects – Infrastructure and non-infrastructure projects	Projects under the Plan category must be located in a disadvantaged community	Annually	N/A	High
Caltrans Sustainable Transportation Planning Grant Program	$34 million	▪ Community needs assessments ▪ Transit-oriented development ▪ Long-range transportation plans ▪ Complete streets plan ▪ Active Transportation Plans ▪ Bike and Pedestrian Plans ▪ Station area planning ▪ Etc.	Must directly benefit the multi-modal transportation system, improve public health, social equity, environmental justice, the overall environment, and other community benefits.	Annually	11.47%-20%	High
California Natural Resource Agency Environmental Enhancement and Mitigation Funds	$500,000	▪ Urban forestry projects ▪ Resource land projects ▪ Mitigation projects	Projects must mitigate, either directly or indirectly, the environmental impacts of the modification of an existing Transportation Facility or new facility.	Annually	N/A	Medium
California Natural Resource Agency Urban Greening Grant Program	$19 million	▪ Active Transportation Projects ▪ Green streets and alleyways ▪ Non-motorized urban trails ▪ Urban heat island mitigation ▪ Neighborhood park expansion, enhancement, and establishment	Projects must reduce greenhouse gas emissions. Project must also acquire, create, enhance, or expand community parks and green spaces, and use natural systems	Annually	N/A	High
California Natural Resource Agency Green Infrastructure Program	$50,000-$3 million	▪ Community parks ▪ Green spaces ▪ GHG emissions reduction ▪ Green infrastructure improvements ▪ Stormwater capture ▪ Recycled water ▪ Community education	All projects must benefit communities, disadvantaged communities, and prevent displacement	Annually	N/A	High
California Department of Parks and Recreation Regional Park Program	$200,000-$3 million	▪ Non-motorized trails ▪ Equestrian centers ▪ Plazas ▪ Playgrounds ▪ Public art ▪ Etc.	Only one park per application, if there is more than one park, applicants must submit more than one application. Creation of new regional parks are prioritized.	Annually	No	High
California Department of Parks and Recreation Statewide Park Development and community Revitalization Program	$200,000-$8,500,00	▪ New parks ▪ Expanding existing parks ▪ Renovating existing parks	Only one park per application, if there is more than one park, applicants must submit more than one application. Creation of new regional parks are prioritized.	Annually	No	High

California Department of Resources Recycling and Recovery Rubberized Pavement Grant Program	$7,750,000	▪ Rubberized pavement projects for roadways, Class I bikeways, greenways, and access at parks	Projects must use a minimum or 3,500 tons of RAC hot-mix and 40,000 square yards of chip seal material	Annually	N/A	Medium
California Strategic Growth Council Transformative Climate Communities Program	$60 million	▪ Transit access and mobility ▪ Solar installation ▪ Water efficiency ▪ Recycling and waste management ▪ Urban greening and green infrastructure ▪ Health and well-being	All projects must meet readiness requirements (CEQA documentation, site control, permits, project maps and designs, etc.)	Annually	N/A	Medium
California Strategic Growth Council Affordable Housing and Sustainable Communities	$30 million maximum per project type	▪ Affordable housing ▪ Pedestrian infrastructure improvements ▪ Bicycle improvements ▪ Transit amenities ▪ Urban greening	Projects must reduce GHG emissions and reduce vehicle miles travelled. Must promote mode shift to low carbon transportation options	Annually	N/A	High
California Strategic Growth Council Sustainable Communities Program	$4.4 million	▪ Land-Use Planning ▪ Transit Planning ▪ Bicycle and Pedestrian Planning ▪ Safe Routes to School ▪ Climate Action Plans ▪ GHG Reduction Programs ▪ Natural Resource Plans	Applicants must identify which category they wish to apply their projects for	Annually	N/A	High
Caltrans State Transportation Improvement Program	Caltrans presents funds in June every other year	▪ Transit and Rail projects ▪ Bicycle and Pedestrian projects ▪ Multi-modal corridor projects ▪ Transportation Management System Improvements	Priority is given to projects that build climate preparedness and reduce GHG emissions	Every two years	11.5%	High
California Department of Parks and Recreation Habitat Conservation Fund – Trails	$2 million	▪ Wetlands restoration ▪ Trails development ▪ Acquisition of habitat ▪ Protect endangered, threatened, or fully protected species.	Project must bring urban residents into park and wildlife areas, protection of various plants and animal species	Annually	50%	Low
Coastal Conservancy Proposition 1 Grant	$100.5 million	▪ Wetland restoration projects ▪ Sustainable forest projects ▪ Climate adaptation projects ▪ Water quality and water protection	Projects must be consistent with the Conservancy's legislation, support the Strategic Plan	Annually	25%-50%	Low
California Transportation Commission Local Partnership Program	$200 million	▪ Transit facility improvements ▪ Safety and operational improvements ▪ Corridor improvements ▪ Bicycle and pedestrian safety improvements ▪ Environmental mitigation improvements	Projects are given priority if can show implementation earlier. Projects show they can demonstrate air quality improvements	50%	Annually	High
Caltrans Transportation Development Act	$1.9 billion	▪ Planning and program activities ▪ Bicycle and pedestrian facilities ▪ Transit services ▪ Public transportation Projects ▪ Bus and rail projects	Projects are given funding priority if they can demonstrate offsetting the increase in cost of fuel, enhance existing public transportation services, and meet high priority transportation needs	Annually	70%-80%	High
California Resilience Challenge	$1.5 million; $100,000-$200,000 for individual grants	▪ Diverse, replicable and innovative climate change adaptation planning projects	Preference for projects that will lead to implementation of resiliency infrastructure, will require broad community support, and significantly serve under-resourced communities.	July 31,2022-July 31,2024	Per project	High

REGIONAL AND LOCAL FUNDING SOURCES						
Name	**Amount Available**	**Types of Eligible Projects**	**Key Eligibility Factors**	**Frequency**	**Local Matches**	**Priority Assessment**
Metro Local Return Program (Measure A, C, R, & M)	$500 million	▪ Public Transportation improvements ▪ Congestion management ▪ Bicycle facilities ▪ Street improvements ▪ Safe Routes to School	Project must comply with Metro's ordinance	Annually	N/A	High
Safe, Clean Water Program (Measure W)	$ 285 million	▪ Water quality improvements ▪ Park and wetland improvements ▪ Stormwater/urban runoff mitigation	Projects will be given priority that show a number of different projects that benefit health, including increase stormwater capture, water pollution mitigation, new technology investigation, etc.	Annually	N/A	High
Metro Active Transport Program	$37.7 million between FY 2021-2025	▪ Bicycle and pedestrian improvements ▪ Bicycle and pedestrian safety projects ▪ First/last mile planning ▪ Traffic calming ▪ Transit statin improvements	Projects must be consistent with Metro's First/Last Mile Strategic Plan or the Active Transportation Strategic Plan	Annually	N/A	High
Metro Open Streets Program	$1 million	▪ Street closure events ▪ Public engagement	Events must promote and encourage active transportation use	Annually	20%	Medium
Metro Transit Oriented Development Planning Grant Program (TOD)	$21.6 million	▪ Bicycle and pedestrian improvements around transit stations ▪ Transit station improvements ▪ Corridor studies near transit stations	Applicants must demonstrate the corridor's relevancy to the development of transit supportive planning around the station area	Annually	N/A	Medium
Metro ExpressLanes Net Toll Revenues Reinvestment Grant Program	$22 million-$28 million	▪ Transit projects ▪ Active Transportation ▪ Roadway Improvements	Projects must provide transportation benefits around the I-10 and I-110	Annually	N/A	Low

PRIVATE FUNDING SOURCES						
Name	**Amount Available**	**Types of Eligible Projects**	**Key Eligibility Factors**	**Frequency**	**Local Matches**	**Priority Assessment**
Conservation Fund- The KODAK American Greenways Program	$500-$2,500	▪ Greenway development ▪ Bicycle paths ▪ Surveying ▪ Ecological assessments ▪ Trail planning	Grants will be awarded to applicants that can show the importance of the project to local greenway development	Annually	N/A	High
PeopleForBikes Community Grant Program	$800-$10,000	▪ Bike paths ▪ Trails ▪ Bridges ▪ Bike parks ▪ Bike parking ▪ Programs like Open Street Days	The program will not consider grant requests in which funding would amount to 50% or more of the project budget	Annually	N/A	High
Robert Wood Johnson Foundation	N/A	▪ Planning and demonstration projects ▪ Research and evaluations ▪ Policy analysis ▪ Public education ▪ Community engagement and coalition-building	Applicants must choose a Grant program they wish to apply for	Annually	N/A	Low
The Kresge Foundation	N/A	▪ GHG reduction ▪ Community development ▪ Public outreach ▪ Public education	Applicants must show that their projects will bring out positive change	Annually	N/A	Low
The Bloomberg American Cities Initiative	N/A	▪ Climate change mitigation ▪ Sustainable cities ▪ Road safety ▪ Research ▪ Autonomous vehicles ▪ Education				
Bloomberg Philanthropies Asphalt Art Initiative	$25,000	▪ Asphalt Art ▪ Pedestrian plazas ▪ Murals on underpasses, utility boxes, etc.	Cities must have a population between 30,000 and 500,000. The project must address a challenge faced by the identified site (traffic safety, underutilized public space, etc.) The project must provide community engagement	Annually	N/A	Low

Appendix D:
Unit Costs

The unit costs below represent typical elements that may be included in a wide range of streetscape enhancements that can incorporate cool tools and strategies.

	DESCRIPTION	UNIT	COST ASSUMPTION	Notes
ROW PAVING, SIGNAGE, STRIPING + SIGNALS				
	Class I Shared-Use Path	MI	$1,500,000	
	Sidewalk, Curb, Gutter	SF	$30	Assumes 6' sidewalk and excavation for stormwater/tree root vault system
	ADA Curb Ramps	EA	$25,000	
	High Visibility Crosswalk	EA	$5,000	One leg, cost varies by length and color of crosswalk
	Transverse Crosswalk with Advance Stop Bar	EA	$3,000	One leg, cost varies by length of crosswalk
	Full depth excavation and re-paving of AC roadway	MI	$300,000	Assumes one 11' lane of travel
	Full depth excavation and re-paving of sidewalk	MI	$250,000	Assumes 6' sidewalk
	Mini-Roundabout with Planting	EA	$75,000	
	Pedestrian Refuge Island	EA	$50,000	Varies on length and width of island; this estimate assumes 10' wide planting area
	Traffic Signal System - HAWK	EA	$400,000	
	Traffic Signal System - RRFB	EA	$60,000	
	Bicycle Loop Detection	EA	$3,000	
	Sign and Post	EA	$500	
	Parking Restrictions	LF	$60	Assumes painted curb and signs
	Advanced Yield/ Stop Lines	EA	$2,000	
	Pedestrian Crosswalk Motion Sensor	EA	$20,000	Per leg of crosswalk
	Traffic and Pedestrian Signal (leading Ped Intervals)	LS	$500,000	Per intersection. Cost varies by type of change and equipment required
UTILITIES				
	Utility pole relocation	EA	$50,000	
	Catch basin remodel	EA	$30,000	
	Stormdrain and manhole relocation	EA	$10,000	
SITE FURNISHINGS				
	Bike Racks	EA	$1,560	
	Bike Lockers	EA	$2,500	
	Bench	EA	$2,600	
	Transit Waiting Area Improvements/ Bus Shelters	EA	$400,000	Varies by type of improvement
	Shade structure (custom)	EA	$260,000	Approximately 30x40' - Estimate per USA Shade
	Hydration Station	EA	$10,000	Assumes existing water line available to tap into
LANDSCAPE + IRRIGATION				
	36" Box Street Trees	EA	$1,200	
	Understory planting	SF	$16	
	Self-watering planter pots	EA	$900	
	Soil (planting areas)	CY	$65	
	Tree root vault cells + soil	EA	$130	City Green Strata Vault cells used for this estimate. 2'x2' units, a minimum of 2 deep. Recommended minimum 6'x6' vault per tree, can extend beneath sidewalk, bikeway, parking to widen area for root growth, which will improve tree longevity and health.
	Irrigation equipment	EA	$10,000	
	Irrigation	SF	$16	
	Deepwell irrigation	EA	$1,950	
Notes:	20% Contingency, 5% Mobilization and 5% Traffic Control is included in unit costs.			
	Design, Environmental and Construction Management, costs are not included in this estimate. Additionally, storm drain and utility relocations are not included.			

Appendix E: Maintenance Matrix

Maintenance Task	Public Works	Engineering	DOT	Transportation Planning	Certified Arborist on-staff internally, or contracted externally?	Business Improvement Districts	Individual Land Owners	Office of Equity
IRRIGATION								
Irrigation installation, removal, replacement	◆					◆		
Hand watering	◆					◆	◆	
Irrigation Inspection	◆					◆	◆	
STREET TREES								
Mulch/wood chip installation and replenishment	◆					◆	◆	
Leaf litter removal	◆					◆	◆	
TREE PRUNING								
Annual tree pruning					◆			
Tree installation, removal, or replacement					◆			
Periodic maintenance of trees & vegetation to keep clear from bike and pedestrian paths	◆							
GREEN INFRASTRUCTURE								
Inspect and clean litter and debris in green infrastructure and inlet and outlets, grates, and filters	◆							
Shrub/understory planting installation, removal, or replacement	◆							
Inspect system after rain events	◆							
Mulch/wood chip installation and replenishment	◆					◆	◆	
Subgrade stormwater storage systems: inspect regularly, at least annually	◆							
Installation of curb extensions, planted center medians,	◆							
Repair storm damage after rainy season	◆							
SHADE STRUCTURES								
Installation, removal, or replacement	◆					◆		
Inspected on a regular basis to confirm: operability of mechanical parts and condition of materials and parts and structural integrity	◆							
Keep free of vandalism, refer to manufacturer specs	◆							

Maintenance Task	Public Works	Engineering	DOT	Transportation Planning	Certified Arborist on-staff internally, or contracted externally?	Business Improvement Districts	Individual Land Owners	Office of Equity
ROADWAY								
Street sweeping	◆							
Roadway resurfacing/ slurry seal application	◆	◆						
Cool Paving application or re-application	◆	◆						
Permeable paving installation and maintenance	◆	◆						
STREET FURNISHINGS								
Installation, removal, or replacement	◆					◆		
Inspection & graffiti removal	◆					◆	◆	
Remove abandoned objects	◆					◆		
Inspect & maintain water features (e.g. drinking fountains, fountains, splash pads, public restrooms) for plumbing issues	◆					◆		

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