Main Street, California

A Guide for People-Centered State Highway Main Streets

It is my pleasure to present the fourth edition of *Main Street, California: A Guide for Fostering People-Centered State Highway Main Streets* (Main Street). This document talks about the special importance of State Highways that are functioning as community main streets. "People-centered" main streets are those that are sustained in ways that elevate the needs of people who use main street. They are fostered with an understanding that supporting travel of all modes is essential, and that main streets are also community places that people value. People-centered main streets improve safety, equity, economic prosperity, and support climate actions that are so urgently needed. People-centered main streets contribute to community quality of life and provide people of all ages and abilities the freedom to comfortably choose the mode of travel that best suits their needs.

The intent of "Main Street" is to inspire discussions that lead to collaboration, creative problem-solving, and a shared vision. Whether you are a member of Caltrans, a partner agency, community organization, and/or a member of the public, we all have an important role to play in making California's main streets shine. Thank you for your interest in "Main Street" and thank you for the important role you play in ensuring that our State Highway main streets help improve the vitality of communities and the transportation system.

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TABLE OF CONTENTS

INTRODUCTION

Main streets are unique and special places. They deserve special consideration by the people who shape them. We all need main streets to support multimodal travel, and we also need main streets to be places that can support the large and small events that make life rich.

Imagine a main street that is an enjoyable part of a commuter's trip to work, a comfortable route for kids to walk or bike to school, and a street that is accessible to people of all abilities. Now imagine a main street that is also a place where people are traveling *to*. Main streets can be a place where community members want to bring their out-of-town guests to visit, a place where residents can gather with friends outside, a place for holiday parades, and a place where people run into neighbors, spontaneously strengthening the social bonds that make a neighborhood great. Main streets can be designed and sustained to improve equity and livability; to help people prosper personally and collectively.

Cultivating a main street that is fully functional for all modes of travel and that is also rich and alive with community life is no small task. Designing a successful main street cannot be achieved through engineering alone—it is a complex, collaborative, and creative endeavor. It starts with imagining a main street where we would want to be and then being curious enough to find out what others think. There are no easy answers, and there may be more than one answer. This document does not provide instructions on what to build. Instead, "Main Street" talks about the importance of multidisciplinary expertise and the wisdom of the people who use main street regularly. It discusses the possibilities for main street, and explores the types of questions that need to be asked to foster a main street that helps people, communities, and the transportation system thrive.

CHAPTER 1

MAIN STREET PRINCIPLES

A California State Highway (State highway) main street is a State highway that is functioning as a community street.

A California State highway main street serves as a community street that provides access to local destinations along the street. It is vital that people have safe and comfortable options to travel on main street on foot and by bicycle, public transit, assistive devices, micromobility modes (such as scooters), and motorized vehicles to important destinations. Main streets are also destinations in their own right, serving as public spaces for the community.

A challenge with many State highway main streets is that they often serve as both a community street and a distributor street. A State highway that is functioning as a community street is generally a lower speed facility that provides direct access to residences, businesses, and other abutting property types. Distributor streets, also called arterials or collectors, are intended to link regions and are therefore often higher-speed facilities with more limited access to local destinations. Main streets that are tasked with serving as both a community street and a distributor street face complex planning and design decisions about how to foster main streets that support multimodal travelers, improve conditions for nonmotorized road users, support the local needs of the community, and support connections between regions.

Main Street, California emphasizes the need to address competing needs with thorough site analysis and meaningful engagement with partners and community members.

State highway main streets (hereafter, main streets) exist in communities of all sizes, including cities, suburbs, and small towns. There are distinct qualities, needs, and opportunities on different main streets, and separate sections of a main street can possess different characters that require different design solutions. What all main streets have in common is that they deserve special attention to make sure that they are functioning well for the people who use them. This attention includes thinking of main streets as places that support both multimodal travel and community well-being.

To meet the challenges and opportunities of main-street-related projects, there are five guiding principles that apply to conversations and decisions about main streets (see next page).

Top: Pedestrians cross the street on Route 116 / Main Street in Sebastopol.

The five guiding principles in "Main Street" reflect current State and California Department of Transportation (Caltrans) strategic goals to foster people-centered transportation infrastructure; improve safety and public health; elevate equity and livability; advance sustainability and climate action; and engage communities, partners, and stakeholders. This chapter illustrates how these five principles apply to main streets.

Principle 1: Champion People-Centered Main Streets

Main streets are places for people

Principle 2: Improve Safety and Public Health

Main streets can advance safety and public health goals

Principle 3: Elevate Equity and Livability

Main streets can improve quality of life for all

Principle 4: Advance Sustainability and Climate Action

Main streets can address the climate challenge

Principle 5: Strengthen Partnerships and Engagement

Main streets thrive through collaboration

Principle 1: Champion People-Centered Main Streets

Main streets are places for people

MAIN STREETS ARE FOR PEOPLE

A people-centered main street is one that improves the quality of life for the people who use the space. Main streets can meet people's needs by both supporting multimodal mobility and preserving or creating a space that supports and enriches daily life. Developing a shared vision for main street is a collaborative process that engages the community and stakeholders. The following paragraphs describe some of the people that have a vested interest in main streets.

Community members have firsthand knowledge and practical experience about what it is like to live in their community and travel on their main street. They likely have insights and opinions about what is working well and what they would like to see improved. There may be local differences of opinion about which roadway features they would prefer, but everyone deserves community places and travel facilities that are inviting, safe, and comfortable.

Workers on main street include people who own or work for a main street service or business, people who maintain the public realm and roadway, first responders, delivery drivers, couriers, and transit drivers. They each have a unique set of needs and experiences that are important to address in planning and design decisions.

Multimodal travelers include pedestrians, bicyclists, public transit riders, micromobility riders, and motorists (in private, commercial or public vehicles such as cars, motorcycles, emergency response vehicles, trucks, buses, vans, and recreational vehicles).

All Ages and Abilities

Caltrans Director's Policy 37: Complete Streets (DP 37) emphasizes that transportation should serve people of all ages and abilities: "...the 'all ages and abilities' concept strives to serve all users—regardless of age, gender, race, or ability and inclusive of the mobility needs of children, older adults, and people with disabilities—by embodying national and international best practices related to traffic calming, speed reduction, universal design, and roadway design to increase user safety and comfort, and accessibility for people with disabilities."

Travelers with Disabilities

Since main streets are important community routes and destinations, it is especially important that access is provided for all travelers. Careful attention to site conditions and accessible design solutions can provide mobility for travelers with disabilities, ensuring that the transportation system is truly accessible to all.

The federal *Americans with Disabilities Act* (ADA) and the *California Government Code (*CGC) prescribe that facilities shall be made accessible to persons with disabilities. Caltrans Design Information Bulletin (DIB) 82 "Pedestrian Accessibility Guidelines for Highway Projects," provides current design guidance on compliance with the various federal and state laws that relate to pedestrian accessibility. The *Highway Design Manua*l (HDM) also discusses ADA design requirements in detail.

Transit Riders

A sustainable multimodal main street offers access to public transit and connections between modes of travel. Public transit improves community livability by increasing access to civic, commercial, and employment destinations. Public transit also provides essential mobility to people who would not be able to travel far on their own, including people with mobility impairments or from low-income households, older adults, students, and others.

Public transit is also a fundamental component of sustainable transportation because public transit makes it possible to reduce the number of single-occupancy vehicle trips. When travelers are able to replace single-occupancy vehicle trips with public transit, there are measurable environmental and public health benefits. Reducing the number of vehicles on the road can improve air quality by reducing congestion and greenhouse gas (GHG) emissions. Use of public transit also usually

involves some accompanying form of active transportation, such as walking, using an assistive device, or biking from a transit stop to a final destination.

During planning and design of main street infrastructure, elements that support the operation of transit on main streets should be evaluated. The costs associated with constructing transit-related features may be the responsibility of the transit agency, local jurisdiction, Caltrans, or a combination of agencies. Although Caltrans does not operate transit services, main street projects may be able to include features that improve access to transit facilities and improve transit reliability and travel times. Partnerships between Caltrans and transit providers will ensure that transit-related issues are addressed and resources are shared to coordinate system improvements on main streets. Coordination among agencies is important to assess existing and needed transit facilities and to evaluate all applicable planning documents (such as general plans and short- and long-range transit plans). Incorporating transit improvements into early planning documents increases the likelihood that such improvements are added to main street projects.

Tribal Governments and Native American Communities

California is home to many Native American Tribes, and Caltrans acknowledges these tribes as unique and separate governments within the United States. Caltrans adheres to government-to-government relationships when interacting with federally recognized California Native American Tribes (Tribal Governments) and consults with Tribal Governments about actions that impact tribal communities. As stated in *Director's Policy No. DP- 19: Working With Native American Communities* (DP-19): "Native American communities include lands held in trust by Tribal Governments, communities of non-federally recognized tribes, tribal members of California tribes living outside the exterior boundaries of a reservation or rancheria, and Native Americans who are not part of a California tribe living in California."

Stakeholders

Stakeholders for main streets are people who are impacted by main street project decisions. Stakeholders can include individuals, organizations, and both governmental and nongovernmental entities. Examples of stakeholders include community members and organizations; public and commercial multimodal travelers; local, state, federal, and tribal planning agencies; elected officials; advocacy and civic interest groups; local businesses; officials from other public agencies such as school districts and emergency responders; and multidisciplinary professionals from areas such as maintenance, traffic operations, and construction. Stakeholders are discussed further in *Principle 5: Strengthen Partnerships and Engagement.*

Partners

Partners are generally considered to be organizations or other entities that help plan, deliver, fund, and/or maintain parts of a site, project, service, or program in coordination with Caltrans. For transportation projects, partners are organizations and entities that develop a shared vision with defined roles and responsibilities for projects, services, and/or sites. Partnering is a project approach that is designed to promote open communication, collaborative problem solving, and teamwork between and among participants. Partnering is discussed further in *Principle 5: Strengthen Partnerships and Engagement*.

MAIN STREETS ARE COMMUNITY PLACES

When a State highway is serving as a community street, it must meet a complex set of needs as both a valued public place and a multimodal travel facility.

Every community needs a vibrant core and healthy neighborhoods. Main streets can be powerful public places that serve as the heart of a community, connecting residents and welcoming visitors. Through partnerships that develop a shared vision, main street designs can improve quality of life, contribute to the local economy, bolster a community's history and identity, and offer inviting public spaces where residents feel they belong.

In small communities, main street may be one of only a few public spaces where people can shop, visit public services, or gather with neighbors. In developed areas, streets constitute a large percentage of public outdoor space, making it essential for streets to function as special public places in their own right. In a wide range of community sizes, main street can house a meaningful portion of the local tax base and may house a large number of local employers. Main streets that function well as a public place support people in communities of all sizes.

Top: Pedestrians on Route 28 / North Lake Boulevard in Kings Beach walking to a popular State Park. Bottom: Route 29 / Lincoln Boulevard in Calistoga.

MAIN STREETS ARE PLACES FOR MULTIMODAL TRAVEL

Main streets have a wide range of road users and travel needs to accommodate. Ideal main streets accommodate motorized vehicles in way that also provides comfortable conditions for biking, walking, micromobility modes, and public transit.

Main street environments need to be designed with the expectation that people will be traveling on foot and that they would like the freedom to choose other modes of travel that fit their individual trip requirements and preferences. Strategies related to Complete Streets and traffic calming are commonly implemented on main streets to make them safer and more inviting places to travel by nonmotorized modes.

Complete Streets

A roadway design that makes it safe, comfortable, and physically possible to travel by multiple modes is called a "complete street." The phrase "complete street" describes a physical roadway configuration that provides space and access for a full range of road users, with emphasis on improving conditions for people who walk, bicycle, or take public transit. DP-37 defines a complete street as: "a transportation facility that is planned, designed, constructed, operated, and maintained to provide comfortable and convenient mobility and improve accessibility and connectivity to essential community destinations for all users, regardless of whether they are traveling as pedestrians, bicyclists, public transportation riders, or drivers. Complete Streets are especially attuned to the needs of people walking, using assistive mobility devices, rolling, biking, and riding transit."

Complete Streets also support more equitable transportation options, especially for those that do not own a vehicle.

New travel facilities can be designed to be Complete Streets from the beginning, but many Complete Streets projects entail modifying situations that favor driving conditions at the expense of other road users. Streets are made "complete" by balancing the needs of all users of the system, although individual Complete Streets may not be identical in design or appearance, nor in the modes of travel they accommodate. Depending on local context and environmental conditions, different streets will require distinct physical design features to best address the needs of travelers in that location. On State highway main streets, complete street designs improve walking, bicycling, and transit conditions using features that are discussed in *Chapter 3, Designing Main Streets.*

Traffic Calming

If main streets are dominated by fast-moving vehicles, conditions are less hospitable to nonmotorized road users, and the environment is less inviting to people outside of vehicles. In this case, "traffic-calming" features, which are design interventions intended to slow driving speeds, can be a powerful corrective measure. Slower driving speeds (also called operating speeds) contribute to a safer place to bicycle and walk and make the environment more comfortable for use as a public place. Features related to traffic calming are discussed in *Chapter 3, Designing Main Streets.*

Top: Pedestrian crosses a street while bicyclists wait.

MAKING MAIN STREETS WORK FOR PEOPLE

Developing and sustaining a main street that works well for all road users and functions as a high-quality public place is a rich and complex endeavor. It requires a holistic appraisal of needs, opportunities, and constraints through data analysis, creative problem-solving, and authentic dialogue with partners and stakeholders. Several related concepts that yield prudent decision-making are design flexibility, context sensitivity, sound engineering judgment, and site analysis.

Design Flexibility

Design flexibility is a holistic design and creative problem-solving approach in which sound engineering design decisions are based on analysis of standards and guidelines, safety considerations, site-specific conditions, applicable policies, and stakeholder goals related to multimodal transportation and the local community. Design flexibility is supported and promoted in the Caltrans HDM by the Federal Highway Administration (FHWA) in *Flexibility in Highway Design* and by the American Association of State Highway and Transportation Officials (AASHTO) in *A Guide for Achieving Flexibility in Highway Design* (and other documents). Design flexibility seeks transportation solutions that improve multimodal travel and safety while complementing and enhancing community values and objectives.

Chapter 80 of the HDM states: "Designers have the flexibility to tailor a project to the unique circumstances that relate to it and its location, while meeting driver expectation to achieve established project goals."

Above: A man travels using a three-wheeled assistive device.

HDM Chapter 80 continues: "A "one-size-fits-all" design philosophy is not Departmental policy. Designers need to be aware of and sensitive to land use, community context and the associated user needs of the facility. In some instances, the design criteria and standards in this manual are based on the land use contexts in which the State highway is located, for instance: large population areas and downtowns in urban areas, small rural towns and communities, suburban commercial/ residential areas, and rural corridors. This approach ensures the standards are flexible, and the approach allows and encourages methods to minimize impacts on scenic, historic, archaeological, environmental, and other important resources."

Context Sensitive Solutions

"Context Sensitive Solutions" (CSS) describes a planning and design process that responds to the full context of a site and a project. Defining the context is accomplished by analyzing the physical site conditions (related to transportation, the community, and the surrounding environment), applying relevant policies and goals, and engaging with stakeholders to arrive at a shared vision for a project. Context-sensitive designs are achieved through site analysis, which enables a project to be tailored to a site using design flexibility and sound engineering judgment.

The Director's Policy on CSS states that: "Caltrans uses "Context Sensitive Solutions" as an approach to plan, design, construct, maintain, and operate its transportation system. These solutions use innovative and inclusive approaches that integrate and balance community, aesthetic, historic, and environmental values with transportation safety, maintenance, and performance goals. [CSS] are reached through a collaborative, interdisciplinary approach involving all stakeholders. The context of all projects and activities is a key factor in reaching decisions. Inherent in Caltrans' mission to increase mobility across California is the need for Context Sensitive Solutions that consider collaborative, community-sensitive approaches to transportation decision-making."

Engineering Judgment

Engineering judgment is the evaluation of existing site conditions and other relevant data and the sound application of appropriate project goals, guidance, best practices, and engineering principles. Chapter 80 of HDM states: "The highway design criteria and policies in this manual provide a guide for the engineer to exercise sound judgment in applying standards…in the design of projects. This guidance allows for flexibility in applying design standards and documenting design decisions that take the context of the project location into consideration; which enables the designer to tailor the design, as appropriate, for the specific circumstances while maintaining safety."

The *California Manual on Uniform Traffic Control Devices* (CA MUTCD), Section 1A.13 defines engineering judgment as: "the evaluation of available pertinent information, and the application of appropriate principles, experience, education, discretion, provisions, and practices as contained in this Manual and other sources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device. Engineering judgment shall be exercised by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer."

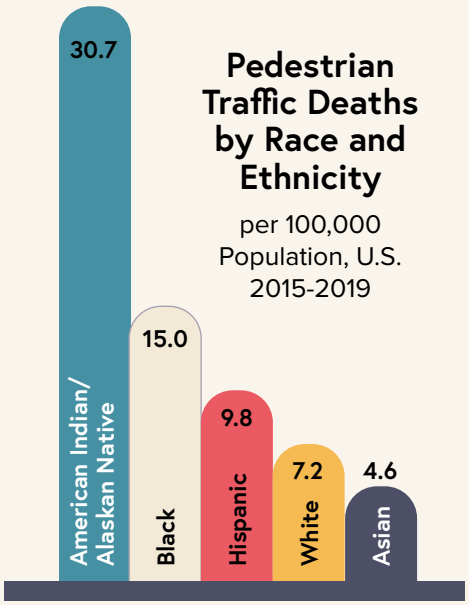
Site Analysis and Engagement

Design flexibility, CSS, and sound engineering judgment are all forms of site analysis. Site analysis gathers data about a physical place, the people who live and travel there, and the policies that apply to the study area to create transportation infrastructure that provides multiple benefits.

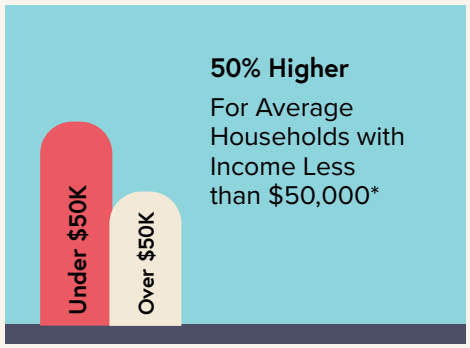
Using site analysis to create places that work well for people requires engagement with the people who use the space. People who live, work, and travel on main street have firsthand knowledge of site conditions, and their assessments about the current strengths and weaknesses of the site are essential discussion points. As stated in DP-22, "Context Sensitive Solutions meet transportation goals in harmony with community goals and natural environments. They require careful, imaginative, and early planning" with "continuous community involvement." The concept of engagement" is discussed further in *Principle 5: Strengthen Partnerships and Engagement* and "Site Analysis" is discussed further in *Chapter 2, Planning Main Streets.*

Principle 2: Improve Safety and Public Health

Main streets can advance safety and public health goals



Data from the GHSA- An Analysis of Traffic Fatalities by Race and Ethnicity



Total Traffic Fatalities: Comparison by Income

**As compared to households with income greater than $50k*

Data from the Caltrans SHSP

SAFETY

Main street communities can benefit from utilizing both "Reactive Safety" and "Proactive Safety" approaches to respond to locations where crashes are already occurring and identify locations with similar characteristics to prevent future crashes.

In 2019, there were more than 3,700 traffic-related fatalities and more than 260,000 people injured on California's roadways. To address this situation, Caltrans is implementing proven methods to improve traveler safety and has adopted a "Safe System Approach," which aims to eliminate fatal and serious injuries for all road users through a holistic view of the roadway system. As described in the *California Safe Roads: 2020-2024 Strategic Highway Safety Plan (2020-2024 SHSP)* and the *Caltrans 2020-2024 Strategic Plan*, this human-centric approach acknowledges that people will make mistakes and therefore implements infrastructure that can accommodate human error and keep the impact energy on the human body at tolerable levels to avoid fatalities and serious injuries. Applying the Safe System Approach on main streets is particularly important to improve safety conditions for communities and nonmotorized road users (e.g., pedestrians and bicyclists).

The Safety First goal in the *State Highway System Management Plan* includes the two objectives noted above, Proactive Safety and Reactive Safety, to reduce fatalities and serious injuries. Reactive Safety projects identify safety mitigations and countermeasures as a result of crash histories. Proactive Safety projects include countermeasures that may reduce the potential for a future crash to occur. These countermeasures can be implemented across the State highway system to address locations that may not have experienced a high rate of crashes but have similar characteristics as the other areas that have higher recorded rates of crashes. This approach can help reduce the occurrence or severity of future crashes by proactively identifying safety improvements.

Safety and Equity

Improving the safety conditions on main streets is a vital step in creating an equitable transportation system. Low-income households and communities of color are more likely to be injured or killed in traffic collisions. As stated in the 2020-2024 SHSP: "Everyone has the right to travel safely on California's

public roads—regardless of race, socioeconomic status, gender, age, and ability." The 2020-2024 SHSP continues: "...equity means taking into account any historical, present-day, and systemic biases so that safety is improved for all groups, particularly our most vulnerable and traditionally underserved populations." Traditionally underrepresented groups include black, brown, indigenous, and other people of color, low-income people, people with disabilities, and people with limited English proficiency.

The Governors Highway Safety Association (GHSA) advises that to address equity-related disparities in traffic fatalities (such as those shown on the exhibits on the preceding page), agencies can "prioritize planning and investment in infrastructure safety countermeasures in underserved and lower socioeconomic communities and neighborhoods." *Director's Policy 36 – Road Safety* directs all Caltrans employees to "prioritize road safety while considering race, age, ability and mode-based equity in transportation outcomes as relevant to their roles."

Traffic Calming

A growing number of communities are interested pursuing traffic-calming strategies, particularly as the prevalence of larger-sized vehicles increases on the road. Excessive speeds combined with heavier vehicles increase the risk to people biking and walking. GHSA states that "although passenger cars are the largest category of vehicles involved in fatal pedestrian crashes, the number of pedestrian fatalities involving SUVs increased at a faster rate—50 percent—from 2013 to 2017 compared with the rate for passenger cars, which increased by 30 percent."

PUBLIC HEALTH

Main streets can be improved to minimize the impacts caused by proximity to transportation related emissions, and improve public health outcomes by providing safe and comfortable places to travel by active modes.

Transportation-related Emissions

Main streets can include trees and vegetation to help clean the air and can support low-carbon or carbon-neutral transportation options to reduce air pollution. Design interventions related to public health are closely connected to creating transportation that addresses equity in the transportation sector. As the U.S. Department of Transportation (DOT) notes: "Low-income and minority communities are more likely to be located near highways and other transportation facilities that produce local reduced air quality, and to suffer from negative health effects such as asthma."

Promoting Active Transportation

Designing main streets to be inviting places to bike and walk and that provide connections to parks, community centers, schools, and other desirable destinations can make active transportation an attractive travel option. As stated in the California Transportation Plan (CTP) 2050, "Chronic illnesses related to lack of physical activity can be mitigated or lessened through increased physical activity, which can be accomplished through transportation modifications that promote active transportation." Well-designed main streets can be a powerful mechanism for encouraging active transportation for daily trips and recreation.

Addressing Climate Extremes

Main streets that include vegetation and street trees sequester carbon and can help reduce air and water pollution. Trees can also help provide shade to road users in hot weather, and shade trees reduce urban heat islands. A heat island is a phenomenon in which developed areas experience hotter temperatures (as compared to nearby rural areas) due to the overheating of pavement and roofs. Heat islands are exacerbated by having less permeable soil, vegetation, and shade which all have cooling benefits. Main streets that include shade and transit shelters can help pedestrians and transit riders maintain safe and comfortable temperatures in hot or stormy weather.

NOTE: Equity is further discussed in Principle 3: Elevate Equity and Livability; Proven Safety Countermeasures & Traffic Calming features are in Chapter 3; Design speed and setting the speed limit are in Chapter 2; Sustainable design strategies are in Chapter 4.

Principle 3: Elevate Equity and Livability

Main streets can improve quality of life for all

A vibrant main street is a place that supports community well-being and mobility for all. Incorporating the principle of equity into main street planning and design describes both a process and a desired outcome.

EQUITY

The CTP 2050 states: "Equity means that all people are justly and fairly included in society and that everyone is able to participate, prosper, and achieve their full potential. It recognizes that everyone enjoys different advantages and faces different challenges, and that everyone should be treated justly and fairly according to their circumstances. Equity is an overarching value and goal within Caltrans to reaffirm our commitment to address the systemic racial inequities that exist within the public transportation sector."

Implementing equity requires acknowledging that we've inherited a transportation system that disproportionately benefits some communities while burdening others.

As stated in the California State Transportation Agency (CalSTA) Equity Statement: "Transportation planning and investments have historically contributed to systemic inequities that "quite literally put up barriers, divided communities, and amplified racial inequities, particularly in our Black and Brown neighborhoods." And these historical inequities have present-day impacts. The CalSTA Racial Equity Statement points out that "Californians living in historically underserved communities are today more likely to be negatively impacted by increased exposure to air pollution and noise from transportation. They are also more likely to be struck or killed by drivers when walking and biking. Such vulnerable communities may have limited access to safe and affordable transportation options to connect residents to jobs, education, healthcare, food, and recreation."

Implementing equity as an action includes involving people who have not always been considered or invited to participate

in planning and design discussions related to transportation. Addressing the reality that some communities have historically lacked beneficial transportation investments while shouldering a disproportionate level of the negative impacts of transportation projects requires engagement with underserved communities to develop design solutions.

Main streets that are planned, designed, and operated with an emphasis on equity seek to repair sub-standard transportation conditions and bolster community well-being. A high-functioning main street helps people achieve economic prosperity by enabling them to get to destinations and opportunities safely, efficiently, and by the travel mode of their choice. A well-designed main street can attract and retain local businesses such as groceries, restaurants, and other services. Above all, a well-designed main street is developed with public input through a process that elevates the needs and goals of people who are most lacking a high-functioning transportation system and public realm.

The mural “Oakland Super Heroes #3,” beautifies a city street under the MacArthur Freeway (Interstate 580) in Oakland. Artists: Attitudinal Healing Connection, Inc. More information about the Caltrans Transportation Art Program is provided in Chapter 3.

Addressing equity in transportation is a federal and state strategic goal, including in the California Transportation Plan (CTP) 2050. The "Advancing Equity" goal in CTP 2050 has three objectives that can be implemented in main streets projects:

1. Improve transportation-related economic, environmental, and public health outcomes for disadvantaged communities.
Attractive and comfortable main street environments can help retain and attract local businesses like grocers, retail establishments, and dining options, which benefit the local economy by providing needed services. Main street businesses can help keep revenue in the community while providing local employment. Main streets can also be developed to provide safe and comfortable active transportation options. Bicycling and walking can improve cardiovascular health and provide a nonpolluting transportation option. Main streets can include street trees and landscaping to help clean the air and storm water.

2. Improve access to a range of high-quality, safe, and affordable mobility options within disadvantaged communities.
Main streets can be developed to support all travel modes, including low-cost transportation options. Where auto-dominated main streets are discouraging or preventing other travel modes, Complete Streets and traffic-calming features can provide people with the freedom to choose the travel mode that fits their trip requirements and their financial needs. Partnerships with transit agencies can help create main street environments that support transit riders by providing space for people to board transit, and shelters to protect people from the elements while they are waiting.

3. Support efforts to include disadvantaged communities in an active and direct role in transportation decision-making.
The CSS process relies on partnerships and collaboration with disadvantaged communities to ensure that historically excluded voices are included in the decision-making process for main street goals and projects.

LIVABILITY

Livability refers to the degree to which the public realm improves the quality of life for people who use the space. Transportation facilities that improve livability are inviting, accessible to all travelers, contribute to improved public health, and enhance economic, community, and environmental vitality. Livable neighborhoods require that streets function as transportation facilities and viable public places. Communities may have goals of preserving historic or unique elements along main streets, supporting local businesses, and energizing public spaces for civic activities and community celebrations such as parades and special events.

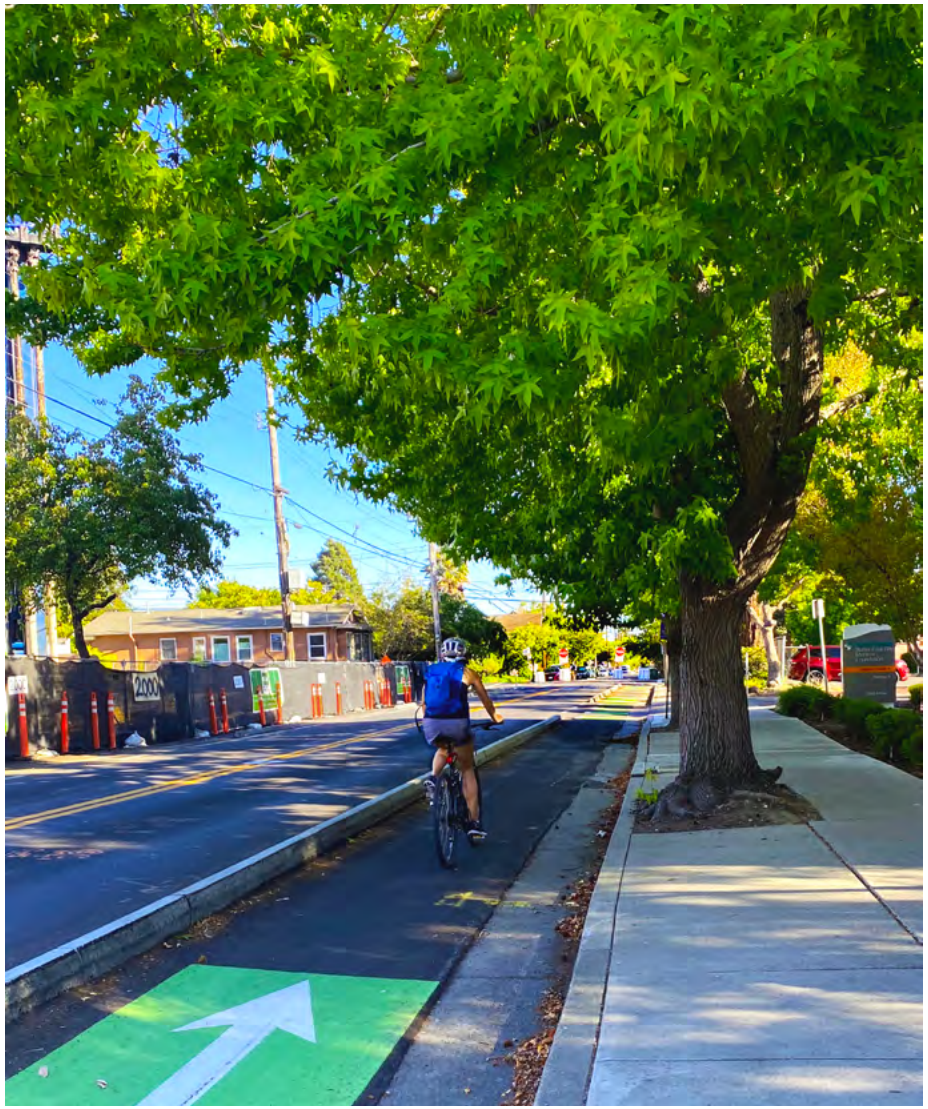
Actions to improve livability on main streets can include preserving elements that a community prizes and/or improving conditions to support active modes of travel and community well-being. The goal is to foster transportation infrastructure that helps make places more livable, sustainable, and economically viable.

In the context of transportation projects, improving livability affects practical aspects of civic life, such as providing connections between homes and employment centers. Overall, livability also encompasses issues that are harder to quantify, such as community cohesion and social bonds. Inviting main streets provide spaces where community members can gather and solidify relationships through planned and spontaneous meetings. Transportation improvements alone cannot address every component of livability, but they can significantly bolster community efforts to preserve, repair, or create a rich and unique sense of place.

Main streets that are comfortable for walking and bicycling that also include inviting street features such as trees, landscaping, and street furnishings are more likely to function as successful multimodal facilities, livable neighborhood centers, and desirable locations for visitors and businesses. Developing livability improvements that benefit underserved communities is an important mechanism for ensuring that transportation facilities improve quality of life for all Californians. *Chapter 3, Designing Main Street* describes specific roadway and roadside features that can improve main street livability.

Principle 4:
Advance Sustainability and Climate Action

Main streets can address the climate challenge



In transportation projects, sustainability balances safety and the life-cycle requirements of transportation facilities with stewardship of natural, social, and economic resources.

Main streets that support sustainable transportation systems encourage low carbon or carbon-neutral travel options to reduce emissions and vehicle miles traveled (VMT). Providing comfortable conditions for biking, walking, and taking public transit gives people the freedom to forgo a motor vehicle trip when they choose. Since many daily trips are 2 miles or less, creating infrastructure that supports nonmotorized options close to homes and main street locations is a powerful mechanism for achieving sustainability and climate-related goals.

The inclusion of site and climate-appropriate trees and landscaping on main street provides sustainability related benefits such as helping to clean air and storm water, promoting storm water infiltration, and supporting and local wildlife such as birds and pollinators. Vegetation also improves the visual appeal of main streets and makes them more attractive places to bicycle and walk.

Left: A Class IV Bikeway in Berkeley provides a low-stress bicycling facility, and trees provide shade, carbon sequestration, and seasonal beauty.

"We don't talk enough about how race, economic factors, access to the outdoors, and climate change are linked, but there are many clear examples of how they interconnect. A 2021 article in the Los Angeles Times captured this concept well, showing how tree canopies in Los Angeles helped stave off stifling heat. The Times found that these tree canopies were almost exclusive to wealthier neighborhoods, where homes were well equipped with air-conditioning systems.
Poorer neighborhoods lacked both trees and air-conditioning. For people with limited or no access to cooling or shade, extreme heat can be dangerous—even deadly. For this reason, as we map out our actions to combat the increasing threat of climate change, we must prioritize investments in communities most vulnerable to extreme heat."

-Wade Crowfoot
California Secretary for Natural Resources

REDUCING VEHICLE MILES TRAVELED

The U.S. Environmental Protection Agency states that, "Car trips of under a mile add up to about 10 billion miles per year, according to the 2009 U.S. National Household Transportation Survey." Replacing single-occupant driving trips with walking, bicycling, or taking public transit has numerous environmental and public health benefits.

Supporting Mode Shift

Creating active transportation infrastructure that is inviting and comfortable to the widest number of people is essential to enabling people to choose to bike, walk, and take transit. Research shows that most people prefer walking and bicycling on routes with wider sidewalks or bikeways, and on facilities that offer physical separation from traffic (accomplished with curbs, landscaped buffers, or other features). When active transportation routes are unavailable or if the route makes people feel uneasy, they are more likely to drive even for a short trip. Advancing climate-related sustainability goals therefore requires physical conditions that make nonmotorized trips possible and comfortable.

Coordinated Efforts

Partnerships with local agencies and organizations can facilitate coordinated transportation and land use decisions that create a main street that is attractive to businesses and public services. Locating public services, retail, and employment opportunities within bicycling and walking distance to residents supports goals to reduce VMT.

Above: Separate facilities for biking and walking, plus a landscaped area that buffers people from vehicular traffic creates a comfortable and inviting travel route for nonmotorized travelers on Route 123/San Pablo Avenue in Albany.

SUSTAINABILITY AND EQUITY

The emphasis on sustainability and climate action is of heightened importance in underserved communities. Increasing access to active transportation facilities, improving safety for nonmotorized road users, and planting trees and vegetation to provide shade and improve air and water quality are important ways to improve equity for low-income people and communities of color. Engagement efforts that develop a shared vision for sustainability-related features are important to ensure that main street investments meet a community's needs.

SUSTAINABLE MATERIALS AND METHODS

Streets themselves can be designed and operated to include techniques or materials that support sustainability. Chapter 4, Green Main Streets, highlights roadway and roadside features can support ecological health and highlights construction techniques and materials that can minimize negative impacts on the environment.

Main streets that are planned to support local and regional sustainability goals and that also include features or materials that contribute to ecological health will have the greatest number of sustainability benefits for the state and local communities.

Left: Trees provide shade to bicyclists on a Class IV bikeway and contribute to cooler and cleaner air on a city street near the District 7 Caltrans office in Los Angeles.

Principle 5: Strengthen Partnerships and Engagement

Main streets thrive through collaboration

Fostering and supporting a high-functioning main street can encompass a wide range of activities and efforts such as repairing, preserving, or connecting community main street spaces; retrofitting a main street to include more Complete Streets and green streets features; working with local partners to align transportation infrastructure with community goals; performing maintenance work; supporting community efforts to hold events on main streets; and other activities and projects.

Developing and sustaining a vibrant main street requires collaborative dialogue and shared decision making. The creation of a successful main street is not a one-time event, it is an evolving series of interventions and preservation activities that meet the needs of the people who use the space. Therefore, the dynamic evolution of a main street cannot be accomplished by any one entity, but requires authentic dialogue among interested parties, with emphasis on underserved communities.

There are likely to be competing demands for limited right of way and different opinions about how to prioritize uses. These negotiations and conversations help foster a main street that balances the multiple roles that main streets play in transportation and the community.

Above: Leadership and staff from Caltrans, local government, partner agencies, and community members gather at an outdoor event.

Stakeholders

People who use main street have firsthand knowledge about travel and public realm conditions. Engaging with stakeholders and community members is an important component of gathering data that is relevant to planning and design efforts. A stakeholder may be anyone who is impacted by the physical design and operation of main street.

Equity and Underserved Communities

Community engagement is a process of developing a shared vision for transportation projects with people who are impacted by the project due to geographic proximity or other association with the project area. An inclusive process enables people with diverse knowledge and experiences of the area to feel that their input is welcome and valued. Meaningful participation of stakeholders, including traditionally underserved communities, relies on a well-designed Community Engagement Plan. The plan identifies key stakeholders and establishes goals and intended outcomes for engagement and participation. "Implementing equity" describes both a process of elevating marginalized voices and the intended outcome of investing in infrastructure to help all Californians and visitors thrive.

Collaborative Options for Funding, Maintaining and Operating Main Street

Arriving at a shared vision for how to incorporate livability and sustainability principles into main street projects requires a creative and collaborative approach. Some design solutions will be familiar or slight variations on traditional strategies, but others will entail a new and broader vision of how main streets can benefit travelers and the local community.

Successful implementation of this expanded view of main streets may require collaboration not only during planning and design but also during construction, operation, and maintenance. Since transportation solutions will vary from place to place depending on local context, transportation needs, and the vision of the local community, it is important that early planning efforts include discussion of each partner's goals, needs, abilities, and limitations.

To best serve community needs, some main street elements may need to be funded, designed, constructed, maintained, and/or owned by local agencies. Caltrans and stakeholders must determine financial and maintenance activity commitments for proposed design elements during early planning and project development. Collaborative negotiation that identifies constraints and assigns roles and responsibilities (for various operational activities, roadway features, and their associated funding) enables appropriate transportation decisions for the design of main streets. "Maintenance Agreements," "Cooperative Work Agreements," and "Relinquishment: Options for Ownership" are discussed in *Chapter 2, Planning Main Streets.*

Engagement and Outreach

Outreach and engagement can include face-to-face events like presentations and meetings or virtually with surveys, public meetings, geospatial data collection, and other online platforms. Providing multiple ways to participate helps people engage at the scale and level that matches their interest and availability. Engagement and outreach are discussed further in *Chapter 2, Planning Main Streets.*

CHAPTER 2

PLANNING MAIN STREETS

Main street planning begins with identifying broad transportation goals for multimodal networks, sustainability, and livability. Long-range planning evaluates transportation corridors that connect regions across the state. It is followed by district-level and project-specific planning, which considers regional impacts and site-specific context and conditions.

The following chapter describes how site analysis is used to determine main streets needs and opportunities, and helps identify planning and design solutions that improve multimodal travel and quality of life.

SITE ANALYSIS

Site analysis gathers data about a physical place, the people who live and travel there, and the policies that apply to the study area. This evaluation leads to Context Sensitive Solutions. Site analysis is conducted at various scales, including regional-, corridor-, and project-level planning and design stages.

Main Street Site Analysis

Site analysis gathers data about a physical **place**, the **people** who live and travel there, and the **policies** that apply to the study area. Initial data collection can come from recorded sources such as maps, planning documents, reports, as-built plan sets, and databases. Getting a full data set requires in-person activities too, like visiting the site and engaging with stakeholders. Site analysis studies how to implement goals associated with a site such as state laws, Caltrans policies, local plans, and pertinent state, local, and national guidance.

Analyzing available data, applicable policies, and community goals for main street provides a foundation for making effective planning and design decisions.

Crucial to main street environments is the concept that main streets are not only transportation facilities but also public places for people in the community. Therefore, a full site analysis analyzes conditions beyond those just related to transportation and asks, How well is this main street functioning for multimodal travel and as a public place?

Although there may not be a final product or deliverable that is overtly labeled as a "site analysis," the findings of these evaluations are routinely included in planning and design documents. The following pages describe many of the topics and questions that are important to address broadly in larger-scale planning efforts and then with more specificity as individual projects are identified.

WHAT IS SITE ANALYSIS ?

Site analysis can be conducted at a variety of scales. A "site" can be defined at the scale of a region, corridor, neighborhood, or specific project location.

REGION

Site analysis can occur on a broad scale. The "site" can be a geographic, jurisdictional, or environmental region.

CORRIDOR

The principles of site analysis can be applied at the level of a transportation corridor to evaluate existing and desired conditions.

NEIGHBORHOOD

Neighborhood-level plans conducted by local governments can incorporate site analysis principles to identify a community's existing and desired conditions.

PROJECT

Site analysis that occurs at the project level is more detailed and focused than evaluations at the levels of the regional corridor or the neighborhood.

When is Site Analysis Conducted?

Site analysis is an evaluation process that is conducted at different scales within a project life cycle. Evaluations begin at the state, regional, and corridor level and become finer-grained in the following project planning and design phases. In sequence, a "site" may begin as a region, Caltrans district, or transportation corridor (a section of highway route that runs through one or more jurisdictions), and as needs are identified, the site becomes a more constrained physical location or project site.

WHAT IS SITE ANALYSIS ?

THE FOCUS

1 PEOPLE

2 PLACE

3 POLICIES

Site analysis includes gathering and studying important information related to the people, place, and policies associated with the study area.

THE METHOD

a RESEARCH

b VISIT

c ENGAGE

Site analysis is accomplished through conducting research, visiting the site, and engaging people.

What Does Site Analysis Accomplish?

Site analysis helps define which existing conditions need to be improved and helps arrive at a shared vision for which solutions will best address community needs, travel conditions, and real-world constraints. Often, there is more than one condition that could be improved and site analysis helps pair prioritized needs with the most effective responses. Site analysis informs conversations between project teams and stakeholders, which are especially important when there are multiple alternatives to consider. Ideally, site analysis facilitates projects that are tailored to the site and meet multiple needs. Tailoring a plan or design to a site is known as developing a Context Sensitive Solution.

CONTEXT SENSITIVE SOLUTIONS

At its core, site analysis reveals that there are not "one size fits all" solutions for transportation projects. The best projects are tailored to the physical opportunities and features of the site and implement policies and goals in a manner that is consistent with the desires of the local community and transportation stakeholders.

Understanding and defining the context of a study area requires gathering information about the physical and social characteristics of a location. Some observations about the natural and built environment can be made directly by the project team, but other important information can only be gathered by engaging with stakeholders and the community. Finding out what gives an individual place meaning to stakeholders and partners is crucial to developing Context Sensitive Solutions.

There are likely competing desires for how to allocate space in a limited right of way, and Context Sensitive Solutions are developed through authentic dialogue with the people who live, work, and travel in the project area.

THE FOCUS

PEOPLE, PLACE, POLICIES

1 PEOPLE

Community members, road users, stakeholders

COMMUNITY

» Community members & organizations
» Underserved communities
» Local businesses
» Public officials & organizations

ROAD USERS

» Multimodal travelers
» Transit riders & operators
» Freight & emergency personnel
» Equestrians

ADDITIONAL STAKEHOLDERS

» Multidisciplinary experts
» Partners
» Additional stakeholders

2 PLACE

The built and natural environment

NATURAL ENVIRONMENT

» Geography & topography
» Local climate

BUILT ENVIRONMENT

» Community place type & local land use
» Locations & destinations
» Transportation infrastructure
» Connectivity & accessibility
» Opportunities for safe system improvements

3 POLICIES

Umbrella term for laws, policies, targets, plans, & guidance.

POLICIES SET BY AGENCIES AND GOVERNING BODIES SUCH AS:

» Caltrans
» Local governments
» Tribal governments
» State entities
» Federal entities

THE METHOD

RESEARCH, VISIT, ENGAGE

PEOPLE

PLACE

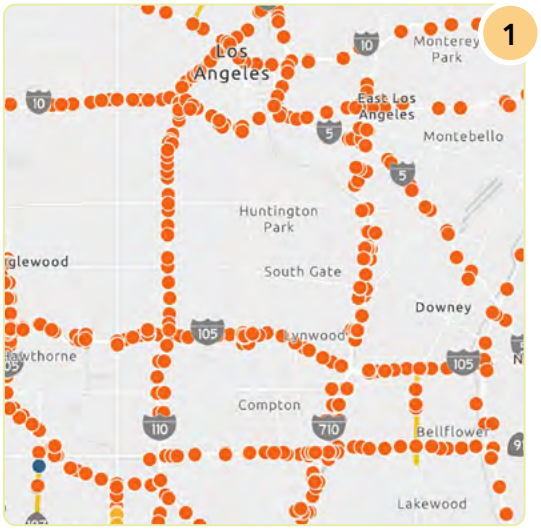
POLICIES

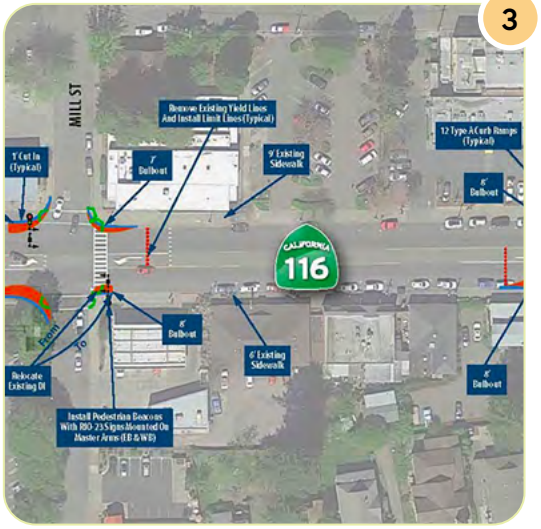
		PEOPLE	PLACE	POLICIES
RESEARCH	a	**RESEARCH & PEOPLE**	**RESEARCH & PLACE**	**RESEARCH & POLICIES**
		1a. Who are the community members, road users & stakeholders? What is their current quality of life?	**2a.** How are natural & built environments defining the site, providing limitations & offering opportunities?	**3a.** According to available data, what opportunities are there for policy implementation at this site?
VISIT	b	**SITE VISIT & PEOPLE**	**SITE VISIT & PLACE**	**SITE VISIT & POLICIES**
		1b. How are people using the site? Does it appear to be a positive experience being there & traveling there?	**2b.** What observations can be made about how natural & built features are impacting quality of life and travel conditions?	**3b.** Using firsthand observation of the site, are there opportunities to advance priority policies?
ENGAGE	c	**ENGAGEMENT & PEOPLE**	**ENGAGEMENT & PLACE**	**ENGAGEMENT & POLICIES**
		1c. Who are the people with firsthand knowledge of the site? Who else do they think should be contacted?	**2c.** Which aspects of the site are prized by people; & what are their needs & priorities for this place?	**3c.** Which policies & goals are most important to the people who use the space?

Examples of Site Analysis Concepts

Site analysis principles are applied to Caltrans products and activities. Some examples are included below:

1. Each district's Caltrans Active Transportation (CAT) Plan was created with public input that identified issues related to walking and bicycling. Data sources were included from district, local, and regional plans and inventories.
2. Caltrans administers Sustainable Transportation Planning Grants for communities to consider holistic planning and design strategies to address transportation, sustainability, livability, and equity related goals.
3. Site analysis findings and recommendations can be included in reports for discussion with project teams, or for public meetings.
4. Visualizations can be created to help the viewer analyze how a project alternative would alter site conditions. It is a method that helps the viewer conduct a form of site analysis from a key view. This can be done for presentations or meetings. Visual simulations are commonly used for projects requiring Visual Impact Assessments—when noticeable visual changes to the environment are proposed.





Examples of Site Analysis Concepts

The importance of applying site analysis principles is supported in existing Caltrans guidance. Some examples are included below:

DP-22: Context Sensitive Solutions states that Caltrans defines CSS as an approach to plan, design, construct, maintain, and operate its transportation system. These solutions use innovative and inclusive approaches that integrate and balance community, aesthetic, historic, and environmental values with transportation safety, maintenance, and performance goals. Context Sensitive Solutions are reached through a collaborative, interdisciplinary approach involving all stakeholders.

Complete Streets Decision Documentation **(Project Development Procedures Manual [PDPM], Appendix FF)** directs staff to identify any bicycle, pedestrian, or transit needs at the project location. This determination is made by consulting earlier planning documents or the TPSIS (if one was prepared) and any other resources such as local agency and stakeholder outreach, project development team discussion, geometric design feasibility evaluation, or other resource relevant to the project location.

Transportation Planning Scoping Information Sheet **(TPSIS)** fosters site analysis related to people, place, and policies by documenting applicable activities, conditions, and issues related to:

- Tribal Government consultation
- Local partner & public engagement coordination
- Stakeholder information
- Climate change considerations
- Smart mobility, active transportation & transit
- Place types
- Bicycle, pedestrian, rail & transit conditions
- Planning & environmental linkage considerations
- Other topics

Design Information Bulletin 94 - Complete Streets: Contextual Design Guidance (DIB 94) provides new design standards and guidance for comfortable complete streets facilities for all ages and abilities. Developed with main streets in mind, the DIB is focused on Urban, Suburban, and Rural Main Street place types, where the posted speed limit is 45 mph or less.

The Focus of Site Analysis

The focus of site analysis is to collect and evaluate information related to the **people, place,** and **policies** that apply to the study area. As the following pages demonstrate, thorough site analysis includes input from diverse experts and voices and is an iterative process that is scaled to the project phase and study area.

1 PEOPLE

Focus on People First

The central question in main street related site analysis is: how well is the site serving people? In other words, are there improvements that could be made to the site that would benefit the people who are impacted by main-street-related conditions? Answering these questions is not always easy, and there is rarely unanimous consensus on each detail, but the central project of ensuring that public investments yield widespread benefits requires that these questions be asked. The following pages discuss some of the methods and concepts that can help yield meaningful results.

The following pages define concepts that help center site analysis on the well-being of people: livability, equity, human comfort, safety, and public health. This begins with discovering what people in the area need and want. Understanding who lives, works, and travels in the study area can help prioritize investments in communities with the greatest need. Some of this information can be gleaned from desktop maps and databases, but much of it needs to be gathered during site visits and by talking to the experts: the people who live, work, and travel in the study area.

Left: A bicyclist waits as a pedestrian crosses a city street in San Francisco.

EQUITY

As discussed in *Principle 3: Elevate Equity and Livability,* transportation services and burdens are not evenly distributed across California. Black, brown, and low-income communities currently experience a greater share of the negative impacts of the transportation system. Rates of injury, loss of life, air pollution, and excessive traffic noise are higher in underserved communities.

Site analysis can scan for opportunities to address equity in transportation. Infrastructure that supports low- or zero-emission travel modes can help reduce air pollution and excessive traffic noise. Incorporating trees and vegetation into main street designs improves air quality and sequesters carbon. Addressing the disproportionate rates of death and serious injury in underserved communities involves site analysis to implement elements of a Safe Systems Approach, as discussed in *Principle 2: Improve Safety and Public Health.* Finally, ensuring that the benefits of transportation infrastructure are equitably distributed requires evaluating a site for improvements that would increase access to a range of high-quality, accessible, and affordable mobility options for the people who need it the most.

Engagement activities during site analysis should include dialogue about how to work in partnership with cities and jurisdictions to assess the risk of displacement when improving a site within an underserved community and how to undertake projects that support a jurisdiction's anti-displacement plan.

LIVABILITY

In the realm of transportation, livability refers to the degree to which the built environment improves human quality of life. People who enjoy a high quality of life are those who have their physical, emotional, spiritual, and social needs met. Although people choose to pursue these necessities in different ways, the transportation network can profoundly shape whether people have the freedom to fully pursue these fundamental needs. Equity is a central concern of livability-related endeavors, since all people, regardless of race, ethnicity, and socioeconomic status, deserve high-quality transportation and public spaces.

Communities generally desire opportunities to participate in decisions that impact both transportation and the quality of their public spaces. Site analysis is an opportunity to find ways to engage people in decision making, create infrastructure that reflects local identities, and identify elements of a site that are valued by the community. These topics are discussed in more detail in the following pages.

People deserve active transportation options for travel that is necessary, travel that is important to them, and because active transportation can be a joyful activity in its own right. To provide people the freedom to choose their travel mode, multimodal routes must be physically connected, without physical barriers. Well-connected travel routes are those in which important destinations are accessible by multiple modes of travel (accessibility is discussed in more detail in the next section, "Places"). But even where it is physically possible to bike, walk, or take public transit, if it is uncomfortable to do so, many people will forgo active transportation options or will forgo the trip entirely. Site analysis can help define which components of the built or natural environment are making a site more or less accessible, connected, and comfortable for people, and it can help prioritize strategies that provide the greatest livability benefits for travelers and the community.

COMMUNITY IDENTITIES & LOCAL CULTURES

Main streets can be sustained and designed to bolster people’s local sense of connection to each other, their heritage, and the places that have meaning to them. Site analysis can help uncover opportunities to reflect local cultural and community identities in the design of main street environments.

Community members and other stakeholders can provide inspiration and ideas for how main street features can reflect local identities and values. Examples of this can include representations of cultural or historical motifs on walls and other built features, and/or inclusion of trees or plants that have special resonance with the community. The people who use the space may have other ideas, and it is important that design concepts are developed with a shared vision to ensure that plans and designs reflect local wishes. Depending on the project scope, phase, and funding source(s), site analysis offers the potential to engage local residents about how they would like to have their community reflected through art, aesthetics, site furnishings, pedestrian-scale lighting, and/or landscaping.

Above: A welcoming dual-language wall on Route 96 in Weitchpec was developed in consultation with the Yurok Cultural Committee.

HUMAN COMFORT AND LEVEL OF TRAFFIC STRESS

Closing gaps in connectivity and making it physically possible to use active transportation options on main streets is essential. However, to fully encourage a mode shift, design solutions must make a majority of the population feel that riding a bicycle and walking on main street is comfortable and appealing. Sites should be analyzed both for accessibility and level of comfort for active transportation users.

BICYCLE LEVEL OF TRAFFIC STRESS

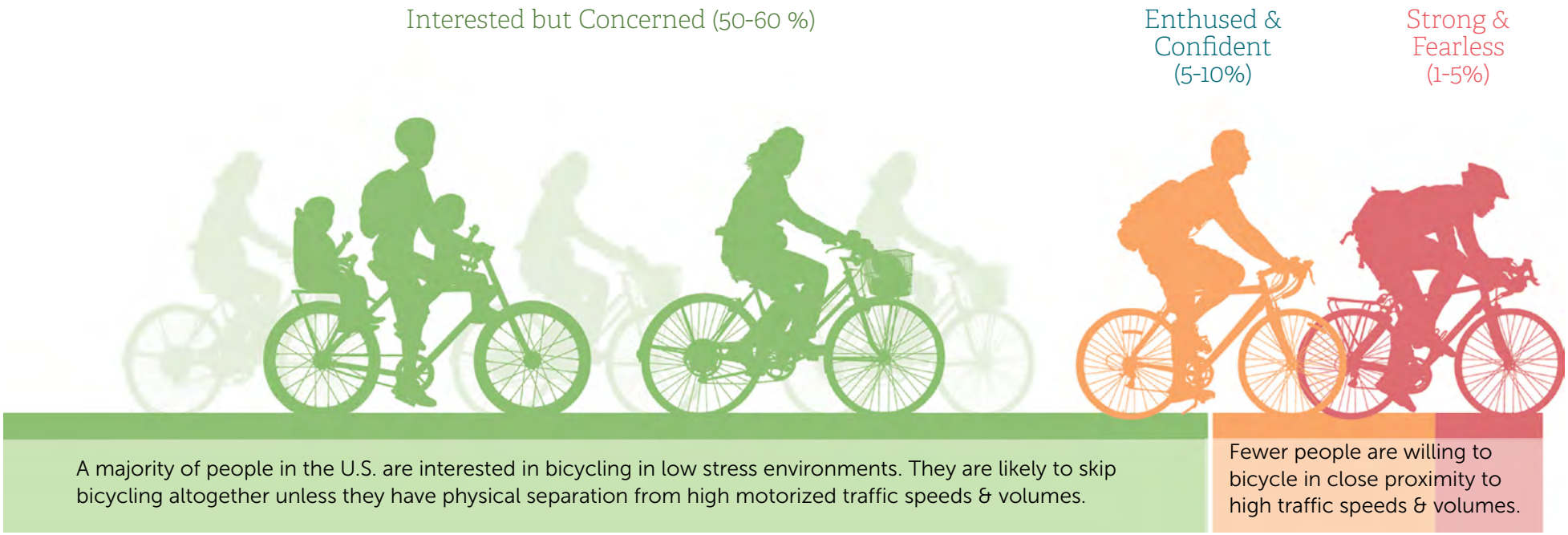
A methodology exists for measuring and describing the level of comfort that different bicyclists experience on a roadway segment or crossing an intersection. It is commonly described as a bicyclist's "level of traffic stress." Researchers who examine people's perceptions about the safety and appeal of bicycling find consistent patterns across the country in bicyclists from different communities and place types. In *Four Types of Cyclists,* Roger Geller developed four general categories of bicycle riders, sorted by their tolerance for stressful bicycling conditions. Geller's findings have been validated by subsequent research and his categories are now used nationally in transportation planning and design efforts.

The patterns for the percentages of people that occupy the four categories of bicyclists tend to be similar across the country. The smallest category of bicyclists (1% to 5%) is the group known as "Strong and Fearless"; this group has a high tolerance for stressful bicycling conditions. Slightly more people (5% to 10%) are "Enthused and Confident," and they are willing to ride under some challenging conditions. The next group (30% to 35%) is the "No Way No How" category of people who are unwilling or unable to consider bicycle travel under any conditions. Consistently, research shows that a majority of the population (50% to 60%) falls into the "Interested but Concerned" category—people who say they would like to travel more by bicycle and would do so if they were more comfortable and less intimidated by bicycling conditions. Understanding the four categories of bicyclists is important because they reveal that a majority of people will only pursue bicycling under low-stress conditions.

The Mineta Transportation Institute states in *Low-Stress Bicycling and Network Connectivity*: "For a bicycling network to attract the widest possible segment of the population, its most fundamental

Photos: The design and conditions of a bicycling route profoundly shape whether most people are willing to travel by bicycle. And even riders who are "Strong and Fearless" (left) when they ride alone, may prefer lower stress routes in other situations, such as when bicycling with children (right).

TYPES OF BICYCLISTS



attribute should be low-stress connectivity…" Designing transportation infrastructure to improve the comfort and reduce the level of traffic stress (LTS) of bicycling for the majority of people who are "Interested but Concerned" promises therefore to yield the highest return on increasing bicycling. Reducing LTS has tested and measurable results in increasing bicycle ridership. LTS is reduced by one or more of the following strategies: separating bicyclists from motorized vehicles; reducing bicyclist proximity to fast-moving traffic, and/or reducing operating speeds; and reducing the number of lanes dedicated to motorized traffic.

Similar principles can be used to assess comfort and stress for pedestrian travel. Pedestrians prefer to be buffered from fast-moving traffic (via landscaped areas and wider pedestrian facilities) and prefer to walk along or across fewer lanes of traffic. Although not all geometric configurations can be adjusted within the limits of every project, the research does illuminate that comfort and stress can indeed be measured and that design solutions can have a meaningful impact on people's interest in traveling via active transportation modes.

Level of traffic stress maps are often created by local governments and stakeholder groups to identify strengths and weak links in a community's active transportation network. Some of these maps include assessments of state facilities that can be consulted during site analysis activities.

Graphic above illustrates that a majority of the population prefers bicycling infrastructure that minimizes the level of traffic stress (LTS).

"These "small things with wheels" come in different sizes, move at a wide range of speeds, handle turns and surfaces differently, and attract people with varying degrees of skill and expertise.

—NACTO "Designing for Small Things With Wheels"

INCREASING MOBILITY OPTIONS FOR PEOPLE

Micromobility travel modes and electric vehicles are quickly becoming essential components of the transportation system. They can provide environmentally sustainable travel options, offer additional opportunities to reach important destinations, and help address first and last mile connections to transit. How roadway space is allocated, designed, and designated for newer transportation modes in a main street environment is an emerging conversation and deserves consideration during site analysis and stakeholder engagement activities.

FHWA broadly defines micromobility as any small, low-speed, human- or electric-powered transportation device, including bicycles, scooters, electric-assist bicycles (e-bikes), electric scooters (e-scooters), and other small, lightweight wheeled conveyances. Proactive conversations between main street designers, local governments, and stakeholders can help strategize how to meet micromobility travel, parking, and docking needs and how to preserve access to the curb, street, or sidewalk space needed by other road users.

Left: A city street in Los Angeles has roadway space allocated for a bike-share docking station; a wide sidewalk enables a scooter to be parked out of the pedestrian path. Right: Bicyclists ride e-bikes from Redding's new electric bike-share system.

ELECTRIC BICYCLES AND VEHICLES

The group of road users driving electric transportation vehicles is diverse and can include people who use e-bikes, all-electric vehicles, and the specialized group of vehicles called neighborhood electric vehicles (NEVs). The rise in electric-powered bicycles and other vehicles may influence main-street-related decisions. Site analysis and stakeholder engagement can include conversations about how to accommodate and support the use of electric modes of transportation within a main street setting.

Electric Bicycles / E-bikes. Electric bicycles and e-bikes promise to amplify the number of people seeking to travel by bicycle. The extra power of an e-bike makes riding a bicycle accessible to a wider group of people since the power both extends the range of bike trips and the types of trips that people are open to taking by bicycle (like shopping, commuting in work clothes, transporting children, or taking longer recreational trips).

Left: Rental e-bikes and scooters parked at bike rack on a city street in Sacramento.
Right: A bicyclist riding an e-bike at a mid-block crossing in Emeryville.

Neighborhood Electrical Vehicles (NEVs). NEVs are electric vehicles that generally travel 25 mph or less. They are classified as a "low-speed vehicle," which is a federally approved street-legal vehicle classification. The California Air Resources Board classifies NEVs as zero-emission vehicles. They must meet federal performance standards and are equipped with safety features like seat belts, turn signals, reflectors, and parking brakes. Some models can run up to 30 miles on a single charge. NEVs are in use across the country and internationally as passenger, cargo, and utility vehicles.

Some local agencies in California have NEV Transportation Plans authorized by legislation in the California Streets and Highways Code and California Vehicle Code. The CA MUTCD provides guidance for signage that is used in NEV Transportation Plan Communities. In one such community, the California Legislature states that the NEV Plan will help support "sustainable development that reduces gasoline demand and vehicle emissions by offering a cleaner, more economical means of local transportation within the plan area."

Photos: A range of NEV models are available for personal transportation and/or additional utilitarian purposes such as transporting passengers or cargo.

2 PLACE

Evaluate the Natural and Built Environment.
Main streets are places that function as travel facilities and as destinations for residents and visitors. Defining the physical attributes of a site by evaluating both built and natural features provides an opportunity to assess the strengths, opportunities, and needs of a main street.

Above: A community market and mural on Route 99/ Live Oak Boulevard Live Oak.

State highway main streets are present in all community sizes and place types:

1. City Center Main Street
San Francisco (Route 101 / Van Ness Avenue)

2. Urban Main Street
Albany (Route 123 / San Pablo Boulevard)

3. Suburban Main Street
Palm Desert (Route 111)

4. Rural Main Street
Bridgeport (Route 395 / Main Street)

NATURAL ENVIRONMENT

GEOGRAPHY, TOPOGRAPHY, AND LOCAL CLIMATE

Site analysis evaluates which aspects of the natural world are presenting constraints and opportunities, and how future design elements could support the natural environment and people using the space. Evaluating the natural environment offers important cues about which strategies are most effective and needed. People traveling outdoors in areas of temperature extremes may need additional sheltered areas to rest or wait; people walking or riding up steep slopes often need places to rest or facilities wide enough to allow others to pass. Natural geography or topography can provide challenges to sight distances and visibility. And physical elements in the local geography can act as an important destination or as a natural barrier to active transportation routes, such as a river or water body.

Main streets can also be planned, designed, and operated to contribute to the local ecosystem by incorporating landscaping and permeable surfaces. Planted areas can help infiltrate and slow storm water discharge, clean the air, sequester carbon, and support birds and pollinators. Water availability and precipitation rates during storm events determine which plants are best suited to the site and influence which types of infiltration facilities would best support local storm water management goals.

Left: Snow removal operations are an important consideration when selecting roadway design features in some areas, as shown here on Route 36/Main Street in Susanville. Right: High summer temperatures can impact design decisions: this transit stop on a local street in the Central Valley, has shade in the morning, but not in the afternoon when summer temperatures can be high.

Main streets serve as destinations themselves and can also help provide active transportation access to important locations in the community like parks, employment centers, schools, and retail.

BUILT ENVIRONMENT

THE IMPORTANCE OF A HIGH QUALITY PUBLIC REALM

The public realm, often just referred to as "public space," describes the publicly owned area within the street right of way, including the roadway, sidewalks, and planted areas where they exist. The condition of the main street public realm has a meaningful impact on the community, visitors, businesses, and road users. The visual character of the public realm profoundly influences community identity and sense of place. Feeling more or less comfortable within a main street environment translates into whether people find the space welcoming as a place to visit.

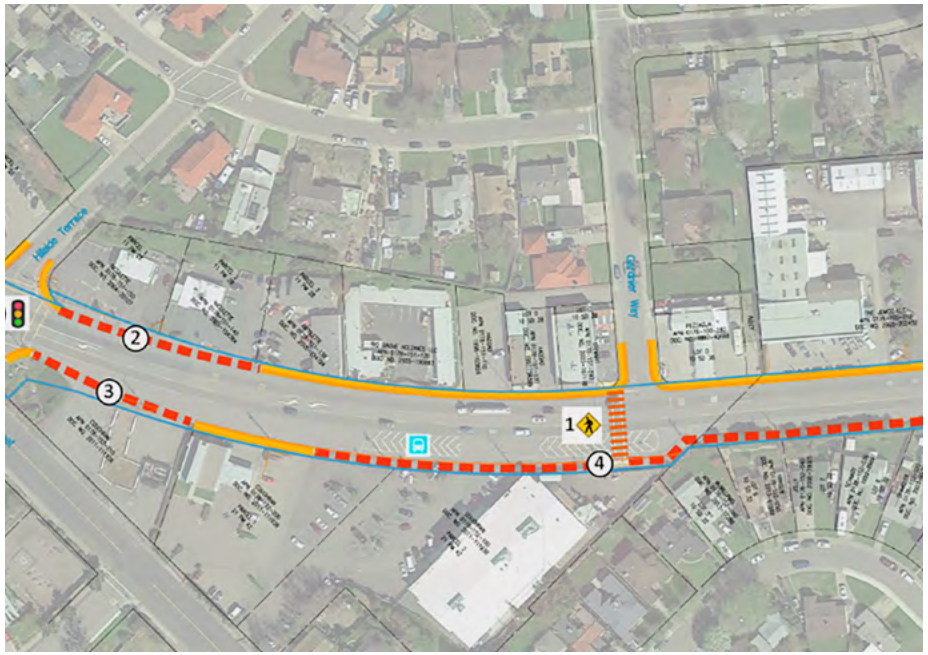
The most significant determinants of whether most people feel comfortable traveling by active transportation modes is the quality and condition of the public realm. Since California's State highway main streets are important destinations and are often the most direct route between other important locations, they are facilities that need heightened accessibility for multimodal use. The presence of connectivity gaps, physical barriers, or positive existing conditions for active transportation modes are all crucial site analysis findings.

When site analysis is evaluating sizable alterations to the public realm, discussions with cities and jurisdictions should assess the risk of displacement when projects will occur at a site within an underserved community. Partner agencies may have anti-displacement plans that can help transportation project decisions align with local community needs and values.

LAND-USE, DESTINATIONS, AND TRIP GENERATING LOCATIONS

Analysis of the relationship of the study area to local land use(s) is an important consideration in main street decision-making. Main streets are a destination in their own right, and their relationship to additional popular destinations reveals high-value locations for active transportation investments. The presence of important destinations such as schools, employment centers, recreational trails, parks, retail areas, civic centers, public transportation hubs, or local transit stops are indications that addressing active transportation conditions deserves heightened attention. Although projects may not be directly adjacent to these high-value locations, all projects should still be evaluated for whether they can contribute to improving multimodal access to important places and services in the nearby community. An assessment of the quality of the trip for active transportation travelers, as they move between key locations, can help reveal the most needed and appropriate investments.

Above: In Davis, pedestrian facilities allow people of wide ranging physical abilities to access green spaces.



PLACE TYPE

Defining the context of a place begins with understanding how the site fits into the broader region and transportation network. Understanding the "place type," which is the character, size, and density of the community, can point to opportunities and common challenges to implementing multimodal solutions. The *Smart Mobility Framework 2020 (SMF 2020)* has descriptions of place types and provides guidance on common barriers and solutions to improving multimodal travel conditions in different place types. It is important to remember that State highway main streets can occur in all sizes of communities, as discussed on the previous page.

CONNECTIVITY

Assessing how integrated and connected the travel network is for different modes of travel is a study of "connectivity." And evaluating how efficiently and comfortably people can reach high-value destinations such as schools and centers of employment is often described as a measure of "accessibility." After decades of building out a transportation network that is highly connected for motor vehicle travel and that offers high accessibility for drivers, a network-level site analysis often reveals barriers or weak links in the system for people who are walking, bicycling, or taking public transit. People need it to be physically possible to make their entire trip by multiple modes, and they need their desired locations to be comfortable and accessible within a reasonable amount of time to make these trips feasible.

Barriers to connectivity may include rail crossings, physical gaps in walking or biking facilities, physical obstructions, or major roads and highways. High speeds and high volumes of motorized traffic along a route may also present a psychological barrier or otherwise discourage crossings.

Left: A site analysis graphic showing dashed lines to represent gaps in sidewalk connectivity for a project on a rural main street. Right: A local road with a mid-block crossing and raised crosswalk provides connectivity for people biking and walking on a shared use path in Emeryville.

EVALUATING THE NEED FOR TRAFFIC CALMING

Site analysis activities can include evaluating the need for traffic calming and how driving speeds are impacting people on main street. According to the FHWA Traffic Calming ePrimer, the "primary purpose of traffic calming is to support the livability and vitality of residential and commercial areas through improvements in non-motorist safety, mobility, and comfort. These objectives are typically achieved by reducing vehicle speeds or volumes on a single street or a street network."

Ideally, traffic calming evaluations happen early in planning phases with stakeholder and partner engagement. The Caltrans *Traffic Calming Guide* states, "Traffic calming strategies should be considered whenever there is a need to reduce vehicle speeds and/or traffic volumes on a roadway or roadway network. Increased consideration should be given to the following areas:

1. Along Safety Corridors* or roadway segments with a high percentage of speed-related collisions

2. In locations or facilities that generate high concentrations of bicyclists and pedestrians

3. Where the community has proposed an operating speed lower than the current operating speed or posted speed

4. To support transitions from high speed to low speed contexts, such as in the Transitional Zone place type or when approaching a Rural Main Street."

Traffic calming features such as road diets, bulb-outs, roundabouts, and crosswalk enhancements are covered in *Chapter 3, Designing Main Streets.* Case studies outlining successful traffic calming strategies are available in the *FHWA Traffic Calming ePrimer* and the Caltrans Traffic Calming Guide.

**Safety Corridors" are defined in Chapter 2B of CA MUTCD.*

Left: A roundabout that includes sidewalks, landscaping, and colored pavement at marked crosswalks near Route 29 in Napa.

The Importance of Traffic Calming Evaluations

The Correlation of Operating Speed and Safety: It is well documented that the probability of a crash increases as driving (operating) speed increases. Higher speeds give drivers less time to observe their surroundings, process information, and react in ways that could avoid or lessen the severity of a crash. Higher driving speeds also increase the severity of injury in a collision, especially for anyone who is struck by a car or truck and is outside of the protective shell of a vehicle such as a pedestrian, bicyclist, or motorcyclist. The human body is vulnerable in a collision, and speed is the leading predictor of injury severity and the likelihood of a crash.

As stated in the Highway Safety Improvement Program (HSIP) Implementation Plan: "Humans are unlikely to survive high-speed collisions. Reducing speeds can accommodate human injury tolerances in three ways: reducing impact forces, providing additional time for drivers to stop, and improving visibility."

The Correlation of Speed and Livability: Operating speed is an important metric for evaluating how well a corridor is working for the community, and how operating speeds are influencing the overall livability of a main street environment.

Higher operating speeds, especially when combined with higher traffic volumes, can have unintended negative impacts on neighborhoods and other travelers. There is a correlation between the presence of large numbers of fast-moving vehicles and the dampening of people's desire to use a route for other uses. Strolling, sitting on porches, and chatting with a neighbor on the sidewalk all become less enjoyable activities when they occur too close to fast-moving traffic. Extensive research shows that proximity to fast-moving vehicles increases the level of stress experienced by people walking and biking. Increasing this "level of traffic stress" discourages many people from choosing active transportation options.

Above: The photo on the left shows a site on Route 61 in Alameda without a road diet (a traffic calming strategy discussed in Chapter 3). On the right is a visual simulation of a road diet in the same spot.

SPEED AND ROADWAY DESIGN CONCEPTS

Operating Speed is the observed "driving speed" during free-flow conditions. The *California Manual for Setting Speed Limits* defines operating speed as "the speed at which a typical vehicle or the overall traffic operates. Operating speed might be defined with speed values such as the average, pace, critical or 85th percentile speeds." Ideally, the operating speed is near the design speed so that the roadway users stay within planned safety factors provided in the roadway geometric features.

Proposed operating speed sometimes called "target speed." Proposed operating speed usually arises during discussions about reducing current operating speed through the implementation of traffic-calming measures. DIB 94 states that "[t]he selected proposed operating speed for the roadway may be used to identify various design elements during the planning and project development process. In some cases, taking measures to lower the operating speed can encourage walking, rolling, and biking by improving comfort, while reducing fatalities or serious injuries."

DIB 94 lists the recommended ranges of proposed operating speeds based on place types. Traffic-calming features are listed in the Caltrans *Traffic Calming Guide* and in *Chapter 3, Designing Main Streets.*

Posted speed, commonly known as "the speed limit," is determined by law and is shown on speed limit signs. When a community seeks to lower operating speeds on their main street, lowering the speed limit may be an option. Recent California legislation provides greater flexibility in lowering speed limits in some conditions. The CA MUTCD and *California Manual for Setting Speed Limits* provide guidance on the options and legal requirements for setting speed limits.

Posting a lower speed limit may only be partially successful in addressing problems of speeding drivers (and often requires increased enforcement). The most effective method of reducing operating speeds is to implement traffic-calming features and other engineering solutions. Research shows that motorists tend to drive at the speed at which they feel comfortable based on the design of the road and current roadway conditions, even when their driving speed is incongruent with the posted speed. A posted speed that drivers perceive as arbitrarily low given the actual roadway conditions does not reliably induce slower driving speeds.

Design speed for a state facility establishes minimum geometric design elements such as stopping sight distance and vertical and horizontal alignments. In California, most highway projects, including main street projects, are modifications of existing facilities. For the design of new highway segments, the HDM lists recommended design speeds. The HDM considers context when selecting appropriate design speeds in lower-speed facilities: "highway context in terms of area place type, land use, types of users, etcetera, need to also be considered when determining the appropriate design speed in lower speed facilities."

The HDM defines main streets as lower-speed facilities. HDM Topic 101 states: "For existing lower-speed conventional highways in urban areas and rural highways that are Main Streets with observed or proposed operating speeds of 45 mph or less, the design speed should be selected to be consistent with the highway context which may discourage high-speed operating behavior. Select a design speed that is logical with respect to topography, operating speed (or anticipated operating speed if the corridor is being redesigned and the physical characteristics of the highway are being changed), adjacent land use, design volumes for all users, collision history, access control, and facility type."

Gateways and Speed Transition Zones

Site analysis can include the evaluation of whether traffic-calming features are appropriate in transitional speed zones. Conventional highways often include stretches where drivers must adjust their driving from a high-speed environment and transition to a lower driving speed, such as when entering a small town from a high-speed rural highway. Slowing driving speeds to a level that is compatible with walking and bicycling on a small town main street improves conditions for nonmotorized road users. Slowing down traffic also improves the overall experience of being on main street, creating an environment where people are more likely to stop and spend time visiting local destinations.

Site analysis can evaluate conditions to see if there is a need or opportunity to create a "transition zone" in which drivers have cues to adjust driving speeds over a length of road before entering a town or developed area. In *Design Guidance for High-Speed to Low-Speed Transitions Zones for Rural Highways* (Transition Zone Guidance) the National Academies of Sciences, Engineering, and Medicine states that: "Drivers need well-designed transition zones with explicit traffic control devices and roadway design features that convey the need to reduce speeds and that encourage gradual, smooth reductions in speed as they transition from high- to low-speed facilities." The Transition Zone Guidance defines a "transition zone" to be "a section of road that is continuous with and connects a road section with a high posted speed limit to a road section with a lower posted speed limit .... The transition zone should not be considered as a specific point along a roadway where a speed change is to occur; rather, it extends over a length of roadway." The Transition Zone Guidance includes specific design guidance for "transition zone treatments" that include roadway features that are discussed in more detail in *Chapter 3, Designing Main Streets.* FHWA's *Small Town and Rural Multimodal Networks* also provides traffic calming and multimodal guidance for gateways and rural areas.

Top: On Route 299 in Willow Creek a welcome sign, street trees, and landscaping visually reinforce the transition from a higher-speed rural facility into a lower-speed rural downtown main street environment.
Bottom: On Main Street in Cambria, sidewalks, pedestrian lighting, and pavement markings further signal a transition to a lower-speed environment on the approach to downtown.

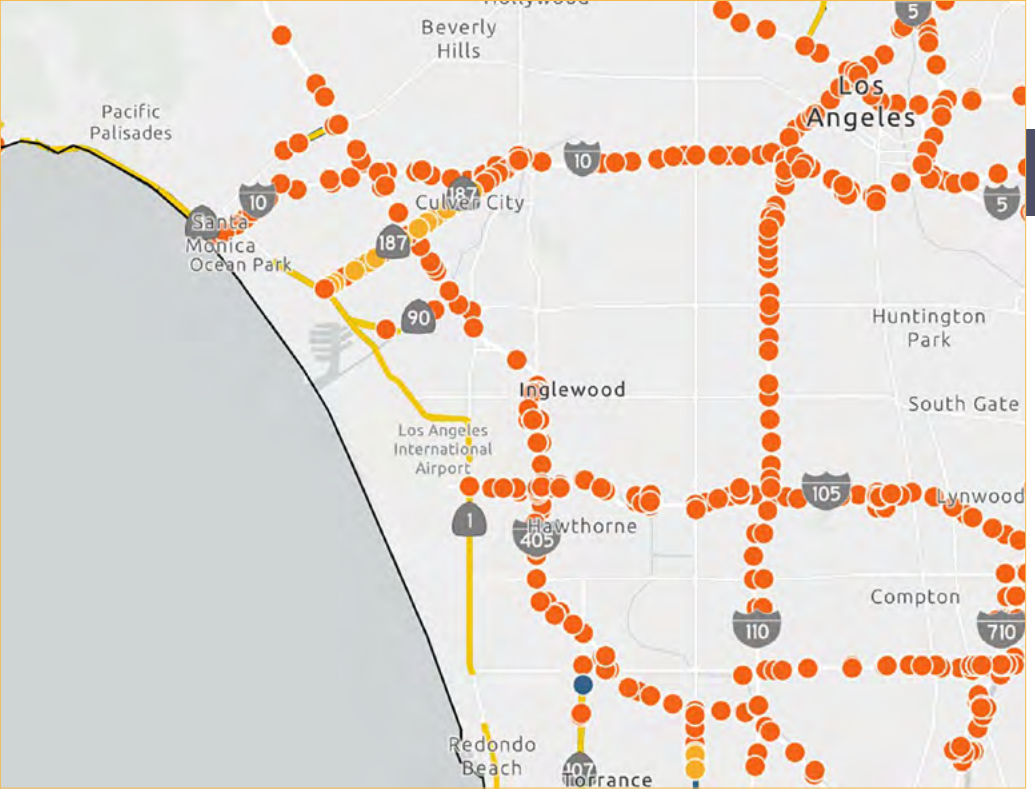
CONDITIONS FOR PUBLIC TRANSPORTATION

Conditions for transit riders traveling on or across a main street is a critical feature to evaluate. Since pedestrians have heightened accessibility needs near transit stops, sidewalks that are wide enough for people to board transit and pass other waiting passengers are especially valuable. All transit facilities must meet ADA requirements. Street trees and landscaping can make transit stops more comfortable and help promote public transportation as an attractive travel option. Caltrans can also partner with other transportation agencies to improve or provide space for transit stop features and amenities, such as benches and shelters. Research, site visits, and engagement with transit agencies and transit users can evaluate strategies to improve access to transit and make main streets more comfortable for transit riders. Engaging early and often with transit agencies can help ensure that designs account for transit vehicle and service needs, including operational challenges and bus turn movements.

Public Transportation and First Mile/Last Mile

In public transportation planning, the phrase "first mile / last mile" describes situations where travelers have difficulty getting from their starting location to a transit stop and from the transit stop to their final destination. The distance that must be traveled to and from the transit stop and the ease of making that trip are both strong predictors of whether people will choose to take public transportation. Since many passengers need to walk or bike to transit stops, making the first mile / last mile of transit trips accessible to all modes, ages, and abilities makes public transportation available to a wider pool of passengers. Caltrans facilities should be evaluated for how they are contributing to first mile / last mile multimodal travel conditions near transit stations and stops. Comfortable active transportation conditions across or along a State highway can play a meaningful role in supporting local transit usage.

Left: Passenger boards a bus at a curb side stop.



3 POLICIES

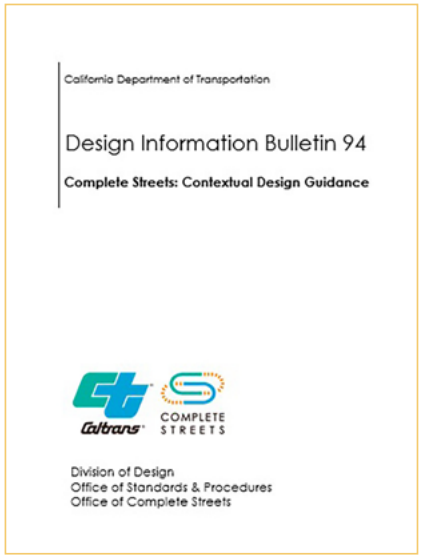
Identify Relevant Policies, Programs, Plans, and Goals

"Policies" in this site analysis discussion is used as an umbrella term to capture relevant policy statements, strategic goals, mandates, guidance, plans, and objectives listed in reports, models, and additional planning documents.

At the broadest scale, evaluating a site begins with understanding the applicable overarching programs, strategic targets, and policies set by agencies at the federal, state, and community levels. Examples include federal requirements related to asset management, state targets for climate action and GHG emissions, Caltrans goals to address equity, and community policies related to Complete Streets.

Understanding which prior planning documents and reports apply to the study area provides the foundation of effective site analysis. Plans range in scale and projected timelines and can also vary from an emphasis on broad policy-related goals, down to specific project-level recommendations such as in some corridor plans. Usually years in the making, planning efforts are developed with considerable partner, stakeholder, and community input and reflect a shared vision for the future of the transportation network.

The following pages discuss how policies relate to site analysis by emphasizing the five foundational principles discussed in Chapter 1 for successful main streets.



Top: A map from a Caltrans Active Transportation Plan identifies active transportation needs. Caltrans *Design Information Bulletin 94* and the Caltrans Active Transportation Plans are two important examples of vital policy, design, and plan guidance that is relevant to main streets.

Below are examples of Caltrans policies that cover all five of the guiding principles in *Main Street, California.* To the right, are Caltrans policies with an emphasis on one or more of the guiding principles.

THE STATE BIKE AND PEDESTRIAN PLAN

The 2017 State Bicycle and Pedestrian Plan, *Toward an Active California*, is a statewide policy-plan to support travel by bicyclists and pedestrians through objectives, strategies, and actions. This policy direction continues support for the recent trend of increasing bicycle and pedestrian travel in the state and strengthens the connection between transportation, environmental sustainability and public health.

INTERREGIONAL, DISTRICT, & CORRIDOR PLANS

Caltrans System Planning implements variety of plans, programs, and strategies that are prepared at the statewide, district, regional, interregional, and local levels. These include Corridor Plans, Congestion Management Plans, the Interregional Transportation Strategic Plan (ITSP), District System Management Plans

CALTRANS DIB 94 COMPLETE STREETS CONTEXTUAL DESIGN GUIDANCE (DIB 94)

DIB 94 provides new design standards and guidance for comfortable complete streets facilities for all ages and abilities. Developed with main streets in mind, the DIB is focused on Urban, Suburban, and Rural Main Street place types, where the posted speed limit is 45 mph or less.

Principle 1: Champion People-Centered Main Streets

Director's Policy No. DP-22: Context Sensitive Solutions

DP-22 states that Caltrans uses CSS "as an approach to plan, design, construct, maintain, and operate its transportation system. These solutions use innovative and inclusive approaches that integrate and balance community, aesthetic, historic, and environmental values with transportation safety, maintenance, and performance goals." CSS is a "collaborative, interdisciplinary approach involving all stakeholders."

Director's Policy No. DP-37: Complete Streets

DP-37 states that Caltrans "recognizes that walking, biking, transit, and passenger rail are integral to our vision of delivering a brighter future for all through a world-class transportation network. Additionally, Caltrans recognizes that streets are not only used for transportation but are also valuable community spaces."

Smart Mobility Framework Guide (SMF 2020)

"Smart Mobility moves people and freight while enhancing California's economic, environmental, and human resources by emphasizing convenient and safe multimodal travel, speed suitability, accessibility, management of the circulation network, and efficient use of land." SMF 2020 defines community place types, and provides additional guidance.

Principle 2: Improve Safety and Public Health

Deputy Directive No. DD-103: Worker Safety on the State Highway System

DD-103 describes the importance of deploying proactive measures to improve the safety of all workers on the State Highway System. Eliminating employee fatalities and serious injuries "in the line of duty" requires consideration of worker safety topics in all project phases.

California Safe Roads: 2020-2024 Strategic Highway Safety Plan (2020-2024 SHSP)

The 2020-2024 SHSP emphasizes the Safe System Approach, which recognizes that safety must be both proactive and reactive to reduce fatalities and serious injuries. The reactive safety approach focuses on high-collision concentration locations through site analysis. The proactive approach identifies strategies to improve conditions at locations with crash risk that based on contextual characteristics that match similar high-crash locations.

Director's Policy No. DP-36 Road Safety

DP-36 affirms that Caltrans intends to "eliminate fatalities and serious injuries on California's roadways by 2050 and provide safer outcomes for all communities." This requires a safety-first mindset that prioritizes road safety through existing safety improvement programs, as well as implementation of new programs that enhance the safe use of our roadways while eliminating race-, age-, ability- and mode-based disparities in road safety outcomes.

"We will achieve equity when everyone has access to what they need to thrive—starting with our most vulnerable—no matter their race, socioeconomic status, identity, where they live, or how they travel."

—*Caltrans 2020-2024 Strategic Plan*

Principle 3: Elevate Equity and Livability

Caltrans Equity Statement
"Caltrans recognizes our leadership role and unique responsibility in State government to eliminate barriers to provide more equitable transportation for all Californians. This understanding is the foundation for intentional decision- making that recognizes past, stops current, and prevents future harms from our actions."

The Caltrans Race & Equity Action Plan (REAP)
REAP documents Caltrans efforts to create more transparent transportation planning processes; coordinate across state agencies to develop standards and practices for meaningful engagement; provide technical assistance resources to those most impacted by projects, including disadvantaged communities, low-income communities, and Black, Indigenous, and People of Color (BIPOC) communities.

Principle 4: Advance Sustainability and Climate Action

Climate Action Plan for Transportation Infrastructure (CAPTI)
CAPTI outlines the guiding principles and strategies that make up the CAPTI Investment Framework, which is meant to guide alignment of the state's discretionary transportation funding with climate, health, and equity goals.

Climate Change Emphasis Area Guidance for Corridor Planning
Corridor planning is a valuable step in Caltrans' climate change goals, that allows planners to deploy a more holistic approach to address the climate change needs of both the transportation system and its users. As a "living" document, this *Climate Change Emphasis Area Guidance* may be updated to reflect significant updates to policies, procedures, and data and the best available science.

Principle 5: Strengthen Partnerships and Engagement

Public Participation Plan (PPP)
The PPP for the CTP and the Federal Statewide Transportation Improvement Program provides guidance on meaningful public involvement that supports stakeholder participation in the planning and programing decision-making process.

Equity, Engagement, & Health (EEH) Action Plan
The *EEH Action Plan* emphasizes equity, engagement, health values, and practices throughout Caltrans transportation planning functions. The action items in the plan are aimed toward promoting equitable decision-making, meaningful and authentic outreach to the public and engagement with stakeholders, and transportation-related public health remedies and improvements.

Elimination of excessive maintenance requirements is vital to reduce worker exposure to the dangers of traffic and driver distraction.

Policies & Principles for Successful Sites

The policies discussed so far in this chapter have largely pertained to the desired outcomes for main streets to function as multimodal travel facilities and as public spaces that improve community livability. To create and/or sustain those desired outcomes, there are additional principles that need to be considered during site analysis efforts that consider the maintenance and operation of main streets. The following pages discuss issues related to maintainability, ownership, and roles and responsibilities. The earlier that these topics are raised in planning and design discussions, the more likely they are to be addressed through solutions that will be successful over the long term.

MAINTAINABILITY

Caltrans strives to plan and design transportation facilities that are safe and efficient to maintain. This broad concept entails consideration of the life cycle of materials, the likelihood of needed repairs and upgrades, the degree of special expertise or training required for maintenance activities, the number of workers needed for specific maintenance activities, and strategies for minimizing vandalism.

Every project will require maintenance over its lifetime. Since planning and design decisions about roadway and roadside features and materials impact maintenance needs, it is vital that maintenance managers be included as early stakeholders in project development. Strategies that minimize maintenance activities are fiscally prudent and even more importantly they reduce the frequency and duration of highway worker exposure to traffic dangers.

Since roadway and roadside maintenance activities expose workers to traffic dangers, every effort should be made to employ designs, materials, and maintenance techniques that minimize worker exposure risks. Many of the traffic-calming strategies discussed in *Chapter 3, Designing Main Streets,* can help reduce driving speeds and traffic conflicts, which may improve conditions for maintenance workers as well as for main street travelers.

To ensure the safe and efficient performance of state facilities, Caltrans maintenance workers provide routine maintenance, perform emergency repair due to accidents, storms, and natural disasters and clear roadways of accidents and roadway debris.

MAINTENANCE AGREEMENTS

Early engagement of maintenance staff is important to help develop design solutions and material choices that are easier and less costly to maintain while still meeting project goals. In some cases, a Maintenance Agreement will be required between Caltrans and local agencies. Maintenance Agreements describe specific locations of work, the responsibilities of the entities that will perform specific activities, and the standard of maintenance that is required. They may also include information pertaining to applicable laws, mandates, and regulations. Maintenance Agreements are required any time a community or local agency assumes responsibility for maintaining an area or specific element within the Caltrans right of way.

The potential need for a Maintenance Agreement should be identified in the planning phase of project development. A process of collaborative negotiation can help define maintenance issues more thoroughly by identifying the abilities and limitations of the various parties and the lifetime maintenance needs of various proposed main street features. A field review that includes all individuals who are authorized to negotiate and commit to the terms, maintenance responsibilities, and limits of work aids the development of a thorough Maintenance Agreement.

Existing Maintenance Agreements should be reevaluated when additional improvements are made in an area. The agreement may need to be amended to include updated information about the type of work, site location(s), or funding sources. Modifications to existing Maintenance Agreements and the creation of new Maintenance Agreements must involve the Division of Maintenance, the Maintenance Agreements Program, and the Legal Division. More information is provided in the Caltrans *Maintenance Manual* in Chapter 1. The PDPM discusses Maintenance Agreements and other project permits and agreements in Chapter 13 and throughout the PDPM as appropriate.

COOPERATIVE WORK AGREEMENTS

Any project within the Caltrans right of way that is sponsored by a local entity requires a Caltrans Cooperative Work Agreement (CWA). A CWA is a legally binding contract that defines the project scope and assigns roles and responsibilities, funding commitments, schedule and any other important arrangements on which the parties must agree. An executed CWA is required before Caltrans can commit funds or resources to assist other entities with the development and construction of any project within a Caltrans right of way. A CWA should be initiated during the planning phase of project development.

RELINQUISHMENT: OPTIONS FOR OWNERSHIP

In some cases, it may benefit the community to accept ownership of all or a portion of a State highway main street. Such ownership is accomplished through the relinquishment process. A relinquishment is a conveyance of all rights, title, and interests of a State highway—or a portion thereof—to a county or city. The relinquishment of facilities such as a roadway, sidewalks, or both allows local agencies to assume the administration, planning, design, construction, maintenance and operation of that facility. Relinquishment options should be initially evaluated in the early planning phase and throughout project development.

The removal of a State highway—either in whole or in part—from the State Highway System requires a relinquishment approved by the California Transportation Commission (CTC). Authority for the CTC to relinquish is given in Streets and Highways Code Section 73, which outlines different types of relinquishments, including "nonmotorized transportation facilities: pedestrian ways, bike ways and equestrian ways." Relinquishment of Caltrans right of way is discussed in Chapters 13 and 25 of the PDPM and in Chapter 6 of the Caltrans *Right of Way Manual.*

THE METHOD

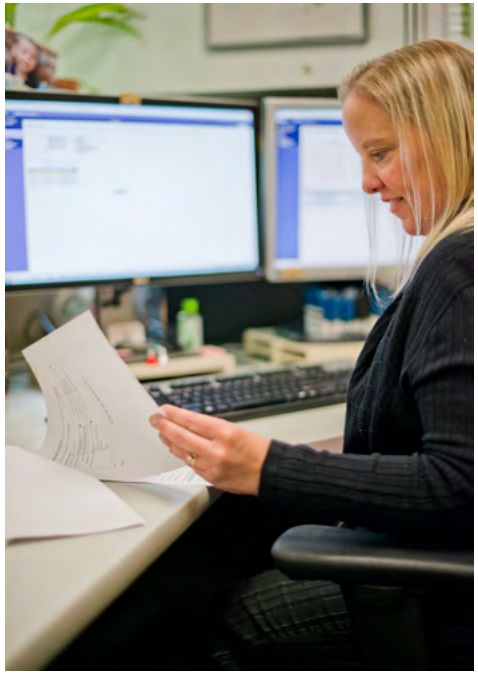
RESEARCH VISIT ENGAGE

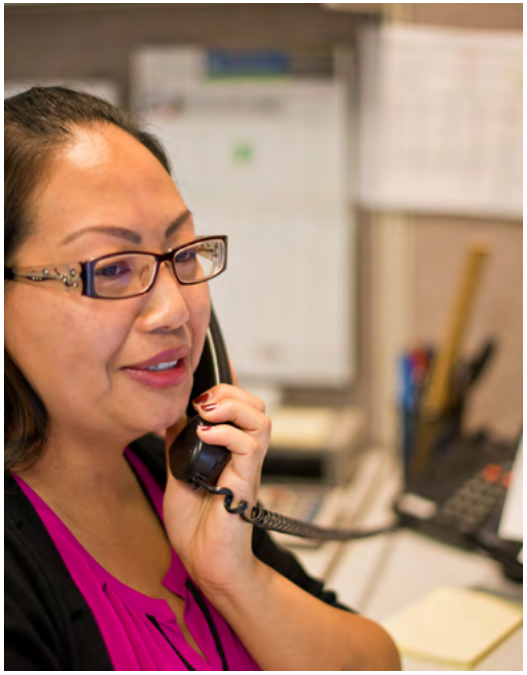
The Method of Site Analysis

The point of site analysis is to collect and evaluate information that is relevant to the study area and to a degree that is appropriate for the scale of the project. As the planning and design phases move from a macro-level effort to micro-scale work, the level of detail that is gathered and analyzed likewise becomes more specific. As the following pages discuss, a thorough site analysis method includes desktop research, site visits, and engagement with stakeholders. The order in which these activities are listed below is not a hierarchy of importance, and in fact the activities are frequently undertaken alongside each other through an iterative process.

RESEARCH

Analyze Available Data, Plans, Policies, and Goals.
Site analysis involves evaluation of recorded data, which is collected and interpreted by multidisciplinary teams. Relevant data can be acquired through monitoring programs, computer models, maps, as-built documents, reports, planning documents, and other data sources.





Analyzing recorded data related to signalization, operating speeds, vehicle volumes, collision data, travel time reliability, peak travel times, transit-related data, bicycling trips, pedestrian activity, environmental data, and the presence of utilities provides greater clarity about how a main street fits into the larger transportation network and can help prioritize future infrastructure investments. Using maps and existing data sets to identifying important destinations in the community such as schools, community services, and concentrated areas of economic activity highlights which areas call for heightened attention during further site analysis and planning phases.

People who live, work, and travel on main street are also a valuable source of data and information about current conditions. Early engagement (discussed in “Engage the People Who Use Main Street,” (p. 70) can help identify issues with multimodal mobility, accessibility, connectivity, the condition of the public realm, and other livability and equity-related concerns.

As site analysis moves from a broad scale to a more specific project scale, maps and aerial images are central to analyzing and documenting road and intersection geometry and identifying design challenges that might be redesigned to improve travel conditions and accessibility for bicyclists and pedestrians.

EXAMPLES: SITE ANALYSIS RESEARCH & DATA COLLECTION

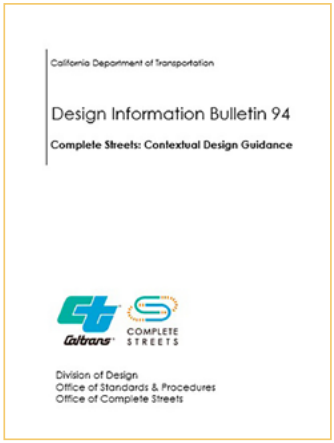
Desktop site analysis makes use of available data sources, aerial images, maps, and street views to assess how main streets fit into the built and natural world. Assessing how main street as a transportation facility interacts with the transportation network, the local geography, and the community is important to understanding the barriers and opportunities related to improving multimodal travel conditions and community livability.

Caltrans District 1 (D1) created the top map using census data to show Priority Equity Areas for the Caltrans District 1 Caltrans Active Transportation Plan 2021.

The middle image is a story map that D1 created with stakeholder input to identify areas of bicycling and pedestrian infrastructure needs. Both maps are now valuable sources of information for others who are collecting data on routes in D1. (All Caltrans districts have Active Transportation Plans.)

District 1 also consults data sources and plans from local partners such as the bottom map from the "Lake County Pedestrian Facility Needs Study," which was created for the Lake Area Planning Council. Plans and reports that were created by local partners with public input are crucial sources of information to incorporate into site analysis research.

SITE ANALYSIS RESEARCH: EVALUATING CONTEXT



The next page portrays a fictional location to graphically illustrate some of the initial research that should be done to understand the context of a main street study area. Topics related to natural features and the social and built environments are listed as the types of information that should be gathered and assessed during site analysis.

In addition to gathering information about the local context and transportation network, the next step would be to overlay additional data sources. For example, each Caltrans district has an Active Transportation Plan and Story Map online that were developed with extensive stakeholder engagement and include important information about Caltrans and stakeholder priorities.

After the initial research phase uncovers needs and opportunities within the study area, additional guidance documents can help identify effective strategies to improve multimodal and community conditions. One resource is the *Smart Mobility Framework Guide 2020* (SMF 2020), which describes the application of place types to identify transportation planning and project development priorities across California.

Another resource is *Design Information Bulletin 94, Complete Streets: Contextual Design Guidance* (DIB 94), which sets minimum expectations for Complete Streets facilities in different place types while considering aspects of roadway context such as speed limits and traffic volumes.

SITE ANALYSIS – EVALUATING CONTEXT

The first step of site analysis is to collect information about the current physical and social conditions that define the "context" of the study site. These are a few of the initial sample questions:

Natural Features:

- »What are the defining physical and natural characteristics of the site?
- »What constraints and/or opportunities exist due to local topography, water availability, seasonal weather conditions, and air quality?

Social and Built Context:

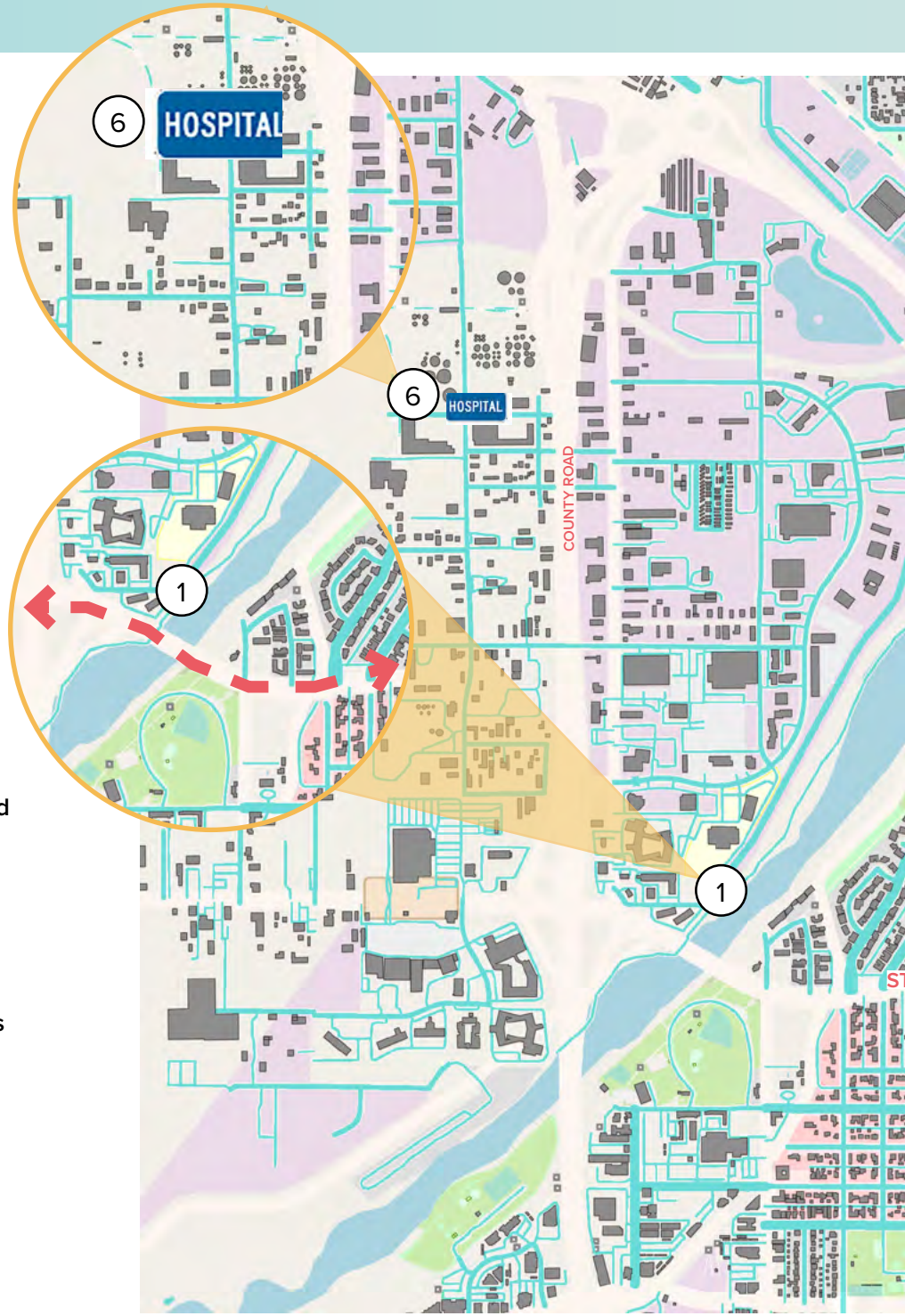
- »How big and densely developed is the community? (Which place type is it?)
- »What are the defining characteristics of the transportation network?
- »Who lives and travels in the site, and what are their needs and priorities?
- »Which local places, destinations, and landmarks are important to the community?
- »What are the applicable policies and safety goals for the site?

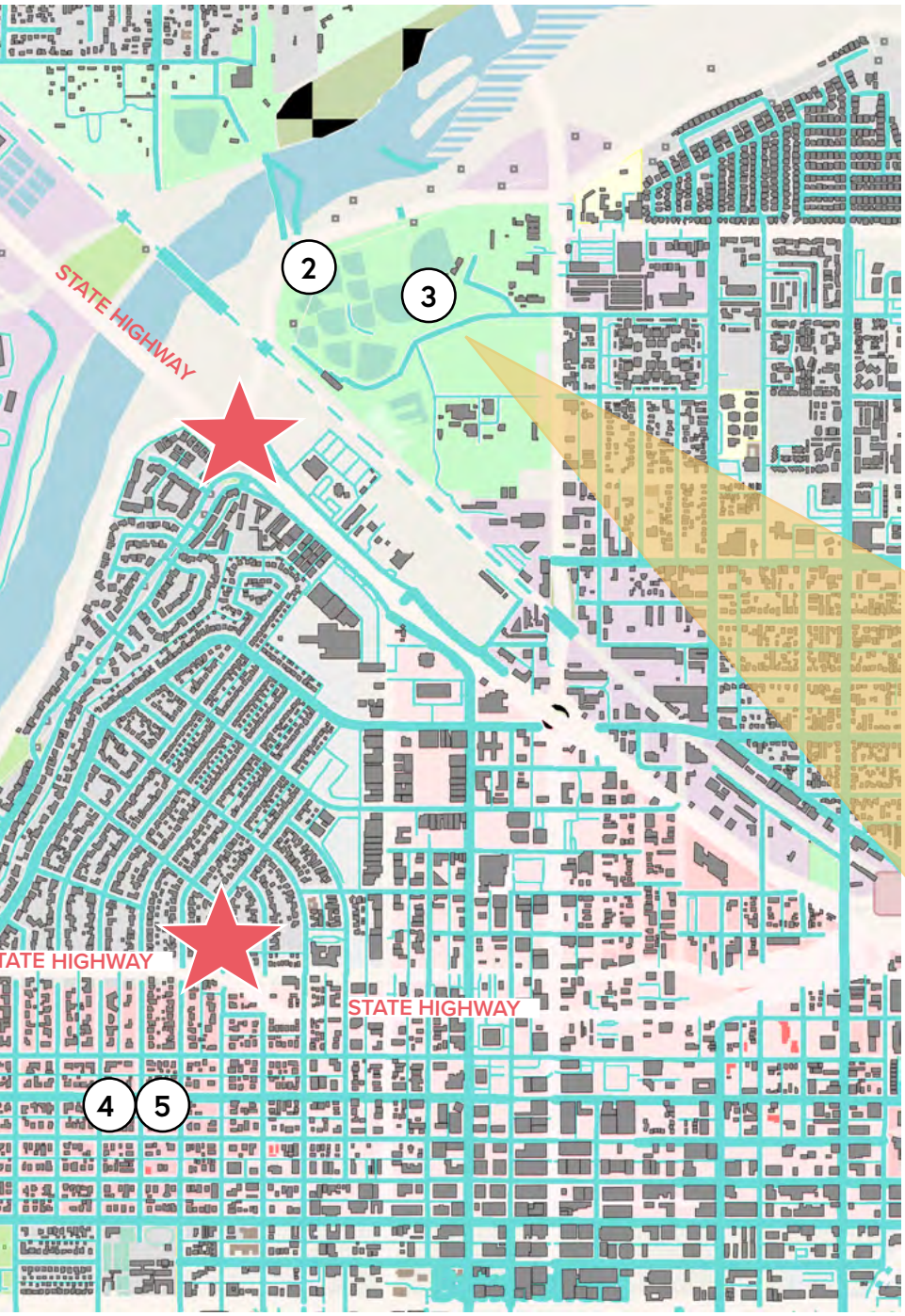
Project Locations: The study area has 2 proposed project locations on State highways (marked with a star). Heightened attention to travel along *and across* highways is crucial to enabling multimodal travelers full access to important destinations.

Numbers below correspond to locations on the map. The map portrays a fictitious community location to illustrate site analysis concepts.

1. **Natural features: The river is a defining physical feature for the study area. As a physical barrier for travelers, it poses a connectivity challenge for residents wanting to reach important retail and employment destinations. Bridges and structures should have heightened emphasis on providing multimodal access to bicyclists and pedestrians.**

2. **Climate: The study site is in California's Central Valley, which will see an increase in the number of days with extreme temperatures. Trees, shade, and multimodal access to the river for recreation are important for people seeking relief from urban heat islands and summer high temperatures.**





3 Access to nature: Parks and open space are high-value locations. Providing access to all requires emphasis on safe crossing of major roads and highways for people on the other side of the state facilities. A site visit could uncover information about how easy it is for people to travel from residential areas, across the State highway, and into this park.

4 Place type: The study area is an urban area. *SMF 2020* provides guidance on opportunities and common challenges associated with providing multimodal access in different place types.

5 CalEnviroScreen identifies this area as one with a high level of "Housing-Burdened Low-Income Households," highlighting a need for transportation investments that improve multimodal accessibility, equity, and livability.

6 Access to destinations: The project context includes a hospital. Hospitals not only provide emergency services, but are often major local employers. The transportation network ideally provides redundant multimodal routes to high-value locations. In this case, multimodal travel along and across State highways is an essential consideration.

Many important destinations like schools or civic centers can be identified by the project team, but community and stakeholder input is essential in identifying which additional locations are valued by the community.

Note: Defining the context of the site also includes consulting previous plans and recorded data (such as active transportation plans and proactive and reactive safety goals and plans) to include previous observations about known needs and opportunities to improve multimodal travel.

b VISIT

Visit the Site in Person

Site visits help practitioners to understand how a site is working for people. Physically visiting a site informs project team members about how it feels to be traveling and spending time on main street at the site. There are vital tactile and sensory data that can only be acquired by being physically present and by walking and bicycling within and near the project area. Valuable observations can be made about how well main street is functioning as multimodal travel facility and as a public space for the community.

During site visits, practitioners should note the strengths of the site. Preserving elements that are contributing to comfortable travel conditions and an inviting public space are vital to a thorough site analysis. Observations about conditions that are challenging or elements that could be improved should be recorded.

Above: A transportation professional makes site observations in the field.

Visiting the site in person can help identify important community places along the route. Assessing whether these destinations are accessible along comfortable multimodal travel routes is a key site analysis question.

Observing who is using the site is vital information, and making note of *who is not there* can yield important findings too. The absence of people biking and walking may be an indication that the route is uncomfortable or inaccessible to them. Their absence does not necessarily indicate a lack of interest in active transportation. Are there improvements that could be made to the site which would increase the number of people in the study area? Assessing whether a site is physically accessible to all ages and abilities is crucial.

Right: Local restaurants and retail on Route 101/ Redwood Highway in Hopland are important community destinations and gathering places. Left: A transit stop in the bay area with a high degree of accessibility for all ages and abilities.

Data about driving speeds and collision data should also be collected during the research phases of site analysis, and in-person visits can help further refine the information. In-person observations about operating speeds (including turning speeds) and yielding rates to nonmotorized road users are data that can inform decisions about appropriate design interventions.

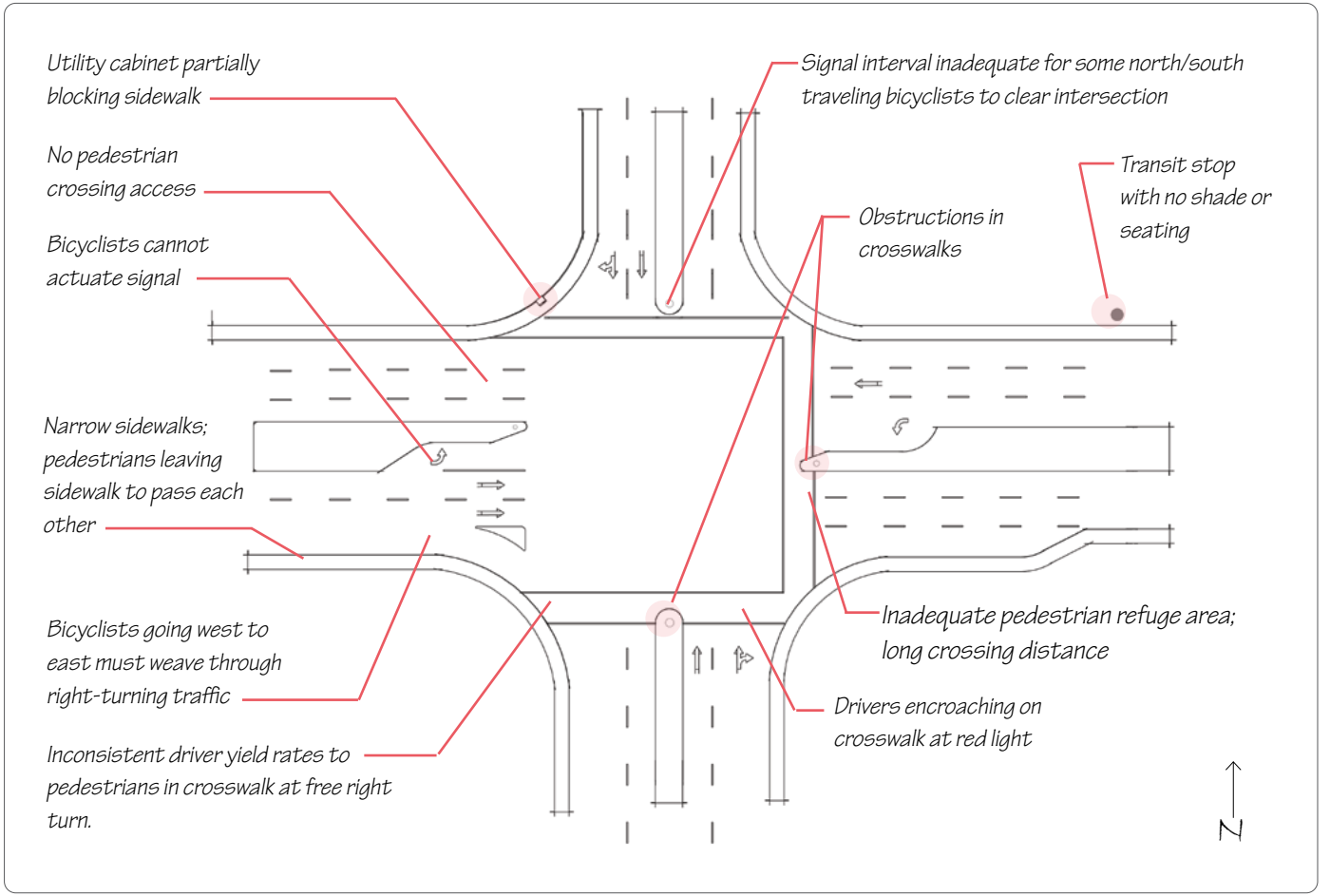
The most traditional method of recording site analysis observations is to sketch the project location by hand during an in-person visit. The sketch captures the current layout of the site and includes notes about conditions, human behavior, and travel experiences.

Sketching and taking notes on top of as-built plans, street-views, maps, or photographs on paper or a tablet are also an effective method of recording site visit observations. Additional information can be gathered by using apps on phones or tablets to enter geolocation data for objects and locations within the study area. Site visit photos are an essential tool for recording current conditions. Photos can note both strengths and short comings related to community livability and multimodal travel.

The graphic on the next page shows how a field sketch and notes can record geometric and signal conditions, travel behavior, and an assessment of how comfortable it is to walk and bike at that location.

Above: Visiting a site provides invaluable data about existing conditions that can inform design decisions, such as a high number of bicyclists (left) or the presence of obstacles in pedestrian paths (right).

RECORDING SITE OBSERVATIONS: FIELD SKETCHES



In the above site analysis sketch, the drawing and notes capture existing geometric, signal, and pavement marking conditions and observations about on-site utilities. Assessments about traveler comfort are also recorded such as "transit stop with no shade or seating" and "long crossing distance." Time spent at the site taking notes about how people are using and experiencing the site (such as "bicyclists cannot actuate signal in left-turn pocket" and "inconsistent driver yield rates at free right turn") provides important information that might not be fully captured during desktop research. The sketch and the notes help uncover and record site needs, strengths, and opportunities that will be useful to project design decisions.

Drawing adapted from "Complete Intersections: A Guide to Reconstructing Intersections and Interchanges for Bicyclists and Pedestrians" Caltrans (2010)

C ENGAGE

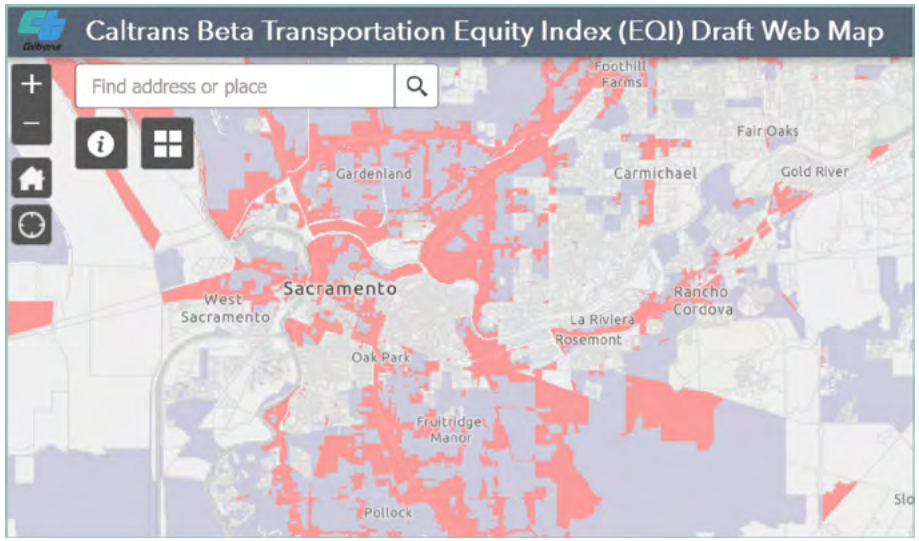
Engage the People Who Use Main Street.
As stated in the Public Participation Plan for development of the California Transportation Plan: "It is Caltrans' policy to encourage the public to express their needs and concerns to ensure that transportation decisions reflect community values and interests."

Engagement can be conducted in person by holding a public meeting or by attending an event or meeting held by others, such as a public agency or CBO. Online engagement can also be a powerful way to gather input from a community. When utilizing this approach, consideration needs to be given to how people with limited access to technology will be able to participate. Ideally, the most robust engagement happens in early planning stages and opportunities to provide input is an iterative process as a project proceeds.

Above: Staff and leaders from Caltrans, local government, partner agencies, and community members gather at a Clean California event.

ENGAGEMENT AND EQUITY

As discussed in *Principle 3: Elevate Equity and Livability* in *Chapter 1, Main Street Principles*, equity is a crucial lens through which we can define and prioritize projects. Engagement with stakeholders, including people who are traditionally underserved by public investments in transportation, helps define which problems and opportunities are a priority for the community and Caltrans.



Online data sets can help determine which regions, counties, and communities are underserved by public investment. Online mapping can provide critical information for this purpose. For example, the Caltrans Transportation Equity Index (EQI) is a screening and evaluation tool that utilizes multiple transportation-specific and socioeconomic indicators to identify transportation-based priority populations at the Census block level. CalEnviroScreen, is another tool that identifies California communities most affected by pollution and where people are especially vulnerable to the effects of pollution. Data points such as median household income, percentage of children receiving reduced-price school meals, and other criteria that can be defined at the local or regional level are important data to include in all phases of site analysis.

Independent of whether a community is identified as disadvantaged in various data sets and online resources, each community outreach effort should include contact with underrepresented members of the community. It is also important that persons with disabilities and/or limited English proficiency be able to participate in engagement efforts. Caltrans can provide resources, including bilingual staff, interpreters, and/or translated materials to ensure that information and services will be made available in the languages and communication methods and modes readily understood by Caltrans stakeholders. In addition, not all people or communities have access to high-speed Internet and other engagement approaches may be appropriate, with virtual engagement as a supplemental activity.

Caltrans planning offices and local planning entities such as metropolitan planning organizations can help identify CBOs and other ways to engage with community members. Direct engagement with communities that are underserved by public investments is essential to effectively address long-standing disparities in the quality of transportation infrastructure in low-income areas and in communities of color.

Above: A beta-version of the Caltrans Transportation Equity Index (EQI), a screening and evaluation tool that utilizes multiple transportation-specific and socioeconomic indicators to identify transportation-based priority populations.

IN-PERSON ENGAGEMENT

Early community and stakeholder engagement helps develop projects that respond to the needs and vision of the community. Ideally, early planning is the phase that includes the most robust engagement activities, giving the project team time to create a scope, cost, and schedule that encompasses the input.

Caltrans conducts a range of in-person engagement activities such as site visits, meetings, workshops, public presentations, charettes, pop-up events, and other types of forums.

Engagement activities are chosen based on the project's goals, complexity, and phase.

Further guidance about in-person and online engagement strategies and best practices is available from the Caltrans Office of State Planning, Equity, and Engagement.

Above: Photos depict a range of Caltrans and partner engagement and outreach activities.

Photos on this page depict a range of online engagement strategies and notices.

ONLINE ENGAGEMENT

Caltrans makes use of digital and online tools to engage with partners and the public. Online engagement can be an effective way to gather input from a community. When utilizing this approach, consideration needs to be given to how people with limited access to technology will be able to participate.

Online engagement activities can include virtual meetings, online presentations, public surveys, graphic visualizations, interactive mapping tools, and other digital communication tools.

CASE STUDY: SITE VISIT & ENGAGEMENT

Caltrans District 6 Walk Audit Program

To support the Caltrans goals to advance equity, livability, and Complete Streets, District 6 (D6) staff initiated a walk audit program for State highway main streets. Walk audits are a form of site visit during which one or more people walk along a route and record observations about existing and desired conditions. D6 is conducting walk audits as a meaningful way of developing a shared vision for main streets improvements.

To date, several walk audits have included discussions with communities about how to better serve older adults, children, and people with disabilities. D6 plans to continue the walk audit program at regular intervals to support vibrant livable places, with a focus on addressing the needs and concerns of underserved communities.

On one of the first walk audits, D6 staff met with the City of Avenal City Manager, Community Development Planning Director, and the Public Works Director (photo left). The walk audit enabled the group to identify areas of concerns and opportunities. The observations and discussions during the site visits helped identify potential funding sources for future improvements and fostered a stronger working relationship between Caltrans and city partners.

Another walk audit with the City of Firebaugh City Manager identified current issues with connectivity for bicyclists and pedestrians. Being on-site allowed Caltrans staff to hear directly from a local business owner, who had concerns about main street businesses. The photo on this page shows a section of main street that has a gap in sidewalk connectivity—an element identified during the walk audit.

CHAPTER 3
DESIGNING MAIN STREETS

Chapter 3 defines geometric features, pavement markings, signals, signs, and livability design strategies to help guide collaborative discussions with stakeholders and to inform project delivery team discussions. The described options are not intended as a recommendation for one solution over another, and they are not presented in order of priority or preference. Main street designs will be as varied as the communities in which they exist, but all planning and design decisions should elevate the priorities of addressing equity goals, improving active transportation access for all ages and abilities, implementing traffic-calming measures when needed, and increasing the livability benefits that main street can provide.

SITE ANALYSIS & ENGAGEMENT IN DESIGN

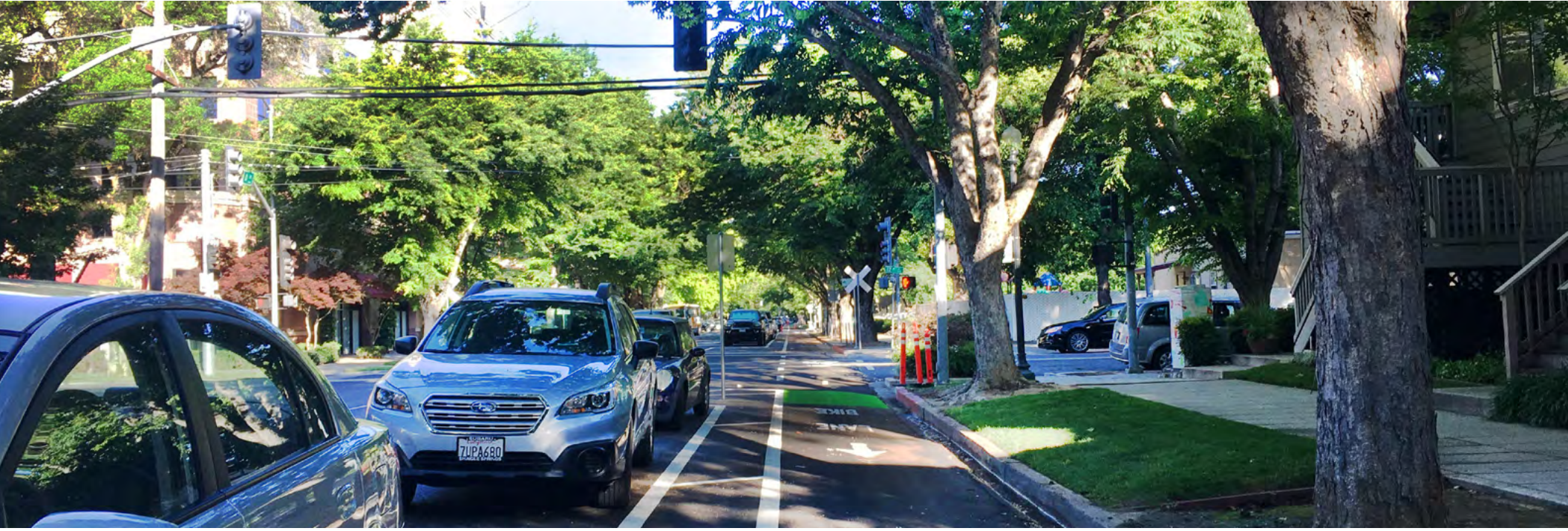
As discussed in *Chapter 2, Planning Main Streets,* the site analysis findings from the planning stages inform the finer-grain investigation of a project area during the next phase, which is the design phase. Through further site analysis activities, it is common in the design phase to uncover additional physical constraints and opportunities that need to be considered.

Outreach and engagement efforts can also be an iterative process that helps further and maintain a shared vision for main streets as the project is developed with more precise detail. It is also important to note that the type of engagement activity will vary greatly based on factors such as project complexity and the amount of information gathered during previous engagement activities. In some situations, public engagement that was conducted during a planning stage was recent and robust enough that the design team can draw on that effort to proceed with project designs.

Balanced Roadways & Intersections

Balanced main street intersections and roadways are those that address the accessibility and comfort of pedestrians, bicyclists, transit riders, and motorists. Main street intersections and roadway designs should encourage and support active use of main streets by people of all ages and abilities.

Above: Roadway reallocation (a road diet) in Bridgeport made space for bike lanes.



Designing the Roadway Cross-section

This section describes the elements to consider related to the cross section of a roadway; the next section focuses on the design of intersections.

Reallocating Roadway Space

Planners and designers typically work in areas of fixed boundaries, with competing demands for use of the space. On some projects, designers have an opportunity to adjust the dimensions of roadway features to make space for new or expanded uses. Accommodating the needs of all travelers, supporting adjacent land uses, and incorporating utilities, drainage facilities, and other functional facilities should be balanced to provide the most successful solutions for each unique main street. The dimensions of all roadway and roadside features should be analyzed on a case-by-case basis to determine how to best balance the competing needs.

DIB 94 provides new flexibility in reallocating roadway width to enhance facilities for bicycles and pedestrians. DIB 94 provides flexible design standards and guidance for the minimum dimensions of traffic lanes and shoulders and guidance for wider bikeways and sidewalks.

Above: A city street in Sacramento moved the parking lane to place a Class IV facility adjacent to the curb; parked cars now buffer bicyclists from faster moving motorized traffic.

ROADWAY REALLOCATION: ROAD DIETS AND NUMBER OF LANES

A "road diet" consists of reallocating some of the roadway width primarily used by motor vehicles to make space for other uses. Most commonly, a road diet reduces a four-lane, undivided street into a three-lane street, with two through lanes and a center turn lane. Reallocating space through lane reduction and/or lane width reduction, generates roadway space that can be used to support bicycling, walking, taking transit, and other livability features such as median plantings, street furniture, and street trees.

Research by FHWA and others shows that implementing road diets can slow driving speeds and reduce crashes (rear-end, left-turn, and right angle). When main streets have excess capacity, a road diet will create only minimal drive-time delay while significantly improving level of traffic stress for bicyclists and pedestrians. Any impacts on travel time for motorists should be considered alongside the safety and livability improvements for nonmotorized road users.

Lane reallocation decisions should consider potential impacts to pedestrian, bicyclist, driver, and transit rider mobility; transit vehicle operations; livability and sustainability goals; traffic conflicts involving all travel modes; movement of freight; parking; drainage; and maintainability (particularly sweeping and snow removal).

Reallocation of roadway space is a design and operations decision that can dramatically alter travel conditions and reshape community space, so it is vital that road diet discussions occur early in the planning process with meaningful stakeholder involvement. **>>**

Above: A road diet on Route 227 made space for bike lanes with a raised median. Below: SR 227 before the road diet.

FHWA Proven Safety Countermeasure: Road Diets (Roadway Configuration)

TRAFFIC LANE WIDTH

In lower-speed environments such as along main streets, there may be opportunities to reduce lane width to improve the conditions for a full range of travelers. Appropriate traffic lane width is determined by proposed operating speed, traffic volume, and types of vehicles served along a main street. Lane width is also influenced by place type, adjacent land uses, local terrain, and the location of the lane within the larger roadway.

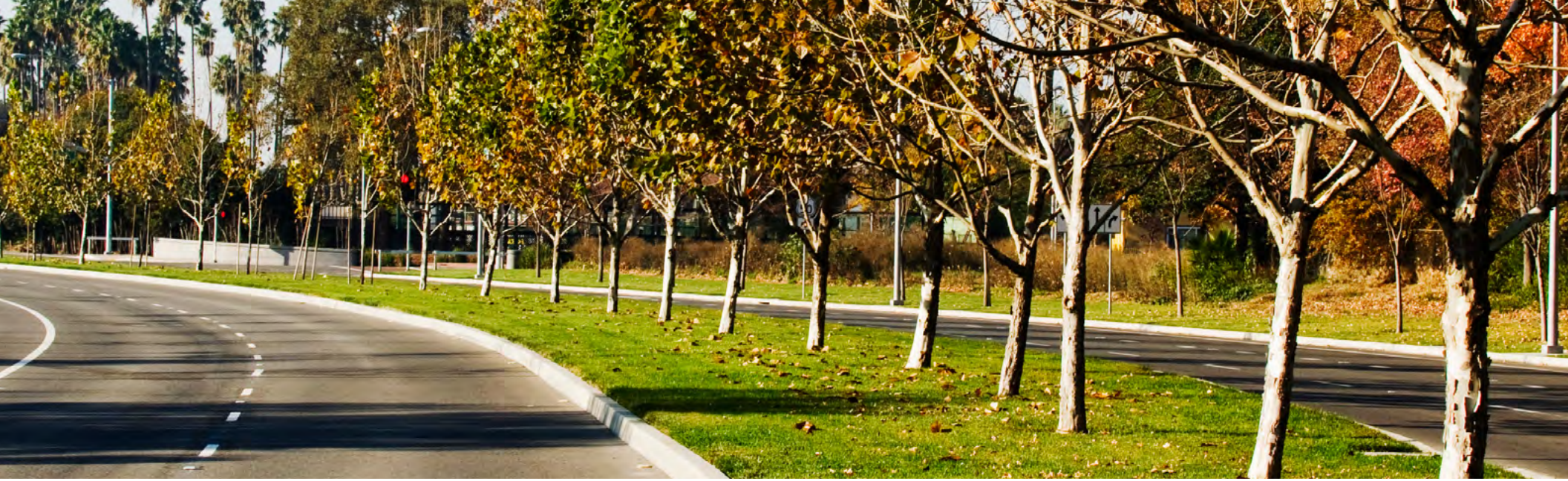
Narrower traffic lanes shorten crossing distances for pedestrians and bicyclists and can provide space for roadway elements like medians, bike lanes, sidewalks, on-street parking, transit stops and landscaping. Reducing lane widths in main street environments can influence drivers to maintain slower vehicle speeds, especially when undertaken in combination with other traffic-calming strategies.

The optimal allocation of space within the main street right of way will depend on site-specific details, community goals, and traveler needs. System access for bicyclists, pedestrians, and transit users should be evaluated alongside the needs of motorists. The operations and physical dimensions of cars, recreational vehicles, trucks, and buses; the classification or use of the highway (whether a route is a designated truck route, for example); and proposed operating speeds influence the selection of the appropriate lane width. When considering use of narrower lane widths, it is also important to thoroughly address how narrower lanes may affect vehicle separation and the functionality of utilities and drainage. Lane width does not include the gutter, so drainage needs to be considered in the cross section. **>>**

TWO-WAY-LEFT-TURN LANES

Two-way-left-turn lanes provide for left-turning movements from a center lane. They remove left-turning vehicles and bicyclists from the traffic flow and provide a buffer between opposing directions of travel. This type of lane can reduce turning-related conflicts and conflicts between opposing directions of traffic. Two-way-left-turn lanes are often introduced in conjunction with traffic lane width reductions or road diets as part of a traffic-calming strategy. **>>**

Above: A two way left turn lane in Sebastopol on Route 116. Roadway space and lane widths were reallocated to make room for bike lanes with green pavement markings on each side of the road.



RAISED MEDIAN ISLANDS

Raised median islands (raised medians) can reduce traffic conflicts, provide pedestrians a crossing refuge, reduce the scale of the street, and with trees and landscaping, improve the aesthetic and environmental value of the site. Raised medians may also be appropriate sites for green infrastructure elements.

At crossing locations, raised medians help reduce conflicts between pedestrians and traffic by allowing pedestrians to cross only one direction of traffic at a time. Raised medians can terminate before the crosswalk, or a pedestrian refuge island can be installed. Where justified, mid-block pedestrian crossings can be constructed to provide more efficient travel routes for pedestrians.

A raised median may be placed to divert through traffic from side streets and all left-turn movements to the nearest signal or intersection where turns are permitted. Designers must conduct proper analysis to ensure that these intersections can handle the added turning movements. Circulation from the side streets may be affected; therefore, bicyclist and pedestrian circulation needs and the impacts on local businesses and neighborhoods should be evaluated.

Features in the island that classify as a fixed object, such as a tree, boulder, bollard, or monument, must meet setback distances from the median curb face. There are also design standards for trunk diameter and the placement of trees and landscaping to ensure that vegetation does not obstruct horizontal and vertical sight distances.

To facilitate safe and routine maintenance of raised medians, worker and equipment access needs should be evaluated and accommodated during design. Designs that minimize maintenance activities related to paving, landscaping, and irrigation reduce worker exposure to traffic dangers. Raised median designs should also be evaluated for compatibility with snow removal activities and equipment needs. **>>**

Above: A raised median on former State Route 275 in West Sacramento.

MID-BLOCK CROSSINGS

Mid-block crossings provide pedestrians and bicyclists additional opportunities to cross along streets with infrequent intersections, where a direct route is needed to a popular destination (such as from a transit stop to a school or shopping center) or to preserve the connectivity of a multiuse path or bike path that crosses a street at a mid-block location.

Above: A mid-block crossing on a local road in West Sacramento includes crosswalk enhancements and aesthetic detailing.

Locations for mid-block crossings and their physical configuration should be based on sound engineering judgment and analysis to provide maximum visibility of pedestrians to motorists, reasonable opportunities for pedestrians to cross, and reasonable disruption to the vehicle travel flow (to prevent traffic conflicts due to unexpected vehicle stopping).

The CA MUTCD states: "Mid-block pedestrian crossings are generally unexpected by the motorist and should be discouraged unless, in the opinion of the engineer, there is strong justification in favor of such installation. Particular attention should be given to roadways with two or more traffic lanes in one direction as a pedestrian may be hidden from view by a vehicle yielding the right of way to a pedestrian."

Pedestrian visibility at mid-block crossings can be enhanced through the use of high visibility crosswalks, advance stop or yield markings, and the signals or beacons discussed in this chapter. For multilane crossings on divided roadways, mid-block crossings benefit by having pedestrian refuge in the median to allow crossing to and from each side of the median separately. **>>**

Top: A mid-block crossing on Route 116 / Petaluma Avenue in Sebastopol (top) with bulb-outs to shorten crossing distances. Bottom: A mid-block crossing in Washington, DC, includes pedestrian-scale lighting.

Intersections

Intersections are complex travel environments. Road users need to be aware of each other's presence, adjust their speed as needed, and be able to predict and interpret the likely upcoming actions of others. The design of an intersection can profoundly influence people's ability to focus on the most important information at the right time, such as by clarifying right of way, assigning movements at signalized intersections, and moderating driving speeds. The HDM (Chapter 400) states: "Most motor vehicle / bicycle collisions occur at intersections. For this reason, intersection design should be accomplished in a manner that will minimize confusion by motorists and bicyclists, eliminate ambiguity, and induce all road users to operate in accordance with the statutory rules of the road in the California Vehicle Code."

Intersections should also be designed to provide visibility for all travel modes, especially nonmotorized road users, through preservation of adequate sight distances, installation of appropriate lighting, and introduction of road features that increase the visibility of bicyclists and pedestrians and shorten their exposure time to traffic (such as curb extensions and pedestrian refuge islands).

The Safe System Approach encourages designers to proactively design transportation infrastructure in a way that anticipates human error and reduces the risk of severe crashes. The Safe System strategies that FHWA lists for intersections include "minimizing and modifying conflict points; reducing speed of vehicles; improving visibility at intersections; and providing space and protection for pedestrians and bicyclists."

In general, pedestrians and bicyclists benefit most from compact intersections, with minimal crossing distances, adequate crossing times, lower operating speeds, and configurations that facilitate predictable travel movements for all users. **>>**

Left: Pedestrians cross a busy urban intersection.

ANGLE OF INTERSECTION

The challenges that bicyclists and pedestrians face at intersections are increased when streets do not come together at square angles. Skewed intersections can facilitate higher speeds by turning motorists, and crossing distances and exposure times are increased for nonmotorized road users. Bicyclists and pedestrians can also be less visible to drivers at skewed intersections. Reconfiguring intersections so that the streets cross at 90 degrees (or as close as possible to 90 degrees) improves traffic conditions for all users. When skewed intersections are unavoidable, potential treatments can include using additional pavement markings such as high-visibility crosswalks, tightening the turning radius, and including pedestrian refuge islands or curb extensions to reduce crossing distances.

The Caltrans *Traffic Calming Guide* states, "The prevalence of speeding vehicles at skewed intersections can have a negative effect on all users of the intersection. If the State highway alignment has an angle or curve, a reconstruction to design intersections at right angles will induce slower speeds to negotiate the turning movements. This concept is especially useful at interchange ramp intersections with local roads." **>>**

CURB RADIUS

The radius of a corner at intersections plays a meaningful role in the mobility and safety of roadway users. Larger curb radii facilitate faster driving speeds during turns and lengthen pedestrian crossing distance and exposure. A smaller curb radius has a traffic calming effect and increases a motorist's ability to see pedestrians. Individual intersections are unique, and evaluating how to use the smallest curb radius appropriate for each location is a key site analysis consideration. When designing or reconstructing intersections, the minimum appropriate turning radius is selected by evaluating the relative mix of roadway users, the design vehicle, the types and volumes of nonmotorized road users, the number and configuration of travel lanes, and local land use. The relative volumes of trucks and buses is a crucial factor to consider when selecting curb radii. At intersections with high numbers of large vehicles, a larger curb radius would reduce the risk that someone making a turn in a large vehicle would drive over the curb and into pedestrian space. The HDM states, "The smallest curb return radius should be used that accommodates the design vehicle." **>>**

BULB-OUTS (CURB EXTENSIONS)

Bulb-outs, also called curb extensions, are physical extensions of the sidewalk into the roadway where there is on-street parking. The Caltrans *Traffic Calming Guide* states that bulb-outs "have a traffic calming effect" because they "require more attention from the driver, while inducing a speed reduction due to larger turning maneuvers." Bulb-outs also increase the visibility of pedestrians to drivers and bicyclists and give pedestrians a better view of oncoming traffic. Bulb-outs can be placed at intersections or mid-block and they can provide additional space for street furniture, landscaping, aesthetic surface treatments, and curb ramps.

Bulb-outs should not extend into bike lanes and need to enable trucks and buses to turn without mounting the curb. They must be designed to allow for adequate drainage (to avoid water, ice, leaf, and road debris buildup) and street sweeper accessibility. In areas of regular snowfall, bulb-outs must be marked by objects visible to snowplow operators.**>>**

Bus bulb-outs are discussed in the section "Connections to Public Transit."

Top: A bulb-out on Route 299 in Willow Creek. Bottom: On Route 49/193 (High Street) in Auburn, a bulb-out incorporates storm water treatment elements.

PEDESTRIAN REFUGE ISLANDS (PEDESTRIAN CROSSING ISLANDS)

Pedestrian refuge islands, or pedestrian crossing islands, are raised islands that separate crossing pedestrians from traffic at intersections or mid-block locations. They allow people a sheltered place to stop before crossing the rest of the street, which allows pedestrians to analyze oncoming traffic in one direction at a time. They provide pedestrians a better view of oncoming traffic and increase the visibility of the pedestrians to drivers. Where raised medians would otherwise hinder access to desirable pedestrian routes, a crossing island can help preserve pedestrian accessibility. FHWA states that "Refuge islands are highly desirable for midblock pedestrian crossings on roads with four or more travel lanes. **>>**

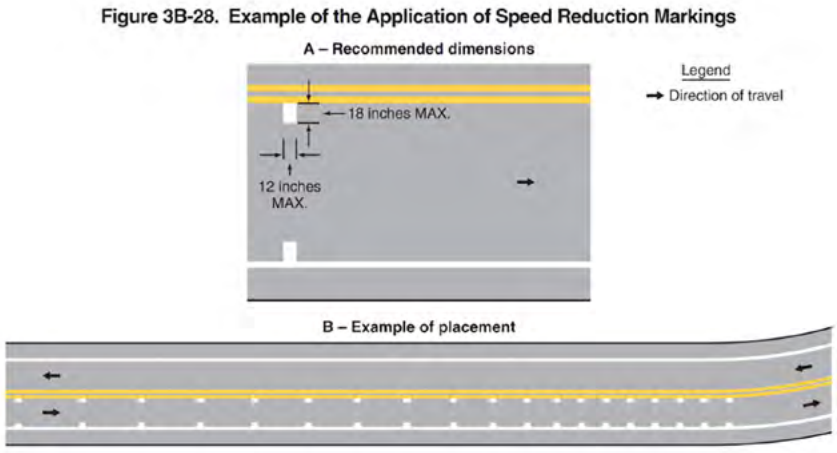
Above: Pedestrian refuge islands on multilane streets in Oakland (left) and Santa Monica (right).
FHWA Proven Safety Countermeasure: Medians and Pedestrian Refuge Islands in Urban and Suburban Areas

PROTECTED INTERSECTIONS

Protected intersections improve travel conditions for bicyclists and pedestrians at intersections through a combination of pavement markings and geometric features. Protected intersections are usually implemented on streets with separated bikeways (Class IV) or bike lanes (Class II). A major defining characteristic is the "corner island," which provides a sheltered place for bicyclists and pedestrians to wait for a traffic signal, shortens crossing distances (and therefore exposure time to vehicle traffic), and tightens curb radii, which slows driving speeds.

As stated in Design Information Bulletin Number 89 (DIB 89): "Protected Intersections provide physical separation between turning vehicles and bicyclists at intersections. This design uses corner islands to provide a buffer for waiting bicyclists and pedestrians, and a dedicated path through the intersection without requiring a merge with mixed traffic. A protected intersection has a bikeway crossing that is set back to improve sight lines and to provide a place for bicyclists and pedestrians to queue outside of the bikeway and sidewalk. Protected intersections also reduce vehicle turning speeds, which reduces the rate of serious injury in the event of collision with bicyclists or pedestrians." **>>**

A protected intersection connects pedestrian and bicyclist routes through an intersection on a local street in Davis.



FREE RIGHT TURN LANES (SLIP LANES)

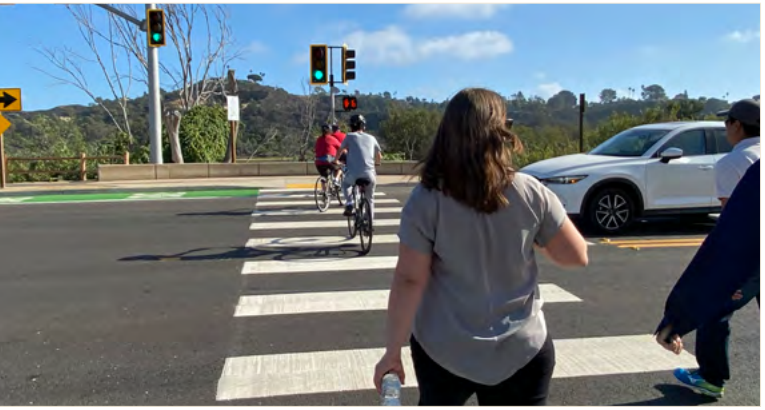
Free right turn lanes reduce the need for drivers to come to a full stop at a right turn. They are intended to minimize congestion, add to driver convenience, and improve maneuverability for large vehicles. When designing or reconstructing an intersection, consideration should be given to whether slip lanes can be eliminated, given that they increase turning speeds, do not shorten crossing distances for nonmotorized road users, and can minimize driver's visibility of pedestrians. If slip lanes are determined to be necessary, improving conditions for pedestrians is crucial. Features such as pedestrian refuge islands, crosswalk enhancements, and crosswalks that cross the lane at a right angle can help minimize driving speeds and increase drivers' ability to see people crossing the street. **>>**

SPEED REDUCTION MARKINGS

Speed reduction markings, sometimes called "optical speed bars" are a pavement marking intended to slow drivers down in advance of a curve or other roadway feature. The Caltrans Traffic Calming Guide states that speed reduction markings "are transverse pavement markings placed with progressively reduced spacing on both edges of the traveled way to create the perception of increased speed. This illusion encourages drivers to slow down as they pass by the markings."

In some situations, these markings may be considered as a strategy to implement when a higher speed rural road will transition into a rural main street area. The Traffic Calming Guide gives further direction that they "should be reserved for unexpected curves and should not be used on long tangent sections of roadway or in locations frequented mainly by local or familiar drivers." **>>**

Left: A free right turn lane on local street and pedestrian refuge island on a city street in Davis.
Right: Graphic showing speed reduction markings from the CA MUTCD.



ADVANCE STOP OR YIELD LINES

Along multilane roads, a motor vehicle stopped for crossing pedestrians may prevent other drivers (approaching in an adjacent lane) from seeing the crossing pedestrians. Stop or yield lines that are placed in advance of crosswalks enable drivers in multiple lanes to see crossing pedestrians and also allow pedestrians greater visibility of oncoming traffic. **>>**

CROSSWALK MARKINGS

The primary goal of a marked crosswalk is to delineate a path for pedestrians to cross the street and to alert road users of designated crossing areas. Legal crosswalks come in various forms, including unmarked crosswalks, marked crosswalks, and marked mid-block crosswalks. Pedestrians may legally cross at any intersection whether a marked crosswalk exists or not (except in specific locations where signage indicates that pedestrians shall not cross). And in recent legislation (Assembly Bill [AB] 1909, Friedman) bicyclists will be permitted to cross streets on pedestrian walk signals rather than only on a green traffic signals.

Marked crosswalks utilize white or yellow (in school areas) pavement lines across a roadway, with standard design details that are required by the CA MUTCD. Intersections that do not have signals or stop signs are called "uncontrolled intersections" and placement of marked crosswalks at these locations should be based on an engineering study. Current research shows that at marked crosswalks at uncontrolled intersections, crossing conditions can be improved with the installation of additional pedestrian safety features, often called "crosswalk enhancements," such as signage, curb extensions, and/or beacons.

There are many tools that can be combined to enhance crosswalks with additional safety and comfort features depending on the site conditions. DIB 94 states "Crosswalks should be considered where Class I bikeways cross the roadway, since the Class I bikeway is for pedestrians and bicycles. When identifying potential crosswalk users, keep in mind individuals who may have more limited mobility, such as children and seniors" **>>**

Top: Advance yield markings on a local road in Pleasant Hill. Middle: A high visibility crosswalk in San Diego. Bottom: A high visibility crosswalk on Route 123 in Albany.

HIGH-VISIBILITY CROSSWALKS

High-visibility crosswalks provide higher visual contrast to approaching motorists as compared to conventional crosswalk markings. FHWA states that, "high-visibility crosswalks use patterns (i.e., bar pairs, continental, ladder) that are visible to both the driver and pedestrian from farther away compared to traditional transverse line crosswalks. They should be considered at all mid-block pedestrian crossings and uncontrolled intersections. Agencies should use materials such as inlay or thermoplastic tape, instead of paint or brick, for highly reflective crosswalk markings."

In DIB 94, high-visibility crosswalks, discussed in the next paragraph, are considered a "crosswalk enhancement." **>>**

CROSSWALK ENHANCEMENTS

"Enhancements" or "enhanced crosswalks" refer to any feature that supports crosswalks beyond the two white or yellow pavement marking lines (which may include high visibility crosswalk markings). Crosswalk Visibility Enhancements are listed as an FHWA Proven Safety Countermeasure: "Three main crosswalk visibility enhancements help make crosswalks and the pedestrians, bicyclists, wheelchair and other mobility device users, and transit users using them more visible to drivers. These include high-visibility crosswalks, lighting, and signing and pavement markings. These enhancements can also assist users in deciding where to cross. Agencies can implement these features as standalone or combination enhancements to indicate the preferred location for users to cross." **>>**

Above: Enhanced crosswalk features in Pleasant Hill.

FHWA Proven Safety Countermeasure: Crosswalk Visibility Enhancements

RAISED CROSSWALKS (SPEED TABLES)

Raised crosswalks, also called "raised pedestrian crossings," are marked crosswalks that occur on a speed table (a raised section of road, with a ramp on both sides) that cross the entire width of the roadway. Raised crosswalks allow pedestrians a more visible and prominent location in which to cross mid-block or at an intersection. FHWA reports that raised crosswalks can reduce vehicle speeds and "reduce pedestrian crashes by 45%."

At early planning stages, consideration of raised crosswalks should include analysis of compatibility with trucks, emergency and transit vehicles, and site analysis of drainage patterns and snow removal operations where applicable. To ensure access is provided to pedestrians with impaired vision, detectable warnings (truncated domes) are installed at the street edge. **>>**

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Left: A raised crosswalk at a highway entrance ramp in Windsor. Right: On a local road in Emeryville.

INTERSECTION SAFETY & OPERATIONAL ASSESSMENT PROCESS

Proposed new intersections, or major modifications to existing intersections undergo a screening process known as "Intersection Safety and Operational Assessment Process" (ISOAP). The process identifies the optimal design strategies for intersection type, geometry, and traffic control.

ISOAP compares the performance and functionality of various intersection designs and evaluates other potential traffic control strategies such as stop signs, yield control (roundabout), and traffic signals. The evaluation includes assessment of multimodal travel conditions, the site's context (including place type and land use), how the intersection design will affect the operation of adjacent intersections, and the conditions in the corridor as a whole.

ISOAP incorporates the six principles of the Safe System Approach to enhance intersection safety. Strategies for Safe System implementation at intersections include minimizing and modifying conflict points; reducing speed of vehicles; improving visibility at intersections; and providing space and protection for pedestrians and bicyclists. ISOAP identifies the highest-performing type of traffic control or intersection configuration that support the principles of the Safe System Approach. Examples of recommendations that can be made with ISOAP include installation of a roundabout, a traffic signal, or Pedestrian Hybrid Beacons or other methods of traffic control. **>>**

Top: A roundabout on Highway 1 south of Fort Bragg. Bottom: A roundabout in Upper Lake on Highway 20.

ROUNDABOUTS

A roundabout is a type of circular intersection without traffic signals or stop signs, in which traffic flows counterclockwise around a central island. As a 'yield control' intersection, approaching traffic yields and waits for a gap in the traffic flow before entering the intersection. Roundabouts lower the driving speeds and speed differentials among all users immediately before, through, and beyond the intersection.

In comparison with other conventional intersections, roundabouts have a proven record of reducing both the number and the severity of traffic conflicts due to reduced vehicle speeds and potential impact angles, common direction of travel, and fewer conflict points for all modes of travel. Roundabouts can be evaluated as a strategy to provide traffic-calming benefits and to reduce motor vehicle congestion.

Providing landscaping within the central island of the roundabout, in the pedestrian crossing islands (splitter islands), or along the approaching roads provides environmental, aesthetic, and traveler safety benefits. Appropriate landscaping and aesthetic treatments in the central island should convey to travelers that they are not to pass through the central island, maintain safety setbacks, encourage pedestrians to cross only at designated crossing locations, and aesthetically integrate the intersection into the surrounding area.

Top: Roundabout on Route 28 / North Lake Boulevard in Kings Beach.

FHWA Proven Safety Countermeasure: Roundabouts

Pedestrians at Roundabouts

Pedestrians travel through roundabout intersections at marked crosswalks that are set back from the entrance points of the circulatory traffic path. Setting the crosswalk back from the traffic entry point shortens both the distance of each crossing location and the travel time that pedestrians must spend in the crosswalk. This crosswalk placement also helps drivers and bicyclists first focus their attention on crossing pedestrians before evaluating the circulating traffic stream. Pedestrians are not permitted in the center of roundabouts located on State highways.

Where warranted, installation of beacons and accessible pedestrian signals can also improve conditions for pedestrians at roundabouts. Accessible pedestrian signals are particularly valuable at multilane roundabouts where auditory traffic cues are difficult for pedestrians with sight impairments to discern. Beacons and signals are discussed in the following section.

Bicyclists at Roundabouts

Single-lane roundabouts can reduce the number of conflict movements between bicyclists and motor vehicles (at intersections) and minimize severe injury collisions due primarily to the reduced speeds of motor vehicles. Bike lanes are not used in roundabouts since this would place bicyclists at the outer edge of circulating traffic, increasing potential traffic conflicts between bicyclists and entering/exiting motor vehicles. Instead, bicyclists may use the shared bicycle/pedestrian path that circulates around the perimeter of the roundabout, or they may take the full lane and merge into the vehicular traffic before entering the roundabout. Multiple-lane roundabouts, as compared to single-lane roundabouts, can increase the level of traffic stress for bicyclists; however, shared bicycle/pedestrian paths with bike exit ramps or other available bikeways can improve travel conditions and reduce LTS for bicyclists. **>>**

Top: Pedestrians crossing areas are set back from the center of the roundabout on Route 28 / North Lake Boulevard in Kings Beach.

Signals, Beacons, and Signs

This section provides a general discussion of signals and beacons that may be used at a variety of intersection types and pedestrian crossing locations on a main street. Thorough guidance regarding the appropriate application of various signals and beacons is in the CA MUTCD and on the Caltrans Traffic Operations website. Early project development discussions should address roles and responsibilities for maintenance activities and the evaluation of life-cycle costs associated with various signals and beacons. **>>**

TRAFFIC SIGNALS

Traffic signals are tools intended to direct the movements of travelers. They assign the right of way to various streams of traffic flow to improve safety and mobility. Traffic signals can be designed to function at an isolated intersection or to be part of a coordinated signal system. Coordinated traffic signals can reduce travel time and delay with a properly designed green light progression. Signals can also function as a speed control mechanism to deter motorists from speeding by setting the green signal timing to be consistent with the main traffic flow moving at the speed limit. An engineering study of the site and traffic conditions determines whether installation of a traffic control signal is warranted at any location. Poorly located traffic control signals and improper signal timing can adversely affect vehicular, bicycle and pedestrian traffic flow and can result in unnecessary congestion.

New traffic signals can help organize the travel of different travel modes and reduce conflicting movements. The CA MUTCD outlines sets of conditions, known as warrants, that are used to justify the installation of a signal, although the final determination of whether a new traffic signal is appropriate at a specific location is made through engineering judgment. Traffic signal warrants analyze factors involving vehicle and pedestrian volumes, crash experience, school crossings, or intersections near railroad grade crossings.

Additional signal heads at large signalized intersections or locations with line-of-sight obstructions can be considered to improve the ability of drivers to see signal changes and reduce the likelihood of driver error. **>>**

BACKPLATES WITH RETROREFLECTIVE BORDERS

A backplate on a traffic signal head with a retroreflective border is listed as an FHWA Proven Safety Countermeasure. FHWA states: "Backplates added to a traffic signal head improve the visibility of the illuminated face of the signal by introducing a controlled-contrast background. The improved visibility of a signal head with a backplate is made even more conspicuous by framing it with a 1- to 3-inch yellow retroreflective border. Signal heads that have backplates equipped with retroreflective borders are more visible and conspicuous in both daytime and nighttime conditions."

"This treatment is recognized as a human factor enhancement of traffic signal visibility, conspicuity, and orientation for both older and color-vision-deficient drivers. This countermeasure is also advantageous during periods of power outages, when the signals would otherwise be dark, providing a visible cue for motorists to stop at the intersection ahead." **>>**

Above: Backplate with Retroreflective Border
FHWA Proven Safety Countermeasure: Backplates with Retroreflective Borders

EXTEND PEDESTRIAN CROSSING TIME

Increasing the duration of the walk phase can be especially beneficial to pedestrians who take longer to cross the street such as children and aging road users or at intersections with high numbers of pedestrians. **>>**

PEDESTRIAN COUNTDOWN TIMERS

Pedestrian countdown timers, sometimes called countdown signals, are incorporated into pedestrian signal heads and inform pedestrians of the number of seconds remaining to cross the street. They are required at all new signalized intersections and pedestrian crossings on the State Highway System. Countdown timers are especially valuable along busy or wide streets to prevent pedestrians from becoming stranded in the middle of the street when the signal changes. **>>**

LEADING PEDESTRIAN INTERVAL

Traffic signal timing can be set so that pedestrians are prioritized to begin crossing the street several seconds before parallel vehicles get a green light. This early walk signal, called a leading pedestrian interval (LPI), provides pedestrians an opportunity to travel farther into the intersection where they are more visible to drivers and bicyclists. LPI works with concurrent pedestrian signal timing, meaning that a parallel driver may turn after yielding to pedestrians. LPI may help to reduce conflicts between pedestrians and right-turning traffic at intersections with high pedestrian volumes and high bicycle and vehicle turning volumes. LPIs may be implemented in combination with "No Right Turn on Red" restrictions to further reduce turning conflicts. With the passage of AB 2264 in 2022, LPI support with accessible pedestrian signals (APS) has been mandated to be used at a majority of the state-owned or operated traffic signals. **>>**

Above: A pedestrian begins walking during the LPI signal phase to get an advance head start on a city street in Sacramento.
FHWA Proven Safety Countermeasure: Leading Pedestrian Interval

EXCLUSIVE PEDESTRIAN PHASE (PEDESTRIAN SCRAMBLE)

An exclusive pedestrian phase, often called a "pedestrian scramble" sets the traffic signal to stop all vehicular traffic while the walk phase is active. When the walk phase is activated under a pedestrian scramble, people may cross the intersection in any direction, including diagonally. Adjusting signal timing to allow pedestrian-only movement is beneficial in areas of high pedestrian volumes, such as an urban downtown area. Exclusive pedestrian phases may be set to be active during only certain periods of the day such as peak commute hours and school arrival/dismissal times.

The advantages to an exclusive pedestrian phase include the safety benefit of eliminating conflicts between pedestrians and vehicles; the efficiency provided to pedestrians by providing space to cross in large numbers; and the ability of pedestrians to choose their most efficient crossing route. Potential disadvantages may be that exclusive pedestrian phasing can increase the overall signal cycle length, resulting in longer wait times for all travelers, including pedestrians, and they may limit the ability to synchronize the timing of adjacent signals. An alternative to an exclusive pedestrian phase is a red arrow signal (which prohibits right or left turns) that is activated when a pedestrian is detected in the crosswalk by a sensor. **>>**

Above: A pedestrian scramble area with aesthetic treatment on a local road in Oakland.

ACCESSIBLE PEDESTRIAN SIGNALS

Accessible Pedestrian Signals (APS) are pedestrian devices that communicate pedestrian signal timing information (walk/don't walk) in nonvisual formats, such as audible tones, speech messages, and/or vibrating surfaces. APS installations are required at all new signalized intersections and pedestrian crossings. APS are especially useful in locations where the auditory cues for sight-impaired travelers may provide beneficial information such as intersections where right turns are permitted on red and intersections with continuous right-turn movements, complex signal operations, multilane roundabouts, or wide streets.

APS may be activated by pedestrians with a push button or by passive detection devices (a feature that activates a pedestrian signal when a sensor detects a waiting pedestrian). Passive pedestrian detection can also extend the length of the pedestrian time by determining whether the pedestrian requires additional time to walk across the intersection. **>>**

AUTOMATIC PEDESTRIAN RECALL

Signals can be set to automatically activate without the need for a pedestrian to actuate the walk signal with a push button. Instead of activating a walk phase only when a pedestrian pushes the walk button, a "recall" activates the walk phase automatically as part of every cycle. These are especially beneficial in areas with high pedestrian volumes; in other cases, they can be set to work during peak pedestrian hours such as during commute hours or school drop-off and pickup times. **>>**

Above: Accessible pedestrian signal activated by pedestrians.

DETECTION FOR BICYCLES AND MOTORCYCLES AT TRAFFIC SIGNALS

Bicycle and motorcycle detection technology allows a traffic signal to be activated when a sensor detects the presence of a waiting bicycle or motorcycle. Without bicycle and motorcycle detection, riders must either wait for a vehicle to arrive to trigger the signal, or they must push the pedestrian button. Bicycle and motorcycle detection is required on all new and modified approaches to traffic-actuated signals. **>>**

BICYCLE SIGNALS

A bicycle signal directs bicycle traffic through an intersection and may only be used in combination with an existing traffic signal. Bicycle signals may be used to address an identified safety or operational problem involving bicycles. The CA MUTCD recommends that alternative means of addressing conflicts between bicycles and motor vehicles be considered before the installation of bicycle signals. Opportunities to improve bicycling conditions are discussed in the section "Design for Bicyclists."

DIB 89 states: "An advantage of using bicycle signal faces is that it can permit separate and protected movements of bicycle traffic to avoid conflicts with other users, such as allowing bicycles to travel straight through an intersection while prohibiting right-turn movements of vehicular traffic." If bicycle signal faces are used, signal phasing shall be such that while bicycles are moving on a green or yellow bicycle indication, they are not in conflict with any simultaneous motor vehicle movements at the signalized location, including right (or left) turns on red. **>>**

Top: A bicycle signal helps bicyclists turn left at a raised median location on Route 123 in Emeryville. Bottom: On a local street in Davis, a bicycle signal is green, while the adjacent signal for motor vehicles is red.

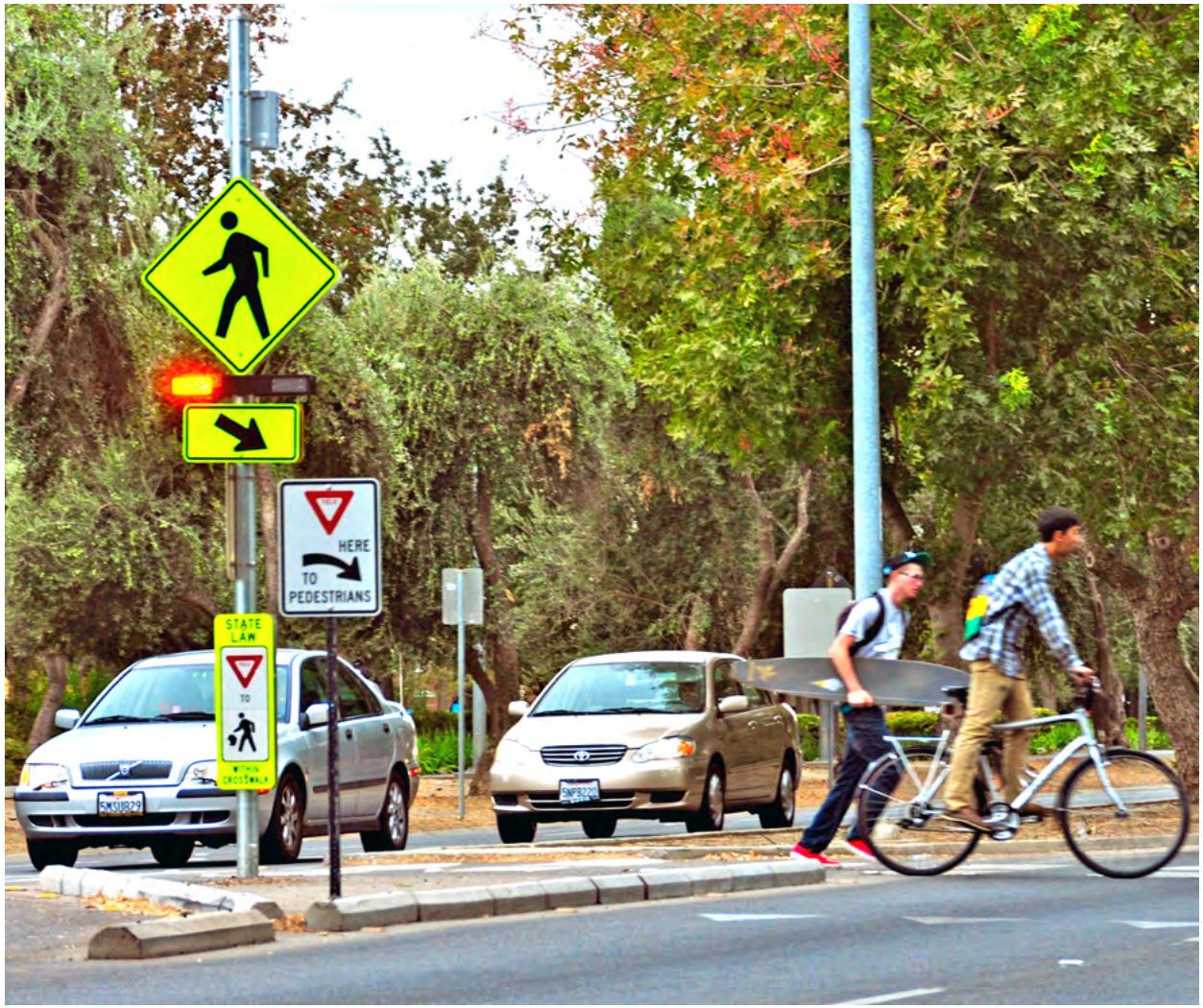
FLASHING BEACONS

Flashing beacons use repeating flashing lights to warn motorists of a potential hazard. Red flashing beacons can provide traffic control when used as an intersection control beacon. Yellow-flashing beacons are used as warning beacons. Some of the typical applications for flashing beacons include unsignalized intersections, mid-block crosswalks, schools, fire stations, and as supplements to warning and regulatory signs. **>>**

PEDESTRIAN HYBRID BEACONS

Pedestrian hybrid beacons (PHBs) are also known as "high-intensity activated crosswalks" or "HAWKs." Pedestrian hybrid beacons are activated by pedestrians using a push button and are only used in conjunction with crosswalk markings. They are commonly used at unsignalized locations such as mid-block crossings and in areas without pedestrian traffic volumes high enough to warrant the installation of a full traffic signal. **>>**

Above: PHBs including one on Route 35 / Sloat Boulevard in San Francisco.
FHWA Proven Safety Countermeasure: Pedestrian Hybrid Beacons

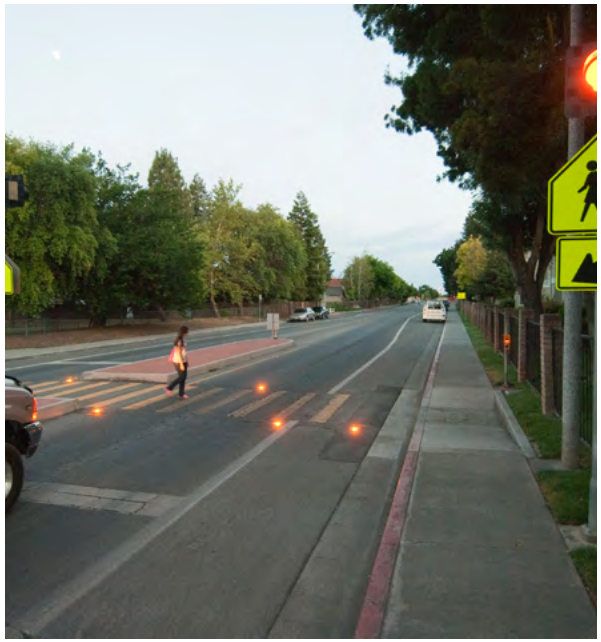


RECTANGULAR RAPID FLASHING BEACONS

Rectangular Rapid Flashing Beacons (RRFBs) utilize rapidly alternating flashing lights to alert drivers that they must yield to pedestrians in the crosswalk. RRFBs use high-intensity light-emitting diode (LED) lights and are used in conjunction with warning signs. The RRFBs are either activated manually by a push button or by using sensors that detect the presence of pedestrians waiting to cross (also known as passive pedestrian detection). The flashing pattern is irregular, like some emergency response vehicles. Research shows that driver yield rates are higher with the RRFBs compared to standard flashing beacons. RRFBs can be used on either two-lane or multi-lane roadways.

FHWA granted an Interim Approval for the optional use of the RRFB as a warning beacon to supplement standard pedestrian crossings or school crossing signs at crosswalks across uncontrolled approaches. Jurisdictions wishing to install RRFBs must comply with conditions outlined in the Interim Approval and must notify Caltrans of the location of the RRFB installation. **>>**

Above: A RRFB on a local street in Davis.
FHWA Proven Safety Countermeasure: Rectangular Rapid Flashing Beacons (RRFB)



IN-ROADWAY LIGHTS

In-roadway lights are installed in the roadway surface to warn travelers that they will need to yield ahead to pedestrians in marked crosswalks at school or mid-block crossing locations, in advance of roundabouts, or in other roadway situations involving pedestrian crossings. In-roadway lights may have notably higher maintenance costs than other devices such as RRFBs and may not be compatible with snow removal activities. **>>**

VEHICLE SPEED FEEDBACK SIGNS

Vehicle speed feedback signs are installed to raise awareness of excessive driving speeds. They are installed in conjunction with a speed limit sign to remind drivers of the speed limit. Providing both speed limit information and a driver's current speed through real-time feedback encourages people to adjust their driving speed to a rate that complies with the law. **>>**

IN-STREET PEDESTRIAN CROSSING SIGNS

In-street pedestrian crossing signs are useful in road segments where motorists need additional cues to be on the alert for pedestrians crossing the street, such as at mid-block crossings. They remind drivers that pedestrians have the right of way at unsignalized crossings. They can be placed in a median or between travel lanes and can include "Yield To" pedestrians symbols. **>>**

Above: In roadway lights on a local street in Woodland; vehicle speed signs; in-street pedestrian crossing sign.

MOTOR VEHICLE PARKING

Parking is a complex topic and decisions about how to allocate roadway space requires collaborative dialogue with stakeholders. In areas of limited roadway width, space for parking is often in competition with other main street features, such as wider pedestrian areas, bicycle facilities, raised medians, bus stops, commercial loading, sidewalk landscaping, and tree plantings. Some communities favor removing or limiting parking spaces to make roadway space for other uses. On-street parking can help support economic vitality for main street businesses, but it is important to remember that customers can arrive by various modes.

On-street parking may provide traffic-calming benefits by narrowing the width allocated to moving vehicles. Consideration can also be given to positioning parked cars so that they provide a buffer to pedestrians and sidewalk spaces from traffic. In some Class IV bikeway designs, parked cars can be positioned to separate bicyclists from motorized traffic.

Left: Street parking on Route 116 / Sebastopol Avenue in Sebastopol. Right: Street parking in Auburn on Route 49 / Lincoln Avenue.

Angled parking, either forward (nose-in) or reverse (back-in), can sometimes provide more spaces than parallel parking, but requires more space within the right of way than parallel parking. Back-in angled parking offers drivers better visibility of bicyclists and other traffic when they are exiting a parking space. Angled parking is most feasible when there is adequate space to allow vehicles to enter or exit the space without interfering with a bicycle lane, or the traveled way of the main street.

Traffic conflicts can be caused when automobile drivers or passengers open the doors of parked vehicles into the path of bicyclists. Bicyclists are at risk of injury if they strike the door and they risk being hit by a moving vehicle if they swerve to avoid the opening car door. Back-in angled parking helps minimize this traffic danger for bicyclists. Additional strategies for improving bicycling conditions near motor vehicle parking areas are listed below in the "Design for Bicyclists" section. **>>**

Left: Reverse angled parking in Esparto.
Right: A car door opened into the path of a bicyclist, sometimes called "dooring."

Design for Bicyclists

The following section describes design options that facilitate comfortable bicycle travel on main streets. Bicyclists also benefit from many of the balanced roadway and intersection strategies discussed earlier in this chapter.

Main street as a travel route and as a destination in its own right will attract bicyclists of diverse ages and abilities. Bicyclists may ride on main streets to commute to work, connect to public transit, run errands, take local or long-distance recreational trips, and/or to stop and patronize main street businesses. Identifying these diverse travel needs may help evaluate which additional roadway or roadside features could help improve bicycling conditions. Caltrans DIB 94 provides additional guidance on selecting appropriate bicycle facilities.

On main streets, bicycle travel may occur on facilities designed specifically for bicycle travel or in traffic lanes shared with vehicles. When evaluating how to improve bicycling conditions at a particular location, planners, designers, and maintenance professionals should also consider that bicyclists possess diverse bicycling abilities and varying levels of comfort with riding close to motor vehicle traffic. Consideration should be given to the full range of novice and experienced riders, such as children who may ride alone or in groups to school and confident bicycling commuters who may ride daily in all forms of weather. All bicyclists will value comfortable and efficient main street travel routes. **>>**

Left: A bicyclist in Oakland.

Bike Path: Class I Bikeway

A completely separated facility for the exclusive use of bicycles and pedestrians with cross-flow by motor vehicles minimized.

(p. 110)

Bike Lane: Class II Bikeway

Top: Buffered bike lanes are separated by a marked buffer between the bike lane and the traffic or parking lane. Bottom: A Class II facility striped for one-way bike travel with green pavement for added visibility.

(p. 111)

Separated Bikeway: Class IV Bikeway

A facility, also called a "cycle track," that is exclusively for bicycles with a horizontal and vertical separation between the bikeway and through vehicular traffic.

(p. 112)

BICYCLE FACILITIES FOR ALL AGES AND ABILITIES

BIKE FACILITY SELECTION

Guidance for selecting bicycle facility type is provided in DIB 94 and the Caltrans *Contextual Guidance for Bike Facilities*, which help transportation practitioners make informed selections about bikeway types based on location, context, traffic conditions, user characteristics, local goals, and project constraints. Caltrans Active Transportation Plans also provide information about needed bicycle facilities that were identified with stakeholder input.

DIB 94 states that maintaining "a comfortable, convenient, and connected bicycle facility is the key goal. Designers should adapt the design of the bicycle facility to match changing site conditions throughout each project segment. Design flexibility allows for transition between facility types as designers encounter constraints like pinch points, speed transition zones, bus transit stops, popular destinations and other unique site conditions. ...The facility selection process begins by identifying opportunities to provide the most physical separation for bicyclists." DIB 94 includes tables that aid in understanding the dimension requirements for each type of bicycle facility. **>>**

SHARED FACILITIES

Bike Route:
Class III Bikeway

Bike routes are designated by signs or pavement markings to denote a preferred bicycling route and/or to connect bike facilities within the larger network. Bike routes are shared-use facilities.

(p. 118)

Shared Roadway:

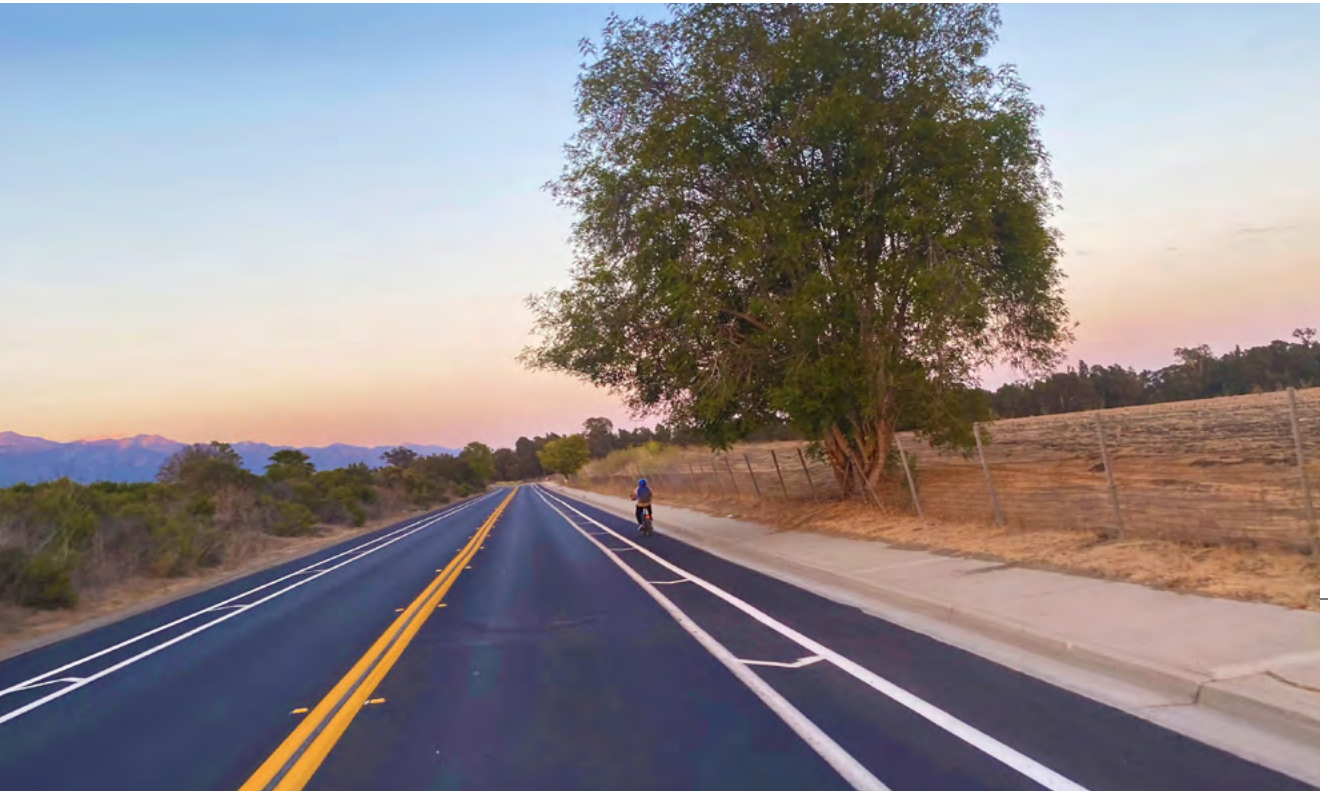
A shared roadway is one that permits bicycle use but is not officially designated as a "bike route." Signage and pavement markings such as the "sharrow" shown here may be used. Green-backed sharrows offer enhanced visibility.

(p. 118)

BIKE PATHS (CLASS I)

Bike paths (Class I bikeways) are paved off-street routes for the exclusive use of bicycles (and often pedestrians). Bike paths can provide a recreational opportunity or in some instances can serve as direct high-speed commute routes if cross-flow by motor vehicles and pedestrian conflicts can be minimized. The most common applications are along rivers, ocean fronts, canals, utility rights of way, abandoned railroad rights of way, within school campuses, or within and between parks. Another common application of Class I facilities is to close gaps to bicycle travel caused by barriers such as freeways, rivers, or other obstructions. Bike paths may provide vital connections between towns and main street locations. If regular pedestrian use is anticipated, separate facilities for pedestrians may be beneficial to minimize conflicts. All pedestrian routes must meet ADA accessibility requirements. **>>**

Top left: The Madonna Inn Bike Path runs parallel to Highway 101. Top right: in San Diego, Class I facility in San Diego runs parallel to I-5. Bottom: Class I facility in San Jose provides an opportunity for bicyclists and pedestrians to cross US 101.



BIKE LANES (CLASS II)

Bike lanes (Class II bikeways) provide a striped lane for one-way bike travel on a street. Bike lanes are intended to delineate the right of way assigned to bicyclists and motorists and to provide for more predictable movements by each type of traveler. Particularly on busy streets, bike lanes can add to the comfort of riders who prefer not to share traffic lanes with motor vehicles. In areas of limited roadway width, the addition of new bike lanes may require reallocating roadway space dedicated to traffic lanes, sidewalks, medians, landscaped areas, or street parking. **>>**

BUFFERED BIKE LANES

A buffered bike lane is a Class II bikeway that has pavement markings to denote a horizontal separation between the bike lane and vehicular traffic lane or parking lane. Buffered bike lanes appeal to a wide group of bicycle riders since the buffer provides greater distance between motorized traffic and bicyclists, allows bicyclists to pass another rider more easily, and enables bicyclists to better avoid the hazard of drivers who open their car doors without first checking for bicyclists. If the marked buffer area also includes vertical separation elements, it is considered a Class IV separated bikeway. *See page 104 for discussion of "dooring."***>>**

Above: A buffered bike lane on Route 135 / Bell Street in Los Alamos. Below: A buffered bike lane on a local road in Goleta.

FHWA Proven Safety Countermeasure: Bicycle Lanes

SEPARATED BIKEWAYS (CLASS IV)

A separated bikeway (Class IV bikeway or cycle track) is a bikeway for the exclusive use of bicycles and requires a vertical separation between the bikeway and through vehicular traffic. The separation can be achieved via grade separation, flexible posts, inflexible posts, inflexible barriers, planted areas, or on-street parking. The separated bikeway may be a one-way or a two-way facility, and it may be located at street level, sidewalk level, or at an intermediate level between the street and sidewalk. At sidewalk level, it must be separated from the adjacent pedestrian facility. The separation from the pedestrian facility may be in the form of vertical elements such as curbs or planters or the use of a different paving material to differentiate the bikeway and walkway.

Separated bikeways may need additional signage and pavement markings at driveways and intersections. For signalized intersections, signage to restrict right turns on red or the usage of bicycle signal faces may be considered to reduce conflicts between users. **>>**

Class IV bikeways in El Cerrito (top left); on a local road in Redding (top right): and on a local road in Oakland (bottom).

GREEN-COLORED PAVEMENT FOR BIKE FACILITIES

Green-colored pavement may be installed within bicycle facilities as a supplement to other bike facility markings. The green color makes the bike facility more conspicuous to all travelers. The color may be used for the entire length or selected portions of the bikeway. Dashed green pavement markings are generally used at conflict areas such as driveways or intersections where bicyclists and drivers may merge or cross paths.

The FHWA cites the positive operational effects of green-colored pavement in bike lanes, such as: "bicyclists positioning themselves more accurately as they travel across intersections and through conflict areas" and "motorists saying that the green colored pavement gives them an increased awareness that bicyclists might be present and where those bicyclists are likely to be positioned within the traveled way."

The conditions of FHWA's Interim Approval to use green-colored pavement are on the MUTCD FHWA website. Maintenance requirements should be evaluated when considering the use of this treatment. **>>**

On a city street in Washington D.C., green pavement highlights the presence of a two-way Class IV bikeway on a one-way street.


BIKE LANE
INTERSTATE
CALIFORNIA
280
SOUTH


15FT 2IN
101 SOUTH
San Francisco
SPEED
HUMP
CLEAR
KEEP


W. MacArthur Blvd
1100

BIKE BOX

Bike boxes are dedicated areas for bicyclists to wait at a traffic signal in front of queued motorized traffic. Bike boxes are demarcated by green-colored pavement and are placed in advance of vehicles stopped at a light. Bike boxes allow bicyclists to gather in one location and efficiently travel together through an intersection. This roadway configuration makes bicyclists more visible to motorists and minimizes "right hook" collisions (when drivers turn right and strike a bicyclist). Pedestrians also benefit from the increased buffer between the crosswalk and the queued vehicles. Bike boxes placed between crosswalks and queued vehicles improve pedestrian visibility and reduce driver encroachment into crossing areas during the red-light signal phase. **>>**

Above: On Route 131 in Tiburon, bicyclists wait in a bike box for the light to change. Previous page clockwise: Green paving in bike lanes near 280 on-ramp in Portola Valley; US 101 on-ramp in Windsor; West Sacramento on former route 275; and Route 123 in Oakland.

BICYCLE TURN BOXES

Bicycle turn boxes, also called "two-stage bicycle turn boxes," demarcate a location in the intersection where bicyclists may wait to make a turn in two signal phases. They are used on multilane streets where bicyclists may be uncomfortable or unable to access turn lanes. Bicyclists may want or need to take the turn in two stages due to the geometrics of the road, because merging into turning lanes is difficult, or to increase their own comfort with the turn.

FHWA's *Interim Approval for Optional Use of Two-Stage Bicycle Turn Boxes (IA-20)* states: "When using a two-stage bicycle turn box to make a left turn, a bicyclist would proceed on a green signal indication to the turn box on the right-hand side of the travel lanes, and then turn left within the turn box and wait for the appropriate signal indication on the cross-street to proceed. Two-stage bicycle turn boxes can also be used with a left-side bicycle facility to facilitate bicyclists turning right. In addition to mitigating conflicts inherent in merging across traffic to turn, two-stage bicycle turn boxes reduce conflicts between bicycles and pedestrians and separate queued bicyclists waiting to turn from through bicyclists moving on the green signal." **>>**

Above: A bicycle turn box in Sebastopol supports bicycle left turns in two signal phases.

BIKES LANES AND ON-STREET PARKING

Bicyclists face two challenges from motorists who are parking vehicles: There can be a conflict during the parking maneuver itself and there can be a conflict known as "being doored," when a motorist suddenly opens a car door into the path of oncoming bicyclist. On streets with parked vehicles, wider bike lanes and/or buffered bike lanes give bicyclists more space to maneuver around vehicles that are being parked and space to avoid the "door zone."

CA MUTCD provides recommended setbacks for parking near driveways and intersections to provide sight distance. Setback distances near intersections vary based on the type of signalization or intersection control that is present. **>>**

BIKE LANES AND RIGHT-TURN LANES

To minimize conflicts between motor vehicles and bicyclists at right-turn lanes, bike lanes are sited to the left of the turn lane. Where roadway width is insufficient to accommodate both a right-turn lane and a bike lane at an intersection, shared lane markings may be used.

Pavement markings may also be used to highlight where bicycles will be positioned within the roadway as they travel through the intersection or during left-hand turns. **>>**

Above: On Route 99 in Los Molinos, the bike lane is clear of the door zone, and the buffer separates bikes and other moving vehicles.
Below: On Route 41 in Atascadero, the bike lane is located to the left of the right-turn lane.

BIKE ROUTES (CLASS III)

Class III bicycle facilities occur on streets shared with motor vehicles, which may be indicated by placing bike route signs along roadways. Designation of bike routes should indicate to bicyclists that there are particular advantages to using these routes as compared with alternative routes. DIB 94 states about Class III facilities: "When bicyclists are required to share a lane with motor vehicles, their comfort and safety will vary widely based on traffic speed and volume. Therefore, shared lanes should only be used in very low speed and volume locations and should be a last resort when there are no other viable alternatives for redistributing space within the cross section." **>>**

SHARED ROADWAYS

A shared roadway is any roadway without a bikeway designation. Most bicycle travel in California occurs on streets and highways without bikeway designations. In some instances, streets may be adequate for safe and efficient bicycle travel, and additional signing and pavement markings for bicycle use may be unnecessary. **>>**

SHARED LANE MARKINGS (SHARROWS)

Shared lane markings are pavement markings that alert roadway users that both bicyclists and drivers may legally use the full traffic lane. They may be used in lanes that are too narrow for a motor vehicle and a bicycle to travel side by side within the same lane. Shared lane markings alert road users of the likely location of bicyclists in the road. They mark the position in the lane where bicyclists can ride to avoid opening car doors where there is on-street parking. Greenback sharrow pavement markings may be more visible than standard markings. The absence of a shared lane marking does not preclude a bicyclist from legally taking the full lane. A shared lane marking and the sign "Bicycles May Use Full Lane" may be used together or independently to communicate that a lane is too narrow for both modes of travel to be side by side. **>>**

Top: A bicyclist on Historic Route 40 / Russell Boulevard, a shared roadway in Davis.
Bottom: A bike route with signage on a local road in Sonoma.

BIKE PARKING

To support bicyclists traveling on main street, bicycle parking is needed at popular destinations. Providing bicycle parking encourages bicycle travel, and it can benefit the local economy by providing opportunities for bicyclists to secure their bikes while visiting main street businesses. Bike parking structures can also be artistically designed, adding to the visual appeal of a main street, though standard U-racks (bottom photo) are considered the most secure. Bicycle parking on sidewalks must not infringe on the ADA requirements for pedestrian zones. **>>**

SIGNS FOR BICYCLE FACILITIES

Signage related to bicycle travel can alert travelers to the presence of bicyclists and alert bicyclists to specific travel conditions. Guide signs and plaques can also assist bicyclists in locating the travel routes with the most optimal bicycling conditions. **>>**

DRAINAGE GRATES

Ideally, drainage grates are positioned outside of the bicycling travel way altogether. Drainage grates that must be placed near bike facilities should be designed for bicycle travel and generally have the bars oriented perpendicular to the direction of travel to avoid the possibility that bicycle wheels get caught in the gaps. Many cities have adopted standard bicycle-proof drainage grates, and Caltrans gives guidance on this topic in the Standard Plans. **>>**

BICYCLE ACCESS DURING CONSTRUCTION

Bicycle access must be preserved during main street construction and maintenance activities. Temporary traffic control zones are required to provide continuity of bicycle travel around a closure. The CA MUTCD Part 6 contains examples of how to manage bicycles through work zones and recommends the traffic control devices to use. **>>**

Artistic bicycle parking in Sacramento (above) and Washington, DC (below) helps bicyclists secure their bikes while working, shopping, and visiting local destinations.

Design for the Pedestrian Realm

This section discusses features that can make the pedestrian realm an inviting and multifunctional public space. Pedestrians also benefit from the traffic-calming and balanced roadway features discussed earlier in this chapter related to roadway cross sections and intersections.

Street trees add shade and beauty to a local road in Los Angeles.

Pedestrian Space is Community Space

It is essential that pedestrian spaces support efficient travel for people who are walking or using other permitted forms of nonmotorized travel. Pedestrian areas on main streets also play an important role as public places that support non-travel-related activities such as resting on a bench, lingering to take in the sights, and gathering with others. Many of the activities that define a desirable community depend on a pedestrian realm that invites people to pursue main street as a destination, not just a travel conduit. When the main street public realm is designed to function as a destination, it supports daily activities such as local shopping, visiting local cafes and restaurants, strolling with friends and pets, and spontaneously meeting up with neighbors.

Photo: Pedestrians have access to markets and other local destinations on Route 135 / Bell Street in Los Alamos.

The aesthetic character and visual identity of a community is strongly associated with the quality of the pedestrian spaces. Tree-lined streets, public art, attractive landscaping, and street furnishings can draw people to main street as an appealing destination in its own right. Well-designed pedestrian spaces are accessible to all ages and abilities, enable comfortable travel, and support community use of the space for daily life. **>>**

MAIN STREETS & AMERICANS WITH DISABILITIES ACT

The pedestrian spaces on main streets are one of the most crucial environments in which to ensure that universal access is provided to people of all ages and abilities. Main street pedestrian areas that meet or exceed ADA requirements strengthen a community by providing everyone the freedom to access opportunities and important destinations. To ensure ADA accessibility, transportation professionals must consider the wide range of abilities of people traveling on main street and consider which features and design treatments can remove travel obstacles and make main street travel more comfortable.

Sometimes design modifications to surface color, texture, or layout can greatly improve the travel conditions for pedestrians with disabilities. Uneven surfaces, excessive slopes and cross-slopes, inadequate crossing times, lack of places to stop and rest, and narrow sidewalks can all be hurdles to comfortable travel for people with disabilities. Evaluating materials and design choices for their compatibility with the needs of a broad range of users may provide a higher degree of ADA accessibility than the minimum design standards required by law or Caltrans policy.

Above: A mid-block crossing on Route 2 / Santa Monica Boulevard in Los Angeles.

Creating an ADA accessible pedestrian realm also creates an environment that is more successful for all. ADA accessible designs help create walking conditions that support the wider community, such as people using strollers or roller bags, delivery drivers with dolly carts, and children on bikes, scooters, and roller-skates. Designing accessible main streets provides a wide, long-term public benefit: People who may not rely on ADA-compatible designs themselves today may eventually need the additional travel support as they age or need to provide travel assistance to aging friends and relatives. **>>**

Above: Accessibility features make travel routes that support a wide range of travelers such as here on a city street in Santa Monica.

SIDEWALKS

Sidewalks are important spaces within the public realm that contribute to pedestrian mobility, economic vitality, community life, and neighborhood aesthetics. Sidewalks connect people to important destinations and are spaces that support daily activities.

Wide sidewalks offer a pleasant pedestrian experience and should at least be wide enough to allow pedestrians to walk side by side or pass comfortably. More width is desirable to accommodate high pedestrian volumes, public transit shelters, street furniture, landscaping, street trees, and other outdoor uses. The quality of the sidewalk environment is foundational to a successful and inviting main street. In areas of limited roadway width, installing or widening sidewalks may require reallocating roadway space dedicated to traffic lanes, bike lanes, medians, landscaped areas, or street parking.

All sidewalks and curb ramps must be designed in compliance with state and federal accessibility standards. Minimum sidewalk clear widths should be free of utilities, furniture, signs, and other obstructions. Pedestrian access must be preserved during main street construction and maintenance activities. Temporary traffic control zones are required to provide continuity of pedestrian travel around a road or sidewalk closure. >>

Top: Route 123 / San Pablo Avenue in El Cerrito. Bottom: Route 16 / Main Street in Woodland.

FHWA Proven Safety Countermeasure: Walkways

Sidewalk Zones

One way of analyzing the ideal sidewalk width is to consider the sidewalk as having "zones" where different uses occur. Although the separate zones may not always be clearly demarcated, physically possible in narrow conditions, or consistent along a sidewalk segment, it is a useful organizing principle for considering how to address the competing needs for sidewalk space. DIB 94 provides additional guidance and standard requirements for sidewalk widths in main street settings.

The numbers in the photo above correspond with the following sidewalk zones:

1. The **buffer zone,** also called a landscape zone or furnishing zone, provides a buffer between pedestrians and traffic. Light poles, utilities, street trees, landscape plantings, and fixed furnishings like bike racks are located here.

2. The **pedestrian through zone** includes the space for pedestrian travel. It must be free of obstructions and meet ADA requirements for a clear path of travel.

3. The **frontage zone** is the space immediately adjacent to buildings; it provides space for people to enter and exit buildings, set out displays, and pause to window-shop.

See DIB 94 for "Suggested Sidewalk Zone Widths by Place Type"

Above: A sidewalk on a local Sacramento street is wide enough to support pedestrians walking side by side. Space is also available for a frontage zone and a buffer zone, which contains utilities, lighting, bike parking, and street trees.

PARKLETS

The term "parklet" refers to a small temporary seating or community gathering platform that is built by covering curb-side parking spaces. The purpose of a parklet is to extend the pedestrian realm where narrow sidewalks cannot accommodate the expansion of an area for seating or gathering without compromising pedestrian safety, ADA-compliant access, or functional walkway area. Parklets can contribute to the aesthetic appeal of a main street through creative design details and inclusion of plant materials. Reallocating one or more parking spaces through the temporary installation of a parklet can provide a place that invites people to linger on main street, benefiting visitors, businesses, and the overall social vibrance of a main street.

The local public entity representing the area in which the parklet is proposed is responsible for its proposal, application, installation, maintenance, and removal. Parklet proposals are administered as "Parks" under the Caltrans Division of Right of Way and Land Surveys, Office of Real Property Services–Property Management, Airspace, Clearance & Demolition. A Right of Way Use Agreement is required. **>>**

Above: Parklets on local streets in San Francisco (left) and Oakland (right) extend the sidewalk to allow for seating, while preserving the path of travel in the pedestrian through zone.

PEDESTRIAN-SCALE LIGHTING

Adequate pedestrian lighting that is provided by human-scale light poles and luminaires creates an inclusive main street environment that feels inviting, comfortable, and secure for all. Although pedestrian areas often receive ambient light from existing larger roadway lights, pedestrian-scale lighting, sometimes called ornamental lighting, directly illuminates walking paths, helps pedestrians navigate, improves the visibility of main street businesses, and can create focal points that add visual appeal to the nighttime main street environment.

Lighting levels and quality should be based on a context-sensitive analysis to determine a light quality that fits in with the local environment and main street needs. Ideally, the height and design of light fixtures on main street are both functional and aesthetically appealing. Through the quality of light they provide and the design style they embody, pedestrian lighting can enhance a town's unique sense of place, historical character, and community identity. Early planning conversations should cover roles and responsibilities related to installing and maintaining pedestrian-scale lighting. **>>**

Top: Pedestrian-scale lighting on Route 16 / Main Street in Woodland helps illuminate an evening holiday street fair.
Bottom: Lighting fixtures on a local road in Alameda complement local architecture.

PAVEMENT TREATMENTS AT INTERSECTIONS

Pavement that is textured, stamped, or colored can help emphasize an intersection, pedestrian crossing, or sometimes an entire street. Aesthetic paving increases the visual appeal of the street and can help communicate that the roadway is a space that is shared by multiple modes of travel.

The life-cycle cost analyses of aesthetic paving treatments should include evaluation of the long-term maintenance expenditures over the life of the material. Some paving treatments have higher maintenance requirements than others. Stamped concrete and asphalt treatments are less expensive to install and easier to maintain than bricks or unit pavers.

Aesthetic paving in crossing areas should provide a comfortable surface for walking and cycling, and must comply with all ADA legal requirements. Materials should be selected with sensitivity toward the amount of vibration exposure that the surface generates for wheelchair users.

Textured and colored surfaces must meet the criteria specified in the CA MUTCD. Additionally, FHWA only permits certain colors and textures so as not to detract from the white or yellow markings establishing the crosswalk. All paving must comply with accessibility requirements and must meet applicable structural section requirements specified by the Caltrans District Materials Engineer. **>>**

Left: Aesthetic paving on Tower Bridge Gateway, former Route 275. Right: Aesthetic paving between yellow school zone crosswalk markings on Route 78/Main Street in Ramona.

STREET LANDSCAPING

Street landscaping makes communities more attractive and can contribute to a more livable and environmentally sustainable public space. Well-designed landscaping along the roadway or in medians can increase driver awareness of the immediate environment as a shared space, which can influence drivers to slow down.

Sidewalk and median landscaping can provide seasonal beauty, an inviting atmosphere, and provide screening of unattractive elements such as utilities. Main street projects may provide locations for local agencies, municipalities, or civic organizations to plant and maintain landscaped areas. Vegetated areas can also be designed to support water management and storm water hydrologic cycles, as discussed in the next chapter. >>

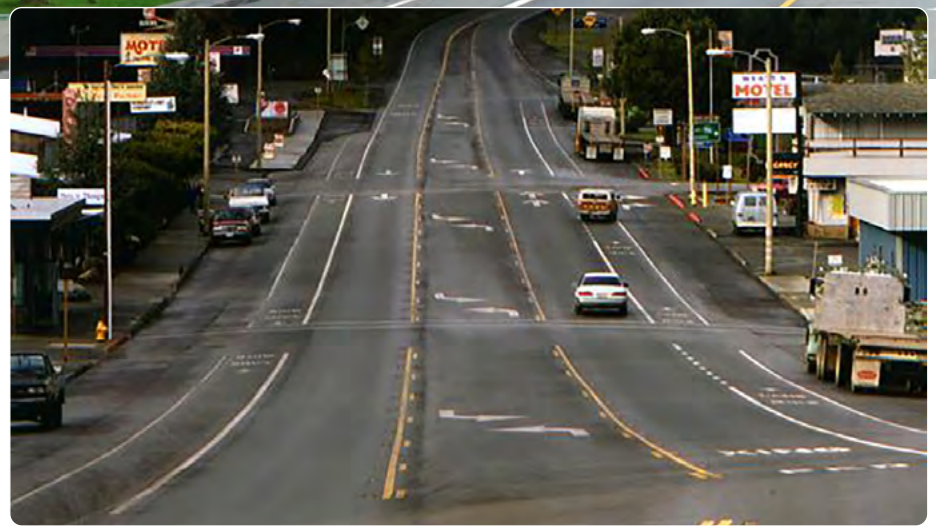
Above: On Route 116 / Petaluma Avenue in Sebastopol, trees and landscaping buffer pedestrians from traffic while providing environmental and aesthetic benefits. Below: climate-appropriate plantings add shade and aesthetic beauty to a sidewalk near a transit center in Chula Vista.

STREET TREES

Trees are a valuable public asset that make main streets beautiful, welcoming, and comfortable. Street trees add an attractive canopy overhead and can increase pedestrian comfort where shade or protection from the wind is desirable. Tree-lined streets contribute to a community's distinctive identity, economic vitality, environmental health, and seasonal beauty. Numerous studies report that trees notably increase property values and the appeal of shopping areas. Research also shows that people associate tree-lined streets with stable, valuable, and well cared-for neighborhoods.

The species characteristics, growth habits, and mature size are important to consider when selecting street trees and other landscape plantings. Choosing tree species that produce lower levels of pollen and volatile organic compounds (VOCs) improves local air quality. Appropriate trees are adapted to the local climate and environment; fit the site at mature size; and have root zones that are appropriate for the local conditions, and proximity to pavement. Although all planted areas require regular maintenance, proper selection of trees and adequately sized tree wells can reduce maintenance expenditures, and increase safety for highway users and workers.

Above: Street trees on Route 29 / Lincoln Avenue add aesthetic beauty and character in Calistoga.



Safety, sight distance standards, utility locations, environmental needs, soil conditions, and maintainability are vital concerns when establishing the locations and species selection for tree plantings along main streets. Tree siting must conform with the Caltrans minimum setback requirements for clear recovery zones and sight distances as listed in the HDM. >>

Bottom: Route 299 in downtown Willow Creek after a road diet project but before landscaping was added. Top: This picture taken later shows the dramatic aesthetic and environmental difference created by adding street trees to this main street environment.

Trees and Traffic Calming Benefits

Research indicates that street trees can contribute to a reduction in the rate of crashes on a corridor and improve driving safety. The Caltrans *Traffic Calming Guide* states: "This effect is often attributed to a perceived narrowing of the roadway, a sense of rhythm and human scale created by framing the street, and the perception that the driver is in a place where they are more likely to encounter pedestrians, cyclists, and cross-traffic. Landscape elements can also be employed in transition zones between rural and urbanized areas, to encourage drivers to reduce speeds by introducing a changed environment in which lower speeds appear appropriate to the driver. Changing the composition or degree of formality of landscaping along the length of the transition zone can reinforce the changing characteristics of the environment, (such as entering a town and proceeding into the downtown area)."

"Landscaping is an important element to include in a suite of traffic-calming features located at a threshold or community gateway, while street trees (trees that line both sides of the roadway or are planted within a raised median) may continue through the community. Within an urban, suburban, or rural main street, a planted buffer strip between the roadway and a sidewalk may contribute to the perception of a narrowed roadway width and encourage slower speeds."

Top: Cherry trees in Washington, DC, create an iconic sense of place. Bottom: Street trees in Washington, DC, visually narrow the space allocated to vehicles, buffer pedestrians from traffic, and add a human scale to a street with tall buildings.

Street trees on a local street in Davis provide aesthetic and ecological value. They also shade pedestrians and bicyclists, making the route more comfortable in the summer months.

STREET FURNISHINGS

Street furniture can add to community livability by making the street a more comfortable and aesthetically appealing place for travelers. The presence of street furniture enhances public awareness of multimodal travelers and can encourage people to stop and visit local businesses and community centers. To create a more livable environment, a main street may include items such as benches, trash cans, bike racks, and way-finding signage. These items are typically require Maintenance Agreement–related discussions during planning and design phases.

All furnishings and their placement must meet ADA requirements. To provide an unobstructed area for pedestrians, the HDM also provides minimum horizontal clearances for objects located on, or adjacent to, sidewalks. Bollards must be tall enough so they do not create a tripping hazard to pedestrians. **>>**

Top left: Site furnishings support transit riders and pedestrians on a local street in Alameda. Bottom left: A bench next to a storm water planter in Live Oak. Top right: On a local street in Washington, DC, bike racks are conveniently located next to the Class IV bikeway.

TRANSPORTATION ART

Caltrans administers the Transportation Art Program to support local efforts to beautify Caltrans facilities, structures, and right of way spaces with sculptural or graphic visual art. Transportation art can contribute to a community's livability goals of supporting a unique character or sense of place by artistically reflecting local aesthetic, cultural, civic, or environmental values.

Well-conceived art forms, properly located, can enhance the experiences of those using transportation facilities and enrich the environment of neighboring communities. Placement of artwork is conditional on appropriate Maintenance Agreements and is restricted to areas where maintenance can be performed safely. Early coordination with the District Transportation Art Coordinator is essential to ensure timely and thorough project completion. **>>**

The mural "Oakland Super Heroes #3," beautifies a city street under the MacArthur Freeway (Interstate 580) in Oakland.
Artists: Attitudinal Healing Connection, Inc. More information about the Caltrans Transportation Art Program is discussed in Chapter 3.

BANNERS AND DECORATIONS

Caltrans issues permits for the temporary placement of banners, decorations, and signing for events sponsored by local agencies and nonprofit organizations over and along main streets. Permanent overhead signs or arches may not be erected over any State highway. **>>**

COMMUNITY IDENTIFICATION

The Community Identification Program supports local sense of place by facilitating visual representation of local identity on engineered highway features, such as walls and bridges. Community identification designs celebrate local character, history, or other defining characteristics and unlike the Transportation Art Program, some types of text are permitted. Early coordination with the District Transportation Art Coordinator is important to ensure that the design and/or proposed text meet the program requirements. Community identifiers are provided and maintained by a local agency. **>>**

GATEWAY MONUMENTS

A gateway monument is defined as any non-required freestanding structure or sign which communicates the name of the local city, county, or incorporated town. Gateway monuments are solely planned, designed, funded, constructed, and maintained by the public agency representing the area. Gateway monuments can improve local visual quality and serve to alert drivers that they are entering a community center which is likely to include slower driving speeds and multimodal road users. **>>**

Above: A banner (Route 36, Red Bluff); Community Identification (San Rafael); Gateway Monument (Route 82, Colma).

Connections to Public Transit

Public transit is a vital transportation service that helps connect main street travelers to their local communities and to other regions. The conditions on main street are central to the performance of transit services. Appropriately designed transit facilities can increase accessibility to riders and encourage people to use transit for their daily travels. Dialogue about how to improve pedestrian, bicyclist, and motorist access to transit should be initiated in the planning stages. Involving transit providers early in the process helps to ensure changes to the roadway that support transit operations and meet local transit stop design standards, including ADA accessibility.

Transit vehicles may travel on and across main streets; therefore, main street designs must accommodate the size and maneuverability of applicable transit vehicles. Transit shelters and facilities must be located to provide efficient and ADA-accessible pedestrian access to the facility and should not obstruct the travel path of pedestrians. Additional main street features that can be used to support public transit are listed on the next page.

Transit along main streets may include a wide range of types: motorbuses, trolley buses, Bus Rapid Transit (BRT), light-rail trains, commuter rail trains, van pools, automated guideways, and demand responsive vehicles. Funding for construction and maintenance of transit facilities may be provided solely by one agency or by a combination of local, state, and federal sources. Early communication between agencies and the drafting of applicable agreements is essential. >>

Left: Space for bike parking (and bikeshare stations where relevant) facilitates transit use, as shown at this Amtrak station in Davis. Right: Seating is important for transit users since most transit trips involve a wait time of some duration.

Features that can be used to support public transit include:

- **Transit stop amenities** such as shelters, shade trees, secure bicycle parking facilities, benches, lighting, trash receptacles, telephones, and signage related to schedule and route information, including displays showing predicted real-time arrivals.

- **Curb-side transit stops.** Transit stops for bus and train loading can be located at intersections (either far-side or near-side) or at mid-block locations. Transit stops enable passengers to wait for transit vehicles without interfering with pedestrians traveling along the sidewalk. Locating transit stops just after intersections (far side) allows pedestrians to cross the street behind transit vehicles, enabling transit vehicles to resume travel more efficiently. Far-side stops are also well suited to work with transit signal priority mechanisms.

- **Bus bulbs,** a type of bulb-out, facilitate passenger loading; they are generally longer than 25 feet and may be up to 55 feet or longer for standard (40-foot) buses. Bus bulbs enable buses to stop for passengers without leaving the travel lane. Bus bulbs increase transit travel time efficiency by eliminating time spent merging back into traffic.

- **Bus bays** are indentations in the curb that allow a bus to stop completely outside of the traveled way.

- **In-street transit boarding islands** create in-lane stops. The boarding island is generally placed between a center transit lane and general traffic lane to the right. Unlike curb-side transit stops, which

Right: An in-street transit boarding island in a center median on Route 185/International Boulevard in Oakland. Left: A transit side boarding island provides physical separation between the bicycle facility and buses on a local street in San Francisco.

require buses to cross over a bicycle facility to reach passengers waiting at the curb, a transit boarding island provides separated space for vehicular traffic, pedestrians, bicyclists and transit to operate.

- **Transit side boarding islands** improve accessibility and reduce conflicts with bicyclists. They are separated from sidewalks with a bikeway facility to reduce conflicts between bicyclists and transit vehicles. They can also improve accessibility when the boarding platform is level with the height of a transit vehicle's entry/exit door.

- **Transit-only lanes** that segregate transit vehicles from the rest of the traffic facilitate efficient and consistent service. The transit lane can be located on the side or in the center lane of a main street. Transit-only lanes on the side of the road can be designed to accommodate right-turning vehicles at intersections.

- **Transit signal priority (TSP)** is a method of adjusting signals so that transit vehicles are prioritized at intersections and spend less time at red lights. Since transit vehicles can hold more people than other vehicles, TSP can increase the person throughput of an intersection. Prioritizing transit with the proper utilization of signal priority tactics reduces transit travel times while minimally impacting cross-traffic and bikes/pedestrians. More reliable and faster travel times encourage transit ridership and make transit services more cost-efficient by reducing transit vehicle fuel consumption. Faster transit travel speeds can also reduce labor costs due to the fewer service hours needed.

- **Queue bypass lanes,** or queue jump lanes, are another type of transit priority that allow buses to be ahead of the long queues of vehicles at signalized intersections. Combining transit priority in space (using queue bypass) and priority in time (using TSP) enables buses to travel faster with higher travel time reliability. Queue bypass lanes provide benefits to transit where it is not practical to provide a bus-only lane.

>>

A curb-side stop for Bus Rapid Transit (BRT) service in a transit only lane on Route 101 / Van Ness Avenue in San Francisco.

CHAPTER 4
GREEN MAIN STREETS

A "green street'" is a street that is built and operated to conserve natural and fiscal resources, provide benefits to local ecosystems, and mitigate existing conditions to help improve the environment.

Green streets, sometimes called "sustainable streets," are designed to minimize negative impacts on the environment and to maximize the positive contributions that the roadway and associated facilities can make to natural systems. Main streets can be built and operated to include green street principles. By including designed features such as storm water treatment facilities and by selecting sustainable building materials and construction methods, green streets can help support environmental health. Green streets can also improve community livability when they make the environment more comfortable and visually appealing for people who use the space. This chapter illustrates how main streets can be created to be green streets through specific built roadway and roadside design features.

Left: State Route 123 / San Pablo Avenue in El Cerrito.

Main streets can be designed and operated to be "greener" by incorporating strategies that:

- Promote on-site storm water infiltration
- Plant site-appropriate trees and vegetation
- Conserve water and soil
- Reduce urban heat islands
- Support natural ecosystems
- Employ sustainable construction practices
- Use recycled materials
- Install energy-efficient fixtures
- Enhance public health and quality of life

Above: Landscaped areas can be designed to incorporate storm water treatment strategies, as shown on the preceding page—and on this page— Route 49 / 93 / High Street) in Auburn.

STORM WATER QUALITY

Precipitation that falls during storm events can collect pollutants that may negatively affect aquatic ecosystems. Another environmental concern related to storm water is that impermeable surfaces, such as pavement and rooftops, do not allow precipitation to percolate back into the soil, which can increase the speed and volume of storm water entering downstream water bodies. An increased volume and velocity of water can cause erosion significant enough to damage the physical and ecological functioning of a region's aquatic system.

Many projects are required to improve storm water quality by removing pollutants and, in some cases, reducing the discharge velocity and volume of runoff. Identifying the pollutants of concern in the receiving water body and determining the space available for storm water treatment will determine which water management strategies are best suited to a particular site.

LOW-IMPACT DEVELOPMENT

In storm water management, low-impact development (LID) is a design strategy that employs a variety of natural and engineered features to mimic natural hydrology to the greatest extent possible. LID employs a variety of natural and engineered features that help to filter pollutants out of storm water runoff, reduce the rate of runoff, and facilitate the infiltration of water into the ground.

LID strategies represent a shift away from sole reliance on traditional or "gray" infrastructure (such as pipes, curbs, concrete ditches, and channels) to manage and direct runoff. Although gray infrastructure is effective and sometimes necessary, recent research shows that an integrated system of "green" infrastructure (small-scale control measures that encourage local infiltration, filtration, storage, evaporation, and detention of runoff) can be an efficient and cost-effective way to improve water quality and reduce the volume and rate of storm water runoff.

Above: A planter on a Jose city street is designed to capture storm water and contains plants that are suited for period of inundation with water.

STORM WATER MANAGEMENT STRATEGIES

On-site infiltration of runoff is the primary goal of storm water management. This approach reduces pollutant discharge and retains more water on-site. In some cases, biofiltration strips and swales alone can meet infiltration requirements. In other areas, local site or environmental constraints may require the use of additional treatment strategies, which can include infiltration and bioretention devices.

Early evaluation of the project site and local environmental factors will enable design solutions that best address water quality issues within a main street context. **>>**

Infiltration
Infiltration features include basins, trenches, and other features that retain runoff, allowing it to infiltrate into the soil. These devices may be scaled to main street applications and can be designed to work in concert with adjacent bioretention and/or biofiltration features.

Biofiltration Strips and Swales
Biofiltration strips and swales are vegetated land areas, over which storm water travels. These features are effective at reducing runoff and removing pollutants. In most cases, flow attenuation is also provided; thus, biofiltration swales and strips can also be considered an LID technique. Vegetation can include grasses, shrubs, trees, and ground covers.

Bioretention
Bioretention areas are landscaped depressions or shallow basins that are used to slow and treat on-site runoff by employing a variety of storm water principles. These features are typically associated with treating smaller drainage areas and are a variation on Caltrans-approved treatment best management practices (BMPs).

Left: Runoff from this Caltrans parking lot in San Diego flows into a storm water treatment area.
Right: Vegetation and soil intercept and treat storm water at the “Bogue Park & Ride,” in Yuba City.

BIORETENTION PLANTERS

Bioretention planters (sometimes called storm water planters, rain gardens, infiltration planters, or biofiltration basins) are planting basins or boxes that are designed to capture storm water from impervious surfaces such as streets and/or sidewalk areas. Bioretention planters contribute to the primary goal of having on-site infiltration of storm water. On-site infiltration helps minimize the amount and rate of storm water that enters a storm drain system, minimizes downstream erosion of rivers and other water bodies, and reduces pressure on storm water and waste water treatment facilities during and immediately after storm events. Plant roots and soil can also help filter out pollutants, helping to clean the storm water before it travels to a receiving water body. Finally, capturing storm water in bioretention planters can help support the watering needs of plants and street trees in a climate of diminishing or variable water availability.

1. Rain water flows through curb cuts into a planted storm water treatment area. The soil and plants improve the storm water quality through filtration and infiltration processes.

2. During larger storm events, excess water beyond what the storm water system can accommodate will bypass the system and enter directly into the storm drain. Proper functioning of the facility requires regular removal of debris from the planted treatment area and curb-cut inlets.

Both photos: Sidewalk storm water planter areas on Route 123 / San Pablo Boulevard in El Cerrito.

DESIGN POLLUTION PREVENTION INFILTRATION AREA

Design Pollution Prevention Infiltration areas (DPPIAs) are a type of treatment system that consists of vegetated or nonvegetated pervious areas that promote infiltration of storm water runoff. DPPIAs are used for treating storm water runoff that contain pollutants of concern. Infiltration is the primary means for pollutant removal of the water quality volume, but may also include additional removal by sedimentation, adsorption to soil particles, and vegetation. For vegetated DPPIA applications, selecting native and climate-appropriate vegetation that does not require irrigation and requires the least amount of maintenance helps ensure the long-term success of these treatments.

Both photos: DPPIA facilities on Route 99 in Live Oak.

NATIVE AND SITE-APPROPRIATE PLANTS

Plants not only contribute to the aesthetic appeal of a main street, but they can also contribute to local ecological health. Native vegetation in particular can help support other plants, pollinators, and animals in the region's ecosystem. Selecting native or site-appropriate plants that are adapted to thrive in the built environment with naturally occurring temperatures, rainfall, and soil nutrients can help reduce maintenance requirements, minimize supplemental irrigation, and reduce pollutants in storm water.

Preserving existing vegetation is an important design and construction consideration that can help the site retain its ecological value. Mature vegetation may be particularly valuable in protecting soils from erosion and in supporting local wildlife and beneficial insect populations.

To establish new vegetation, important considerations include preserving topsoil during construction, weed control, seasonal timing of planting, supplementing the soil with compost and mulch, and planning for long-term maintenance. **>>**

The community livability benefits provided by trees and landscaping are discussed in the previous chapter.

Climate appropriate plantings on Route 299 / Main Street in Weaverville (left) and on the University of California, Davis, campus (right)

TREES BENEFIT THE ENVIRONMENT

Trees Capture Carbon
Trees capture atmospheric carbon and store it in their roots, foliage, and wood. Removing and storing carbon dioxide from the atmosphere, known as carbon sequestration, is a primary strategy for combating climate change. Online calculators can help estimate rates of carbon sequestration, which vary by tree species, climate, and other factors.

Trees Clean the Air
Through the leaf structures that facilitate photosynthesis and gas exchange, trees remove gaseous pollutants from the air such as ozone, sulfur dioxide, nitrogen dioxide, and carbon monoxide. Trees also intercept airborne particulate matter. (Airborne particulates can exacerbate health conditions such as asthma.) To further improve air quality, designers can prioritize tree species with low VOC and pollen emissions.

Trees Treat Storm Water
Trees, vegetation, and their associated soils are often referred to as "green infrastructure" because of their ability to treat storm water runoff. By intercepting precipitation in their canopies, trees slow the speed and decrease the volume of runoff entering storm drains and downstream water bodies. Trees also improve water quality by taking up storm water pollutants through their roots.

Trees Cool Communities
Trees shade pavements and rooftops, which helps maintain more comfortable summertime temperatures. In hot weather, unshaded roofs and pavements can be heated to temperatures far above that of the surrounding air, creating what is called a "heat island." Heat islands increase summertime peak energy demands, air-conditioning costs, air pollution, GHG emissions, and heat-related illnesses.

Trees also cool the air via evapotranspiration. Evapotranspiration is the combination of the processes of evaporation and transpiration, which both release moisture into the air. Transpiration occurs when trees and other vegetation absorb water through their leaves, flowers, and roots and emit it through their leaves. During evaporation, heat from the sun and the air changes water (found on wet surfaces such as soil or vegetation) from a liquid to a vapor. Evapotranspiration, alone or in combination with shading, can help reduce peak summer air temperatures and heat islands.

Above: Along a city street in Sacramento, trees cool pavement and buildings and contribute to a comfortable travel route for bicyclists, pedestrians and motorists.

WATER CONSERVATION

State mandate requires that California communities adopt local water conservation ordinances to ensure that new development includes water-efficient landscapes and that existing landscapes reduce water waste. In some cases, new development can include the use of recycled water to irrigate landscaped areas.

Emerging technologies also enable water conservation through the use of "smart controllers," which are irrigation controllers that can be networked and managed via wired or wireless communications. Smart controllers can remotely adjust irrigation levels to compensate for local weather conditions such as precipitation. Energy consumption and maintenance issues can also be monitored remotely. Combining water-efficient plants with the ability to network irrigation controllers is a long-term cost-effective strategy for reducing water consumption and maintenance expenditures.

RECLAIMED WATER

In some areas, reclaimed water, also called recycled water, is available as a water supply for landscaped areas. This water is reclaimed from a variety of sources and is treated so that it is safe for reuse as irrigation water. Even varieties of plants that are appropriate for low-water environments may need supplemental irrigation to withstand periods of extreme heat and drought. Use of reclaimed water is an environmentally friendly method of maintaining levels of irrigation that can help native and site-appropriate plants survive and thrive. Use of reclaimed water should inform plant selection, as many species adapted for salt tolerance and sea-spray are often well-suited to irrigation that comes from reclaimed water sources.

Left: A smart irrigation controller. Middle: Signage for reclaimed water raises public awareness. Right: Reclaimed water irrigation pipes are purple to denote that they contain nonpotable water.

PERMEABLE PAVEMENTS

As discussed earlier in this chapter, increasing the amount of storm water that can infiltrate into the soil has ecological benefits. Permeable paving, also called pervious pavement, is one strategy for promoting infiltration since the material contains void spaces that allow water to percolate through the pavement. Permeable pavements can be a storm water best management practice for main street applications along shoulders, parking areas, and other locations not subjected to regular heavy vehicular traffic (permeable pavements are not suitable for use in traffic lanes/mainline applications).

The surface texture of any potential permeable paving material must be evaluated for suitability in pedestrian areas, with special attention to the vibration impacts on wheelchair users.

Like all paving, permeable paving requires routine sweeping and maintenance. For permeable pavement to function properly, sediment must be periodically removed by a sweeper equipped with an industrial vacuum. Neither pressure washing nor mechanical broom sweeping adequately removes sediment from the porous spaces that enable infiltration. A Maintenance Agreement may be appropriate to assign roles and responsibilities related to the use of specialized maintenance equipment and the level and frequency of maintenance. **>>**

Top: Permeable pavement (lighter colored pavement in photo) allows storm water to pass through pavement and into underlying soil at the Palomar Transit Station and Park & Ride. Inset: Permeable pavements use fewer fine particles in the paving mix, which leaves voids within the pavement that allow water to infiltrate into soil below.

REUSED AND RECYCLED MATERIALS

Since energy is required to extract, process, manufacture, and deliver construction materials, opportunities to "reduce, reuse, and recycle" construction materials helps minimize the environmental impacts of main street projects.

Some materials that no longer serve their original purpose can be recycled for a secondary use. Recycling allows construction material such as concrete and asphalt to be incorporated back into the new construction project as base material for the new roadway. Other types of materials that can be reused include guardrail, traffic signals, signs, and sign standards.

Tire-derived aggregate (TDA), made from waste tires that are no longer suitable for use on vehicles, can be processed and used as either light-weight fill material or incorporated into making rubberized hot mix asphalt (RHMA). In either case, utilizing waste tire material can offer both engineering and economic benefits while minimizing the quantity of waste entering landfills.

Trees, plants and topsoil can also be salvaged and stockpiled at the beginning of projects and used to revegetate areas after construction. Trees and logs that need to be relocated can be placed as habitat features in some cases, or they can be converted to mulch for planting areas.

ENERGY CONSERVATION AND LIGHTING

LED technology provides greater energy efficiency over other means of lighting. LED bulbs are long lived, free of mercury, and provide a focused light that can minimize light pollution. Like other electronic components, LED bulbs can be recycled. As compared to traditional high-pressure sodium lights, LEDs allow colors to appear more natural at night and provide a higher degree of lighting uniformity, which improves visibility. Although they may have higher initial cost, LEDs have a longer life cycle and cost less to operate.

Local governments may be interested in adopting emerging technologies that enable streetlights to be networked and managed using wired or wireless communications, an approach that is often called "smart streetlighting." Smart streetlighting systems can be set so that streetlights are dim until sensors detect people and cars. Lighting levels can also be remotely adjusted to compensate for local conditions such as inclement weather. Energy consumption and maintenance issues can also be monitored remotely.

Combining efficient hardware such as LED bulbs with networking ability enables cost-effective streetlight systems that can reduce energy consumption and maintenance expenditures.

COLD-RECYCLED PAVEMENT

Under the right conditions, cold recycling can reduce environmental impacts and lower the life-cycle costs associated with paving projects. Strategies that fall under cold recycling include partial-depth recycling (PDR), full-depth recycling (FDR), and cold central plant recycling (CCPR). Full-system life-cycle assessment (LCA) is used to determine differences in environmental impacts between pavement recycling and conventional paving strategies.

Since cold recycling requires limited quantities of new materials and primarily uses previously purchased existing materials, it can be a cost- effective strategy for preserving natural resources. And since fewer materials need to be transported to the site, there is less fuel consumption and cost associated with pavement recycling. Also, pavement recycling can sometimes be faster than conventional strategies, resulting in a reduction in working days, traffic disruptions, and worker exposure to traffic. The Caltrans Pavement Program provides guidance on the different recycling techniques that apply to different pavement types and conditions.

RECLAIMED ASPHALT PAVEMENT

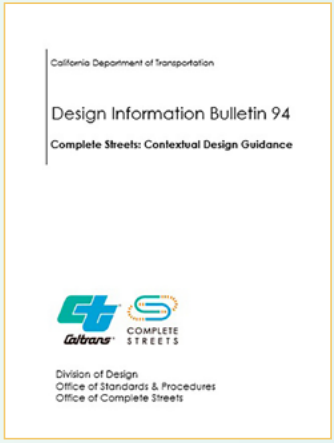
According to FHWA: "Reclaimed asphalt pavement (RAP) is the term given to removed and/or reprocessed pavement materials containing asphalt and aggregates. These materials are generated when asphalt pavements are removed for reconstruction, resurfacing, or to obtain access to buried utilities. When properly crushed and screened, RAP consists of high-quality, well-graded aggregates coated by asphalt cement." RAP can be processed for immediate reuse or stockpiled for future projects.

With a good mix design, RAP decreases project costs by replacing some virgin aggregate and virgin asphalt binder. Other benefits include diverting solid waste from landfills and reducing GHG emissions (due to minimizing the need to deliver new materials or transport removed materials). Since 2009, Caltrans has allowed contractors to substitute RAP aggregate as part of the virgin aggregate in Hot Mix Asphalt (HMA) in a quantity not exceeding 15 percent of the aggregate blend by weight. Starting in 2017, the allowable RAP aggregate in HMA has increased to 25 percent. Caltrans is working with the asphalt industry to determine the feasibility of increasing the percentage of RAP without negatively impacting long-term pavement performance.

WARM MIX ASPHALT

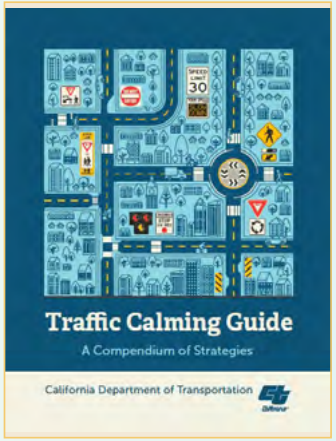
Warm Mix Asphalt (WMA) is a term for the incorporation of additives during asphalt production that allow lower temperatures to be used during asphalt mixing and roadbed application. Since less energy is needed to heat the asphalt mix, less fuel is needed to produce WMA. The FHWA reports that fuel consumption during WMA manufacturing is typically reduced by 20 percent. WMA also produces fewer emissions, which is better for air quality and improves working conditions by reducing exposure to fuel emissions and fumes. WMA may also result in labor and transportation cost savings since it is easier to transport, mix, and compact.

Left: Pavement recycling in Colusa County.



Design Information Bulletin 94 (DIB 94)

DIB 94 provides new design standards and guidance for comfortable complete streets facilities for all ages and abilities. Developed with main streets in mind, the DIB is focused on Urban, Suburban, and Rural Main Street place types, where the posted speed limit is 45 mph or less.



Traffic Calming Guide (TCG)

The Caltrans TCG is for use on the California State highway system and provides best practices, relevant standards, and traffic calming resources. The intent of the TCG is to build self-enforcing roadways that guide road users to travel at a safe speed, especially through conflict points.

GUIDANCE RESOURCE LIST

CALTRANS GUIDANCE LINKS:

- California Manual on Uniform Traffic Control Devices
- Cooperative Work Agreement (CWA)
- Design Information Bulletins
- Encroachment Permits Manual
- Highway Design Manual
- Maintenance Manual
- Project Development Procedures Manual
- Smart Mobility Framework Guide 2020
- Traffic Calming Guide
- *Additional Caltrans Manuals*

ADDITIONAL GUIDANCE LINKS:

- The American Association of State Highway & Transportation Officials
- Federal Highway Administration
- Transportation Research Board
- National Association of City Transportation Officials

GUIDANCE ACRONYMS

CALTRANS GUIDANCE:

CA MUTCD
California Manual on Uniform Traffic Control Devices

DD
Deputy Directive

DIB
Design Information Bulletin

DP
Director's Policy

HDM
Highway Design Manual

PDPM
Project Development Procedures Manual

TOPD
Traffic Operations Policy Directive

ADDITIONAL GUIDANCE:

AASHTO
The American Association of State Highway and Transportation Officials

FHWA
Federal Highway Administration

TRB
Transportation Research Board

NACTO
National Association of City Transportation Officials

Roadway Cross Section

Roadway Reallocation: Road Diets & Number of Traffic Lanes

(p. 79)

»HDM Topic 102 – Design Capacity and Level of Service: Number of Traffic Lanes; Chapter 300 and Index 301.1: Lane width guidance

»CA MUTCD – Sections 2C; 3B

»Caltrans Traffic Calming Guide

»FHWA, Proven Safety Countermeasure: Road Diet (Roadway Reconfiguration)

»FHWA Safety Program: Road Diet Informational Guide

»Roadway Cross Section Reallocation: A Guide

Two-Way-Left-Turn Lanes

(p. 80)

»HDM, Topic 102 – Design Capacity and Level of Service: Number of Traffic Lanes

»CA MUTCD – Sections 2C; 3B

Traffic Lane Width

(p. 80)

»DIB 94 Complete Streets: Contextual Design Guidance

»HDM, Chapter 300 Geometric Section

»CA MUTCD – Sections 2C; 3B

»Roadway Cross Section Reallocation: A Guide

»FHWA Proven Safety Countermeasure – Road Diet (Roadway Reconfiguration)

»FHWA, Safety Program: Road Diet Informational Guide

Raised Median Islands

(p. 81)

»HDM, Chapter 300 Geometric Section; Chapter 400 Intersections at Grade; Chapter 900 Landscape Architecture – Roadsides

»Caltrans Traffic Calming Guide

»FHWA, Safety Benefits of Raised Medians and Pedestrian Refuge Areas

»NACTO, Median Refuge Island,Pedestrian Safety Island, & Storm water Median

»DIB 93, Evacuation Route Design Guidance.

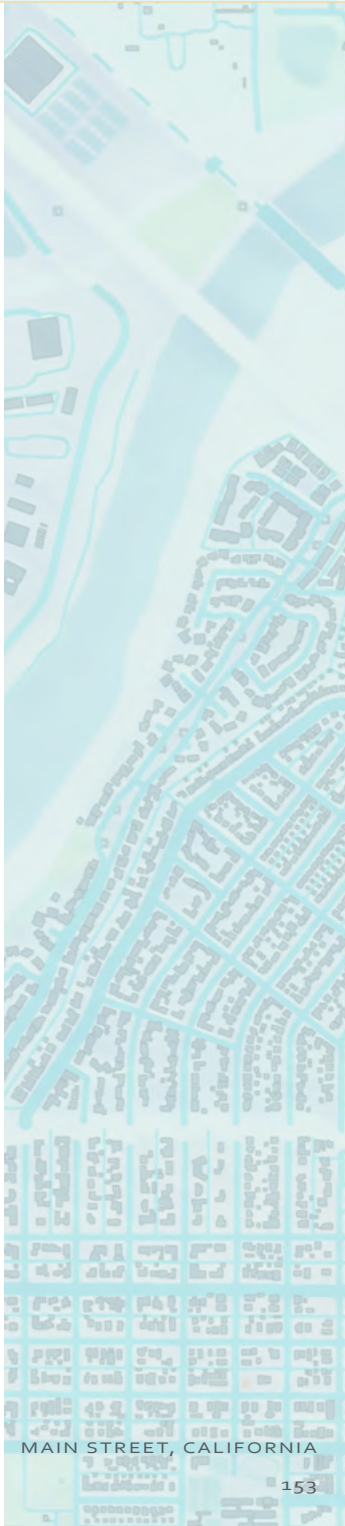
Mid-Block Crossings

(p. 82)

»CA MUTCD, Chapters 3B; 4E; 4F; 4L; 6H

»DIB 82

»FHWA, Raised Crosswalk Countermeasure Tech Sheet



MAIN STREET, CALIFORNIA

Intersections

(p. 84)

»HDM, Chapter 400: Intersections at Grade.

»Caltrans, Complete Intersections

»The AASHTO Highway Safety Manual (Provides a methodology to compare the performance of various intersection designs)

»FHWA, Alternative Intersections/ Interchanges: Informational Report (AIIR)

»FHWA Handbook for Designing Roadways for the Aging Population

»NACTO Urban Street Design Guide

Angle of Intersection

(p. 85)

»HDM, Chapter 400–403.3 Angle of Intersection; Topic 405.8 – City Street Returns and Corner Radii

»Caltrans Traffic Calming Guide

»NACTO, Urban Street Design Guide, “Complex Intersections”

Curb Radius

(p. 85)

»HDM, Chapter 400: Topic 403.6 Turning Traffic; Topic 404 – Design Vehicles

»Complete Intersections: A Guide to Reconstructing Intersections and Interchanges

»NACTO, Urban Street Design Guide

Bulb-outs (Curb Extensions)

(p. 86)

»HDM, Section 303.4, Curb Extensions

»CA MUTCD, Sections 2B.46–48, 3B.19–20, 3B.23, & 3D.01

»DIB 94, Complete Streets: Contextual Design Guidance

»Caltrans Traffic Calming Guide

»DIB 82, Pedestrian Accessibility Guidelines for Highway Projects

»Caltrans, Pedestrian Safety Countermeasure Toolbox

»NACTO, Bus Bulb, Pull-Out, Bus Stops, Storm water Transit Stop, & Curb Extensions

Pedestrian Refuge Islands/ Pedestrian Crossing Islands

(p. 87)

»HDM, Topic 305 – Median Standards; Figure 405.4– Pedestrian Refuge Islands.

»CA MUTCD, Chapter 3L

»Caltrans, Pedestrian Safety Countermeasure Toolbox

»FHWA, Proven Safety Countermeasure: Medians and Pedestrian Crossing Islands in Urban and Suburban Areas.

Protected Intersections

(p. 88)

»DIB 89

»NACTO, Protected Intersections

Speed Reduction Markings

(p. 89)

»CA MUTCD, Chapter 3B

»Caltrans, Traffic Calming Guide

Free Right Turn Lanes (Slip Lanes) / Eliminate Free Right Turn

(p. 89)

»HDM, Topic 403.6 & 405.1

Advance Stop or Yield Lines

(p. 90)

»CA MUTCD, Section 2C; Section 2B.12 and 7B.12

»DIB 94, Complete Streets: Contextual Design Guidance

»Caltrans, Pedestrian Safety Countermeasure Toolbox

»NACTO, Don’t Give up at the Intersection

Crosswalk Markings

(p. 90)

»CA MUTCD, Chapter 3B

»DIB 94, Complete Streets: Contextual Design Guidance

»Caltrans, Pedestrian Safety Countermeasure Toolbox

High-Visibility Crosswalks

(p. 91)

»CA MUTCD, Chapter 3B

»DIB 94, Complete Streets: Contextual Design Guidance

»Caltrans, Pedestrian Safety Countermeasure Toolbox

»Caltrans, Standard Plan A24F

Crosswalk Enhancement

(p. 91)

»CA MUTCD, Section 2B; 3B.18 and Figure 3B-17(CA)

»Caltrans, Traffic Operations Policy Directive (TOPD) 12-03

»DIB 94, Complete Streets: Contextual Design Guidance

»Caltrans, Traffic Calming Guide

»FHWA, Proven Safety Countermeasure: Crosswalk Visibility Enhancements

Raised Crosswalks

(p. 92)

»DIB 93, Evacuation Route Design Guidance

»CA MUTCD, Section 3B.18

»FHWA, Traffic Calming ePrimer

»FHWA, Pedestrian Safety Guide and Countermeasure Selection System

»Institute of Transportation Engineers, Traffic Calming Fact Sheets

»NACTO, Urban Street Design Guide

Intersection Safety and Operational Assessment Process

(p. 93)

»HDM, Chapter 400: Intersections at Grade

»Caltrans, TOPD Intersection Control Evaluation (ICE)

»FHWA, Alternative Intersections / Interchanges: Informational Report (AIIR)

Roundabouts

(p. 94)

»HDM, Index 405.10 (Roundabouts)

»CA MUTCD, Chapter 3C – Roundabout Markings.

»Caltrans, Traffic Calming Guide

»FHWA, Proven Safety Countermeasure – Roundabouts.

»National Cooperative Highway Research Program (NCHRP), Research Report 1043: Guide for Roundabouts

Signals and Beacons

(p. 96)

»Caltrans, Traffic Signal Operations Manual

Traffic Signals, Install Traffic Signal, Additional Signal Heads

(p. 96)

»CA MUTCD, Chapter 4A; 4C; 4E

»Caltrans, Traffic Operations Policy Directive 09-06

Backplates with Retroreflective Borders

(p. 97)

»FHWA, Proven Safety Countermeasures: Backplates with Retroreflective Borders

Extend Pedestrian Crossing Time

(p. 98)

»CA MUTCD, Chapter 4E

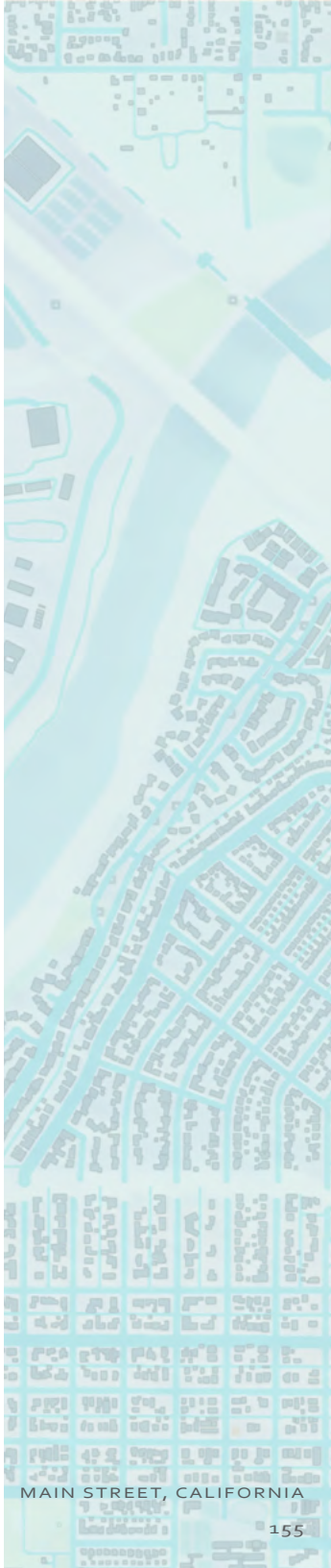
»Caltrans, Pedestrian Safety Countermeasure Toolbox

Pedestrian Countdown Timers

(p. 98)

»CA MUTCD, Chapter 4E

»Caltrans, Pedestrian Safety Countermeasure Toolbox



Leading Pedestrian Interval (LPI)

◀ (p. 98)

»CA MUTCD, Chapter 4

»Caltrans, Traffic Safety Bulletin 21-01, Leading Pedestrian Interval Implementation Guidelines

»FHWA, Proven Safety Countermeasures: Leading Pedestrian Interval

Exclusive Pedestrian Phase (Pedestrian Scramble)

◀ (p. 99)

»CA MUTCD, Chapter 4E

Accessible Pedestrian Signals (APS)

◀ (p. 100)

»CA MUTCD, Section 4E

»Caltrans, Pedestrian Safety Countermeasure Toolbox

»Caltrans, TOPD 21-06, Touch-free Accessible Pedestrian Signal (APS)

»Caltrans, Authorization Criteria for Touchless Accessible Pedestrian Signals

Automatic Pedestrian Recall

◀ (p. 100)

»CA MUTCD, Section 4E

»Caltrans, Pedestrian Safety Countermeasure Toolbox

Detection for Bicycles and Motorcycles at Traffic Signals

◀ (p. 101)

»CA MUTCD, Part 4

Bicycle Signals

◀ (p. 101)

»CA MUTCD, Part 4

Rectangular Rapid Flashing Beacons

◀ (p. 103)

»CA MUTCD, Part 4

»DIB 94, Complete Streets: Contextual Design Guidance

»FHWA, Interim Approval for Optional Use of Rectangular Rapid Flashing Beacons (IA-11).

»FHWA, Proven Safety Countermeasure: Rectangular Rapid Flashing Beacons (RRFB)

Flashing Beacons

◀ (p. 102)

»CA MUTCD, Part 4, Highway Traffic Signals

»DIB 94, Complete Streets: Contextual Design Guidance

»Caltrans, Traffic Calming Guide

Pedestrian Hybrid Beacons

◀ (p. 102)

»CA MUTCD, Chapter 4F

»Caltrans, Traffic Calming Guide

»Caltrans, Pedestrian Safety Countermeasure Toolbox

»FHWA, Proven Safety Countermeasure: Pedestrian Hybrid Beacon

In-Roadway Lights

◀ (p. 104)

»CA MUTCD, Chapter 4N

»Caltrans, Traffic Calming Guide

»DIB 94, Complete Streets: Contextual Design Guidance

In-Street Pedestrian Crossing Signs

◀ (p. 104)

»CA MUTCD, Section 2B.12 and 7B.12

»Caltrans, Traffic Calming Guide

»FHWA, Crosswalk Visibility Enhancements

Vehicle Speed Feedback Signs

(p. 104)

»CA MUTCD, Chapter 2B

»Caltrans, Traffic Calming Guide

Motor Vehicle Parking

(p. 105)

»HDM, Chapter 300; Topic 402.3 – On-Street Parking

»CA MUTCD, Part 3; Section 3B

»Caltrans, Traffic Calming Guide

»Caltrans, Standard Plan Accessible Parking, On-Street.

»The United States Access Board

Design for Bicyclists & Bike Facility Guidance

(p. 107)

»DIB 94, Complete Streets: Contextual Design Guidance

»HDM, Chapters 300, 400; Chapter 1000, Bicycle Transportation Design; and throughout as appropriate

»Caltrans, Bikeway Facility Selection Guidance

Bike Routes

(p. 118)

»HDM, Chapters 300, 400 and throughout as appropriate; Chapter 1000, Bicycle Transportation Design

»CA MUTCD, Part 9, Traffic Control for Bicycle Facilities; and Part 6, Temporary Traffic Control Signals

»Caltrans, TOPD 11-01, Accommodating Bicyclists in Temporary Traffic Control Zones

Shared Roadways

(p. 118)

»HDM, Chapter 1000

»CA MUTCD, Chapter 1A; 2A; 3A; 3B; 9A

»California Vehicle Code (VEH) 21202 and 21650

Shared Lane Markings (Sharrows)

(p. 118)

»HDM, Chapters 300, 400 and throughout as appropriate: Bike lane guidance

»HDM, Chapter 1000, Bicycle Transportation Design, Chapter 300, Geometric Cross Section and throughout; HDM topics where appropriate

» CA MUTCD, Part 9, Traffic Control for Bicycle Facilities; and Part 6, Temporary Traffic Control Signals

Bike Paths

(p. 110)

»HDM, Chapters 300, 400 and throughout as appropriate; Chapter 1000, Bicycle Transportation Design

»Caltrans, Traffic Operations Policy Directive 11-01: Accommodating Bicyclists in Temporary Traffic Control Zones

Bike Lanes & Buffered Bike Lanes

(p. 111)

»HDM, Chapters 300, 400 and throughout as appropriate; Chapter 1000, Bicycle Transportation Design

»CA MUTCD, Part 9, Traffic Control for Bicycle Facilities; and Part 6, Temporary Traffic Control Signals

»Caltrans, Traffic Operations Policy Directive 11-01: Accommodating Bicyclists in Temporary Traffic Control Zones.

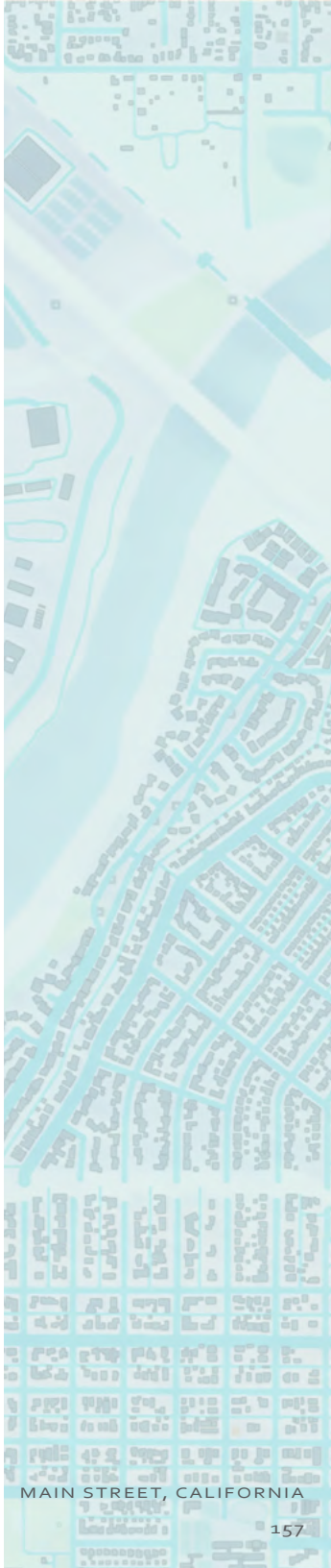
»FHWA, Proven Safety Countermeasure: Bicycle Lane

Green-Colored Pavement for Bikeways

(p. 113)

»MUTCD, Interim Approval IA-14

»NACTO, Urban Bikeway Design Guide



Separated Bikeways

(p. 112)

»Caltrans, DIB 89, Class IV Bikeway Guidance

»DIB 94, Complete Streets: Contextual Design Guidance

»HDM, Chapters 300, 400 and throughout as appropriate; Chapter 1000, Bicycle Transportation Design

»CA MUTCD, Part 9

»FHWA Separated Bike Lane Planning and Design Guide

Bike Box & Bicycle Turn Box

(p. 115)

»Caltrans, DIB 89

»Interim Approval for Optional Use of an Intersection Bicycle Box (IA-18)

»Interim Approval for Optional Use of Two-Stage Bicycle Turn Boxes (IA-20)

»Caltrans, Traffic Calming Guide

»NACTO, Urban Bikeway Design Guide

Bike Lanes and On-Street Parking

(p. 117)

»HDM, Topic 402.3

»CA MUTCD, Sections 2B; 2D; 9B

»Caltrans, DIB 82, Pedestrian Accessibility Guidelines for Highway Projects

»FHWA, On-Street Motor Vehicle Parking and the Bikeway Selection Process

»FHWA, Remove/Restrict Parking

Bike Lanes and Right-Turn Lanes

(p. 117)

»HDM, Chapters 300, 400 and throughout as appropriate; Chapter 1000, Bicycle Transportation Design

»CA MUTCD, Part 9, Traffic Control for Bicycle Facilities; and Part 6, Temporary Traffic Control

»Caltrans, Traffic Operations Policy Directive 11-01: Accommodating Bicyclists in Temporary Traffic Control Zones

Bike Parking

(p. 119)

»FHWA, Bicycle Parking and Storage

»Association of Pedestrian & Bicycle Professionals, Essentials of Bike Parking

Signs for Bicycle Facilities

(p. 119)

»CA MUTCD, Part 9

Bicycle Access During Construction

(p. 119)

»CA MUTCD, Part 9, Traffic Control for Bicycle Facilities; and Part 6, Temporary Traffic Control Signals

»Caltrans, Traffic Operations Policy Directive 11-01: Accommodating Bicyclists in Temporary Traffic Control Zones

Drainage Grates & Bicycles

(p. 119)

»HDM, Topic 837 – Inlet Design

»Caltrans, Standard Plans D77B “Grate Details”

Design for the Pedestrian Realm

(p. 120)

»DIB 94, Complete Streets: Contextual Design Guidance

»HDM, Topic 105, Pedestrian Facilities

»Caltrans, Pedestrian Safety Countermeasure Toolbox

»FHWA, Proven Safety Countermeasure: Walkways

»NACTO, Urban Street Design Guide

Accessible Main Streets (ADA)

(p. 122)

»DIB 82, Design Information Bulletins (DIBs) | Caltrans

»Caltrans, Curb Ramp Scoping and Design

»HDM, Topic 105 - Pedestrian Facilities

»CA MUTCD, 1A; 2B; 2I; 3A; 3B; 4C; 4D; 4E; 6A-H; 8D

»FHWA, Accessibility Resource Library

»Local Assistance Procedures Manual, Chapter 11

»Caltrans, Complete Intersections Guide

Sidewalks

(p. 124)

»HDM, Topic 105 – Pedestrian Facilities; Chapter 300, Clearances

»DIB 94, Complete Streets: Contextual Design Guidance

»DIB 82

Parklets

(p. 126)

»Caltrans, Encroachment Permits Manual, Section 500.3I

»SFMTA, Meeting the Smart City Challenge

»NACTO, Parklets

»California Legislature, AB 904

Pedestrian Scale Lighting

(p. 127)

»Pedestrian Lighting Primer (dot.gov)

»FHWA, Informational Report on Lighting Design for Midblock Crosswalks

Pavement Treatments at Intersections

(p. 128)

»CA MUTCD, Chapter 3B; 3G

»DIB 82

»Interpretation Letter 3(09)-24(I), Application of Colored Pavement

Street Landscaping & Street Trees

(p. 129)

»HDM, Topic 309 – Clearances; Topic 902 – Planting Guidelines; Chapters 900 and 910

»PDPM, Chapter 29

»Encroachment Permits Manual, Chapter 500

»Caltrans, Landscape Architecture website

»NACTO, Urban Street Design Guide

Street Furnishings

(p. 134)

»HDM, Topic 309 Clearances

»DIB 82

»NACTO Urban Street Design Guide

Banners and Decorations

(p. 136)

»Caltrans, The Encroachment Permits Manual

Community Identification & Gateway Monuments

(p. 136)

»Caltrans, Community Identification: Caltrans Project Development Procedures Manual (PDPM)

»HDM, Topic 309 – Clearances

Transportation Art

»Caltrans, Transportation Art Program

»Caltrans, Transportation Art Guidelines for Local Agencies

Connections to Public Transit

(p. 137)

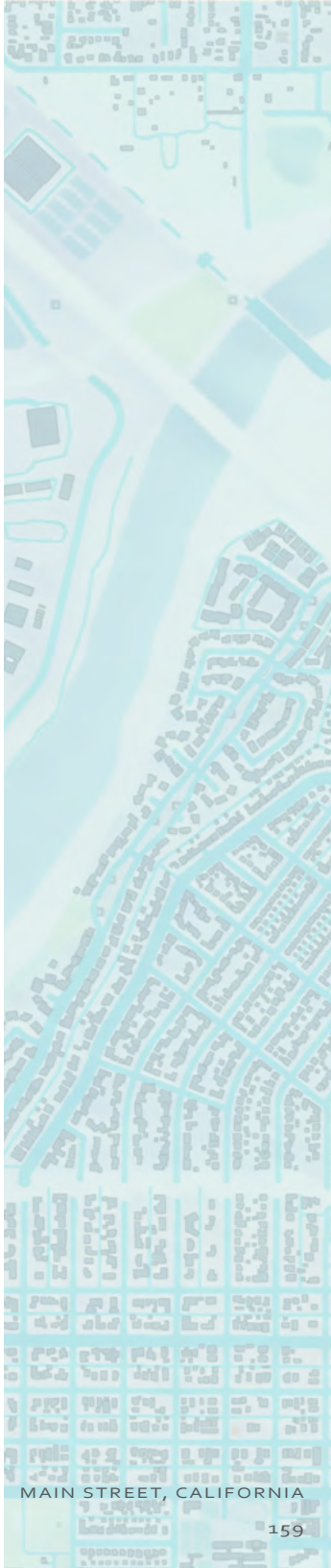
»HDM, Topic 108 – Coordination with Other Agencies; 108.2, Transit Loading Facilities; Table 302.1 includes shoulder widths for bus stops; 303.4, Curb Extensions discusses bus bulbs and bus bays; 1003.3, Shared Transit and Bikeways

»DIB 82 Pedestrian Accessibility Guidelines for Highway Projects

»DIB 94 Complete Streets: Contextual Design Guidance

»Rail and Mass Transportation | Caltrans

»NACTO Transit Street Design Guide



Bus Bulb / Bus Pull-Out

(p. 137)

»HDM, Topic 303.4

»CA MUTCD, Sections 2B.46-48, 3B.19-20, 3B.23, & 3D.01

»DIB 82

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»NACTO, Transit Street Design Guide

Transit Shelter and Design

(p. 137)

»HDM, Topic 108 – Coordination With Other Agencies; Topic 303.4

»NACTO, Transit Street Design Guide

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(p. 137)

»CA MUTCD, Sections 2B.46–48, 3B.19–20, 3B.23, & 3D.01

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»Caltrans, Development of an Integrated Adaptive Transit Signal Priority (ATSP) and Dynamic Passenger Information (DPI) System

»CA MUTCD, Sections 2B.19–22 & 4D.27

»US DOT, Transit Signal Priority (TSP): A Planning and Implementation Handbook

»NACTO, Active Transit Signal Priority

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Storm Water Quality Topics

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»Caltrans, Treatment BMP Design Guidance

»Caltrans, The Project Planning and Design Guide (PPDG)

»DIB 94, Complete Streets: Contextual Design Guidance

»HDM, Chapter 900, Landscape Architecture

»U.S. Environmental Protection Agency (EPA), Green Infrastructure Design and Implementation

»NACTO, Urban Street Storm water Guide

»San Francisco Public Utilities Commission, Storm Water Management Design Guidelines

Permeable Pavement

(p. 149)

»Caltrans, Pervious Pavement Design Guidance

»FHWA, TechBrief: Permeable Concrete Pavements

»EPA, Storm Water BMP: Fact Sheet: Permeable Pavements

Street Landscaping & Street Trees

See "Street Landscaping & Street Trees " guidance on preceding page.

INDEX OF CHAPTER 3 COMPLETE STREETS FEATURES:

Photography & Map Acknowledgements

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The recurring map graphics used in the document, as shown on the back cover, were created with OpenStreetMap, available under the Open Database License. Thank you.

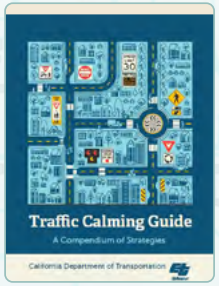
Main Street, California

for more information contact the Caltrans Landscape Architecture Program

Additional New Caltrans Guidance for State Highway Main Streets:

Design Information Bulletin 94 (DIB 94)

DIB 94 provides new design standards and guidance for comfortable complete streets facilities for all ages and abilities. Developed with main streets in mind, the DIB is focused on Urban, Suburban, and Rural Main Street place types, where the posted speed limit is 45 mph or less.



Traffic Calming Guide (TCG)

The Caltrans TCG is for use on the California State highway system and provides best practices, relevant standards, and traffic calming resources. The intent of the TCG is to build self-enforcing roadways that guide road users to travel at a safe speed, especially through conflict points.