PDQ

PROJECT DELIVERY QUARTERLY

Caltrans

SUMMER 2018

SPECIAL EDITION

Construction • Design • Engineering Services • Environmental Analysis • Project Management • Right of Way and Land Surveys

PROJECT DELIVERY & Complete Streets

CONTENTS

I am pleased to present the Summer 2018 "Project Delivery and Complete Streets" edition of the PROJECT DELIVERY QUARTERLY (PDQ). This special edition message of the PDQ is endorsed by all of the Caltrans District Directors and Executive Management in order to reaffirm that across Caltrans, we all have an important role to play in successful implementation of Complete Streets. As stated in ***Deputy Directive 64 (DD-64): Complete Streets,*** the development of Complete Streets "requires collaboration among all Department functional units and stakeholders."

Since the release of *DD-64-R1* in 2008, Caltrans has made great strides in promoting Complete Streets. We remain focused on improving travel conditions for all travelers, and the institutional momentum for including Complete Streets features in our projects has never been greater. Caltrans is poised to make great progress in Complete Streets implementation due to a historic confluence of supportive legislation, funding mechanisms, and strategic and long-term planning efforts. Some examples include:

Senate Bill 1 (SB-1) provided a much needed influx of funding for road maintenance, safety projects, railroad grade separations, and Complete Streets. SB-1 specifically states that Complete Streets features should be implemented where they are "beneficial, cost effective, and practicable" for "active transportation purposes, pedestrian and bicycle safety projects, transit facilities, and drainage and stormwater capture projects in conjunction with any other allowable project."

State Highway Operation and Protection Program (SHOPP) funds the repair and rehabilitation of the State Highway System (SHS). Caltrans recently altered the process for distributing funds within SHOPP programs. The new process facilitates more efficient development of projects with multi-objective benefits, including those related to multimodal travel. Complete Streets features are included in the SHOPP Tool. The SHOPP Tool, used in the project programming nomination process, identifies various features, performance metrics, and activities within a proposed SHOPP Project. Caltrans is also developing a SHOPP funding eligibility document to define eligibility requirements for features that can be funded in the SHOPP, which will include Complete Streets features.

In 2015, the ***Caltrans Strategic Management Plan (SMP)*** set ambitious goals related to multimodal transportation. "Toward Zero Deaths" was a strategic objective included under Goal 1 "Safety and Health." Goal 1 includes performance measures related to reducing the number of injuries and fatalities for auto, bicycle, pedestrian and transit modes of travel. Goal 3 "Sustainability, Livability and Economy," sets targets for tripling bicycling rates, and doubling pedestrian and transit travel. Goal 4 "System Performance," includes the strategic objective: "Increase the number of Complete Streets features on State highways that are also local streets in urban, suburban, and small town settings."

Front cover photos clockwise from top left: Route 35/Sloat Boulevard in San Francisco; a Class I bikeway in District 11; former Route 275 in West Sacramento; and a pedestrian ramp crossing in San Jose.

Inside cover photos from top: Karla Sutliff, Chief Engineer, and District Directors gather for photo to show statewide endorsement of Complete Streets implementation in Project Delivery. Caltrans *May is Bike Month* photos: John Bulinksi, District 8 Director, with partners and colleagues (middle photo). Ryan Chamberlain, Chief Deputy Director, Tamie McGowen, Assistant Deputy Director Public Affairs, with partners and colleagues (bottom left). Adnan Maiah, District 12 Director (Acting), with partners and colleagues (bottom right).

In 2017, Caltrans adopted ***Toward an Active California: The State Bicycle and Pedestrian Plan (Active California***)- which defines actions that Caltrans and our partners agencies will take to achieve the *SMP* goals. To implement strategies outlined in ***Active California,*** all Caltrans Districts have completed or initiated district-level "active transportation plans," which will include project level recommendations for Complete Streets investments.

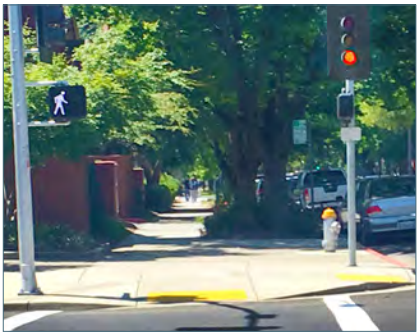
The recently released ***California Transportation Asset Management Plan (TAMP)*** was the first comprehensive asset management plan for California, and the first in the nation. The TAMP outlines a performance-driven approach to select and fund projects, and maintain SHS assets. This innovative investment strategy prioritizes preservation activities, focuses on selected asset classes, implements sustainable pavement practices, and facilitates inclusion of Complete Streets. The TAMP promotes the efficient use of investments to achieve multi-objective benefits which include those related to improving active transportation.

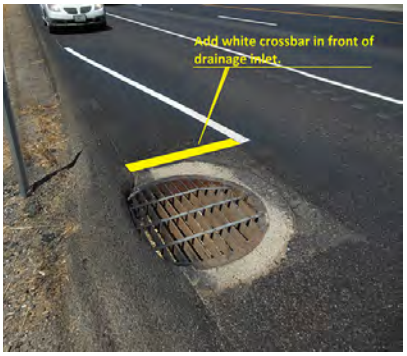
The ***Bicyclist Safety Improvement Monitoring Pilot Program*** **(Pilot)** was released by the Division of Traffic Operations in April 2018. The Pilot identifies bicyclist-involved high collision concentration locations (HCCLs) and corridors with the long-term goal of substantially reducing bicyclist fatalities and serious injuries on the SHS. The Pilot includes 96 corridors and 156 HCCLs. The 252 locations will be investigated to determine probable cause, and to identify potential countermeasures to reduce collisions involving bicyclists on the SHS.

My gratitude goes out to everyone who helped make ***May is Bike Month*** such a great success for Caltrans. Whether you were able to ride in an organized event in your District or not, I hope we can all continue to search out opportunities to replace motor vehicle trips with bicycling, walking or taking public transit. Increasing the number of trips we use via active transportation modes benefits personal health and well-being, and it furthers our professional development —as we develop firsthand knowledge of the joys and challenges of bicycling, walking, or taking public transit on, and across, our system.

This edition of the PDQ provides Complete Streets definitions; identifies common challenges faced by people who walk, ride bicycles, or take transit as they travel on and across State facilities; and emphasizes the importance of evaluating Complete Streets opportunities through all project phases, and on all project sites. By making strategic investments, and employing design flexibility, we can build the right features, in the right places for all modes of travel. A sustained emphasis on Complete Streets will make a lasting contribution to comfortable travel conditions for all ages and abilities. Thank you for your daily commitment to public service and for your ongoing desire to improve quality of life in California.

Karla B. Sutliff
Project Delivery Deputy Director
(Chief Engineer)





What are "Complete Streets?"

"Complete Street - A transportation facility that is planned, designed, operated, constructed, and maintained" to provide mobility "for all users, including bicyclists, pedestrians, transit riders, and motorists appropriate to the function and context of the facility."
–Caltrans Deputy Directive-64-R2

The Caltrans document ***Main Street, California,*** defines "Complete Streets" as "the incorporation of multimodal principles into the physical configuration of roadways and associated facilities. Streets are made "complete" by addressing 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 upon local context and environmental conditions, different streets will require distinct physical design features to best address the needs of travelers in that location."

Under the banner of "Complete Streets," are features that vary in scale, cost, and the level of planning and design required to implement them. Shown clockwise on this page, the photos show how wide-ranging Complete Streets solutions can be: pedestrian overcrossings, mid-block crossings, walk signals timed to give pedestrians a head start crossing the street (leading pedestrian interval), multi-use paths, and various pavement markings ("flying wedge" bicycle pavement marking shown) are all solutions tailored to address specific challenges that multimodal travelers are facing at that location.

Since transportation infrastructure provides a vital lifeline for people to participate in daily activities, it is crucial that it functions well for all ages and abilities—including children, seniors, and people with disabilities. Complete Streets provide people the freedom to choose the mode of travel that best suits their needs, interests, and trip requirements.

Complete Streets: A transportation solution that improves community livability, sustainability, and freedom of travel choice.

Many of the most pressing social and fiscal challenges facing California, such as public health, transportation system efficiency, and environmental quality, can be addressed in part through designing transportation to support bicycling, walking, and taking public transit (collectively known as "active transportation"). Complete Streets implementation can be a cost-effective strategy for improving transportation system efficiency, while also contributing to desirable co-benefits. Complete streets can encourage mode shift, which supports Caltrans goals related to reducing greenhouse gas emissions, and vehicle miles traveled per capita. Infrastructure that is designed to function well for pedestrians provides important community functions beyond those related to travel, by serving as a cornerstone of the public realm. Wide sidewalks for example, not only make walking more comfortable, they are also attractive to local business seeking to entice people to the area, and can provide space for trees and landscaping which offer shade, provide ecological services, and beautify communities.

Are Complete Streets features only for "main streets?"

All Caltrans transportation projects should be evaluated for Complete Streets opportunities.

As outlined in Caltrans ***DD-64-R2***, Caltrans "views **all transportation improvements as opportunities"** to improve "access, and mobility for all travelers in California and recognizes bicycle, pedestrian, and transit modes as integral elements of the transportation system."

While State highway main streets (conventional highways that serve as community streets) are especially important in Complete Streets evaluations, all Caltrans transportation projects should be evaluated for Complete Streets opportunities. Even where bicyclists and pedestrians are prohibited, such as on some freeways, opportunities may exist to improve pedestrian and bicyclist access *across a State facility*, or by providing access that is *parallel to the facility.*

The following pages provide examples of Complete Streets features that can be included on main streets, although the emphasis is on features that can improve travel conditions across freeway facilities (ramps, overcrossings, and undercrossings). This edition also stresses the need to evaluate Complete Streets near locations that are likely to generate walking, bicycling and public transit trips; and highlights the importance of increasing visibility and comfort for people using active transportation modes.

Crossing location at I-880 and Stevens Creek Boulevard, District 4.


US-101 Class I Bike Path, in District 7.

When are Complete Streets opportunities analyzed?

Complete Streets opportunities are analyzed at every project stage.

Corridor Planning- Corridor-level analyses performed in System Planning are important for evaluating and prioritizing Complete Streets investments. Since there are always competing needs for resources and right of way, corridor evaluations can identify areas of the highest need. Evaluations at this stage can include prioritizing investments that provide connected travel routes for active transportation users, emphasize accessibility improvements near important destinations such as schools and employment centers, and propose design solutions that provide travel, livability and sustainability related benefits to the state and local community. System planning and corridor analyses that include project-level recommendations can help drive the subsequent project nomination process.

Complete Streets priorities are set with stakeholder input. ***Director's Policy 21- Environmental Justice*** directs all employees to ensure "that the public, including minority and low-income populations, have a fair opportunity to express their needs and concerns in planning and transportation investment decisions." ***DD-64-R2*** directs Divisions within Caltrans to "partner, and collaborate with stakeholders to address the needs of bicyclist, pedestrian, and transit travelers in all program areas." ***Design Information Bulletin (DIB) 89—Class IV Bikeway Guidance (Separated Bikeways/Cycle Tracks)*** states that "local jurisdictions (cities and counties) must be involved" in the analysis of community impacts of proposed street modifications, with input from "local residents, businesses, and advocacy groups" to decide which features are to be considered during discussions regarding Class IV bikeway proposals (Class IV bikeways are discussed on the following pages). Smaller and/or required interventions, such as installing curb ramps, will require less extensive community outreach.

Project Initiation Document (PID)- Since the project scope, cost and schedule are set in the PID phase, it is essential to scan the project area for Complete Street opportunities at this stage. While corridor level evaluations should have identified areas of greatest need, a scan for Complete Streets issues is an iterative process. During the PID stage, it is important to analyze whether the highest priority Complete Streets issues within the project site are adequately addressed. More detailed site analysis can reveal additional opportunities. Complete Streets assessments should take into account Caltrans planning priorities, as well as any recent updates to local planning documents like general plans, vision documents, or bicycle and pedestrian plans. Recent changes in local development patterns, such as changes in population density or land-use may also warrant a reevaluation of Complete Streets priorities.

3 Route 62/Twentynine Palms Highway, Joshua Tree

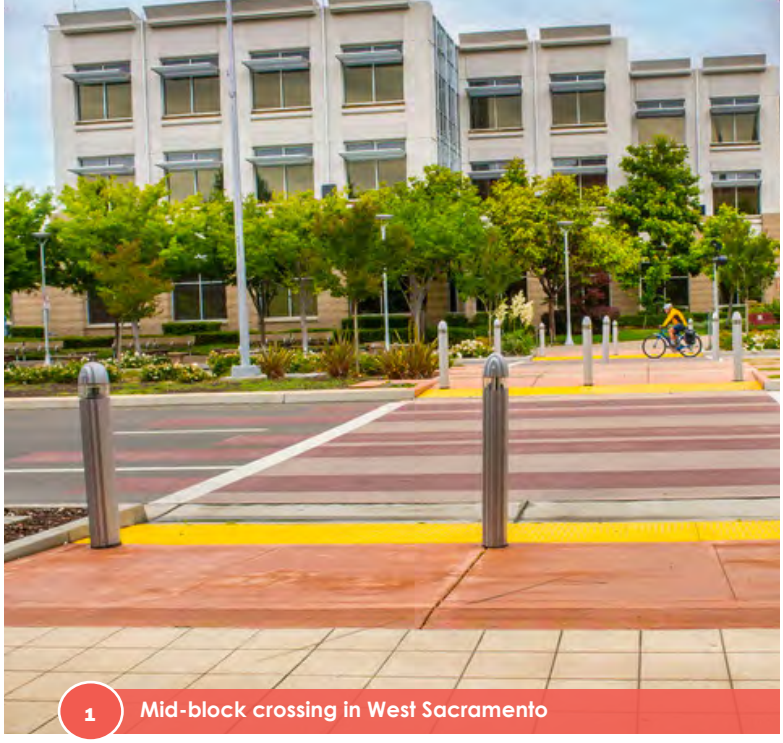
Project Delivery- The need to scan for Complete Streets priorities continues in project delivery. While the PID defines the parameters of the project, it is essential at every phase to evaluate whether the project adequately includes high value Complete Streets investments. When Project Engineers and the Project Development Team find that a Complete Streets opportunity was previously unidentified, but promises a high return on investment, such as providing an Americans with Disabilities Act (ADA) compliant feature, or a design solution that can close a gap in a bicycle or pedestrian route, a change in scope can be considered. The Project Delivery Team can consider high value investments, and if needed, bring in additional managers and stakeholders to develop a shared solution for managing or revising the project scope, cost and schedule.

The ***Project Development Procedures Manual,*** (Chapter 8), includes direction to "include the district bicycle, pedestrian and transit coordinators on the project development team (PDT) whenever users of these modes of transportation are present or if there are multimodal needs to address." The inclusion of multidisciplinary team members, from diverse Caltrans functional units, facilitates efficient project delivery of Complete Streets priorities.

Construction- During construction, a primary Complete Streets consideration is to provide continued access to bicyclists, pedestrians and transit riders in all detours and temporary traffic control strategies.

The ***Transportation Management Plan Guidelines*** state in *Section 2.4.4 Pedestrian and Bicycle Traffic:* "Work zone activities can disrupt the public's mobility and access. Temporary lane restrictions, use of shoulders as travel lanes, detours, and other transportation management strategies should be designed to accommodate non-motorized travelers wherever they are legally permitted." Additionally, "convenient access should be maintained for pedestrians and bicyclists, who are susceptible to disruptions because of their slower speeds and sensitivity to noise, airborne dust, road debris, and fumes. Special care should be taken to consider areas where schools or senior citizen centers are located.

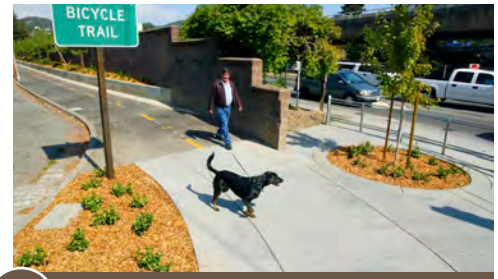
A travel path that replicates, if possible, the most desirable characteristics of their usual travel route should be provided. The needs and control of all road users including motorists, bicyclists, pedestrians within the highway, and persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA) through a Temporary Traffic Control (TTC) zone shall be an essential part of highway construction, utility work, maintenance operations, and the management of traffic incidents."



1 Mid-block crossing in West Sacramento

5 Shared use path in Half Moon Bay

2 Pedestrian/Bicycle Bridge in Belmont



4 Shared-use path in San Rafael

6 Bike and pedestrian access under Route 17 in Campbell

How are Complete Streets opportunities identified

Determining which Complete Streets features are appropriate requires an analysis of the physical site, and an evaluation of the quality of the travel experience for multimodal users. Important questions include:

1. Is there an opportunity to improve multimodal accessibility for people of **all ages and abilities?**
2. Does the existing facility serve as a **barrier** or provide a **connection** for people to walk, bike or take transit to **important destinations** such as schools, stores, employment centers, and residential areas?
3. Does the facility **enhance the visibility** of non-motorized travelers to motorists and vice versa?
4. Is the facility **comfortable and inviting** to multimodal users?
5. Does the project **complement Caltrans active transportation plans** and **local plans** for Complete Streets, and other livability related improvements?
6. Are there Complete Streets improvements that would improve **community livability**, and contribute to the facility functioning as **an inviting public space**?

"Campbell Avenue Portal" under Route 17 in Campbell

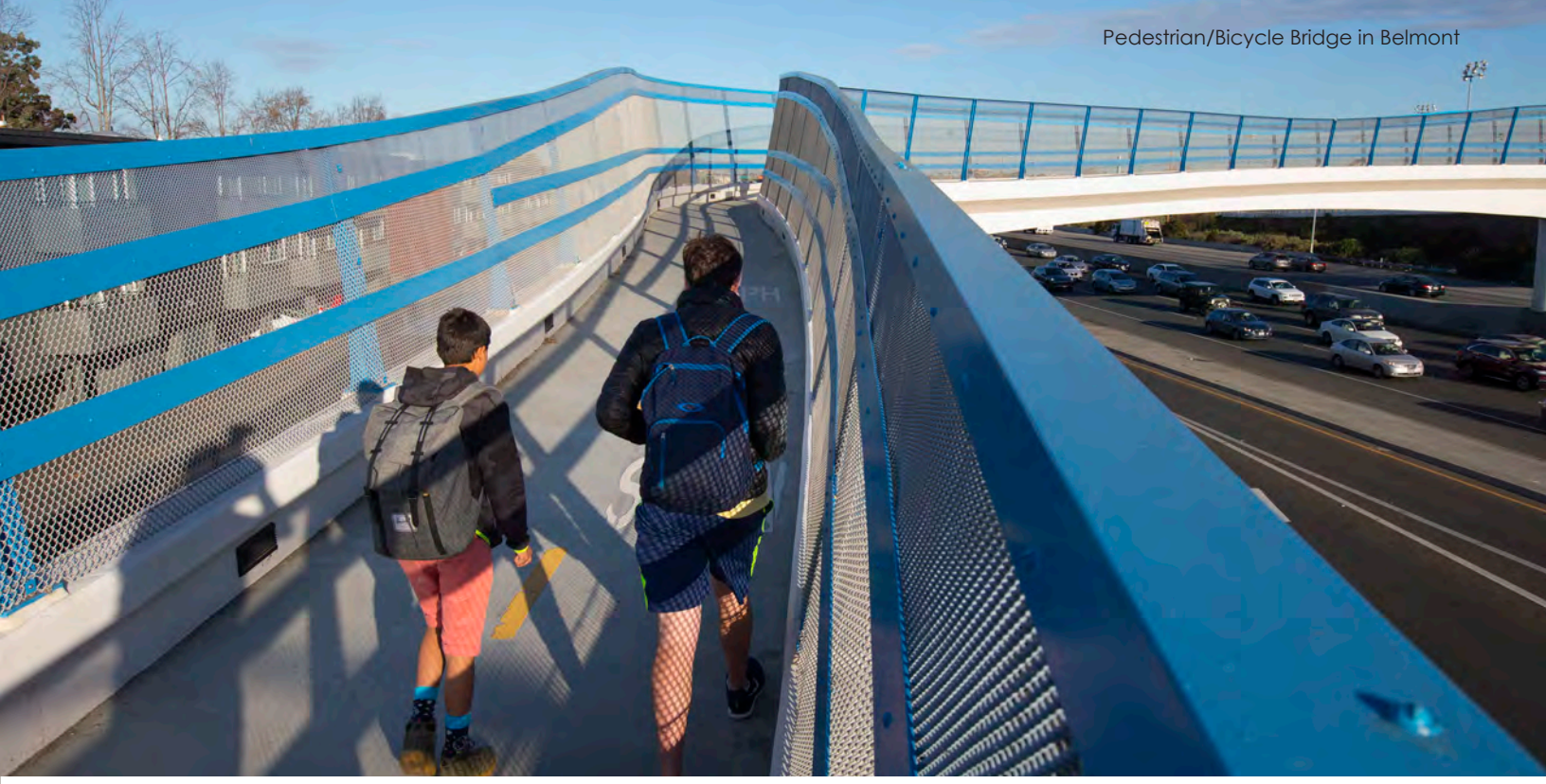
Complete Streets Across a Route

Freeways that do not include sufficient bicyclist and pedestrian crossing opportunities become physical barriers to important destinations. ***Active California*** states that "Caltrans is committed to reducing the barriers that State highways can create for communities." Even where it is physically possible to bike or walk across a State facility, the degree to which the facility is comfortable to use (due to its condition or physical design), substantially influences whether people will choose to bike or walk at that location.

Projects to replace or rehabilitate structures can be evaluated for opportunities to improve bicycling and walking conditions across the route. Caltrans may also have opportunities to partner with locals to integrate State and local facilities—so that they work together to provide accessibility for all travelers.

The photo above shows the "Campbell Avenue Portal," a recent local project intended to provide more comfortable access underneath Route 17 for bicyclists and pedestrians. The highly successful project encourages people to forgo a motor vehicle trip and choose an active transportation mode when traveling from a residential area to downtown Campbell—a popular local retail area, and home to a weekly farmer's market.

The top photo on the following page shows the US 101/Ralston Avenue Pedestrian/Bicycle Bridge in Belmont which connects a residential area to school, retail, and public recreational areas. The middle left photo shows green colored pavement to clearly delineate space for bicyclists traveling under Route 24 in Orinda. The middle right photo shows a wide sidewalk with aesthetic treatment to provide an inviting place for pedestrians to cross Route 5 in Redding. The Bay Bridge Trail in the bottom picture, provides active transportation access under the "MacArthur Maze" in Oakland, and includes attractive plantings and site furniture to make the route inviting to bicyclists and pedestrians.



Pedestrian/Bicycle Bridge in Belmont

Green Colored Pavement in Bike Lane in Orinda

Aesthetic paving on sidewalk across Route 5 in Redding

Bay Bridge Trail in Oakland

Bicyclists on HIghway 1 in Marin County

Shared-use path in Redding

Shared-use path in Emeryville/Oakland

Complete Streets On or Along a Route

All projects should be evaluated for opportunities to improve bicyclist and pedestrian access on or along a route.

Since California's highways and freeways often serve as the most direct route between important destinations, they are often the most efficient routes for bicyclists and pedestrians as well as motorists. Active transportation facility improvements can be made directly on a route where bicyclists and pedestrians are legally permitted to travel, or parallel to a route where they are not.

Of the more than 4,000 miles of freeways in California, about 1,000 miles are open to bicyclists. These are often on open sections in rural areas where there is no alternate route. Class I bikeways, also known as bike paths or shared-use paths, can be especially

Shared-use path in Half Moon Bay

Green colored pavement in bike lane in Joshua Tree

valuable when they are parallel to routes that prohibit bicyclists and pedestrians. Class I bikeways provide exclusive right of way for bicyclists and pedestrians, and are located away from the roadway. Even on routes where bicyclists and pedestrians are permitted, installation of a Class I bikeway can encourage people who are uncomfortable being directly adjacent to motorized traffic, to bicycle or walk away from the roadway on the shared-use path.

Projects that will not include new or improved active transportation facilities should still be evaluated for how they impact the multimodal network, and how well they align with local planning documents, and proposed projects listed in each District's Active Transportation Plans. Over the coming years, Caltrans intends to have Active Transportation Plans for each District. An early example is the recently released ***Caltrans District 4 Bike Plan*** which is currently available online, and lists priority projects by County and Route.

Bus bay, landscaping, and green colored pavement in bike lane on former SR 247, Tower Bridge Gateway, in West Sacramento.

A side boarding island transit stop in Los Angeles is separated from the sidewalk by a bike channel, eliminating conflicts between transit vehicles and bikes at stops. Photo credit: LADOT Bike Blog.

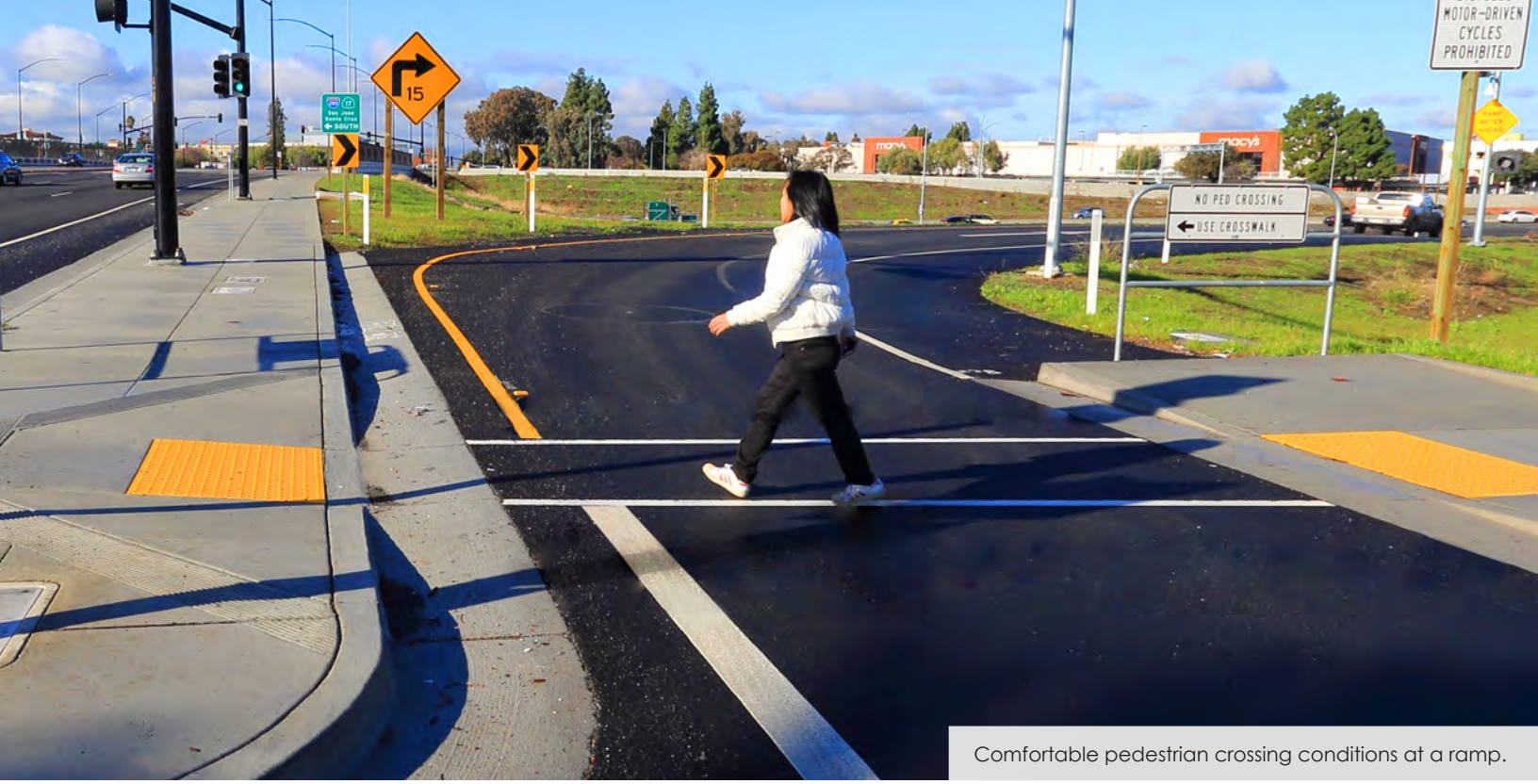
A Transit Priority Red Lane on a San Francisco street.
Photo credit: NACTO and SFMTA, Flickr CCL

Public Transportation On or Along a Route

Conditions for transit on or along a route should also be evaluated on Caltrans projects. Projects that are reallocating space within roadways (often called "road diets") may help make space for stopping locations where transit vehicles can pull out of the traffic flow while passengers are boarding. Pavement markings, such as the red Bus Rapid Transit Lane shown in the bottom photo, help improve travel time reliability by enabling buses to travel more quickly through congested areas.

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. 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.

Given the potential conflicts created when buses enter Class II Bike Lanes to pick up transit riders at bus stops, some cities are piloting the use of "floating" bus boarding islands/side boarding island stops, paired with Class IV Separated bikeways to eliminate these conflicts (shown in middle photo).



Comfortable pedestrian crossing conditions at a ramp.

Complete Streets Across a Ramp

Crossing locations that pose undue discomfort on pedestrians or bicyclists can persuade people to forgo active transportation options, and to make the trip by car instead. Freeway ramps are key locations that should be assessed for how comfortably pedestrians and bicyclists can cross. Motorists at ramps are often speeding up as they anticipate merging with freeway traffic, or they are still in the process of slowing down from a freeway speed. Designs that make ramps more comfortable crossing locations are those that improve the visibility of all travelers, help drivers maintain proper speeds, and minimize the time that bicyclists and pedestrians spend crossing the ramp.

Examples of how to improve crossing conditions include: minimizing the number of lanes that need to be crossed, (such as by beginning the High-Occupancy Vehicle (HOV) lane after a crosswalk); clearly designating crossing locations for pedestrians and bicyclists; and configuring crossing locations to be perpendicular to approaching vehicular traffic.

The photo above shows a design that enhances access and comfort for pedestrians by incorporating wide sidewalks, curb ramps, detectable warning surfaces, and marked crosswalks that are perpendicular to approaching vehicles.

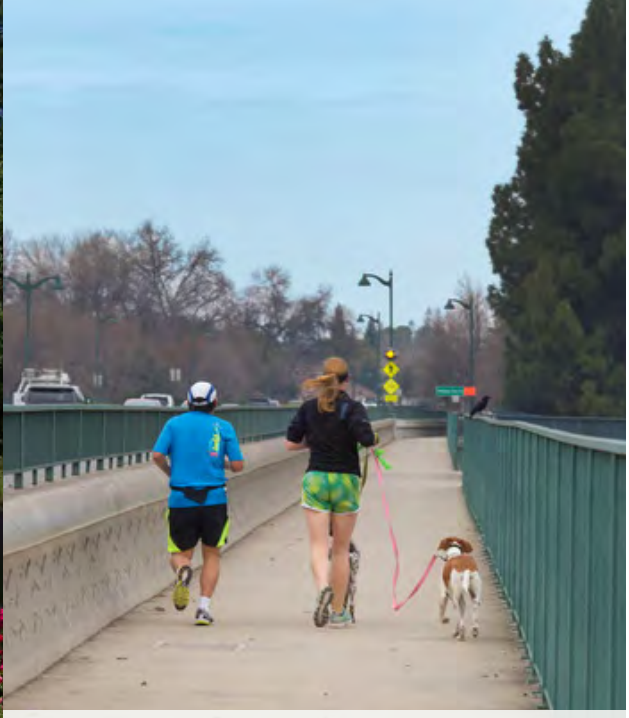
Highway 101/Old Redwood Highway in Windsor.

Highway 101/Old Redwood Highway in Windsor.

Ramp locations at Highway 101 and Old Redwood Highway in Windsor shown on this page, highlight some design solutions to improve crossing conditions for pedestrians and bicyclists at freeway ramps. Green colored pavement clarifies to bicyclists and motorists where each traveler is expected to be in the roadway. The raised crosswalk, wide sidewalks, and landscaping are all visual cues that alert drivers to the likely presence of pedestrians.

The landscaped area between the roadway and the sidewalk makes the route a more comfortable and attractive pedestrian route by providing a buffer from traffic. The plantings also provide ecological benefits, such as facilitating stormwater infiltration on-site.

Making active transportation facilities and travelers more visible can signal to motorists that there is a heightened need to maintain proper driving speeds, and can prompt increased visual scanning for multimodal travelers.



A bridge over the American River provides pedestrian and bicyclist access to a popular recreational area in Sacramento.

This side boarding island transit stop on a San Francisco street ensures access for all ages and abilities. SB-1 provides an additional $350 million in public transit funding for fleet and service improvements

A sidewalk installation on a rural route as part of a "Safe Route to School" initiative.
Photo credit: Valdosta-Lowndes MPO, Flickr CCL.

Complete Streets at Trip Generating Locations

Analysis of local land use is an important consideration in Complete Streets decision making. For instance, residential areas are inherently locations where people need Complete Streets features in order to initiate a trip via active transportation. Subsequent consideration of where people will most likely travel *to* can reveal additional high value locations for Complete Street 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 Complete Streets features deserve heightened attention. While 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 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 Complete Street investments.

Public Transportation

Within the realm of 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

Amtrak Station in Davis, CA
Photo credit: Dianne Lee, Flickr CCL.

During a *May is Bike Month* event, Caltrans District 12 employees bike to a Metrolink station (a regional passenger rail system), gaining firsthand knowledge of bicycling conditions around the station.

trip, are both strong predictors of whether people will choose to overcome first mile/last mile challenges in order 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 route, can play a meaningful role in supporting local transit usage.

The top photo taken in Caltrans District 3 provides an example of the importance of connecting bicycle, pedestrian, and transit routes. The photo captures the high number of daily passengers who ride their bikes to the Davis Amtrak train station. Upon arrival at the station, bicyclists may lock their bike on a rack for the day, or board with their bike in order to complete the "last mile" of their trip by bicycle. (Amtrak, in partnership with Caltrans, provides intercity rail service to three popular routes in California, including the Capital Corridor route that stops in Davis. It is the third busiest Amtrak operated route in the country.) People travelling from south Davis to the train station must cross Interstate 80. Projects that impact freeway crossing locations (such as the I-80 crossing encountered by some Davis Amtrak passengers), should include an analysis of how the State or local project is impacting travel conditions for people traveling to nearby transit facilities.

Class IV Separated Bikeway on a city street in Sacramento

Complete Streets to Improve Comfort and Visibility

The first goals of Complete Streets are to provide infrastructure that makes it physically possible to travel via active transportation, and to create connected networks without gaps in accessibility. To create transportation facilities that are truly embraced by large numbers of bicyclists, pedestrians and transit users however, the facilities must also be comfortable and inviting. While the concept of "comfortable" travel conditions inherently contains a degree of subjectivity, research shows that there are general preferences that most travelers apply when they assess the quality of travel conditions.

Most people prefer shade and a place to sit while waiting for a bus in the summer heat, and they welcome shelter during winter weather. Most people prefer to be separated from fast moving traffic while bicycling, and would prefer a row of street trees and landscaping to buffer them from multiple lanes of traffic while walking on a sidewalk. Evaluating the comfort levels experienced by bicyclists, pedestrians and transit riders within a project site can reveal planning and design solutions that will bolster the Caltrans goal of increasing trips made via active transportation.

In order to strategically and objectively measure "comfort" for bicyclists, a growing number of cities, counties and transportation agencies are employing a tested methodology for measuring "level of traffic stress" (LTS) for bicyclists (and in some cases for pedestrians as well). LTS ratings are given to a road segment or a crossing location to indicate the traffic stress imposed on bicyclists at that location. This methodology, developed by the Norman Y. Mineta International Institute (Mineta Institute) and researchers at Northeastern University, helps identify areas of greatest need within a bicycling network, thereby informing planning and design priorities.

A Class IV Separated Bikeway using planted areas to separate bicyclists from motorized traffic and the sidewalk in Vancouver. *Photo: Paul Krueger, Flickr CCL.*

A Class IV Separated Bikeway using planted areas to separate bicyclists from motorized traffic and sidewalk in Seattle. *Photo: Seattle DOT, Flickr CCL.*

Research that examines people's perceptions of the safety and appeal of bicycling find consistent patterns, and researchers describe those patterns using four general categories. The smallest category of bicyclists (1-5%), are *Strong and Fearless*—this group will bicycle regardless of challenges in infrastructure. Slightly more people (5-10%), are *Enthused and Confident,* and they are willing to ride under some challenging conditions. The next group (30-35%), is the *No Way No How* category of people who are unwilling for various reasons to consider bicycle travel under any conditions. Consistently, research shows that a majority of the population (50-60%), 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.

The Mineta 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 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, and is achieved primarily by separating bicyclists from motorized vehicles; reducing bicyclist proximity to fast moving traffic and/or reducing prevailing speeds; and reducing the number of lanes dedicated to motorized traffic.

Similar principles are beginning to be applied to assessing comfort and stress for pedestrian travel as well. 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. While not all of these 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.

Examples of Complete Streets features that increase the visibility and comfort of active transportation travelers are discussed below. They vary in cost, complexity, and the degree of planning and design that is required to implement— showing that some lower cost Complete Streets interventions can be highly successful at increasing the visibility and comfort of people biking and walking.

Class IV Separated Bikeways, sometimes referred to as protected bike lanes, or cycle tracks, are bikeways that are parallel to the roadway, and contain a physical separation from vehicular traffic. Separation from motorized vehicles is achieved through the placement of a vertical element such as flexible posts, a grade change, landscaped areas, or parked cars. The physical separation from motorized traffic via a vertical element is one feature that distinguishes it from a Class II Bikeway (Bike Lane). Separated bikeways are also different than Class I Bikeways (Bike Paths), which often permit pedestrian access. Separated bikeways are for bicycle use only.

In 2014, the National Institute for Transportation and Communities issued ***Lessons from the Green Lanes: Evaluating Protected Bike Lanes in the U.S.*** which found that bicycling rates increased in the study area after the installation of separated bikeways. Researchers found that 10% of surveyed riders switched to bicycling from other modes, and that over a quarter of riders were bicycling more in general. A majority of those surveyed reported that they felt safety had increased for bicyclists due to the installation of separated bikeways.

Being able to bicycle in a designated space that includes a physical buffer from motorized traffic makes many people comfortable enough to take up riding, and/or to increase their bicycling trips. The National Association of City Transportation Officials (NACTO), reports that "60% of the total population are *Interested but Concerned* about biking. Of those, 80% would be willing to ride on streets with a separated or protected bike lane." NACTO provides citations for these findings in the report: ***Equitable Bike Share Means Building Better Places for People to Ride.***

As evidence mounts that appropriately designed separated bikeways are effective in persuading people to take more trips by bicycle, they continue to grow in popularity across California, and throughout the country. Caltrans design guidance for Class IV bikeways is available in the recently updated ***DIB 89-01: Class IV Bikeway Guidance.***

Rectangular Rapid-Flashing Beacons (RRFBs)

RRFBs are a proven strategy for increasing pedestrian visibility and driver yield rates at crossing locations that do not meet the criteria for full signalization. As described in ***Main Street, California,*** 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 beacons are either activated manually by a push button or through the use of sensors that detect the presence of pedestrians waiting to cross (also known as passive pedestrian detection). The flashing pattern is irregular, similar to some emergency response vehicles. Research shows that traffic yields at a greater rate with the RRFBs compared to standard flashing beacons. RRFBs can be used on either two-lane or multi-lane roadways."

The Federal Highway Administration (FHWA) has issued Interim Approval "for the optional use of Rectangular Rapid-Flashing Beacons (RRFB) as pedestrian-actuated conspicuity enhancements for pedestrian and school crossing warning signs under certain limited conditions."

A Leading Pedestrian Interval enables a pedestrian to begin crossing before the parallel traffic gets a green light in Sacramento

Rapid Rectangular Flashing Beacon at a mid-block crossing in Davis.

Bicycle box at Route 131/Tiburon Boulevard in Mill Valley.

A Leading Pedestrian Interval (LPI) refers to a signal control strategy in which the pedestrian walk signal activates a few seconds before the parallel green light is activated for vehicles. The LPI allows pedestrians to get a head-start entering the intersection while parallel traffic is still at a stop. The pedestrian head-start reduces the amount of time that pedestrians are in the street with motorized traffic, and it also allows them time to move into a more visible location in the intersection, where drivers are more likely to see pedestrians before beginning a vehicular right or left turn. The May 2018 edition of the ***ITE Journal***, published by the Institute of Transportation Engineers, states that the "advantages of an LPI are primarily safety related, with evidence of reduced conflicts between pedestrians and turning vehicles." FHWA includes LPI as a ***Proven Safety Countermeasure.*** LPI was also recently added as a new countermeasure in FHWA's Highway Safety Improvement Program Call for Projects.

Bicycle Box

FHWA states in the ***Interim Approval for Optional Use of an Intersection Bicycle Box (IA-18)*** that an "intersection bicycle box is a designated area on the approach to a signalized intersection, between an advance stop line and the intersection stop line, intended to provide bicycles a space in which to wait in front of stopped motor vehicles during the red signal phase so that they are more visible to motorists at the start of the green signal phase. Positioning bicyclists in the center of the appropriate lane allows them to turn from a location where they are more visible to surrounding traffic, can increase the visibility of stopped bicycle traffic at an intersection, can reduce conflicts between bicycles and motor vehicles, can help mitigate intersection right-turn ("right-hook") conflicts, and can help group bicycles together to clear intersections more quickly."

During review of intersections included in experimental studies of bicycle box installations, FHWA found reductions in the number of conflicts between bicyclists and turning drivers, and reductions in bicyclists and drivers encroaching into pedestrian crosswalks.

A mid-block crossing on West Capital Avenue in West Sacramento that includes crosswalks, curb ramps, bollards, flashing beacons, trees, landscaping, aesthetic detailing and design features to create comfortable conditions for biking, walking, and taking transit. West Sacramento began developing plans and policies to revitalize the area in the 1990's and since then has emphasized transportation infrastructure that not only functions for travelers of all ages and abilities, but also intentionally contributes to an attractive sense of place.

Complete Streets and Quality of Life

Physical inactivity continues to impose an enormous burden on public health and fiscal resources in California. Project planners and designers who make active transportation not only possible, but appealing, play a significant role in encouraging people to walk and bike more as part of daily life. Closing gaps in bicycling, walking and transit routes enables people to travel via active transportation; and providing conditions that are *comfortable and inviting* can tip the scales, to make walking and biking an activity that people happily and regularly pursue.

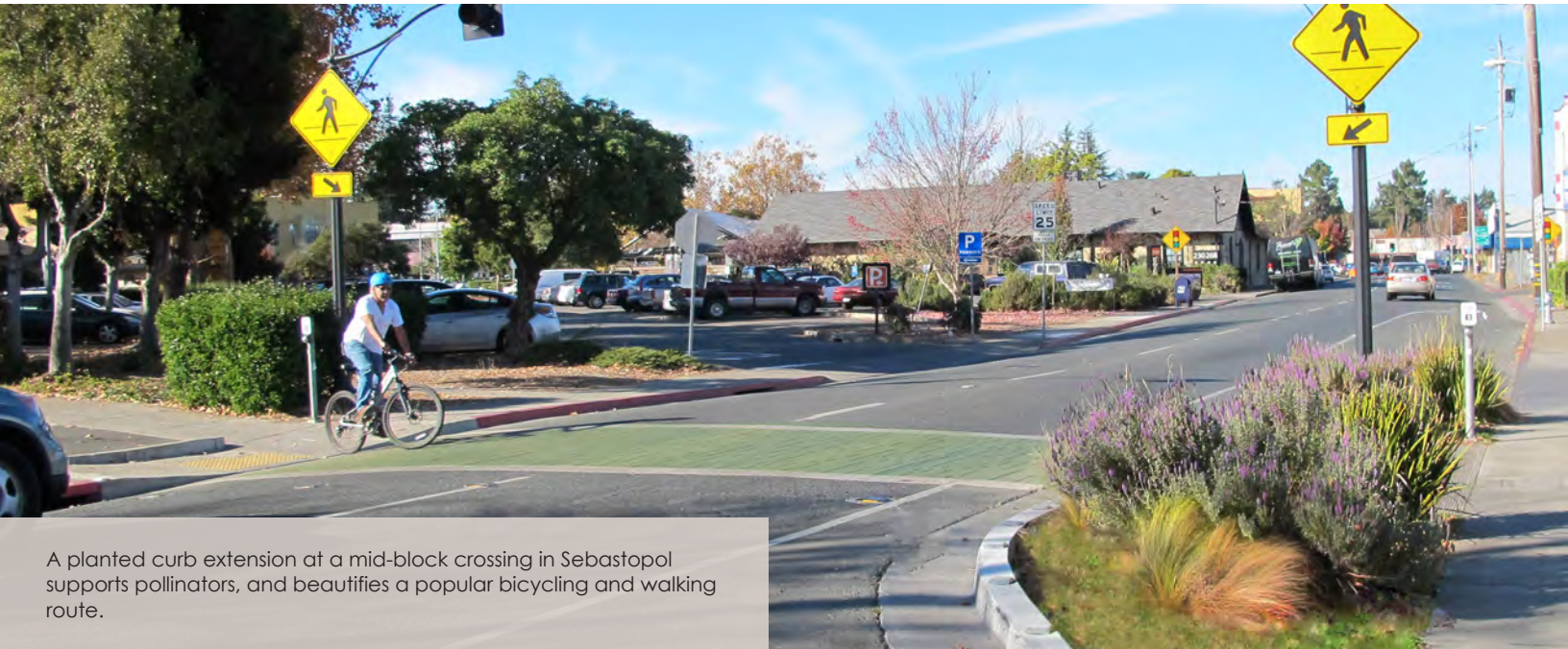
The most inviting streets for active transportation travelers are those that are designed with attention to the aesthetic appeal of the designed features, and often include landscaped areas and tree plantings. Appealing transportation infrastructure can help energize the local economy when it functions not just as a travel facility, but also as an enticing public space that draws visitors to restaurants and local businesses. Attracting and retaining local businesses is also easier in areas where the public realm offers a pleasurable environment for residents, local customers, and tourists.

Climate appropriate planting on Route 111 in Palm Desert, helps buffer pedestrians from traffic, and creates an aesthetically pleasing public realm.

Mature Oaks in a city street median in Oakland provide ecological benefits, provide shade to travelers, and contribute to community visual character.

Tree planting and landscaping are cost effective strategies for making bicycling and walking a refreshing experience. Trees and plants that provide shade, wind protection, and aesthetic enjoyment are places that people seek out when selecting bicycling and walking routes.

Planted areas can also strengthen the boundaries of pedestrian and bicycling spaces. The three photos on this page show Complete Streets projects with landscaped areas that physically and visually separate crossing locations and sidewalks from motor vehicles.



A planted curb extension at a mid-block crossing in Sebastopol supports pollinators, and beautifies a popular bicycling and walking route.

A city street in Paso Robles.

Route 49/143, High Street in Auburn.

Climate appropriate trees and landscaping also provide ecological benefits such as cleaning and cooling the air, and slowing the accumulation of atmospheric greenhouse gases, through carbon capture and storage. "Urban trees in the conterminous United States currently store 770 million tons of carbon, valued at $14.3 billion," according to researchers from the U.S. Forest Service.

Planted areas that are designed to receive stormwater run-off, and allow it to percolate into the soil on-site, have well-documented local and regional water quality benefits. The photos on this page show Complete Streets projects that incorporate tree plantings in landscaped stormwater treatment areas. The U.S. Environmental Protection Agency states: "in cities, trees can play an important role in stormwater management by reducing the amount of runoff that enters stormwater and combined sewer systems. Trees, acting as mini-reservoirs, control stormwater at the source."

A city street in McClellan.

"If you look at a tree, and think of it as a design assignment, it would be like asking you to make something that makes oxygen, sequesters carbon, fixes nitrogen, distills water, provides habitat for hundreds of species, accrues solar energy's fuel, makes complex sugars and food, changes colors with the seasons, creates microclimates, and self-replicates."

— William McDonough,
American Architect

Planning Guidance for Complete Streets

Toward an Active California, State Bicycle and Pedestrian Plan (Active California) is a statewide plan that lays out policies and actions that Caltrans and partner agencies will take to achieve statewide goals, including the Caltrans goal of doubling walking and tripling bicycling trips by 2020- and beyond.

Many local governments and transportation agencies across California have adopted design guidelines for the public realm, and planning documents related to bicycle, transit and pedestrian infrastructure. These are important references for integrating community livability goals and transportation projects.

Local and regional plans can be found on local government websites, and a partial list of local plans is compiled on the Safe Transportation Research and Education Center website.

All Caltrans Districts are scheduled to create active transportation plans to implement goals listed in *Active California.* An early example of this planning effort is the ***District 4 Bike Plan***-an evaluation of bicyclist needs and a listing of proposed improvements. The plan informs selection and scoping of District 4 projects from all funding sources. The project list is a living document that will be updated as additional opportunities are identified.

A growing number of cities are setting transportation project priorities informed by "Level of Traffic Stress" maps, which convey bicycling conditions across the network. The map above, from the ***City of Berkeley's Bicycle Plan,*** shows an approximation of conditions felt by bicyclists as they ride throughout Berkeley, including on some State facilities.

The Division of Transportation Planning's ***Complete Streets Elements Toolbox*** and upcoming ***Complete Streets Planning Guide*** provide implementation guidance for including Complete Streets features in Caltrans plans and projects. The Toolbox provides definitions, feature selection information, project examples, and quantification data for all Complete Streets Elements listed in the SHOPP Tool.

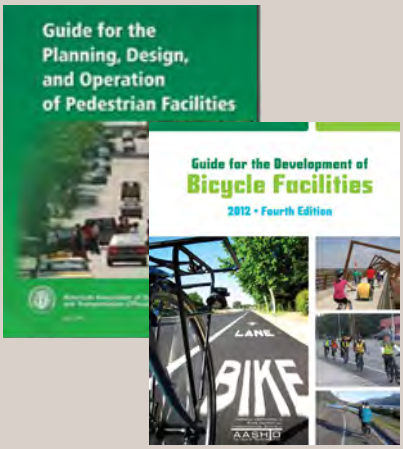
Caltrans has District Bicycle and Pedestrian Coordinators in every district who provide technical and policy related guidance about active transportation and Complete Streets implementation. In the photo above, Marlon Regisford, one of District 12's Bicycle and Pedestrian Coordinators, leads a bicycle tour for a *May is Bike Month* event.

Design Guidance for Complete Streets

The Sixth Edition Highway Design Manual (HDM) underwent a comprehensive manual-wide change in 2012, incorporating design guidance in support of a transportation system that serves all modes of travel – highway users, transit users, pedestrians, and bicyclists. Caltrans continues to improve its design guidance to meet the needs of all users.

Main Street, California: A Guide for Improving Community and Transportation Vitality is a Caltrans document that emphasizes planning and design strategies related to Complete Streets principles, and design elements that contribute to livable and sustainable communities.

The California Manual on Uniform Traffic Control Devices (California MUTCD), published by Caltrans, is issued to adopt uniform standards and specifications for all official traffic control devices, in accordance with Section 21400 of the California Vehicle Code.



The *Guide for the Planning, Design, and Operation of Pedestrian Facilities, July 2004;* and the ***Guide for the Development of Bicycle Facilities, 2012,*** are published by AASHTO.

NACTO, the National Association of City Transportation Officials, has several design guides related to Complete Streets that Caltrans and the FHWA accept for use in conjunction with other mandated guidance. The guides also have the endorsement of numerous cities, states, and transportation agencies.

Design guidance for Complete Streets features is available from a wide range of transportation agencies and organizations.

Caltrans supports the use of guidance developed by the American Association of State Highway and Transportation Officials (AASHTO), the Federal Highway Administration (FHWA), the National Association of City Transportation Officials (NACTO), and other organizations, when coupled with the HDM and sound engineering judgement. Referencing a full range of available design guidance facilitates informed decision making, design flexibility, and context sensitive solutions.

Caltrans employees may borrow many of the titles discussed in this document from the ***Caltrans Library.***

Thank you for your participation in another successful *May is Bike Month!*

PDQ

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