Other Bicycle Infrastructure Funding Options

The American Recovery and Reinvestment Act of 2009 is commonly referred to as the "stimulus" or the "stimulus package" and targets infrastructure development and enhancement. In 2011, the original expenditure estimate of $787 billion was increased to $840 billion to be in line with the President's 2012 budget and with scoring changes made by the Congressional Budget Office since the enactment of the Recovery Act. There was no end date written into the Recovery Act because, while many of its projects were focused on jumpstarting the economy, others are expected to contribute to economic growth for many years.

States must use 18.2 percent of their funding for public safety and government services. An eligible activity under this section is to provide funding to K-12 schools and institutions of higher education to meet green building standards. This is particularly applicable for active transportation and Safe Routes to School projects because the Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), addresses green standards for schools that include bicycle and pedestrian facilities providing safe access to schools.

Another $5 billion is provided for the Energy Efficiency and Block Grant Program. This provides formula funding to cities, counties and states to undertake a range of energy efficiency activities and an eligible use is bicycle and pedestrian infrastructure.

State Sources

State Highway Account

Section 157.4 of the Streets and Highways Code requires Caltrans to set aside $360,000 for the construction of non-motorized facilities that will be used in conjunction with the State highway system. The Office of Bicycle Facilities also administers the State Highway Account fund. Funding is divided into different project categories. Minor B projects (less than $42,000) are funded by a lump sum allocation by the CTC and are used at the discretion of each Caltrans District office. Minor A projects (estimated to cost between $42,000 and $300,000) must be approved by the CTC. Major projects (more than $300,000) must be included in the State Transportation Improvement Program and approved by the CTC. Funded projects have included fencing and bicycle warning signs related to rail corridors.

Caltrans Active Transportation Program (ATP)

This program was created to encourage increased use of active modes of transportation, such as biking and walking. The ATP consolidates existing federal and State transportation programs, including the Transportation Alternatives Program (TAP), Bicycle Transportation Account (BTA), and State Safe Routes to School (SR2S), into a single program with a focus to make California a national leader in active transportation. The ATP is administered by the Division of Local Assistance, Office of Active Transportation and Special Programs. This is a competitive program to increase biking and walking trips, safety and mobility, to support regional agency GHG reduction, enhance public health, benefit disadvantaged communities, and include a broad spectrum of projects. As of March 2015, no local match is required.

The SR2S component of the ATP addresses eligible city and county infrastructure projects. Projects must be infrastructure projects within two miles of a grade school or middle school and be completed within four years after project funds are allocated to the agency. Targeted beneficiaries must be children in grades K-12.

Transportation Development Act Article 3 (SB-821)

TDA funds are based on State sales tax, with revenues made available primarily for transit operating and capital purposes. By law, the County Auditor's office estimates the apportionment for the upcoming fiscal year.

TDA Article 3 funds may be used for activities related to the planning and construction of bicycle and pedestrian facilities such as engineering expenses leading to construction, right-of-way acquisition, and construction or reconstruction. This can include a number of activities, such as retrofitting existing bicycle and pedestrian facilities to comply with ADA requirements, route improvements like signal controls for cyclists, bicycle loop detectors and rubberized rail crossings. Also eligible are the purchase and installation of facilities such as intersection improvements, bicycle parking, benches, drinking fountains, rest rooms, showers adjacent to paths, employment centers, park-and-ride lots, and/or transit terminals accessible to the general public.

Local Sources

Developer Impact Fees

As a condition for development approval, municipalities can require developers to provide certain infrastructure improvements, which can include bikeway projects. These projects have commonly provided Class 2 facilities for portions of on-street, previously planned routes. They can also be used to provide bicycle parking or shower and locker facilities. The type of facility that should be required to be built by developers should reflect the greatest need for the particular project and its local area. Legal challenges to these types of fees have resulted in the requirement to illustrate a clear nexus between the particular project and the mandated improvement and cost.

New Construction

Future road widening and construction projects are one means of providing on-street bicycle facilities. To ensure that roadway construction projects provide bicycle lanes where needed, it is important that the review process includes input pertaining to consistency with the proposed system. Future development in the City will contribute only if the projects are conditioned.

Other Sources

Local sales taxes and fees may be implemented as new funding sources for bicycle projects. However, either of these potential sources would require a local election. Volunteer programs may be developed to substantially reduce the cost of implementing some routes, particularly multi-use paths. For example, a local college design class may use such a multi-use route as a student project, working with a local landscape architectural or engineering firm. Work parties could be formed to help clear the right of way for the route. A local construction company may donate or discount services beyond what the volunteers can do. A challenge grant program with local businesses may be a good source of local funding, in which the businesses can "adopt" a route or segment of one to help construct and maintain it.

Private Sources

Private funding sources can be acquired by applying through the advocacy groups such as the League of American Bicyclists and the Bikes Belong Coalition. Most of the private funding comes from foundations wanting to enhance and improve bicycle facilities and advocacy. Grant applications will typically be through the advocacy groups as they leverage funding from federal, State and private sources. The tables on the following pages summarize many of the numerous funding sources available.

Table 6-2: Federal Funding Sources

Grant Source	Annual Total	Agency	Funding Cycle	Match	Remarks
Land and Water Conservation Act of 1965 (LWCF)	$450 million federal; $3.6 million CA (2012)	National Parks Service/ California Department of Parks and Recreation	Dec-Jan	50% + 2-6% admin. surcharge	LWCF funds subject to north/ south split (60% for southern California). LWCF grants may be used for statewide outdoor recreational planning and for acquiring and developing recreational parks and facilities, especially in urban areas. Fund provides matching grants to state and local governments for land acquisition and development for outdoor recreation use.
Surface Transportation Program (STP)	$10 billion Federal; $888 million CA (pre-set-aside, pre-penalty)	FHWA/Caltrans	June 1	20%	STP funds wide variety of bicycle and pedestrian improvements, including on-street bicycle facilities, off-street trails, sidewalks, crosswalks, bicycle and pedestrian signals, parking and other ancillary facilities. May be exchanged for local funds for non-federally certified local agencies. No match required if project improves safety.
Transportation Alternatives Program (TAP) Includes Trails and SRTS Programs	$820 million Federal; $72.5 million CA	FHWA/Local MPO	Annual	20%	TAP funds construction, planning and design of facilities for pedestrians, bicyclists and other non-motorized forms of transportation.
Recreational Trails Program	$5.75 million guaranteed set-aside from TAP ($65 million in 2013)	FHWA, Regional agency may also contribute	Annual	Federal and regional must not exceed 95%	Provides funds to develop and maintain recreational trails and trail-related facilities for both non-motorized and motorized recreational trail uses. Percentage of TAP funding allocated to Recreational Trails Program at discretion of State.

Table 6-2: Federal Funding Sources (Cont.)

Grant Source	Annual Total	Agency	Funding Cycle	Match	Remarks
National Highway Performance Program	$1.9 billion (pre-set-aside, pre-penalty)	FHWA/Caltrans	Not available	Federal 80-100%; State 0-20%	Program provides funding for construction and maintenance projects located on newly expanded National Highway System (NHS), including those related to bicycle and pedestrian infrastructure. Certain safety projects may have a federal cost share of up to 100%.
Highway Safety Improvement Program (HSIP)	$2.4 billion Federal; $197 million CA (pre-set-aside, pre-penalty)	FHWA/Caltrans		Federal 90%; State 10%	Projects must address safety issues and may include education and enforcement programs. Program includes Railroad-Highway Crossings and High Risk Rural Roads programs. Bicycle projects must provide high degree of safety.
Congestion Mitigation and Air Quality (CMAQ)	$464 million CA (pre-set-aside, pre-penalty)	FHWA/Caltrans	April	20%	Amount of CMAQ funds depends on state's population share and on degree of air pollution
Safe Routes to School Program (SRTS)	$21 million (2012); See remarks for more information	FHWA/Caltrans and then MPO		80% Federal; 20% State	Caltrans proposed funding SRTS from a $21 million set aside in STP, approved by CTC as one year policy. Future funding for SRTS will be determined through the FAST Act implementation process.
Rivers, Trails and Conservation Assistance Program (RTCA)		National Park Service	August		Expenditures include bikeway plans, corridor studies and trails assistance

Table 6-2: Federal Funding Sources (Cont.)

Grant Source	Annual Total	Agency	Funding Cycle	Match	Remarks
Energy Efficiency and Block Grant Program	$3 million	Department of Energy			Provided formula funding for cities, counties and states to take part in energy efficient activities
Community Development Block Grants (CDBG)	$3 million	HUD and CA Dept of Housing and Community Development	Ongoing	10%	Funds improve land use and transportation infrastructure in low-income neighborhoods or citywide for accessibility improvements.
Federal Lands Highway Program	$611 million 2008-10	FLH/FHWA	Ongoing	Varies	May be used to build bicycle and pedestrian facilities in conjunction with roads and parkways at discretion of grantee.
Pilot Transit-Oriented Development Planning Program	$10 million	Federal Transit Administration	Not Available	Not available	Provides funding to advance planning efforts that seek to increase access to transit hubs for pedestrian and bicycle traffic.
Partnership for Sustainable Communities	$409 million in grants and/or assistance in 2010	HUD/DOT/EPA	Ongoing	Not available	Funding for preparing or implementing regional plans for sustainable development.
Community Transformation Grants (CTG)	$35 million in 2012	Regional health and planning agencies	Not Available	N/A	Funds to implement broad, sustainable strategies to reduce health disparities and expand preventive health care services.

Table 6-2: Federal Funding Sources (Cont.)

Grant Source	Annual Total	Agency	Funding Cycle	Match	Remarks
Associated Transit Improvements	1% of Urbanized Area Formula Grant; for FY2014 would be 1% of 4.5 billion (~ $45 million)	Federal Transit Administration/ MPO	Not Available	80% Federal Assistance (Capital); 50% Federal Assistance (Operational)	Recipients of Section 5307 (Urbanized Area Formula Grants) must certify they are spending no less than 1 percent of their federal transit funds on associated transit improvements (formerly transit enhancements). Typical projects have included bicycle lockers and parking near transit stations and stops.
Partnership for Sustainable Communities	$409 million in grants and/or assistance in 2010	HUD/DOT/EPA	Ongoing	Not available	Funding for preparing or implementing regional plans for sustainable development.
Community Transformation Grants (CTG)	$35 million in 2012	Regional health and planning agencies	Not Available	N/A	Funds to implement broad, sustainable strategies to reduce health disparities and expand preventive health care services.
Transportation Investment Generating Economic Recovery Program (TIGER)	$474 million Federal; $31 million CA (2013)	US DOT	October	80% Federal; 20% State	Can be used for innovative, multi-modal and multi-jurisdictional transportation projects (including bicycle and pedestrian projects) that promise significant economic and environmental benefits to an entire metropolitan area, region or the nation. Minimum project cost is $10 million.
Bus and Bus Facilities Program: State of Good Repair	$2.17 billion Federal (2014)	Federal Transit Administration	March	80% Federal; 20% State	Can be used for projects to provide bicycle access to public transportation facilities. More specifically, funds are used for shelters for people, bicycle parking amenities and accommodating bicycles on transit.

Grant Source	Annual Total	Agency	Funding Cycle	Match	Remarks
Bus Livability Initiative	$125 million (2012)	Federal Transit Administration	March	90% Federal; 10% State	Can be used for bicycle and pedestrian support facilities, such as bicycle parking, bicycle racks on buses, pedestrian amenities and educational materials.
Federal Lands Transportation Program, Category 3, "Alternative Transportation"	$3.38 million for Pacific West Region (2013)	FHWA	Varies, generally October; programmed through 2017	None	Funds transportation modes that reduce congestion and pollution in parks and public lands. Formerly the Paul S. Sarbanes Transit in Parks Grant Program.
Local Highway Bridge Program	$300 million	FHWA/Caltrans	Ongoing	88.53% Federal match for Local Highways; 100% for Federal Highways	Funds to replace or rehabilitate public highway bridges over waterways, other topographical barriers, other highways, or railroads.
Section 5310	$20-35 million	Federal Transit Administration	Annually	11.47%	Funds provide transportation services to meet needs of seniors and persons with disabilities for whom public transportations services are otherwise unavailable, insufficient or inappropriate.

Table 6-3: State Funding Sources

Grant Source	Annual Total	Agency	Funding Cycle	Match	Remarks
State Highway Account (SHA): Bicycle Transportation Account (BTA)	Varies	Caltrans	March application deadline. Consult Local Assistance Office	10%	Must have an adopted Bicycle Transportation Plan. Funding available for all phases of projects.
Active Transportation Program	$124 million	Caltrans	Two-year cycle	12%	Consolidates BTA, Transportation Alternatives and Safe Routes to School funding. 60% awarded by State, 40% by MPOs.
Transportation Development Act (TDA) Section 99234	$149 million (2014)	Local MPO or CTC	Annually	None	2% of TDA total, funds for bicycle and pedestrian projects.
Regional Improvement Program (STIP)	$3.4 billion over 5 years	Caltrans	Every two years		Capital improvement projects (planning and rideshare activities).
AB-2766 Vehicle Registration Funds	$30 million (2010)	SCAQ	February	None	Competitive program for projects that benefit air quality.
Vehicle Registration Surcharge Fee (AB-434) RCF		APCB	July	None	Competitive program for projects that benefit air quality.
Vehicle Registration Surcharge Fee (AB-434) PMF	40% from grant source	APCB	April	None	Funds distributed to county communities based on population.
Developer Fees or Exactions	Project-specific	Cities	Ongoing	None	Mitigation required during land use approval process.
State Gas Tax (local share)		Allocated by State Auditor-Controller	Monthly allocation	None	Major Projects, >$300,000.

Table 6-3: State Funding Sources (Cont.)

Grant Source	Annual Total	Agency	Funding Cycle	Match	Remarks
State and Local Transportation Partnership Program (SLPP)	Est. $200 million state-wide	Caltrans	Summer	50%	Road projects with bicycle lanes are eligible, requires developer or traffic fee match.
Caltrans Minor Capital Program	Varies	Caltrans	Ongoing after July 1	None	Projects must be on state highways; such as upgraded bicycle facilities.
Environmental Enhancement and Mitigation Program (EEM)	$10 million state-wide	State Resources Agency	October annually	None required, but favored	Individual grants limited to $350K.
Petroleum Violation Escrow Account (PVEA)	Varies	Caltrans, CA Community Services and Development, Air Resources Board	March	None	Projects must save energy, provide public restitution and be approved by CA Energy Commission and US DOE.
Community Based Transportation Planning Demonstration Grant Program	$3 million	Caltrans	November	20%	Projects must have a transportation component or objective.
Habitat Conservation Fund Grant Program (HCF)	$2 million	CA Dept of Park and Recreation	October	50%	Available until July 1, 2020.
Office of Traffic Safety Program (OTS)	Varies	Office of Traffic Safety	January	None	Goal to reduce vehicle fatalities and injuries through safety program to include education, enforcement and engineering.
Safe Routes to School Program (SR2S)	$24 million (2009)	Caltrans	April	10%	Eligible for projects in vicinity of a school and grades K-12.

Table 6-3: State Funding Sources (Cont.)

Grant Source	Annual Total	Agency	Funding Cycle	Match	Remarks
State Transportation Improvement Program (STIP)	Varies	Caltrans	Every 4 years	None	Gives metropolitan regions more control over state transportationfundinvestment.
California Conservation Corps (CCC)		California Conservation Corps			CCC provides emergency assistance and public service conservation work.
Environmental Justice (EJ) Planning Grants	$9 million (2010)	Caltrans	Annually	10%	Engage low-income and minority communities in transportation projects to ensure equity and positive social, economic and environmental impacts.
California River Parkways	Varies	CA Natural Resources Agency	October	None	Create or expand trails for walking, bicycling and/ or equestrian activities compatible with other conservation objectives.
Safe Routes to School (AB-1475)	$21-25 million	Caltrans	June	10%	Increase the number of children who walk or bicycle to school through funding of programs that remove barriers from doing so
Land and Water Conservation Fund	$2.3 million in CA (2009)	NPS, CA Department of Parks and Recreation	March	50% + 2-6% admin. surcharge	Provides funding for the development of river-adjacent bicycle facilities.
Environmental Enhancement and Mitigation Program	$10 million	California Natural Resources Agency	October	None	Support projects that offset environmental impacts of modified or new public transportation facilities.
Tire-Derived Product Grant Program	Varies	CA Department of Resources Recycling and Recovery (CalRecycle)	Varies	Not applicable	Funds to purchase materials for bicycle and pedestrian projects, including sidewalks/ pathways, accessibility ramps, and traffic safety products.

Table 6-4: Local Funding Sources

Grant Source	Annual Total	Agency	Funding Cycle	Match	Remarks
Parking Meter Districts		City	Annual Budget	N/A	Parking Meter Districts can use parking meter revenues for streetscape improvements such as pedestrian facilities, landscaping and lighting.
Transient Occupancy Tax (TOT)		City	Annual Budget	None	Created to cover expenses and improvements related to tourism and to encourage more tourists to visit. Fund may be appropriate in areas of heavy tourism such as along waterfronts, major parks and historic neighborhoods.
SB-821	Varies	Riverside County Transportation Commission (RCTC)	Annually	Up to 25%	Eligible projects include sidewalks, bicycle paths, lanes and routes, and access ramps or curb cuts.
SCAG Sustainability Program	Varies	SCAG	Annually	None	Direct funding of innovative planning initiatives for member agencies through Compass Blueprint Demonstration Projects.
SCAG Active Transportation	Varies	SCAG	Annually	11.47%	New division intended to assist bicycle and pedestrian planning efforts. Program will focus on voluntary efforts to meet local needs and contribute to implementing SCS, reducing greenhouse gas (GHG) emissions.

Table 6-5: Private Funding Sources

Grant Source	Annual Total	Agency	Funding Cycle	Match	Remarks
Surdna Foundation	Project-specific	Surdna Foundation	Ongoing		Surdna Foundation makes grants to nonprofit organizations in areas of environment, community revitalization, effective citizenry, arts, and the nonprofit sector.
Bikes Belong	$180,000	Bikes Belong Coalition	Three times a year	50%	Community grants focus on funding facilities and programs.
Kaiser Permanente Community Health Initiatives	$54 million	Kaiser Permanente	Ongoing	None	Numerous programs to support Healthy Initiatives.
Health Foundations	Project-specific	Various foundations	Ongoing		Focus active transportation improvements for an obesity prevention strategy. Examples include California Wellness Foundation, Kaiser and California Endowment.
Rails to Trails Conservancy	Project-specific	Rails to Trails Conservancy			Provides technical assistance for converting abandoned rail corridors to use as multi-use trails.
Donations	Project-specific	Depends on nature of project	Ongoing		Corporate or individual donations, sponsorships, merchandising or special events.
In-kind Services	Project-specific	Depends on nature of project	Ongoing		Donated labor and materials for facility construction or maintenance such as tree planting programs or trail construction and maintenance.
People for Bikes Community Grant Program	Up to $10,000	People for Bikes	Twice a year	None	Focuses most grant funds on bicycle infrastructure projects such as bicycle paths, lanes, trails and bridges, mountain bike facilities, bike parks and pump tracks, BMX facilities, end-of-trip facilities such as bicycle racks, parking and storage.

City of Eastvale

Bicycle Master Plan

Appendices

February 2016

CITY OF EASTVALE

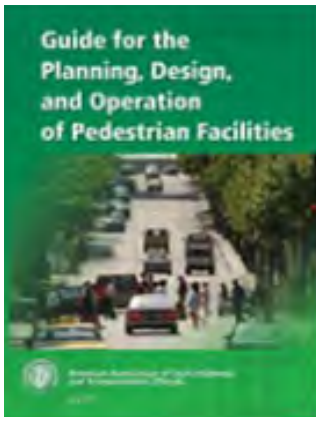
EST. 2010

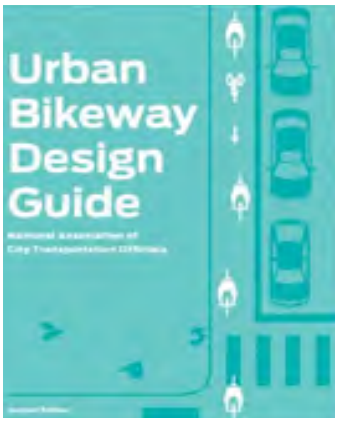
Community ✦ Pride ✦ Property

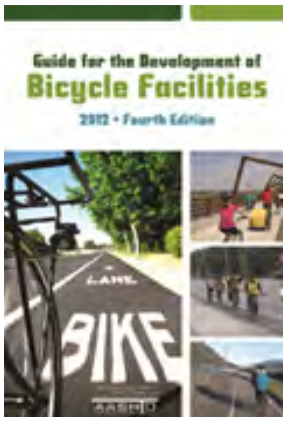
Appendix A: Toolbox - Design Guidelines

This appendix is intended to assist in the selection and design of bicycle and trail facilities through illustrating best practices by facility type from public agencies and municipalities nationwide. Design treatments are addressed within a single sheet tabular format relaying important design information and discussion, example photos, schematics (if applicable) and existing summary guidance from current or upcoming draft standards.

Existing standards are referenced throughout and should be the first source of information when seeking to implement any of the treatments featured here. Several agencies and organizations provide bike and pedestrian facilities design standards for the US, including the most commonly used manuals shown below.







National Standards

The Federal Highway Administration's Manual on Uniform Traffic Control Devices (MUTCD) defines the standards used by roadway managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways and private roadways open to public traffic. The FHWA MUTCD forms the basis of the California MUTCD.

To further clarify the MUTCD, the FHWA created a table of contemporary bicycle facilities that lists various bicycle related signs, markings, signals and other treatments and identifies their official status, such as whether it can be implemented or is currently experimental. See Bicycle Facilities and the Manual on Uniform Traffic Control Devices.

Bikeway treatments not explicitly covered by the MUTCD are often subject to experiments, interpretations and official rulings by the FHWA. The MUTCD Official Rulings is an online resource that allows website visitors to obtain information about these supplementary materials. Copies of various documents (such as incoming request letters, response letters from the FHWA, progress reports and final reports) are available on this website.

American Association of State Highway and Transportation Officials (AASHTO) Guide for the Development of Bicycle Facilities, updated in June 2012 provides guidance on dimensions, use and layout of specific bicycle facilities. The standards and guidelines presented by AASHTO provide basic information, such as minimum sidewalk widths, bicycle lane dimensions, detailed striping requirements and recommended signage and pavement markings.

The National Association of City Transportation Officials' (NACTO) 2014 Urban Bikeway Design Guide is the newest publication of nationally recognized bikeway design standards and offers guidance on current design state of the practice. Its intent is to offer substantive guidance for cities seeking to improve bicycle transportation in places where competing demands for the use of the right-of-way present unique challenges. All of the NACTO Urban Bikeway Design Guide treatments are in use internationally and in many cities around the US.

Meeting the requirements of the Americans with Disabilities Act (ADA) is an important part of any bicycle and pedestrian facility project. The United States Access Board's proposed Public Rights-of-Way Accessibility Guidelines (PROWAG) and the 2010 ADA Standards for Accessible Design (2010 Standards) contain standards and guidance for the construction of accessible facilities. This includes requirements for sidewalk curb ramps, slope requirements and pedestrian railings along stairs.
Some of these treatments are not directly referenced in the current versions of the AASHTO Guide or the MUTCD, although many of the elements of these treatments are found within these documents. In all cases, engineering judgment is recommended to ensure that the application makes sense for the context of each treatment, given the many complexities of urban streets.

Additional References and Guidelines

FHWA Bicycle Facilities and Manual on Uniform Traffic Control Devices, 2011.
MUTCD Official Rulings, FHWA.

State Standards and Guidelines

California Highway Design Manual (HDM) (2012)

This manual establishes uniform policies and procedures to carry out highway design functions for the California Department of Transportation. The 2012 edition incorporated Complete Streets focused revisions to address the Department Directive 64 R-1.

Complete Intersections: A Guide to Reconstructing Intersections and Interchanges for Bicyclists and Pedestrians (2010)

This California Department of Transportation reference guide presents information and concepts related to improving conditions for bicyclists and pedestrians at major intersections and interchanges. The guide can be used to inform minor signage and striping changes to intersections, as well as major changes and designs for new intersections.

Main Streets: Flexibility in Design & Operations (2005)

This Caltrans booklet is an informational guide that reflects many of the recent updates to the Caltrans manuals and policies that improve multimodal access, livability and sustainability within the transportation system. The document will help users locate information about standards and procedures descried in the Caltrans Highway Design Manual (HDM), the California Manual on Uniform Traffic Control Devices (California MUTCD) and the Project Development Procedures Manual (PDPM).

New Legislation Allowing Safety Standards Other Than Caltrans HDM

AB-1193, signed into law in September 2014, allows local agencies to adopt, by resolution, safety standards for bikeways other than Caltrans' Highway Design Manual. According to the Legislative Analyst, AB-1193 "allows local governments to deviate from state criteria when designing bikeways, but does not give them complete control. Cities and counties that elect to use design criteria not contained within the HDM would have to ensure that the alternative criteria have been reviewed and approved by a qualified engineer, are adopted by resolution at a public meeting and adhere to guidelines established by a national association of public agency transportation officials, such as the National Association of City Transportation Officials." The bill also expands the definition of bikeways to include cycle tracks or separated bikeways, also referred to as "Class IV bikeways," which promote active transportation and provide a right-of-way designated exclusively for bicycle travel adjacent to a roadway and which are protected from vehicular traffic. Types of separation include, but are not limited to, grade separation, flexible posts, inflexible physical barriers, or on-street parking.

NCHRP Legal Digest 53: Liability Aspects of Bikeways (2010)

This digest is a useful resource for city staff considering innovative engineering solutions to localized issues. The document addresses the liability of public entities for bicycle collisions on bikeways as well as on streets and highways. The report will be useful to attorneys, transportation officials, planners, maintenance engineers and all persons interested in the relative rights and responsibilities of drivers and bicyclists on shared roadways.

Bicycle Facility Standards Compliance

Some of these bicycle facilities covered by these guidelines are not directly referenced in the current versions of the AASHTO Guide or the California MUTCD, although many of the elements of these treatments are found within these documents. An "X" in the following table identifies the inclusion of a particular treatment within the national and state design guides. No marking indicates a treatment is not specifically mentioned, but is allowable assuming MUTCD-compliant signs and markings are used. In all cases, engineering judgment is recommended to ensure that the application makes sense for the context of each treatment, given the potential complexities of any specific site.

Facility Type	California MUTCD (2014)	Guide for the Development of Bicycle Facilities (2012)	Urban Bikeway Design Guide (2014)
Signed Shared Roadway	X	X	
Marked Shared Roadway	X	X	X
Bicycle Boulevard		X	X
Bicycle Lane	X	X	X
Buffered Bicycle Lane	X	X	X
Cycle Tracks		"One-way sidepath"	X
Bike Box	X		X
Bike Lanes at Right Turn Only Lanes	X	X	X
Colored Bike Lanes in Conflict Areas	FHWA Interim Approval	X	X
Combined Bike Lane/Turn Lane	X		X
Intersection Crossing Markings	X	X	X
Wayfinding Sign Types and Placement	X	X	X
Shared-Use Path	X	X	X
Active Warning Beacons	X	X	X
Pedestrian Hybrid Beacons	X	X	X

Multimodal Level of Service

Description

Multimodal Level of Service (MMLOS) methods are used to inventory and evaluate existing conditions, or to forecast future conditions for roadway users under different design scenarios. While automobile-oriented LOS measures vehicle delay, Bicycle, Pedestrian and Transit LOS is oriented toward user comfort. MMLOS scores different modes independently, but their results are interdependent, allowing an understanding of trade-offs between modes for different street designs. A compatible A-F scoring system makes comparison between modes simple.

There are a variety of Multimodal or Bicycle/Pedestrian LOS tools available for use. Different tools require different data and may present different or conflicting results. Despite potential limitations of MMLOS methodology, the results help jurisdictions better plan for all road users.

Guidance

MMLOS modeling is an emerging practice and current methods continue to be improved and revised. Local resident and planner knowledge should be used to verify MMLOS model results. The current standard for MMLOS calculation is described in the 2010 Highway Capacity Manual (HCM 2010). This method has limitations, particularly for Bicycle LOS modeling (See Discussion). An alternative MMLOS method/tool should be considered if HCM 2010 is not appropriate for the community. Other multimodal "Service Quality" tools include:

- Florida DOT LOSPLAN
- LOS+
- Mineta Level of Traffic Stress (LTS) Analysis (Bicycle-only scoring)

Discussion

HCM 2010 model for Bicycle LOS calculation limitations include:

- Calculations do not address gradients.
- Contemporary facility types included in this guide, such as shared lane markings, bike boxes or cycle tracks, are not included in the HCM (Florida LOSPLAN update does feature cycle tracks).
- Scoring is for a "typical" adult bicyclist and heavily weighs the presence of bike lanes. Results may not be appropriate in communities that seek to encourage bicycle travel by people of varying ages and abilities where bike lanes may not be adequate.

Additional References and Guidelines

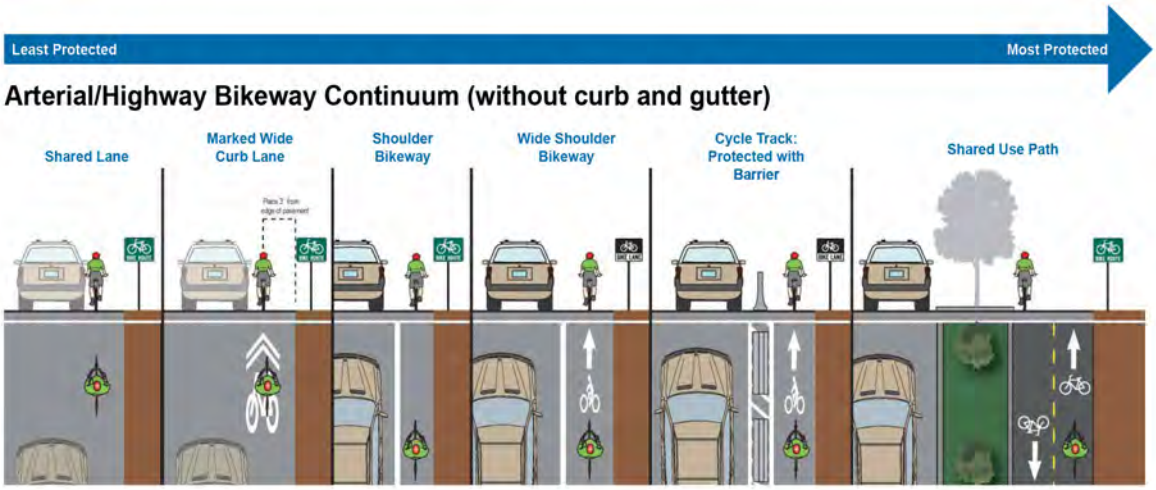
Transportation Research Board, Highway Capacity Manual, 2010.
Florida Department of Transportation, LOSPLAN, 2012.
Fehr&Peers, LOS+ Multi-Modal Roadway Analysis Tool.
Mineta Transportation Institute, Low-Stress Bicycling and Network Connectivity, 2011.

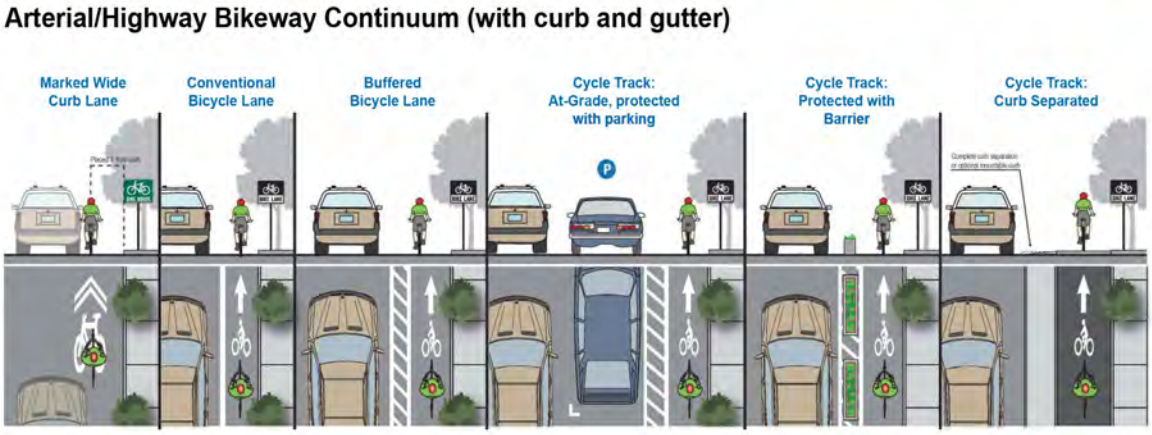
Bicycle Facility Selection

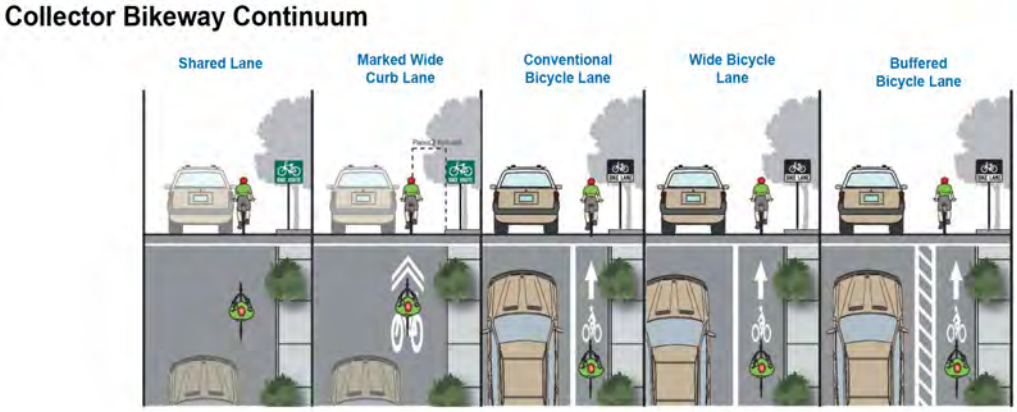
There are no "hard and fast" rules for determining the most appropriate type of bicycle facility for a particular location – roadway speeds, volumes, right-of-way width, presence of parking, adjacent land uses and expected bicycle user types are all critical elements of this decision. Studies find that the most significant factors influencing bicycle use are motor vehicle traffic volumes and speeds. Additionally, most bicyclists prefer facilities separated from motor vehicle traffic or located on local roads with low motor vehicle traffic speeds and volumes. Because off-street pathways are physically separated from the roadway, they are perceived as safe and attractive routes for bicyclists who prefer to avoid motor vehicle traffic. Consistent use of treatments and application of bikeway facility standards allows users to anticipate whether they would feel comfortable riding on a particular facility and plan their trips accordingly. This section provides guidance on various factors that affect the facility types that should be provided.

Facility Continua

The following continua illustrate the range of bicycle facilities applicable to various roadway environments, based on the roadway type and desired degree of separation. Engineering judgment, traffic studies, previous municipal planning efforts, community input and local context should be used to refine criteria when developing bicycle facility recommendations for a particular street. In some corridors, it may be desirable to construct facilities to a higher level of treatment than those recommended in relevant planning documents in order to enhance user safety and comfort. In other cases, existing and/or future motor vehicle speeds and volumes may not justify the recommended level of separation and a less intensive treatment may be acceptable.







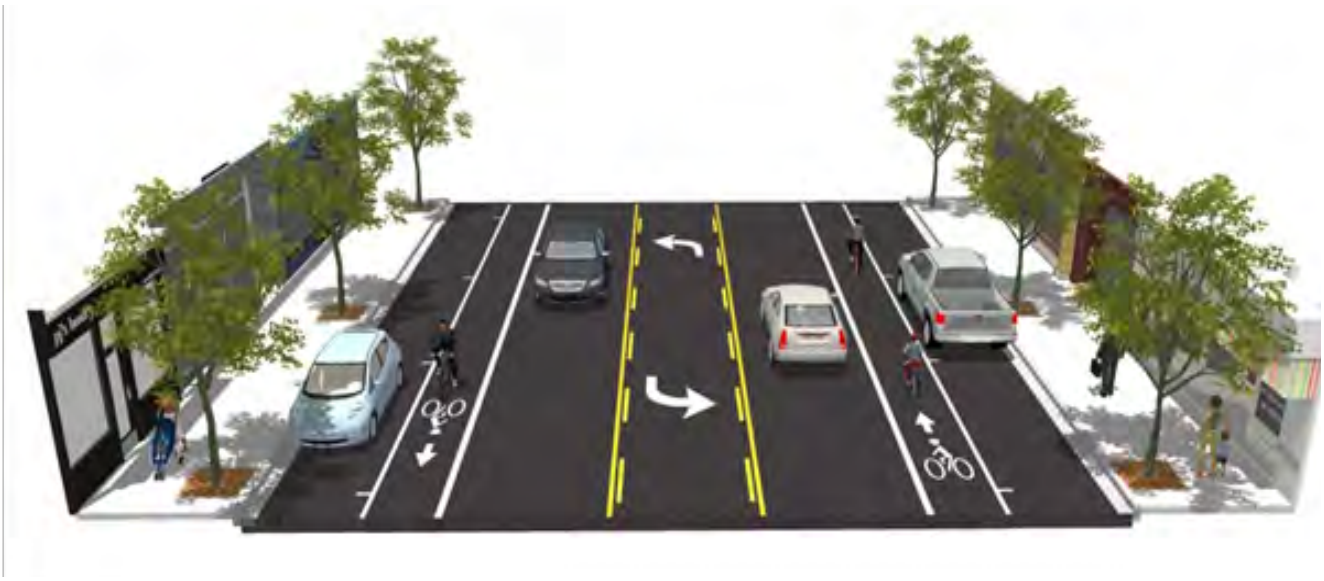
Facility Classification

Description

Consistent with bicycle facility classifications throughout the United States, these design guidelines identify the following facility classes by degree of separation from motor vehicle traffic.
Shared Roadways (No bikeway designation) are bikeways where bicyclists and cars operate within the same travel lane, either side by side or in single file depending on roadway configuration. In some instances, streets may be fully adequate and safe without bicycle specific signing and pavement markings.

Class III (Bike Routes) are Shared Roadways configured with pavement markings, signage and other treatments including directional signage, traffic diverters, chicanes, chokers and /or other traffic calming devices to reduce vehicle speeds or volumes. Such enhanced treatments often are associated with Bicycle Boulevards.

Class II (Bike Lanes) use signage and striping to delineate the right-of-way assigned to bicyclists and vehicle drivers. Bike lanes encourage predictable movements by both bicyclists and drivers.



Class IV (Cycle Tracks) are exclusive bike facilities that combine the user experience of a separated path with the on-street infrastructure of conventional bike lanes.

Class I (Multi-use Paths) are facilities separated from roadways for use by primarily bicyclists and pedestrians, as well as other users.

Shared Roadways

On shared roadways, bicyclists and motor vehicles use the same roadway space. These facilities are typically on roadways with low speeds and traffic volumes, but they can be used on higher volume roads with wide outside lanes or shoulders. A vehicle driver will usually have to cross over into the adjacent travel lane to pass a bicyclist, unless a wide outside lane or shoulder is provided.

Typical shared roadways often employ a variety of treatments, primarily signage and lane markings. Bicycle boulevards are a special class of shared roadways designed for a broad spectrum of bicyclists. They are low-volume local streets where drivers and bicyclists share the same travel lane. Bicycle boulevards treatments are selected as necessary to support appropriate vehicle volumes and speeds and to provide safe crossing opportunities of busy streets. Bicycle boulevards usually employ more complex treatments than other shared roadways, including traffic diverters, chicanes, chokers and other traffic calming devices to reduce vehicle speeds or volumes. See Pages 14-15 for examples.

Signed Shared Roadway

Marked Shared Roadway

Bicycle Boulevard

Signed Shared Roadway

Description

Class III facilities are generally located on roadways with lower speeds and traffic volumes. Class III facilities are designated as roadways with no striped bicycle lanes, but include signage to indicate the roadway is a bicycle route. Shared roadways can be used on higher volume roads with wide outside lanes or shoulders. A vehicle driver will usually have to cross over into the adjacent travel lane to pass a bicyclist, unless a wide outside lane or shoulder is provided.

Guidance

"BIKE ROUTE" - This sign (D11-1) is intended for use where no unique route designation is desired. However, when used alone, this sign conveys very little information. Directional changes should be signed with appropriate arrow sub-plaques (D1-1b) or directional signage.

"BICYCLES MAY USE FULL LANE" (BMUFL) - This sign (R4-11) sign may be used:

- On roadways without bicycle lanes or adjacent shoulders usable by cyclists and where travel lanes are too narrow for cyclists and motor vehicles to safely operate side-by-side.
- In locations where it is important to inform all road users that cyclists may occupy the travel lane.

Discussion

A BICYCLE MAY USE FULL LANE sign (R4-11) may be used on a lane too narrow for a bicycle and an automobile to share the road side by side within the same lane).

Materials and Maintenance

Maintenance needs for bicycle wayfinding signs are similar to other signs and will need periodic replacement due to wear and fading.

SHARE THE ROAD plaque (W16-1p) may be used in conjunction with bicycle warning sign (W11-1) to warn drivers to watch for slower forms of transportation

MUTCD D11-1

Additional References and Guidelines

AASHTO, Guide for the Development of Bicycle Facilities, 2012.

California MUTCD, 2014.

Marked Shared Roadway

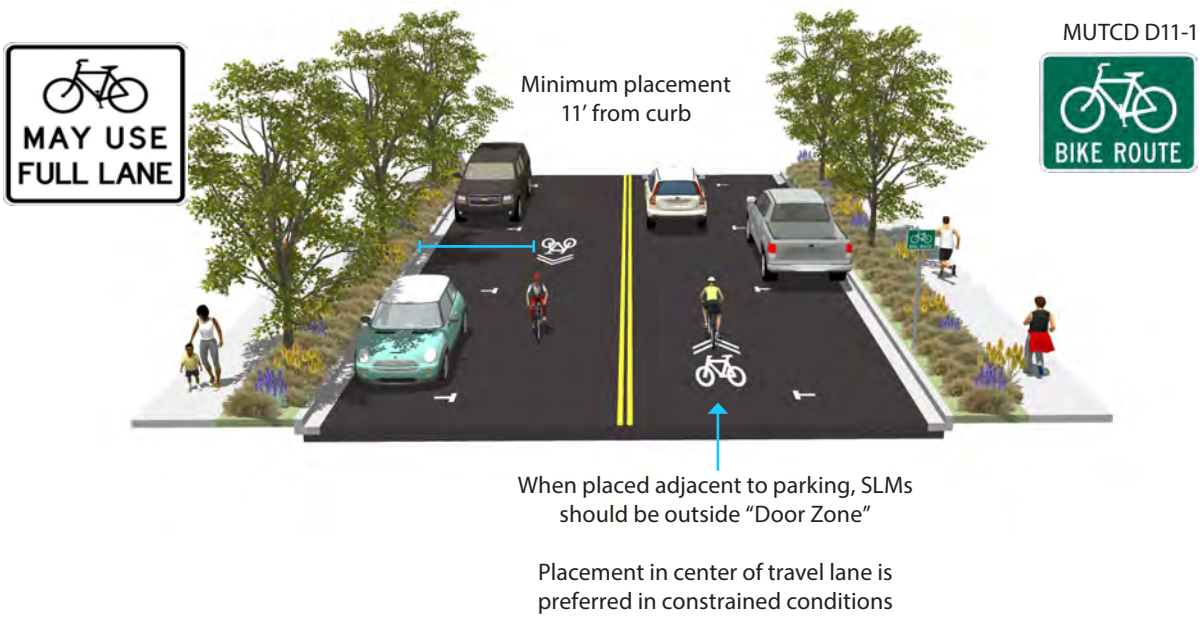
Description

The shared lane marking (SLM) or "Sharrow" is commonly used where vehicle parking is provided adjacent to the travel lane. The center of the marking should be located a minimum of 11 feet from the curb face or edge of the road. If used on a street without on-street parking that has an outside travel lane less than 14 feet wide, the centers of the Shared Lane Markings should be at least four feet from the face of the curb, or from the edge of the pavement where there is no curb. (Note that these criteria are evolving and that it is now common practice to place SLMs in the center of the rightmost travel lane.)

Guidance

Shared lane markings may be considered in the following situations:

- On roadways with speeds of 40 mph or less (CA MUTCD).
- On constrained roadways too narrow to stripe with bicycle lanes.
- To delineate space within a wide outside lane where cyclists can be expected to ride.
- On roadways where it is important to increase vehicle driver awareness of cyclists.
- On roadways where cyclists tend to ride too close to parked vehicles.



Discussion

Bike lanes should be considered on roadways with outside travel lanes wider than 15 feet, or where other lane narrowing or removal strategies may provide adequate road space. SLMs can not be used in shoulders, designated bike lanes, or to designate bicycle detection at signalized intersections. (MUTCD 9C.07)

Materials and Maintenance

Placing SLMs between vehicle tire tracks will increase the life of the markings and minimize the long-term cost of the treatment.

Additional References and Guidelines

Caltrans HDM Chapter 300.
California MUTCD 2014.
NACTO Urban Bikeway Design Guide, 2014.
Model Design Manual of Living Streets, 2011.
FHWA MUTCD, Interim Approval for Optional Use of Green Colored Pavement for Bike Lanes (IA-14).

Bicycle Boulevard

Description

Bicycle boulevards are low-volume, low-speed streets modified to enhance bicyclist comfort by using treatments such as signage, pavement markings, traffic calming and/or traffic reduction and intersection modifications. These treatments allow through movements of bicyclists while discouraging similar through-trips by non-local motorized traffic.

Guidance

- Signs and pavement markings are minimum treatments necessary to designate a street as a bicycle boulevard.
- Bicycle boulevards should have a maximum posted speed of 25 mph. Use traffic calming to maintain an 85th percentile speed below 22 mph.
- Implement volume control treatments based on bicycle boulevard context, using engineering judgment. Target motor vehicle volumes range from 1,000 to 3,000 vehicles per day.
- Intersection crossings should be designed to enhance safety and minimize delay for bicyclists.

Shared lane markings are MUTCD compliant and widely used to mark bicycle boulevards.

Signs identify street as a bicycle priority route.

MUTCD D11-1

Partial closures and other volume management tools limit the number of cars traveling on the bicycle boulevard.

Enhanced Crossings:
Use signals, beacons and road geometry to increase safety at major intersections.

Discussion

The term "bicycle boulevard" implies a facility that encourages bicycle usage while reducing motor vehicle volumes and/or speeds to a greater extent than on a typical Class III route. Methods used may include preferential treatment such as turn restrictions, contra-flow access through one-way streets, exclusive traffic signal phases, or the reorientation of stop sign control to favor the bicycle boulevard. Traffic calming techniques may include curb extensions, chokers, traffic circles, roundabouts, speed humps, turn restrictions or barricades.

Materials and Maintenance

Vegetation should be regularly trimmed to maintain visibility and attractiveness.

Additional References and Guidelines

Caltrans HDM Chapter 300.
California MUTCD 2014.
NACTO Urban Bikeway Design Guide, 2014.
AASHTO Guide for the Development of Bicycle Facilities, 2012.
FHWA Mini-Roundabouts, 2010.

Separated Bikeways

Designated exclusively for bicycle travel, separated bikeways are segregated from vehicle travel lanes by striping (Class II - Bicycle Lane), or physical measures such as bollards or curbs (Class IV - Cycle Tracks). Separated bikeways are most appropriate on arterial and collector streets where higher traffic volumes and speeds warrant greater separation. Separated bikeways can increase safety and promote proper riding by:

- Defining road space for bicyclists and drivers, reducing the possibility that drivers will stray into the bicyclists' path.
- Discouraging bicyclists from riding on the sidewalk.
- Reducing the incidence of wrong way riding.
- Reminding drivers that bicyclists have a right to the road.

Bicycle Lane

Bicycle Lanes and Diagonal Parking

Buffered Bicycle Lanes

Cycle Tracks

Bicycle Lane

Description

This facility provides an exclusive lane for one-way bicycle travel on a street or highway, installed along streets in corridors where there is significant bicycle demand and where there are distinct needs that can be served by them. On streets with on-street parking, bicycle lanes are located between the parking area and the traffic lanes and used in the same direction as motor vehicle traffic.

Many bicyclists, particularly less experienced riders, are more comfortable riding on a busy street if it has a striped and signed bikeway than if they are expected to share a lane with vehicles.

Guidance

Provide five foot minimum width for bicycle lanes located between parking and traffic lanes. Six feet desired.

- Provide four foot minimum width if no gutter exists. With a normal two foot gutter, minimum bicycle lane width is five feet.
- 14.5 feet preferred from curb face to edge of bike lane (12 foot minimum).
- Seven foot maximum width for use adjacent to arterials with high travel speeds. Greater widths may encourage motor vehicle use of bike lane.

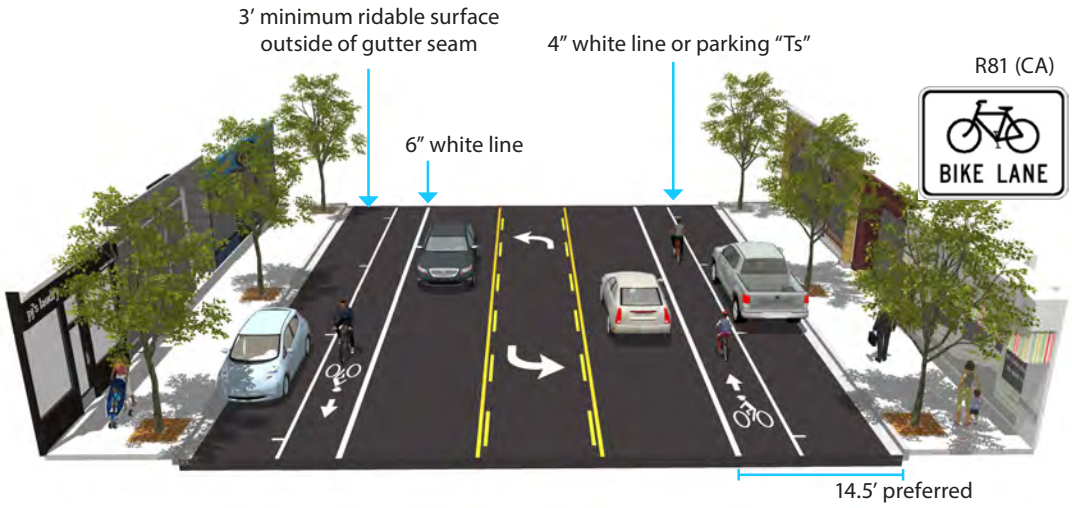
When approaching an intersection with right turn only lanes, the bike lane should be transitioned to a through bike lane to the left of the right turn only lane.

Discussion

Wider bicycle lanes are desirable in certain situations such as on higher speed arterials (45 mph+) where use of a wider bicycle lane would increase separation between passing vehicles and bicyclists. Consider buffered bicycle lanes when further separation is desired.

Materials and Maintenance

Paint can wear more quickly in high traffic areas.



Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
NACTO Urban Bikeway Design Guide, 2014.
Caltrans California HDM, 2012.
California MUTCD, 2014.

Bicycle Lanes and Diagonal Parking

Description

The back-in/head-out parking is considered safer than conventional head-in/back-out parking due to better visibility when leaving. This is particularly important on busy streets or where vehicle drivers may find their views blocked by large vehicles or tinted windows in adjacent vehicles. The presence of raised median islands helps prevent drivers from using a back-in stall for head-in parking.

Guidance

Based on existing dimensions from test sites and permanent facilities, provide 16 feet from curb edge to inner bicycle lane stripe and a five foot bicycle lane.

Discussion

Test the facility on streets with existing head-in angled parking and moderate to high bicycle traffic. Additional signs to direct vehicle driver in how the back-in angled parking works is recommended.

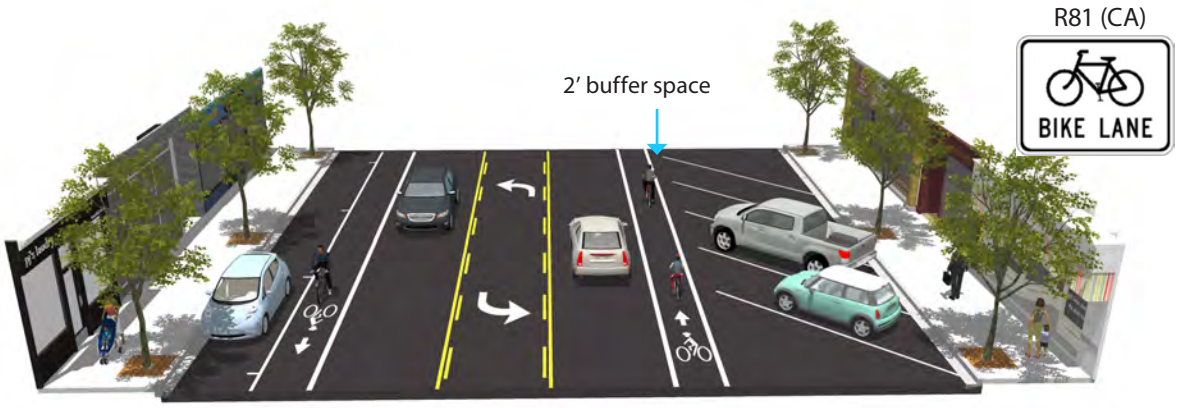
Materials and Maintenance

Paint can wear more quickly in high traffic areas.

Additional References and Guidelines

Back-in/Head-out Angle Parking, Nelson/Nygaard Consulting Associates, 2005.
City of Los Angeles Bicycle Plan Update, City of Los Angeles.

Back-in Diagonal Parking



Buffered Bicycle Lane

Description

Buffered bike lanes are defined in the Urban Bikeway Guide as "conventional bike lanes paired with a buffered space separating the bike lane from the adjacent motor vehicle travel lane and/or parking lane." Buffered bike lanes are allowed per California 2014 MUTCD guidelines for buffered preferential lanes (Section 3D-01).

Conventional bike lanes typically provide 5 to 6 foot wide space between the curb and travel lane. However, many bicyclists are uncomfortable riding this close to moving traffic particularly on higher speed and/or higher volume roadways. A recent Portland State University study titled "Evaluation of Innovative Bicycle Facilities," shows that bicyclists feel a lower risk of being "doored" in a buffered bike lane and nearly nine in ten bicyclists prefer buffered lanes to standard lanes. Seven in ten bicyclists indicated they would go out of their way to ride on a buffered bike lane over a standard lane.

The NACTO Urban Bikeway Design guides list several advantages of buffered lanes including:

- Providing "shy" distance between motor vehicles and bicyclists.
- Providing space for bicyclists to pass another bicyclist without encroaching into the adjacent motor vehicle travel lane.
- Encouraging bicyclists to ride outside the door zone when buffer is between parked cars and the bike lane.
- Providing a greater space for bicycling without making the bike lane appear so wide that it might be mistaken for a travel or parking lane.
- Appealing to a wider cross-section of bicycling users.
- And encouraging bicycling by contributing to the perception of safety among users of the bicycle network.

There are three types of buffers:

- Parking or side or curb buffer
- Travel lane side buffer
- Combined side or double buffer

Parking Side or Curb Buffers

Parking or curb side buffers provide space between the bicyclist and parked cars or the gutter pan. This (1) reduces the potential for a bicyclist to strike a car door being opened by a driver, (2) eliminates use of the gutter pan as part of the bike lane and (3) moves the bicyclist out of the blind spots of drivers approaching on the side streets or driveways. The limitation to the parking side or curb side buffer is that they do not provide the "shy space" that makes bicyclists feel more comfortable, but they do reduce the risk of dooring and the use of the gutter pan as part of the bike lane.

Travel Side Buffer

Travel side buffers provide space between the bicyclist and motor vehicles in the travel lane. High speed, high volume roadways make many bicyclists uncomfortable. Recent studies from the Portland State have shown that a simple buffer substantially increases the level of comfort for most bicyclists.

Combined Side or Double Sided Buffer

The combined side or double sided buffer offers the advantage of guiding the bicyclists away from the door zone while providing a perceived safer distance between the bicyclist and the motor vehicles.

Guidance

According to California MUTCD 2014 Section 3D, buffered bike lanes are considered "allowable" treatments. Signage and dimensional guidelines are the same as for Class II bicycle lanes. Additional guidance is included in the NACTO Urban Bikeway Design Guide.

- Bike lane word and/or symbol shall be used (MUTCD Figure 9C-3).
- The buffer shall have interior diagonal cross hatching or chevron markings if it is three feet in width or wider.
- The buffer shall be marked with two white lines. California MUTCD 2014 standards (Section 3D.01) indicate that for a bicyclist to be allowed to cross a double white line, it must be dashed (these are the same standards applied to buffered HOV Lanes). Therefore, it is recommended that the inside line be dashed instead of solid.
- Buffers should be at least 24 inches wide.

Discussion

Add diagonal striping on the outer buffer adjacent to the traffic lanes every 10 feet. However longitudinal spacing should be determined by engineering judgment considering factors such as speed and desired visual impacts.

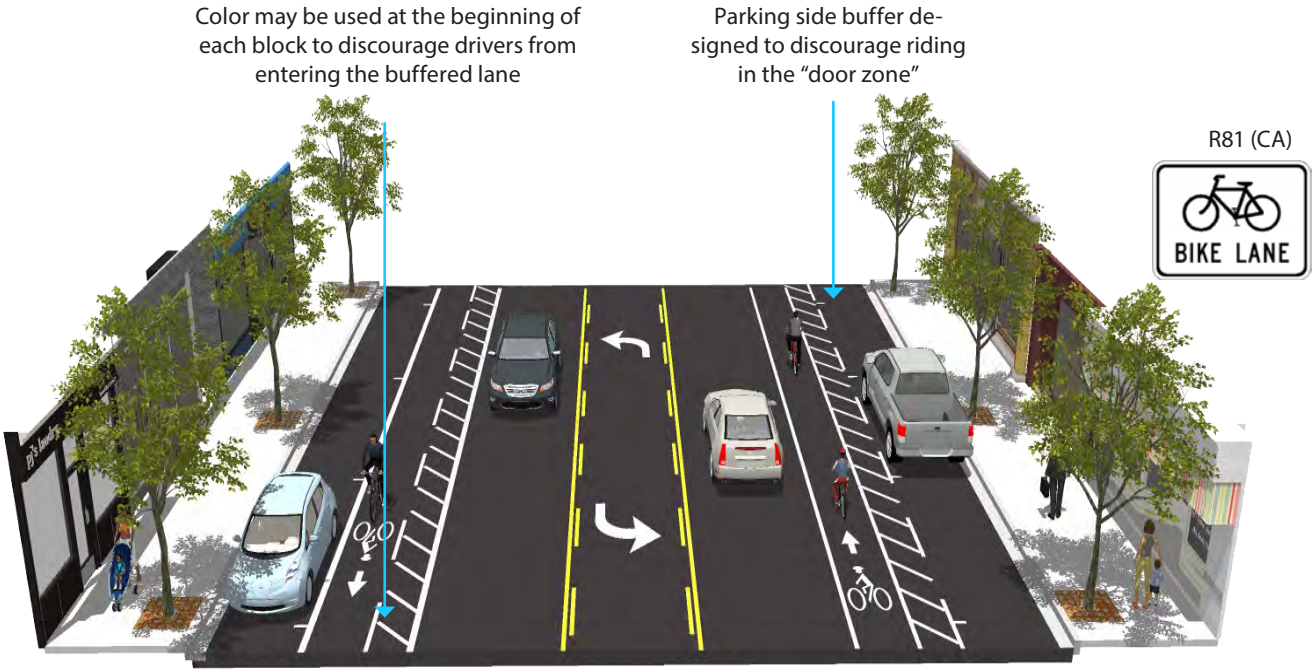
- On-street parking remains adjacent to the curb.
- A travel lane may need to be eliminated or narrowed to accommodate buffers.

Materials and Maintenance

Paint can wear more quickly in high traffic areas.

Additional References and Guidelines

NACTO Urban Bikeway Design Guide, 2014.
CA MUTCD, 2014.



Travel side (left) and parking side (right) buffers

Cycle Track

Description

Cycle tracks, which were recently officially designated as Class IV bikeway facilities in California, are an exclusive bike facility that combines the user experience of a separated path with the on-street infrastructure of a conventional bike lane. Cycle tracks are physically separated from motor traffic and distinct from the sidewalk. They differ from buffered lanes in that the bicyclist is separated from travel lanes by a physical barrier.

Cycle tracks have different forms but all share common elements. They provide space exclusively or primarily used by bicycles and are separated from motor vehicle travel lanes, parking lanes and sidewalks. Raised cycle tracks may be at the level of the adjacent sidewalk or set at an intermediate level between the roadway and sidewalk to separate the cycle track from the pedestrian area.

Over the past five years, more than 100 new separated bike facilities have been added in the US. This relatively new type of facility has been shown to be effective in increasing the number of bicyclists using the street, increasing safety for bicyclists, pedestrians and drivers and increasing access to local businesses (Lessons from the Green Lanes: Evaluating Protected Bike Lanes in the US, National Institute for Transportation and Communities, 2014)

Separated bikeways can increase safety and promote proper riding by:

- Defining road space for bicyclists and drivers, reducing the possibility that drivers will stray into the bicyclists' path.
- Discouraging bicyclists from riding on the sidewalk.

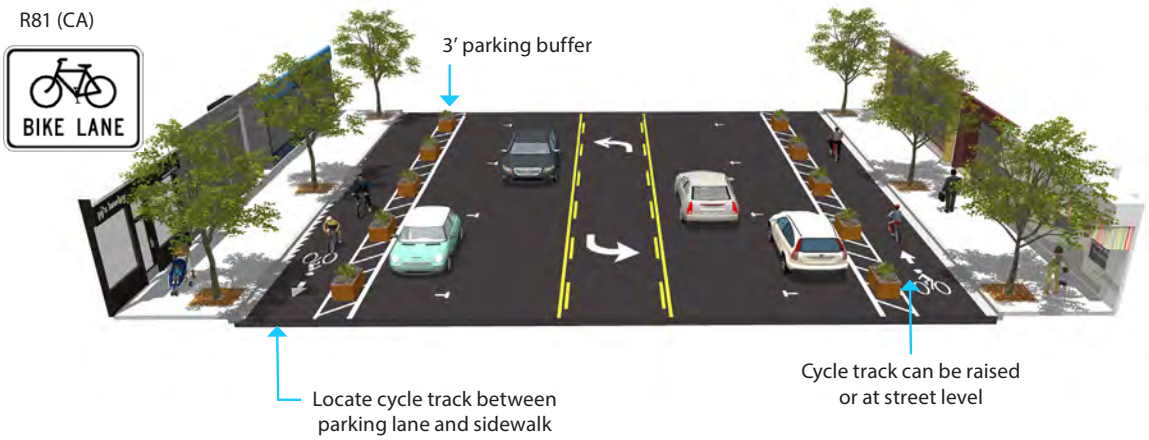
Guidance

Cycle tracks should ideally be placed along streets with long blocks and few driveways or mid-block motor vehicle access points.

One-Way Cycle Tracks

NACTO Guidelines recommend seven foot minimum width to allow passing and five foot minimum in constrained locations. Note: In accordance with AB-1193, local agency must pass a resolution to adopt NACTO Guidelines in lieu of Caltrans Highway Design Manual if one-way cycle track width is less than nine feet.

- One way cycle tracks can be either conventional flow (go the same direction as the adjacent traffic) or contra-flow (opposite direction of adjacent traffic flow, such as to the left side of traffic on a one-way street).



Two-Way Cycle Tracks

- Cycle tracks on one-way streets have fewer potential conflict areas than those on two-way streets.
- 12 foot recommended minimum for two-way facility. Eight foot minimum in constrained locations. Note: In accordance with AB-1193, local agency must pass resolution to adopt NACTO Guidelines in lieu of Caltrans Highway Design Manual if two-way cycle track is less than 12 feet wide.

Discussion

Special consideration should be given at transit stops to manage bicycle and pedestrian interactions. Driveways and minor street crossings are unique challenges to cycle track design. Parking should be prohibited within 30 feet of the intersection to improve visibility.

Materials and Maintenance

Depending on the width, barrier-separated and raised cycle tracks may require smaller sweeping equipment.

Additional References and Guidelines

NACTO Urban Bikeway Design Guide, 2014.
Lessons from the Green Lanes: Evaluating Protected Bike Lanes in the US, National Institute for Transportation and Communities, 2014.

R81 (CA)

Separated Bikeways at Intersections

Intersections are junctions at which different modes of transportation meet and facilities overlap. Intersection facilitate the interchange between bicyclists, drivers, pedestrians and other modes to advance traffic flow in a safe and efficient manner. Designs for intersections with bicycle facilities should reduce conflict between bicyclists (and other vulnerable road users) and vehicles by heightening the level of visibility, denoting clear right-of-way and facilitating eye contact and awareness with other modes. Intersection treatments can improve both queuing and merging maneuvers for bicyclists and are often coordinated with timed or specialized signals. The configuration of a safe intersection for bicyclists may include elements such as color, signage, medians, signal detection and pavement markings.

Intersection design should take into consideration existing and anticipated bicyclist, pedestrian and driver movements. In all cases, the degree of mixing or separation between bicyclists and other modes is intended to reduce the risk of crashes and increase bicyclist comfort. The level of treatment required for bicyclists at an intersection will depend on the bicycle facility type used, whether bicycle facilities are intersecting and the adjacent street function and land use.

Bike Boxes

Bike Lanes and Right Turn Only Lanes

Colored Bike Lanes in Conflict Areas

Combined Bike Lane/Turn Lane

Intersection Crossing Markings

Bike Box

Description

A bike box is a designated area located at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible space to get in front of queuing motorized traffic during the red signal phase. Motor vehicles must queue behind the white stop line at the rear of the bike box.

Guidance

Bike boxes are currently experimental treatments and require more data before an official ruling is made by the FHWA. Obtaining experimental approval is a 4-6 week process and evaluation of the treatment is performed for a minimum of one year.

- 10-16 foot depth. Deeper boxes help to prevent motor vehicle encroachment.
- "STOP HERE ON RED" sign should be post mounted at stop line to reinforce stop line observance.
- "YIELD TO BIKES" sign should be post-mounted in advance of and in conjunction with an egress lane to reinforce that bicyclists have the right-of-way going through the intersection.
- An ingress lane should be used to provide access to the box.
- Supplemental "WAIT HERE" legend can be provided in advance of stop bar to increase visibility.
- Requires permission to experiment from Federal Highway Administration.

Discussion

Bike boxes should be placed only at signalized intersections and motor vehicle right turns on red shall be prohibited. Bike boxes should be used in locations that have a large volume of bicyclists and are best utilized in central areas where traffic is usually moving more slowly.

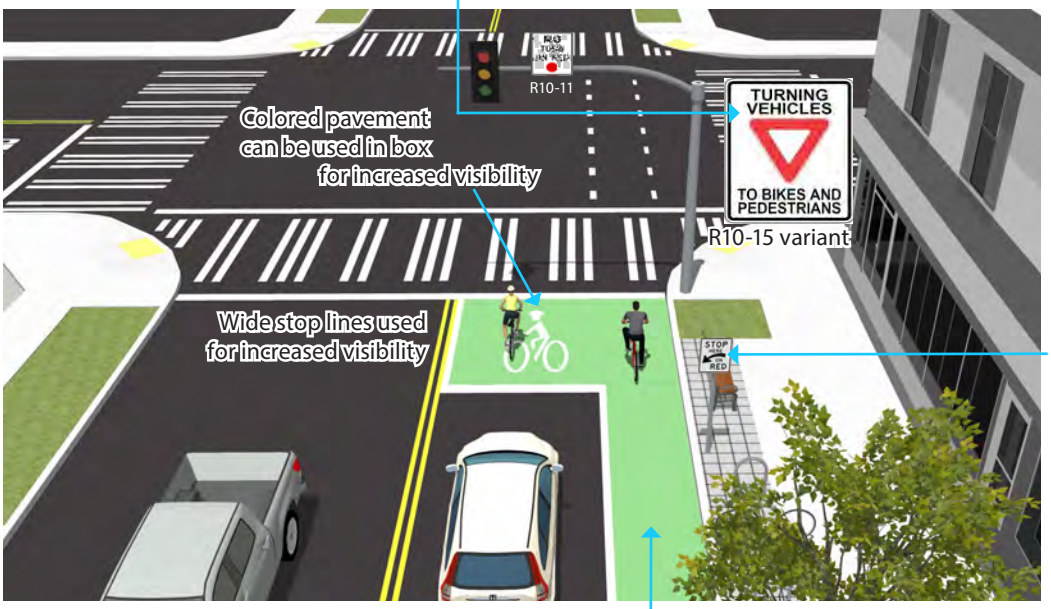
Materials and Maintenance

Because the effectiveness of markings depends entirely on their visibility, maintaining markings should be a high priority.

Additional References and Guidelines

NACTO Urban Bikeway Design Guide, 2014.
FHWA MUTCD Interpretations, Experimentations, Changes and Interim Approval (IA-14), 2011.

May be combined with intersection crossing markings and colored bike lanes in conflict areas



STOP HERE ON RED

R10-6a

If used, colored pavement should extend 50′ from the intersection

Bike Lanes at Right Turn Only Lanes

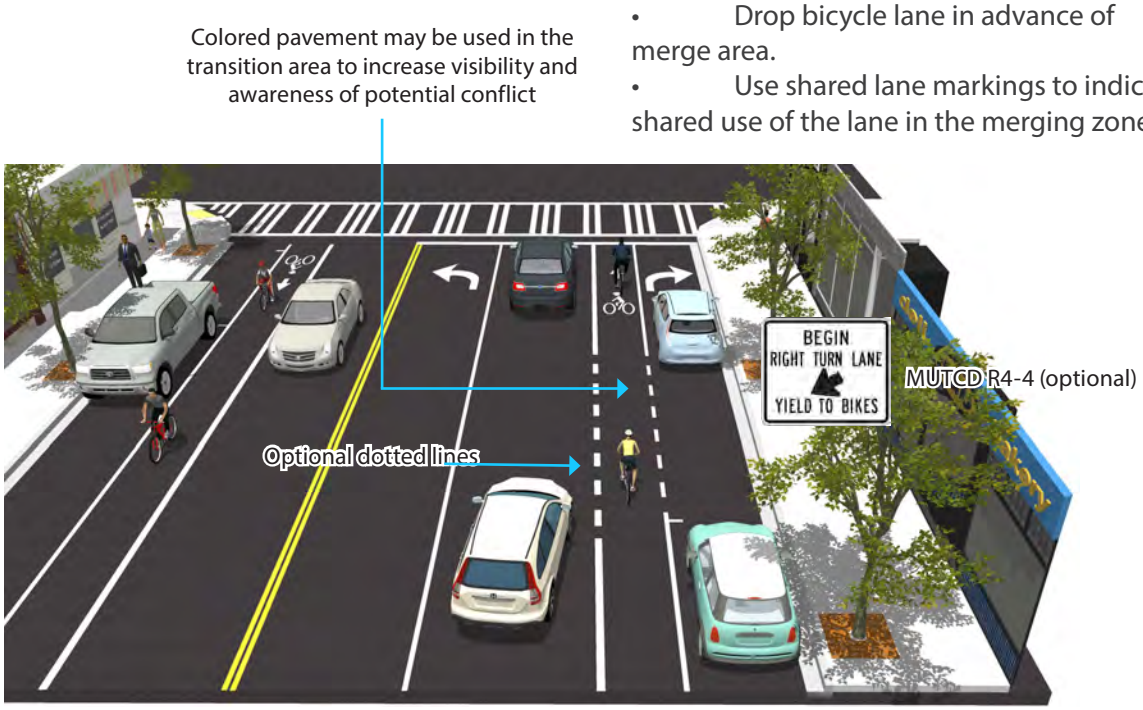
Description

The appropriate treatment at right-turn lanes is to place the bike lane between the right-turn lane and the right-most through lane or, where right-of-way is insufficient, to use a shared bike lane/ turn lane. The design (right) illustrates a bike lane pocket, with signage indicating that drivers should yield to bicyclists through the conflict area.

Guidance

At auxiliary right turn only lanes (add lane):

- Continue existing bike lane width; standard width of 5 to 6 feet (4 feet in constrained locations).
- Use signage to indicate that drivers should yield to bicyclists through the conflict area.
- Consider using colored conflict areas to promote visibility of the mixing zone. Where a through lane becomes a right turn lane:
- Do not define a dotted line merging path for bicyclists.
  - Drop bicycle lane in advance of merge area.
  - Use shared lane markings to indicate shared use of the lane in the merging zone.



Discussion

For other potential approaches to providing accommodations for bicyclists at intersections with turn lanes, please see combined bike lane/ turn lane, bicycle signals and colored bike facilities.

Materials and Maintenance

Because the effectiveness of markings depends entirely on their visibility, maintaining markings should be a high priority.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
California MUTCD, 2014.
NACTO Urban Bikeway Design Guide, 2014.
Caltrans California HDM, 2012.
Caltrans Complete Intersections, 2010.

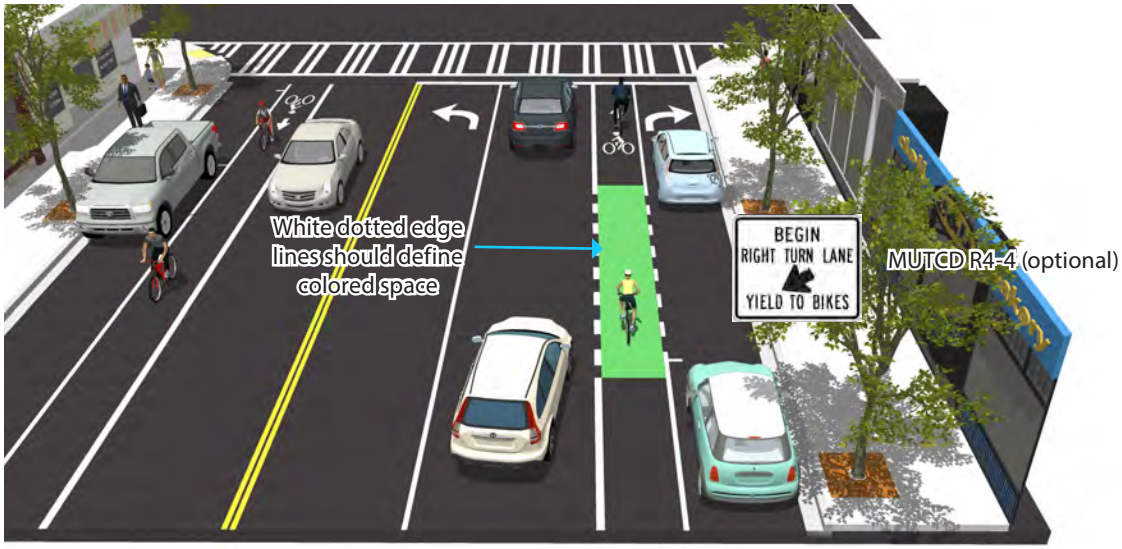
Colored Bike Lanes in Conflict Areas

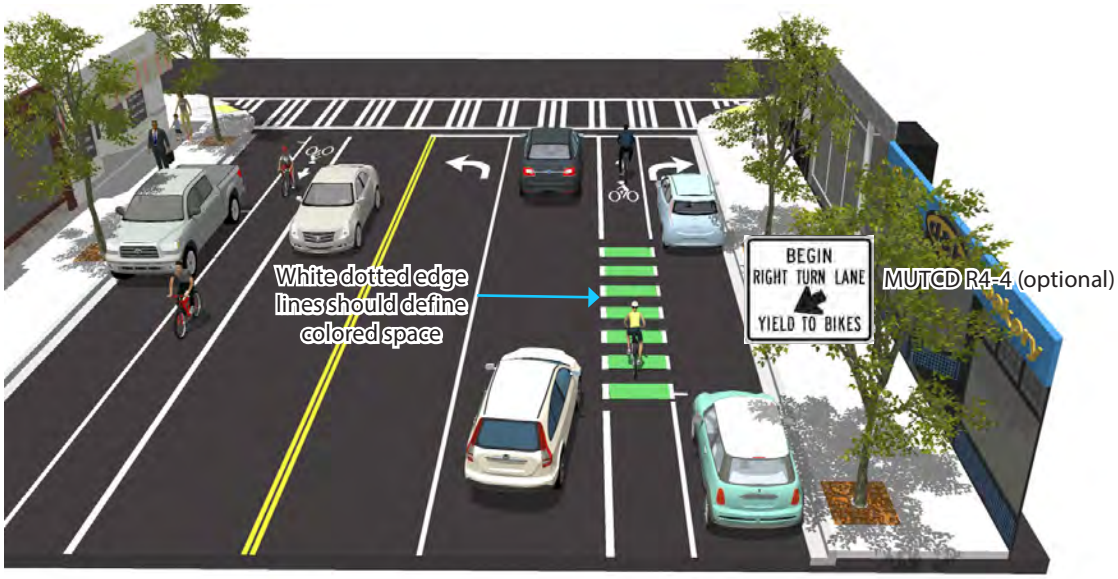
Description

The Federal Highway Administrative (FHWA) has granted the State of California approval for optional use of green colored pavement in marked bicycle lanes and in extensions of bicycle lanes through intersections and other traffic conflict areas. It should be noted that the green colored pavement as described under this approval is used for two different situations:

- To denote a lane exclusively for bicyclists.
- To advise drivers and bicyclists that they are sharing the same patch of pavement and should be aware of each other's presence.

Local agencies have adopted different philosophies on the usage of green colored pavement. Some agencies use green colored pavement only for Class II lanes where bicyclists have exclusive use and leave the conflict zones uncolored. Other agencies use the green colored pavement only in conflict zones, such as the weave shown in the figure below.





Guidance

Jurisdictions must notify Caltrans where the treatment is being installed as part of FHWA's conditions to maintain an inventory list.
At auxiliary right turn only lanes (add lane):

- Continue existing bike lane width; standard width of 5 to 6 feet (4 feet in constrained locations).
- Use signage to indicate that drivers should yield to bicyclists through the conflict area.
- Consider using colored conflict areas to promote visibility of the mixing zone. Where a through lane becomes a right turn lane:
- Do not define a dotted line merging path for bicyclists.
- Drop the bicycle lane in advance of the merge area.
- Use shared lane markings to indicate shared use of the lane in the merging zone

Discussion

The best practices for green colored pavement are still evolving. As of this date, more agencies use green colored pavement for conflict zones than for exclusive bicyclist lanes. The amount of green paint used by such agencies varies dramatically. Some agencies fill the entire conflict zone with solid green paint, while others use a pattern of green stripes. Some agencies use green colored pavement across every driveway, alley and cross streets, while others reserve the use of green colored pavement for conflict zones that merit special attention. The precise design of green colored pavement remains at the discretion of the local agencies.
It should be noted that combing a shared lane marking ("sharrow") within green colored pavement is no longer approved for new experimentation by the FHWA. However, the FHWA may accept for experimentation the use of green colored pavement as a "background conspicuity enhancement."

Materials and Maintenance

Because the effectiveness of markings depends entirely on their visibility, maintaining markings should be a high priority.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
California MUTCD, 2014
NACTO Urban Bikeway Design Guide, 2014.
Caltrans California HDM, 2012.
Caltrans Complete Intersections, 2010.

Combined Bike Lane/Turn Lane

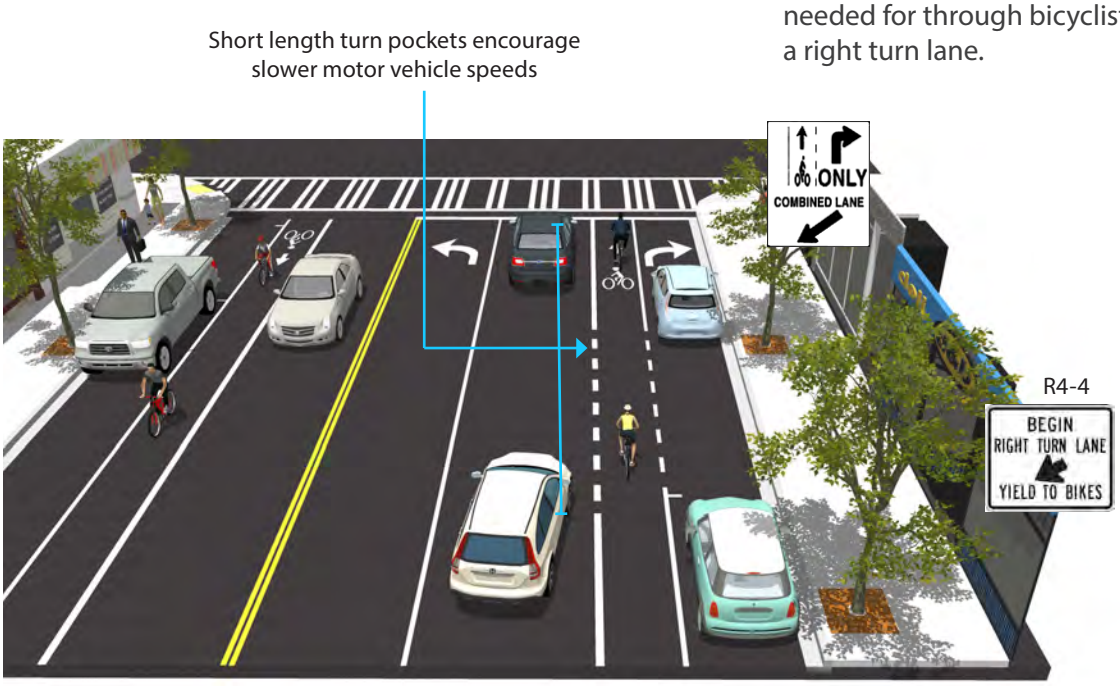
Description

The combined bicycle/right turn lane places a standard-width bike lane on the left side of a dedicated right turn lane. A dotted line delineates the space for bicyclists and drivers within the shared lane. This treatment includes signage advising drivers and bicyclists of proper positioning within the lane. This treatment is recommended at intersections lacking sufficient space to accommodate both a standard through bike lane and right turn lane.

Guidance

The FHWA has disallowed the experimental use of combined bike lane/turn lane markings. Previously, installations were as follows: Maximum shared turn lane width is 13 feet; narrower is preferable.

- Bike lane pocket should have a minimum width of 4 feet with 5 feet preferred.
- Dotted 4 inch line and bicycle lane marking should be used to clarify bicyclist positioning within the combined lane, without excluding cars from the suggested bicycle area.
- "RIGHT TURN ONLY" sign with an "EXCEPT BICYCLES" plaque may be needed for through bicyclists to legally use a right turn lane.



Discussion

Unless the FHWA resumes granting permission to experiment with a combined bike lane/turn lane, this treatment will not be recommended.

Materials and Maintenance

Because the effectiveness of markings depends on their visibility, maintaining markings should be a high priority.

Additional References and Guidelines

NACTO Urban Bikeway Design Guide, 2014.
AASHTO Guide for the Development of Bicycle Facilities, 2012.

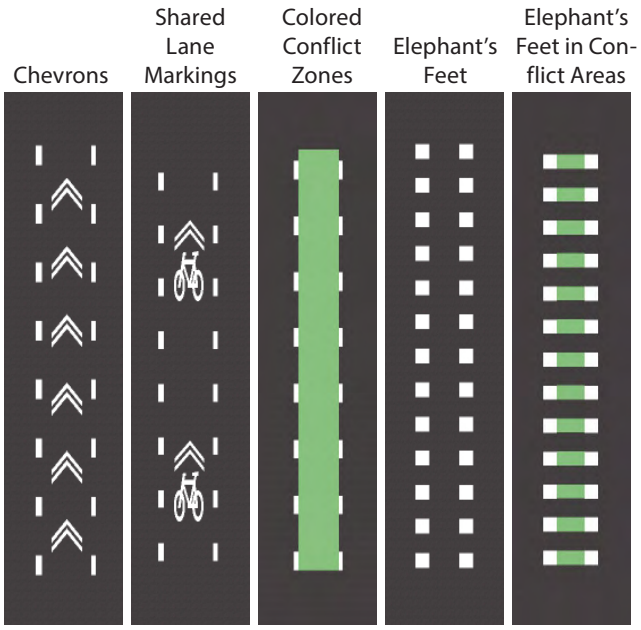
Intersection Crossing Markings

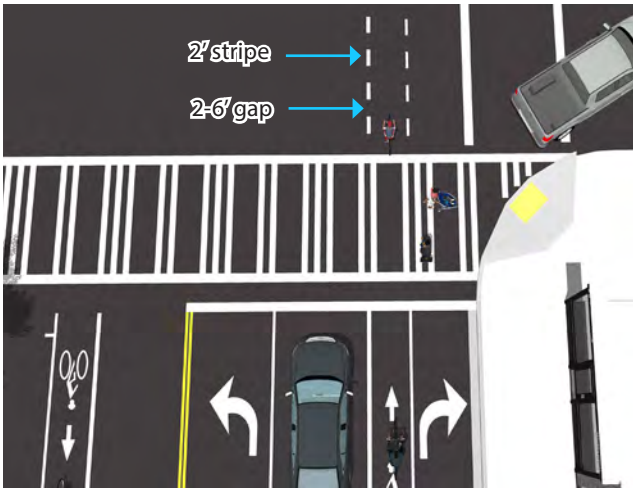
Description

Bicycle pavement markings through intersections indicate the intended path of bicyclists through an intersection or across a driveway or ramp. They guide bicyclists on a safe and direct path through the intersection and provide a clear boundary between the paths of through bicyclists and either through or crossing motor vehicles in the adjacent lane.

Guidance

- See MUTCD Section 3B.08: "dotted line extensions"
- Crossing striping shall be at least six inches wide when adjacent to motor vehicle travel lanes.
- Dotted lines should be two-foot lines spaced two to six feet apart.
- Chevrons, shared lane markings, or colored bike lanes in conflict areas may be used to increase visibility within conflict areas or across entire intersections.





Discussion

Additional markings such as chevrons, shared lane markings, or colored bike lanes in conflict areas are strategies currently in use in the United States and Canada. Cities considering the implementation of markings through intersections should standardize future designs to avoid confusion.

Materials and Maintenance

Because the effectiveness of marked crossings depends entirely on their visibility, maintaining marked crossings should be a high priority.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
California MUTCD, 2014.
NACTO Urban Bikeway Design Guide, 2014.

Two-Stage Turn Box

Description

Many bicyclists are reluctant to cross traffic lanes to turn left. Two-stage turn boxes offer bicyclists a safe way to make left turns at multi-lane signalized intersections from a right side cycle track or bike lane. Bicyclists continue straight while the traffic signal displays green for the original direction of travel during the first stage of a traffic signal and then wait for the second stage when the cross street receives a green light to complete the move.

Discussion

While two stage turns may increase bicyclist comfort in many locations, it results in higher average signal delay for bicyclists versus a vehicular style left turn maneuver.

Materials and Maintenance

Paint can wear more quickly in high traffic areas or in winter climates.

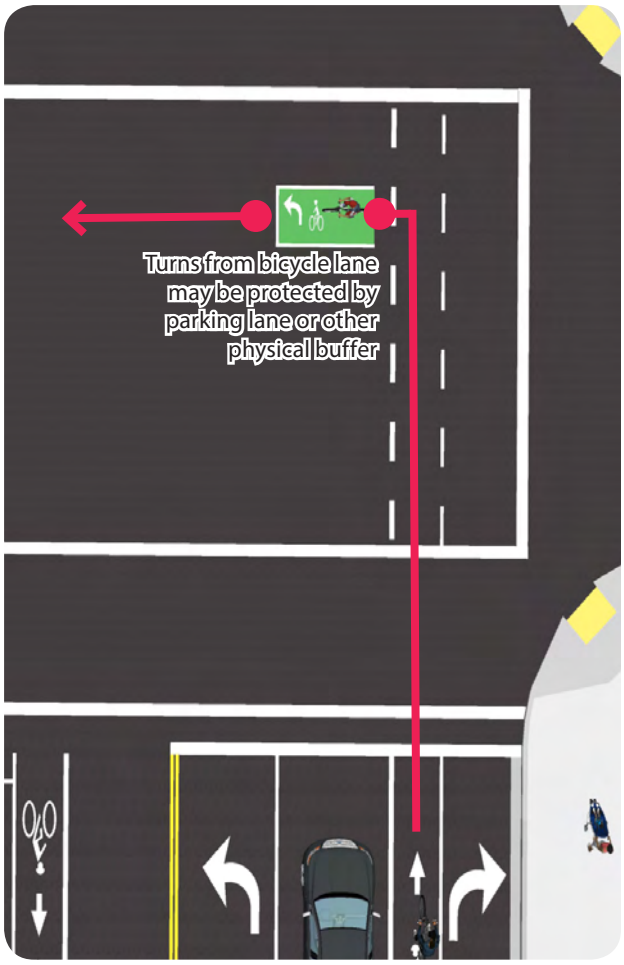
Additional References and Guidelines

NACTO Urban Bikeway Design Guide, 2014.

Guidance

- Two-stage turn box to facilitate jughandle turn at T-intersection is presently allowed in the Federal and California MUTCDs.
- Two-stage turn box for use other than for jughandle turn at T-intersection is experimental. Required design elements include bicycle symbol pavement marking, a pavement marking turn or through arrow, full-time turn on red prohibition for the cross street and passive detection of bicycles if the signal phase that permits bicyclists to enter the intersection during the second stage of their turn is actuated.
- Green colored pavement is optional.

Turns from a bicycle lane may be protected by an adjacent parking lane or crosswalk setback.



Bike Lanes at Diverging Ramp Lanes

Description

Some arterials may include high speed freeway-style design, such as merge lanes and exit ramps, which can create difficulties for bicyclists. These entrance and exit lanes typically have intrinsic visibility problems because of low approach angles and high speed differentials between bicyclists and motor vehicles. Strategies to improve safety focus on increasing sight distances, creating formal crossings and minimizing crossing distances.

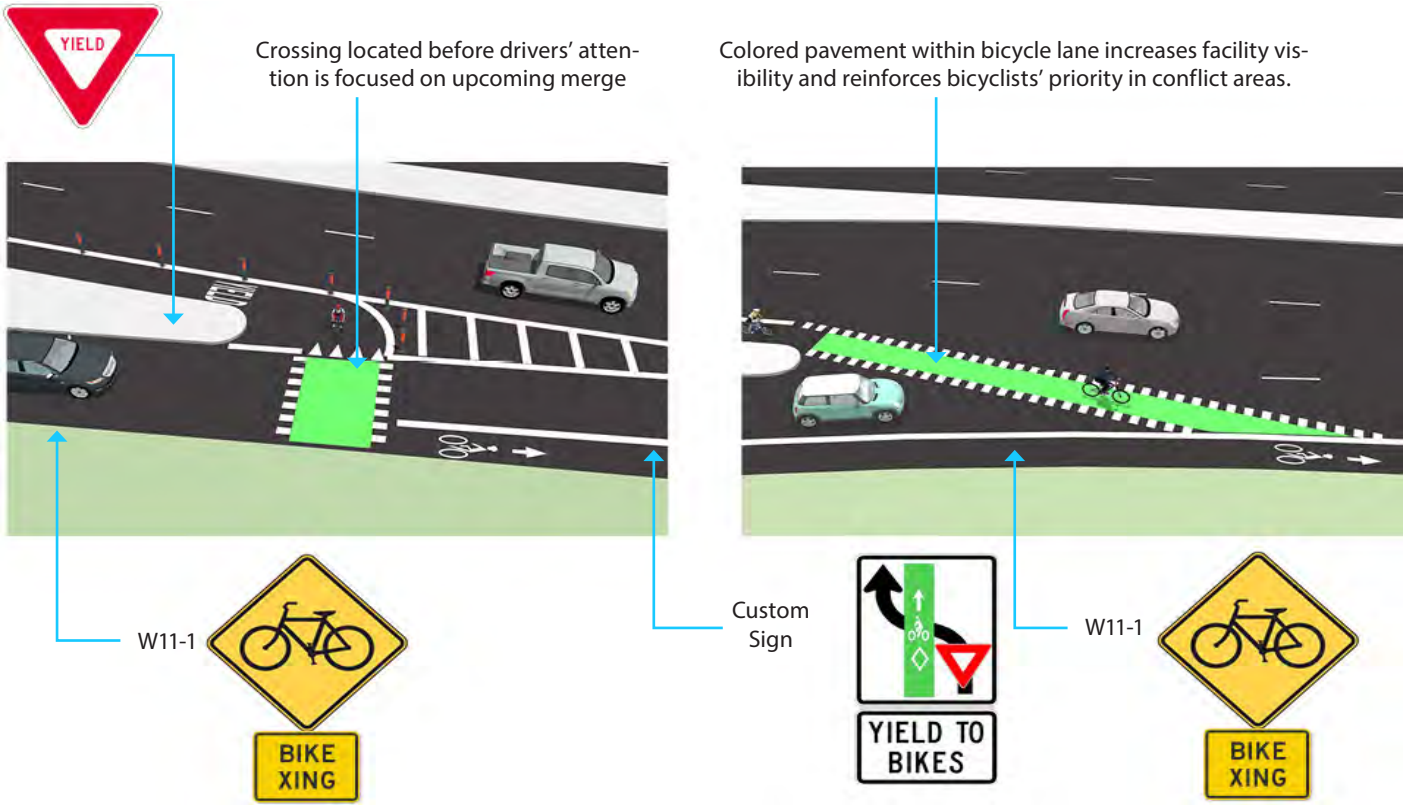
Guidance

Entrance Ramps:

Angle bike lane to increase approach angle with entering traffic. Position crossing to draw drivers' attention prior to being focused on upcoming merge.

Exit Ramps:

Use a jug handle turn to increase bicyclists approach angle with exiting traffic and add yield striping and signage to the bicycle approach.



Discussion

Green colored pavement is optional.

Materials and Maintenance

Paint can wear more quickly in high traffic areas or in winter climates. Locate crossing markings out of wheel tread when possible to minimize wear and maintenance costs.

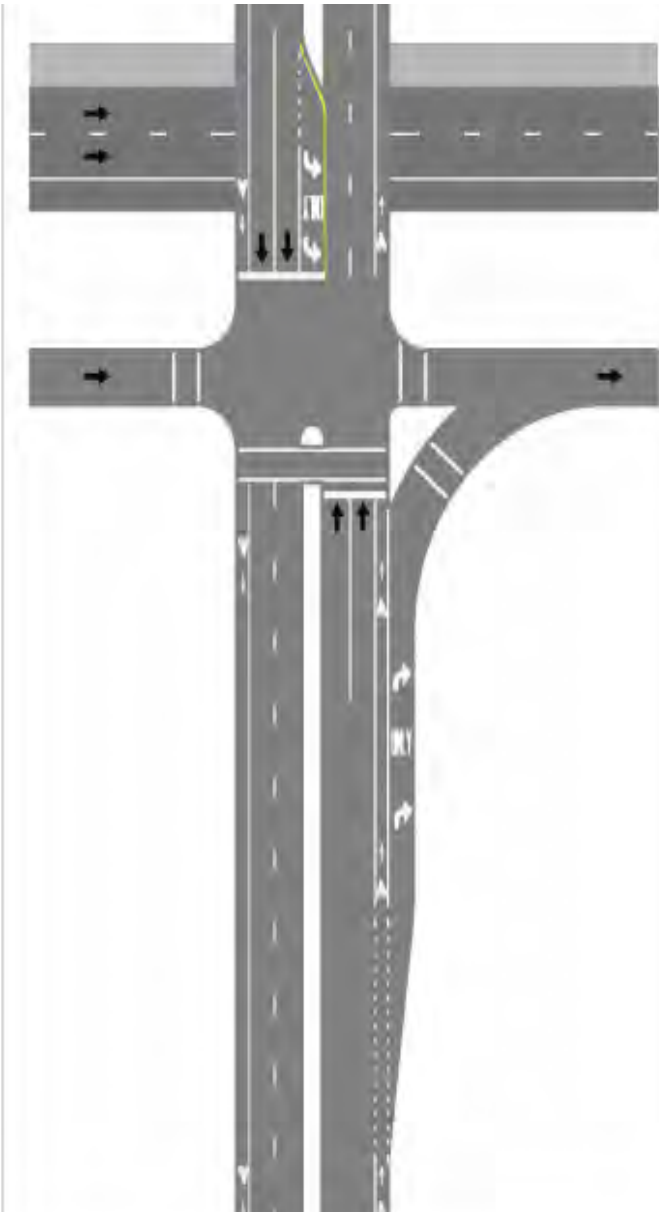
Additional References and Guidelines

California MUTCD, 2014.
AASHTO Guide for the Development of Bicycle Facilities, 2012.
Caltrans Complete Intersections, 2010.

Freeway Interchange Design

Description

Freeway Interchanges can be significant obstacles to bicycling if they are poorly designed. Travel through some interchange designs may be particularly challenging for youth bicyclists. Key design features at conflict areas through interchanges should be included to improve the experience for bicyclists.



Guidance

Entrance Ramps:

- Right-turn lane should be configured with a taper as an "add-lane" for drivers turning right onto the freeway entrance ramp.
- Bike lane should be provided along left side of right turn lane. Dotted through bike lane striping provides clear priority for bicyclists at right turn "add lane" on-ramps.

Exit Ramps:

- Drivers existing freeway and turning onto crossroad should be controlled by a stop sign, signal, or yield sign, rather than allowing free flowing movement.

Discussion

The on-ramps should be configured as a right-turn-only "add lane" to assert through bicyclist priority. Designs that function for bicycle passage typically encourage slowing or require motor vehicle traffic to slow or stop. Designs that encourage high-speed traffic movements are difficult for bicyclists to negotiate.

Materials and Maintenance

Locate crossing markings out of wheel tread when possible to minimize wear and maintenance costs.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
California MUTCD, 2014.
Caltrans Complete Intersections, 2010.

Signalization

Determining which type of signal or beacon to use for a particular intersection depends on a variety of factors. These include speed limits, Average Daily Traffic (ADT), anticipated bicycle crossing traffic and the configuration of planned or existing bicycle facilities. Signals may be necessary as part of the construction of a protected bicycle facility such as a cycle track with potential turning conflicts, or to decrease vehicle or pedestrian conflicts at major crossings. An intersection with bicycle signals may reduce stress and delays for a crossing bicyclist and discourage illegal and unsafe crossing maneuvers.

Bicycle Detection and Actuation

Bicycle Signal Head

Bicycle Detection and Actuation

Loop Detectors or Video Detectors

For signalized intersection movements that do not normally receive a green light unless actuated by a car or pedestrian, the California Vehicle Code requires installation of detectors capable of detecting bicyclists at the limit line. This is most commonly done with either inductive loop detectors or video detection. Traffic actuated signals should be sensitive to bicycles, should be located in the bicyclist's expected path and stenciling should direct the bicyclist to the point where the bicycle will be detected. This allows the bicyclist to stay within the lane of travel without having to maneuver to the side of the road to trigger a push button.

Push Button Actuation

A bicyclist pushbutton may be used to supplement the required limit line detectors. These buttons should be mounted in a location that permits their activation by a bicyclist without having to dismount.

Remote Traffic Microwave Sensor Detection (RTMS)

RTMS is uses radio signals to detect objects and marks the detected object with a time code to determine its distance from the sensor. The RTMS system is unaffected by temperature and lighting, which can affect standard video detection.

Discussion

Bicycle detection should meet two primary criteria:

- Accurately detect bicyclists.
- Provide clear guidance to bicyclists on how to actuate detection (e.g., what button to push, where to stand).

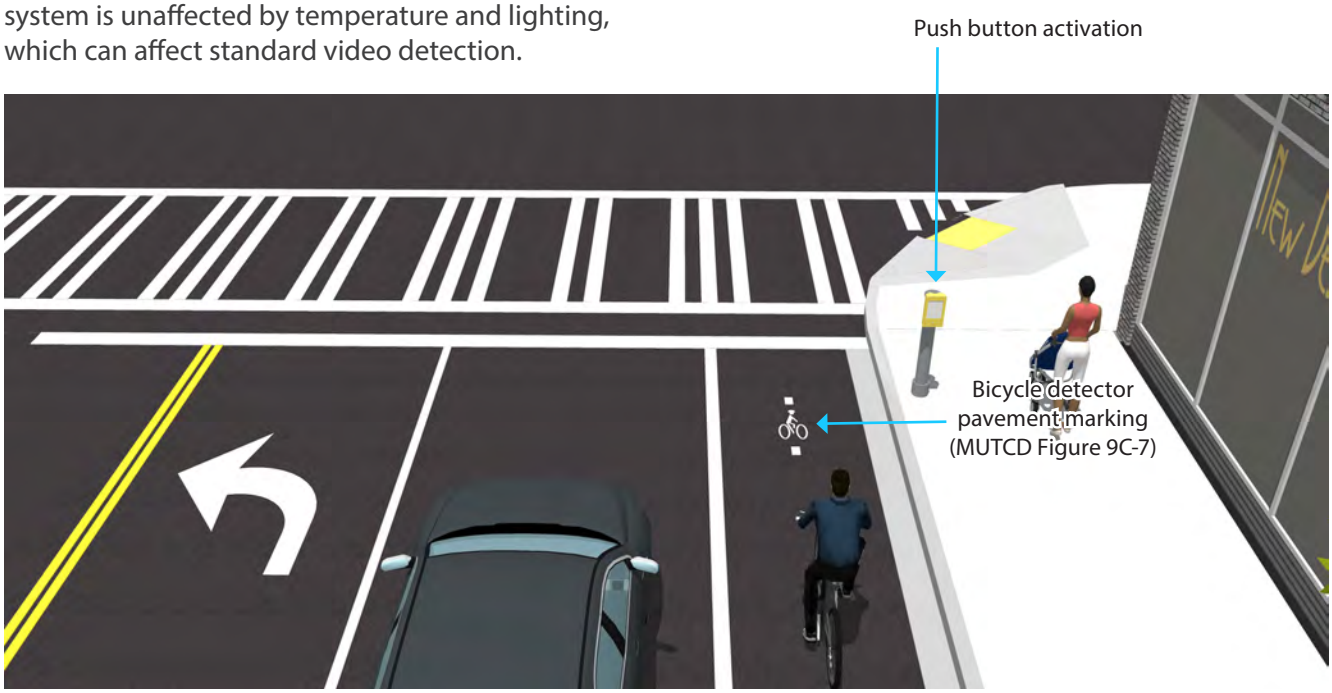
Requirement for bicycle detection at all new and modified approaches to traffic signals is included in 2014 California MUTCD.

Materials and Maintenance

Signal detection and actuation for bicyclists should be maintained with other traffic signal detection and roadway pavement markings.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
NACTO Urban Bikeway Design Guide, 2014.
California MUTCD. 2014.
Caltrans Policy Directive 09-06, 2009.
Caltrans Complete Intersections, 2010.



Bicycle Signal Heads

Description

The California MUTCD authorizes bicycle signal heads only at locations that meet Caltrans Bicycle Signal Warrants. FHWA's Interim Approval IA-I6 specifies a more detailed application of bicycle signal indications. Bicycle signal heads may be used for a movement not in conflict with any simultaneous motor vehicle movements at a signalized intersection, including right or left turns on red. The bicycle movement may not be modified by lane-use signs, turn prohibition signs, pavement markings, separate turn signal indications, or other traffic control devices. The signal lens size may be 4 inches, 8 inches, or 12 inches, with 4 inch lens size reserved only for supplemental near-side mountings.

Discussion

For improved visibility, smaller (4 inch lens) near-side bicycle signals should be considered to supplement far-side signals.

Materials and Maintenance

Bicycle signal heads require the same maintenance as standard traffic signal heads, such as lamp replacement and responding to power outages.

Guidance

California MUTCD Bicycle Signal Warrant is based on bicyclist volumes, collision history, or geometric warrants:

- Those with high peak hour bicyclist volumes.
- Those with high bicycle/motor vehicle collision numbers, especially those caused by turning vehicle movements.
- Where a multi-use path intersects a roadway.
- At locations to facilitate a bicycle movement not permitted for a motor vehicle.
- Bicycle signals must utilize appropriate detection and actuation.

Additional References and Guidelines

FHWA Interim Approval IA-I6, 2013.
California MUTCD, 2014.

Active Warning Beacons

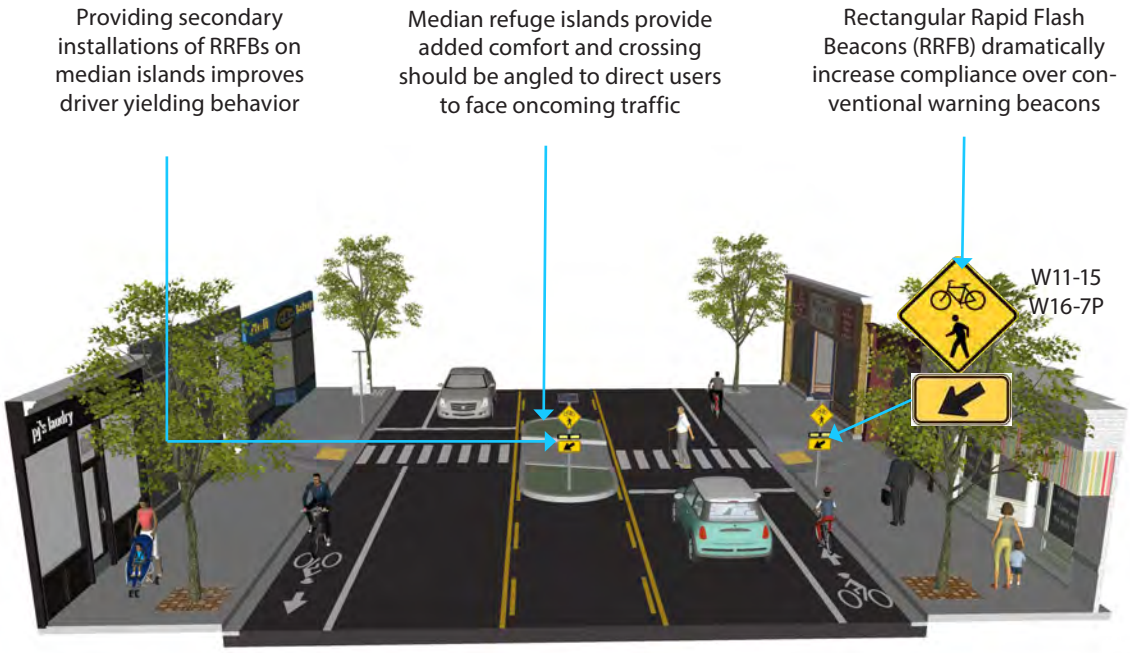
Description

Active warning beacons are user actuated illuminated devices designed to increase motor vehicle yielding compliance at crossings of multi lane or high volume roadways. Types of active warning beacons include conventional circular yellow flashing beacons, in roadway warning lights, or Rectangular Rapid Flash Beacons (RRFB). RRFBs have blanket approval in California per FHWA MUTCD IA11.

Guidance

Warning beacons shall not be used at crosswalks controlled by YIELD signs, STOP signs or traffic signals.

- Warning beacons shall initiate operation based on pedestrian or bicyclist actuation and shall cease operation at a predetermined time after actuation or, with passive detection, after the pedestrian or bicyclist clears the crosswalk.



Discussion

Rectangular rapid flash beacons have the highest compliance of all warning beacon enhancement options. A study of the effectiveness of going from a no-beacon arrangement to a two-beacon RRFB installation increased yielding from 18 percent to 81 percent. A four-beacon arrangement raised compliance to 88 percent.

Materials and Maintenance

Depending on power supply, maintenance can be minimal. Solar-powered RRFBs can operate for years without issue.

Additional References and Guidelines

NACTO Urban Bikeway Design Guide, 2014.
California MUTCD, 2014.
FHWA Interim Approval (IA-11), 2008.
Caltrans Complete Intersections, 2010.

Pedestrian Hybrid Beacons

Description

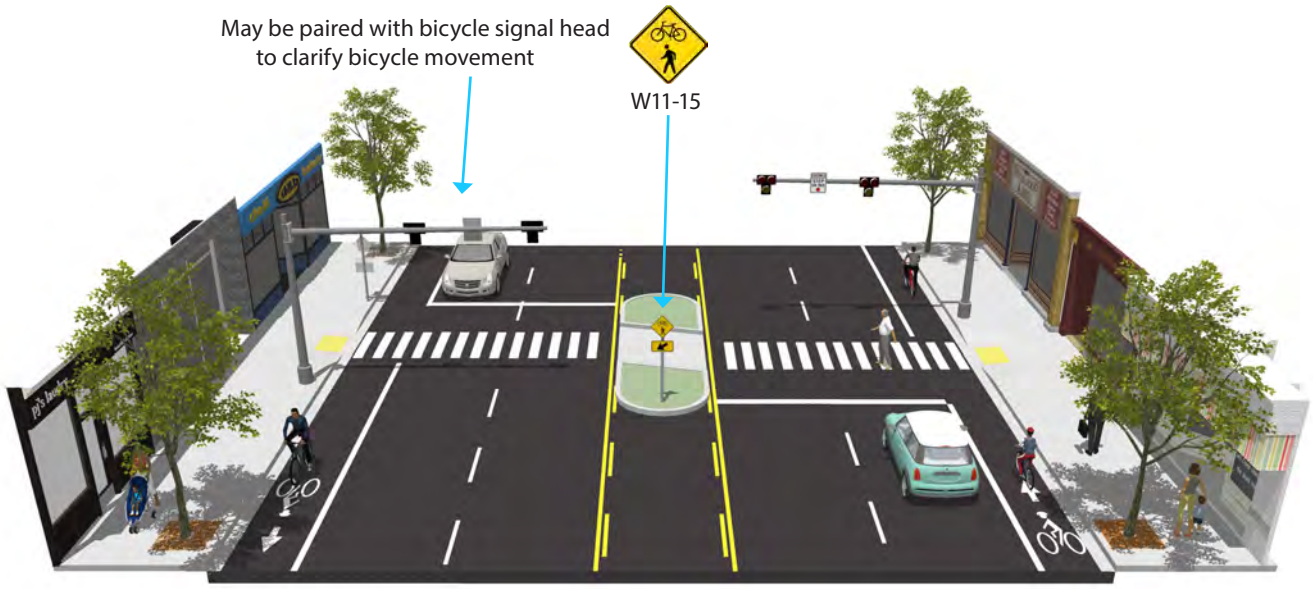
A pedestrian hybrid beacon (PHB), previously known as a high-intensity activated crosswalk (HAWK), consists of a signal head with two red lenses over a single yellow lens on the major street and pedestrian and/or bicycle signal heads for the minor street. There are no signal indications for motor vehicles on the minor street approaches.

Pedestrian hybrid beacons are used to improve non-motorized crossings of major streets in locations where side-street volumes do not support installation of a conventional traffic signal or where there are concerns that a conventional signal will encourage additional motor vehicle traffic on the minor street. Hybrid beacons may also be used at mid-block crossing locations.

Guidance

Pedestrian hybrid beacons may be installed without meeting traffic signal control warrants. The need should be considered on the basis of an engineering study that considers speed , major-street volumes and gaps:

- If installed within a signal system, signal engineers should evaluate the need for the pedestrian hybrid beacon to be coordinated with other signals.
- Parking and other sight obstructions should be prohibited for at least 100 feet in advance of and at least 20 feet beyond the marked crosswalk.



Discussion

An alternative to a pedestrian hybrid beacon is a standard signal face that displays a flashing red indication during the pedestrian clearance phase. The advantage of a standard signal face is that it displays no dark indications that could be interpreted by a driver to be a symptom of a power outage that requires coming to a stop.

Materials and Maintenance

Signing and striping need to be maintained to help users understand any unfamiliar traffic control.

Additional References and Guidelines

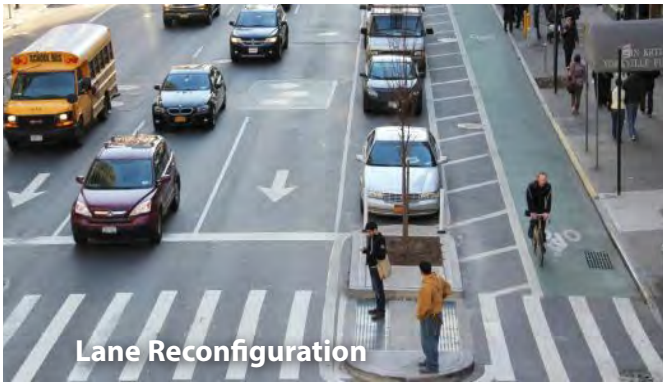
California MUTCD, 2014.

Retrofitting Existing Streets to Accommodate Bikeways

Most major streets are characterized by high vehicle speeds and/or volumes for which dedicated bike lanes are the most appropriate facility to accommodate safe and comfortable riding. Although opportunities to add bike lanes through roadway widening may exist in some locations, many major streets have physical and other constraints that would require street retrofit measures within existing curb-to-curb widths. As a result, much of the guidance provided in this section focuses on effectively reallocating existing street width through striping modifications to accommodate dedicated bike lanes.

Although largely intended for major streets, these measures may be appropriate for any roadway where bike lanes would be the best accommodation for bicyclists.

Lane Narrowing


Lane Reconfiguration

Lane Narrowing ("Lane Diet")

Description

Lane narrowing utilizes roadway space that exceeds minimum standards to provide the needed space for bike lanes. Many roadways have existing travel lanes wider than those prescribed in local and national roadway design standards, or which are not marked. Most standards allow for the use of 11 foot and sometimes 10 foot wide travel lanes to create space for bike lanes.

Guidance

Vehicle Lane Width

- Before: 10-15 feet
- After: 10-11 feet

Bicycle Lane Width

- Bicycle lane guidance applies to this treatment.

Before

After

Discussion

Special consideration should be given to the amount of heavy vehicle traffic and horizontal curvature before the decision is made to narrow travel lanes. Center turn lanes can also be narrowed in certain situations to provide space for bike lanes.

Materials and Maintenance

Repair rough or uneven pavement surface.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
AASHTO A Policy on Geometric Design of Highways and Streets, 2004.
Caltrans California HDM, 2012.
Caltrans Main Streets, 2005.

Lane Reconfiguration ("Road Diet")

Description

The removal of a single travel lane will generally provide sufficient space for bike lanes on both sides of a street. Streets with excess vehicle capacity provide opportunities for bike lane retrofit projects.

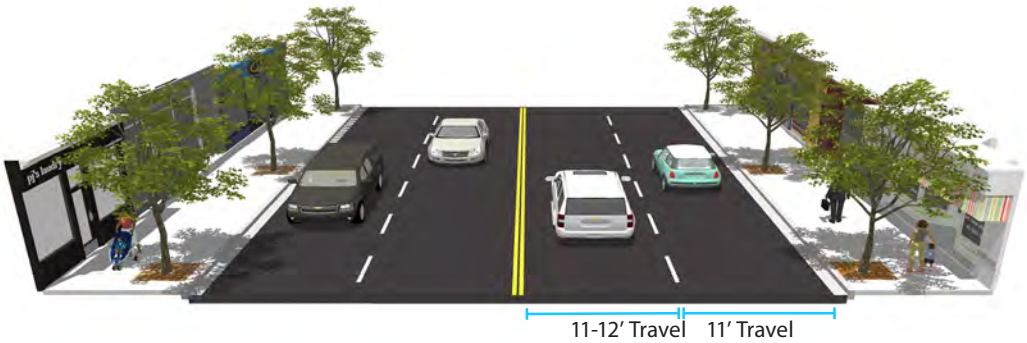
Guidance

Width depends on project. No narrowing may be needed if a lane is removed.

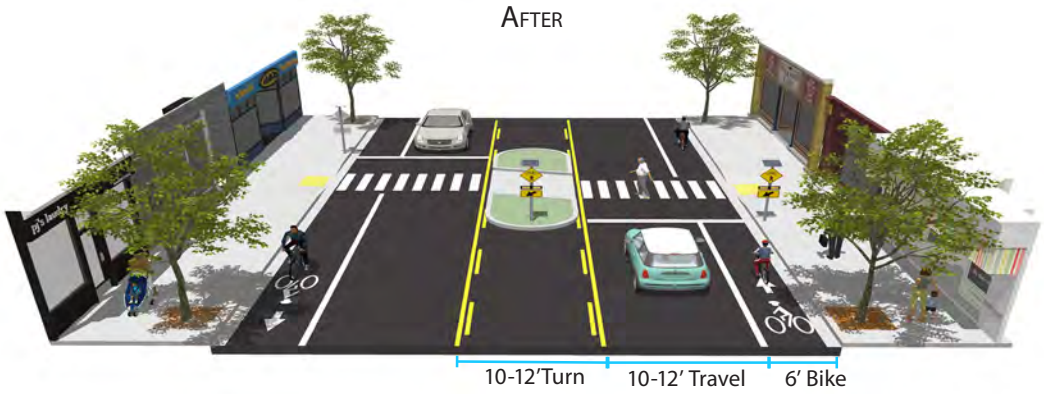
Bicycle lane width:

- Bicycle lane guidance applies to this treatment.

Before



After



Discussion

Depending on a street's existing configuration, traffic operations, user needs and safety concerns, various lane reduction configurations may apply. For instance, a four-lane street (with two travel lanes in each direction) could be modified to provide one travel lane in each direction, a center turn lane and bike lanes.

Materials and Maintenance

Repair rough or uneven pavement surface.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
FHWA Evaluation of Lane Reduction "Road Diet" Measures on Crashes, 2010.
Caltrans Main Streets, 2005.

Shared Use Path

Shared-use paths allow for two-way, off-street bicycle use and also may be used by pedestrians, skaters, wheelchair users, joggers and other non-motorized users. These facilities are frequently found in parks, along rivers, beaches and in greenbelts or utility corridors where there are few conflicts with motorized vehicles. Path facilities can also include amenities such as lighting, signage and fencing (where appropriate).

Key features of greenways include:

- Frequent access points from the local road network.
- Directional signs to direct users to and from the path.
- Limited number of at-grade crossings with streets or driveways.
- Terminating path where it is easily accessible to and from the street system.
- Separate treads for pedestrians and bicyclists when heavy use is expected.

General Design Practices

Description

Shared-use paths can provide a desirable facility, particularly for recreation and for users of all skill levels preferring separation from traffic. Paths should generally provide directional travel opportunities not provided by existing roadways.

Discussion

AASHTO Guide for the Development of Bicycle Facilities generally recommends against development of shared use paths along roadways.

Materials and Maintenance

Asphalt is the most common surface for Class I paths, but concrete has proven to be more durable over the long term.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
California MUTCD, 2014.
Caltrans California HDM, 2012.

Guidance

Width

- 9 feet is minimum allowed by HDM for one-way Class I multi-use path consisting of a five foot paved width with two foot shoulders.
- 12 feet is minimum allowed by HDM for two-way Class I multi-use path consisting of two four foot lanes and two foot shoulders. On structures, Class I multi-use path clear width between railings shall not be less than 10 feet.

Lateral Clearance

- Minimum separation between edge of pavement of one-way or a two-way multi-use path and edge of travel way of parallel road or street shall be five feet plus standard shoulder width. Prior to 2012, the Highway Design Manual allowed narrower separation if a physical barrier was included. Since 2012, however, physical barrier would not result in reduced separation.

Overhead Clearance

- Minimum vertical clearance allowed by HDM to obstructions across width of multi-use path is eight feet and seven feet over shoulders.

Striping

- When striping is required, use a four inch dashed yellow centerline stripe with four inch solid white edge lines.
- Solid centerlines can be provided on tight or blind corners and on the approaches to roadway crossings.

Paths in River and Utility Corridors

Description

Utility and waterway corridors often offer excellent shared-use path development and bikeway gap closure opportunities. Utility corridors typically include power line and sewer corridors, while waterway corridors include canals, drainage ditches, rivers and beaches. These corridors offer excellent transportation and recreation opportunities for bicyclists of all ages and skills.

Discussion

Similar to railroads, public access to flood control channels or canals is undesirable by all parties. Appropriate fencing may be required to keep path users within the designated travel way. Creative design of fencing is encouraged to make the path facility feel welcoming to the user.

Materials and Maintenance

For paths susceptible to flooding or ponding, permeable pavement is an option to reduce water collection, but will require additional regular maintenance to maintain effectiveness.

Guidance

Shared-use paths in utility corridors should meet or exceed general design practices and must conform to the Caltrans Highway Design Manual if designated as a Class I multi-use path. If additional width allows, wider paths and landscaping are desirable.

Access Points

Any access point to the path should be well-defined with appropriate signage designating the pathway as a bicycle and pedestrian facility and prohibiting motor vehicles.

Path Closure

Public access to the path may be prohibited during the following events:

- Canal/flood control channel or other utility maintenance activities
- Inclement weather or the prediction of storm conditions

Local Neighborhood Accessways

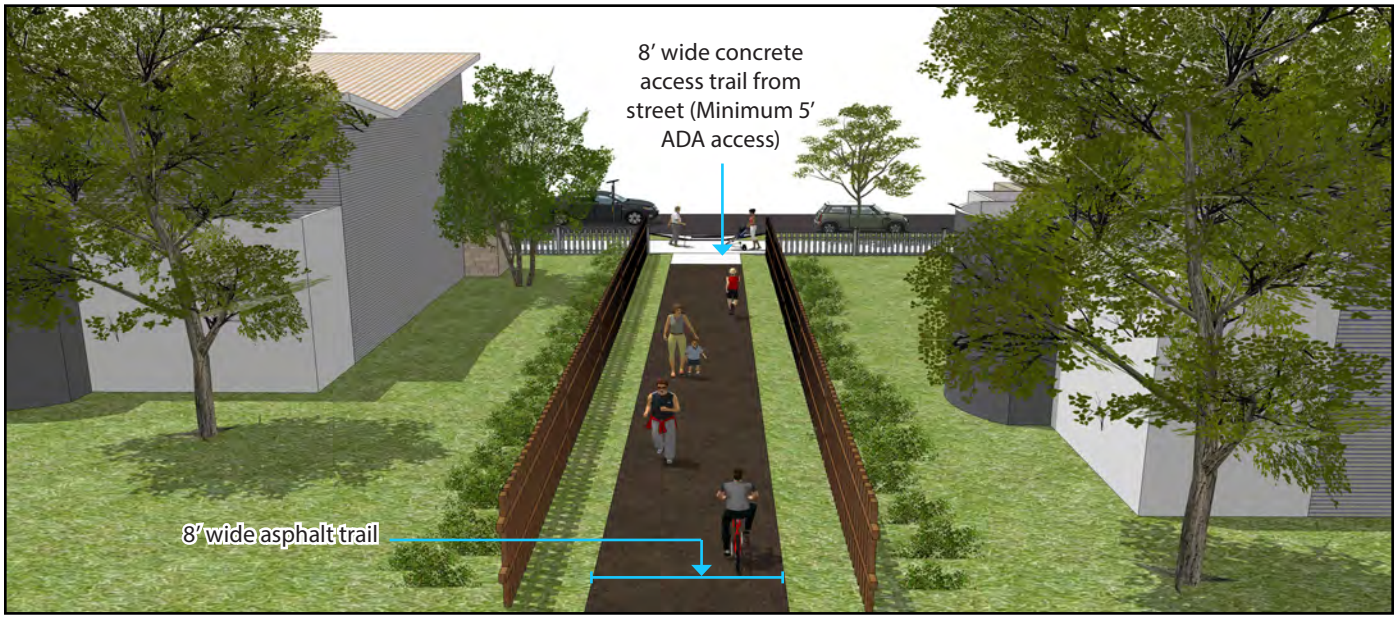
Description

Neighborhood accessways provide residential areas with direct bicycle and pedestrian access to parks, trails, green spaces and other recreational areas. They most often serve as small trail connections to and from the larger trail network, typically having their own rights-of-way and easements.

Additionally, these smaller trails can be used to provide bicycle and pedestrian connections between dead-end streets, cul-de-sacs and access to nearby destinations not provided by the street network.

Guidance

- Neighborhood access should remain open to the public
- Trail pavement should be at least 8 feet wide to accommodate emergency and maintenance vehicles, meet ADA requirements and be considered suitable for multi-use
- Trail widths should be designed to be less than 8 feet wide only when necessary to protect large mature native trees over 18 inches in caliper, wetlands or other ecologically sensitive areas.
- Access trails should slightly meander whenever possible to take advantage of available right-of-way space.



Discussion

Neighborhood access should be designed into new subdivisions wherever possible.

Materials and Maintenance

For paths susceptible to flooding or ponding, permeable pavement is an option to reduce water collection, but will require additional regular maintenance to maintain effectiveness.

Additional References and Guidelines

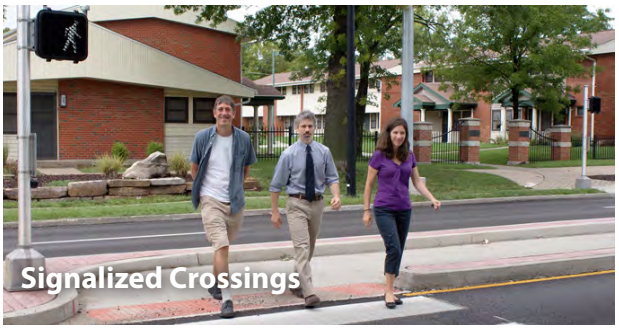
AASHTO Guide for the Development of Bicycle Facilities, 2012.
California MUTCD, 2014.
Flink, C. Greenways, 1993.

Path/Roadway Crossing

At-grade roadway crossings can create potential conflicts between path users and drivers, but well-designed crossings can mitigate many operational issues and provide a higher degree of safety and comfort for path users. This is evidenced by the thousands of successful facilities around the United States with at-grade crossings. In most cases, at-grade path crossings can be properly designed to provide a reasonable degree of safety and can meet existing traffic and safety standards.

Path facilities that cater to bicyclists require additional considerations due to the higher travel speed of bicyclists versus pedestrians. In addition to guidance presented in this section, see previous entries for active warning beacons and pedestrian hybrid beacons (PHBs) for other methods for enhancing trail crossings.

Marked/Unsignalized Crossings


Signalized Crossings

Overcrossings

Marked/Unsignalized Mid block Crossings

Description

Marked/unsignalized mid block crossings typically consist of a marked crossing area, signage and other markings to slow or stop traffic. Designing crossings at mid-block locations depends on an evaluation of vehicular traffic, line of sight, pathway traffic, use patterns, vehicle speed, road type, road width and other safety issues such as proximity to major attractions.

When space is available, using a median refuge island can improve user safety by providing pedestrians and bicyclists space to safely cross one side of the roadway at a time.

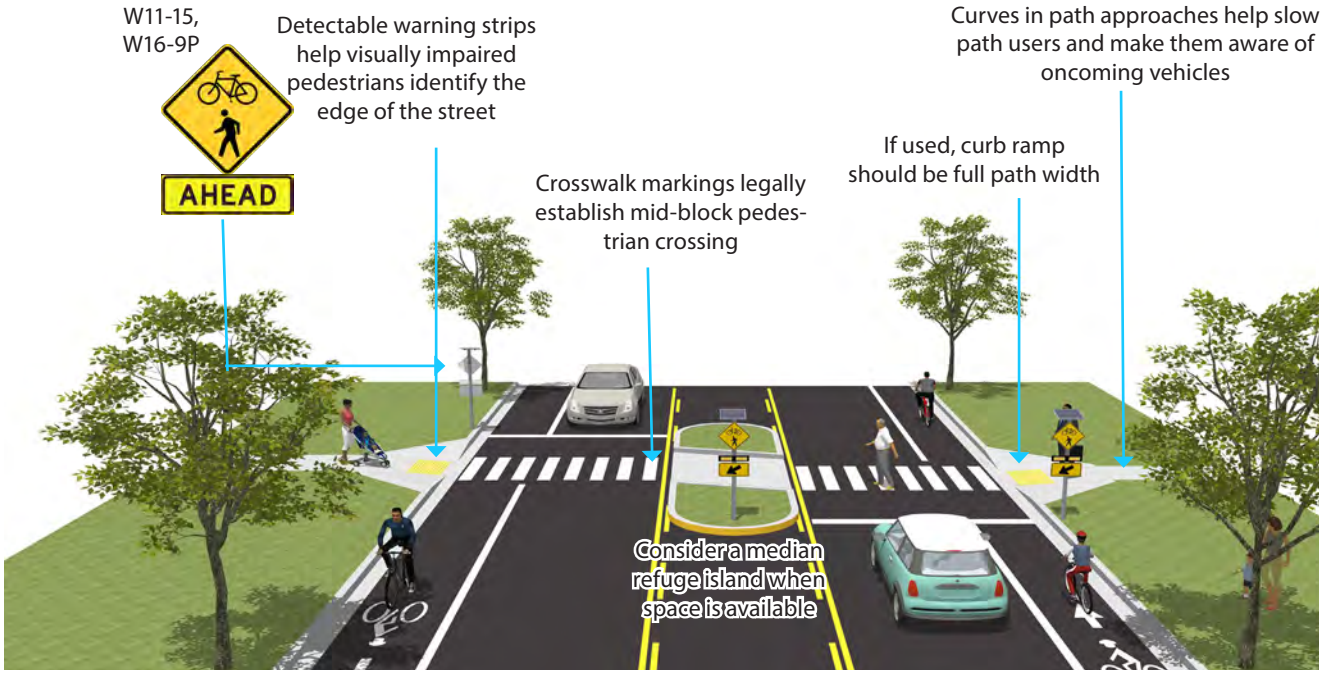
Guidance

Maximum traffic volumes

- <9,000-12,000 Average Daily Traffic (ADT) volume
- Up to 15,000 ADT on two-lane roads, preferably with a median
- Up to 12,000 ADT on four-lane roads with median
- Maximum travel speed: 35 mph

Minimum line of sight

- 25 mph zone: 155 feet
- 35 mph zone: 250 feet
- 45 mph zone: 360 feet



Discussion

Unsignalized crossings of multi-lane arterials over 15,000 ADT may be possible with features such as sufficient crossing gaps (more than 60 per hour), median refuges and/or active warning devices like rectangular rapid flash beacons.

Materials and Maintenance

Locate markings out of wheel tread when possible to minimize wear and maintenance costs.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012
California MUTCD, 2014
Caltrans California HDM, 2012

Overcrossings

Description

Bicycle/pedestrian overcrossings provide critical non-motorized system links by joining areas separated by barriers such as deep canyons, waterways or major transportation corridors. In most cases, these structures are built in response to user demand for safe crossings where they previously did not exist.

Grade-separated crossings may be needed where existing bicycle/pedestrian crossings do not exist, where ADT exceeds 25,000 vehicles and where 85th percentile speeds exceed 45 miles per hour.

Guidance

- 10 foot minimum width between railings, 14 feet preferred. If overcrossing has any scenic vistas additional width should be provided to allow for stopping. A separate 5 foot pedestrian area may be provided for facilities with high bicycle and pedestrian use.
- 10 foot headroom on overcrossing; clearance below will vary depending on feature being crossed.
- Roadway: 17 feet
- Freeway: 18.5 feet
- Heavy Rail Line: 23 feet

Discussion

Overcrossings for bicycles and pedestrians typically fall under the Americans with Disabilities Act (ADA), which strictly limits ramp slopes to 8.33 percent (1:12) with landings every 30 feet. Title 24 of the California Code of Regulations requires gradients up to five percent (1:20) with five foot landings at 400 foot intervals.

Materials and Maintenance

Potential vandalism may be addressed with sacrificial coatings.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
AASHTO Guide for the Planning, Design and Operation of Pedestrian Facilities, 2004.

Signalized Crossings

Description

Path crossings within approximately 300 feet of an existing signalized intersection with pedestrian crosswalks are typically diverted to the intersection to avoid traffic operation problems when located so close to an existing signal. For this restriction to be effective, barriers and signing may be needed to direct path users to the signalized crossing. If no pedestrian crossing exists at the signal, modifications should be made.

Guidance

Mid block crosswalks shall not be signalized if they are located within 300 feet of the nearest traffic control signal and should not be controlled by a traffic control signal if the crosswalk is located within 100 feet from side streets or driveways controlled by STOP signs or YIELD signs. If possible, offset the path to the intersection.

Discussion

In the US, the minimum distance a marked crossing can be from an existing signalized intersection varies from approximately 250 to 660 feet. Engineering judgment and location context should be taken into account when choosing the appropriate allowable setback.

Materials and Maintenance

If a sidewalk is used for crossing access, it should meet ADA guidelines.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
AASHTO Guide for the Planning, Design and Operation of Pedestrian Facilities, 2004.
California MUTCD, 2014.

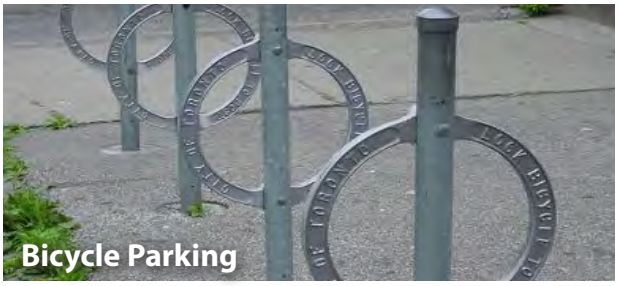
Bicycle Support Facilities

Bicycle Parking

Bicyclists expect a safe, convenient place to secure their bicycle when they reach their destination. This may be short-term parking of two hours or less, or long-term parking for employees, students, residents or commuters.

Access to Transit

Safe and easy access to bicycle parking facilities is necessary to encourage commuters to access transit via bicycle. Providing bicycle access to transit and space for bicycles on buses and rail vehicles can increase the feasibility of transit in lower-density areas, where transit stops are beyond walking distance of many residences. People are often willing to walk only a quarter- to half-mile to a bus stop, but they may bike as much as two or more miles to reach a transit station.


Bicycle Parking

On-Street Bicycle Corral

Bicycle Lockers

Secure Parking Areas (SPA)

Access to Transit

Bicycle Racks

Description

Secure bicycle parking at likely destinations is an integral part of a bikeway network. Adequate bicycle parking should be incorporated into any new development or redevelopment project. Bicycle parking should be given a balanced level of importance when considering car parking improvements or development. In commercial areas where bicycle traffic is more prevalent, as well as parks and shopping centers, increased bicycle parking is recommended.

Bicycle rack type plays a major role in the utilization of the bicycle racks. Only racks that support the bicycle at two points and allow convenient locking should be used. The Association for Pedestrian and Bicycle Professionals (APBP) recommends selecting bicycle racks that:

- Supports the bicycle in at least two places, preventing it from falling over.
- Allow locking of the frame and one or both wheels with a U-lock.
- Are securely anchored to ground.
- Resist cutting, rusting, bending or deformation.

Guidance

Acceptable racks:

- Do not bend wheels or damage other bicycle parts
- Accommodate high security U-locks.
- Accommodate securing the frame and wheels.
- Do not trip pedestrians.
- Are easily accessed yet protected from motor vehicles.
- Are covered if users will leave their bicycles for long periods.
- Are located where cyclists are most likely to travel.

Discussion

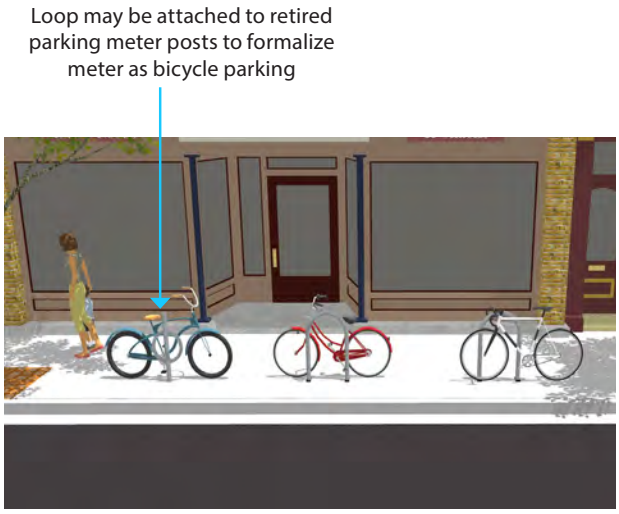
Where bicycle parking is very limited, an occasional parking space could be converted into a bicycle corral to increase the attraction of cycling to the commercial district instead of driving there. See bike corrals.

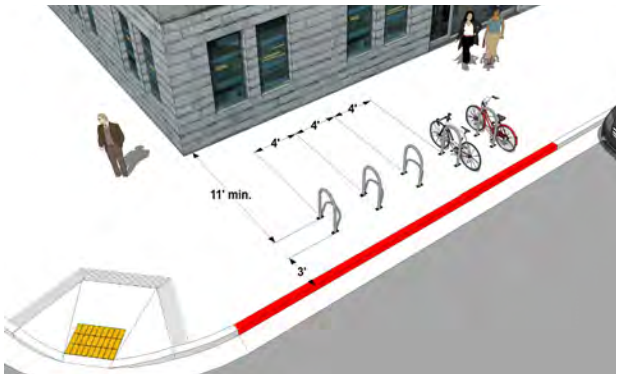
Materials and Maintenance

Use proper anchors to prevent vandalism or theft.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
APBP Bicycle Parking Guide 2nd Edition, 2010.





Bicycle Lockers

Description

Bicycle parking facilities intended for long-term parking must protect against theft of the entire bicycle and its components and accessories. Three common ways of providing secure long-term bicycle parking are:

- Fully enclosed lockers accessible only by the user, either coin-operated, or by electronic, on-demand locks operated by "smartcards" equipped with touch-sensitive imbedded RFID chips.
- A continuously monitored facility that provides at least medium-term type bicycle parking facilities generally available at no charge
- Restricted access facilities in which short-term type bicycle racks are provided and access is restricted only to the owners of the bicycles stored there

Perhaps the easiest retrofit is the bicycle locker. Generally, they are as strong as the locks on their doors and can secure individual bicycles with their panniers, computers, lights, etc, left in place. Some bicycle locker designs can be stacked to double the parking density.

Discussion

Long-term parking facilities are more expensive to provide than short-term facilities, but are also significantly more secure. Although many bicycle commuters would be willing to pay a nominal fee to guarantee the safety of their bicycle, long-term bicycle parking should be free wherever automobile parking is free.

Materials and Maintenance

Regularly inspect moving part function and enclosures. Change keys and access codes periodically to prevent access by unapproved users.

Guidance

- Minimum dimensions: width (opening) 2.5 feet; height four feet; depth six feet.
- Four foot side and six foot end clearance.
- Seven foot minimum distance between facing lockers.
- Locker designs that allow visual inspection are recommended for security.
- Access controlled by a key or access code.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
APBP Bicycle Parking Guide 2nd Edition, 2010.

On-Street Bicycle Corral

Description

Bicycle corrals are generally former vehicle parking stalls converted to bicycle parking. Most have been on-street conversions, but they are now being incorporated into shopping center parking lots as well. Corrals can accommodate up to 20 bicycles per former vehicle parking space. On-street bicycle corrals provide many benefits where bicycle use is high and/or growing:

- Businesses - Corrals provide a much higher customer to parking space ratio and advertise "bicycle friendliness." They also allow more outdoor seating for restaurants by moving the bicycle parking off the sidewalk. Some cities have instituted programs that allow local businesses to sponsor or adopt a bicycle corral to improve bicycle parking in front of their business.
- Pedestrians - Corrals clear sidewalks and those installed at corners also serve as curb extensions
- Cyclists - Corrals increase cycling visibility and greatly expand bicycle parking options
- Vehicle drivers - Corrals improve visibility at intersections by preventing large vehicles from parking at street corners and blocking sight lines

Guidance

See bicycle rack guidelines section.

- Bicyclists should have an entrance width from the roadway of 5–6 feet.
- Desirable to put bicycle corrals near intersections.
- Can be used with parallel or angled parking.
- Parking stalls adjacent to curb extensions are good candidates for bicycle corrals since the concrete extension serves as delimitation on one side.

Lockers can be custom designed and fabricated to complement specific locations.

Materials and Maintenance

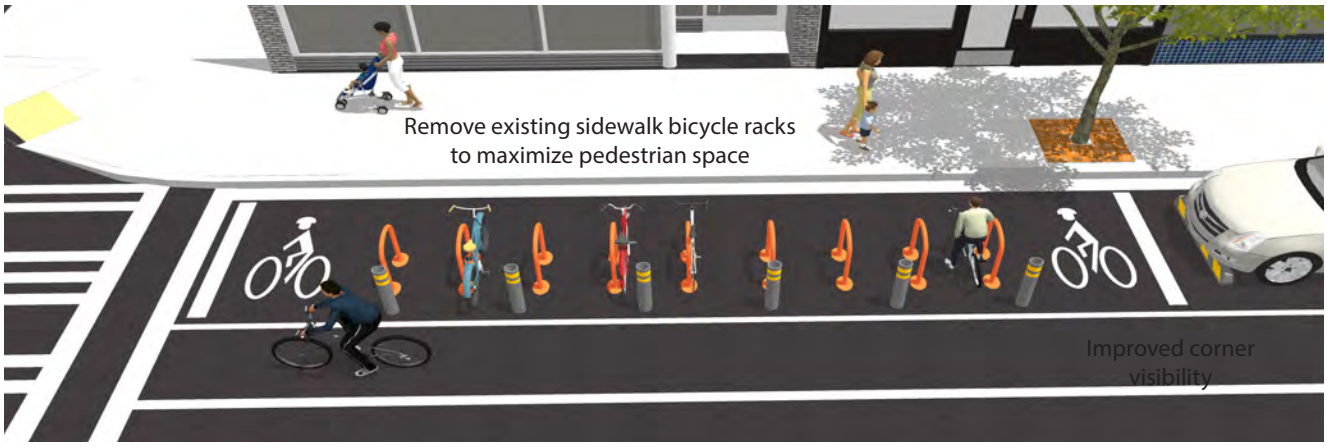
Physical barriers may obstruct drainage and collect debris. Establish a maintenance agreement with neighboring businesses.

Discussion

In many communities, the installation of bicycle corrals is driven by requests from adjacent businesses and is not a city-driven initiative. In other areas, the city provides corrals and business associations take responsibility for maintenance.

Additional References and Guidelines

APBP Bicycle Parking Guide 2nd Edition, 2010.



Secure Parking Areas (SPA)

Description

A Secure Parking Area for bicycles, also known as a Bike SPA or Bike & Ride (when located at transit stations), is a semi-enclosed space that offers a higher level of security than ordinary bike racks. Accessible via key-card, combination locks, or keys, Bike SPAs provide high-capacity parking for 10 to 100 or more bicycles.
Increased security measures create an additional transportation option for those whose biggest concern is theft and vulnerability.

Guidance

Key features may include:

- Closed-circuit television monitoring
- Double high racks and cargo bike spaces
- Bike repair station with bench
- Maintenance item vending machine
- Bike lock "hitching post" – allows people to leave bike locks
- Secure access for users

Discussion

Long-term parking facilities are more expensive to provide than short-term facilities, but are also significantly more secure. Although many bicycle commuters would be willing to pay a nominal fee to guarantee the safety of their bicycles, long-term bicycle parking should be free wherever automobile parking is free.

Materials and Maintenance

Regularly inspect moving part function and enclosures. Change keys and access codes periodically to prevent access by unapproved users.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
APBP Bicycle Parking Guide 2nd Edition, 2010.

Bike Fix-It Stations

Description

A bike fix-it station is a public work stand complete with tools to perform basic bike repairs and maintenance including fixing a flat to adjusting brakes. While there are several stand designs, they all provide an ergonomic work environment for any rider. The tools are attached to the stand via stainless steel gauge cables to prevent theft. Hanging the bike from the arm hangar allows the pedals and wheels to move freely while making adjustments to the bike.

Discussion

Stations employ universal bike mounting and should be ADA compliant. Common bike tools are tethered to the station by stainless steel cables. The stations' tubing are generally powder coated, galvanized or stainless steel anchored into concrete or another proper base material specified by vendor. Stations can be color customized from a variety of colors available by vendor. Many stations have a QR code with repair instructions should the rider need additional information.

Materials and Maintenance

Stations are built for outdoor use and sealed from the elements. Some vendors provide a warranty for service and repair should vandalism or mechanical failure occur.

Guidance

Stations are best placed in public areas with a significant amount of bicycle traffic or at popular trailheads.

Wall Setbacks

- Minimum of 48 inches from side of station to wall or other objects
- Minimum of 12 inches from back of station to wall or other objects

Street or Trail Setback

- Minimum of 60 inches from perpendicular street/trail
- Minimum of 96 inches from parallel street/trail.

Bicycle Access to Transit

Description

Safe and easy access to transit stations and secure bicycle parking facilities is necessary to encourage commuters to access transit via bicycle. Bicycling to transit reduces the need to provide expensive and space consuming car parking spaces. Many people who ride to a transit stop will want to bring their bicycle with them on the transit portion of their trip, so buses and other transit vehicles should be equipped accordingly.

For staircases at bus or rail transit stations, bicycle access could be facilitated with bicycle staircase side ramps. These consist of narrow channels just wide enough to accommodate typical bicycle tires, installed below the handrails of staircases. Cyclists place their bicycle tires onto the side ramps and walk them up or down the stairs, so the bicycles roll within the channels.

Discussion

Providing bicycle routes to transit helps combine the long-distance coverage of bus and rail travel with the door-to-door service of bicycle riding. Transit use can overcome large obstacles to bicycling, including distance, hills, riding on busy streets, night riding, inclement weather and breakdowns.

Guidance

Wayfinding

- Provide direct and convenient access to transit stations and stops from bicycle and pedestrian networks.
- Provide maps, wayfinding signage and pavement markings from bicycle network to transit stations.

Bicycle Parking

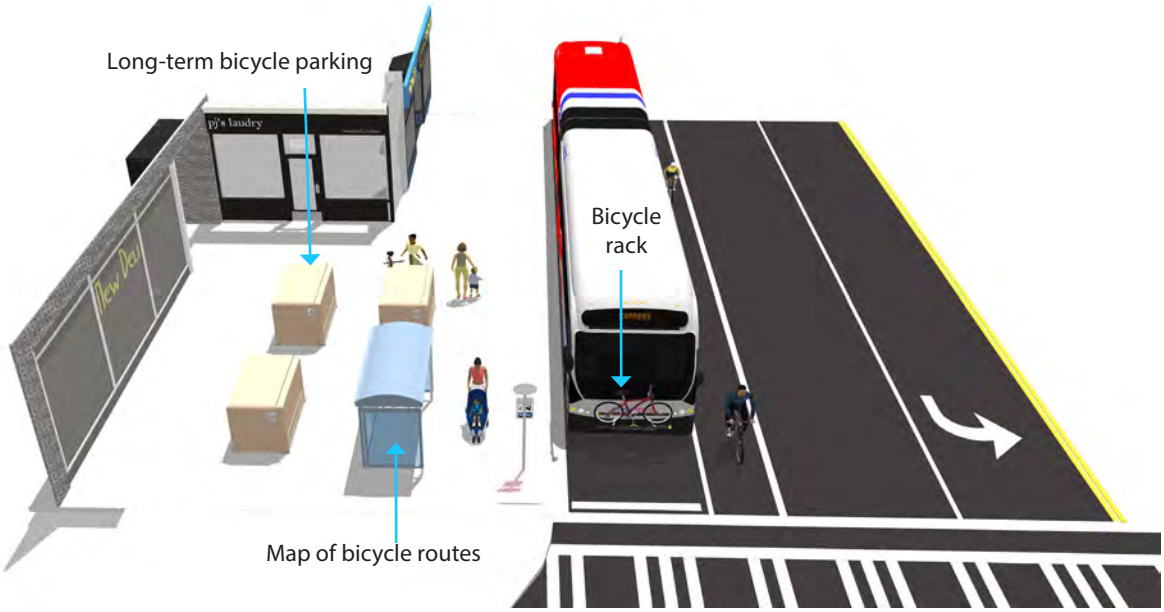
- Route from bicycle parking locations to station/stop platforms should be well-lit and visible.
- Signing should note bicycle parking location, rules for use and instructions, as needed.
- Provide safe and secure long-term parking such as bicycle lockers at transit hubs. Parking should be easy to use and well maintained.

Materials and Maintenance

Regularly inspect the functioning of long-term parking moving parts and enclosures.

Additional References and Guidelines

APBP Bicycle Parking Guide 2nd Edition, 2010.
FHWA University Course on Bicycle and Pedestrian Transportation.
Lesson 18: Bicycle and Pedestrian Connections to Transit, 2006.



Bikeway Facility Maintenance

Regular bicycle facility maintenance includes sweeping, maintaining a smooth roadway, ensuring that the gutter-to-pavement transition remains relatively flat and installing bicycle-friendly drainage grates. Pavement overlays are a good opportunity to improve bicycle facilities. The following recommendations provide a menu of options to consider enhancing a maintenance regimen.

Sweeping

Gutter to Pavement Transition

Roadway Surface

Drainage Grates

Sweeping

Description

Bicyclists often avoid shoulders and bike lanes filled with gravel, broken glass and other debris; they will ride in the roadway to avoid these hazards, potentially causing conflicts with drivers. Debris from the roadway should not be swept onto sidewalks (pedestrians need a clean walking surface), nor should debris be swept from the sidewalk onto the roadway. A regularly scheduled inspection and maintenance program helps ensure that roadway debris is regularly picked up or swept.

Guidance

Establish a seasonal sweeping schedule that prioritizes roadways with major bicycle routes.

- Sweep walkways and bikeways whenever there is an accumulation of debris on the facility.
- In curbed sections, sweepers should pick up debris; on open shoulders, debris can be swept onto gravel shoulders.
- Pave gravel driveway approaches to minimize loose gravel on paved roadway shoulders.
- Perform additional sweeping in the Spring to remove debris from the Winter.
- Perform additional sweeping in the Fall in areas where leaves accumulate.

Note: Some separated bike facilities (cycle tracks) that employ curbs or other physical barriers for separation may be too narrow for a standard street sweeper, which requires 10 foot clearance. If this is the case, smaller sweepers are available.

Gutter to Pavement Transition

Description

On streets with concrete curbs and gutters, 1 to 2 feet of the curbside area is typically devoted to the gutter pan, where water collects and drains into catch basins. On many streets, bikeway is situated near the transition between gutter pan and pavement edge. This transition can be susceptible to erosion, creating potholes and a rough surface for travel. These areas can also be prone to standing water during and after rains.

Guidance

- Ensure that gutter-to-pavement transitions have no more than a ¼" inch vertical difference.
- Examine pavement transitions during every roadway project for new construction, maintenance activities and construction project activities that occur in streets.
- Inspect the pavement two to four months after trenching construction activities are completed to ensure that excessive settlement has not occurred.
- Provide at least three feet of pavement outside of the gutter seams.
- When adding new bike facilities such as separated lanes, roundabouts and traffic circles, check for potential drainage issues. Installing bioswales to capture runoff and avoid standing water in bike lanes is becoming a standard part of building bike facilities in bike-friendly communities.

Roadway Surface

Description

Bicycles are much more sensitive to changes in roadway surface than motor vehicles. Various materials are used to pave roadways and some are smoother than others. Uneven settlement after trenching can affect roadway surface nearest the curb where bicycles travel. If compaction is not achieved to a satisfactory level, uneven pavement surface can result due to settling. When resurfacing streets, use the smallest chip size and ensure that the surface is as smooth as possible for bicyclist safety and comfort.

Guidance

- Maintain a smooth pothole-free surface.
- Ensure that on new roadway construction, the finished surface on bikeways does not vary more than ¼ inch.
- Maintain pavement so ridge buildup does not occur at the gutter-to-pavement transition or adjacent to railway crossings.
- Inspect the pavement two to four months after trenching construction activities are completed to ensure that excessive settlement has not occurred.
- If chip sealing is to be performed, use the smallest possible chip on bike lanes and shoulders. Sweep loose chips regularly following application.
- During chip seal maintenance projects, if bike lane pavement condition is satisfactory, it may be appropriate to chip seal the travel lanes only. However, use caution when doing so as not to create an unacceptable ridge between the bike lane and travel lane.

Drainage Grates

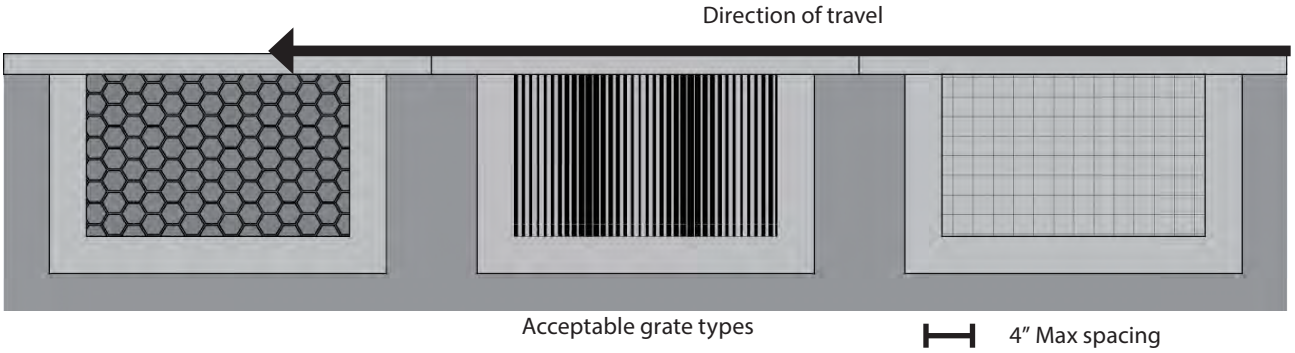
Description

Drainage grates are typically located in the gutter area near the curb of a roadway. Drainage grates typically have slots through which water drains into the municipal storm sewer system. Some older grates were designed with linear parallel bars spread wide enough for a tire to become caught so that if a bicyclist were to ride on them, the front tire could become caught in the slot, causing the bicyclist to go over the handlebars and sustain potentially serious injuries.

Guidance

Require all new drainage grates be bicycle-friendly, including grates with horizontal slats to prevent bicycle and assistive device tires from falling through.

- Create a program to inventory all existing drainage grates and replace hazardous grates as necessary – temporary modifications such as installing re-bar horizontally across the grate should not be an acceptable alternative to replacement.



Bikeway Maintenance and Operations

Description

Motor vehicle traffic tends to "sweep" debris like litter and broken glass toward the roadways edges where it can accumulate in bicycle lanes. Maneuvering to avoid such hazards can cause a cyclist to fall. In this way, proper maintenance directly affects safety and street sweeping must be a priority on roadways with bicycle facilities, especially in curb lanes and along curbs themselves. Law enforcement can assist by requiring towing companies to fully clean up crash sites to prevent glass and debris from being left in place or simply swept to the curb or shoulder after collisions.

When any roadwork repairs are done by the city or other agencies, the roadway must be restored to satisfactory quality with particular attention to surface smoothness suitable for cycling. Striping must be restored to the prior markings, or new markings if called in for a project. Bicycle facilities also sometimes seem to "disappear" after roadway construction occurs. This can happen incrementally as paving repairs are made over time and are not promptly followed by proper re-striping. When combined with poor surface reconstruction following long periods of no service due to road work, bikeway facilities can be "lost", which can discourage cycling in general. Construction projects that require the demolition and rebuilding of adjacent roadways can cause problems maintaining and restoring bikeway function.

Construction activities controlled through permits, such as driveway, drainage and utility work can have an important effect on roadway surface quality where cyclists operate in the form of mismatched pavement heights, rough surfaces or longitudinal gaps in adjoining pavements, or other pavement irregularities. Permit conditions should ensure that pavement foundation and surface treatments are restored to their pre-construction conditions, that no vertical irregularities will result and that no longitudinal cracks will develop. Strict specifications, standards and inspections designed to prevent these problems should developed. A five year bond should be held to assure correction of any deterioration that might occur as a result of faulty reconstruction of the roadway surface.

Bicycle facilities should be swept regularly, at least twice a month and preferably more often for heavily traveled routes. Also, adjacent shrubs and trees should be kept trimmed back to prevent encroachment into the pathway or obstructing cyclists' views.

Guidance for Colored Pavements:

Waterborne Paints

Over the past 10 years, transportation agencies in the United States have gradually replaced conventional solvent paints with waterborne paints that have low volatile organic compounds (VOC) and other newer pavement marking materials. Waterborne traffic paints are the most widely used and least expensive pavement marking material available. Glass beads are either pre-mixed into the paint or dropped onto the waterborne paint to provide retro-reflectivity. Waterborne paints generally provide equal performance on asphalt and concrete pavements, but have the shortest service life of all pavement marking materials. This paint type tends to wear off rapidly and lose retro-reflectivity quickly after being exposed to factors such as high traffic volumes. Although still a widely used material, waterborne paint is also used as an interim marking material until they can apply something more durable.

Regular Solvent Paint

This type of paint can be used universally for any pavement needing paint and is the least expensive. Additives such as reflective glass beads for reflectivity and sand for skid resistance are widely used to mark road surfaces. This is typically considered a non-durable pavement marking and is easily worn by vehicle tires and often requires annual re-application.

Durable Liquid Pavement Markings

Durable liquid pavement markings (DLPM) include epoxy and methyl methacrylate (MMA). Epoxy paint has traditionally been viewed as a marking material that provides exceptional adhesion to both asphalt and concrete pavements when the pavement surface is properly cleaned before application. The strong bond that forms between epoxy paints and both asphalt and concrete pavement surfaces results in the material being highly durable when applied on both pavement surfaces. These markings are highly durable and can be sprayed or extruded but generally require long no-track times.

Thermoplastics

Thermoplastics are a durable pavement marking material composed of glass beads, pigments, binders (plastics and resins) and fillers. There are two types of thermoplastics: hydrocarbon and alkyd. Hydrocarbon thermoplastics are made from petroleum-derived resins; and alkyd thermoplastics are made from wood-derived resins. One of the added advantages of using thermoplastic is that the material can be re-applied over older thermoplastic markings, thereby refurbishing the older marking as well as saving on the costs of removing old pavement markings. Although thermoplastic materials usually perform very well on all types of asphalt surfaces, there have been mixed results when they have been applied on concrete pavements.

Use of Green Paint

A significant recent change is the FHWA's interim approval for the use of green colored pavement within bicycle lanes in mixing or transition zones, such as at intersections and in other potential conflict zones where motor vehicles may cross a bicycle lane. They are intended to warn drivers to watch for and to yield to cyclists when they encounter them within the painted area. FHWA studies have also shown that green bicycle lanes improve cyclist positioning as they travel across intersections and other conflict areas. Jurisdictions must notify Caltrans before proceeding with green bicycle lane projects because the agency is required to maintain an inventory, but since Caltrans has requested to participate in this interim approval, the process has been streamlined because FHWA experimental treatment protocol is no longer required.

Product Life Estimates for Paint

- 9-36 months
- Inexpensive
- Quick-drying
- Longer life on low-volume roads
- Easy clean-up and disposal
- Short life on high-volume roads
- Subject to damage from sand/abrasives
- Pavement must be warm or will not adhere

Durable Liquids for Pavement Markings:

Epoxy

- 4 years
- Longer life on low-volume roads
- More retro-reflective
- Slow drying
- Requires coning and/or flagging during application
- Heavy bead application-may need to be cleaned off of roadway
- High initial cost
- Subject to damage from sand/abrasives

Thermoplastic

- 3-6 years
- Long life on low-volume roads
- Retro-reflective
- No beads needed
- Any temperature for application
- Recommended use for symbols and spot treatments
- Subject to damage from sand/abrasives
- Cost prohibited if used for large scale applications
- Shown to wear quickly in conflicts areas
- Life of pavement marking will depend on traffic volume, road condition and application time of year

Additional References and Guidelines

NACTO Urban Bikeway Design Guide, 2014.
FHWA Durability and Retro-Reflectivity of Pavement Markings (Synthesis Study), 2008.

On-street Bikeway Signing

The following signage system guidelines specifically address on-street bicycle routes. Such signage is regulated by the Manual of Uniform Traffic Control Devices (MUTCD), which establishes national standards for traffic signs and related traffic control devices. This ensures MUTCD-compliant signs are familiar to all roadway users.

The MUTCD should therefore govern sign design and placement technical aspects, such as dimensions, font size and ground clearance. It guidance is intended to improve cyclists' experience and to help encourage people to ride more frequently, or to begin riding.

The ability to navigate through a city's streets is informed by landmarks, natural features and other visual cues. Signs throughout the system should indicate:

- Travel direction
- Destinations locations
- Travel time/distance to those destinations

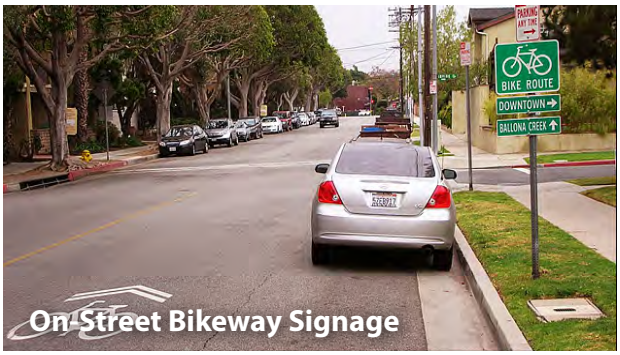
These signs will increase users' comfort and bikeway system accessibility.
Signage can serve both wayfinding and safety purposes including:

- Helping to familiarize users with the bicycle network
- Helping users identify the best routes to destinations
- Helping to address misconceptions about time and distance
- Helping overcome a "barrier to entry" for people who are not frequent bicyclists (e.g., "interested but concerned" bicyclists)

A community-wide bicycle wayfinding signage plan identifies:

- Sign locations
- Sign types – what information should be included and design features
- Destinations to be highlighted on each sign – key destinations for bicyclists
- May include approximate distance and travel time to each destination bicycle wayfinding signs also visually cue drivers that they are driving along a bicycle route and should use caution.
- Sign placement such as at key locations leading to and along bicycle routes, including intersection of multiple routes.

Too many road signs tend to clutter the right-of-way and it is recommended that these signs be posted at a level most visible to bicyclists rather than per vehicle signage standards.



On-Street Bikeway Signage

On-street Bikeway Sign Types

Description

A on-street bicycle wayfinding system consists of comprehensive signing and/or pavement markings to guide bicyclists to their destinations along preferred bicycle routes. There are three general on-street bikeway wayfinding sign types:

Confirmation

- Indicate to bicyclists that they are on a designated bikeway.
- Make drivers aware of the bicycle route.
- May include destinations and distance/time, but not arrows.

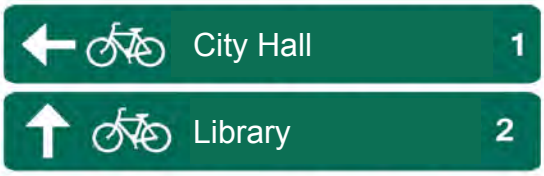
Decision

- Mark junctions of two or more bikeways.
- Inform bicyclists of the designated bike route to access key destinations.
- Destinations and arrows are required, distances are optional, but recommended.
- Travel time is nonstandard, but recommended.

Turn

- Indicate where a bikeway turns from one street onto another street. Can include pavement markings.
- Include destinations and arrows.

Confirmation Sign



Decision Sign

Turn Sign

Discussion

There is no standard color for bicycle wayfinding signage. Section 1A.12 of the MUTCD establishes the general meaning for signage colors. Green is the color used for directional guidance and is the most common color of bicycle wayfinding signage in the US, including those in the MUTCD.

Materials and Maintenance

Maintenance needs for bicycle wayfinding signs are similar to other signs and will need periodic replacement due to wear and fading, to which south-facing signs are especially prone.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
California MUTCD, 2014.
NACTO Urban Bikeway Design Guide, 2014.

On-street Bikeway Sign Placement

Guidance

Signs are typically placed at decision points along bicycle routes – typically at the intersection of two or more bikeways and at other key locations leading to and along bicycle routes.

Decisions Signs

- Near-side of intersections in advance of junction with another bicycle route.
- Along route to indicate nearby destination.

Confirmation Signs

- Every two or three blocks along on-street bicycle facilities, unless another sign type is used (e.g., within 150 feet of a turn or decision sign).
- Should be placed soon after turns to confirm destination(s). Pavement markings can also be used for confirmation that a bicyclist is on a preferred route.

Turn Signs

- Near-side of intersections where bike routes turn (e.g., where the street ceases to be a bicycle route or does not go through). Pavement markings can also indicate the need to turn to the bicyclist.

Discussion

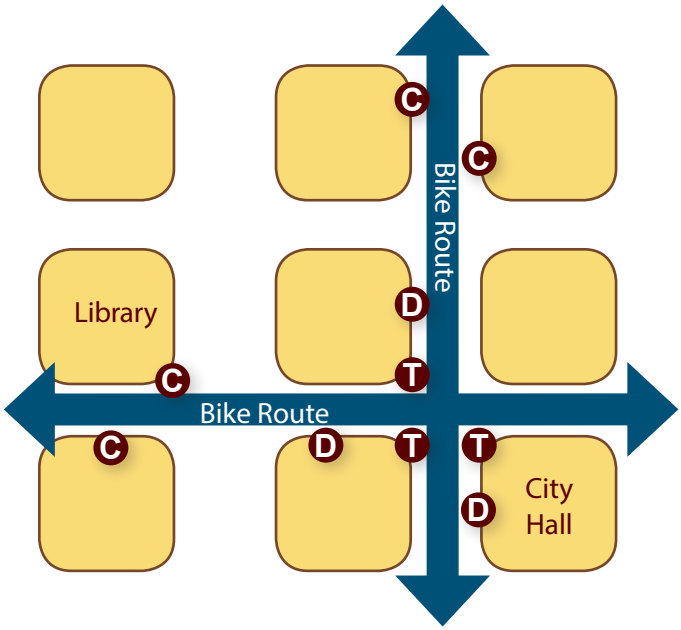
A list of destinations on signs should be based on their relative distance to users from a particular sign's location. A particular destination's ranking in the hierarchy can be used to infer the physical distance from which the location is signed.

Materials and Maintenance

Maintenance needs for bicycle wayfinding signs are similar to other signs and will need periodic replacement due to wear.

Additional References and Guidelines

AASHTO Guide for the Development of Bicycle Facilities, 2012.
California MUTCD, 2014.
NACTO Urban Bikeway Design Guide, 2014.



C Confirmation Sign

D Decision Sign

T Turn Sign

Appendix B: Project Prioritization

Overview

The purpose of project prioritization is to determine which projects will provide the most benefit from among the list of projects defined within a master plan, and should therefore be expedited for implementation. Prioritizing projects is also a requirement of the State of California's bicycle master planning enabling legislation, Streets and Highways Code (SHC) Section 891.2, Items a-k. Bicycle master plans must be approved by Caltrans for the municipality to be eligible for future Bicycle Transportation Account (BTA) funding. Item j is written as follows:

A description of the projects proposed in the plan and a listing of their priorities of implementation.

Directly associated with this, it is becoming common for grant funding programs to require an explanation of a municipality's prioritization methodology as part of grant scoring inputs. This is intended to help verify that the municipality carefully considered and can therefore justify the specific project's priority relative to the rest of the municipality's projects listed in its bicycle master plan.

An important example is the State of California's recently developed Active Transportation Plan (ATP) Grant Program, which has the potential to be a significant source of future funding for the types of projects listed in this master plan. Item n of ATP Guidelines is worded very similarly to the SHC Section 891.2's Item j, but takes the prioritization requirement a substantial step further by requiring the applicant to not just list the projects by prioritization, but to describe the prioritization methodology:

A description of the projects and programs proposed in the plan and a listing of their priorities of implementation, including the methodology for prioritization and a proposed timeline for implementation.

Methodology

Project prioritization is primarily a data-driven process underpinned as much as possible by objective information. It is therefore subject to the availability of suitable data, supplemented with other information sources where applicable. Initial prioritization model results are generally ported to carefully designed spreadsheets where they are combined and evaluated with other available data types to yield the best results for a specific location and project type.

No matter what criteria are employed, the initial prioritization model run's results are evaluated to determine which criteria should continue to be employed in subsequent refinement. This is because analyzing the initial run often reveals that certain criteria did not help to differentiate between alternatives. Eliminating them streamlines the analysis process.

Once the criteria have been selected, they are differentially weighted relative to each other, primarily to take advantage of expert knowledge to help address specific local issues, conditions and values. For example, City of Eastvale staff felt that public input requesting specific facilities should be given high priority. In addition, the City agreed with a strong public preference that a facility's proximity to schools should also be given higher consideration and relative weighting compared to other criteria.

The following appendix section describes the six criteria determined to be most useful to prioritize recommended projects in Eastvale, with each one's normalized (rounded) score and its cumulative percent effect on the total of all six per facility.

Future facility ranking and implementation should be fine-tuned and adjusted accordingly based on any changing circumstances. Prioritized projects can be re-ranked within the State's mandated five year bicycle master plan update cycle, or at whatever interval best fits future funding cycles. Prioritization updates could be scheduled to take into consideration the availability of new information, new funding sources, updated crash statistics, updated CIP lists, etc.

Gap Closure

This criterion addressed potential bicycle connectivity improvements by evaluating each recommended facility's overall contribution to system completeness.

- Closes gap in an existing bicycle facility = 3
- Upgrades facility to higher classification (ex. Class 3 bike route to Class bike lane) = 2
- New facility connecting existing and proposed bicycle facilities = 1

Normalized score: 1.0 of 6 points (17 percent of total)

Reported Collisions

This criterion addressed safety through five years of collision data, normalized by collisions per mile of recommended facility. Compared to automobile collisions, the lower number of bike crashes and lack of robust, long term exposure data (i.e. number of bicyclists using each corridor) means that this dataset is not as statistically sound. However, it is still commonly reported and easily understood. Dataset was derived from the California Highway Patrol's Statewide Integrated Traffic Records System (SWITRS). This criteria uses collisions per mile and gives points to recommended facilities that have high collision rates along their segments.

Normalized score: 1.0 of 6 points (17 percent of total)

Economic Efficiency

Economic efficiency measured the financial benefits associated with a corridor, normalized by the number of anticipated users (in turn a product of the facility type and length), and divided by the rough order construction cost estimates.

Using National Cooperative Highway Research Program (NCHRP) Report 552 methods, 1/4, 1/2 and one mile buffers were drawn around each corridor to obtain American Community Survey (ACS) population and journey to work mode share data. An extrapolation of all bicycle trips was made and estimates of potential ridership developed, based on multi-use path or bicycle lane attractiveness functions as defined by the NCHRP research. Using the existing and estimated ridership, annual mobility, health, recreation and reduced auto use, cost saving benefits were calculated. Economic efficiency is further explained through sample projects in Appendix C.

Normalized score: 0.25 of 6 points (4 percent of total)

Required vs. Existing Width Constraints

This criterion looked at the common constraint of existing right-of-ways for adding bicycle facilities, particularly for on-street bicycle lanes and cycle tracks. However, any recommendations that included adjacent shared-use off-street paths would also be affected.

- 0 feet needed = 4
- 1-4 feet needed = 3
- 5-9 feet needed = 2
- 10+ feet needed = 1

Normalized score: 0.5 of 6 points (8 percent of total)

Proximity to Schools

This criterion addressed the distance from schools for each recommended facility and was given the highest weighting based on strong community preference.
Normalized score: 1.75 of 6 points (29 percent of total)

Public Outreach Input

Public outreach conducted for this plan consisted of three public workshops and an online survey available throughout the course of the project. The survey was filled out by almost 500 respondents. In both the survey and at the public meetings, City staff and residents were asked to identify the projects they felt were most important by facility type. Like the previous criterion, this one was highly weighted based City on guidance.

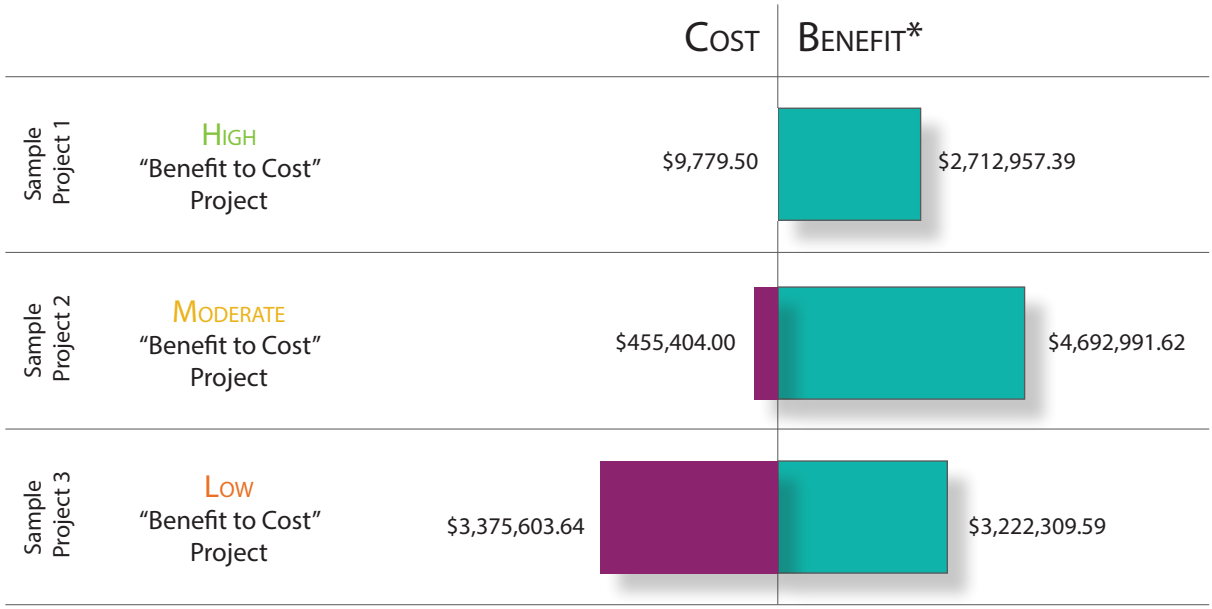
- >6 points = 3
- 3-6 points = 2
- <3 points = 1

Normalized score: 1.5 of 6 points (25 percent of total)

Appendix C: Benefit-Cost Analysis

To illustrate the benefit-cost relationship, three sample projects representing high, moderate and low benefit-cost ratios are shown below. These are real projects selected from the 30 projects recommended by this plan (See "Table 9-2: Inputs - Benefit-Cost Analysis" on page A-70 for benefit-cost information for all projects). The high "benefit to cost" project (Sample Project 1) is a bike boulevard along Blossom Way; the moderate "benefit to cost" project (Sample Project 2) is a protected bike lane on Citrus Street; and the low "benefit to cost" project (Sample Project 3) is a multi-use path along the Cucamonga River/Flood Control Path.

While these benefit-cost ratios do provide some information about projects – and a means of comparison – it is important to note that they are relatively insensitive to facility type. On other words, they do not distinguish between facilities types other than multi-use paths (e.g. bike routes vs. protected bike lanes). For this reason, benefit-cost ratios have only a minor influence on overall project ranking, with reported collisions, proximity to schools and community input playing much larger roles.



*"Benefit" is a combination of several financial benefits associated with the given projects: mobility benefits, health benefits, recreation benefits and reduced automobile use.

Table 9-2: Inputs - Benefit-Cost Analysis

Project Number (Rank)	Total Population (Quarter Mile)	Total Population (Half Mile)	Total Population (One Mile)	Adult Population, 18+ (Quarter Mile)	Adult Population, 18+ (Half Mile)	Adult Population, 18+ (One Mile)	Workers 16+ (Quarter Mile)	Workers 16+ (Half Mile)	Workers 16+ (One Mile)	Bike Commuters (Quarter Mile)	Bike Commuters (Half Mile)	Bike Commuters (One Mile)	Combined Benefit*	Total Length of Existing Class 1 Facilities in Project (mi)	Total Length of Project (mi)	Estimated cost of project	Benefit Cost Ratio (BCR)
1	5755	11961	28411	36	76	205	2413	5013	12180	14	29	106	3438668.121	0.00	2.52	$1,310,750.00	2.62
2	6819	14284	30951	36	78	190	2959	6176	13364	35	70	147	5429840.674	0.00	2.33	$179,697.00	30.22
3	7845	16373	32668	37	80	207	3488	7252	14403	54	110	190	7428215.029	0.00	2.14	$1,114,761.00	6.66
4	489	1385	6422	3	8	45	204	573	2757	3	8	38	1166766.878	0.00	0.41	$5,365.72	217.45
5	9965	20732	42354	59	123	278	4383	9097	18459	58	119	223	8494756.410	0.00	3.93	$1,629,031.00	5.21
6	11122	23351	37626	65	137	235	4876	10203	16320	65	132	199	8759213.847	0.99	3.78	$2,650,501.00	3.30
7	2258	5372	15349	16	38	110	984	2323	6636	12	27	81	2715661.548	0.00	1.53	$586,184.00	4.63
8	8175	16948	29575	55	113	191	3715	7662	13100	58	116	187	9324317.130	2.00	2.33	$3,204,465.00	2.91
9	7255	15222	32041	44	94	222	3153	6579	13702	37	75	156	5771526.757	0.00	3.76	$1,952,799.00	2.96
10	7659	16728	34961	43	99	218	3413	7428	15339	50	104	187	7781019.018	0.50	1.77	$861,624.00	9.03
11	4701	11251	26412	28	73	204	2060	4960	11589	24	60	131	4692991.619	0.00	1.50	$455,404.00	10.31
12	1063	2854	8714	6	19	86	438	1170	3650	4	9	35	1118030.213	0.00	1.14	$15,108.26	74.00
13	8193	16968	31580	40	98	208	3635	7594	13963	55	114	189	7875603.231	0.41	2.16	$677,431.00	11.63
14	4422	9795	21637	27	61	165	1850	4103	9200	12	25	66	2290860.258	0.00	1.10	$14,498.51	158.01
15	6073	12487	26779	47	106	226	2719	5588	11752	37	78	153	5736752.370	0.00	3.55	$1,847,948.00	3.10
16	3175	7409	19068	24	50	126	1427	3286	8379	20	43	109	3856448.589	0.06	1.27	$106,331.00	36.27
17	7734	13837	26763	63	101	193	3557	6245	11824	55	90	165	6626691.579	0.17	2.65	$307,151.00	21.57
18	721	4203	14889	5	25	90	312	1856	6519	2	25	88	2712957.390	0.00	0.74	$9,779.50	277.41
19	10183	17786	32161	60	106	199	4492	7804	14005	60	98	168	6775282.102	0.00	2.55	$33,660.00	201.29
20	11224	22663	40566	66	134	263	4925	9934	17673	64	127	212	8688776.234	0.38	3.27	$1,014,338.00	8.57
21	5817	13287	29141	34	75	190	2459	5690	12588	19	56	130	4529861.635	0.00	1.84	$24,334.14	186.15
22	610	1542	11512	4	11	68	262	652	4916	1	3	48	1330118.112	0.00	0.72	$9,561.13	139.12
23	1547	4247	13226	9	35	130	643	1801	5730	6	18	66	2104762.131	0.02	1.76	$55,465.00	37.95
24	2944	6610	17272	23	48	114	1337	2951	7577	21	44	104	3730433.268	0.04	1.51	$107,493.00	34.70
25	1301	3752	11461	9	28	80	567	1645	4964	8	23	64	2754775.482	1.03	1.03	$1,640,836.70	1.68
26	813	1837	8140	5	11	61	338	748	3520	5	10	53	1686912.433	0.14	1.03	$234,201.00	7.20
27	1351	3033	12456	8	19	96	554	1237	5416	7	16	82	3222309.592	2.11	2.11	$3,375,603.64	0.95
28	2447	5571	14816	19	39	96	1109	2487	6525	17	38	100	4432161.467	1.40	1.35	$2,240,000.00	1.98
29	6585	13752	29368	32	70	168	2911	6026	12819	43	82	161	6261944.957	0.20	2.09	$349,016.00	17.94
30	1433	3532	10246	20	53	161	613	1513	4313	5	11	28	979314.138	0.00	1.32	$114,373.00	8.56

* Combined benefit is a combination of several financial benefits associated with the given projects: mobility benefits, health benefits, recreation benefits and reduced automobile use. Combined benefits also uses a time series to account for forecasted benefits.

Appendix D: Applicable Legislation

Overview

Several pieces of legislation support increased cycling in the State of California. Much of the legislation concerns greenhouse gas (GHG) reduction and employs cycling as a means to achieve GHG reduction targets. Other legislation highlights the intrinsic worth of cycling and treats the safe and convenient accommodation of cyclists as a matter of equity. The most relevant legislative acts for bicycle policy, planning, infrastructure and programs are discussed below.

State Legislation and Policies

AB-32 Global Warming Solutions Act

This bill specifies greenhouse gas emissions reduction and codifies the 2020 emissions reduction goal. This act also directs the California Air Resources Board to develop specific early actions to reduce greenhouse gases while also preparing a scoping plan to identify how best to reach the 2020 limit.

AB-902 Diversion Programs

This bill was signed in September 2015 and sponsored by the California Bicycle Coalition. It allows local jurisdictions to create diversion programs that allow ticketed cyclists to have their tickets removed from their records if they successfully complete a bicycle training course. This type of program has been available for children for some time, but this legislation expands availability to adults. It also offers all cyclists, ticketed or not, more opportunities to learn the rules of the road and safe bicycle handling skills.

AB-1096 Redefine Electric Bikes

The bill was passed by the California Senate in September 2015 and awaiting the Governor's signature. It would replace California's existing vehicle law that does not allow motorized bicycles on non-motorized paths. The updated law splits e-bikes from other motorized bikes and divide them into three categories:

- Class I: pedal-assisted electric bike with a top assisted speed of 20mph
- Class II: pedal-assisted or propelled unassisted with a top motor-driven speed of 20mph
- Class III: pedal-assisted electric bike with a top assisted speed of 28mph

Of those three categories, the first two will now be allowed on any infrastructure where conventional bicycles are allowed, but the bill also provides local authorities the specific ability to limit or prohibit those uses. Class III electric bikes or any bikes with a non-electric motor would not be allowed on off-street paths, but could still be used on on-street bike lanes. The changes apply to the state's vehicle code and would not affect open space trails or public lands access rules.

AB-1193 Bikeways

This act amends various code sections, all relating to bikeways in general, specifically by recognizing a fourth class of bicycle facility, cycle tracks. However, the following may be even more significant to future bikeway development: Existing law requires Caltrans, in cooperation with county and city governments, to establish minimum safety design criteria for the planning and construction of bikeways, and requires the department to establish uniform specifications and symbols regarding bicycle travel and traffic related matters. Existing law also requires all city, county, regional and other local agencies responsible for the development or operation of bikeways or roadways to utilize all of those minimum safety design criteria and uniform specifications and symbols. This bill revises these provisions and required Caltrans to establish minimum safety design criteria for each type of bikeway and also authorizes local agencies to utilize different minimum safety criteria if adopted by resolution at a public meeting.

AB-1358 Complete Streets Act

This bill requires the legislative body of a city or county, upon revision of the circulation element of their general plan, to identify how the jurisdiction will provide for the routine accommodation of all users of the roadway including motorists, pedestrians, cyclists, individuals with disabilities, seniors and users of public transportation. The bill also directs the OPR to amend guidelines for the development of general plan circulation elements so that the building and operation of local transportation facilities safely and conveniently accommodate everyone, regardless of their mode of travel.

AB-1371 Passing Distance/3 Feet for Safety Act

This statute, widely referred to as the "3 Foot Passing Law," requires drivers to provide at least three feet of clearance when overtaking cyclists. If traffic or roadway conditions prevent drivers from giving cyclists three feet of clearance, they must "slow to a speed that is reasonable and prudent" and wait until they reach a point where passing can occur without endangering the cyclist. Violations are punishable by a $35 base fine, but drivers who collide with cyclists and injure them in violation of the law are subject to a $220 fine.

AB-1581 Bicycle and Motorcycle Traffic Signal Actuation

This bill defines a traffic control device as a traffic-actuated signal that displays one or more of its indications in response to the presence of traffic detected by mechanical, visual, electrical or other means. Upon the first placement or replacement of a traffic-actuated signal, the signal would have to be installed and maintained, to the extent feasible and in conformance with professional engineering practices, so as to detect lawful bicycle or motorcycle traffic on the roadway. Caltrans has adopted standards for implementing the legislation.

SB-375 Redesigning Communities to Reduce Greenhouse Gases

This bill seeks to reduce vehicle miles traveled through land use and planning incentives. Key provisions require the larger regional transportation planning agencies to develop more sophisticated transportation planning models, and to use them for the purpose of creating "preferred growth scenarios" in their regional plans that limit greenhouse gas emissions. The bill also provides incentives for local governments to incorporate these preferred growth scenarios into the transportation elements of their general land use plans.

SB-743 CEQA Reform

Just as important as the pieces of legislation described in this section that support increases in cycling infrastructure and accommodation, is one that promises to remove a longstanding roadblock to cycling infrastructure and accommodation. That roadblock is vehicular Level of Service (LOS) and the legislation with the potential to remove it is SB-743. For decades, vehicular congestion has been interpreted as an environmental impact and has often stymied bicycle projects. Projections of degraded Level of Service have, at a minimum, driven up project costs and, at a maximum, precluded projects altogether.
SB-743 could completely remove LOS as a measure of car traffic congestion that must be used to analyze environmental impacts under the California Environmental Quality Act (CEQA). This is extremely important because adequately accommodating cyclists, particularly in built-out environments, often requires reallocation of right-of-way and the potential for increased vehicular congestion. The reframing of Level of Service as a matter of motorist inconvenience, rather than an environmental impact, will allow planners to assess the true impacts of transportation projects and will help support cycling projects that improve mobility for all roadway users.

According to the Association of Environmental Professionals 2014 CEQA Guidelines 229, a project involving only feasibility or planning studies for possible future actions that an agency has not approved, adopted or funded, does not require an EIR or Negative Declaration, but does require consideration of environmental factors. This has been supported by numerous cities and counties, as well as State agencies. Planning projects such as this bicycle master plan are therefore exempt from CEQA analysis since they are comprised of planning and conceptual recommendations. However, as individual recommendations move forward through design and implementation, the City will need to determine if there are impacts associated with them for which environmental review may be necessary.

Caltrans' Deputy Directive 64-R1

Deputy Directive 64-R1 is a policy statement affecting Caltrans mobility planning and projects requiring the agency to: "...provide for the needs of travelers of all ages and abilities in all planning, programming, design, construction, operations, and maintenance activities and products on the State highway system. The Department views all transportation improvements as opportunities to improve safety, access, and mobility for all travelers in California and recognizes bicycle, pedestrian, and transit modes as integral elements of the transportation system." The directive goes on to mention the environmental, health and economic benefits of more Complete Streets.

Federal Legislation

Safe Streets Act (S-2004/HR-2468)

HR2468 encourages safer streets through policy adoption at the state and regional levels, mirroring an approach already being used in many local jurisdictions, regional agencies and states governments. The bill calls upon all states and metropolitan planning organizations (MPOs) to adopt Safe Streets policies for federally funded construction and roadway improvement projects within two years. Federal legislation will ensure consistency and flexibility in road-building processes and standards at all levels of governance.

Appendix E: BTA Reviewer Checklist

For reviewer convenience, California Streets and Highways Code Section 891.2, items a-k code text and associated document sections and/or responses are listed below.

(a) The estimated number of existing bicycle commuters in the plan area and the estimated increase in the number of bicycle commuters resulting from implementation of the plan.

Current estimate of bicycle commuters is 662 using industry standard calculation methods. Expected increase as a result of this plan was based on other jurisdictions' experience with bikeway system development. This also addresses forecasted future employment increase of seven percent to 18,305, yielding 1,274 commuting cyclists, or 612 additional cyclists, a 92 percent increase resulting from implementation of this plan. This includes students and transit users.

This document recommends establishing a cycling activity baseline using annual count locations.

(b) A map and description of existing and proposed land use and settlement patterns which shall include, but not be limited to, locations of residential neighborhoods, schools, shopping centers, public buildings and major employment centers.

See Chapter 2 maps and tables.

(c) A map and description of existing and proposed bikeways.

See Chapter 4 maps and tables.

(d) A map and description of existing and proposed end-of-trip bicycle parking facilities. These shall include, but not be limited to, parking at schools, shopping centers, public buildings and major employment centers.

See Chapter 4 maps and tables.

(e) A map and description of existing and proposed bicycle transport and parking facilities for connections with and use of other transportation modes. These shall include, but not be limited to, parking facilities at transit stops, rail and transit terminals, ferry docks and landings, park and ride lots, and provisions for transporting cyclists and bicycles on transit or rail vehicles of ferry vessels.

See Chapter 2 maps and tables.

(f) A map and description of existing and proposed facilities for changing and storing clothes and equipment. These shall include, but not be limited to, locker, restroom and shower facilities near bicycle parking facilities.

See Chapters 2 and 4 maps and tables.

(g) A description of bicycle safety and education programs conducted in the area included in the plan, efforts by the law enforcement agency having primary traffic law enforcement responsibility in the area to enforce provisions of the Vehicle Code pertaining to bicycle operation, and the resulting effect on accidents involving cyclists.

The Eastvale Police Department, in conjunction with the Public Works Department and Corona-Norco Unified School District, provides parents and students with safety pamphlets that specifically address safe driving practices. In addition to the training brochures, police traffic team and School Resource Officers conduct traffic enforcement in school zones before and after school. Many violations are related to bicyclist and/or helmet violations. The City also posts driving safety tips on its website.
Eastvale Police Department also pass out free "slurpee" coupons to students wearing bicycle helmets and cite those who are not.

Bike Month is promoted by the regional bicycle advocacy organization, Inland Empire Bike Alliance.

(h) A description of the extent of citizen and community involvement in development of the plan including, but not be limited to, letters of support.

See Appendix C, Community Input Summary.

(i) A description of how the bicycle transportation plan has been coordinated and is consistent with the local or regional transportation, air quality or energy conservation plans, including, but not be limited to, programs that provide incentives for bicycle commuting.

Encouraging bicycle commuting is addressed throughout the document, particularly Chapter 5: Recommended Programs and Policies.

(j) A description of the projects proposed in the plan and a listing of their priorities of implementation.
See Chapter 4 maps, tables and recommendations text.

(k) A description of past expenditures for bicycle facilities and future financial needs for projects that improve safety and convenience for bicycle commuters in the plan area.

The City of Eastvale was only incorporated in 2010. This master plan is its inaugural bicycle planning effort and intended to be a comprehensive blueprint for future system development.