

APPENDIX B

COUNTERMEASURE TOOLBOX

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ABOUT THIS TOOLBOX

This toolbox presents safety countermeasures applicable in different roadway contexts across Lancaster. Many of these countermeasures are recommended as part of the Representative Location Projects included in this report. Many of the countermeasures included in the Caltrans Local Roadway Safety Manual (LRSM) and can be advantageous for use in Caltrans Highway Safety Improvement Program (HSIP) grant funding applications. In the toolbox, these countermeasures are noted with an HSIP icon. There are many effective safety countermeasures beyond those listed in the LRSM, and several are included in this toolbox. Safety benefits, key design features, and application considerations are included in the countermeasure descriptions.

BIKEWAY COUNTERMEASURES

CLASS I BIKE PATHS ▶▶▶



TYPICAL APPLICATIONS

Facility Design

Class I bike paths should generally be designed as separated facilities away from parallel streets. They are commonly planned along rights-of-way such as waterways, utility corridors, railroads, and the like that offer continuous separated riding opportunities.

Adherence to Design Guidelines

All Class I bike paths should conform to the design guidelines set forth by Caltrans. Sidewalk paths and unpaved facilities that are not funded with federal transportation dollars and that are not designated as Class I bike paths do not need to be designed to Caltrans standards.

Where Possible, Separate from Sidewalks

Both AASHTO and Caltrans recommend against using most sidewalks for bike paths. This is due to conflicts with driveways and intersections. Where sidewalks are used as bike paths, they should

be placed along routes with few driveways and intersections, be properly separated from the roadway, not contain obstructions (bus stops, signs, trees, trash receptacles, etc.), and have carefully designed intersection crossings.

Recommended Widths

Bike paths should have a minimum of eight feet of pavement, with at least two feet of unpaved shoulders for pedestrians/runners, or a separate pathway for pedestrians/runners where feasible. A pavement width of 12 feet is preferred.

Roadway Crossings Design

Class I bike path roadway crossings should be carefully engineered to accommodate safe and visible crossing for users. The design needs to consider the width of the roadway, whether it has a median, and the roadway's average daily and peak-hour traffic volumes. Crossings of low-volume streets may require simple stop signs. Crossings of streets

with Average Daily Traffic (ADT) of over 15,000 vehicles per hour should be assessed for signalized crossing, flashing LED beacons, crossing islands, or other devices. Roundabouts may be a desirable treatment for a bike path intersecting with roadways where the bike path is not next to a parallel street.

Lighting

Lighting should be provided where bicyclists will likely use the bike path in the late evening, such as along commuter routes.

Physical Barriers & Signs

Barriers at path entrances to prevent motorized vehicles from entering, such as obstacle posts and gates, can obstruct bicyclists and should be avoided when possible. Typically, barriers should not be considered until after it has been determined that other measures to prevent motor vehicles from entering have failed, and where the safety and other issues posed by unauthorized vehicles are more serious than the safety and access issues posed to path users. Signs and other design solutions are preferred.

Maintenance & Emergency Vehicle Access

Bike path construction should take into account vertical requirements and the impacts of maintenance and emergency vehicles on shoulders.



CLASS II BIKE LANES ▶▶▶



TYPICAL APPLICATIONS

Facility Design

Class II bike lanes are a portion of the roadway designated for preferential use by bicyclists; they have been designated by striping, signage, and pavement markings.

Bike lanes run adjacent to the travel lanes and flows in the same direction as motor vehicle traffic. Bike lanes are typically on the right side of the street, between the adjacent travel lane and curb, road edge, or parking lane.

Adherence to Design Guidelines

The following guidelines should be used when designing Class II bikeway facilities. The Caltrans HDM Chapter 1000, AASHTO, the CA MUTCD, and the Caltrans Traffic Manual provide these guidelines.

Recommended Widths

Class II bike lane facilities should conform to the minimum design standard of five feet in width in the direction of vehicle travel adjacent to the curb lane. Where space is available, a width of six feet to eight

feet is preferred, especially on busy arterial streets, on grades, and adjacent to parallel parking.

Under certain circumstances, bike lanes may be four feet in width. Situations where this is permitted include:

- > Bike lanes located between through traffic lanes and right turn pockets at intersection approaches
- > Where there is no parking, the gutter pan is no more than 12 inches wide, and the pavement is smooth and flush with the gutter pan
- > Where there is no curb and the pavement is smooth to the edge

Signs

"Bike Lane" (R81) and "Bike Route" (D11-1) Signage shall be posted after every significant intersection along the route of the bike lane facility. "Begin" and "End" plaques (R81A or R81B) should accompany the "Bike Lane" sign when appropriate. The route number shown on the Bike Route Identification sign should correspond to the latest City Bicycle Routes and Facilities Map. The Bike Route Identification sign can also be used in conjunction with an arrow plaque



(M6 series) in advance of another approaching bike lane or route to direct bicyclists. If a bike lane exists where parking is prohibited, “no parking” signage may accompany bike lane signage.

Striping

Bike lanes should be striped with a six-inch wide solid white stripe (CA MUTCD Detail 39) and should be dashed (Detail 39A) at an intersection approach. The length of Detail 39A shall be 100 feet when the block is short (less than 400 feet) and 200 feet where the block is longer or vehicle speeds are high (greater than 35 mph). The dashed bike lane stripe allows for use of the bike lane as a right-turn pocket for motor vehicles.

Bike lanes with two stripes are more visible than those with one and are preferred. The second inside stripe (4-inch solid white) would differentiate the bike lane from the parking lane where appropriate.

Markings

At the beginning and end of each block and at approximately 150-foot to 250-foot intervals, pavement stencils of a bicycle and arrow shall be used to show the direction of travel. The stencils at the end of the block should be placed just before the dashed bike lane stripe (Detail 39B).

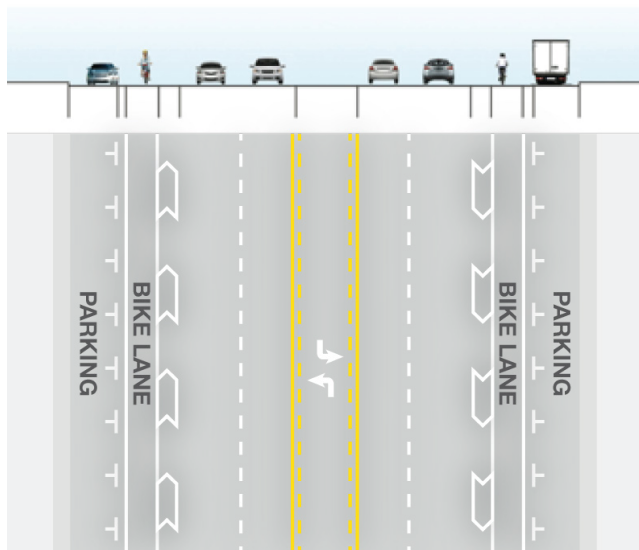


Intersection Treatments

Where space permits, intersection treatments should include bike lane 'pockets'. At signalized intersections, loops or other means of bicycle detection should be installed near the limit line in the bike lane and all vehicle lanes that have detection. Signal timing and phasing should be set to accommodate bicycle acceleration speeds. Painted bicycle detector stencils may be placed at detection zones located within the bike lane to notify bicyclists where they can actuate the signal. Traffic signals can be timed and coordinated for cyclists (where appropriate).

Transitions from Class II Bike Lanes to Class III Bike Routes

Where bike lanes terminate, they typically should transition to a Class III bike route when possible. Cyclists should be notified through a sign that includes the Bike Lane sign (R81) with End plaque (R81B). Shared lane markings (sharrows) should be placed in the transition zone to help guide cyclists



to the proper place to ride in the lane. Class III bike route time, distance and destination signs should help provide continuity.

Roadway Conditions

When bike lanes are to be implemented on existing roadway surfaces, it is important to identify and remediate any longitudinal cracking greater than one half-inch wide, vertical deformations such as utility covers that are not flush, and other conditions that may affect rideability.

Buffered Bike Lanes

Buffered bike lanes provide a painted divider between the bike lane and the adjacent travel lane. This additional space can improve the comfort of cyclists, as they don't have to ride as close to motor vehicles. Buffered bike lanes can also be used to narrow travel lanes, which slows traffic. Buffered bike lanes are most appropriate on wide, busy streets. They can be used on streets where physically separating the bike lanes with protected bike lanes is undesirable for cost, operational, or maintenance reasons.

CLASS III BIKE ROUTES ▶▶▶



TYPICAL APPLICATIONS

Facility Design

Class III bike routes are typically simple-signed routes along corridors, usually local streets and collectors. With proper route signage, design, and maintenance, bike routes can be effective in guiding bicyclists along a route suited for bicycling that does not have enough roadway space for a dedicated Class II bike lane. Class III bike routes can be designed in a manner that encourages bicycle usage, convenience, and safety.

Bike routes can become more useful when coupled with the following techniques:

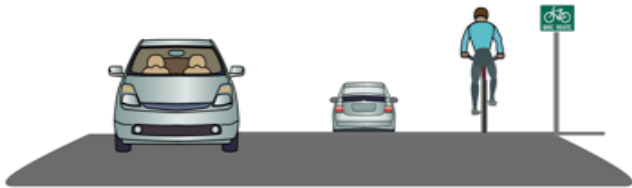
- > Route, directional, and distance signage
- > Wide curb lanes
- > Shared lane marking stencils painted in the traffic lane along the appropriate path of where a bicyclist would ride in the lane
- > Accelerated pavement maintenance schedules
- > Traffic signals timed and coordinated for cyclists (where appropriate)
- > At signalized intersections, loop detectors

or other means of bicycle detection should be installed near the limit lane in all vehicle lanes that have vehicle detection.

- > Traffic signals can be timed and coordinated for cyclists (where appropriate); signal timing and phasing should be set to accommodate bicycle acceleration speeds
- > Traffic calming measures
- > Remediation of longitudinal cracking greater than one half-inch wide, utility covers that are not flush, vertical deformations, and other conditions that may affect rideability

Signs

“Bike Route” (D11-1) signage should be posted after every intersection along the route to inform bicyclists that the bikeway facility continues and alert motorists to the presence of bicyclists. “Begin” and “End” plaques (M4-14 and M4-6) should accompany the Bike Route sign when appropriate. The route number shown on the Bike Route Identification sign should correspond to the latest City Bicycle Routes and Facilities Map. The Bike Route sign can also be used in conjunction with an arrow plaque (M6 series) in advance of another approaching bike route or



lane to direct bicyclists. If a bike route exists where parking is prohibited, “no parking” signage may accompany bike lane signage.

SHARROWS

TYPICAL APPLICATIONS

Facility Design

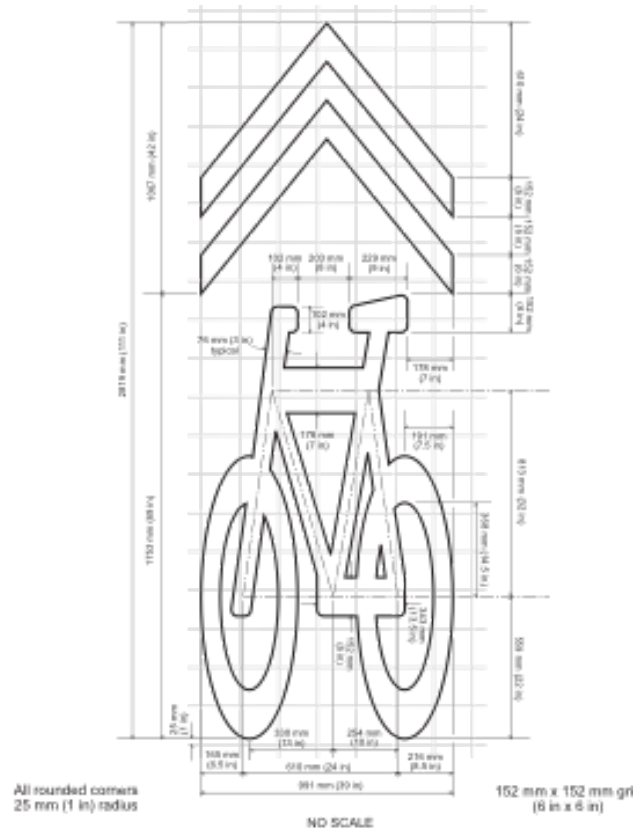
Sharrow stencils are recommended as a way to enhance the visibility and safety of Class III bike routes. Sharrows (officially known as “shared lane markings”) indicate to cyclists the proper position to ride within the travel lane and assist with wayfinding. They also alert motorists that the travel lane is to be shared with bicyclists.

Adherence to Design Guidelines

CA MUTCD, Section 9C.103(CA) Shared Roadway Bicycle Markings states: “The shared roadway bicycle marking shall only be used on a roadway (Class III Bikeway (Bike Route) or Shared Roadway (No Bikeway Designation)).”

Placement & Spacing of Sharrows

When used on streets with on-street parking, sharrows are to be placed such that the centers of the markings are a minimum of 11 feet from the curb face or edge of paved shoulder on streets with on-street parallel parking. Where space is available, 12 feet or more from the curb is preferred. On streets without on-street parking that have an outside travel

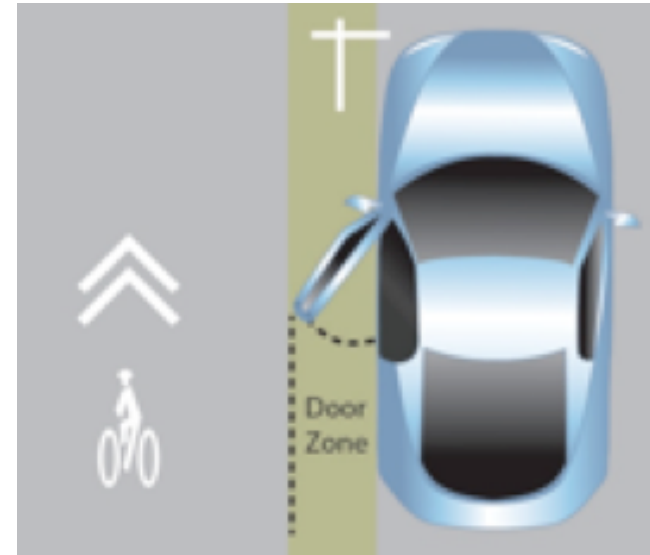


lane that is less than 14 feet wide, the centers of the sharrows should be at least four feet from the face of the curb.

On two-lane roadways, these minimum distances allow vehicles to pass bicyclists on the left within the same lane without encroaching into the opposite lane of traffic. On multi-lane roadways, motorists must change lanes to pass a cyclist.

On streets with on-street parking, installing sharrows more than 11 feet from the curb will also move the bicyclist farther from the "door zone" (approximately four feet).

Sharrows should be placed in straight lines to encourage the bicyclist to travel in a straight line. This often means the sharrows are in the center of the lane, greater than the minimum guideline of four feet or 11 feet from the curb. Sharrows should always be placed outside the "door zone" where on-street parking is provided.



CLASS IV SEPARATED BIKE LANES ▶▶▶



TYPICAL APPLICATIONS

Facility Design

Separated bike lanes, sometimes called “protected bike lanes” or “cycle tracks”, provide a physical barrier between the bike lane and the adjacent travel lanes, parking lanes, and sidewalks. They are most effective in attracting users who are concerned about conflicts with motorized traffic.

Separated bike lanes may be one-way or two-way. They may also be at the level of the street, at the level of the sidewalk, or between the two. If they are at the sidewalk level, different pavement colors and textures separate the bike lanes from the sidewalks. If at the street level, they can be separated from the travel lanes by physical barriers. If there is on-street parking, they are placed between the sidewalk and parking.

Adherence to Design Guidelines

The design guidelines issued by Caltrans for Class IV separated bike lanes are compliant with HDM Chapter 1000 and the CA MUTCD.

Types of Separation

The methods of vertical separation can be implemented with a variety of design approaches. Separated bike lanes can be separated from motor traffic by raised medians, concrete curbs, landscaping, on-street parking, bollards, flexible delineator posts, or by a change in elevation between the bike lane and the travel lane.

Intersection Design

Separated bike lanes tend to work most effectively where there are few uncontrolled crossing points with unexpected traffic conflicts. These concerns include treatment at intersections, uncontrolled midblock driveways and crossings, and difficulty accessing or exiting the facility at midblock locations.

If the separated bike lanes are protected by parking, parking should be prohibited near the intersection to improve visibility. The recommended no-parking zone is 30 feet from each side of the intersection crossing.

Two-stage turn queue boxes should be provided to assist in making turns from the separated bike lane facility.

A dedicated bicycle signal phase can prevent conflicts at intersections between turning vehicles and bicyclists.

Markings

Pavement stencils of a bicycle and arrow markings shall be placed at the beginning of a separated bike lane facility and at periodic intervals along the facility to define the bike lane direction and designate that portion of the street for preferential use by bicyclists.

Maintenance

The separated bike lane area to be used by bicycles should be designed with adequate width for street sweeping to ensure that debris will not accumulate.

Adherence to ADA Considerations

When providing accessible parking spaces along separated bike lanes, the following design considerations are recommended to accommodate persons with disabilities in the design of one-way and two-way separated bike lanes:

- > Widened buffer space to accommodate a side mounted vehicle ramp or lift
- > Mid-block curb ramps and tactile surfaces may be provided near accessible parking spaces
- > Roadway cross-slopes that do not exceed a 2% grade
- > If bollards are used, to consider placement of bollards that avoid impeding access by disabled users



ONE-WAY PROTECTED BIKE LANES

One-way separated bike lanes are bikeways that are at street level and use a variety of methods for physical protection from motor traffic. They are generally placed on both sides of the street.

Recommended Widths

The minimum recommended width for a one-way separated bike lane is five feet, although six feet is preferred. In areas with high bicyclist volumes or uphill sections, the recommended minimum width is seven feet to allow for bicyclists passing each other.

At least three feet is recommended for a parking buffer to allow for passenger loading and to prevent “dooring” crashes. Without a parking buffer, two feet is preferred.

BIKEWAY INTERSECTIONS ►►►



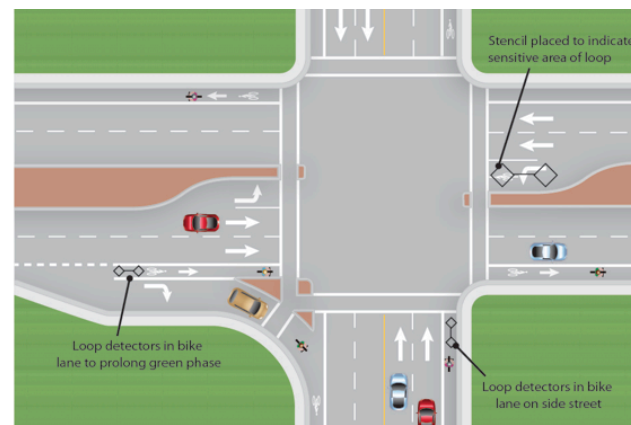
Intersections are junctions at which different modes of transportation meet and facilities overlap. A well-designed intersection facilitates the interchange between bicyclists, pedestrians, motorists, and transit so traffic flows in a safe and efficient manner. Designs for intersections with bicycle facilities should reduce conflicts between bicyclists (and other vulnerable road users) and vehicles by heightening visibility, denoting a clear right of way, and ensuring that the various users are aware of each other. Intersection treatments can resolve 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 additional elements such as color, signs, medians, signal detection, and pavement markings. Intersection design should take into consideration existing and anticipated bicyclist, pedestrian, and motorist 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, the adjacent street function, and the adjacent land use.

BIKEWAY MARKINGS AT INTERSECTIONS

Continuing marked bicycle facilities at intersections (up to the crosswalk) ensures that separation, guidance on proper positioning, and awareness by motorists are maintained through these potential conflict areas. The appropriate treatment for



right-turn only lanes is to place a bike lane pocket between the right-turn lane and the right-most through lane. If a full bike lane pocket cannot be accommodated, a shared bicycle/right-turn lane can be installed that places a standard-width bike lane on the left side of a dedicated right-turn lane. A dashed strip delineates the space for bicyclists and motorists within the shared lane. This treatment includes signs advising motorists and bicyclists of proper positioning within the lane. Sharrows are another option for marking a bikeway through an intersection where a bike lane pocket cannot be accommodated.

BIKE BOXES

A bike box is a designated area at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible way to get ahead of queuing traffic during the red signal phase. Appropriate locations include:

- > At signalized intersections with high volumes of bicycles and/or motor vehicles, especially those with frequent bicyclist left-turns and/or motorist right-turns
- > Where there may be right or left-turning conflicts between bicyclists and motorists
- > Where there is a desire to better accommodate left-turning bicycle traffic
- > Where a left turn is required to follow a designated bike route or boulevard or access a shared-use path, or when the bicycle lane moves to the left side of the street
- > When the dominant motor vehicle traffic flows right and bicycle traffic continues through (such as at a Y intersection or access ramp)

