BIKE-RELATED STANDARDS

CHAPTER 3

3.1 STREET RELATED MANUALS

3.2 BIKE FACILITY DESCRIPTION

3.3 BIKE-RELATED STANDARDS USED IN THE CITY OF MERCED

3.4 RECOMMENDATIONS

3.1 Street-Related Manuals

In response to the State mandate for complete streets, California cities, including the City of Merced, are looking at ways to adjust the way they design and construct their streets. Existing standards and guidelines may prevent them from making the changes they seek, however. There are various local, state, and federal road design standards and guidelines. The following discussion of street-related manuals is provided to remove any confusion that may exist as to:

- What the City of Merced must follow
- What is merely guidance
- When the City can adopt its own standards
- When the City can use designs that differ from existing standards

To plan and construct a successful bicycle system, it is critical to understand these standards and guides. The most important of those standards and guides are the following:

- The American Association of State Highway and Transportation Officials' (AASHTO) *A Policy on Geometric Design of Highways and Streets* (the "Green Book")
- The California *Highway Design Manual*
- The *Manual on Uniform Traffic Control Devices* (MUTCD)
- The California Fire Code
- The California Streets and Highways Code and California Vehicle Code
- Local manuals or street design standards

3.1.1 The "Green Book"

The Green Book, otherwise known as the *American Association of State Highway and Transportation Officials' (AASHTO) A Policy on Geometric Design of Highways and Streets* provides guidance for designing geometric alignment, street width, lane width, shoulder width, medians, and other street features. The Green Book applies only to streets and roads that are part of the National Highway System (NHS). These are Interstate Freeways, principal routes connecting to them, and roads important to strategic defense. Although the Green Book's application is limited to these streets, some cities apply its recommendations to all streets. [1]

3.1.2 The California Highway Design Manual

The *California Highway Design Manual* (HDM) applies only to State Highways and State Bikeways within local jurisdictions. If cities deviate from the minimum widths and geometric criteria for bikeways spelled out in Chapter 1000, they are advised to follow the exemption process or experimental process as applicable. The HDM does not establish legal standards for designing local streets. However, like the Green Book, some cities apply HDM guidance to all streets. [1]

3.1.3 The Manual on Uniform Traffic Control Devices (MUTCD)

The MUTCD provides standards and guidance for the application of all allowed traffic control devices including roadway markings, traffic signs, and signals. The Federal Highway Administration oversees application of the MUTCD. California cities must follow the California MUTCD, which generally mirrors the federal MUTCD, but not always. The rules and requirements for the use of traffic control devices are different than for street design criteria. Local agencies have limited flexibility to deviate from the provisions of the California MUTCD in the use of traffic control devices due to the relationship between the MUTCD and state law. [1]

3.1.4 The California Fire Code

The *National Fire Code* has been adopted by the State of California. This code includes a design requirement for a minimum of 20 feet of an unobstructed clear path on streets, unless exempted by the local fire department. [1]

3.1.5 CA Streets and Highways Code and CA Vehicle Code

The *California Streets and Highways Code* and the *California Vehicle Code* include laws that must be followed in street design. These are embodied in the California MUTCD. Changes to the Streets and Highways Code and the Vehicle Code may cause the California MUTCD to change. [1]

3.1.6 Local Manuals and Street Design Standards

Cities are authorized to adopt or modify their own practices, standards, and guidelines that may reflect differences from the Green Book and the HDM.

NOTE: See Discussion in Section 3.4 for a description of what bike-related standards the City of Merced uses.

3.2 Bike Facility Descriptions

3.2.1 Introduction

Bike Facilities is a generic term for all types of bike-related improvements. Bike facilities fall into one of two broad categories: 1) Bikeways; and, 2) Bike Support Facilities. Bikeways generally consist of linear areas used for bike travel, whereas support facilities include items located along these paths such as bikeway undercrossings (or other safe methods to cross a road), drinking fountains, parking, signage, and lights. The discussion that follows describes bike-related improvements in terms of definitions, characteristics, and standards.

NOTE: It is important to note that while Caltrans standards will be met, where appropriate, to the extent consistent with the City's fiscal priorities, and that can be accommodated within the financial constraints of the City.

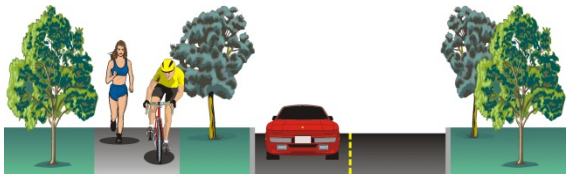
3.2.2 Bikeways

"Bikeway" is a generic term for any road, street, path, or way which in some manner is specifically designated for bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other transportation modes. The *Caltrans Highway Design Manual (Chapter 1000)* provides specific design criteria for the different types of bike facilities.[3] Bikeways can be "off- road" or "on-road."

Off-road bikeways are trails and dedicated paths that are available to bicyclists which offer significant separation from motorized vehicle traffic

On-Road bikeways are located within or immediately adjacent to motorized vehicle travel lanes or on-street parking areas. Bicyclists riding on a roadway are granted all of the rights and are subject to all of the responsibilities applicable to the driver of a vehicle, with certain exceptions.

CLASS I – BIKE PATH



DEFINITION:

A bike path, or Class I bikeway, is a separate off-road bikeway that runs within its own right-of-way and does not share a road or street right-of-way with motor vehicles.

BICYCLE PATH CHARACTERISTICS:

- Bike paths are intended for the exclusive use of bicyclists, although they can also be utilized by pedestrians.
- Pathways are completely separated from motor vehicles by space or physical barrier, and have minimal cross-flow by motor vehicles (e.g. at driveways, roads and street intersections).
- Primarily used for recreational purposes along open space corridors, though they may be used for bike-related commuting too.
- Bike paths are physically separated from automobile traffic so that bicycles are not forced to travel in directions opposite the direction of travel of motor vehicles.
- Bike paths have relatively straight alignments that provide bicyclists good visibility and smooth turns.

BICYCLE PATH STANDARDS:

In many cases, an existing bike path or multi-use trail will not meet Caltrans design standards. For safety reasons and because most federal and state funding is geared towards transportation facilities, this master plan recommends that Caltrans standards be met wherever possible:

- The minimum paved area for a two-way bike path is eight feet, with at least two feet of shoulder on each side, although three feet is recommended. The preferred paved width of bike paths is at least 12 feet, especially where bicycle traffic is expected to be heavy. Widths greater than eight feet are also needed if significant pedestrian traffic is anticipated, although such dual use is undesirable; the preferred solution is to provide separate bicycle and pedestrian facilities.
- Consistency with the Americans with Disabilities Act (ADA).
- If equestrians and/or heavy equipment (including fire trucks) are expected to use the facility, the vertical clearance should be 12 feet minimum.
- Landscaping should be low maintenance and low water types. Use or preservation of native materials, especially along riparian habitats, is recommended. Lighting should be provided along bike paths if open after dusk. Lighting standards may be similar to street standards.
- Barriers (gates) should provide for disabled access (5 feet minimum between bollards). Barriers to prevent motorcycle entry onto bike paths should be constructed; all barriers should be removable by emergency vehicles.
- Provide striping and signing for speed limits, stop, slow warnings, and bike path.
- Construct bike path to accommodate maintenance vehicles (Note: Path sweepers may require more than 8 feet of vertical clearance. An evaluation should be performed on proposed undercrossings between the cost of providing additional headroom and the impact on sweeping operations).
- Direct pedestrians to unpaved path when opportunity exists.
- Provide adequate fencing (54-inch minimum) to protect privacy of neighbors.
- Provide at least 2 feet of unpaved shoulder for pedestrians where feasible.
- Provide trail head facilities (portable restroom, parking, drinking fountain) at appropriate locations.
- Maximum speed will be 15 mph unless otherwise posted.
- Minimum 5 feet of separation between bike path and adjacent roadway unless a barrier is provided.
- 2 percent cross slope should be provided for drainage.
- All curve radii, super elevations, stopping sight distances, and lateral clearances on horizontal curves should conform to Caltrans *Highway Design Manual,* Chapter 1000, specifications.

MULTI-USE PATH (SIDEWALK BIKEWAY)

{The following paragraphs about "Sidewalk Bikeways" is from Chapter 1000 of the California Highway Design Manual Index 1003.3 -Class III Bikeways]

In general, the designated use of sidewalks (as a Class III bikeway) for bicycle travel is unsatisfactory. It is important to recognize that the development of extremely wide sidewalks does not necessarily add to the safety of sidewalk bicycle travel, as wide sidewalks will encourage higher speed bicycle use and can increase potential for conflicts with motor vehicles at intersections, as well as with pedestrians and fixed objects.

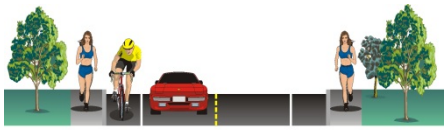
Sidewalk bikeways should be considered only under special circumstances, such as:

> *(a) To provide bikeway continuity along high speed or heavily traveled roadways having inadequate space for bicyclists, and uninterrupted by driveways and intersections for long distances.*
>
> *(b) On long, narrow bridges. In such cases, ramps should be installed at the sidewalk approaches. If approach bikeways are two-way, sidewalk facilities should also be two-way.*

Whenever sidewalk bikeways are established, a special effort should be made to remove unnecessary obstacles. Whenever bicyclists are directed from bike lanes to sidewalks, curb cuts should be flush with the street to assure that bicyclists are not subjected to problems associated with crossing a vertical lip at a flat angle. Also, curb cuts at each intersection are necessary. Curb cuts should be wide enough to accommodate adult tricycles and two-wheel bicycle trailers.

In residential areas, sidewalk riding by young children too inexperienced to ride in the street is common. With lower bicycle speeds and lower auto speeds, potential conflicts are somewhat lessened, but still exist. Nevertheless, this type of sidewalk bicycle use is accepted. But it is inappropriate to sign these facilities as bikeways. Bicyclists should not be encouraged (through signing) to ride facilities that are not designed to accommodate bicycle travel.

CLASS II – BIKE LANE



DEFINITION:

A Bike Lane, or Class II bikeway, is a bikeway established within the paved area of a road or street and shares the roadway with motor vehicles, demarked by painted stripes, pavement markings and signage. Bike lanes are intended to promote an orderly flow of traffic, by establishing specific lines of demarcation between areas reserved for bicycles and lanes to be occupied by motor vehicles. Bike lane signs and pavement markings support this effect. Bike lanes can increase bicyclists' confidence that motorists will not stray into their path of travel.

BICYCLE LANE CHARACTERISTICS:

- Bike lanes are appropriate on busy urban thoroughfares. They may also be used on other streets where bicycle travel and demand is substantial.
- Bike lanes provide preferred, but not exclusive use to bicyclists (see exceptions below).
- Motor vehicles or pedestrians are not allowed in bike lanes, but vehicle cross-flow is allowed to access on-street parking.
- Lane designated by solid white striping, and dashed striping at intersection approaches, where vehicles may cross to make turns.

BICYCLE LANE STANDARDS:

- Where no curbside parking is allowed, bike lanes should generally be 5 feet wide in each direction, as measured from the curb. Where the paved width is inadequate, bike lanes can be narrowed to 4 feet, but only if absolutely necessary.
- Bike lanes should extend at least 3 feet beyond the edge of the gutter.
- Where curbside parallel parking is allowed, the area delineated as a bike lane should be at least 13 feet wide to accommodate a 7-foot parking lane, a 3-foot buffer zone for opening car doors, and a minimum 3-foot bike lane beyond the door zone. However, if absolutely necessary, a bike lane with parking can be narrowed to eleven feet. Bike lanes are not recommended in areas where perpendicular or angle parking is allowed, due to the poor site lines for motor vehicles backing into the street.
- Bike lanes are to be delineated by 6-inch-wide, continuous striping.
- On arterial streets where parking is allowed and demand is high, a second stripe should delineate the bike lane from the parking lane.
- It is often possible to re-stripe existing multi-lane streets to provide space for bike lanes.
- Bike lane standards are well defined by Caltrans, and are the preferred on-street system for the *2013 BTP*. Caltrans has specific standards for Class II lanes such as striping (solid 6-inch white stripe), and signing (at the beginning of each bike lane, at the far side of each arterial crossing, and at change in directions). Wherever existing bike lanes do not meet Caltrans design standards, they should be improved. If improvements cannot be done, they should not be identified as an official Class II bike lane.

Bike lanes should conform to Caltrans standards on all existing and proposed roadways. Sub-standard bike lanes should be designated as Class III bikeways, unless they are programmed for upgrading to meet Caltrans Class II standards.

OTHER DESIGN STANDARDS INCLUDE:

- Bike lanes should be located on the right hand side of one-way streets. The ability to install all of these improvements is dependent on the available right-of-way and need, but should also apply to all new intersections along the proposed route.
- Where possible, four-foot pockets should be provided at intersections between the right turn only lane and the through lane.
- Signal loop detectors should be provided at major signalized intersections unless pre-timed signal coordination is in effect.

CLASS III – BIKE ROUTE

DEFINITION:

A bike route, or Class III bikeway, is a bikeway that shares the street with motor vehicles, but is located to the side of a travel lane, not within a travel lane as are sharrows (see below). A bike route contains signs, but no stripes. Class III bike routes, to be avoided if possible, are used only to connect or continue Class I or II facilities for short distances. In general, as discussed above under "Multi-use Path/Sidewalk Bikeway," the designated use of sidewalks as a Class III bikeway for bicycle travel is unsatisfactory.

BIKE ROUTE CHARACTERISTICS:

- Bike routes are common on neighborhood residential streets, on rural roads, and low-volume highways.
- Bike routes should be primarily used in small street segments that provide a connection from a discontinuous Class II bike lane.

BICYCLE ROUTE STANDARDS:

The decision to select and sign a bicycle route should be based on the advisability of encouraging bicycle travel in the corridor. Adequate width for a bike route depends on the volume, speed, and mix of traffic, the presence or absence of a paved shoulder, surface condition, grade, curves, sight distance, obstacles such as parked cars, and the skill of bicyclists using the road.

Bike routes should provide a higher level of service than other streets and roadways to bicyclists, as defined as follows:

- Provide for through and direct travel in bicycle-demand;
- Connect discontinuous segments of bike lanes;
- Access traffic control priority at intersections;
- Removal of parking in areas of restricted width;
- Correction of surface imperfections or irregularities; and,
- Maintenance at a higher standard than comparable streets.

Bicycle routes should be provided on the proposed system if any of the requirements described for Class II bicycle lanes cannot be met. Bicycle routes, while lacking striped lanes, should provide the following where practical:

- Detectors at signalized intersections;
- Curb travel lanes at least 14 feet wide (excluding parking), or 21 feet including parking;
- Warning signs to motorists;
- Directional signs to bicyclists; and,
- Adequate pavement conditions and maintenance.

SHARROWS

DEFINITION:

A shared lane marking, or Sharrow, is a bikeway with markings on the ground to: 1) show bicyclists the correct direction of travel; 2) remind bicyclists to ride further from parked cars to prevent "dooring" collisions; and, 3) alert road users of the lateral location bicyclists are likely to occupy within the traveled way.

The bike sharrows were introduced into the MUTCD 2009 edition and are still being studied. Based on guidance from the Bicycle Friendly Community, as well as many bike transportation professionals from local jurisdictions who have deployed this type of bikeway, it is strongly recommended that significant public outreach occur to inform the community of its meaning and use to bicyclists and operators of motor vehicles alike. Due to the lack of knowledge to motorists and bicyclists around the community about sharrows, education should be key in preventing potential accidents.

The Bicycle Friendly Community and the Oregon Department of Transportation provided much of the guidance and standards below:

SHARROW CHARACTERISTICS:

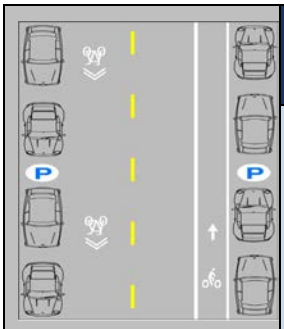
- Encourages safe passing of bicyclists by motorists
- Reduces the incidence of wrong-way bicycling

SHARROW GUIDANCE:

- Provide a lot of education
- Do not place on major arterials; if used, place on streets with low traffic amounts
- Use on streets with low speeds (20-35 mph)
- Place in rural or residential neighborhoods
- Place on narrow streets so motorists are encouraged to pass cyclist
- Place on roads with high bicycle demand
- On streets with posted 35 mph speeds or faster and motor vehicle volumes higher than roughly 3,000 vehicles per day (vpd), shared lane markings are generally not a preferred treatment. On these streets other bikeway types are preferred.

SHARROW STANDARDS

- Shared Lane Marking should be placed immediately after an intersection and spaced at intervals of 50 to 100 feet along busier streets and up to 250 feet in low traffic streets. [4]
- The Shared Lane marking in use within the United States is the Bike-and-chevron "sharrow," illustrated in MUTCD figure 9C-9.[5]
- Shared lane markings shall not be used on shoulders or in designated bicycle lanes.
- On streets with posted 25 mph speeds or slower, preferred placement is in the center of the travel lane to minimize wear and encourage bicyclists to occupy the full travel lane.

	**On-Street Parallel Parking**		**Diagonal Parking**
	The center of the marking should be at least 11 ft from the curb, or greater to assure marking is in the middle of the travel lane, unless waived.		**The center of the marking should be in the middle of the traffic lane. Where street width has space for bike lane in only one direction place marking in middle of lane. [8]**

BIKE BOULEVARD

DEFINITION:

A Bicycle Boulevard is a street that has been modified to prioritize through bicycle traffic and discourages motor vehicle traffic. Traffic calming devices control traffic speeds and discourage through trips by automobiles. Traffic controls limit conflicts between vehicles and bicyclist and give priority to through bicycle movement at intersections.

BIKE BOULEVARD STANDARDS:

- Select a direct and continuous street, rather than a circuitous route that winds through neighborhoods.
- This works best on a street grid system.
- Place motor vehicle traffic diverters at key intersections to reduce through motor vehicle traffic.
- Turning stop signs towards intersecting streets, so bicyclist can ride with few interruptions.
- Place traffic-calming devices on streets to lower motor vehicle traffic speeds.
- Place directional signs or markings to route cyclists to key destinations, to guide cyclists through difficult situations, and to alert motorists of the presence of bicyclists.
- Provide crossing improvements where the boulevard crosses high speed/high-volume streets like:
- Signals, where a traffic study has shown that a signal will be safe and effective and to ensure that bicyclists can activate the signal.
- Loop detection should be installed where bicyclists ride and/or a push button that won't require dismounting.
- Provide median refuges, wide enough to provide a refuge (8 feet min) and with an opening wide enough to allow bicyclists to pass through (6 feet). The design should allow bicyclists to see the travel lanes they must cross.

3.2.3 Bike Support Facilities and Activities

Several types of support facilities and activities can be deployed to encourage bicycle commuting to work, commercial centers, public offices, parks, colleges and schools. These include, but are not limited to:

Bike Support Facilities	
Undercrossing	Used to provide a safe crossing under the road for a Class I bikeway.
Parking	Include secure racks, lockers, storage rooms, and valet service.
Showers	Allow bicyclists to refresh themselves before starting work or school.
Lockers	For storing a change of clothes.
Water Fountains	Along paths for refreshment.
Lighting	Along bikeways to increase safety and security
Repair Depots	Along bikeways providing air, water, and basic tools for bicycle repair.
Transit Connections	Includes bike racks/storage at transit centers and bike racks on buses.
Bikeway Trailhead Facilities	Includes such items as restrooms, parking, and drinking fountains.
Bridges	Widened road bridge, pedestrian/bike over roads.
Bike Detection Loops/Video/Push-Button	
Bike Commuter Map	Guide citizens and visitors to navigate Merced bikeways.
Signs	Provide directional, way-finding, and safety information.
Bike Rodeos	Educate citizenry about traffic safety laws.
Bike to Work Week Events.	

3.2.4 Bike Route Signage Standards

BIKE ROUTE/PARKING SIGNS

G93

G93A

G93B

WHITE ON GREEN

G93C

GREEN ON WHITE

The BIKE ROUTE signs (G93) may be used to mark bicycle routes, lanes, or paths may be used on the right along designated bike lanes. At turns, the sign shall be supplemented with G33 directional arrows. Special guide signs indicating high demand destinations (e.g., “To Downtown” may be placed beneath the G93 sign.

The BEGIN and END plates (G93A, G93B) may be used to supplement the G93 sign.

The BIKE PARKING sign (G93C) may be used to identify bicycle parking at Park and Ride lots and should be used at other bicycle parking facilities. The sign is to be placed at or near the parking area, or in any case, where the sign can be easily seen by traffic on the adjacent street.

3.3 Bike-Related Standards Used in the City of Merced

Sections 3.2 and 3.3 discussed the *Street-Related Manuals* and *Bike Facility Descriptions*, respectively. In Section 3.5, application of bike related standards is discussed in an effort to clarify which bike-related standards are to be used in the City of Merced. The discussion also sheds light on opportunities to update the City's Official Design Manual, the *Standard Design of Common Engineering Structures.*

3.3.1 City of Merced Bicycle-Related Design Standards

Transportation-related improvements within the City conform to the Green Book as augmented by the City of Merced's local manual, *Standard Design of Common Engineering Structures*, and the *State of California: Business, Transportation and Housing Agency, Department of Transportation Standard Specifications*. The *Work Area Traffic Control Handbook* (WATCH) is adopted as supplementary referral.

The right is reserved by the City Engineer to modify the attached standards to fit individual situations. The local standards are a result of much seasoning and refinement. In many cases, they have been developed to their present state by continued use and modification over a period of many years. From time to time, new standards are added, and as need becomes apparent, we may revise those already in existence.

As with prior versions of the City's Bicycle Transportation Plan (BTP), the *City of Merced 2013 BTP* includes design standards for most bikeways and bike support facilities. The City's *Standard Design of Common Engineering Structures* includes standards for only some bikeways and support facilities, however. The standards provided in the *2013 BTP*, where absent from the City's *Standard Design of Common Engineering Structures,* and specifies the minimum or greater standards than state guidelines or standards, may be used in designing public and private improvements in the City of Merced until such time as the City's standard designs are updated.

Table 3.1 on the next page shows where the City's *Standard Design of Common Engineering Structures* does not address bikeways and support facilities, and where the standards in the BTP (Section 4.3), within the threshold described above, will be used to design public and private improvements in the City of Merced.

3.3.2 Bikeways and Support Facilities in the City's Design Manual

As part of the *2013 BTP*, a simple needs assessment was prepared showing whether or not the *City of Merced Standard Design Manual* included standards for bikeways and bike support facilities (by a ✓ mark) ; the results are presented in Table 3.1 below.

Table 3.1: Bicycle Facility Types Included in the City's Design Manual

Bicycle Facility Types		Bicycle Support Facilities
Bikeways		**Undercrossings**
Class I Bike Path	**(✓)**	**Bike Parking**
Offset Bikeway Access	**(✓)**	**Bike Showers**
Bikeway Barrier	**(✓)**	**Bike Lockers**
Class II Bike Lanes	**(✓*)**	**Water Fountains**
Class III Bike Routes		**Lighting for Class I Bikeway**
Sharrows		**Bike Repair Depots**
Bike Boulevard		**Bikeway Trailhead Facilities**
		Pedestrian/Bike Bridges
		Bike Detection Loops/Video/Push-Button
*** - An update is needed to reflect new policies in the City's General Plan.**		

3.3.3 Public Review Process

A wide range of public improvement types, locations, and settings occur in the City of Merced. Depending upon the nature of the improvement or site, the City could elect to broaden public outreach. Generally, identification and selection of projects, as well as election to seek grant funds for projects, are guided by established City policy and planning documents. The BAC has jurisdiction to review and advise the City on changes and updates to the *2013 BTP*, General Plan, Municipal Code and other policy documents which relate to bicycling.

Then, as part of the detailed design phase of a project, field surveys, engineering assessments, and public input will occur to create a detailed project description. As they relate to bicycling, the Bicycle Advisory Commission reviews and advises the City on the design of capital improvement projects, street improvements, and parking facility projects, not including matters pertaining to pedestrian issues.

Public meetings are held on even-numbered months where these topics are discussed by City Staff, the BAC, and interested members of the public.

3.4 Recommendations

Over the course of the last 25 years, the City of Merced has shown a serious commitment to creating a bicycle friendly community investing over 4 million dollars in developing its bikeway system. The *2013 BTP* continues that tradition by including over 100 potential projects for bikeways, support facilities, and other related activities and tasks. The *2013 BTP* accomplishes one-step of several to fully realize the development of the listed projects. The ability to accomplish projects, however, is dependent upon a dynamic setting of funding and staff resources as they apply to all steps, which include:

- ***Describing the community vision (the BTP)***
- ***Having available local funding sources***
- ***The ability and success to compete for and be awarded state and federal grant funds***
- ***Completed environmental reviews***
- ***Completed engineering and design***
- ***Continued community support for projects***

Thus, while the *2013 BTP* is a significant initial step toward realization of the City's intent to construct bikeways and support facilities, the scope and function of the *2013 BTP* is to identify the desired possibilities of the community which may be implemented during the 5-year life of the BTP.

3.4.1 Bicycle Design Standards

As new bikeways are planned for and constructed, the *Official City Design Standards* should be updated to include such bikeways. For example, standard designs are needed for sharrows and bike boulevards. The City's Standard Designs should also be amended to be consistent with the guidelines and standards in this section.

3.4.2 Road Standard Recommendations

TRAFFIC SIGNALS

Where bicyclists and pedestrians must cross roads with traffic levels high enough to warrant signals, seek to provide bicycle-activated signals at such intersections where bikeways are within the roadway, and push button signal activators where they are not within the roadway, but are on a separate path or on the sidewalk.

Priority sites for this upgrade include major intersections on the proposed bikeway network, and at locations where school children cross a busy street to gain access to school.

As intersections are upgraded, consider the installation of bicycle sensors at all signalized intersections in the bikeway system Sensors should be appropriately placed, and sensitive to detect most bicyclists.

In specific intersections where future bicycle vs. vehicle traffic volumes and resulting safety conflicts are expected to be high, such as near the UC Merced Campus when student attendance grows, consider installing bicycle signal heads at those crossings. Bicycle signal heads are commonly used in Europe and have proved their effectiveness in other college towns.

TRAFFIC CALMING

Serious consideration should be given to creating traffic calmed streets, which will provide safer conditions for bicycle riders. There are a variety of ways to slow and/or discourage traffic on certain residential streets. Traffic circles, chicanes, traffic diverters, and signs are just a few of the options for traffic calming.

ROAD SURFACES

Consider establishing standards regarding uniform pavement edges and pothole repair, particularly on roadways shared by bikeways.

Consider a bikeway improvement and maintenance system as an element of existing pavement management systems, in the local Department of Public Works, where all observed and recorded hazardous conditions are listed, and scheduled for replacement or repair.

Obstructions and potholes should be repaired as soon as possible after being reported. As a part of the City's current effort to develop citizen complaint tracking systems, include a link for cyclists to report problems and request maintenance services in specific areas.

DRAINAGE GRATES

Install drainage grates that have openings that run perpendicular to the direction of bicycle travel, and seek to replace grates that run parallel. Require grates with openings perpendicular to the direction of bicycle travel, or with "waffle" patterns that do not trap bicycle tires regardless of the direction in which they are installed or tire size.

RAILROAD CROSSINGS

Consider adopting specific guidelines for all railroad crossings and other potential hazards to bicyclists that meet Caltrans or other relevant guidelines. All railroad crossings will be at 90 degrees, preventing bicycle wheels from becoming lodged.

MAINTAIN CLEAR ZONES FOR BIKE TRAVEL

Where maintenance operations, roadway improvement projects, or other operations are likely to cause disruptions to bicycle facilities, require the provision and maintenance of a clear, safe passage to bicycles, as would be required for automobile traffic, including the placement of construction signs, equipment, and vehicles out of bikeways.

TRENCHING AND REPAIR

Where trenching or repair of roadway surfaces designated for bicycle traffic requires replacement or repair of roadway surfaces, require that such repairs or replacement of pavement extend the full width of the bicycle facility, in order to minimize joints, grooves, or other disruptions to bicycles.

SWEEPING

Consider establishing a regular schedule for sweeping bikeways that ensures that bikeway surfaces are clean and safe. Each Class I bikeway should be scheduled for sweeping at least four times per year, more frequently in areas where tree or other debris on paths tends to be a nuisance. Establish a volunteer maintenance program where the City organizes weekly work parties and provides support. Bike paths may be "adopted" by corporations or clubs and maintained by them, in exchange for public acknowledgment.

On-street bikeways are swept twice per month to control road debris hazards. Streets in the downtown maintenance district are swept three times per week. Enable the Public Works Department to schedule these and other areas at a higher frequency, as needs arise.

3.4.3 New Development Standards

Density

Plan for new residential, commercial, and employment development at a density and mix of uses that support bicycle, pedestrian, and other non-motorized forms of transport.

Continuous, Uninterrupted Bicycle and Pedestrian Systems

Plan for new development that allows full, continuous, and uninterrupted access for bicycle, pedestrian, and other non-motorized forms of transport at build-out. Limit dead-end cul-de-sacs, unless bicycle and pedestrian connections between such streets are provided to adjoining streets. Continuous access systems, such as the traditional grid or modified grid are preferred over cul-de-sacs. The street system should be clear, and paths and routes should be clear and clearly marked.

Consider placing directional signing, with approximate distances to certain points, for bicycle path users to help guide them towards their school, shopping, or work destinations.

Frequent, Safe Crossings

Plan roads that have frequent, safe crossings. Plan for bicycle-activated signals where bicyclists use the roadway or manually controlled traffic signals where they do not. Plan for clearly marked crossings.

Integrate Bicycle, Pedestrian Facilities And Systems, And Transit System Routes

Provide for bicycle and pedestrian access adjacent to all new public roads, and work in tandem with local public transit systems to find the most ideal transit stops, facilities, and designs in order to effectively integrate all modes of transportation. Also, other modes of transportation such as train stations should also be integrated with bicycle facilities, if possible.

Crime Prevention Through Design

Implementing Action P-3.2.h of the *Merced Vision 2030 General Plan* states, “Bike path designs should reflect security and other needs of the surrounding community.” If feasible, bikeways should be designed with multiple access points from surrounding neighborhoods so there is sufficient visibility from public roadways to facilitate surveillance by residents and police patrols. Where feasible, bike paths should be designed so that at least one side is open to a public street. Situations where bike paths are located along the back sides of homes with limited visibility should be avoided as much as possible. Open fencing along bike paths should be considered, especially adjacent to multi-family developments.

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Study Results

- Shared Lane Marking reduces the number of wrong way riders by 80%.[6]
- Shared Lane Marking reduces the number of sidewalk riders by 35%.[6]
- Shared Lane Marking shows better motorist behavior as seen through:

  More likely to change lanes when passing, less likely to pass, and less likely to encroach on the adjacent lane when passing, all indications of safer driving. [7]