

5.0 Design and Maintenance Standards

This chapter provides details on the recommended design and operating standards for the Alameda Bikeway System.

5.1 Existing Bicycle Design Standards and Classifications

National design standards for bikeways have been developed by the American Association of State Highway and Transportation Officials (AASHTO) and the California Department of Transportation (Caltrans). The Caltrans Highway Design Manual, Chapter 1000: Bikeway Planning and Design, serves as the official design standard for all bicycle facilities in California. Design standards in Chapter 1000 fall into two categories, mandatory and advisory. Caltrans advises that all standards in Chapter 1000 be followed, which also provides a measure of design immunity to the City. Not all possible design options are shown in Chapter 1000. For example, intersections, ramp entrances, rural roads, and a variety of pathway locations are not specified in the Caltrans Highway Design Manual.

The following section summarizes key operating and design definitions:

Bicycle	A device upon which any person may ride, propelled exclusively by human power through a belt, chain, or gears, and having either two or three wheels in tandem or tricycle arrangement.
Class I Bikeway	Variouly called a bike path or multi-use trail. Provides for bicycle travel on a paved right of way completely separated from any street or highway.
Class II Bikeway	Referred to as a bike lane. Provides a striped lane for one-way travel on a street or highway.
Class III Bikeway	Referred to as a bike route. Provides for shared use with pedestrian or motor vehicle traffic.

Graphic descriptions of Class I, II, and III bikeways are shown in Figure 1 on page 17.

5.2 General Design Recommendations

5.2.1 *Conform to Caltrans and Other Appropriate Design Guidelines for All Bikeways*

1. All designated Class I, II, or III bicycle facilities shall conform where feasible to the Caltrans Highway

Design Manual Chapter. As stated in the Highway Design Manual (p. 80-1): the design standards used for any project should equal or exceed the minimum given in the Manual to the maximum extent feasible, taking into account costs, traffic volumes, traffic and safety benefits, right of way, socioeconomic and environmental impacts, etc. This philosophy provides for use of lower standards when such use best satisfies the concerns of the given situation. Because design standards have evolved over many years, many existing highways do not conform fully with current standards. It is not intended that current manual standards be applied retroactively to existing streets and highways; such is neither warranted nor economically feasible. Design Exceptions shall be per City Engineer which is in accordance with Caltrans Local Assistance Procedures Manual=s section for Plans, Specifications & Estimates.

Alameda is an older city with a developed street grid system and right of way constraints which require flexibility in the application of bikeway design standards. Design exceptions are anticipated in the already developed urbanized areas for gap closures, however in the new and redevelopment areas the design of facilities should be based on the general principals outlined in the Highway Design Manual, plus other sources such as the U.S. Department of Transportation, Federal Highway Administration (Implementing Bicycle Improvements at the Local Level), The Bicycle Compatibility Index: A Level of Service Concept, Implementation Manual, Selecting Roadway Design Treatments to Accommodate Bicycles, Manual on Uniform Traffic Control Devices, American Association of State Highway Transportation Officials (A Policy on Geometric Design of Highways and Streets), Transportation Research Board (Highway Capacity Manual), and the Institute of Transportation Engineers (Transportation Engineering Handbook), and the Uniform Vehicle Code. Final design shall be approved by a licensed traffic and/or civil engineer.

5.3 Class I, II and III Bikeway Design Guidelines

The following guidelines present the recommended minimum design standards and ancillary support items for Class I bike paths (also referred to as multi-use trails), Class II bike lanes, and Class III bike routes.

5.3.1 All Class I bike paths should generally conform to the design recommendations in Table 4 and Figure 7.

1. Multi-use trails and unpaved facilities that serve primarily a recreation rather than a transportation function and will not be funded with federal transportation dollars may not need to be designed to Caltrans standards.
2. Class I bike path crossings of roadways require preliminary design review. A prototype design is presented in Figure 8. Generally speaking, bike paths that cross roadways with ADTs over 20,000 vehicles will require signalization or grade separation. Most of the proposed multi-use trails do not cross a major arterial at an unprotected location with ADTs over 20,000 vehicles with the exception of the Atlantic Avenue bike pathway proposal which would cross Webster and Constitution in Alameda.
3. Landscaping should generally be low water native vegetation.
4. Lighting should be provided where the bike path will be used by commuters.
5. Barriers at pathway entrances should be clearly marked with reflectors and ADA accessible (min. 5 feet clearance).
6. Bike path construction should take into account impacts of maintenance and emergency vehicles on shoulders and vertical requirements..
7. Provide adequate trailhead parking and other facilities such as restrooms, drinking fountains (at appropriate locations).

Table 4: Class I Bicycle Path Specifications

Pavement Type:	Recycled Asphalt	3"	(75 mm)
	Asphalt ¹	3"	(75 mm)
	Concrete ²	3"	(75 mm)
Sub-Base:	Granite	4-6"	(100-150 mm)
	Gravel	4-6"	(100-150 mm)
Shoulders:	Decomposed Granite	2-4"	(50-100 mm)
Width:	Minimum 1-way Path	5'	(1.5 m)
	Minimum 2-way Path	10'	(3.1 m)
	Preferred 2-way Path	12-15'	(3.6-4.6 m)
Shoulders:		2-3'	(0.6-1.0 m)
Lateral Clearance:		2-3'	(0.6-1.0 m)
Vertical Clearance: w/Equestrians		8-10'	(2.5-3.0 m)
		12'	(3.6 m)
Striping:	Centerline (none, dashed yellow, solid yellow)	4"	(100 mm)
	Edgeline (none or solid white)	4"	(100 mm)
Signing:	(See Caltrans Traffic Manual and MUTCD)		
Minimum Cross Slope:		2%	2%
Minimum Separation from Roadway: ³		5'	(1.5 m)
Design Speed:		20-30 mph	(40-50 kph)
Maximum Super Elevation:		5%	5%
Maximum Grades (over 100'):		5%	5%
Removable Bollards (minimum spacing):		5'	(1.5 m)
Lighting (if night use is expected):		5-22 LUX	5-22 LUX

Source: (Caltrans Highway Design Manual, Chapter 1000)

¹ Asphalt may be unsuitable for bike paths in stream channels due to asphalt oils. Concrete paving is recommended in areas where the trail is subject to regular water flow.

² A 6" concrete thickness may be use directly on compacted native material.

³ Unless a physical barrier is provided.

Figure 7: Class I Bicycle Path Cross Section

Figure 8: Class I Bicycle Path Crossing Prototype

5.3.2: All Class II bike lanes should generally conform to the design recommendations in Table 5 and Figure 9.

1. Intersection and interchange treatment. Caltrans provides recommended intersection treatments in Chapter 1000 including bike lane >pockets= and signal loop detectors. The Department of Public Works should develop a protocol for the application of these recommendations, so that improvements can be funded and made as part of regular improvement projects. Figure 10 (Class II Bike Lanes at Intersections) and Figure 9 (Recommended Right Turn Channelization) provides details for recommended intersection treatments.
2. Signal loop detectors should be considered for all arterial/arterial, arterial/collector, and collector/collector intersections. The location of the detectors should be identified by a stencil of a bicycle and the words >Bicycle Detector=.
3. Bike lane pockets (min. 4' wide) between right turn lanes and through lanes should be provided wherever available width allows, and right turn volumes exceed 150 motor vehicles/hour.

5.4 Other Facilities

In addition to those identified by Caltrans, there are a variety of improvements which will enhance the safety and attraction of streets for bicyclists.

Bicycle Boulevards. Palo Alto pioneered the concept of a bicycle boulevard, which in that city is a street directly parallel to a major commercial corridor that was designed to promote bicycle movement and discourage through vehicle movement. This was achieved by partial street closures and lack of coordinated signals. In addition, wider curb lanes and frequent signing as a >Bicycle Boulevard= helps increase the motorists= awareness. A bicycle boulevard treatment may be applied to Pacific Avenue, San Jose Avenue or Oak Street (after a study of traffic and parking impacts) to make it safer and more usable for residents and as a viable alternative route for bicyclists.

5.4.1: The bicycle boulevard concept should be studied for possible implementation on Pacific Avenue, San Jose Avenue, and Oak Street.

Sidewalks. The use of sidewalks as bicycle facilities is not encouraged by Caltrans, even as a Class III bike route. There are exceptions to this rule. The California Vehicle Code states: >Local authorities may adopt rules and regulations by ordinance or resolution regarding the (...) operation of bicycles (...) on the public sidewalks.= (CA VC 21100, Subdiv. H). Caltrans adds in Chapter 1000: >In residential areas, sidewalk riding by young children too inexperienced to ride in the street

Figure 9: Class II Bike Lane Cross Section
Table 5: Class II Bike Lane Specifications

Minimum Widths Adjacent Parking	5'	(1.5m)
No Parking ⁴	4'	(1.2m)
Combination Parking Lane ⁵	11-13'	(1.2m)
Striping Left side line: solid white stripe	6"	(150mm)
Right side line: solid white stripe	4"	(100mm)
Approach to intersections: Dashed white stripe	100-200'	(30m-60m)

Signing R81 Bike Lane Sign

- β beginning of all bike lanes
- β far side of all bike path crossings
- β at approaches and far side of all arterial crossings
- β at major changes in direction
- β maximum $\frac{1}{2}$ mile (0.8km) intervals

Custom Bike Route Sign with G33 Directional Arrow and destination signs (where needed)

- β see items under R81 Bike Lane Sign
- β at approach to arterial crossings

Pavement Markings "Bike" legend
 "Lane" legend
 Directional arrow

- β see items under R81 Bike Lane Sign
- β at beginning and end of bike lane pockets at approach to intersection

⁴ Minimum 3' (.9m) between stripe and gutter joint.

⁵ Rolled curb 11' (3.3m), vertical curb, 12' (3.6m), 13' (3.9m) recommended with significant parking or turnover.

Source: Caltrans Highway Design Manual, Chapter 1000, MUTCD, Caltrans Traffic Manual

Figure 10: Bike Lane Intersection Design

Figure 11: Recommended Right Turn Channelization

is common. With lower bicycle speeds and lower auto speeds, potential conflicts are somewhat lessened, but still exist. 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.

5.4.2: *Adopt Caltrans recommendations.*

5.5 Other Design Guidelines

Traffic Calming. This includes any effort to moderate or reduce vehicle speeds and/or volumes on streets where traffic has a negative impact on bicycle or pedestrian movement. Because these efforts may impact traffic outside the immediate corridor, study of traffic impacts is typically required. For example, the City of Berkeley instituted traffic calming techniques by blocking access into residential streets. The impact was less traffic on local streets, and more traffic on arterials and collectors. Other techniques include installing traffic circles, intersection islands, partial street closings, >bulb-out= curbs, pavement treatments, lower speed signal timing, and narrowing travel lanes. The City of Alameda already has a relatively continuous street grid system with some filtering of through traffic into residential neighborhoods. Traffic circles, roundabouts, and other measures may be considered for residential collector streets where there is a desire to control travel speeds and traffic volumes but not to install numerous stop signs or traffic signals.

Signing, Striping, and Signalization. All bikeway signing in Alameda should conform to the signing identified in the Caltrans Traffic Manual and/or the Manual on Uniform Traffic Control Devices (MUTCD). These documents give specific information on the type and location of signing for the primary bike system. A list of bikeway signs from Caltrans and the MUTCD are shown in Table 6 (List of Bikeway Signs). Typical signing for a school commute corridor is shown in Figure 12. A typical bike route sign is shown in Figure 13.

5.5.1 *Develop a Alameda Bikeway System logo for use on the primary network. This sign may include a bikeway numbering system that is keyed into a publicly produced bikeway map. An*

example of a Caltrans-approved bicycle route number sign is shown in Fig. 14.

5.5.2: Installing bikeway signs should be a high priority, and may begin immediately on Class III bike route portions of the bikeway network. Examples of bikeway signing at signalized and unsignalized intersections is shown in Figures 15 and 16. Examples of bikeway warning signs are shown in Figure 17.

5.5.3: The City should identify locations in downtown and other employment areas where centralized public covered bicycle parking can be installed, such as parking lots. These facilities may charge a small user fee and/or be subsidized by nearby employers.

Table 6: Recommended Signing and Marking

Table 6 (cont=d): Recommended Signing and Marking

Table 6 (cont=d): Recommended Signing and Marking

Table 6 (cont=d): Recommended Signing and Marking

Figure 12: Signs and Markings within School Zones

Figure 13: Bike Route Sign

Figure 14: Numbered Bike Route Sign

Figure 15: Signing at Unsignalized Intersections

Figure 16: Signing at Signalized Intersections

Figure 17: Warning Signs

5.5.4 *New and retrofitted traffic signals should provide bicycle-sensitive detectors and/or signal buttons near the curb to help bicyclists trigger actuated signals.*

5.6 Monitoring, Maintenance, and Security**5.6.1 Monitoring**

Once the plan has been adopted, a monitoring effort is required to ensure that the recommendations are enforced over time. The following actions are recommended to achieve this.

Action: Identify a bicycle coordinator position, preferably located in the Public Works or General Services Department, who will be responsible for many of the monitoring responsibilities. They will also be responsible for coordinating with planning, recreation and parks, police, and other departments.

Action: Plan Review. All development and infrastructure improvement plans should be routed through the bicycle coordinator to ensure that bikeway segments are implemented, developer requirements are being met, and design standards adhered to.

Action: Accident monitoring. Bicycle-related accident data should be collected annually from the police department and evaluated to determine areas of concern.

Action: Marketing/Public Awareness. The coordinator should assist with promotional and educational events, safety fairs, and programs.

Action: Maintenance. The coordinator should be responsible for an annual maintenance and operations budget, coordinating with the Public Works Department. The coordinator should track long term bike path maintenance, schedule repairs, and respond to calls from the public or staff regarding maintenance needs.

Action: Funding. The coordinator should work closely with agencies such as Caltrans to keep abreast of funding opportunities and prepare application packages.

Action: Enforcement/Security. The coordinator should be responsible for coordinating with the police department to provide needed enforcement and safety education along bike paths. Also, problems regarding security, privacy, vandalism, and crime along bike paths should be addressed through the coordinator.

5.6.2 Maintenance

The total annual maintenance cost of the primary bikeway system is estimated to be \$228,000 when it is fully implemented. A substantial portion of these costs would be borne by either the East Bay Regional Park District or State Parks & Recreation. All of the maintenance costs are associated with the proposed off-road bike paths, as bike lanes and routes are assumed to be maintained as part of routine roadway maintenance. Class I bike path maintenance costs are based on \$8,500 per mile, which covers labor, supplies, and amortized equipment costs for weekly trash removal, monthly sweeping, and bi-annual resurfacing and repair patrols.

Maintenance access on the city-controlled Class I bike paths will be achieved using standard City pick-up trucks on the pathway itself. Sections with narrow widths or other clearance restrictions should be clearly marked. Class I bike path maintenance includes cleaning, resurfacing and restriping the asphalt path, repairs to crossings, cleaning drainage systems, trash removal, and landscaping. Underbrush and weed abatement should be performed once in the late spring and again in mid-summer. Table 6b provides details of standard bikeway maintenance schedule.

Action: Identify a reliable source of funding to cover all new Class I bike path maintenance. All proposed designs should be closely examined to minimize future maintenance costs.

5.6.3 Security

Security may be an issue along portions of the proposed Class I bike paths. Evaluation of specific security issues along these paths as well as the following actions are recommended to address concerns.

Action: Enforcement of applicable laws on the bike path will be performed by the City of Alameda Police Department, using both bicycles and vehicles. Enforcement of vehicle statutes relating

to bicycle operation will be enforced on Class II and Class III bikeways as part of the department's normal operations. No additional manpower or equipment is anticipated for Class II or III segments.

Action: Normal bike path hours of operation should be 6am to 9pm, unless otherwise specified.

**Table 6b
Bicycle Maintenance Schedule**