7.0 Design and Maintenace Standards

This chapter provides details on the recommended design and operating standards for the Folsom Bikeways System. (Standards for bicycle facilities during roadway construction are addressed in Appendix E.)

7.1 Existing Bicycle Design Standards and Classifications

National design standards for bikeways have been developed by the American Association of Highway and Transportation Officials (AASHTO) and 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 variety of pathway locations are not specified.

The following section summarizes key operating and design definitions:

Bicycle A device upon which any persons 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 Variously 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 pedestrian or motor vehicle traffic.

Class III Bikeway Referred to as a bike route. Provides for shared use with pedestrian or motor vehicle traffic.

Bicycle Boulevard Is a roadway which has been designed or modified to prevent or at least discourage its usage for through travel by automobiles while still allowing through travel by cyclists. They are designated to give priority to cyclists.

Graphic descriptions of Class I, II, and III bikeways are shown in ***Figure 1*** on page 14.

7.2 General Design Recommendations

7.2.1 Conform to Caltrans design guidelines for all bikeways

1. All designated Class I, II, or III bicycle facilities should conform to the Caltrans Highway Design Manual Chapter 1000. Where facilities do not meet this criteria, they should not be referred to as a Class I, II, or III.

7.3 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.

*7.3.1 All Class I bike paths should generally conform to the design recommendations in **Table 9** and **Figure 8**.*

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 9***. According to a variety of research documents including a 1997 University of North Carolina study, bike paths that cross roadways with Average Daily Traffic (ADTs) over 20,000 vehicles will require signalization or grade separation. Grade separation is the preferred option at trail and major street crossings.

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 (minimum 5 feet clearance).

6. Bike path construction shall take into account impacts of maintenance and emergency vehicles on shoulders, weight and vertical requirements.

7. Provide 4 feet wide unpaved shoulders for pedestrians/runners, or a separate tread way where feasible. Direct pedestrians to left side of pathway with signing and stenciling.

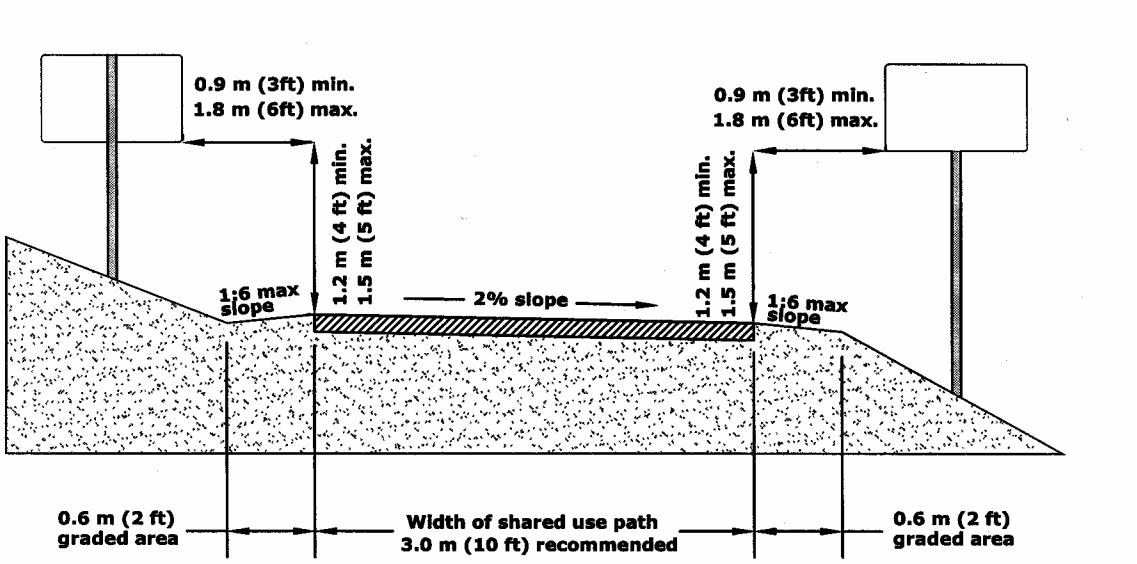
8. Provide adequate trailhead parking and other facilities such as restrooms, drinking fountains at appropriate locations.

Table 9: Class I Bicycle Path Specifications

Description	Details	Measurements
Pavement Type:	Recycled Asphalt	3”
	Asphalt[1]	3”
	Concrete[2]	3”
Sub-Base:	Aggregate *Base*	4”- 6”
	Gravel	4”- 6”
Shoulders:	Decomposed Granite	3”
Width:	Minimum 1- way Path	5’
	Minimum 2- way Path	10’
	Preferred 2-way Path	12’ - 15’
Shoulders:	Minimum width 2’ each side Preferred width 4’ on one side and 2’ on the other	
Lateral Clearance:		2’ – 3’
Vertical Clearance:		8’ – 10’
W/ Equestrians		12’
	Centerline (none, dashed yellow, solid yellow)	4”
	Edgeline (none or solid white)	4”
Signing:	(See Caltrans Traffic Manual MUTCD)	
Minimum Cross Slope:		2%
Minimum Separation from Roadway[3]		5’
Design Speed:		20-30 mph
Maximum Super Elevation:		2%
Maximum Grades (over 100’)		5%
Removable / Fold down Bollards (minimum spacing):		5’
Barrier Post (spacing from fold down bollard):		6’
Lighting (if night use is expected):		5-22 LUX

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.

Source: Caltrans Highway Design Manual Chapter 1000: Bikeway Planning and Design.



Cross Section of Two-Way Shared Use Path on Separated Right-of-Way

Figure 8: Class I Bicycle Path Cross Section

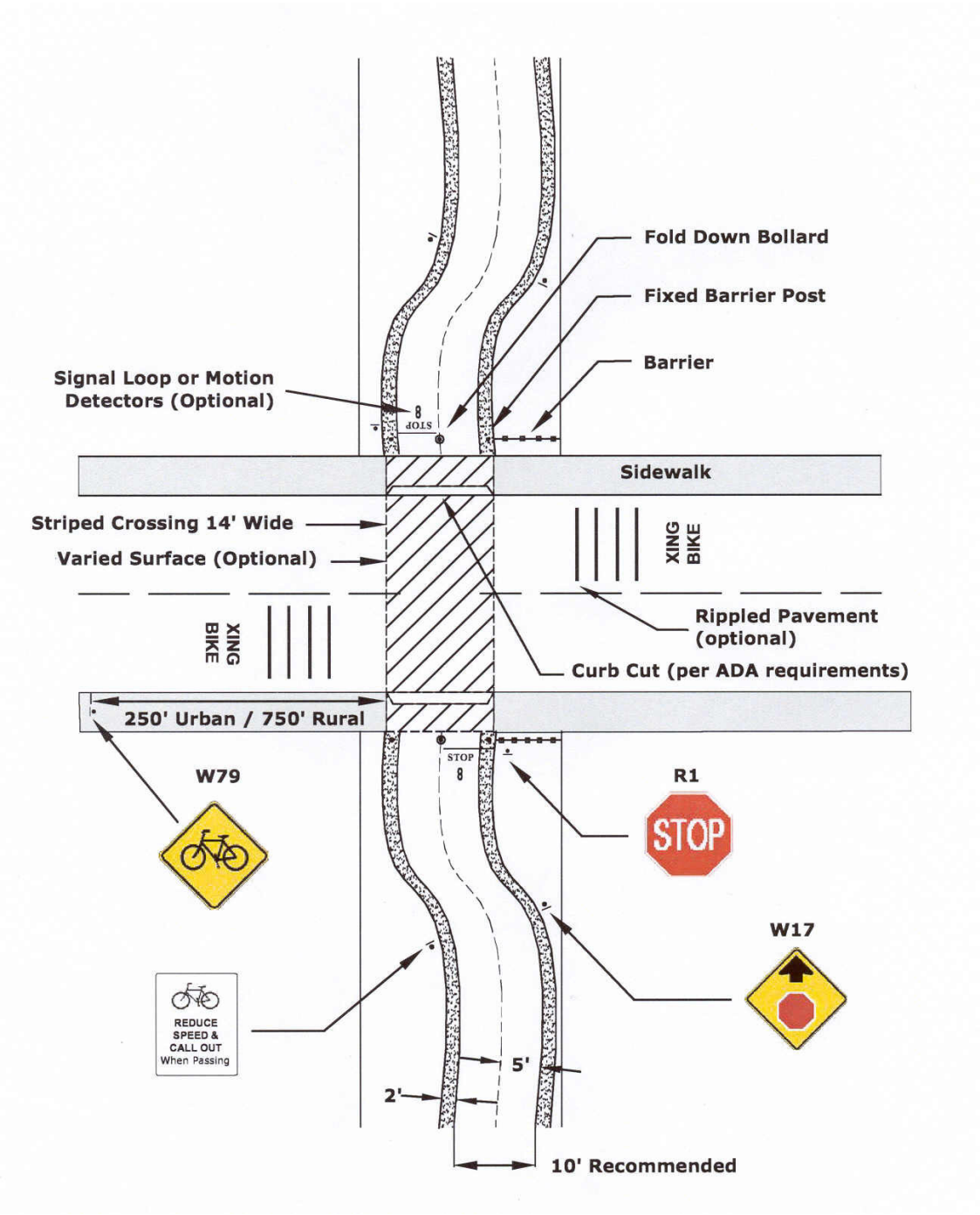


Figure 9: Class I Bicycle Path Crossing Prototype

*7.3.2 All Class II bike lanes should generally conform to the design recommendations in **Figure 10** and **Table 10**.*

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 11*** (Class II Bike Lane at Intersections) and ***Figure 12*** (Recommended Right Turn Channelizations) provides details for recommended intersection treatments.
2. Signal loop detectors should be considered for all arterial/arterial/collectors, and collector/collector intersections. The location of the detectors should be identified by a stencil of a bicycle and the words 'Bicycle Detector'.
3. Per MUTCD 2003 edition, a through bicycle lane shall not be positioned to the right of a right turn only lane.

7.4 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. The City of Palo Alto pioneered the concept of a bicycle boulevard, which is a street directly parallel to a major a 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.

7.4.1: The bicycle boulevard concept should be implemented by the City. Natoma Station Drive, School Street, Wales Drive and Dean Way should be considered a high priority for the bike boulevard concept.

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 inexperience to ride in the street is common. With lower bicycle speeds and lower auto speeds, potential conflicts are somewhat lessened, but still exists. 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.'

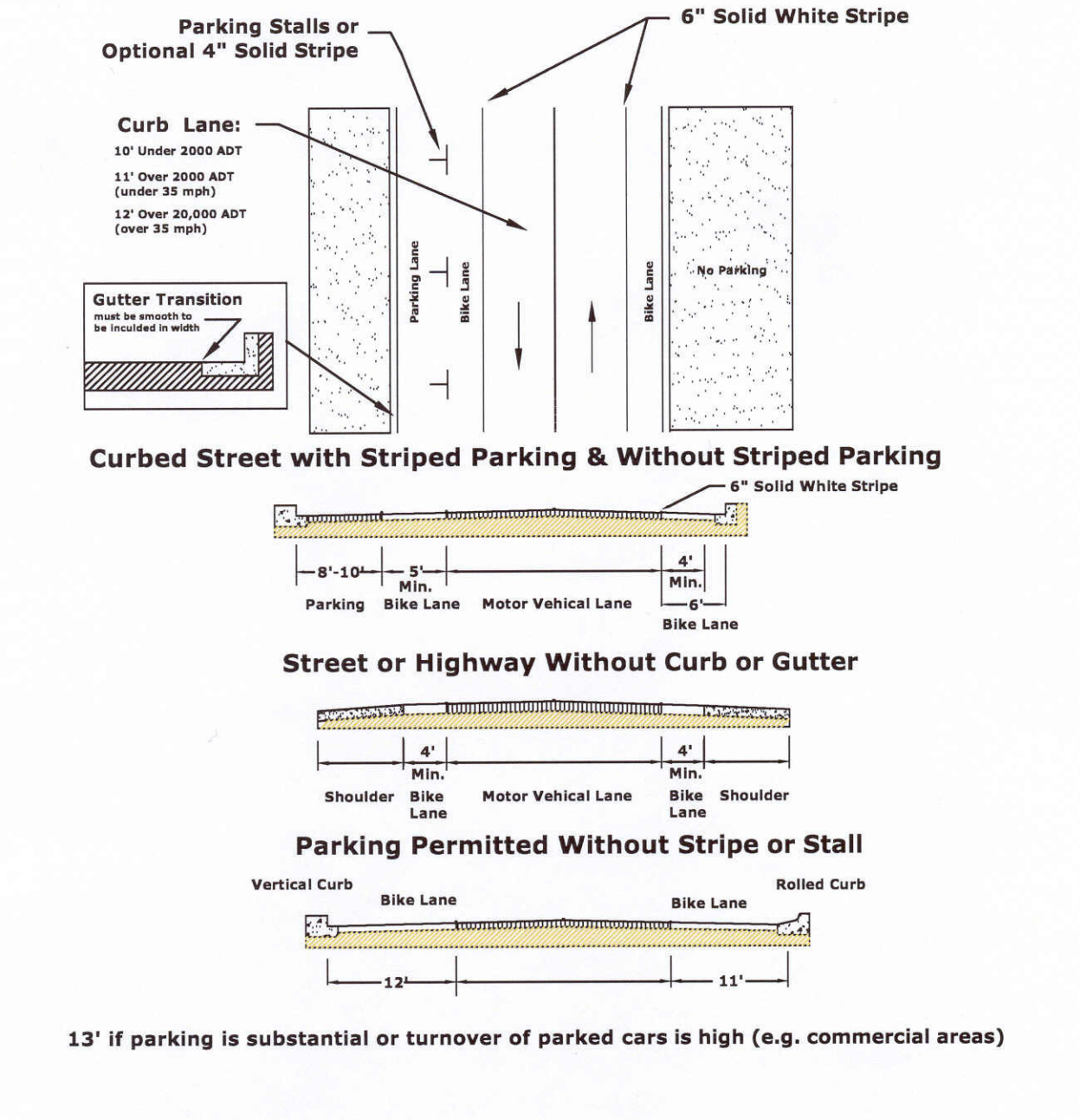


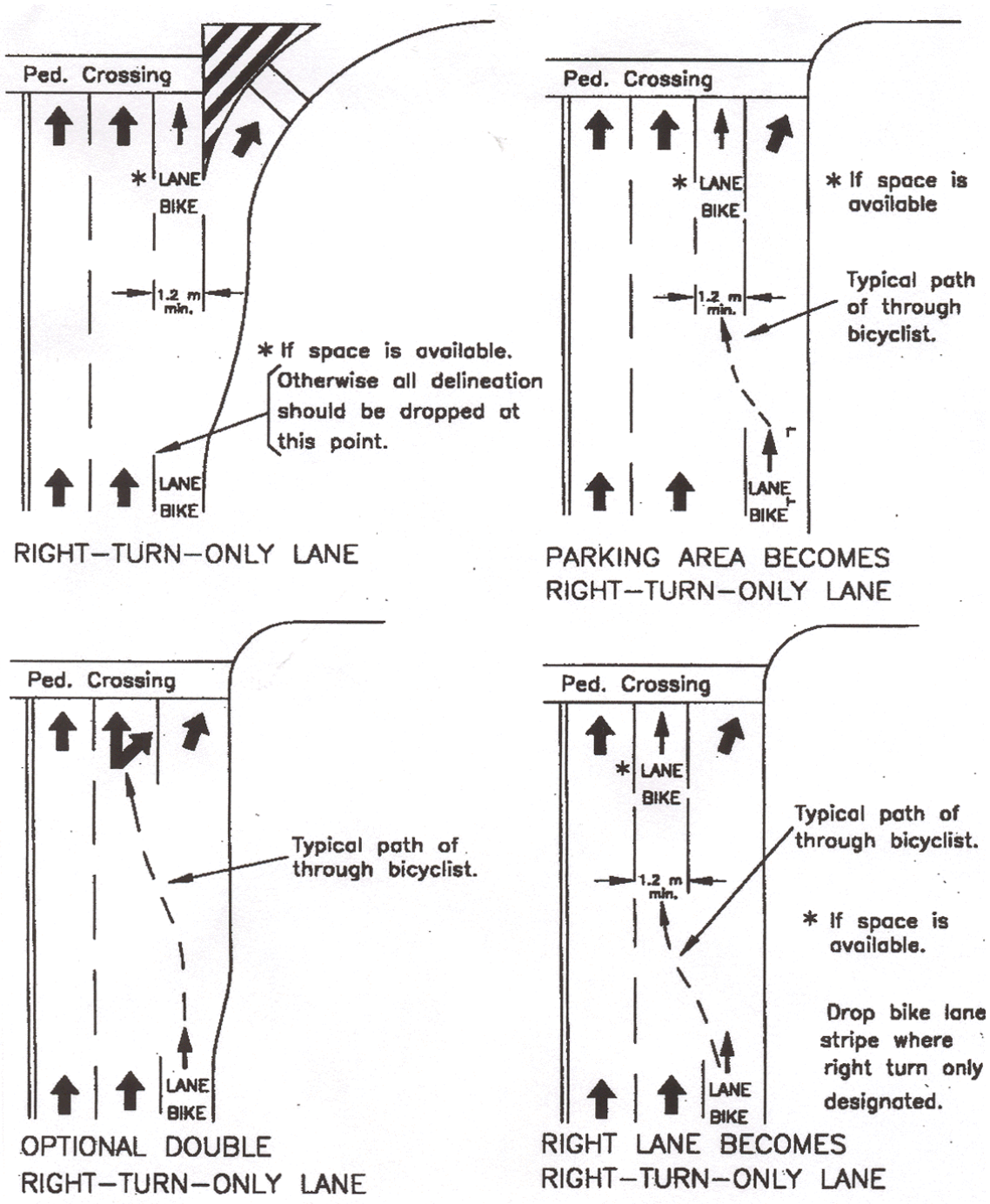
Figure 10: Class II Bike Lane Cross Section

Table 10: Class II Bike Lane Specifications

Minimum Width	Adjacent Park	5’
	No Parking[4]	6’
	Combination Parking Lane[5]	11’ - 13’
Striping	Left side line: solid white stripe	6”
	Right side line: solid white stripe	4”
	Approach to intersections:	100’ - 200’
	Dashed white stripe line	
Signing	R81 Bike Lane Sign	
	❖ Beginning of all bike lanes	
	❖ Far side of all bike path crossings	
	❖ At approaches and far side of all arterial crossings	
	❖ At major changes in direction	
	❖ Maximum ½ mile (0.8 km) intervals	
	Custom Bike Route sign with G33 directional arrow and destination signs (where needed)	
	❖ See items under R81 Bike Lane Sign	
	❖ At approach to arterial crossings	
Pavement Markings	“Bike” legend	
	“Lane” legend	
	Directional arrow	
	❖ Spacing same as R81 Bike Lane sign (1/2 mile intervals)	
	❖ See items under R81 Bike Lane Sign	
	❖ At beginning and end for bike lane pockets at approach to intersection	

Source: Caltrans Highway Design Manual, MUTCD, and Caltrans Traffic Manual

4 Minimum 4’ (0.9 m) between stripe and gutter joint.
5 Rolled curb 11’ (3.3m); vertical curb 12’ (3.6 m) and 13’ (3.m) is recommended with significant parking or turnover.



* Note: See Appendix F for alternative configuration of optional double right-turn lane with island.

Figure 11: Bicycle Lane Intersection Design

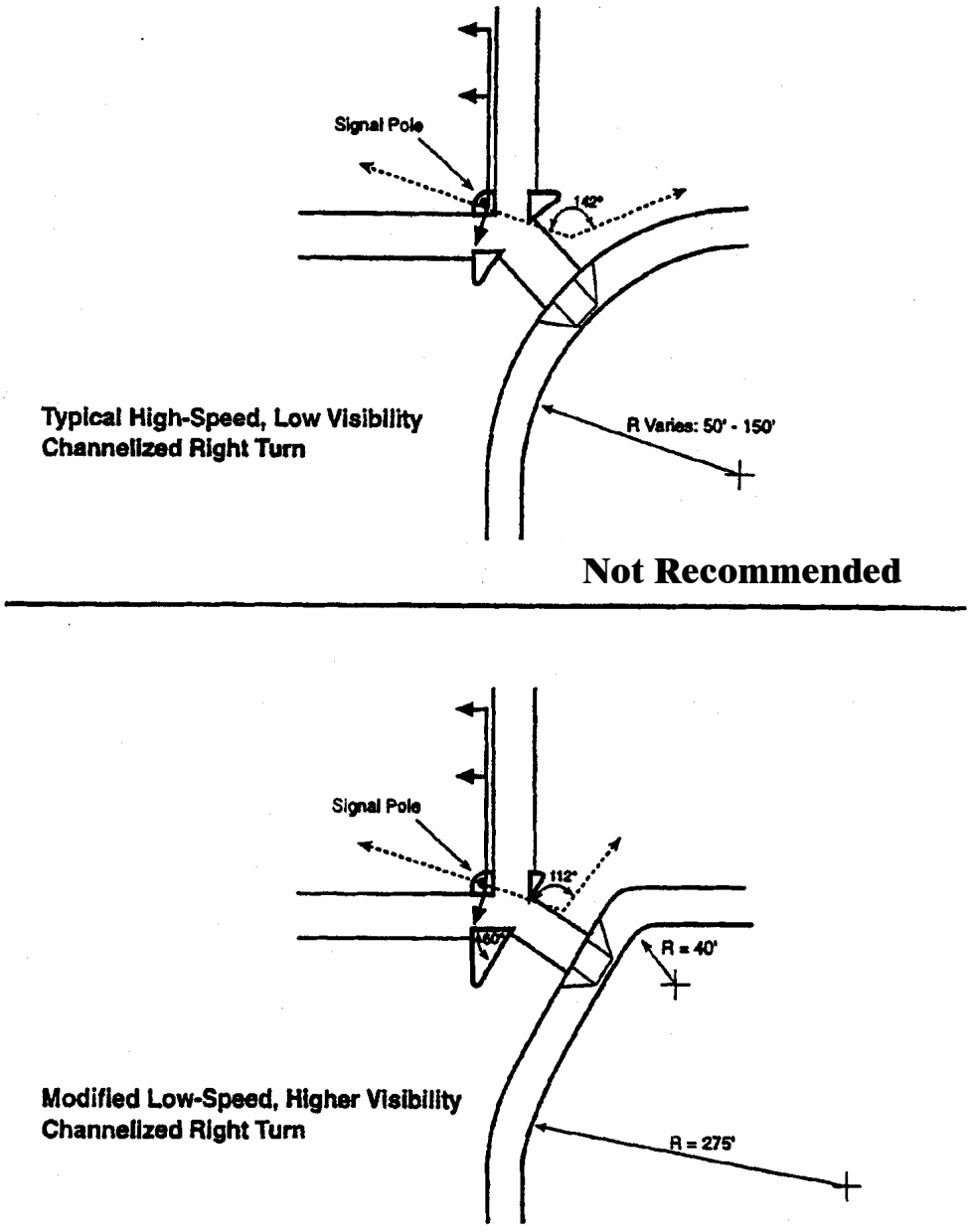


Figure 12: Recommended Right Turn Channelization

7.4.2.: Adopt Caltrans recommendations.

Traffic Calming. This includes any effort to moderate or reduce vehicle speeds and/or volumes on streets where that 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, intersections islands, partial street closings, 'bulb-out' curbs, pavement treatments, lower speed signals timing, and narrowing travel lanes. The City of Folsom has relatively discontinuous street grid system with limited 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 and Striping. All bikeway signing in Folsom should conform to the signing identified in the Caltrans Traffic Manual and/or the Manual of Uniform Traffic Control Devices (MUTCD).

These documents give specific formation 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 11*** (List of Bikeway Signs). Typical signing for a school commute corridor is shown in ***Figure 13***. A typical bike route sign is shown in ***Figure 14***.

7.4.3: Develop a Folsom 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 such a sign is shown in ***Figure 15***.

7.4.4: 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 unsigalized intersections in ***Figure 16*** and signalized intersections in ***Figure 17***. Examples of bikeway warning signs are shown in ***Figure 18***.

7.4.5: 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.

7.4.6: Implement traffic calming on the following streets to encourage and increase safer bicycle travel – School Street between Blue Ravine and Dean Way and Dean Way between Coloma and Wales.

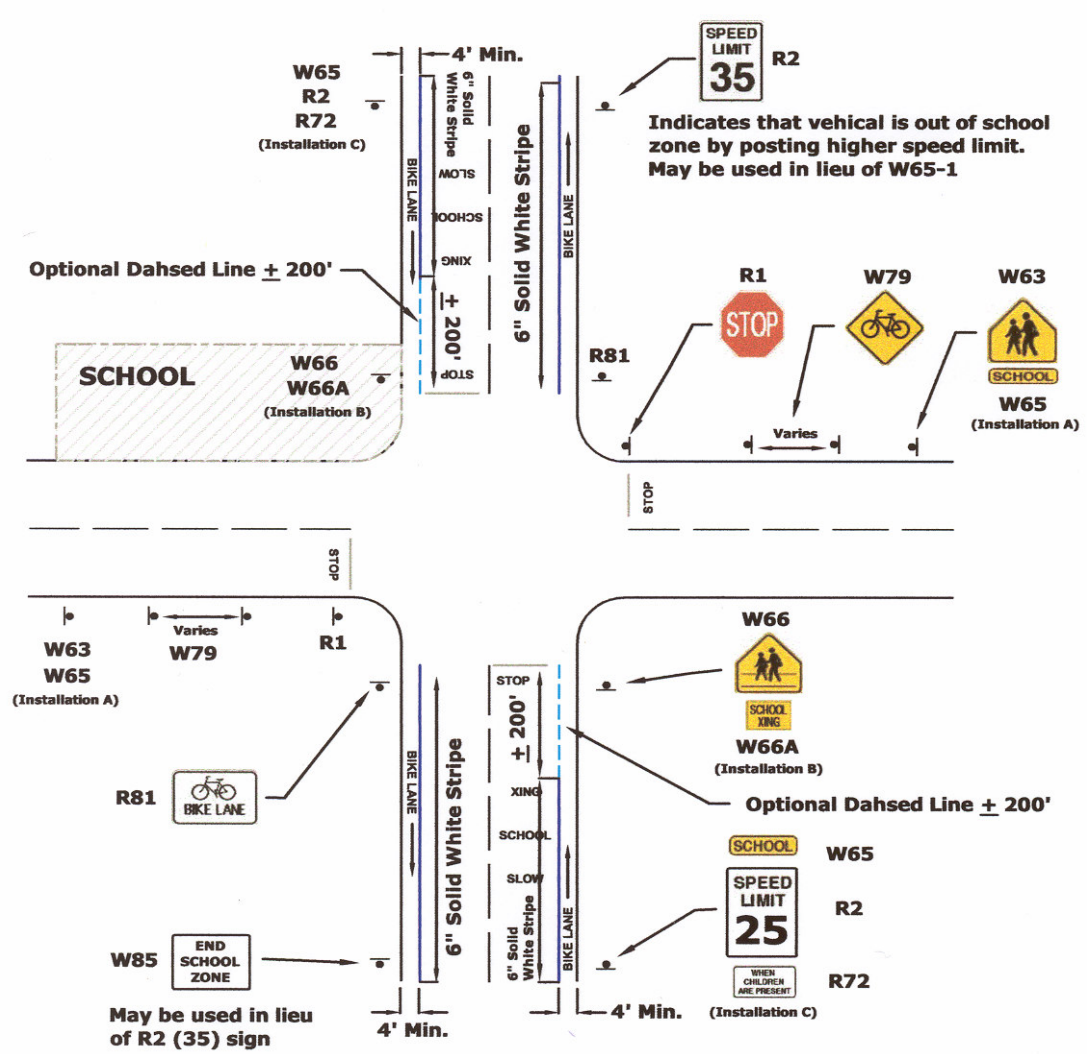
Table 11: Recommended Signing and Marking

BIKE PATH SIGNS					
Use	***Sign Description***	***Location***	***Color***	***Caltrans Designation***	***MUTCD 2000***
Yes	Bike path-No Motor Vehicles or Motorized Bicycles	Entrance to trail	B on W	R44A	N/A
No	No Motor Vehicles	Entrance to trail	B on W	N/A	R5-3
Yes	Trail Logo Sign	Trail logo: at all trail entrances and major access points	Varies	N/A	N/A
Yes	Trail Regulations	All trail entrances (where people reading sign will not block trail)	B on W	N/A	N/A
Yes	Trail Curfew 10 PM-5 AM	Based on local ordinance	R on W	N/A	N/A
Yes	Multi-use Trial: Bikes Yield to Pedestrians/Horses	All trail entrances		N/A	N/A
Yes	Bike Reduce Speed & Call Out Before Passing	Every 2,000 feet	B on W	N/A	N/A
Yes	Keep Peds Right/Bikes Keep Right/Peds Left Bikes	Every 1000-2000 feet where ped and bike areas are designated	B on W	N/A	R9-7
Yes	Please Stay on Trail	In environmentally sensitive areas		N/A	N/A
Yes	Speed Limit Signs	Where speed limits should be reduced from the trail design speed	B on W	R2	R2-1
Yes	Caution: Storm Damaged Trail	Storm damaged locations	B on Y	N/A	N/A
Yes	Trail Closed: No Entry Until Made Accessible & Safe for Public Use	Where trail or access points closed due to hazardous conditions	B on W	N/A	N/A
Yes	STOP	At trail intersections with road and other primary trails	W on R	R1	R1-1
Yes	YIELD	At trail intersections with road and other primary trails	W on R	R1-2	R1-2
Yes	Bicycle Push Button for Green Light	Above push button signal	B on W	R62C	N/A
Yes	Bicycle Use Ped Signal	For ped signal at cross walks	B on W	N/A	R9-5
Yes	Bicycle Yield to Peds	Where facility is shared by peds	B on W	N/A	R9-6
Yes	Bicycle Symbol	For motorist before/at uncontrolled trail crossings and road with unexpected bikes	B on Y	W79	W11-1
Yes	STOP Ahead	Before unexpected STOP sign	B, R on Y	W17	W3-1a
Yes	YIELD Ahead	Before unexpected YIELD sign	B, R, W on Y	YW28	W3-2a
Yes	Signal Ahead	Before unexpected signal	B, R, G on Y	YW41	W3-3

Yes	Cross Traffic Does Not Stop	Stop or yield based on engineering judgment	B on W	W1	N/A
Yes	Turns and Curves	Before turns and curves less that design speed specifications	B on Y	W1,2,3 W4,5,6,14 W56,57	W1-1,2 W1-4,5 W1-6,7
Yes	Trail Intersections	Before uncontrolled trail approach, or where visibility is limited	B on Y	W7,8,9	W2-1,2,3 W2-4,5
Yes	Bikeway Narrows	Before bikeway less than 8' wide	B on Y	W 15 (mod)	W5-4
Yes	Narrow Bridge	Before bridge less than 12' wide	B on Y	W23	W5-2
Yes	Downgrade	Before sustained bikeway hill greater than 5%	B on Y	W29 (mod)	W5-4
Yes	Pedestrian Crossing	Where pedestrian walkway crosses trail	B on Y	W54	W11A-2
Yes	Restricted Vertical Clearance	Before vertical clearance less than 8'-6"	B on Y	W34	W12-2
Yes	Railroad Crossing	Before trail crosses railway tracks	B on Y	W47	W10-1
Yes	Do Not Enter When Flooded	Undercrossings subject to flooding	W on G	N/A	N/A
	BIKE LANE SIGNS				
Use	***Sign Description***	***Location***	***Color***	***Caltrans Designation***	***MUTCD***
Yes	Bike Lane	Far side of intersections, etc.	B on W	R 81	N/A
Yes	Begin	Beginning of bike lane	B on W	R 81A	N/A
Yes	End	End of bike lane	B on W	R 81B	N/A
No	Bike Lane Ahead/Ends	At beginning/end bike lanes	B on W	N/A	R3-16
No	Right/Left/Curb Lane Bikes Only	Along bike lanes	B on W	N/A	R3-17
Yes	Right Lane Must Turn Right	At required vehicle right turns	B on W	R18	R3-7
No	Begin Right turn Here, Yield to Bikes	Where bike lanes ends and before intersection	B on W	N/A	R4-4
Yes	No Parking Any Time	Where parking is prohibited	R on W	R26, 26A R28, 28A	R7-1
Yes	No Parking Bike Lane	Where parking is prohibited	B, R on W	N/A	R7-9,9a
Yes	No Bikes Wrong Way	On back of signs visible to wrong way riders	B, R on W	N/A	N/A
	BIKE ROUTE SIGNS				
Use	***Sign Description***	***Location***	***Color***	***Caltrans Designation***	***MUTCD***
Yes	Bike Route	Before intersections, etc.	W on G	G 93	D11-1
Yes	Begin	Beginning of bike route	W on G	G93A	M4-11
Yes	End	End of bike route	W on G	G93B	M4-12
Yes	Arrows	Before intersections, etc.	W on G	G33-45	M7-1-7
Yes	Route Name	On primary named routes	W on G	S17	N/A

Yes	Logo Numbered Route	On logo numbered routes	W on G	SG45	M1-8,9
Yes	Street Names and Directional Signs (i.e. Beaches, Downtown, etc.)	At intersections where access to major destinations is available	W on G	G7, G8	D1-1, D1-1b (r/1)
	OTHER BIKE SIGNS				
Use	***Sign Description***	***Location***	***Color***	***Caltrans Designation***	***MUTCD***
Yes	Bicycle Parking	At bike parking locations	G on W	G93C	D4-3
Yes	Hazardous Condition	Before slippery or rough pavement, such as steel deck, ford, etc.	B on Y	W42	W8-10
Yes	Angled Railroad Crossing	Before angled tracks	B on W	SW27-1	N/A
Yes	No Bike Facility (sidewalks, etc.)	At entrance to prohibited areas	B, R on W	R95, 95A	R5-6
Yes	Pedestrians Bicycles Motor-Driven Cycles Prohibited	On freeway on-ramps where bikes prohibited	B on W	R44	R5-10A, 10B
Yes	Bicycles Motor-Driven Cycles Must Exit	At ramp where bikes must exit a freeway	B on W	R44B, 44C	N/A

Color Key: B = Black; G =Green; R = Red; W= White; Y = Yellow



Installation A:
In advance of remote school crosswalks and on street with prima facle 25 MPH
Installation B:
Optional at school crosswalks. Not used with stop signs, yeild signs, or signals.
Installation C:
On streets with higher speeds, to warn drivers of School Zone with 25 MPH spped limits at certain times.
Notes:
1. The Bicycle Crossing sign (W79) is optional where the approach is controlled by a signal, stop sign, or yield sign.
2. For urban situations, post 250' prior to intersections, 750' in rural areas.
3. The bike lane may either be dropped entirely approximately 200' in advance of the intersection, or a dashed line carreid to the intersection or through the intersection is optional.

Figure 13: Signs and Marking within School Zones

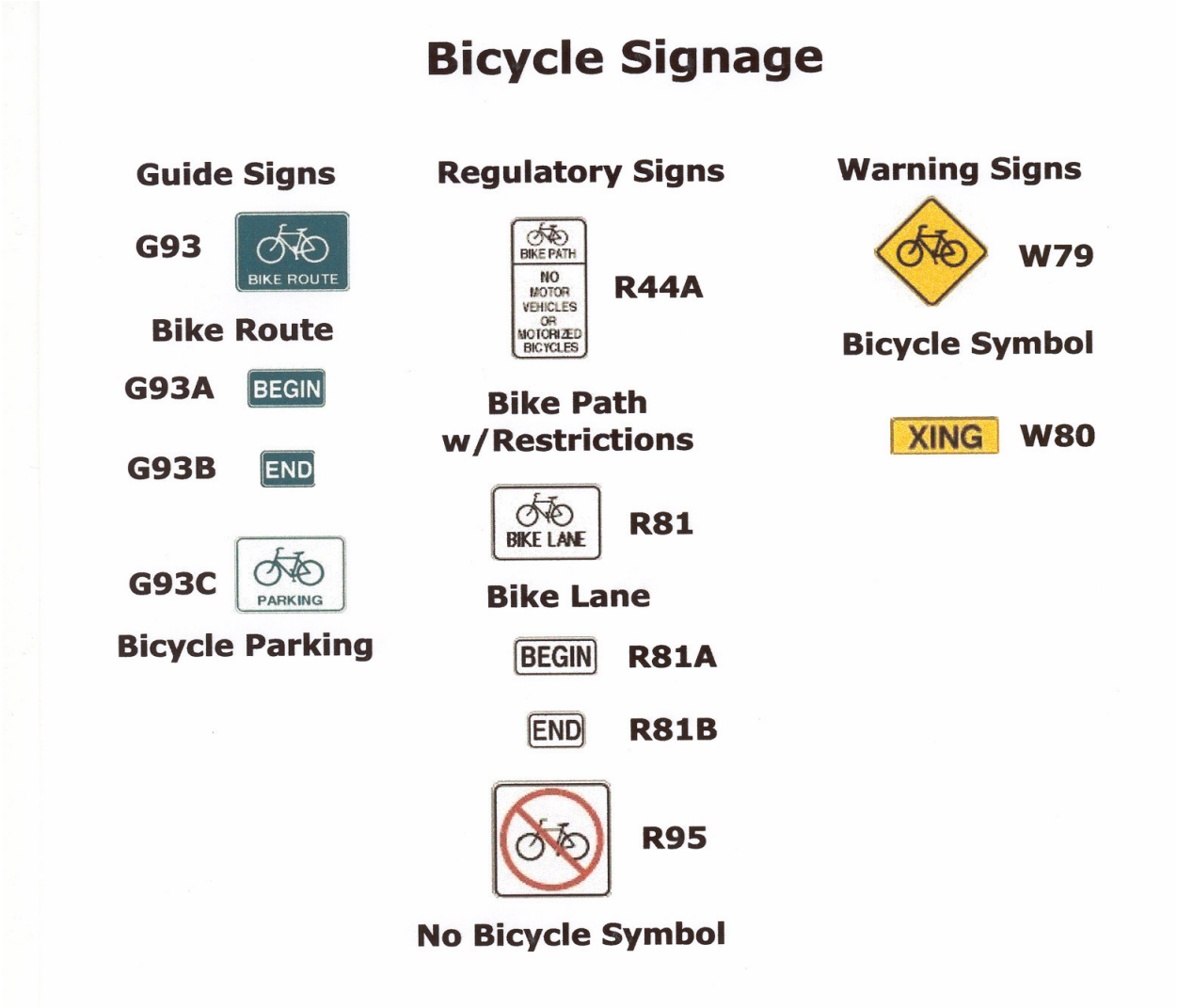
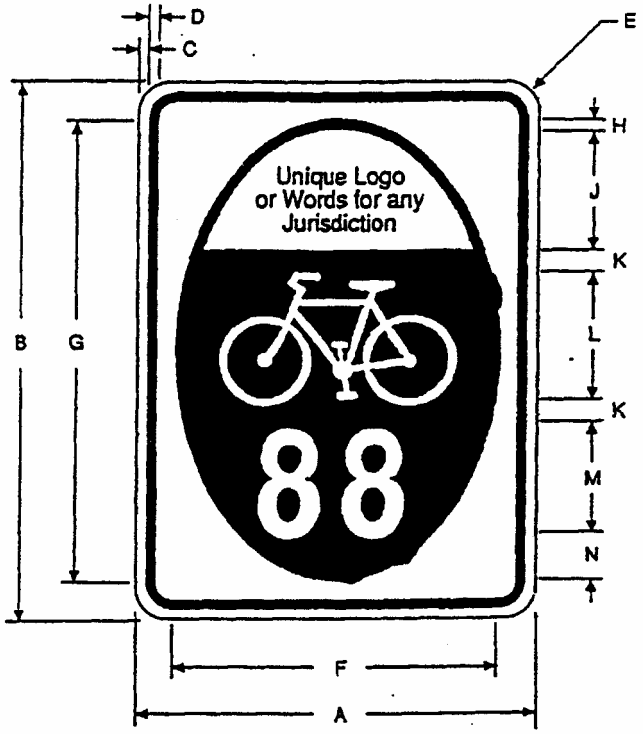


Figure 14: Bike Route & Bike Path Sign

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

MUTCD NUMBER None CODE SG45

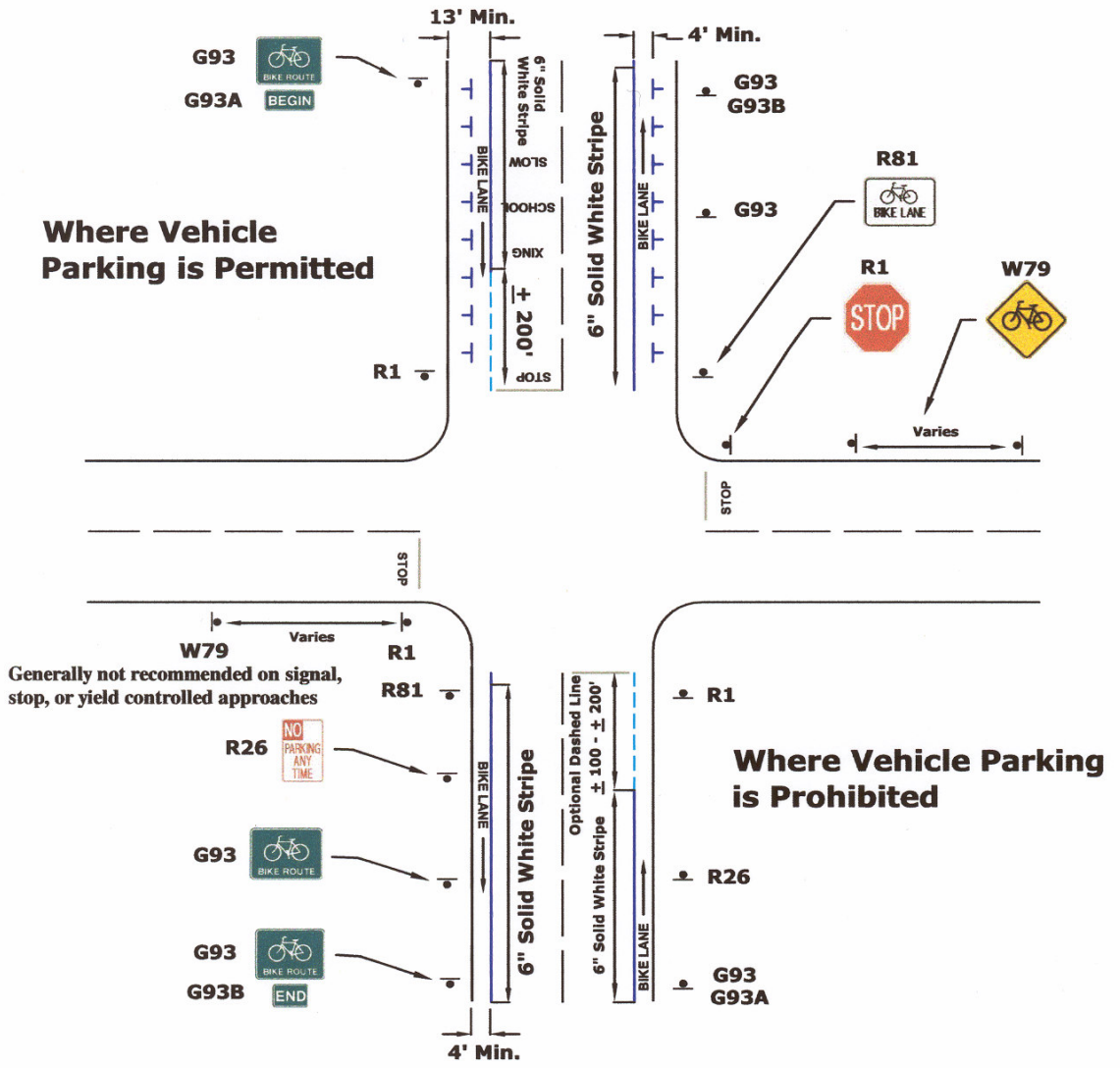


SIGN SIZE	DIMENSIONS (INCHES)												
	A	B	C	D	E	F	G	H	J	K	L	M	N
12 x 18	12	18	1/4	1/4	1-1/2	10	16	1/4	4	3/4	4-1/2	4D	1-3/4
18 x 24	18	24	3/8	1/2	1-1/2	15	21	1/2	5	1	6	5D	2-1/2

COLORS
BORDER & LEGEND - GREEN (Reflective)
BACKGROUND - WHITE (Reflective)

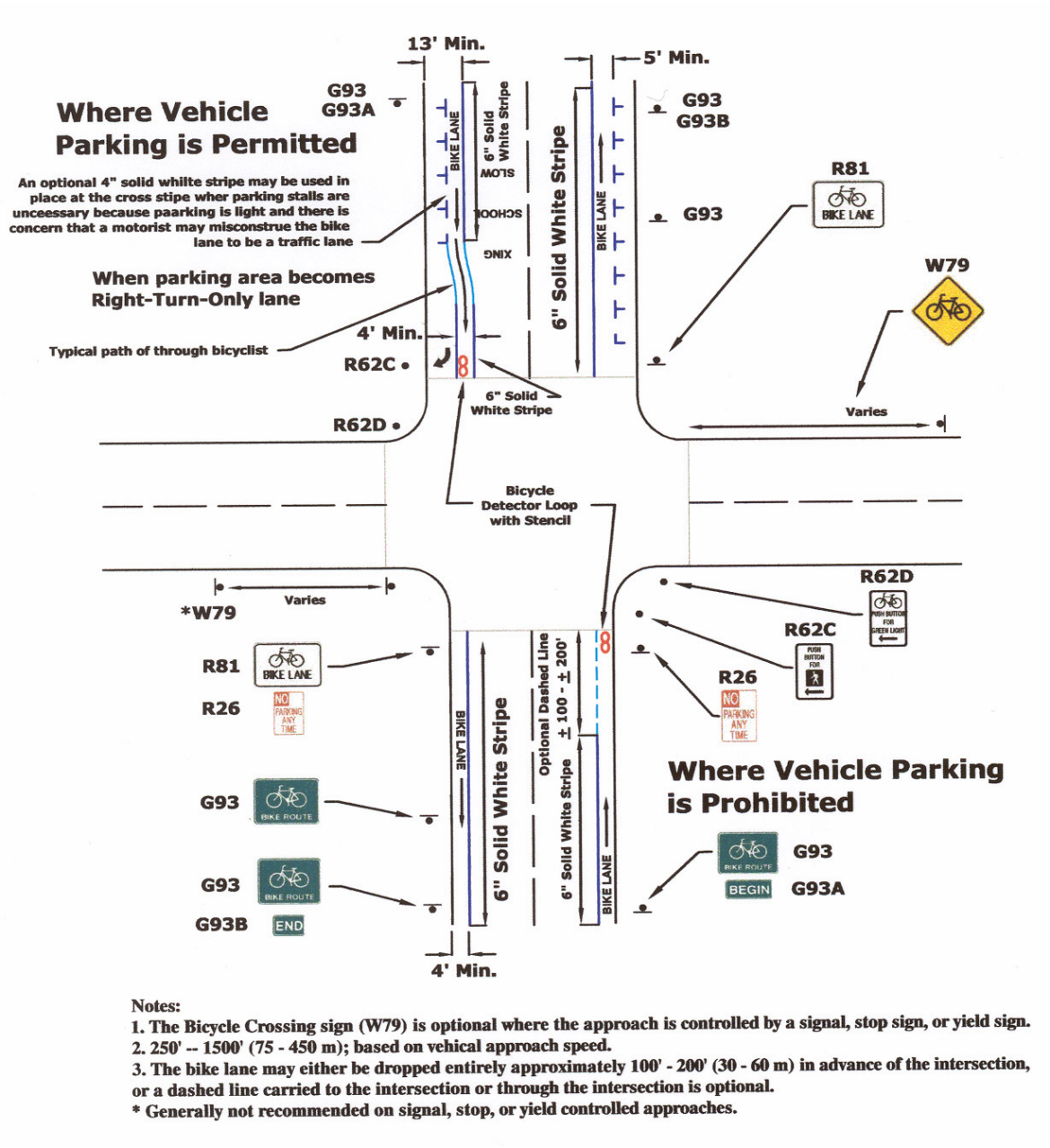
- THE POLICY FOR INTENDED USAGE OF THIS SIGN IS SHOWN ON REVERSE SIDE -

Figure 15: Numbered Bike Route Sign



Notes:
1. The Bicycle Crossing sign (W79) is optional where the approach is controlled by a signal, stop sign, or yield sign.
2. 250' -- 1500' (75 - 450 m); based on vehical approach speed.
3. The bike lane may either be dropped entirely approximately 100' - 200' (30 - 60 m) in advance of the intersection, or a dashed line carried to the intersection or through the intersection is optional.

Figure 16: Signing at Unsignlaized Intersections



Notes:
1. The Bicycle Crossing sign (W79) is optional where the approach is controlled by a signal, stop sign, or yield sign.
2. 250' -- 1500' (75 - 450 m); based on vehical approach speed.
3. The bike lane may either be dropped entirely approximately 100' - 200' (30 - 60 m) in advance of the intersection, or a dashed line carried to the intersection or through the intersection is optional.
*** Generally not recommended on signal, stop, or yield controlled approaches.**

Figure 17: Signing at Signalized Intersections

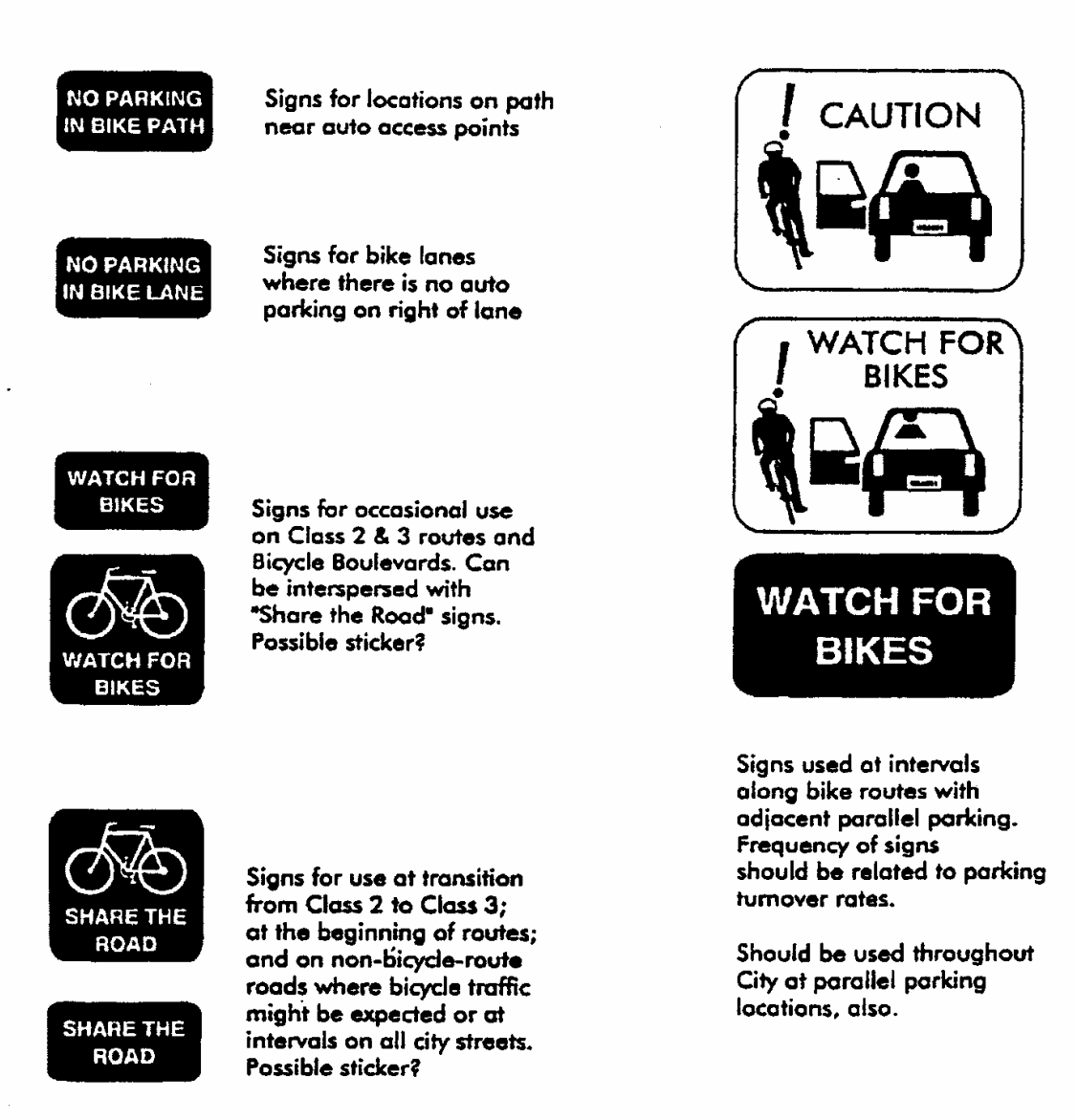


Figure 18: Warning Signs

7.5 Monitoring, Maintenance, and Security

7.5.1 Monitoring

Once the plan has been adopted, a monitoring effort is requires 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, Planning, or Parks and Recreation Department, who will be responsible for many of the monitoring responsibilities. The coordinator will also be responsible for coordinating with Planning, Parks and Recreation, Police, and other departments.*

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

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

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

Action: *Maintenance. The coordinator shall be responsible for an annual maintenance and operations budget, and coordinating with 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 shall work closely with agencies such as Caltrans to keep abreast of funding opportunities and prepare application packages.*

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

7.5.2 Maintenance

The total average annual maintenace cost of the off-street bikeway system is estimated to be $220,000 when it is fully implemented. 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 $4,890 per mile, which covers labor, supplies, and amortized equipment costs for weekly trash removal, monthly sweeping, and bi-annual resurfacing and repair patrols (***Table 13 page 97***).

Maintenance access on the Class I bike path 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 maintenances includes cleaning, resurfacing and restriping the asphalt path, repairs to bridge crossings, cleaning drainage systems, trash removal, and landscaping. Underbrush and weed abatement should be preformed once in the late spring and again in mid-summer.

Class II maintenance is projected to have an average annual cost of $100,00 over the next 20 years, and consists of the purchase and operation of street sweeping equipment. The bikeway program is not expected to cover 100% of the cost of additional street sweeping since the operation will also benefit motor vehicles, but will pay for a portion of the additional costs.

Action: *All streets identified on the Folsom Bikeway Master Plan map as having Class II bike lanes or Class II bike routes should be swept at least once a month.*

Action: *Street sweeping operators must ensure that bike lanes and shoulder areas of roadways are swept as part of routine street sweeping operations.*

Action: *As part of the permit process, all new construction projects should be required to pay for the street sweeping of streets in the immediate vicinity of the project as needed to keep the streets free of debris.*

Action: *The City may consider adding a fee for all new construction projects to help cover the cost of sweeping City streets, under the assumption that a large part of the roadway gravel and debris is linked to trucks serving construction projects.*

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

7.5.3 Security

Security may be an issue along portions of the proposed Class I bike paths. The following actions are recommended to address these concerns:

Action: *Enforcement of applicable laws on the bike path will be performed by the City of Folsom Police Department, using both bicycles and vehicles. Enforcement of vehicle statues relating to bicycle operation will be enforced on Class II and Class III bikeways as part of the department's normal operations. No additional staffing or equipment is anticipated for Class II or III segments.*

Action: *Recommended bike path hours of operation are from 1 hour before sunrise to 1 hour after sunset, unless otherwise specified. (Hours of operation should correlate with the applicable laws on trails under the enforcement of the operating parks jurisdiction).*