Appendix A – Evaluation Criteria

EVALUATION CRITERIA
As stated in the planning criteria in Chapter 2, a bikeway system should contain primary and secondary routes as part of the system designations. These designations signify the specific uses for the routes and are important for maximizing riding opportunities for a variety of users. To identify the priority projects in each jurisdiction, evaluation criteria were refined and applied from previous bicycle plans.

This appendix shows the STA staff evaluation criteria for prioritizing bicycle projects. Upon application of the evaluation criteria, the BAC and other interested members were provided with a recommendation from staff as a starting point to discussion. Through coordinating meetings with the BAC and staff from each of the local jurisdictions, each priority project was carefully identified. The decisions were based on the quantitative analysis provided through the criteria as well as the qualitative analysis provided through discussion and review of supporting documentation such as maps and project status reports.

The evaluation criteria focus on six (6) main areas: Implementation, Accessibility and Safety, Connectivity and Regional Significance, Quality of Life, Local Coordination, and Wayfinding.

Implementation
The system should be constructed as efficiently as possible. This criterion considers project readiness, additional local match/other funding availability, prior commitment/performance, federal mandates.

Accessibility and Safety
The system should provide access from all portions of Solano County's population centers for both commuting (primary) and recreation (secondary) routes. This criterion considers elimination of barriers, access to activity centers/schools/transit, safety improvement for all groups of bicyclists, and population served.

Connectivity and Regional Significance
The system will serve the routes of regional significance and transit facilities of regional significance. This criterion considers countywide destinations, connectivity, and regional significance.

Quality of Life
The system should improve health and reduce vehicle usage. This criterion considers the health benefits of bicycling, reduction of vehicle usage by offering alternatives, and cost/benefit calculations.

Local Coordination
The proposed system should consider local information in the bicycle planning process. This criterion considers local plan adoption, community participation, long-term plans/policies, and design aspects.

Wayfinding
The system will provide an adequate directional wayfinding signage system such as those incorporated on the roads/highway system. This criterion considers installation of a Solano County Bikeway sign and interest in a wayfinding sign plan.

STA Staff Evaluation Criteria for Prioritizing Bicycle Projects

Six (6) criteria have been developed by STA staff based on the 2004 criteria as well as their ability to meet the goals identified in the 2009 bicycle plan update. **The criteria will be applied by STA staff during the prioritization process for the proposed bikeway system in Solano County.**

Criterion	Description	Points
Criterion #1 – Implementation: The system should be constructed as efficiently as possible.		
Project Readiness	High: Short-term project that can be constructed within 0-5 years of the Plan's adoption (Tier1)	8-10
	Med: Mid-term project that can be constructed within 6-10 years of the Plan's adoption (Tier2)	4-7
	Low/Needs Improvement: Long-term project that is highly expensive or may take a long time to construct and should therefore not begin until 11 or more years after the plan's adoption (Tier3)	0-3
Additional Local Match/Other Funding Availability (Strategically funded project: other funds with a copy of local resolution[1])	High: Project can commit over 35% of project cost from other sources	2
	Med: Project can commit 20 – 34% of project cost from other sources	1
	Low/Needs Improvement: Project can commit 10 – 19% of total project cost from other sources OR project cannot commit other fund sources	0
Prior Commitment/Performance	High: Project sponsor has completed past projects with committed STA funding on-time or within 12 months of its agreement's original termination date	4-5
	Med: Project sponsor has completed past projects with committed STA funding within 24 months of its agreement's original termination date	2-3
	Low/Needs Improvement: Project sponsor has not completed past projects with committed STA funding or has taken beyond X years or the agreement terms (an appropriate period of time for this part TBD)	0-1
Federal Mandates	High: Federal mandate requires the proposed project improvements	2
	Med: Federal mandate encourages the proposed project improvements	1
	Low: No known Federal mandate applies to the project	0
Addresses Goal #2: Build the bicycle transportation network by planning, designing, funding, constructing, and managing transportation facilities that will meet the needs of the cycling public.		

[1] If applicable, required federal funding local match of 11.47% will be included

Criterion	Description	Points
Criterion #2 – Accessibility and Safety: The system should provide safe access from all portions of Solano County's population centers for both commuting (primary) and recreation (secondary) routes.		
Elimination of barriers[2] to major destinations/gap closures in a regional bicycle network serving mobility needs	High: Project provides means to overcome a barrier (e.g. bridge over freeway, expressway, interchanges, or rail line) or eliminates a gap (e.g. a new bike lane/path in a corridor without facilities) where no nearby facility exists.	11-15
	Med: Project reduces consequences of an existing barrier or gap to provide more direct non-motorized travel where limited or inferior alternatives exist.	6-10
	Low/Needs Improvement: Project extends a regional bicycle route (e.g. bike lane or bike path), working towards a gap closure, but not eliminating it.	0-5
Access to schools, transit, lifeline transit[3] or to/within activity centers (commercial/employment centers or recreational facilities)	High: Project is specifically designed to significantly improve access to a destination and/or planned/existing link. Project will be within ½ mile in actual biking distance from the destination and/or planned/existing link	8-10
	Med: Project will generally enhance access to the destination and/or planned/existing link. Project will be within 1 mile in actual biking distance from the destination and/or planned/existing link.	4-7
	Low/Needs Improvement: Project improves upon limited existing access. Project will be beyond 1 mile in actual biking distance from the destination and/or planned/existing link.	0-3
Safety improvement for all groups of bicyclists	High: Project will address a demonstrated safety issue (e.g. collision statistics are high). Project will address safety concern with a proven or demonstrated counter measure	11-15
	Med: Project will improve a situation with some safety issues (e.g. some reported collisions, conflicts, near-misses, or evidence of high vehicle traffic volume or speed)	6-10
	Low/Needs Improvement: Project will generally improve safety, even though there are no known problems	0-5
Population Served	High: The ratio of potential cyclists served relative to the traffic volume on the street is 3% or greater.	8-10
	Med: The ratio of potential cyclists served relative to the traffic volume on the street is greater than one percent, but less than three	4-7
	Low/Needs Improvement: The ratio of potential cyclists served relative to the traffic volume on the street is less than one percent	0-3
Addresses Goals #3, 4, 5, and 6: Goal #3: Improve bicyclist safety in Solano County; Goal #4: Increase the use of bicycles as a viable alternative to the automobile; Goal #5: Develop an integrated and coordinated transportation system that connects bicycling with other modes of transportation; Goal #6: Provide safe access for bicyclists to all points in Solano County.		

[2] Barriers include major arterials, freeways, major transit facilities, railroad tracks, creek/streams/bays, etc. A substandard or deficient facility is generally considered a "medium" gap.
[3] Lifeline transit serves low-income, transit-dependent communities

Criterion	Description	Points
Criterion #3 – Connectivity and Regional Significance: The system will serve the routes of regional significance and transit facilities of regional significance.		
Countywide Destinations (multimodal)	High: Serves a route of regional significance and creates connections to the regional transit system – including transit centers, ferry terminals, bus rapid transit, and rail stations (e.g. BART stations, light rail stations, airports, and commuter rail) – from all directions surrounding each station	4-5
	Med: Provides access to and through the major central business districts of the county	3
	Low: Establishes connections to regionally significance activity centers including selected commercial districts, universities and community colleges, hospitals, regional parks, and recreational venues	1
	Needs Improvement: Does not establish a connection to any of the above areas.	0
Connectivity	High: Project provides continuous connection for users across county lines or provides a connection between two or more cities	4-5
	Med: Project provides an improvement to an existing connection for users across county lines or between cities	2-3
	Low/Needs Improvement: Project extends an existing regional bicycle facility, but does not connect to a destination or provide a connection to a planned/existing countywide bicycle route.	0-1
Regional Significance (e.g. RRS, TFRS)	High: Project provides at least a Class II improvement on a Route of Regional Significance (RRS) or serves a Transit Facility of Regional Significance (TFRS)	3-4
	Med: Project improves access to a existing regional bicycle route or connection to a RRS or TFRS	1-2
	Low/Needs Improvement: Project does not connect to a RRS or TFRS	0
Addresses Goal #7: Develop a bicycle network that connects to northern California's alternative modes system		

Criterion	Description	Points
Criterion #4 – Quality of Life: The system should improve health and reduce vehicle usage. (Staff)		
Health Benefits of bicycling	High: Project creates extensive and attractive opportunities for all groups to improve their health by biking (e.g., bike path near high density housing, a well-lit and sheltered bike path)	3
	Med: Project creates some and attractive opportunities for all groups to improve their health by biking (e.g., bike path near high density housing, a well-lit and sheltered bike path)	2
	Low/Needs Improvement: Project does little to create attractive opportunities for all groups to improve their health by biking (e.g., bike path near high density housing, a well-lit and sheltered bike path)	1
Reduction of vehicle usage by offering alternatives	High: Project sponsor is able to project heavy usage of the facility to deter peak-period trips made by cars (e.g., trips made towards transit stations, park and ride lots, schools, etc.)	3
	Med: Project sponsor is able to project moderate usage of the facility to deter peak-period trips made by cars (e.g., trips made towards transit stations, park and ride lots, schools, etc.)	2
	Low/Needs Improvement: Project sponsor is able to project minimal usage of the facility to deter peak-period trips made by cars (e.g., trips made towards transit stations, park and ride lots, schools, etc.)	1
Cost/Benefit calculations used by BAAQMD	High: Cost per ton of total ROG, Nox, and weighted PM_{10} reduced is less than $60,000	3
	Med: Cost per ton of total ROG, Nox, and weighted PM_{10} reduced is between $60,000 and $90,000	2
	Low/Needs Improvement: Cost per ton of total ROG, Nox, and weighted PM_{10} reduced is greater than $90,000	1
Addresses All Goals		

Criterion	Description	Points
Criterion #5 – Local Coordination: The proposed system should consider local information in the bicycle planning process. (Staff/User)		
In a locally adopted plan	High: Incorporated in the community's General Plan, Adopted Growth Management Plan, STA Bicycle Plan, Local Plan, and Capital Improvement Plan	8-10
	Medium: Incorporated in local or regional bikeway master plan	4-7
	Low/Needs Improvement: Project is unplanned	0-3
Community Participation	High: Project has strong documented community, neighborhood, or user group participation (e.g. STA BAC, bicycle club members, bicycle shop owner, current riders, bicycle route maps, and the general public). Letters OR minutes indicating actions taken by communities, neighborhood groups, user groups, or countywide committees are provided. Projects are included in a local or community-based plan.	4-5
	Med: Project has some community, neighborhood, or user group participation (two or less public outreach meetings/workshops)	2-3
	Low/Needs Improvement: Project has submitted a Complete Streets Checklist. Community outreach will be completes as part of the project, but little or none conducted to date.	0-1
Long-term plans and policies of the project as part of the countywide bikeway system	High: Project sponsor has adopted a long-term plans and policies that is consistent with Solano Countywide Bicycle Plan with BAC support	4-5
	Med: Project sponsor is developing a long-term plan for a continuous countywide bikeway system while obtaining BAC input	2-3
	Low/Needs Improvement: Project sponsor has not worked towards a long-term plan for a continuous bikeway system and without BAC support	0-1
Design Aspects from bicycle plans or advisory committee suggestions followed	High: Project uses or improves design recommendations from both the Solano Countywide Bicycle Plan and recommendations by the BAC	4-5
	Med: Project uses or improves some design features recommended in the Solano Countywide Bicycle Plan and some recommendations provided by the BAC	2-3
	Low/Needs Improvement: Project uses design features not found in the Solano Countywide Bicycle Plan and ignores recommendations provided by the BAC	0-1
Addresses Goals #1 and 8: Goal #1: Plan and maintain a current Countywide Bikeway Network; projects should be identified in a local plan (i.e. general plan, bike plan, pedestrian/trails plan, CIP, etc.); Goal #8: Develop the Countywide Bicycle Plan to serve as a bicycle master plan or a foundation for local agencies to use in the development of a local bicycle plan.		

Criterion	Description	Points
Criterion #6 – Wayfinding: The system will provide adequate directional wayfinding signage system such as those incorporated on the highway system. (Staff)		
Solano County Bikeway Sign	High: Includes or will include a Solano Countywide Bikeway Sign and Bike Route signs	3
	Med: Includes bike route signs only	2
	Low/Needs Improvement: Will include pavement markings with limited or no signage	1
Wayfinding Sign Plan	High: Will include existing signs in the MUTCD and future standards for countywide wayfinding when it is developed	3
	Med: Will incorporate existing signs identified in the MUTCD	2
	Low/Needs Improvement: Project will consider as part of project, but has not been identified to date	1
Addresses Goal #9: Develop a countywide wayfinding signage plan		

Appendix B – Analysis of Demand

ANALYSIS OF DEMAND

This appendix includes the following sections:

I. The Benefits of Bicycling
II. Land Use and Demand
III. Major Activity Centers and Public Facilities
IV. Commuter and Recreational Needs
V. Specialized Facilities
VI. Planning Process
VII. Needs and Attitude Survey
VIII. Trip Reduction Potential/Air Quality Benefits

The Analysis of Demand appendix provides the analytical background and foundation for the Countywide Bicycle Plan. It reviews the relationship between bicycle use, demographics, and land use in Solano County. It also identifies major activity centers and public facilities where bicyclists may be destined, along with the needs of recreational and commuter bicyclists. The purpose of reviewing the needs of commuter and recreational bicyclists is twofold: it is instrumental when a planning system that must serve both user groups and it is useful when attempting to quantify future usage and benefits to justify expenditures of resources.

I. The Benefits of Bicycling

A key goal of the Bicycle Plan is to maximize the number of bicycle commuters in order to help achieve large transportation goals such as minimizing traffic congestion and air pollution. In order to set the framework for these benefits, national statistics and policies are used as a basis for determining the benefits to the County. According to the 2000 U.S. Census, less than one percent of all employed County residents commute primarily by bicycle (0.5%). This does not include those who ride less than 50 percent of the time. Thus, the bicycle commute rate in Solano County is about average compared to the rate of California and the United States as a whole. Based on information in the 2000 U.S. Census, below are a few key points that were concluded:

- Currently, nearly 3 million adults (about 1 in 60) commute by bicycle. This number could rise to 35 million if adequate facilities were provided (according to a 1991 Lou Harris Poll).

- The latent "need" for bicycle and pedestrian facilities—versus actual bicyclists and pedestrians—is difficult to quantify; we must rely on evaluation of comparable communities to determine potential usage.
- Currently, the average household in the U.S. generates about 10 vehicle trips per day. Work trips account for less than 30 percent of these trips on average.

The distances between residences and workplaces combined with the types of employment, climate, and available bicycle facilities all influence these commute shares. As Solano County grows and additional local employment opportunities become available and better inter-city bicycle connections are provided, this mode share can be expected to increase.

II. Land Use and Demand

The concept of "demand" for bicycle facilities is difficult to enumerate. Unlike automobile use, where historical trip generation studies for different types of land uses permits an estimate of future "demand" for travel, no such methodology exists for bicycles.

Consider the following: do people who already ride bicycles in Solano County have any "demand" for additional facilities? Is it possible to measure the "demand" for recreational facilities any more than, say, the demand for a park or library? While the concept is still soft, the need to quantify and understand the need for various types of bicycle facilities is critical. Without it, there can be no good long range planning and no good argument to invest public dollars in improvements.

One of the first steps in evaluating demand is to review population and land use in the County. Solano County has a 2003 population of approximately 410,000 and is growing at approximately 2.2% per year according to the 1999 State Department of Finance estimates and the Association of Bay Area Governments "Population Projections 2003." Existing land use in the county can be summarized as having the following significant features:

- Major agricultural resources, particularly in the north and east
- Large open space areas including wetlands and hills
- Major transportation corridors (I-80, I-505, I-680, I-780, SR 12, SR 29, SR 37, SR 113, and Union Pacific Railroad)
- Three mid-sized cities over 90,000 (Fairfield, Vacaville, and Vallejo)
- Four smaller cities under 30,000 (Benicia, Dixon, Rio Vista, and Suisun City)

- A major air base (Travis Air Force Base)
- Several large industrial and warehousing areas
- A relatively low concentration of employment

This last issue results in a net out-migration of daily commuters toward the Bay Area and Sacramento region. Solano County is also one of the fastest growing counties in northern California (see Table B.1), although growth has slowed somewhat in the last few years. Much of the growth has been in the form of residential subdivisions and, to a lesser extent, office parks, shopping centers, and light industrial uses.

Table B.1 –Population and Demographics

	2000 Population*	2035 Population Estimate	% Increase	Employed Persons Estimate (2035)	Median Age*
Benicia +	26,928	577,300	↑16%	18,950	33.9
Dixon +	16,180	31,200	↑111%	17,020	38.9
Fairfield +	96,545	34,300	↑49%	78,530	31.5
Rio Vista +	4,715	114,700	↑292%	78,530	31.1
Suisun City +	26,640	18,500	↑35%	8,080	40.7
Vacaville +	89,304	36,100	↑41%	17,870	31.7
Vallejo +	119,917	126,800	↑40%	68,220	33.9
Solano County +	394,542	169,000	↑46%	305,500	34.9
Unincorporated Areas Outside City Spheres of Influence	14,313	16,700	↑16%	9,180	N/A

Source: Association of Bay Area Governments Projections 2035: A Smart Growth Forecast

*2000 Census

+Sphere of Influence

Future growth and changes in land use are important to bikeway planning for two reasons. First, new developments will require new and upgraded roadways—which will provide bike lanes as part of the standards recommended in this report. Much of the cost of the proposed system, therefore, will be borne as part of the cost of developing new roadways. There are numerous areas in Solano County where major future development will occur, some of these include North Village, Lagoon Valley, south of Alamo, east of Vanden, and the industrial zones in the Vacaville area; Columbus Parkway and Mare Island in Vallejo; Peabody and the Cement Hill area in Fairfield; Cordelia and the lower Green Valley; and the Lake Herman Area in Benicia. As shown in Table B.1, Rio Vista is poised for explosive growth in the next 25 years, while overall the County will experience above-average growth rates.

Second, changes in land use (and particularly employment areas) impact average commute distance, which in turn affects the attractiveness of bicycling as a commute mode. Currently, the average one-way commute time in Solano County (28.2 minutes) is about 10 percent higher than the Bay Area as a whole due to the imbalance between residential and employment land uses in the County. From a bicycling perspective, any policy that encourages higher land use densities and an increase in local employment is a very positive step as explained below.

Demographics are linked to bicycling in several ways. Of all demographic features, average age is most directly linked to potential bicycle riding. A survey conducted by the Bureau of Transportation Statistics and the National Traffic Safety Administration in 2002 found a steep decline in bicycle ridership as people age. Of the respondents aged 16-24, nearly 40% rode bicycles. In the 45-54 age group, only 26% rode bicycles. Only 9% of those surveyed over the age of 65 rode bicycles. It may be argued that older people do not ride as often because of concerns about safety, and this is a valid consideration.

Solano County's average age (34 years) is slightly lower than the national norm of 35.3 years. Using a formula developed by the U.S. Department of Transportation (DOT) and the Trail & Bikeway Center, potential mode split for commuting purposes in Solano County by the year 2010 is four percent—compared to an existing mode split of about one percent. This represents a significant reduction in VMT (vehicle miles traveled), congestion, roadway construction, and air pollutants. It also represents an important argument supporting increased investment in bicycle facilities in the future.

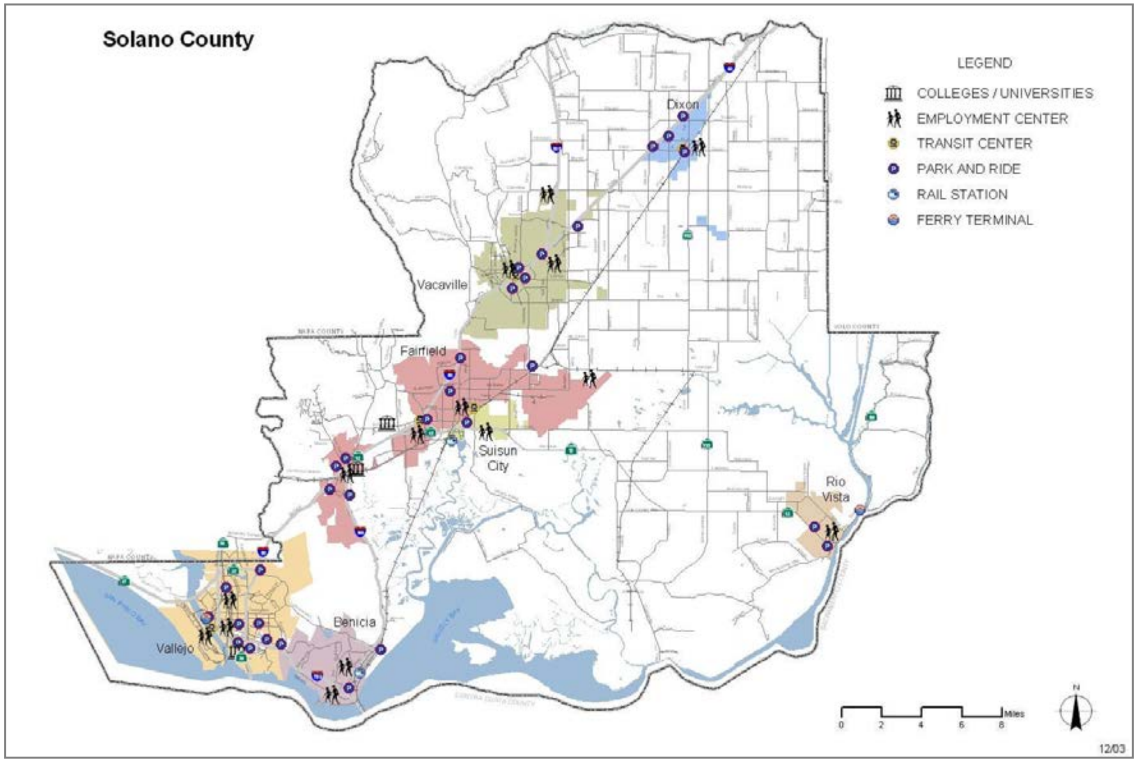
III. Major Activity Centers and Public Facilities

The proposed regional bikeway network will connect the neighborhoods where people live to the places they work, shop, recreate, or go to school. It will also provide loop routes for those who have no specific direction but ride for exercise or enjoyment. Loop routes are important as they provide for safe recreational riding by limiting turning movements thereby avoiding conflicts with automobile and other traffic. Figure _ shows the major regional activity centers in Solano County such as downtowns, regional shopping centers, and commercial districts. The major activity centers and public destination sin Solano County (shown in Figure _) include:

- Downtowns: Benicia, Dixon, Fairfield, Rio Vista, Suisun City, Vacaville, Vallejo, and Solano County
- Travis Air Force Base (AFB)
- Benicia Industrial Complex
- Mare Island in Vallejo
- California Medical Facility at Vacaville
- Major shopping destinations
- Solano Community College (Fairfield, Vacaville, and Vallejo)
- North Vacaville/I-505 Industrial Parks
- Anheiser-Busch and Cordelia industrial park
- Marine World/Solano County Fairgrounds
- Vaca Valley Hospital
- Vallejo Ferry Terminal
- Multi-modal locations such as park and ride lots and bus transfer stops and Amtrak stations
- Chapman College in Fairfield
- Vallejo Ferry Terminal
- U.C. Davis located just north of the Solano County Line to the east; nationally known for its bicycle usage

These activity centers will be used as planning criteria for selecting new regional bikeways.

Figure B-1 – Commuter and Student Destinations



IV. Commuter and Recreational Needs

Key general observations about bicycling needs in the county include:

- **Bicyclists are typically separated between casual and experienced writers.** The United States Department of Transportation identifies thresholds of traffic volumes, speeds, and curb lanes where less experienced bicyclists begin to feel uncomfortable. For example, on an arterial with traffic moving between 30 and 40 miles per hour, less experienced bicyclists require bike lanes while more experienced bicyclists are still willing to ride in the few feet of pavement between vehicles and the street's curb, if there is at least a 14—or 15-foot wide curb lane.
- **Casual Riders include those who feel less comfortable navigating traffic.** Others such as children and elderly may have difficulty gauging traffic, responding to changing conditions, or moving rapidly enough to clear intersections.

Other bicyclists experienced or not, may be willing to sacrifice time by avoiding heavily traveled arterials and using quieter side streets. In some cases, casual riders may perceive side streets (or sidewalks) as being safer alternatives than major through routes, when in fact they may be less safe. Other attributes of the casual bicyclist include cycling shorter distances than the experienced rider and unfamiliarity with many of the rules of the road.

All bicyclists will benefit from route markers, bike lanes, wider curb lanes, and educational programs. Casual bicyclists may also benefit from marked routes that lead to parks, museums, historic districts, and other visitor destinations.

- **Experienced bicyclists include those who have skills and confidence to ride within or near the travel lanes.** Experienced bicyclists typically prefer the most direct, through route between origin and destination and have the ability to navigate streets in the same manner as motor vehicles, merging across traffic to make left turns, and avoiding bike lanes and shoulders that contain gravel and glass. The experienced bicyclist will benefit from wider curb lanes and loop detectors at signals. The experienced bicyclist who is primarily interested in exercise will benefit from loop routes that lead back to the point of origin.

- **Who rides bicycles?** While the majority of Americans (and Solano County residents) own bicycles, most of these people are recreational riders who ride relatively infrequently. School children between ages of about 7 and 12 make up a large percentage of the bicycle riders today, often riding to school, parks, or other local destinations on a daily basis weather permitting. The serious adult road bicyclist who may compete in races, "centuries" (100 mile tours), and/or ride for exercise makes up a growing and important segment of bikeway users, along with serious off-road mountain bicyclists who enjoy riding on trails and dirt roads. The single biggest group of bicyclists is the intermittent recreational rider who generally prefers to ride on pathways or quiet side streets.

Commuter Needs

Commuter bicyclists range from employees who ride occasionally to work to a child who rides to school. Millions of dollars have been spent attempting to increase the number of people who ride to work or school, with moderate success. Bicycling require shorter commutes, which run counter to our land use and transportation policies which encourage people to live further and further from where they work. Access to transit helps extend the commute range of cyclists, but transit systems also face an increasingly dispersed live-work pattern that is difficult to serve. Despite these facts, Solano County has a great potential to increase the number of people who ride to work or school.

Bicycle commuters in the City of Davis have reduced peak hour traffic volumes by over 15 percent—to the point that many downtown streets that would normally be four lanes of traffic (with no bike lanes) have only two traffic lanes and ample room for bicyclists. While Davis may be an anomaly, national surveys have shown that 20 percent of the adult population would use a bicycle to ride to work at least occasionally if there were a properly designed bikeway system.

Key commuter needs are summarized below:

- Commuter trips range from several blocks to one or more miles
- Commuters typically seek the most direct and fastest route available, with regular adult commuters often preferring to ride on arterials rather than side streets.
- Commute periods typically coincide with peak traffic volumes and congestion, increasing the exposure to potential conflicts with vehicles.
- Places to safely store bicycles are of paramount importance to all bicycle commuters.
- Major commuter concerns include changes in weather (rain), riding in darkness, personal safety and security.
- Rather than be directed to side streets, most commuting cyclists would prefer to be given bike lanes or wider curb lanes on direct routes.
- Unprotected intersections in general are the primary concerns of all bicycle commuters.
- Many younger students use sidewalks for riding to schools or parks, which is acceptable in areas where pedestrian volumes are low and driveway visibility is high. Where on-street parking and/or landscaping obscures visibility, sidewalk riders may be exposed to a higher incidence of accidents. Older students who consistently ride at speeds over 10 mph should be directed to riding on-street wherever possible.
- Students riding the wrong-way on-street are common and typically account for many recorded accidents, pointing to the need for education.

Table B-1 shows commute to work statistics in Solano County based on the 2005-2007 American Community Survey.

TABLE B-1 – COMMUTE TO WORK STATISTICS, 2005-2007 American Community Survey (ACS) Transportation Profiles

Mode of	State of CA	Solano	Benicia	Dixon	Fairfield	Rio Vista	Suisun City	Vacaville	Vallejo

Transportation	%	County %	%	%	%	%	%	%	%
Car, Truck, Van; Drive-alone	71.8	73.3	77.6	79.6	79.0	70.8	74.5	78.8	66.6
Car, Truck, Van; Carpooled	14.5	17.7	11.7	12.2	13.7	14.3	18.2	14.5	22.9
Transit	5.1	2.7	4.2	0.7	0.9	1.1	2.6	0.7	5.0
Walked	2.9	1.6	1.0	1.7	0.3	6.9	1.0	1.8	1.2
Bicycle	0.8	0.5	0.5	1.4	1.2	0.6	0.3	0.4	0.9
Other Means	1.0	1.2	0.8	1.0	0.5	0.0	1.2	1.4	0.9
Worked at Home	3.8	3.1	4.2	3.4	3.0	6.4	2.4	2.4	2.9

*Source: http://www.fhwa.dot.gov/ctpp/

Commuters and students follow similar paths, which is typically the most direct possible route from origin to destination. For grammar school students, this may consist of residential or collector streets, with few crossings of major arterials. For junior high and high school students, riders may have to cross up to five or six arterials to reach school. For college students and adult commuters, rides are most often less than five miles but may be as long as 10 or 15 minutes.

Unfortunately, commuters and students need to travel during periods of peak traffic activity, and to destinations that may have high levels of congestion and traffic volumes/speeds. For example, one of the most dangerous parts of a young student's commute is the drop off zone in front of their school where dozens of vehicles jockey for position.

Once they have arrived at their destinations, bicycle commuters often find no (or poor) bicycle racks, and no showers or lockers. Rather than providing an incentive for bicyclists, most schools and employers inadvertently discourage bicyclists while continuing to subsidize parking for the automobile.

Commuting bicyclists have very obvious and straightforward needs. They require bicycle lanes or wider curb lanes along all arterials and collectors, loop detectors at signalized intersections, new signals where school children need to cross busy arterials, adequate maintenance of the pavement, and adequate bicycle storage and showers at their destinations.

Most commute bicycle trips are under five miles (eight kilometers) and therefore not regional trips, except for those commuters linking to another mode such as an Amtrak Station, transit stop, or park and ride lot. Allowing bicycles on other modes such as rail or bus, or providing bicycle lockers at multi-modal stations will help extend the range of the bicycle commuter. Other bicycle commuters will depend on a well-devised local bikeway network produced by a city in its bikeway master plan.

Recreational Needs

The needs of recreational bicyclists must be understood prior to developing a system or set of improvements. While it is not possible to serve every single neighborhood and every single need, a good plan will integrate recreational needs to the extent possible. The following points summarize recreational needs:

Recreational bicycling typically falls into two categories: exercise and touring.

- Recreational users range from children to healthy adults mountain biking to senior citizens. Each group has their own abilities, interests, and needs.
- Directness of route is typically less important than routes with less traffic conflicts, visual interest, shade, moderate gradients, shelter from wind and other amenities.
- People exercising or touring often (though not always) prefer a loop route rather than having to backtrack.
- Mountain bikers, a fast growing segment of recreational users, prefer off-road trails. The development of long distance trails between cities would go a long way to satisfy their off-street needs. It would also serve to reduce the impacts of bicycles at popular parks such as Rockville Hills and Lagoon Valley.
- Self-contained touring, an emerging form of eco-tourism is popular n the Pacific Coast Bike Route and is increasing statewide. Touring activities can be expected to increase with the completion of the Cross State Bike Route which will pass through Solano County, connecting the Lake Tahoe area to the San Francisco Bay. Campsites and rest stops are important amenities for touring cyclists.

Solano County offers several excellent recreational bicycle routes for different types of bicycle riders. These include bike paths for the less experienced rider such as the Linear Park in Fairfield and the River Park in Vallejo, and scenic back roads for longer distance riders such as Pleasants Valley Road and Putah Creek Road.

Some of the most obvious deficiencies are the lack of public awareness of bicycling opportunities and poor connectivity to regional recreation destinations and facilities such as parks and rest stops. Many roads outside developed areas lack shoulders or sufficient width for bicyclists, inhibiting some of the less adventuresome riders. Finally, there is demonstrated demand for additional bike paths where families, children, and others can ride closer to home without having to worry about traffic.

Two known issues on multi-use trails are, roadway/pathway interfaces and conflicts between bicyclists, pedestrians, roller blades, and others. As a multi-use trail begins to exceed 200 people per hour, those conflicts become more of a problem unless the trail has adequate width (at least 10 feet), unpaved shoulders for walkers, and adequate signing and enforcement. Regardless of the design and operation, many experienced riders choose not to use multi-use trails because of the unpredictability of other users. Accident studies have shown that most bicycle-related accidents involve other bicyclists or pedestrians rather than automobiles. As such, multi-use trails should be designed to separate users as much as possible and the system should not depend on multi-use trails for critical connections to serve all riders.

With a favorable climate and gentle topography, recreational riders abound in Solano County. Bicycle clubs provide both the serious and casual recreational rider the opportunity to ride socially-and be guided through the maze of secondary roads to scenic destinations.

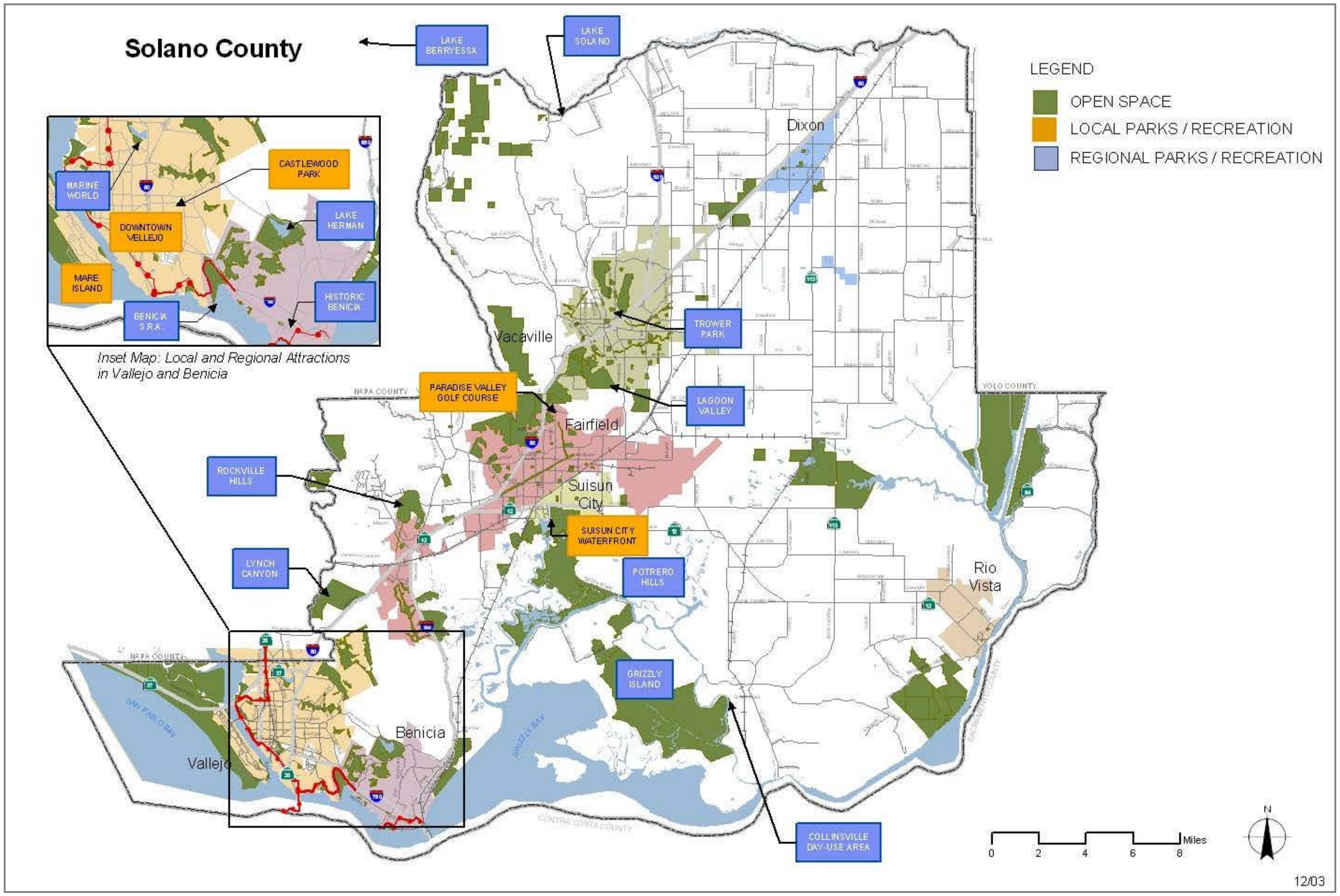
Regional recreation destinations and routes are shown in Figure B-1 and include:

- Western Railway Museum
- Historic Benicia
- Lake Solano Park
- Potrero Hills and Grizzly Island
- Rockville Hills Park
- Pleasants Valley Road
- Lagoon Valley Regional Park
- Benicia State Recreation Area
- Fairfield Linear Park
- Marine World/County Fairgrounds
- San Francisco Bay Trail
- Putah Creek Road
- Suisun Valley Road
- Suisun City Downtown/Waterfront District
- Solano Community College
- Montezuma Hills
- Sacramento Delta Scenic Bike Route
- Mare Island
- Bay Area Ridge Trail
- Vallejo River Park

These destinations will be used as part of the evaluation criteria for selecting regional bikeway routes. Recreational bicyclist needs will be met by planning, designing, and implementing a series of bike routes that increase accessibility to Solano

County's recreational assets (parks, libraries, historic areas, shopping areas, etc…) as well as loop routes that lead outside towns and cities away from traffic and congestion.

Figure B-1 – Recreation Destinations



V. Specialized Facilities

Specialized facilities include off-road bicycling areas in Solano County. The majority of bicycles being sold today can be classified as dual function bikes, that is, they are designed for mountain biking and for short trips on roadways. In some areas, mountain bikes outnumber hikers on trails and the demand for multi-use trails is growing.

Mountain bikers enjoy varied trails that lead through a variety of topography and landscapes. Contrary to popular belief, bicycles and equestrians can co-exist given that bicyclists ride with a certain level of restraint and control. The biggest problems facing mountain bikers have been conflicts with hikers—especially on single-track trails—and some claims of environmental damage.

Some of the existing regional off-road bicycling areas in Solano County include:

- Rockville Hills Park
- Lower Lagoon Valley Park/Peña Adobe
- River Park (Vallejo)

The most successful approach will be to identify off-road bicycling areas and ensure that they serve the needs of bicyclist and protect the rights of other trail users.

VI. Planning Process

Although the bicycle planning process involves the use of standards and criteria, it also relies heavily on the input of local citizens from the planning area. The Solano County Bicycle Advisory Committee (BAC), comprised of citizens from throughout the County, has been involved through each process, in addition to regular monthly or bi-monthly meetings. For 2004 Solano Countywide Bicycle Plan, the South County Plan and this 2010 update, local citizens were involved throughout the planning process in a number of different forums. The following discussion describes the planning process used to develop the proposed system and the involvement of local citizens.

Public workshops were held for the Comprehensive Transportation Plan Update in each of the STA's member agencies. The main purpose of these meetings was to solicit public comment on the countywide transportation system and to identify bicycle related concerns of the general public. The last public workshop, which was held in conjunction with a meeting with the BAC, provided the public and the BAC members an opportunity to make changes to the proposed system. This meeting generated a number of comments and changes, which have been incorporated throughout the Plan. Many of the comments, though, were related to implementation and funding. These issues were addressed in the Chapter 5 – Cost Analysis and Implementation Strategy.

VII. Needs and Attitude Survey

Field data was collected for the feasibility analyses presented in this section. In 1994 and again in 2003, a needs and attitude survey was conducted to identify (a) the existing bicycle riding patterns in Solano County, (b) reasons why people don't ride or ride more often, and (c) what types of improvements would encourage people to ride more often. The survey methodology consisted of interviewing a cross section of people at public locations throughout the county, and distributing surveys through bike shops, bicycle clubs, and major employment centers. While a statistically significant sample would cost several times the budget of this entire study, this survey provides information—that when used with other sources such as the U.S. Census—helps identify existing and potential bicycle ridership.

1. How many bicycles are in your household?
2. What type of bicyclist are you?
3. Factors for not riding or not riding more often?
4. What improvements would convince you to ride or ride more often? (you may answer more than once)
5. How long is your current one-way commute?
6. Are you aware of the Solano BikeLinks Map
7. Is the Solano BikeLinks Map useful?

Survey results from questionnaires left in bicycle shops, employment centers, and distributed through the Bicycle Advisory Committee showed:

Question 1: How many bicycles are in your household?

Answer	2003		1994		Change
	#	%	#	%	%
0	0	0%	22	18%	-18%
1	3	10%	26	22%	-12%
2	9	29%	18	15%	+14%
3+	19	61%	53	46%	+15%

Question 2: What type of bicyclist are you? (You may answer more than once)

Answer	2003		1994		Change
	#	%	#	%	%
Casual Recreation Rider	19	61%	77	63%	-2%
Mountain Biker	14	45%	21	17%	+28%
Occasional Commuter	9	45%	8	7%	22%
Regular Commuter	9	29%	2	2%	27%
Club Bicyclist	3	10%	3	2%	8%
Racing/Touring Rider	11	35%	12	10%	25%

Question 3: Factors for no riding or not riding more often?

Answer	2003		1994		Change
	#	%	#	%	%
Too strenuous	1	3	8	5	-2
No time	8	26	53	35	-9
Inconvenient	7	23	7	5	+18
Distance	8	26	15	10	+16
Weather	8	26	11	7	+19
Safety	10	32	20	13	+19
Not interested	0	0	15	10	-10
Clothing constraints	1	3	4	3	0
Other	6	19	18	12	7

Question 4: What improvements would convince you to ride or ride more often? (You may answer more than once)

Answer	2003		1994		Change
	#	%	#	%	%
Comprehensive bike lane network	27	87%	73	37%	+50%
Secure, covered bike parking	10	32%	24	12%	+20%
Showers/lockers at work	1	3%	15	8%	-5%
Half-hour off work day	0	0%	23	12%	-12%
Guaranteed rides home	2	6%	14	7%	-1%
$10/ week incentive	4	13%	19	10%	+3%
Bike racks on buses	8	26%	25	13%	+13%
Other	4	13%	6	3%	+10%

Question 5: How long is your current one-way commute?

Answer	2003		1994		Change
	#	%	#	%	%
No commute	3	10%	25	21%	-11%
0-5 miles	12	39%	29	26%	+13%
6-10 miles	3	10%	12	10%	0%
Over 10 miles	13	42%	52	44%	-2%

Question 6: Are you aware of the Solano BikeLinks Map?

Answer	2003		1994		Change
	#	%	#	%	%
Yes	20	64%	N/A	N/A	N/A
No	10	10%	N/A	N/A	N/A

Question 7: If yes to question 6, is it useful?

Answer	2003		1994		Change
	#	%	#	%	%
Yes	18	58%	N/A	N/A	N/A
No	3	9%	N/A	N/A	N/A

Survey results from questionnaires left in bicycle shops and distributed through the Bicycle Advisory Committee showed:

- The vast majority of households have bicycles (100% of respondents)
- Most bicyclists describe themselves as casual recreational riders (61%)
- A significant portion (29% of respondents) commute by bicycle at least occasionally
- Most obstacles to increased bicycle riding are personal (not interested, too strenuous, etc.)
- Safety was the highest single response for not riding (32%)
- Physical improvements such as bike lanes ranked highest among incentives to increase bicycle riding (87%)

The results of this survey compare very closely to other communities in California, where a similar surveys have been conducted. As the statistical variance on this questionnaire is quite high, it should be used with caution and in conjunction with other sources.

VIII. Trip Reduction Potential/Air Quality Benefits

Based on the results of the survey and other sources on current ridership, it is possible to project future bicycle ridership in Solano County along with the trip reduction and air quality benefits. While these projections are only ambitious estimates, they are important to building an argument for investing in bicycle facilities and programs over time. The projection on bicycle usage and benefits forecast changes in modal choice—not travel behavior—based on a combination of empirical and theoretical data. Research conducted around the U.S. by the U.S Department of Transportation shows a definitive link between bicycle use and age and the miles of bicycle facilities provided. It is possible to derive a causal relationship from this information.

Table B-2 on the following page quantifies the estimated reduction in vehicle miles traveled (VMT) in Solano County, and the estimated reduction in air pollutants based on the best available local and national data. The proposed bikeway system in Solano County could increase the bicycle mode share of trips from less than one percent in 2000 (U.S. Census) to nearly five percent by 2030. This will result in an estimated decrease of 272,216 vehicle miles, 9.5 tons or ROG, and 6.5 tons of Nox per day.

Table B-2: Demographics, Bicycle Commuters, and Air Quality

Category	Total	Source/Calculation
Population	394,542	2000 US Census
# of Employed Persons	174,571	2000 US Census
# Bicycle-to-Work Commuters	803	2000 US Census
Bicycle-to-Work Mode Share	.46%	Calculated from above
Population: Ages 5-14 years (K-8)	59,088	2000 US Census
# of College Students	10,116	2000 US Census
# of Daily Bike-Transit Users	6,000	2005 CTP
Total # of Bicycle Commuters	9,757	Assumes 5% of school students commute by bicycle – from national studies and estimates
Utilitarian Bicyclists	11,837	
# Miles Ridden by Bicycle Commuters per Weekday	152,076	Work commuters (including bike-transit users) x8 miles + school students x1 mile (round trip)
# of Future Daily Bicycle Commuters	19,515	Estimated using the Federal goal of doubling # of bicycle commuters nationwide by 2030
Future # Miles Ridden by Bicycle Commuters per Weekday	424,292	
Reduced Vehicle Miles per Weekday	270,216	
Reduced PM10 (lbs/weekday)	5,008.78	(.0184 tons per reduced mile)
Reduced NOX (lbs/weekday)	13,578.15	(.04988 tons per reduced mile)
Reduced ROG (lbs/weekday)	19,762.91	(.0726 tons per reduced mile)
Reduced Vehicle Miles Per Year	5,1966,163	180 days for students, and 256 days for employed persons
Reduced PM10 (lbs/year)	956,177.40	(.0184 tons per reduced mile)
Reduced NOX (lbs/year)	2,592,072.21	(.04988 tons per reduced mile)
Reduced ROG (lbs/year)	3,772,743.44	(.0726 tons per reduced mile)

PM10 – Particulate Matter
NOX – Nitrogen Oxides
ROG – Reactive Organic Gasses

TECHNICAL DESIGN MINI GUIDE

This Appendix is a recommendation of the 2011 Solano Countywide Bicycle Transportation Plan. STA staff has developed a preliminary outline for development in the next year.

This Technical Design Mini Guide is intended to assist the STA and its member agencies in the selection and design of bicycle facilities in Solano County. The Mini Guide is made up of various elements that provide the standards and best practices by facility type. There are many new policy standards that are being incorporated as part of existing guiding documents. These standard documents are:

1. American Association of State Highway and Transportation Officials (AASHTO) Guide for Development of Bicycle Facilities
2. California Manual of Uniform Traffic Control Devices (CAMUTCD)
3. National Manual of Uniform Traffic Control Devices (MUTCD)
4. Caltrans Highway Design Manual (HDM)

This Guide provides a summary of the critical information from above documents as well as best practices recommendations from other public agencies in the Bay Area and nationwide. Currently, the CAMUTCD and HDM are the standards for bicycle facilities in California. The following sections are included as part of the Technical Design Mini Guide:

I. Design Needs
II. Bicycle Paths (Class I)
III. Bicycle Lanes (Class II)
IV. Bicycle Routes (Class III)
V. Signalized Intersections
VI. Bicycle Parking*
VII. Bikeway Signage*
VIII. Non-standard Treatments
IX. List of Other Resource Guides

This document is work intended to provide general guidelines, while introducing the framework for new concepts yet to be incorporated into Solano County's bikeway system. For example, Section 7: Bikeway Signage is a recommendation from the Solano Countywide

Bicycle Transportation Plan, however, its development is in progress. Sections to be further developed in the future are denoted with an asterisk.

APPENDIX D – COMPLETED PROJECTS LIST

PROGRESS SINCE THE 2001 BICYCLE PLAN

Since the 2001 Plan Update was adopted, much progress has been made toward achieving the goals it set forth. The achievements include:

Solano Bikeway –Phase I (Vallejo): Phase I of the Solano Bikeway project was awarded approximately $2,350,000 in Transportation Enhancement Activities (TEA), Transportation Fund for Clean Air (TFCA), Environmental Enhancement and Mitigation (EE&M) funds, and local TDA Article 3 funds to construct a Class I bike path adjacent to I-80 from Columbus Parkway to Hiddenbrooke Parkway in Vallejo. This first phase of the project was fully completed and opened to the public in the fall of 2001.

The Solano Bikeway, which opened in the fall of 2001, parallels I-80 in Vallejo from Columbus Parkway to Hiddenbrooke Parkway.

Dixon to Davis Bike Route (County): The County of Solano completed the Dixon to Davis Bike Route in October 2003, a vital 6-mile link in the north County that connects the communities of Dixon and Davis. The newly opened bikeway has exceeded use expectations and proven to be widely used by both commuter and recreation riders. Central County Bikeway (Suisun City): Suisun City was awarded over $1.4 million in grants from more than 10 different sources to construct the Central County Bikeway along Highway 12 from the Suisun City Multi-Modal (Amtrak) Station to Peterson Road and Travis Air Force Base. The project has been constructed from Marina to Peterson and opened to the public in July 2003.

Ribbon cutting ceremonies at the Dixon to Davis Bike Route were in October 2003.

Southside Bikeway (Vacaville): the City of Vacaville continued to expand its popular bikeway system, linked to the Alamo Creek Pathway system and part of the countywide primary bikeway system. Vacaville continued its implementation of the Alamo Creek and Southside Bikeways.

The Green Valley Class I Bike Path (County): The County completed a new Class I path in 2001 along Green Valley Road from Rockville Road to the Fairfield City Limit, linking to existing Fairfield facilities.

Ribbon cutting ceremonies at the Central County Bikeway were held in July 2003.

2003 Solano Bikeway Extension Feasibility Study (Fairfield):

The City of Fairfield recently completed the Solano Bikeway Extension Feasibility Study. The extension study was performed to identify an alignment for the Phase 2 extension of the Solano Bikeway from its current terminus at McGary Road just south of Hiddenbrooke Parkway/American Canyon Road, north to the Solano Community College in Fairfield. Implementation of the Solano Bikeway Extension is critical to close a major gap in the current bikeway system between Fairfield and Vallejo.

BikeLinks Maps (STA):

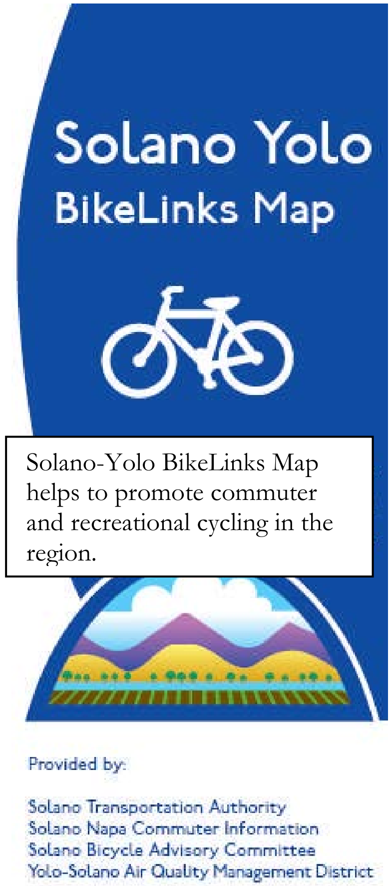
The Solano Transportation Authority produced a fourth version of the popular BikeLinks map. The latest edition of this useful guide to bicycling conditions in the region is available on-line on the STA's website, www.solanolinks.com/.

Bicycle Advisory Committee (STA): The BAC continued to meet and make bicycle funding recommendations and decisions on bicycle project planning and issues of countywide significance.

Carquinez Bridge Bikeway (Caltrans): The Carquinez Bridge Bikeway, completed and opened in the spring of 2004, is a component of the Carquinez Bridge Replacement Project. The new suspension bridge, designed to meet seismic safety, replaces the existing 1927 steel truss bridge and provides pedestrian and bicycle access across the straight.

State Route 37 Improvement Project (Vallejo): Caltrans is currently constructing improvements on a 2.5 mile portion of State Route 37 in Vallejo from the Napa River Bridge on the west end to beyond Walnut Street/Mini Drive on the east end. The project includes a new Class I bikeway which will be located on the north side of the improvements. The project will become an alignment of the Bay Trail connecting to trails in the White Slough area, and will serve local neighborhoods and businesses in the area.

Pleasants Valley Road Bridge Replacement Program (County): The County constructed a new bridge on Pleasants Valley Road at Pleasants Creek to replace a narrow bridge that was destroyed in a storm. The new bridge has four-foot shoulders – suitable for Class II bike lanes – to accommodate bicycle travel. This is the seventh bridge that the County re-constructed on Pleasants Valley Road in the past decade in an effort to eliminate some of the constrictions along the road.



Solano-Yolo BikeLinks Map helps to promote commuter and recreational cycling in the region.

Below are projects identified for completion within five years in the 2004 Plan, which have since been completed:

- Central County Bikeway –a critical gap closure in the Central County Bikeway project connecting the existing route from its terminus at Marina Boulevard to the Amtrak Station in Suisun City
- The Solano Bikeway Extension –connecting Vallejo and Fairfield
- State Park Road Overcrossing –connecting cyclists across I-780 in Benicia to the Benicia State Recreation Area.

These projects are also listed in the following table.

RECENTLY COMPLETED BICYCLE PROJECTS

ID	Agency	Project Name	From/To	Description	Status/ Comments
1.	Fairfield	Linear Park Path Alternative Route: Nightingale Drive	Dover Avenue to Air Base Parkway	Construction of 0.5 miles of Class II or Class III improvements on Nightingale Drive from Dover Avenue to Air Base Parkway Pedestrian Bridge (near Swan Way). The improvements would remain even if the Linear Park is extended. This project also includes other project components such as: including enhancements to the existing Laurel Creek multiuse trail, signage, lighting, and signage north of Airbase Parkway	Permitted and Ready to Construct; to be moved to existing projects list when completed
2.	Dixon	Bicycle Racks at City Facilities	Various Locations	Construction of bicycle racks, lockers, and other related amenities for bicyclists at City facilities	Permitted and Ready to Construct; to be moved to existing projects list when completed
3.	Vallejo	McGary Road	Vallejo City Limit to Hiddenbrooke Parkway	0.25 mile class II bicycle lane on McGary Road from Vallejo City Limit to Hiddenbrooke Parkway in both directions.	Completed; to be moved to existing projects list.
4.	Dixon	Vaca-Dixon Bicycle Route: North Adams Street	SR 113 to Porter Road A Street to Pitt School Road	Phase 1: Striping for a Class II pathway on Adams Street from SR 113 to Porter Road in both directions Phase 2: Road widening to add Class II path on Porter Road between A Street and Pitt School Road in both directions	Permitted and Ready to Construct Planned
5.	Vacaville*	Ulatis Creek Bicycle Facilities – Priority #1	Phase I: Ulatis Dr to Leisure Town Rd;	Construct Class 1 off-street bicycle path, and Class 2 bicycle lanes at various locations along Ulatis Creek from Vaca Valley Rd to Leisure Town Rd. Various segments are either Planned or Preliminary Design (depending upon location). Phase 1: Ulatis Drive to Leisure Town Road	Permitted and Ready to Construct

PROJECTS CURRENTLY IN PROGRESS

ID	Agency	Project Name	From/To	Description	Status/ Comments
1.	Suisun City*	Grizzly Island Trail	Grizzly Island Road to Mariana Boulevard	Construct a safe route to school path system from Crescent Elementary School to Crystal Middle School. Path will include a Class I Path along the south side of SR 12 from Grizzly Island Road to Marina Boulevard, then south along Marina Boulevard to Driftwood Drive.	Preliminary Design; **$2,100,000** committed; fully funded. $814,000 recommended STA funding. $900,000 local SR2S grant secured.
2.	Fairfield	Linear Park Alternate Route: Nightingale Drive	Dover Avenue to Air Base Parkway	Install sharrows, bike route signs, improve crosswalks, and lighting.	Preliminary Design: **$250,000** CMAQ/TDA committed. No funding shortfall.
3.	Vacaville	Ulatis Creek Bicycle Facilities: Phase 1	Ulatis Drive to Leisure Town Road	Construct Class I to connect downtown to citywide loop system and regional bikeways such as vaca-dixon bike route.	Environmental clearance: **$915,000** ECMAQ in FY 2010/11. No funding shortfall.

Appendix E – Safe Routes to Schools Implementation Strategies

Local jurisdictions are encouraged to participate in STA Safe Routes to School Program (see http://solanosr2s.ca.gov/ for current Safe Routes to School Plan) which as implemented the following strategies:

Implementation Strategies

There is a need in each school district to establish an organization concerned with student commuting. Through such an organization, the school district can be responsibly involved in safety issues and the processing of requests for traffic controls as well as for safety programs and the coordination of activities within and between the community and public agencies.

School commute projects are usually developed in a traditional planning process that includes (a) school administrators and teachers, (b) local PTA's and other groups, (c) neighborhood groups and the public, (d) police departments, and (e) local public agencies staff such as planning, engineering, and public works departments. Employing a formal process that includes local agency staff, transportation engineers and professionals, and police departments helps to ensure route integrity and reduce liability. The following steps are recommended to develop safe routes projects:

- Form a School Commute Task Force composed of representatives from the school district, city staff and law enforcement agencies, the local neighborhood, parent teachers organization or other similar group, and the school itself.
- 2. Set objectives and a reasonable schedule for this Task Force to accomplish its goals. Determine the preferred basic school commute routes to the school based on (a) parent and student input, (b) a survey of parent and student commute patterns, (c) city staff and law enforcement input, and (d) observations of actual commuting patterns.
- Identify school commute goals. For example, does the school wish to encourage more students to walk or bicycle to school? While there is a perception of safety being a concern, statistics show that walking and bicycling are just as safe as driving. Yet many parents insist on driving their children even a few blocks to school, thus contributing to the traffic congestion.
- Study the parking lot and drop off areas of the school. Is there a pattern where students are walking between cars or through parking lots or drop off areas to reach the school? Are there management efforts to get parents to follow any specific drop-off protocol?
- Identify if there are adequate sidewalks and bike lanes on the streets directly serving the school. Are there Class I facilities that lead directly to the school? Are there school access points which encourage students to cross mid-block or at other less desirable locations? Are there gaps in the walking or biking routes?
- Identify the first major street crossings on the main school commute routes. Many accidents occur at these intersections. Are there crossing guards?

- Identify locations where students are crossing major or minor streets at mid-block or unprotected locations, (i.e., no stop signs or signals). Because children are sometimes hard to see and have difficulty in gauging vehicle speed, these locations can be the focus of improvements.
- Identify locations where students forced to cross intersections that have very wide turning radii, where vehicles can accelerate and merge while turning. These are problematic because driver's attention is focused to their left at merging traffic rather than in front at crosswalks where students may be present.
- Evaluate intersection designs. Do all intersections have properly designed crosswalks? The crosswalks should be located so that students can wait safely on the sidewalk prior to seeing if they can cross. Is there adequate visibility and lighting given the speed of traffic? Are there adequate warning signs in advance of the crosswalk?
- Evaluate actual traffic speeds along school commute routes. What are the 85th percentile speeds of traffic on the major school commute corridors? Are they significantly above or below the posted speed limits? When was the last speed survey conducted? What is the level of police enforcement, and does it occur only at the beginning of the school year? It is possible to lower speed limits near schools. In other locations, it may be necessary to make physical changes, such as narrowing travel lanes, to slow traffic.
- A more detailed evaluation methodology which rates improvements and corridors according to objective criteria, has been developed and is available for use by local schools. However, it may require the services of specialists who understand traffic safety and engineering.
- Once the improvements have been identified, a preliminary design or plan must be completed which describes the project and its cost. For example, a crosswalk improvement would need to be designed so that it can be reviewed and approved by the appropriate agency. Again, a professional may be engaged for this effort.
- With a plan and cost estimate, the project still needs a sponsor. Typically this would be the jurisdiction, which is best connected to available funding sources and familiar with the State and Federal procedures necessary to obtain funding. The project sponsor will need an official authorization and confirmation that (a) the right-of-way is publicly owned, (b) staff have reviewed and approved the project, and (c) no negative impacts have been identified. With this in hand, the project sponsor can seek funding, which usually requires a 10% or greater matching amount. Caltrans has a Safe Routes to School grant program specifically for construction projects at or near schools.
- Programs that may be implemented include a "Walking School Bus Program," which involves parents taking turns walking (or bicycling) with groups of children to school. A good opportunity to kick-off a Safe Routes to School program is during International Walk to School Day is early October. Good resources and start-up material can be found at www.cawalktoschool.com. Organized Bike and Walk to School Days should be held monthly or weekly to keep the momentum going and encourage more children and their parents to walk or bike to school. Prizes or drawings for prizes offered to participants have been used in some schools as an incentive.

- Curriculum programs implemented in the schools can teach children the basics regarding pedestrian and bicycle safety on the roads. Education materials should be expanded to promote the benefits of bicycling and walking, the need for education and safety improvements, the most recent educational tools available in the country (including the use of low-cost safety videos), and directives to parents on the proper school drop-off procedure for their children. Incentive programs to reward good behavior should be developed. Educational programs, and especially on-bike training, should be expanded to more grades and for more hours per year. A standard safety handbook format should be developed incorporating the best elements of those currently in use, and made available to each school in a digital format so they may be customized as needed. Each school should develop a circulation map of the campus and immediate environs to include in the handbooks, clearly showing the preferred circulation and parking patterns and explaining in text the reason behind the recommendations. This circulation map should also be a permanent feature in all school newsletters. A variety of bicycle helmet subsidy programs are available in California, and should be used to provide low-cost approved helmets for all school children that ride bicycles.

School Zone Improvements

Traffic control measures in school zones can be a sensitive subject. In some cases, parents, schools, and school-based organizations have ideas for improvements which conflict with or exceed sound engineering practices. The best solution to ensure the safety of students and all roadway users is to adhere to accepted engineering practices that are proven effective. Traffic engineering analysis reveals that unnecessary control measures tend to lessen the respect for those controls that are needed. It is important to stress the point that effective traffic control can best be obtained through the uniform application of realistic policies, practices and guidelines developed through properly conducted engineering studies.

This study recommends that the decision to use a particular device at a particular location shall be made on the basis of an engineering and traffic survey. Of equal importance is the maintenance of traffic control devices. Devices should be properly maintained to ensure legibility, visibility, and functionality. Furthermore, if a device is found to be ineffective, it should be removed. Finally, devices which are used on a part-time basis, such as warning flashers, should be in operation only during the time periods when they are required.

To provide safe access for children on their approaches to schools, school sites should have designated pedestrian access points. Roadway geometry should minimize travel speeds to 15-20 mph. Slowing or calming vehicle traffic may be accomplished with raised crossings, traffic diverters, roundabouts, on-street parking and other land use and engineering designs. School sites should have pedestrian access points which do not require students to cross in front of drop off and pick up traffic. The approaches to all schools should have curb and gutter sections, except in unusual circumstances. Streetscaping should assure maximum sight distance on all access, crossings, and intersections. School zone designations for speed limits should be an element of a comprehensive “circulation” plan that also includes crossing guard programs and identification of “safe routes” for bicycling and walking to school.

Appendix F - List of Hyperlinks from Table 5-3A – Summary of Funding Sources

Name of Funding	Webpage	Used For	Amount per Year (estimates)
Transportation Development Act (TDA) Article 3	http://www.mtc.ca.gov/funding/STA-TDA/	Bicycle and Pedestrian Projects	Approximately $260,000 to $350,000
Congestion Mitigation & Air Quality Improvement Program (CMAQ)	http://www.fhwa.dot.gov/environment/air_quality/cmaq/	Projects to reduce vehicle emissions and traffic congestion	Varies
Transportation for Livable Communities (TLC)	http://www.mtc.ca.gov/planning/smart_growth/tlc/	Bicycle, pedestrian, transit or other projects that enhance community vitality	$1 million
Surface Transportation Program (STP)[1]	http://www.dot.ca.gov/hq/LocalPrograms/lam/prog_g/g04stp.pdf	Capital projects including highways, bus/rail transit, local streets, port facilities, bicycle and pedestrian projects, etc.	Varies
Eastern Solano CMAQ	None Available	Projects to reduce vehicle emissions (i.e. clean vehicle technologies, alternative modes of transportation and public education)	$250,000
Yolo-Solano Air Quality Management District (YSAQMD) Clean Air Funds (CAF)	http://www.dcn.davis.ca.us/go/ysaqmd/Incentives10.php	Clean technologies/low emission vehicles, alternative transportation, transit services, public education	
Transportation Fund for Clean Air (TFCA)	http://www.baaqmd.gov/~/media/Files/Strategic%20Incentives/TFCA/TFCA%20Regional%20Fund%20Guidance%20FY10-11%20-%20July2010.ashx	Transportation programs/projects that improve air quality	$100-150,000
State Transportation Improvement Program (STIP)	http://www.dot.ca.gov/hq/LocalPrograms/STIP.htm	Projects may include, but not limited to, improving State highways, local roads, public transit (including buses), intercity rail, pedestrian and bicycle facilities, grade separations, transportation system management, transportation demand management, soundwalls, intermodal facilities, and safety.	Varies
Transportation Enhancements (TE)	http://www.fhwa.dot.gov/environment/te/guidance.htm	For scenic beautification, bicycle and pedestrian facilities, historic rail depot upgrades, bus shelter, access for disabled persons, etc.	Discretionary varies annually

[1] Also see http://www.mtc.ca.gov/funding/STPCMAQ/

CHAPTER 1000 BIKEWAY PLANNING AND DESIGN

Topic 1001 - General Criteria

Index 1001.1 - Introduction

The needs of non-motorized transportation are an essential part of all highway projects. Topic 105 discusses Pedestrian Facilities with Index 105.3 addressing accessibility needs. This chapter discusses bicycle travel. All city, county, regional and other local agencies responsible for bikeways or roads where bicycle travel is permitted must follow the minimum bicycle planning and design criteria contained in this and other chapters of this manual (See Streets and Highways Code Section 891).

Bicycle travel can be enhanced by improved maintenance and by upgrading existing roads used regularly by bicyclists, regardless of whether or not bikeways are designated. This effort requires increased attention to the right-hand portion of roadways where bicyclists are expected to ride. On new construction, and major reconstruction projects, adequate width should be provided to permit shared use by motorists and bicyclists. On resurfacing projects, it is important to provide a uniform surface for bicyclists and pedestrians. See Index 625.1(1) and 635.1(1) for guidance in accommodating bicyclist and pedestrian needs on resurfacing projects. **When adding lanes or turn pockets, a minimum 1.2 m shoulder shall be provided (see Topic 405 and Table 302.1).** When feasible, a wider shoulder should be considered. When placing a roadway edge line, sufficient room outside the line should be provided for bicyclists. When considering the restriping of roadways for more traffic lanes, the impact on bicycle travel should be assessed. Bicycle and pedestrian traffic through construction zones should be addressed in the project development process. These efforts, to preserve or improve an area for use by bicyclists, can enhance motorist and bicyclist safety and mobility.

1001.2 The Role of Bikeways

Bikeways are one element of an effort to improve bicycling safety and convenience - either to help accommodate motor vehicle and bicycle traffic on shared roadways, or to complement the road system to meet needs not adequately met by roads.

Off-street bikeways in exclusive corridors can be effective in providing new recreational opportunities, or in some instances, desirable commuter routes. They can also be used to close gaps where barriers exist to bicycle travel (e.g., river crossing). On-street bikeways can serve to enhance safety and convenience, especially if other commitments are made in conjunction with establishment of bikeways, such as: elimination of parking or increasing roadway width, elimination of surface irregularities and roadway obstacles, frequent street sweeping, establishing intersection priority on the bike route street as compared with the majority of cross streets, and installation of bicycle-sensitive loop detectors at signalized intersections.

1001.3 The Decision to Develop Bikeways

The decision to develop bikeways should be made with the knowledge that bikeways are not the solution to all bicycle-related problems. Many of the common problems are related to improper bicyclist and motorist behavior and can only be corrected through effective education and enforcement programs. The development of well conceived bikeways can have a positive effect on bicyclist and motorist behavior. Conversely, poorly conceived bikeways can be counterproductive to education and enforcement programs.

1001.4 Definitions

The Streets and Highway Code Section 890.4 defines a "Bikeway" as a facility that is provided primarily for bicycle travel.

(1) Class I Bikeway (Bike Path). Provides a completely separated right of way for the exclusive use of bicycles and pedestrians with crossflow by motorists minimized.

(2) Class II Bikeway (Bike Lane). Provides a striped lane for one-way bike travel on a street or highway.

(3) Class III Bikeway (Bike Route). Provides for shared use with pedestrian or motor vehicle traffic.

1001.5 Streets and Highways Code References - Chapter 8 - Nonmotorized Transportation

(a) Section 887 -- Definition of nonmotorized facility.

(b) Section 887.6 -- Agreements with local agencies to construct and maintain nonmotorized facilities.

(c) Section 887.8 -- Payment for construction and maintenance of nonmotorized facilities approximately paralleling State highways.

(d) Section 888 -- Severance of existing major nonmotorized route by freeway construction.

(e) Section 888.2 -- Incorporation of non-motorized facilities in the design of freeways.

(f) Section 888.4 -- Requires Caltrans to budget not less than $360,000 annually for nonmotorized facilities used in conjunction with the State highway system.

(g) Section 890.4 -- Class I, II, and III bikeway definitions.

(h) Section 890.6 - 890.8 -- Caltrans and local agencies to develop design criteria and symbols for signs, markers, and traffic control devices for bikeways and roadways where bicycle travel is permitted.

(i) Section 891 -- Local agencies must comply with design criteria and uniform symbols.

(j) Section 892 -- Use of abandoned right-of-way as a nonmotorized facility.

1001.6 Vehicle Code References - Bicycle Operation

(a) Section 21200 -- Bicyclist's rights and responsibilities for traveling on highways.

(b) Section 21202 -- Bicyclist's position on roadways when traveling slower than the normal traffic speed.

(c) Section 21206 -- Allows local agencies to regulate operation of bicycles on pedestrian or bicycle facilities.

(d) Section 21207 -- Allows local agencies to establish bike lanes on non-state highways.

(e) Section 21207.5 -- Prohibits motorized bicycles on bike paths or bike lanes.

(f) Section 21208 -- Specifies permitted movements by bicyclists from bike lanes.

(g) Section 21209 -- Specifies permitted movements by motorists in bike lanes.

(h) Section 21210 -- Prohibits bicycle parking on sidewalks unless pedestrians have an adequate path.

(i) Section 21211 -- Prohibits impeding or obstruction of bicyclists on bike paths.

(j) Section 21717 -- Requires a motorist to drive in a bike lane prior to making a turn.

(k) Section 21960 -- Use of freeways by bicyclists.

Topic 1002 - Bikeway Facilities

1002.1 Selection of the Type of Facility

The type of facility to select in meeting the bicycle need is dependent on many factors, but the following applications are the most common for each type.

(1) *Shared Roadway (No Bikeway Designation).* Most bicycle travel in the State now occurs on streets and highways without bikeway designations. This probably will be true in the future as well. In some instances, entire street systems may be fully adequate for safe and efficient bicycle travel, and signing and

pavement marking for bicycle use may be unnecessary. In other cases, prior to designation as a bikeway, routes may need improvements for bicycle travel.

Many rural highways are used by touring bicyclists for intercity and recreational travel. It might be inappropriate to designate the highways as bikeways because of the limited use and the lack of continuity with other bike routes. However, the development and maintenance of 1.2 m paved roadway shoulders with a standard 100 mm edge line can significantly improve the safety and convenience for bicyclists and motorists along such routes.

(2) *Class I Bikeway (Bike Path)*. Generally, bike paths should be used to serve corridors not served by streets and highways or where wide right of way exists, permitting such facilities to be constructed away from the influence of parallel streets. Bike paths should offer opportunities not provided by the road system. They can either provide a recreational opportunity, or in some instances, can serve as direct high-speed commute routes if cross flow by motor vehicles and pedestrian conflicts can be minimized. The most common applications are along rivers, ocean fronts, canals, utility right of way, abandoned railroad right of way, within college campuses, or within and between parks. There may also be situations where such facilities can be provided as part of planned developments. Another common application of Class I facilities is to close gaps to bicycle travel caused by construction of freeways or because of the existence of natural barriers (rivers, mountains, etc.).

(3) *Class II Bikeway (Bike Lane)*. Bike lanes are established along streets in corridors where there is significant bicycle demand, and where there are distinct needs that can be served by them. The purpose should be to improve conditions for bicyclists in the corridors. Bike lanes are intended to delineate the right of way assigned to bicyclists and motorists and to provide for more predictable movements by each. But a more important reason for constructing bike lanes is to better accommodate bicyclists through corridors where insufficient room exists for safe bicycling on existing streets. This can be accomplished by reducing the number of lanes, reducing lane width, or prohibiting parking on given streets in order to delineate bike lanes. In addition, other things can be done on bike lane streets to improve the situation for bicyclists, that might not be possible on all streets (e.g., improvements to the surface, augmented sweeping programs, special signal facilities, etc.). Generally, pavement markings alone will not measurably enhance bicycling.

If bicycle travel is to be controlled by delineation, special efforts should be made to assure that high levels of service are provided with these lanes.

In selecting appropriate streets for bike lanes, location criteria discussed in the next section should be considered.

(4) *Class III Bikeway (Bike Route)*. Bike routes are shared facilities which serve either to:

(a) Provide continuity to other bicycle facilities (usually Class II bikeways); or

(b) Designate preferred routes through high demand corridors.

As with bike lanes, designation of bike routes should indicate to bicyclists that there are particular advantages to using these routes as compared with alternative routes. This means that responsible agencies have taken actions to assure that these routes are suitable as shared routes and will be maintained in a manner consistent with the needs of bicyclists. Normally, bike routes are shared with motor vehicles. The use of sidewalks as Class III bikeways is strongly discouraged.

It is emphasized that the designation of bikeways as Class I, II and III should not be construed as a hierarchy of bikeways; that one is better than the other. Each class of bikeway has its appropriate application.

In selecting the proper facility, an overriding concern is to assure that the proposed facility will not encourage or require bicyclists or motorists to operate in a manner that is inconsistent with the rules of the road.

An important consideration in selecting the type of facility is continuity. Alternating segments of Class I and Class II (or Class III) bikeways along a route are generally incompatible, as street crossings by bicyclists are required when the route changes character. Also, wrong-way bicycle travel will occur on the street beyond the ends of bike paths because of the inconvenience of having to cross the street.

Topic 1003 - Design Criteria

1003.1 Class I Bikeways

Class I bikeways (bike paths) are facilities with exclusive right of way, with cross flows by motorists minimized. Section 890.4 of the Streets and Highways Code describes Class I bikeways as serving "the exclusive use of bicycles and pedestrians". However, experience has shown that if significant pedestrian use is anticipated, separate facilities for pedestrians are necessary to minimize conflicts. Dual use by pedestrians and bicycles is undesirable, and the two should be separated wherever possible.

Sidewalk facilities are not considered Class I facilities because they are primarily intended to serve pedestrians, generally cannot meet the design standards for Class I bikeways, and do not minimize motorist cross flows. See Index 1003.3 for discussion relative to sidewalk bikeways.

By State law, motorized bicycles ("mopeds") are prohibited on bike paths unless authorized by ordinance or approval of the agency having jurisdiction over the path. Likewise, all motor vehicles are prohibited from bike paths. These prohibitions can be strengthened by signing.

(1) *Widths.* **The minimum paved width for a two-way bike path shall be 2.4 m. The minimum paved width for a one-way bike path shall be 1.5 m. A minimum 0.6 m wide graded area shall be provided adjacent to the pavement (see Figure 1003.1A).** A 1.0 m graded area is recommended to provide clearance from poles, trees, walls, fences, guardrails, or other lateral obstructions. A wider graded area can also serve as a jogging path. Where the paved width is wider than the minimum required, the graded area may be reduced accordingly; however, the graded area is a desirable feature regardless of the paved width. Development of a one-way bike path should be undertaken only after careful consideration due to the problems of enforcing one-way operation and the difficulties in maintaining a path of restricted width.

    Where heavy bicycle volumes are anticipated and/or significant pedestrian traffic is expected, the paved width of a two-way path should be greater than 2.4 m, preferably 3.6 m or more. Another important factor to consider in determining the appropriate width is that bicyclists will tend to ride side by side on bike paths, necessitating more width for safe use.

    Experience has shown that paved paths less than 3.6 m wide sometimes break up along the edge as a result of loads from maintenance vehicles.

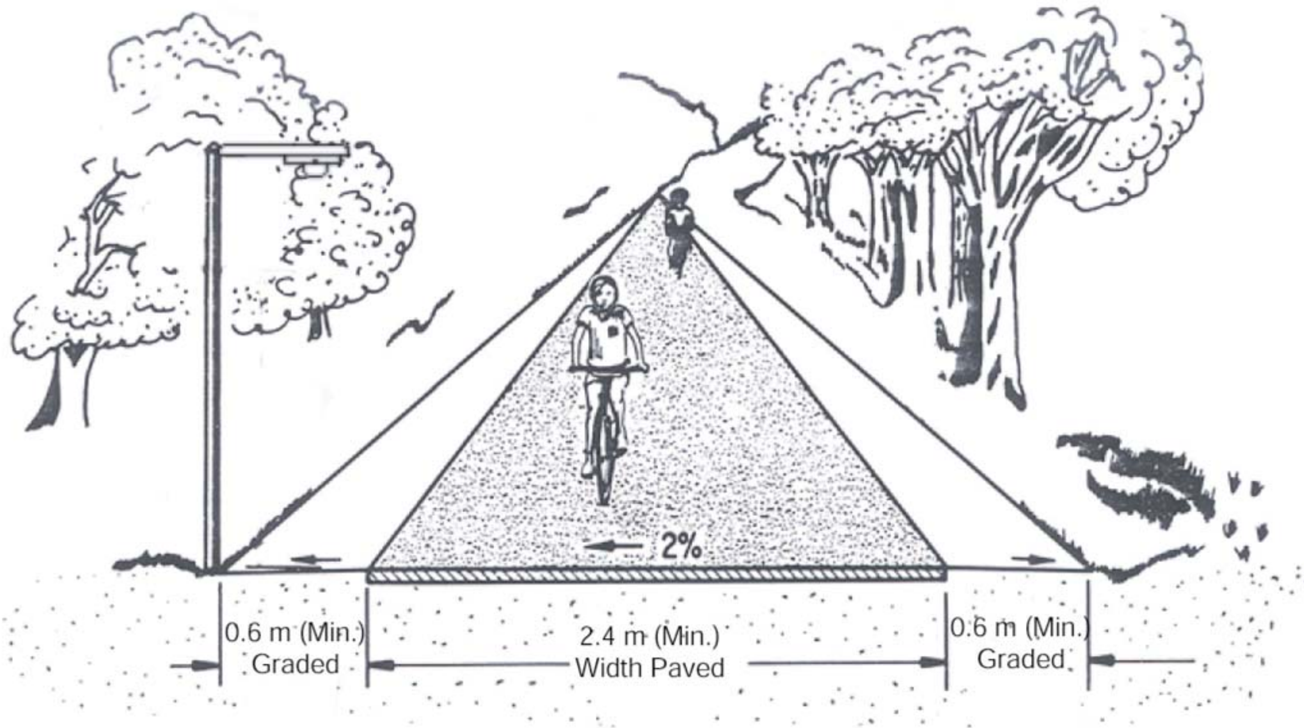
    Where equestrians are expected, a separate facility should be provided.

(2) *Clearance to Obstructions.* **A minimum 0.6 m horizontal clearance to obstructions shall be provided adjacent to the pavement (see Figure 1003.1A).** A 1.0 m clearance is recommended. Where the paved width is wider than the minimum required, the clearance may be reduced accordingly; however, an adequate clearance is desirable regardless of the paved width. If a wide path is paved contiguous with a continuous fixed object (e.g., block wall), a 100 mm white edge line, 0.6 m from the fixed object, is recommended to minimize the likelihood of a bicyclist hitting it**. The clear width on structures between railings shall be not less than 2.4 m.** It is desirable that the clear width of structures be equal to the minimum clear width of the path (i.e., 3.6 m).

    The vertical clearance to obstructions across the clear width of the path shall be a minimum of 2.5 m. Where practical, a vertical clearance of 3 m is desirable.

Figure 1003.1A

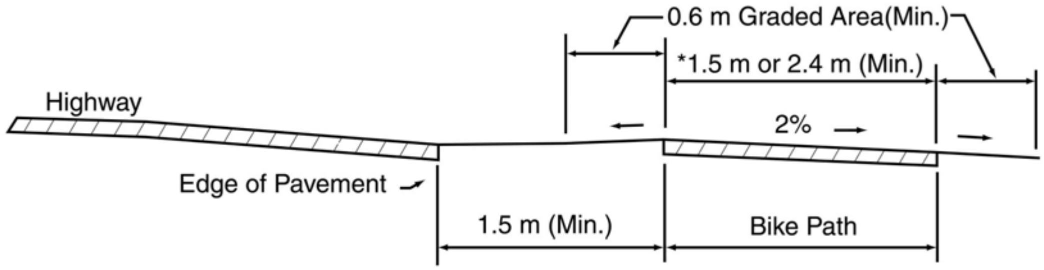
Two-Way Bike Path on Separate Right of Way



Note: For sign clearances, see MUTCD, Figure 9B-1.

Figure 1003.1B

Typical Cross Section of Bike Path Along HIghway



NOTE: See Index 1003.1(5)

*One - Way: 1.5 m Minimum Width
Two - Way: 2.4 m Minimum Width

(3) *Signing and Delineation*. For application and placement of signs, see the Manual on Uniform Traffic Control Devices (MUTCD), Section 9B.01 and the MUTCD and California Supplement Section 9B.01 and Figure 9B-101. For pavement marking guidance, see the MUTCD, Section 9C.03.

(4) *Intersections with Highways*. Intersections are a prime consideration in bike path design. If alternate locations for a bike path are available, the one with the most favorable intersection conditions should be selected.

Where motor vehicle cross traffic and bicycle traffic is heavy, grade separations are desirable to eliminate intersection conflicts. Where grade separations are not feasible, assignment of right of way by traffic signals should be considered. Where traffic is not heavy, stop or yield signs for bicyclists may suffice.

Bicycle path intersections and approaches should be on relatively flat grades. Stopping sight distances at intersections should be checked and adequate warning should be given to permit bicyclists to stop before reaching the intersection, especially on downgrades.

When crossing an arterial street, the crossing should either occur at the pedestrian crossing, where motorists can be expected to stop, or at a location completely out of the influence of any intersection to permit adequate opportunity for bicyclists to see turning vehicles. When crossing at midblock locations, right of way should be assigned by devices such as yield signs, stop signs, or traffic signals which can be activated by bicyclists. Even when crossing within or adjacent to the pedestrian crossing, stop or yield signs for bicyclists should be placed to minimize potential for conflict resulting from turning autos. Where bike path stop or yield signs are visible to approaching motor vehicle traffic, they should be shielded to avoid confusion. In some cases, Bike Xing signs may be placed in advance of the crossing to alert motorists. Ramps should be installed in the curbs, to preserve the utility of the bike path. Ramps should be the same width as the bicycle paths. Curb cuts and ramps should provide a smooth transition between the bicycle paths and the roadway.

(5) *Separation Between Bike Paths and Highways*. A wide separation is recommended between bike paths and adjacent highways (see Figure 1003.1B). **Bike paths closer than 1.5 m from the edge of the shoulder shall include a physical barrier to prevent bicyclists from encroaching onto the highway. Bike paths within the clear recovery zone of freeways shall include a physical barrier separation.** Suitable barriers could include chain link fences or dense shrubs. Low barriers (e.g., dikes, raised traffic bars) next to a highway are not recommended because bicyclists could fall over them and into oncoming automobile traffic. In instances where there is danger of motorists encroaching into the bike path, a positive barrier (e.g., concrete barrier, steel guardrailing) should be provided. See Index 1003.6 for criteria relative to bike paths carried over highway bridges.

Bike paths immediately adjacent to streets and highways are not recommended. They should not be considered a substitute for the street, because many bicyclists will find it less convenient to ride on these types of facilities as compared with the streets, particularly for utility trips.

(6) *Bike Paths in the Median of Highways*. As a general rule, bike paths in the median of highways are not recommended because they require movements contrary to normal rules of the road. Specific problems with such facilities include:

(a) Bicyclist right turns from the center of roadways are unnatural for bicyclists and confusing to motorists.

(b) Proper bicyclist movements through intersections with signals are unclear.

(c) Left-turning motorists must cross one direction of motor vehicle traffic and two directions of bicycle traffic, which increases conflicts.

(d) Where intersections are infrequent, bicyclists will enter or exit bike paths at midblock.

(e) Where medians are landscaped, visual relationships between bicyclists and motorists at intersections are impaired.

For the above reasons, bike paths in the median of highways should be considered only when the above problems can be avoided. **Bike paths shall not be designed in the medians of freeways or expressways.**

(7) *Design Speed*. The proper design speed for a bike path is dependent on the expected type of use and on the terrain. **The minimum design speed for bike paths shall be 40 km/h except as noted in Table 1003.1.**

Table 1003.1

Bike Path Design Speeds

Type of Facility	Design Speed (km/h)
Bike Paths with Mopeds Prohibited	40
Bike Paths with Mopeds Permitted	50
Bike Paths on Long Downgrades (steeper than 4%, and longer than 150 m)	50

Installation of "speed bumps" or other similar surface obstructions, intended to cause bicyclists to slow down in advance of intersections or other geometric constraints, shall not be used. These devices cannot compensate for improper design.

(8) *Horizontal Alignment and Superelevation*. The minimum radius of curvature negotiable by a bicycle is a function of the superelevation rate of the bicycle path surface, the coefficient of friction between the bicycle tires and the bicycle path surface, and the speed of the bicycle.

For most bicycle path applications the superelevation rate will vary from a minimum of 2 percent (the minimum necessary to encourage adequate drainage) to a maximum of approximately 5 percent (beyond which maneuvering difficulties by slow bicyclists and adult tricyclists might be expected). A straight 2% cross slope is recommended on tangent sections. The minimum superelevation rate of 2% will be adequate for most conditions and will simplify construction. Superelevation rates steeper than 5 percent should be avoided on bike paths expected to have adult tricycle traffic.

The coefficient of friction depends upon speed; surface type, roughness, and condition; tire type and condition; and whether the surface is wet or dry. Friction factors used for design should be selected based upon the point at which centrifugal force causes the bicyclist to recognize a feeling of discomfort and instinctively act to avoid higher speed. Extrapolating from values used in highway design, design friction factors for paved bicycle paths can be assumed to vary from 0.31 at 20 km/h to 0.21 at 50 km/h. Although there is no data available for unpaved surfaces, it is suggested that friction factors be reduced by 50 percent to allow a sufficient margin of safety.

The minimum radius of curvature can be selected from Figure 1003.1C. When curve radii smaller than those shown in Figure 1003.1C must be used on bicycle paths because of right of way, topographical or other considerations, standard curve warning signs and supplemental pavement markings should be installed. The negative effects of nonstandard curves can also be partially offset by widening the pavement through the curves.

(9) *Stopping Sight Distance*. To provide bicyclists with an opportunity to see and react to the unexpected, a bicycle path should be designed with adequate stopping sight distances. The distance required to bring a bicycle to a full controlled stop is a function of the bicyclist's perception and brake reaction time, the initial speed of the bicycle, the coefficient of friction between the tires and the pavement, and the braking ability of the bicycle.

Figure 1003.1D indicates the minimum stopping sight distances for various design speeds and grades. For two-way bike paths, the descending direction, that is, where "G" is negative, will control the design.

Figure 1003.1C

Curve Radii & Superelevations

$$R = \frac{V^2}{127\left(\frac{e}{100} + f\right)}$$

where,

R = Minimum radius of curvature (m),

V = Design Speed (km/h),

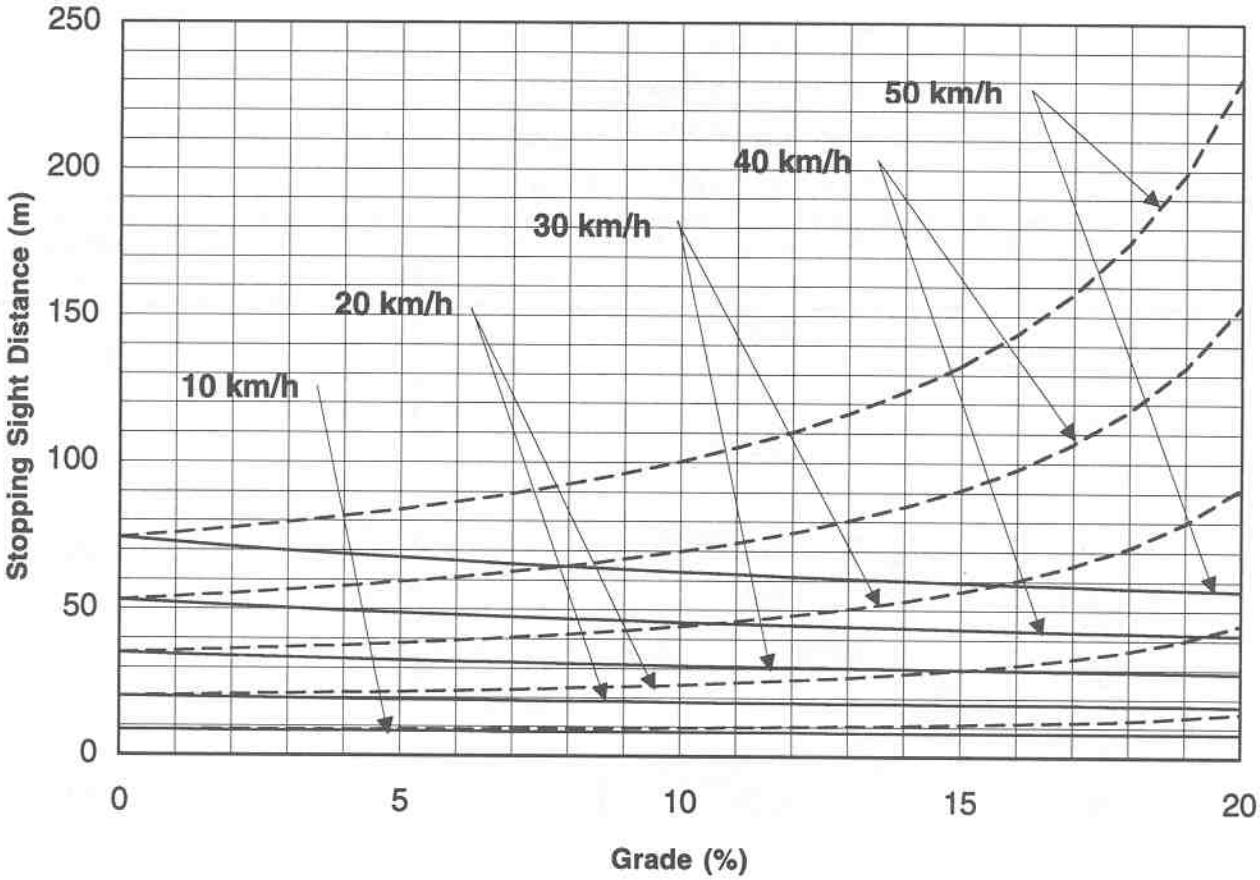
e = Rate of bikeway superelevation, percent

f = Coefficient of friction

Design Speed-V (km/h)	Friction Factor-f	Superelevation-e (%)	Minimum Radius-R (m)
20	0.31	2	10
30	0.28	2	24
40	0.25	2	47
50	0.21	2	86
20	0.31	3	9
30	0.28	3	23
40	0.25	3	45
50	0.21	3	82
20	0.31	4	9
30	0.28	4	22
40	0.25	4	43
50	0.21	4	79
20	0.31	5	9
30	0.28	5	21
40	0.25	5	42
50	0.21	5	76

Figure 1003.1D

Stopping Sight Distance



$$S = \frac{V^2}{254\,(f \pm G)} + \frac{V}{1.4}$$

Descend - - - - - -
Ascend ———

Where : S = stopping sight, m

V = velocity, km/h

f = coefficient of friction (use 0.25)

G = grade, m/m (rise/run)

(10) *Length of Crest Vertical Curves*. Figure 1003.1E indicates the minimum lengths of crest vertical curves for varying design speeds.

(11) *Lateral Clearance on Horizontal Curves*. Figure 1003.1F indicates the minimum clearances to line of sight obstructions for horizontal curves. The required lateral clearance is obtained by entering Figure 1003.1F with the stopping sight distance from Figure 1003.1D and the proposed horizontal curve radius.

Bicyclists frequently ride abreast of each other on bicycle paths, and on narrow bicycle paths, bicyclists have a tendency to ride near the middle of the path. For these reasons, and because of the serious consequences of a head on bicycle accident, lateral clearances on horizontal curves should be calculated based on the sum of the stopping sight distances for bicyclists traveling in opposite directions around the curve. Where this is not possible or feasible, consideration should be given to widening the path through the curve, installing a yellow center line, installing a curve warning sign, or some combination of these alternatives.

(12) *Grades*. Bike paths generally attract less skilled bicyclists, so it is important to avoid steep grades in their design. Bicyclists not physically conditioned will be unable to negotiate long, steep uphill grades. Since novice bicyclists often ride poorly maintained bicycles, long downgrades can cause problems. For these reasons, bike paths with long, steep grades will generally receive very little use. The maximum grade rate recommended for bike paths is 5%. It is desirable that sustained grades be limited to 2% if a wide range of riders is to be accommodated. Steeper grades can be tolerated for short segments (e.g., up to about 150 m). Where steeper grades are necessitated, the design speed should be increased and additional width should be provided for maneuverability.

(13) *Pavement Structure*. The pavement structure of a bike path should be designed in the same manner as a highway, with consideration given to the quality of the basement soil and the anticipated loads the bikeway will experience. It is important to construct and maintain a smooth riding surface with skid resistant qualities. Principal loads will normally be from maintenance and emergency vehicles. Expansive soil should be given special consideration and will probably require a special structural section. A minimum pavement thickness of 50 mm of asphalt concrete is recommended. Type "A" or "B" asphalt concrete (as described in Department of Transportation Standard Specifications), with 12.5 mm maximum aggregate and medium grading is recommended. Consideration should be given to increasing the asphalt content to provide increased pavement life. Consideration should also be given to sterilization of basement soil to preclude possible weed growth through the pavement.

At unpaved highway or driveway crossings of bicycle paths, the highway or driveway should be paved a minimum of 3 m on each side of the crossing to reduce the amount of gravel being scattered along the path by motor vehicles. The pavement structure at the crossing should be adequate to sustain the expected loading at that location.

(14) *Drainage*. For proper drainage, the surface of a bike path should have a cross slope of 2%. Sloping in one direction usually simplifies longitudinal drainage design and surface construction, and accordingly is the preferred practice. Ordinarily, surface drainage from the path will be adequately dissipated as it flows down the gently sloping shoulder. However, when a bike path is constructed on the side of a hill, a drainage ditch of suitable dimensions may be necessary on the uphill side to intercept the hillside drainage. Where necessary, catch basins with drains should be provided to carry intercepted water across the path. Such ditches should be designed in such a way that no undue obstacle is presented to bicyclists.

Culverts or bridges are necessary where a bike path crosses a drainage channel.

Figure 1003.1E

Minimum Length of Crest Vertical Curve (L) Based on Stopping Sight Distance (S)

$L = 2S - \frac{450}{A}$ when S>L

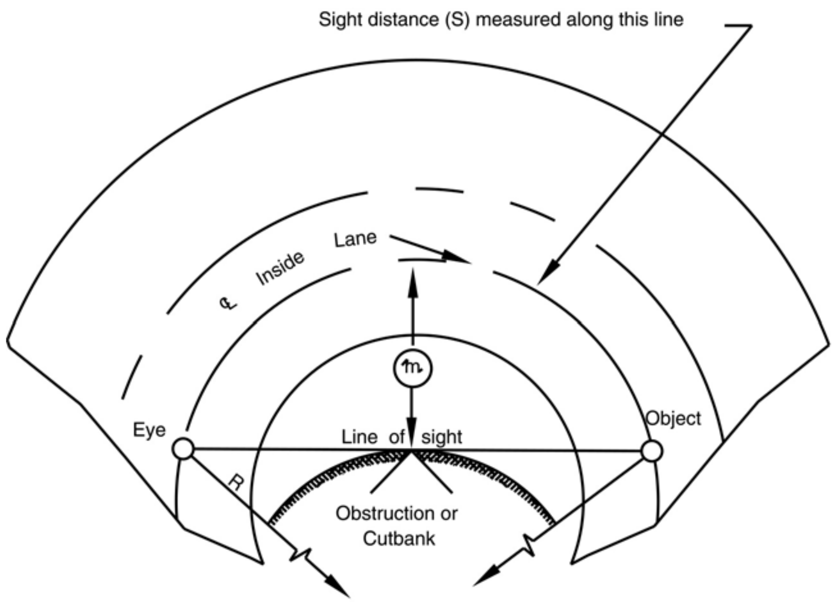
$L = \frac{AS^2}{450}$ when S<L

Double line represents S = L
L = Minimum length of vertical curve - meters
A = Algebraic grade difference - %
S = Stopping sight distance - meters
See Figure1003.1D to determine "S" for a given design speed "V"

Height of cyclist eye - 1400 mm   Height of object - 100 mm

A (%)	S = Stopping Sight Distance (m) 15	20	25	30	35	40	45	50	55	60	
5								10.0	20.0	30.0	
6						5.0	15.0	25.0	35.0	45.0	
7		**S>L**			5.7	15.7	25.7	35.7	45.7	55.7	
8				3.8	13.8	23.8	33.8	43.8	53.8	64.0	
9				10.0	20.0	30.0	40.0	50.0	60.5	72.0	
10			5.0	15.0	25.0	35.0	45.0	55.6	67.2	80.0	
11			9.1	19.1	29.1	39.1	49.5	61.1	73.9	88.0	
12		2.5	12.5	22.5	32.5	42.7	54.0	66.7	80.7	96.0	
13		5.4	15.4	25.4	35.4	46.2	58.5	72.2	87.4	104.0	
14		7.9	17.9	27.9	38.1	49.8	63.0	77.8	94.1	112.0	
15		10.0	20.0	30.0	40.8	53.3	67.5	83.3	100.8	120.0	
16	1.9	11.9	21.9	32.0	43.6	56.9	72.0	88.9	107.6	128.0	
17	3.5	13.5	23.5	34.0	46.3	60.4	76.5	94.4	114.3	136.0	
18	5.0	15.0	25.0	36.0	49.0	64.0	81.0	100.0	121.0	144.0	
19	6.3	16.3	26.4	38.0	51.7	67.6	85.5	105.6	127.7	152.0	**S<L**
20	7.5	17.5	27.8	40.0	54.4	71.1	90.0	111.1	134.4	160.0	
21	8.6	18.6	29.2	42.0	57.2	74.7	94.5	116.7	141.2	168.0	
22	9.5	19.5	30.6	44.0	59.9	78.2	99.0	122.2	147.9	176.0	
23	10.4	20.4	31.9	46.0	62.6	81.8	103.5	127.8	154.6	184.0	
24	11.3	21.3	33.3	48.0	65.3	85.3	108.0	133.3	161.3	192.0	
25	12.0	22.2	34.7	50.0	68.1	88.9	112.5	138.9	168.1	200.0	

Figure 1003.1F
Lateral Clearances on Horizontal Curves



S = Sight distance in meters.
R = Radius of ℄ of lane in meters.
m = Distance from ℄ of lane in meters.
V = Design speed for S in km/h.
(Refer to Figure 1003.1D to determine "V", after "S" is determined.)

Angle is expressed in degrees

$$m = R\left[1-\cos\left(\frac{28.65S}{R}\right)\right]$$

$$S = \frac{R}{28.65S}\left[\cos^{-1}\left(\frac{R-m}{R}\right)\right]$$

Formula applies only when S is equal to or less than length of curve.

Line of sight is 600 mm above ℄ inside lane at point of obstruction.

GIVEN "R" AND "S"; FIND "m"

R (m)	S=10 m *m* meters	S=20 m *m* meters	S=30 m *m* meters	S=40 m *m* meters	S=50 *m* meters	S=60 m *m* meters	S=70 m *m* meters	S=80 m *m* meters	S=90 m *m* meters	S=100 m *m* meters	S=110 m *m* meters
25	0.50	1.97	4.37	7.58	11.49	15.94	20.75	25.73	30.68	35.41	39.72
50	0.25	1.00	2.23	3.95	6.12	8.73	11.76	15.17	18.92	22.99	27.32
75	0.17	0.67	1.50	2.65	4.13	5.92	8.02	10.42	13.10	16.06	19.28
100	0.12	0.50	1.12	1.99	3.11	4.47	6.06	7.90	9.96	12.24	14.75
125	0.10	0.40	0.90	1.60	2.49	3.58	4.87	6.35	8.01	9.87	11.91
150	0.08	0.33	0.75	1.33	2.08	2.99	4.07	5.30	6.70	8.26	9.97
175	0.07	0.29	0.64	1.14	1.78	2.57	3.49	4.55	5.75	7.10	8.57
200	0.06	0.25	0.56	1.00	1.56	2.25	3.06	3.99	5.04	6.22	7.52
225	0.06	0.22	0.50	0.89	1.39	2.00	2.72	3.55	4.49	5.53	6.69
250	0.05	0.20	0.45	0.80	1.25	1.80	2.45	3.19	4.04	4.98	6.03
275	0.05	0.18	0.41	0.73	1.14	1.63	2.22	2.90	3.67	4.53	5.48
300	0.04	0.17	0.37	0.67	1.04	1.50	2.04	2.66	3.37	4.16	5.03
350	0.04	0.14	0.32	0.57	0.89	1.29	1.75	2.28	2.89	3.57	4.31
400	0.03	0.13	0.28	0.50	0.78	1.12	1.53	2.00	2.53	3.12	3.78
500	0.03	0.10	0.23	0.40	0.62	0.90	1.22	1.60	2.02	2.50	3.02
600	0.02	0.08	0.19	0.33	0.52	0.75	1.02	1.33	1.69	2.08	2.52
700	0.02	0.07	0.16	0.29	0.45	0.64	0.87	1.14	1.45	1.79	2.16
800	0.02	0.06	0.14	0.25	0.39	0.56	0.77	1.00	1.27	1.56	1.89
900	0.01	0.06	0.13	0.22	0.35	0.50	0.68	0.89	1.12	1.39	1.68
1000	0.01	0.05	0.11	0.20	0.31	0.45	0.61	0.80	1.01	1.25	1.51

Figure 1003.1F

Lateral Clearances on Horizontal Curves (continued)

GIVEN "R" AND "m"; FIND "S"

R (m)	*m* = 1 meter	*m* = 2 meters	*m* = 3 meters	*m* = 4 meters	*m* = 5 meters	*m* = 6 meters	*m* = 7 meters	*m* = 8 meters	*m* = 9 meters	*m* = 10 meters	*m* = 11 meters
	S (m)	S (m)	S (m)	S (m)	S (m)	S (m)	S (m)	S (m)	S (m)	S (m)	S (m)
25	14.19	20.13	24.74	28.67	32.17	35.37	38.35	41.15	43.81	46.36	48.82
50	20.03	28.38	34.81	40.27	45.10	49.49	53.55	57.35	60.93	64.35	67.61
75	24.52	34.72	42.57	49.21	55.08	60.40	65.32	69.91	74.23	78.34	82.26
100	28.31	40.06	49.11	56.75	63.51	69.63	75.27	80.54	85.50	90.20	94.68
125	31.64	44.78	54.88	63.41	70.94	77.77	84.06	89.92	95.44	100.67	105.66
150	34.66	49.04	60.10	69.43	77.67	85.13	92.00	98.41	104.44	110.15	115.60
175	37.43	52.96	64.90	74.97	83.86	91.91	99.32	106.23	112.73	118.88	124.75
200	40.01	56.61	69.36	80.13	89.62	98.22	106.13	113.51	120.45	127.01	133.27
225	42.44	60.04	73.56	84.97	95.04	104.15	112.53	120.35	127.70	134.66	141.28
250	44.73	63.28	77.53	89.56	100.16	109.76	118.59	126.82	134.56	141.89	148.86
275	46.91	66.37	81.31	93.92	105.03	115.09	124.35	132.98	141.09	148.77	156.08
300	49.00	69.32	84.92	98.08	109.69	120.19	129.86	138.86	147.33	155.34	162.97
350	52.92	74.86	91.71	105.92	118.45	129.79	140.22	149.94	159.08	167.72	175.95
400	56.58	80.03	98.03	113.22	126.61	138.73	149.87	160.26	170.01	179.25	188.04
500	63.25	89.47	109.59	126.57	141.53	155.06	167.52	179.11	190.01	200.32	210.13
600	69.29	98.00	120.04	138.63	155.02	169.83	183.47	196.16	208.09	219.38	230.12
700	74.84	105.85	129.65	149.73	167.42	183.42	198.14	211.85	224.72	236.91	248.50
800	80.00	113.15	138.60	160.05	178.97	196.07	211.80	226.45	240.21	253.23	265.62
900	84.85	120.01	147.00	169.76	189.81	207.95	224.63	240.16	254.75	268.56	281.69
1000	89.44	126.50	154.95	178.93	200.07	219.18	236.76	253.13	268.51	283.06	296.90

(15) *Barrier Posts*. It may be necessary to install barrier posts at entrances to bike paths to prevent motor vehicles from entering. For barrier post placement, visibility marking, and pavement markings, see the MUTCD and California Supplement, Section 9C.101.

Generally, barrier configurations that preclude entry by motorcycles present safety and convenience problems for bicyclists. Such devices should be used only where extreme problems are encountered.

(16) *Lighting*. Fixed-source lighting reduces conflicts along paths and at intersections. In addition, lighting allows the bicyclist to see the bicycle path direction, surface conditions, and obstacles. Lighting for bicycle paths is important and should be considered where riding at night is expected, such as bicycle paths serving college students or commuters, and at highway intersections. Lighting should also be considered through underpasses or tunnels, and when nighttime security could be a problem.

Depending on the location, average maintained horizontal illumination levels of 5 lux to 22 lux should be considered. Where special security problems exist, higher illumination levels may be considered. Light standards (poles) should meet the recommended horizontal and vertical clearances. Luminaires and standards should be at a scale appropriate for a pedestrian or bicycle path.

1003.2 Class II Bikeways

Class II bikeways (bike lanes) for preferential use by bicycles are established within the paved area of highways. Bike lane pavement markings 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. This effect is supported by bike lane signs and pavement markings. Bike lane pavement markings can increase bicyclists' confidence that motorists will not stray into their path of travel if they remain within the bike lane. Likewise, with more certainty as to where bicyclists will be, passing motorists are less apt to swerve toward opposing traffic in making certain they will not hit bicyclists.

Class II bike lanes shall be one-way facilities. Two-way bike lanes (or bike paths that are contiguous to the roadway) are not permitted, as such facilities have proved unsatisfactory and promote riding against the flow of motor vehicle traffic.

(1) *Widths*. Typical Class II bikeway configurations are illustrated in Figure 1003.2A and are described below:

(a) Figure 1003.2A-(1) depicts bike lanes on an urban type curbed street where parking stalls (or continuous parking stripes) are marked. Bike lanes are located between the parking area and the traffic lanes. **As indicated, 1.5 m shall be the minimum width of bike lane where parking stalls are marked.** If parking volume is substantial or turnover high, an additional 0.3 m to 0.6 m of width is desirable.

Bike lanes shall not be placed between the parking area and the curb. Such facilities increase the conflict between bicyclists and opening car doors and reduce visibility at intersections. Also, they prevent bicyclists from leaving the bike lane to turn left and cannot be effectively maintained.

(b) Figure 1003.2A-(2) depicts bike lanes on an urban-type curbed street, where parking is permitted, but without parking stripe or stall marking. Bike lanes are established in conjunction with the parking areas. **As indicated, 3.3 m or 3.6 m (depending on the type of curb) shall be the minimum width of the bike lane where parking is permitted.** This type of lane is satisfacory where parking is not extensive and where turnover of parked cars is infrequent. However, if parking is substantial, turnover of parked cars is high, truck traffic is substantial, or if vehicle speeds exceed 55 km/h, additional width is recommended.

(c) Figure 1003.2A-(3) depicts bike lanes along the outer portions of an urban type curbed street, where parking is prohibited. This is generally the most desirable configuration for bike lanes, as it eliminates potential conflicts resulting from auto parking (e.g., opening car doors). **As indicated, if no gutter exists, the minimum bike lane width shall be 1.2 m. With a normal 600 mm gutter, the minimum bike lane width shall be 1.5 m.** The intent is to provide a minimum 1.2 m wide bike lane, but with at least 0.9 m between the traffic lane and the longitudinal joint at the concrete gutter, since the gutter reduces the effective width of the bike lane for two reasons. First, the longitudinal joint may not always be smooth, and may be difficult to ride along. Secondly, the gutter does not provide a suitable surface for bicycle travel. Where gutters are wide (say, 1.2 m), an additional 0.9 m must be provided because bicyclists should not be expected to ride in the gutter. Wherever possible, the width of bike lanes should be increased to 1.8 to 2.4 m to provide for greater safety. 2.4 m bike lanes can also serve as emergency parking areas for disabled vehicles.

Striping bike lanes next to curbs where parking is prohibited only during certain hours shall be done only in conjunction with special signing to designate the hours bike lanes are to be effective. Since the Vehicle Code requires bicyclists to ride in bike lanes where provided (except under certain conditions), proper signing is necessary to inform bicyclists that they are required to ride in bike lanes only during the course of the parking prohibition. This type of bike lane should be considered only if the vast majority of bicycle travel would occur during the hours of the parking prohibition, and only if there is a firm commitment to enforce the parking prohibition. Because of the obvious complications, this type of bike lane is not encouraged for general application.

Figure 1003.2A(4) depicts bike lanes on a highway without curbs and gutters. This location is in an undeveloped area where infrequent parking is handled off the pavement. This can be accomplished by supplementing the bike lane signing with R25 (park off pavement) signs, or R26 (no parking) signs. **Minimum widths shall be as shown.** Additional width is desirable, particularly where motor vehicle speeds exceed 55 km/h.

Per Topic 301, the minimum lane width standard is 3.6 m. There are situations where it may be desirable to reduce the width of the traffic lanes in order to add or widen bicycle lanes or shoulders. In determining the appropriateness of narrower traffic lanes, consideration should be given to factors such as motor vehicle speeds, truck volumes, alignment, bicycle lane width, sight distance, and the presence of on-street vehicle parking when vehicle parking is permitted adjacent to a bicycle lane, or on a shoulder where bicycling is not prohibited, reducing the width of the adjacent traffic lane may allow for wider bicycle lanes or shoulders, to provide greater clearance between bicyclists and driver-side doors when opened. Where favorable conditions exist, traffic lanes of 3.3 m may be feasible but must be approved per Topic 301.

Bike lanes are not advisable on long, steep downgrades, where bicycle speeds greater than 50 km/h are expected. As grades increase, downhill bicycle speeds will increase, which increases the problem of riding near the edge of the roadway. In such situations, bicycle speeds can approach those of motor vehicles, and experienced bicyclists will generally move into the motor vehicle lanes to increase sight distance and maneuverability. If bike lanes are to be marked, additional width should be provided to accommodate higher bicycle speeds.

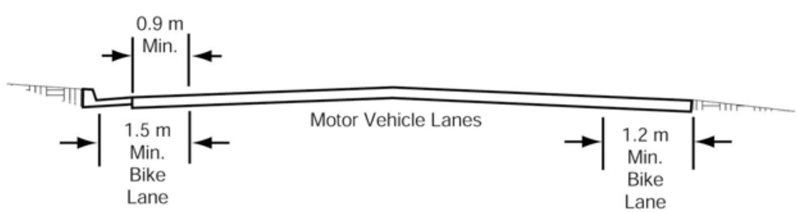
If the bike lanes are to be located on one-way streets, they should be placed on the right side of the street. Bike lanes on the left side would cause bicyclists and motorists to undertake crossing maneuvers in making left turns onto a two-way street.

Figure 1003.2A
Typical Bike Lane Cross Sections
(On 2-lane or Multilane Highways)

(1) MARKED PARKING

* 3.9 is recommended where there is substantial parking or turnover of parked cars is high (e.g. commerical areas).

(2) PARKING PERMITTED WITHOUT MARKED PARKING OR STALL



(With Gutter) **(3) PARKING PROHIBITED** (Without Gutter)

(4) TYPICAL ROADWAY IN OUTLYING AREAS PARKING RESTRICTED

Note: For pavement marking guidance, see the MUTCD and California Supplement, Section 9C.04

(2) *Signing and Pavement Markings*. Details for signing and pavement marking of Class II bikeways are found in the MUTCD and California Supplement, Section 9C.04.

(3) *At-grade Intersection Design*. Most auto/bicycle accidents occur at intersections. For this reason, bikeway design at intersections should be accomplished in a manner that will minimize confusion by motorists and bicyclists, and will permit both to operate in accordance with the normal rules of the road.

Figure 1003.2B illustrates a typical at-grade intersection of multilane streets, with bike lanes on all approaches. Some common movements of motor vehicles and bicycles are shown. A prevalent type of accident involves straight-through bicycle traffic and right-turning motorists. Left-turning bicyclists also have problems, as the bike lane is on the right side of the street, and bicyclists have to cross the path of cars traveling in both directions. Some bicyclists are proficient enough to merge across one or more lanes of traffic, to use the inside lane or left-turn lane. However, there are many who do not feel comfortable making this maneuver. They have the option of making a two-legged left turn by riding along a course similar to that followed by pedestrians, as shown in the diagram. Young children will often prefer to dismount and change directions by walking their bike in the crosswalk.

(4) *Interchange Design*. As with bikeway design through at-grade intersections, bikeway design through interchanges should be accomplished in a manner that will minimize confusion by motorists and bicyclists. Designers should work closely with the local agency in designing bicycle facilities through interchanges. Local Agencies should carefully select interchange locations which are most suitable for bikeway designations and where the crossing meets applicable design standards. The local agency may have special needs and desires for continuity through interchanges which should be considered in the design process.

For Class II bikeway signing and lane markings, see the MUTCD and California Supplement, Section 9C.04.

The shoulder width shall not be reduced through the interchange area. The minimum shoulder width shall match the approach roadway shoulder width, but not less than 1.2 m or 1.5 m if a gutter exists. If the shoulder width is not available, the designated bike lane shall end at the previous local road intersection.

Depending on the intersection angles, either Figure 1003.2C or 1003.2D should also be used for multilane ramp intersections. Additionally, the outside through lane should be widened to 4.2 m when feasible. This allows extra room for bicycles to share the through lane with vehicles. The outside shoulder width should not be reduced through the interchange area to accommodate this additional width.

1003.3 Class III Bikeways

Class III bikeways (bike routes) are intended to provide continuity to the bikeway system. Bike routes are established along through routes not served by Class I or II bikeways, or to connect discontinuous segments of bikeway (normally bike lanes). Class III facilities are shared facilities, either with motor vehicles on the street, or with pedestrians on sidewalks, and in either case bicycle usage is secondary. Class III facilities are established by placing Bike Route signs along roadways.

Minimum widths for Class III bikeways are not presented, as the acceptable width is dependent on many factors, including the volume and character of vehicular traffic on the road, typical speeds, vertical and horizontal alignment, sight distance, and parking conditions.

Since bicyclists are permitted on all highways (except prohibited freeways), the decision to designate the route as a bikeway should be based on the advisability of encouraging bicycle travel on the route and other factors listed below.

Figure 1003.2B

Typical Bicycle/Auto Movements at Intersections of Multilane Streets

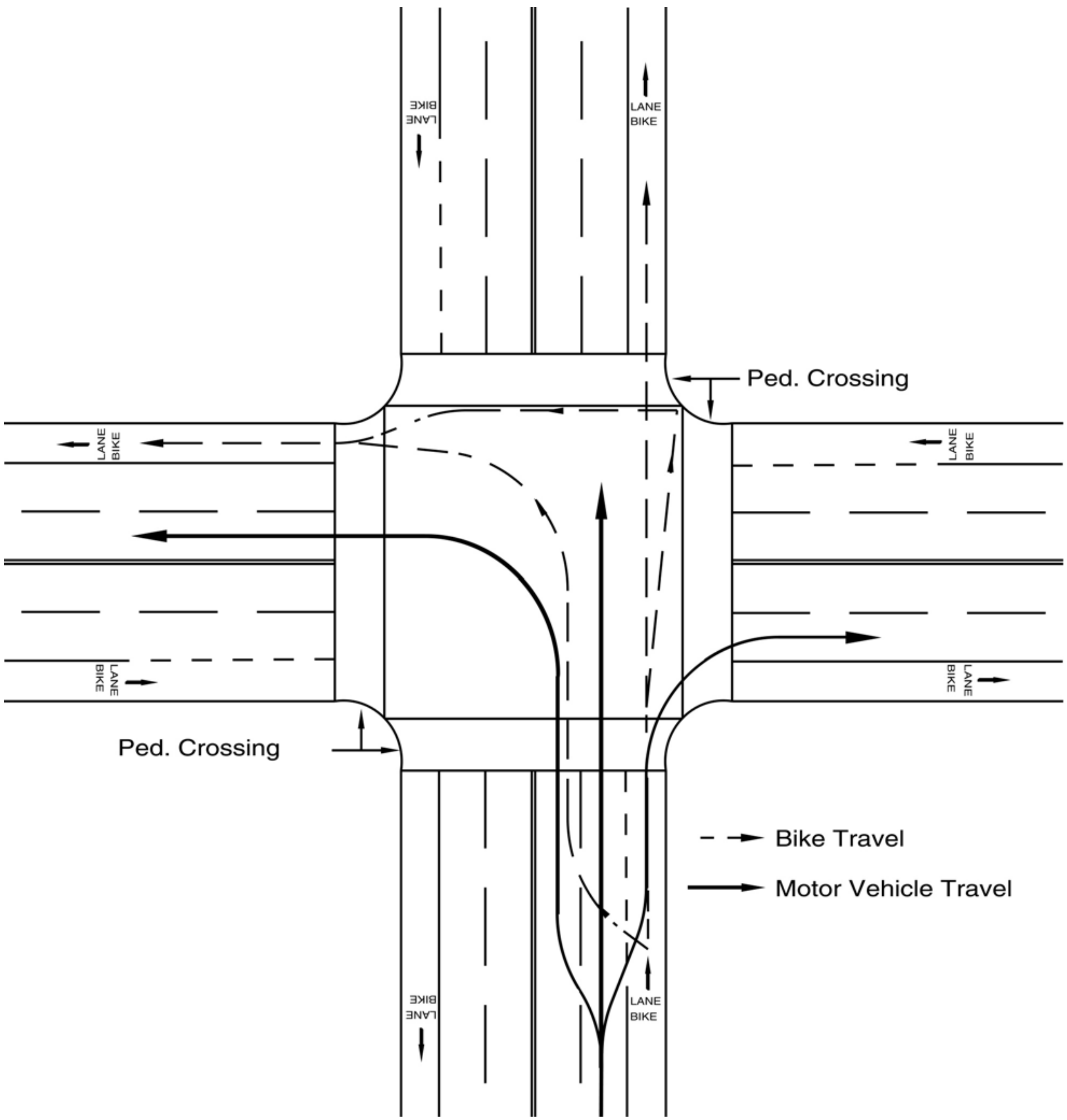
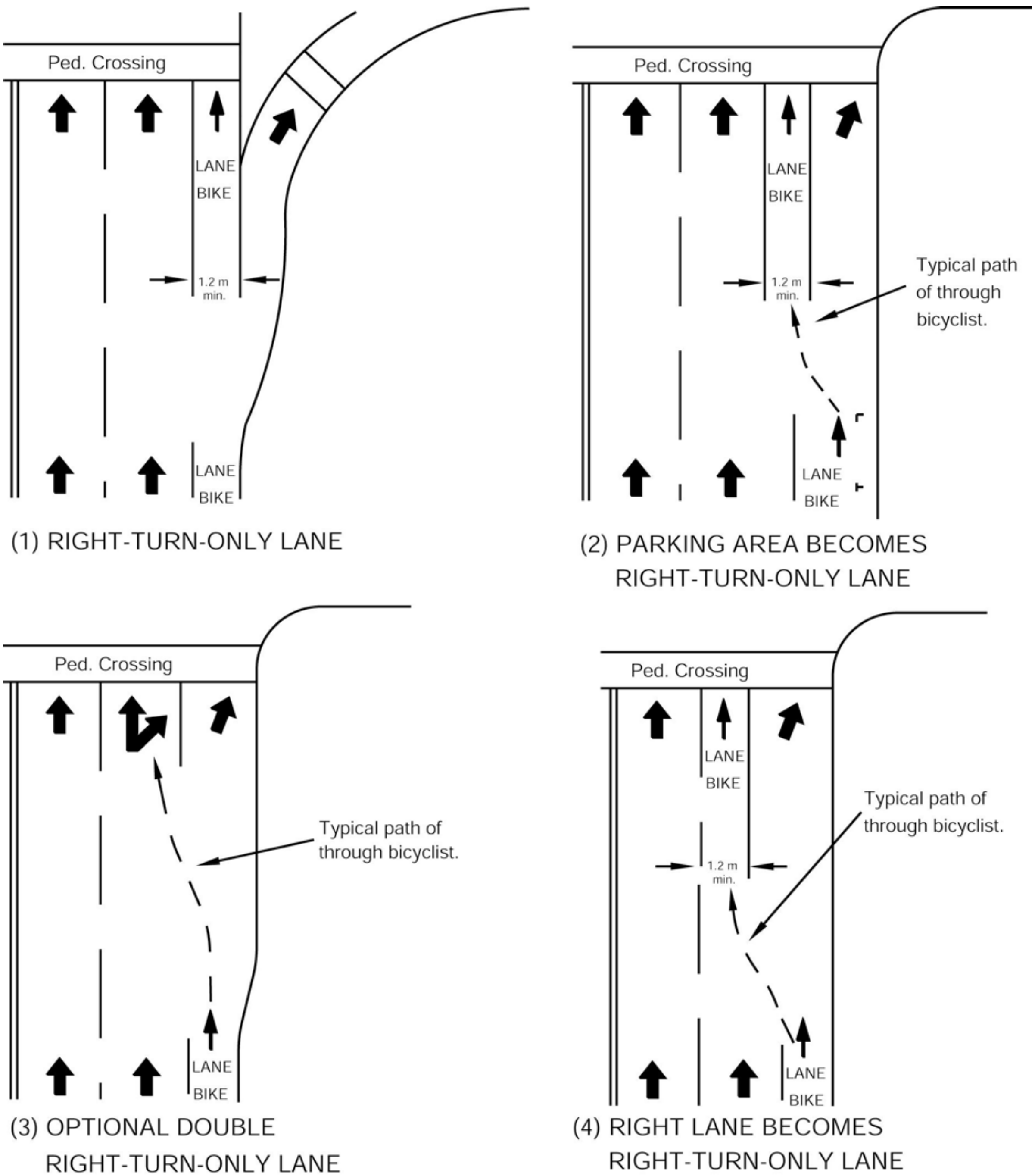
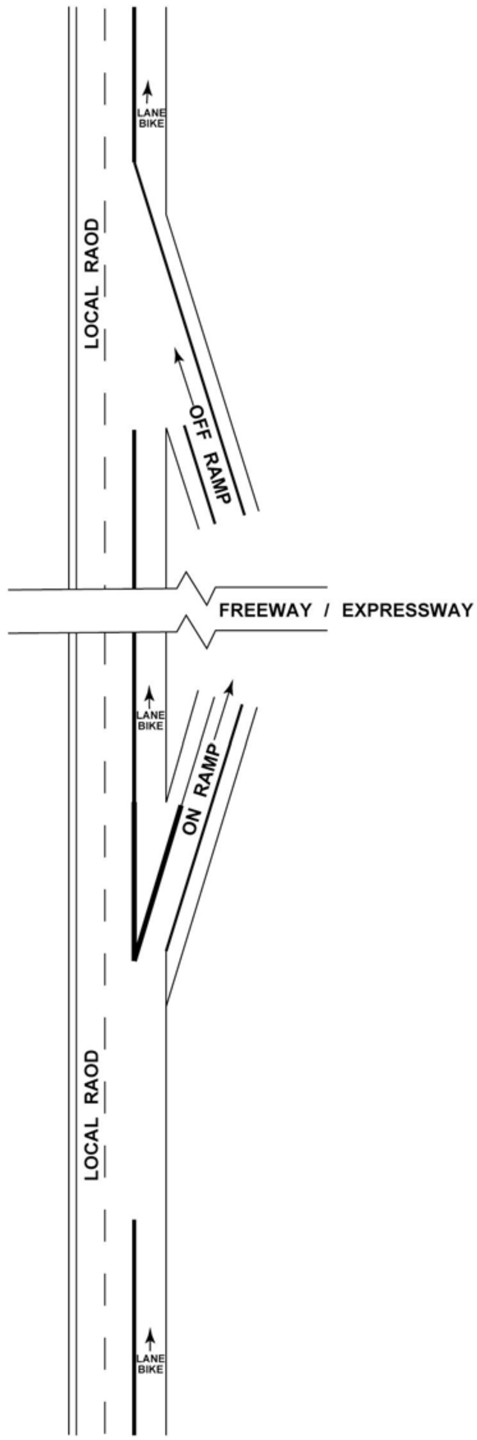


Figure 1003.2C
Bike Lanes Approaching Motorist Right-turn-only Lane



Note: For bicycle lane markings, see the MUTCD and California Supplement, Section 9C.04.

Figure 1003.2D
Bike Lanes Through Interchanges



Notes:

1.) See Index 1003.2 (4) for additional information.

2.) The shoulder width shall not be reduced through the interchange area. The minimum shoulder width shall match the approach roadway shoulder width, but not less than 1.2 m or 1.5 m if a gutter exists. If the shoulder width is not available, the designated bike lane shall end at the previous local raod intersection.

3.) See Index 1003.3 (4) for information on Bike Routes Through Interchanges.

(1) *On-street Bike Route Criteria*. To be of benefit to bicyclists, bike routes should offer a higher degree of service than alternative streets. Routes should be signed only if some of the following apply:

(a) They provide for through and direct travel in bicycle-demand corridors.

(b) Connect discontinuous segments of bike lanes.

(c) An effort has been made to adjust traffic control devices (stop signs, signals) to give greater priority to bicyclists, as compared with alternative streets. This could include placement of bicycle-sensitive detectors on the right-hand portion of the road, where bicyclists are expected to ride.

(d) Street parking has been removed or restricted in areas of critical width to provide improved safety.

(e) Surface imperfections or irregularities have been corrected (e.g., utility covers adjusted to grade, potholes filled, etc.).

(f) Maintenance of the route will be at a higher standard than that of other comparable streets (e.g., more frequent street sweeping).

(2) *Sidewalk Bikeway Criteria*. 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.

(3) *Destination Signing of Bike Routes*. For Bike Route signs to be more functional, supplemental plates may be placed beneath them when located along routes leading to high demand destinations (e.g., "To Downtown"; "To State College"; etc. For typical signing, see the MUTCD and California Supplement, Figures 9B-5 and 9B-6.

There are instances where it is necessary to sign a route to direct bicyclists to a logical destination, but where the route does not offer any of the above listed bike route features. In such cases, the route should not be signed as a bike route; however, destination signing may be advisable. A typical application of destination signing would be where bicyclists are directed off a highway to bypass a section of freeway. Special signs would be placed to guide bicyclists to the next logical destination. The intent is to direct bicyclists in the same way as motorists would be directed if a highway detour was necessitated.

(4) *Interchange Design* As with bikeway design through at-grade intersections, bikeway design through interchanges should be accomplished in a manner that will minimize confusion by motorists and bicyclists. Designers should work closely with the local agency in designing bicycle facilities through interchanges. Local Agencies should carefully select interchange locations which are most suitable for bikeway designations and where the crossing meets applicable design standards. The local agency may have special needs and desires for continuity through interchanges which should be considered in the design process.

Within the Interchange area the bike route shall require either an outside lane width of 4.8 m or a 3.6 m lane and a 1.2 m shoulder. If the above width is not available, the designated bike route shall end at the previous local road intersection.

1003.4 Bicycles on Freeways

In some instances, bicyclists are permitted on freeways. Seldom would a freeway be designated as a bikeway, but it can be opened for use if it meets certain criteria. Essentially, the criteria involve assessing the safety and convenience of the freeway as compared with available alternate routes. However, a freeway should not be opened to bicycle use if it is determined to be incompatible. The Headquarters Traffic Liaisons and the Design Coordinator must approve any proposals to open freeways to bicyclists.

If a suitable alternate route exists, it would normally be unnecessary to open the freeway. However, if the alternate route is unsuitable for bicycle travel the freeway may be a better alternative for bicyclists. In determining the suitability of an alternate route, safety should be the paramount consideration. The following factors should be considered:

- Number of intersections
- Shoulder widths
- Traffic volumes
- Vehicle speeds
- Bus, truck and recreational vehicle volumes
- Grades
- Travel time

When a suitable alternate route does not exist, a freeway shoulder may be considered for bicycle travel. Normally, freeways in urban areas will have characteristics that make it unfeasible to permit bicycle use. In determining if the freeway shoulder is suitable for bicycle travel, the following factors should be considered;

- Shoulder widths
- Bicycle hazards on shoulders (drainage grates, expansion joints, etc.)
- Number and location of entrance/exit ramps
- Traffic volumes on entrance/exit ramps
- Bridge Railing height

When bicyclists are permitted on segments of freeway, it will be necessary to modify and supplement freeway regulatory signs, particularly those at freeway ramp entrances and exits, see the MUTCD and California Supplement, Section 9B.101.

Where no reasonable alternate route exists within a freeway corridor, the Department should coordinate with local agencies to develop or improve existing routes or provide parallel bikeways within or adjacent to the freeway right of way.

The long term goal is to provide a safe and convenient non-freeway route for bicycle travel.

1003.5 Multipurpose Trails

In some instances, it may be appropriate for agencies to develop multipurpose trails - for hikers, joggers, equestrians, bicyclists, etc. Many of these trails will not be paved and will not meet the standards for Class I bikeways. As such, these facilities should not be signed as bikeways. Rather, they should be designated as multipurpose trails (or similar designation), along with regulatory signing to restrict motor vehicles, as appropriate.

If multipurpose trails are primarily to serve bicycle travel, they should be developed in accordance with standards for Class I bikeways. In general, multipurpose trails are not recommended as high speed transportation facilities for bicyclists because of conflicts between bicyclists and pedestrians.

Wherever possible, separate bicycle and pedestrian paths should be provided. If this is not feasible, additional width, signing and pavement markings should be used to minimize conflicts.

It is undesirable to mix mopeds and bicycles on the same facility. In general, mopeds should not be allowed on multipurpose trails because of conflicts with slower moving bicyclists and pedestrians. In some cases where an alternate route for mopeds does not exist, additional width, signing, and pavement markings should be used to minimize conflicts. Increased patrolling by law enforcement personnel is also recommended to enforce speed limits and other rules of the road.

It is usually not desirable to mix horses and bicycle traffic on the same multipurpose trail. Bicyclists are often not aware of the need for slower speeds and additional operating space near horses. Horses can be startled easily and may be unpredictable if they perceive approaching bicyclists as a danger. In addition, pavement requirements for safe bicycle travel are not suitable for horses. For these reasons, a bridle trail separate from the multipurpose trail is recommended wherever possible.

1003.6 Miscellaneous Bikeway Criteria

The following are miscellaneous bikeway criteria which should be followed to the extent pertinent to Class I, II and III bikeways. Some, by their very nature, will not apply to all classes of bikeway. Many of the criteria are important to consider on any highway where bicycle travel is expected, without regard to whether or not bikeways are established.

(1) Bridges. Bikeways on highway bridges must be carefully coordinated with approach bikeways to make sure that all elements are compatible. For example, bicycle traffic bound in opposite directions is best accommodated by bike lanes on each side of a highway. In such cases, a two-way bike path on one side of a bridge would normally be inappropriate, as one direction of bicycle traffic would be required to cross the highway at grade twice to get to and from the bridge bike path. Because of the inconvenience, many bicyclists will be encouraged to ride on the wrong side of the highway beyond the bridge termini.

The following criteria apply to a two-way bike path on one side of a highway bridge:

(a) The bikeway approach to the bridge should be by way of a separate two-way facility for the reason explained above.

(b) **A physical separation, such as a chain link fence or railing, shall be provided to offset the adverse effects of having bicycles traveling against motor vehicle traffic.** The physical separation should be designed to minimize fixed end hazards to motor vehicles and if the bridge is an interchange structure, to minimize sight distance restrictions at ramp intersections.

It is recommended that bikeway bridge railings or fences placed between traffic lanes and bikeways be at least 1.4 m high to minimize the likelihood of bicyclists falling over the railings. Standard bridge railings which are lower than 1.4 m can be retrofitted with lightweight upper railings or chain link fence suitable to restrain bicyclists. See Index 208.10(6) for guidance regarding bicycle railing on bridges.

Separate highway overcrossing structures for bikeway traffic shall conform to Caltrans' standard pedestrian overcrossing design loading. The minimum clear width shall be the paved width of the approach bikeway but not less than 2.4 m. If pedestrians are to use the structure, additional width is recommended.

(2) Surface Quality. The surface to be used by bicyclists should be smooth, free of potholes, and the pavement edge uniform. For rideability on new construction, the finished surface of bikeways should not vary more than 6 mm from the lower edge of a 2.4 m long straight edge when laid on the surface in any direction.

Table 1003.6 indicates the recommended bikeway surface tolerances for Class II and III bikeways developed on existing streets to minimize the potential for causing bicyclists to lose control of their bicycle (Note: Stricter tolerances should be achieved on new bikeway construction.) Shoulder rumble strips are not suitable as a riding surface for bicycles. See the MUTCD and California Supplement, Chapter 3B for additional information regarding rumble strip design considerations for bicycles.

Table 1003.6
Bikeway Surface Tolerances

Direction of Travel	Grooves(1)	Steps(2)
Parallel to travel	No more than 12 mm wide	No more than 10 mm high
Perpendicular to travel	---	No more than 20 mm high

(1) Groove--A narrow slot in the surface that could catch a bicycle wheel, such as a gap between two concrete slabs.

(2) Step--A ridge in the pavement, such as that which might exist between the pavement and a concrete gutter or manhole cover; or that might exist between two pavement blankets when the top level does not extend to the edge of the roadway.

(3) *Drainage Grates, Manhole Covers, and Driveways*. Drainage inlet grates, manhole covers, etc., on bikeways should be designed and installed in a manner that provides an adequate surface for bicyclists. They should be maintained flush with the surface when resurfacing.

Drainage inlet grates on bikeways shall have openings narrow enough and short enough to assure bicycle tires will not drop into the grates (e.g., reticuline type), regardless of the direction of bicycle travel. Where it is not immediately feasible to replace existing grates with standard grates designed for bicycles, 25 mm x 6 mm steel cross straps should be welded to the grates at a spacing of 150 mm to 200 mm on centers to reduce the size of the openings adequately.

Corrective actions described above are recommended on all highways where bicycle travel is permitted, whether or not bikeways are designated.

Future driveway construction should avoid construction of a vertical lip from the driveway to the gutter, as the lip may create a problem for bicyclists when entering from the edge of the roadway at a flat angle. If a lip is deemed necessary, the height should be limited to 15 mm.

(4) *At-grade Railroad Crossings and Cattle Guards*. Whenever it is necessary to cross railroad tracks with a bikeway, special care must be taken to assure that the safety of bicyclists is protected. The bikeway crossing should be at least as wide as the approaches of the bikeway. Wherever possible, the crossing should be straight and at right angles to the rails. For on-street bikeways where a skew is unavoidable, the shoulder (or bike lane) should be widened, if possible, to permit bicyclists to cross at right angles (see Figure 1003.6A). If this is not possible, special construction and materials should be considered to keep the flangeway depth and width to a minimum.

Pavement should be maintained so ridge buildup does not occur next to the rails. In some cases, timber plank crossings can be justified and can provide for a smoother crossing. Where hazards to bicyclist cannot be avoided, appropriate signs should be installed to warn bicyclists of the danger.

All railroad crossings are regulated by the California Public Utilities Commission (CPUC). All new bike path railroad crossings must be approved by the CPUC. Necessary railroad protection will be determined based on a joint field review involving the applicant, the railroad company, and the CPUC.

The presence of cattle guards along any roadway where bicyclists are expected should be clearly marked with adequate advance warning.

(5) *Obstruction Markings*. Vertical barriers and obstructions, such as abutments, piers, and other features causing bikeway constriction, should be clearly marked to gain the attention of approaching bicyclists. This treatment should be used only where unavoidable, and is by no means a substitute for good bikeway design. See the MUTCD, Section 9C.06.

Figure 1003.6A
Railroad Crossings