

City of Aurora

Bicycle Facility

Design Guidelines



**These guidelines were presented as an informational item
to City Council at Study Session on July 14, 2008,
and approved unanimously**

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Preface

The City of Aurora Bicycle Design Guidelines is based on information provided from the following sources:

1. *Manual on Uniform Traffic Control Devices (MUTCD)*, 2003 edition;
2. *Guide for the Development of Bicycle Facilities*, American Association of State Highway and Transportation Officials' (AASHTO), 1999;
3. *A Policy on Geometric Design of Highways and Streets*, AASHTO, 2004;
4. *Model Traffic Code for Colorado*, Colorado Department of Transportation, 1995;
5. *Implementing Bicycle Improvements at the Local Level*, Publication No. FHWA-98-105, Federal Highway Administration, 1998;
6. *Bicycle Facility Design Reference Manual*, Publication No. FHWA-NHI-02-065, Federal Highway Administration, October 2004;
7. *Accessible Rights of Way: A Design Manual*, U.S. Access Board, 1999, and
8. *Chicago Bike Lane Design Manual*, 2002.

This document contains specifications and designs for on-street bike routes, on-street bike lanes, bicycle-related signs, and intersections of shared use paths with public and private streets. The design of shared use paths beyond their intersections with streets is under the purview of the Parks & Open space Department and will be addressed in detail at a future time.

The guidelines and drawings contained herein will not necessarily work in every situation where bicycle facilities are being installed. Instances where bike facilities are being retrofitted onto existing streets are particularly demanding and require field observations to take into consideration travel speeds, lane widths, vehicle mix, adjacent land uses, traffic volumes and other critical factors. City of Aurora bicycle facility designers must use the information contained in this document, and any new developments in bicycle facility design, along with their best judgment to solve challenges that may arise as bicycle facilities are planned and installed.

This document is intended for use by City of Aurora Public Works, Parks & Open Space, and Planning Department staff involved in planning, design, new construction, reconstruction, and resurfacing projects. The document will also be useful to city subcontractors, developers, planners, bicycle advocates and the general public.

At the time of this writing (February 2008), the Federal Highway Administration has a Notice of Proposed Amendments to the MUTCD that would potentially change some signs and markings that are used to designate bicycle facilities. Visit <http://mutcd.fhwa.dot.gov/> to access the most current version of the MUTCD and any proposed changes to the manual.

Chapter One – Introduction

“Bicyclists have the same mobility needs as every other user of the transportation system and use the highway system as their primary means of access to jobs, services and recreational activities. Planning for existing and potential bicycle use should be integrated into the overall transportation planning process.” –

AASHTO Guide for the Development of Bicycle Facilities

“Every person propelling a vehicle by human power or riding a bicycle shall have all the rights and all the duties applicable to the driver of any other vehicle...” –

C.R.S. 42-4-1412

1.1 Purpose. The general purpose of this document is to protect and promote the public health, safety, and welfare of the citizens of Aurora, Colorado by establishing guidelines for the development of bicycle facilities.

The general purpose of this document is advanced by the following means:

- Promoting the purposes and principles of the Manual on Uniform Traffic Control Devices (MUTCD) as they relate to bicycles;
- Enhancing street safety and efficiency by providing for the orderly movement for all modes of transportation;
- Providing warning and guidance for the safe, uniform, and efficient operation of bicycles;
- Organizing comprehensive bicycle design guidelines for the city and other entities retrofitting or planning new bicycle facilities within the corporate limits of the city;
- Ensuring that all bicycle facilities are constructed to consistently high standards;
- Increasing sustainability and decreasing traffic congestion and air pollution by encouraging more people to bicycle as an alternative mode of transportation;
- Creating safe and effective bicycle linkages between neighborhoods and destinations;
- Facilitating public acceptance of the rights of bicyclists; and
- Implementing the transportation goals and objectives of the 2003 Comprehensive Plan, the Northwest Aurora Bicycle & Pedestrian Master Plan, the 1998 Aurora Bike Plan, and the 2007 Parks & Open Space Framework Master Plan.

The guidelines contained within this document have been gathered from a number of sources that include federal, state and local policies and regulations related to providing safe and efficient bicycle transportation facilities. Resources used in the development of this document are listed in the Preface. As new national, state and local transportation policies are adopted that recognize and advance the importance and safety of bicycle facilities, this document should be amended to include those enhancements when they complement the guidelines contained herein and further the purpose of this document.

1.2 Background

While much of the northwest quadrant of the city was developed on the grid, most surrounding areas provide relatively poor connectivity. This condition emphasizes the need to optimize the opportunities that exist to provide adequate bicycle facilities. There are a number of existing streets, that with relatively inexpensive improvements, can form the framework for an adequate bicycle network.

“Nationwide, people are recognizing the energy efficiency, cost effectiveness, health benefits and environmental advantages of bicycling. Local, state and federal agencies are responding to the increased use of bicycles by implementing a wide variety of bicycle-related projects and programs.” -

AASHTO Guide for the Development of Bicycle Facilities

Bicycle facilities can play an important role in the city’s transportation network. Bicycling promotes important urban land use and environmental policies supportive of compact, integrated, and sustainable mixed-use development patterns. These patterns reduce parking needs while providing for urban infill and efficient land use development. Bicycle connectivity is integral to the functionality of the city’s planned rail transit system. A safe and efficient bicycle network can significantly enhance Aurora’s identity in the metro area and raise the quality of life for its citizens.

The provision of functional bicycle routes reduces the number of cyclists forced to use sidewalks as an alternative to on-street bicycle facilities. The practice of mixing cyclists and pedestrians on sidewalks can be especially dangerous in areas with high concentrations of pedestrians and is a primary cause of accidents between cyclists and pedestrians. The American Association of State Highway and Transportation Officials (AASHTO) and the Federal Highway Administration (FHWA) both discourage this practice except under limited and controlled circumstances.

1.3 Bicycle Users

AASHTO and FHWA recognize bicyclists can be categorized into three groups:

- **Group A - Advanced Bicyclists:** This group of cyclists ride for utility, recreation, and speed and want direct access to destinations with a minimum of delay. They are comfortable riding in motor vehicle traffic but prefer adequate operating space to keep conflicts with motor vehicles at a minimum.
- **Group B - Basic Bicyclists:** This group may use their bicycles for utilitarian as well as recreational purposes but are not as comfortable riding with motor vehicle traffic unless given ample space between themselves and motorized traffic as can be provided by a bike lane or sufficiently wide shared lane.

- **Group C - Children Bicyclists:** Whether riding on their own or with a parent, this group includes children that are less skilled at riding bicycles. Because of their lack of transportation options, these cyclists have the greatest need for dedicated, safe access to major destinations in their neighborhoods, such as schools, churches and recreational facilities.

It is rare when any one bicycle facility can fulfill the needs of all three groups of bicyclists identified above. Nonetheless each facility should be designed using consistently high standards to accommodate the widest range of types of users and types of bicycle trips as possible.

1.4 Balancing Competing Interests

Providing a balanced transportation system that allows access for all and safety in equal measure for each mode of travel requires that we formalize the methods by which bicycle facilities are designed. It is the goal of this document to fulfill this requirement.

“The goal of the travel framework is to improve accessibility and mobility by providing a more balanced transportation system.” -

*2003 Aurora
Comprehensive Plan*

“Starting at the centerline, [transportation infrastructure] was developed according to the number of motor vehicle travel lanes that were needed well into the future, as well as providing space for breakdowns. Beyond that, facilities for bicyclists and pedestrians, environmental mitigation, accessibility, community preservation, and aesthetics were at best an afterthought, often simply overlooked, and, at worst, rejected as unnecessary, costly, and regressive. Many states passed laws preventing the use of state gas tax funds on anything other than motor vehicle lanes and facilities. The resulting [transportation infrastructure] discourages bicycling and walking and has made the two modes more dangerous. Further, the ability of pedestrians with disabilities to travel independently and safely has been compromised, especially for those with vision impairments.

“The call for more walkable, livable, and accessible communities, has seen bicycling and walking emerge as an "indicator species" for the health and well-being of a community. People want to live and work in places where they can safely and conveniently walk and/or bicycle and not always have to deal with worsening traffic congestion, road rage and the fight for a parking space.

“The challenge for transportation planners, highway engineers and bicycle and pedestrian user groups, therefore, is to balance their competing interest in a limited amount of right-of-way, and to develop a transportation infrastructure that provides access for all, a real choice of modes, and safety in equal measure for each mode of travel.” *A US DOT Policy Statement – Integrating Bicycling and Walking into Transportation Infrastructure*

1.5 Applicability

These guidelines shall apply to all newly constructed, reconstructed, and retrofitted on-street and off-street bicycle facilities in the City of Aurora.

1.6 Administration and Interpretation

The directors of Planning, Public Works, and Parks & Open Space shall jointly perform or assign the following responsibilities and authorities:

- A. Administer the bicycle facility design guidelines;
- B. Interpret the provisions of the bicycle facility design guidelines;
- C. Modify the bicycle facility design guidelines where special conditions indicate that such modification will best meet the purpose of the bicycle design guidelines.

1.7 Implementation

It shall be the responsibility of the Planning Department to coordinate the implementation of the standards contained herein.

1.8 Revisions to This Document

Revisions to the MUTCD are a regular and ongoing occurrence as new information, studies, and research is made available. The National Committee on Uniform Traffic Control Devices (NCUTCD) provides recommendations to FHWA on the MUTCD. NCUTCD technical committees are constantly reviewing traffic control design alternatives to ensure the safety of all street users. As new regulations pertinent to bicycles are adopted into the MUTCD they should be incorporated into this document if they further the purpose of this document as established in Section 1.1 above. Adoption of new regulations into this document shall be made administratively with the concurrence of the Public Works, Parks & Open Space, and Planning Department directors.

Chapter Two – Signed Shared Streets

2.1 Purpose. The purpose of signing streets as preferred routes for bicycle traffic is as follows:

- To provide connected routes through the city where sufficient street right-of-way does not exist to install bike lanes, and on streets with sufficient right-of-way for bike lanes but the character of the street (low traffic volumes and vehicle speeds) does not necessitate the installation of bike lanes;
- To provide connections between different types of bicycle facilities and destinations such as parks, schools and activity centers; and
- To alert motorists of the likely presence of cyclists along high demand corridors.

2.2 Criteria for Selecting a Signed Shared Street

- The roadway should provide connectivity and a direct route of travel with other bicycle facilities and key destinations.
- The roadway should generally be free of excessive traffic control devices such as stop signs and traffic signals to allow the cyclist to travel with as few interruptions as possible.
- The bike route should cross arterial streets only at controlled intersections.

BIKE SIGN TYPES AND THEIR USE ON SIGNED SHARED STREETS

2.3 D11-1 BIKE ROUTE GUIDE SIGN



D11-1

This sign shall be provided along streets selected as a bike route, including bike lanes, unless the route has a specific designation in which case the M1-8 sign shall be used (see Section 2.4 below). The D11-1 sign shall also be used in conjunction with D1, M4, and M7 series sign plates (see Section 2.5 and Figure 2.A below) as needed to alert cyclists of route direction changes, intersecting bike routes, significant destinations, and to generally increase the utility of the sign.

2.3.1 D11-1 Placement Criteria

- A. **High Volume or Urban Streets.** Signs should be placed approximately every ¼ mile immediately following arterial and collector street intersections and other key intersections adjacent to community facilities, and following signalized intersections.
- B. **Lower Volume Streets.** Signs should be placed approximately every ½ mile immediately following collector and arterial street intersections.
- C. **All Streets.** In addition to the sign placement guidelines above in sections 2.3.1 A and B, D11-1 bike route guide signs should also be placed at the following locations:
 - 1. At the junction of intersecting bike routes in combination with D1, M4 and M7 supplemental sign plates (see Section 2.5 and Figure 2.A below).
 - 2. At decision points along designated bike routes to notify bicyclists of a change in the direction of the bike route and as a confirmation of route direction following the change in direction in combination with D1, M4 and M7 supplemental sign plates; and
 - 3. At intervals to supply information on major destinations and distances in combination with D1, M4 and M7 supplemental sign plates to increase the utility of the signs.



M1-8

2.4 M1-8 BIKE ROUTE SIGN

This sign type is used in place of the D11-1 sign to identify unique route designations – e.g., named or numbered routes and bike lanes and may include the city’s logo to heighten sign recognition. The M1-8 sign shall also be used in combination with D1, M4, and M7 series plates (see Section 2.5 and Figure 2.A below) as needed to alert users of intersecting bike routes, route direction changes, significant destinations, and to generally increase the utility of the sign.

2.4.1 M1-8 Placement Criteria

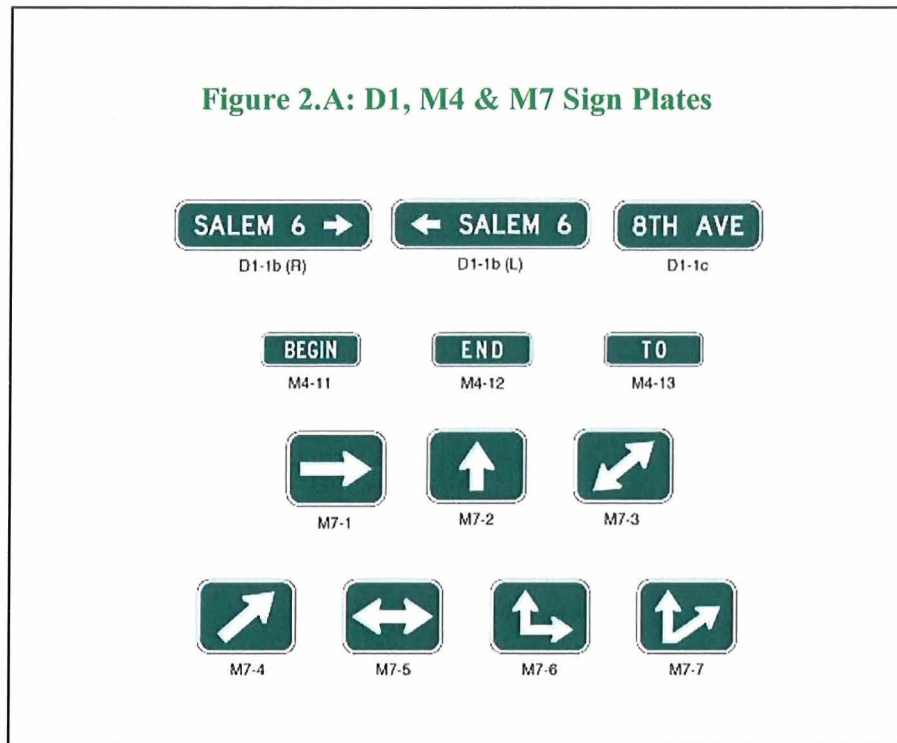
- A. **High Volume or Urban Streets.** Bike route signs should be placed approximately every ¼ mile immediately following arterial and collector street intersections and other key intersections adjacent to community facilities, and following signalized intersections.
- B. **Lower Volume Streets.** Bike route signs should be placed approximately every ½ mile immediately following collector and arterial street intersections.

C. All Streets.

1. At the junction of intersecting bike routes in combination with D1, M4 and M7 supplemental sign plates (see Section 2.5 and Figure 2.A below)
2. At decision points along designated bike routes to notify bicyclists of a change in the direction of the bike route and as a confirmation of route direction following the change in direction in combination with D1, M4 and M7 supplemental sign plates; and
3. At intervals to supply information on major destinations and distances in combination with D1, M4 and M7 supplemental sign plates to increase the utility of the signs.

2.5 D1, M4, and M7 SERIES SIGN PLATES

These supplemental information, direction and destination sign plates shall be used in conjunction with the D11-1 and M1-8 signs when needed to convey route direction changes and significant nonpolitical destinations. The sign plates shown in Figure 2.A represent a sample of the sign plates available and serve only as a guide to the type of information that can be conveyed by the sign plates.



BICYCLE WARNING SIGN



W11-1 Bicycle Warning Sign

This sign should be used to alert motorists to entries into the roadway by bicyclists and other activities that might cause conflicts. The W11-1 bicycle warning sign shall always be used in combination with the sign plates described in Section 2.6.1 below. The preferred color for these signs is yellow. Although fluorescent yellow-green signs are recommended by many, the city has specifically chosen to reserve the use of the fluorescent yellow-green signs exclusively for school signs because of their high visibility and our desire to provide a special measure of protection to school children.

2.6.1 W11-1 Placement Criteria

- A. **At a Bikeway Crossing Location.** When used at the point of crossing, W11-1 shall be supplemented with a downward pointing arrow (W16-7p) to show the location of the crossing.
- B. **In Advance of a Bikeway Crossing.** W11-1 shall be used in conjunction with the supplemental AHEAD (W16-9p) sign plate. MUTCD *Guidelines for Advance Placement of Warning Signs* shall be used to determine the location of this advance warning sign.
- C. **To Warn Motorists of Cyclists on the Street.** Used together the W11-1 and W16-1 (SHARE THE ROAD) signs should be placed immediately following the end of a striped bike lane (see Figure 3.F, page 18) and along limited streets where high volumes of bicycle traffic are likely to be encountered and bike routes or lanes are not designated.



W11-1 w/W16-7p Bike Facility Crossing Sign



W11-1 w/W16-9p Advance Bike Warning Sign



W11-1 w/W16-1 Share The Road Bike Warning Sign

2.7 M4-9c (L or R) BICYCLE DETOUR SIGN

This sign should be used when an established bicycle facility has been closed to through traffic and a preferred interim route has been created to direct bicycle traffic around the closed portion of the bicycle path or route. If used, the bicycle detour sign shall include a supplemental arrow to direct bicycle traffic in the appropriate direction. It is advisable that the bicycle detour sign include a plaque that identifies the name of the bicycle facility for all major facilities.



M4-9c (R or L)

Chapter Three – Bike Lanes

3.1 Purpose

The purpose of this section is to minimize conflict between cyclists and motorists and maximize the safety of the cyclist by providing for the orderly movement of all vehicles along streets with bike lanes.

3.2 The Safety Advantages of Bike Lanes

The installation of bike lanes has several very important public safety benefits. Numerous studies have shown that bike lanes provide the following benefits:

- Improve the organization and flow of traffic by defining road space for the exclusive use by bicyclists;
- Reduce the likelihood that motorists will stray into the path of cyclists or swerve towards oncoming traffic to avoid cyclists;
- Discourage cyclists from riding in the wrong direction – against the flow of traffic;
- Respond to cyclists’ preference for striped on-street bike lanes;
- Reduce the number of cyclists riding on sidewalks;
- Increase the number of cyclists while reducing the number and severity of bicycle crashes;
- Increase cyclists that obey stop signs; and
- Provide a statement to motorists that cyclists have an exclusive right to that portion of the road.

3.3 Fundamentals of Bike Lane Design

- Bike lanes shall be one-way facilities with bicycle traffic moving in the same direction as the adjacent motor vehicle traffic lane.
- When installed on two-way streets, bike lanes should always be installed on both sides of the street.
- Roadway condition and maintenance, drainage grates, utility covers, bus stop configurations, traffic control devices, and other factors that may influence bicycle safety shall be evaluated before bike lanes are installed on a street.
- Bike lanes should not be placed on streets with diagonal or perpendicular parking.
- Bike lane stripes shall not cross into stop bars, crosswalks, or street intersections except through particularly complex intersections where guidance is prudent.

3.4 Bike Lane Widths

A. **Bike Lane Width Measurement.** The following criteria shall be used to locate the position of the bike lane on streets with on-street parking and streets where parking is prohibited.

1. **Streets with On-Street Parking.** Where the street cross section permits on-street parking, two stripes shall be installed for both sides of the bike lane. The stripe that separates the travel lane from the bike lane is the *bike lane stripe*. The stripe that separates the bike lane from the parallel parking stalls is the *parking lane stripe*. The bike lane width shall be measured from the centerline of the bike lane stripe to the centerline of the parking lane stripe.
2. **Streets with Parking Prohibited.** Where the street cross section prohibits on-street parking and the bike lane is located adjacent to the curb only the bike lane stripe is required to delineate the bike lane except at intersections where an exclusive right turn lane is added (see Figure 3.E, page xx). In this case the bike lane width shall be measured from the curb face to the center of the bike lane stripe.

B. **City Code Chapter 126.** Section 126-36 of the Aurora City Code establishes criteria for the design of all new city street construction. Section 126-36 identifies the following four street cross sections as having on-street bike lanes.

1. **62 Foot ROW Alternative Two-Lane Collector Street.** On-street parking is prohibited and a 6-foot bike lane is required. **Note:** The 6-foot bike lane measurement includes the adjacent 2-foot gutter pan.
2. **74 Foot ROW Two-Lane Collector Street.** On-street parking is permitted and a 5-foot bike lane is required between the travel lane and parallel parking stalls.
3. **84 Foot ROW Four-Lane Collector Street.** On-street parking is prohibited and a 6-foot bike lane is required. **Note:** The 6-foot bike lane measurement includes the adjacent 2-foot gutter pan.
4. **114 Foot ROW Four-Lane Arterial with Raised or Painted Median.** On-street parking is prohibited and a 5-foot bike lane is required. **Note:** The 5-foot bike lane measurement does **not** include the adjacent 2-foot gutter pan.

C. **Retrofitting Existing Streets.** When retrofitting existing streets that vary from current city street standards the following minimum bike lane widths are recommended:

1. **On Streets Where On-Street Parking is Prohibited.**

Minimum 4-foot bike lane not including the adjacent gutter pan. If adequate street ROW is available, 5-foot wide bike lanes (not including adjacent gutter pans) are preferred and should be considered.

2. **On Streets Where On-Street Parking is Permitted.**

Minimum 5-foot wide bike lane combined with a minimum 7-foot parking stall. In only very limited cases should the combined width of the parking stall and bike lane be less than 12 feet in width. These limited cases include streets where on-street parking use is minimal and traffic volumes are low.

On streets where the amount and turnover of parking is moderate to substantial, and sufficient ROW exists, it is advisable to increase the minimum width for the combined bike lane and parking stall to 13 or 14 feet. Bike lane and parking stall widths should be increased in equal increments as shown below.

Recommended adjacent bike lane and parking stall measurements:

- 5-foot bike lane – 6-foot parking stall (this configuration shall be considered only under very limited circumstances as explained in Section C.2. above);
- 5-foot bike lane – 7-foot parking stall (this is the preferred minimum dimensional requirement);
- 5 ½-foot bike lane – 7 ½-foot parking stall;
- 6-foot bike lane – 8-foot parking stall.

3. **Travel Lane Width Guidance.** When retrofitting existing streets for bike lanes, it may be necessary to adjust the width of travel lanes. Travel lanes can be reduced to 10, 10 ½, or 11 feet wide when street width will accommodate a combined 12 foot wide bike lane and parking stall (for guidance see *A Policy on Geometric Design of Highways and Streets, AASHTO, 2004*).

**For Urban Arterials,
“Lane widths may vary
from 10 to 12 feet...
Under interrupted-flow
operating conditions at
low speeds (45 mph or
less), narrower lane
widths are normally
quite adequate and have
some advantages.”**

*A Policy on Geometric
Design of Highways and
Streets, AASHTO, 2004
pg. 472-473*

3.5 Bike Lane Stencils

- A. **Stencil Type & Dimensions.** Figure 3.A illustrates the preferred bike lane stencils: the bike with rider symbol and the directional arrow, solid white in color, precut plastic, and reflectorized.
- B. **Stencil Location Criteria.** The two stencils shall be used in combination at locations immediately following arterial and collector street intersections, following the intersection of another bicycle facility, and following major curb cuts for land uses that attract higher levels of bicycle traffic, e.g. schools, transit facilities, recreation centers... At all other locations the bike with rider stencil may be used without the directional arrow. Bike lane stencils shall be centered in the bike lane and also applied at the following locations:
1. The start of the bike lane at the far side of each intersecting street (Figure 3.B, Detail A).
 2. No more than 120 feet prior to an intersection (Figure 3.B). Preferably the bike lane stencil should be placed away from the wheel track of turning vehicles – i.e. in advance of the bike lane stripe turning from a solid line to a dashed line.
 3. Approximately every 660 feet (Figure 3.B).
 4. Immediately following a bus stop clearance area (Figure 3.C).
 5. Immediately following major curb cuts;
 6. At T-intersections (Figure 3.D).
 7. Immediately preceding stop bars, crosswalks, and intersections if the bike lane has been dashed or discontinued to allow for an exclusive right turn travel lane (Figure 3.E).

Bike Lane Stencil Spacing & General Rules for Dashing Bike Lane Stripes

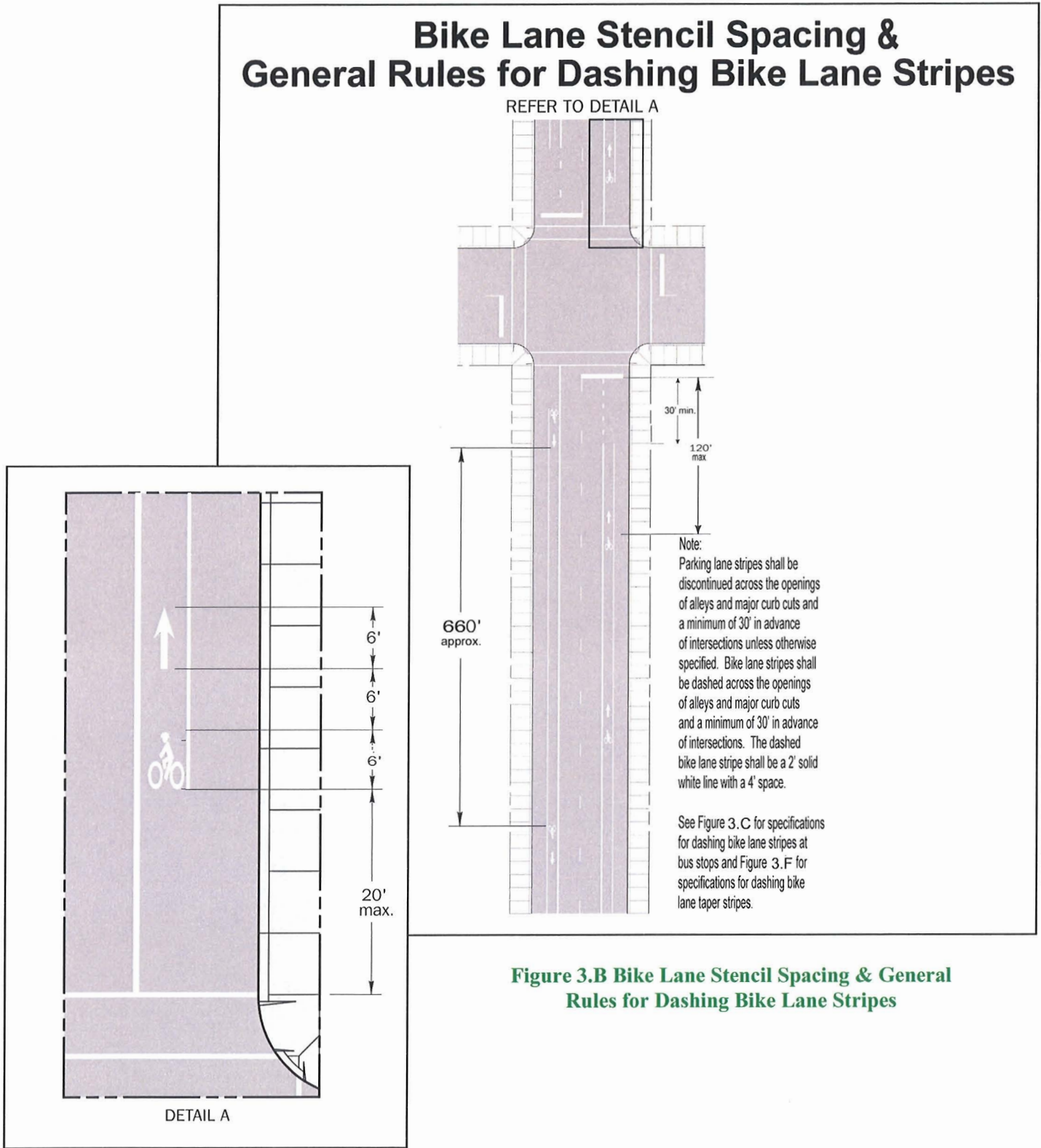


Figure 3.B Bike Lane Stencil Spacing & General Rules for Dashing Bike Lane Stripes

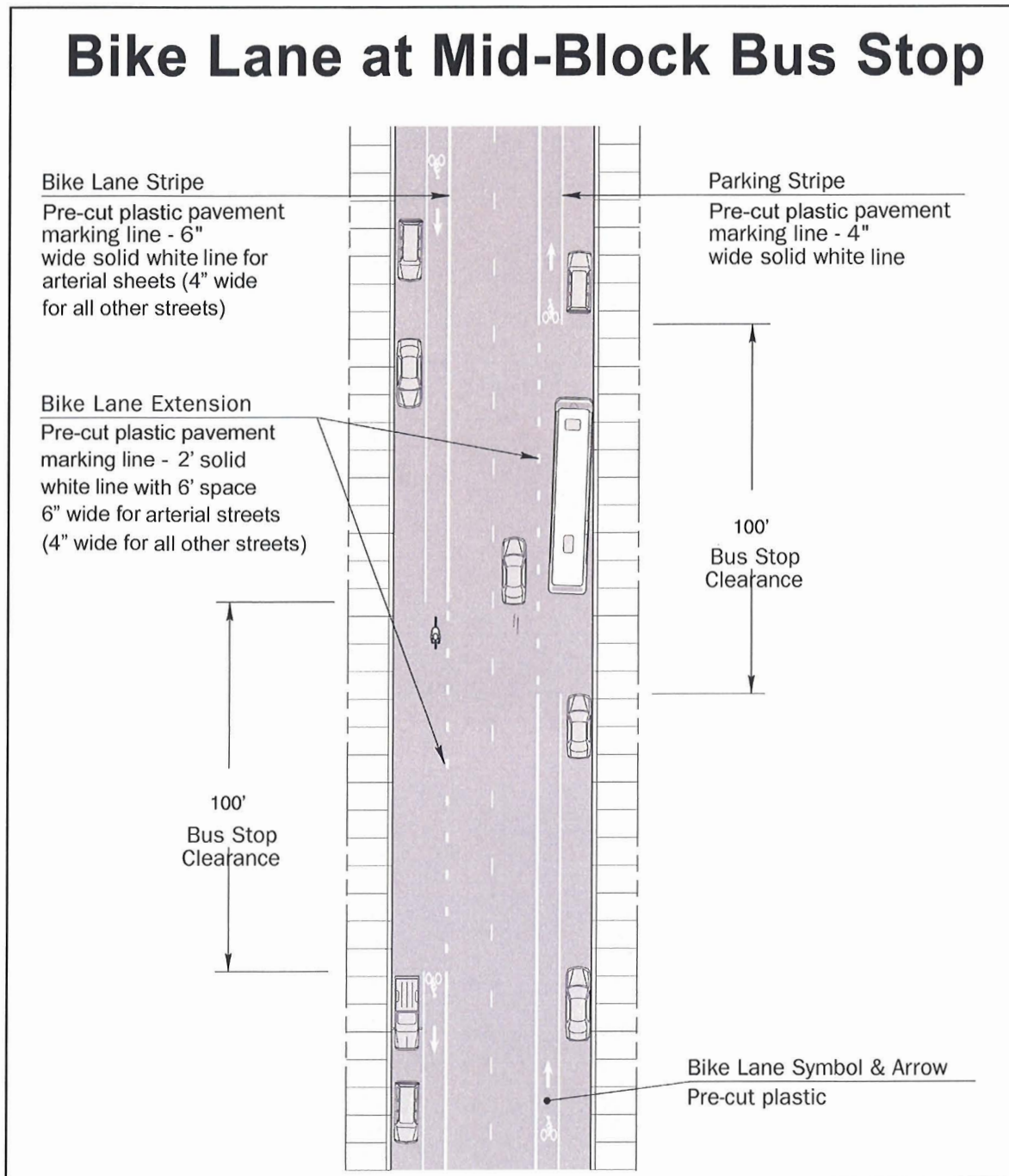


Figure 3.C – Bike Lane Striping & Stencils at Bus Stops

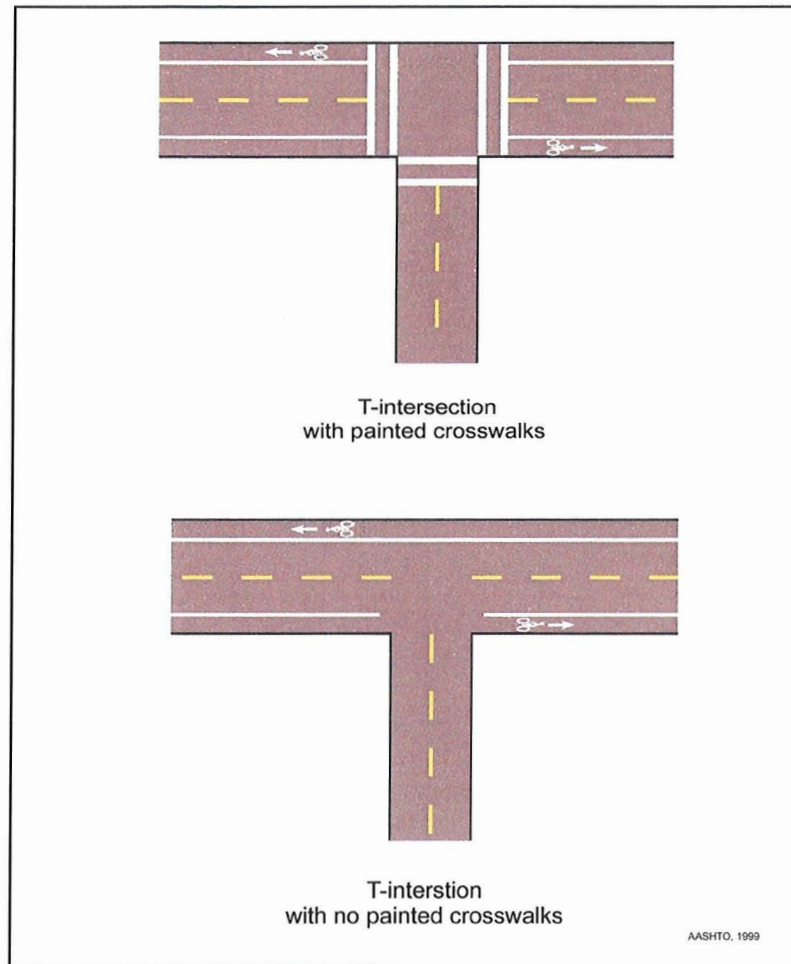


Figure 3.D Bike Lane Stencil and Striping at T-intersections

3.6 Bike Lane Stripe Dimensions

- A. **Bike Lane Stripe.** Bike lane stripes adjacent to the motor vehicle travel lane shall be 6 inches wide for arterial streets and 4 inches wide for all other streets, a solid white line, and reflectorized precut plastic. Where bike lane stripes cross alleys and major curb cuts, and 30 feet in advance of intersections, the stripe shall be dashed with a 2-foot solid white line and a 4-foot space (Figure 3.B). Bike lane stripes at bus stops (Figure 3.C) and bike lane tapers (Figure 3.F) shall be dashed with a 2-foot solid white line and a 6-foot space.
- B. **Parking Lane Stripe.** The parking lane stripe that separates the bike lane from the parallel parking stall shall be a solid white line 4 inches wide and reflectorized precut plastic (Figures 3.C & 3.F). Parking lane stripes shall discontinue when crossing alleys, major curb cuts, and bus stops.

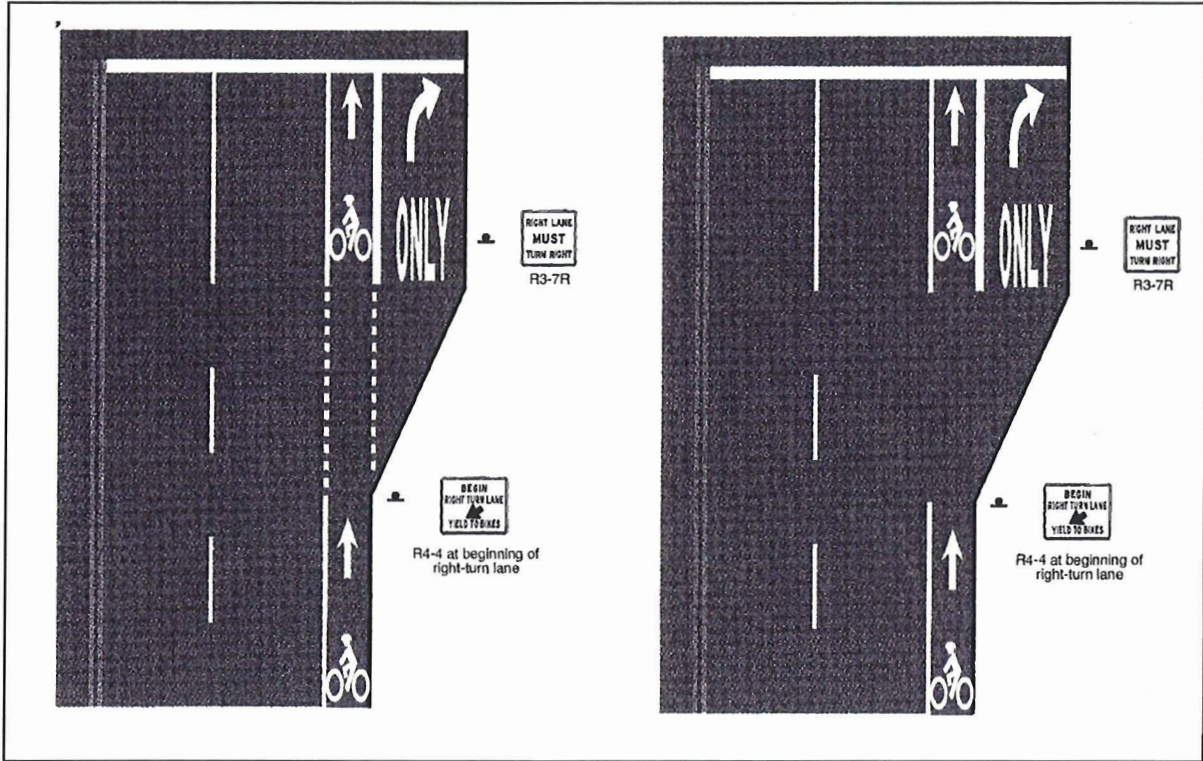


Figure 3.E Bike Lane Striping and Stencil Treatments at Intersections with Exclusive Right Turn Lanes

3.7 Bike Lane Striping at Street Intersections

- A. **Generally.** At intersections bicyclists continuing straight ahead and motorists turning right must cross paths. The following striping alternatives have been specifically developed to minimize conflict between bicycles and motor vehicles at intersections and encourage a predictable weave maneuver in advance of intersections.
- B. **Retrofitting Bike Lanes on Existing City Streets.** Retrofitting street intersections that vary from current street standards with bike lanes is much more challenging and often necessitates that a bike lane come to an end in advance of an intersection. This condition requires a cyclist to “take the lane” and share the road with motor vehicles through the intersection until the bike lane resumes again on the far side of the intersection (Figure 3.F). Parallel to the point where the bike lane is discontinued a W11-1 and W16-1 Share the Road warning sign shall be placed.

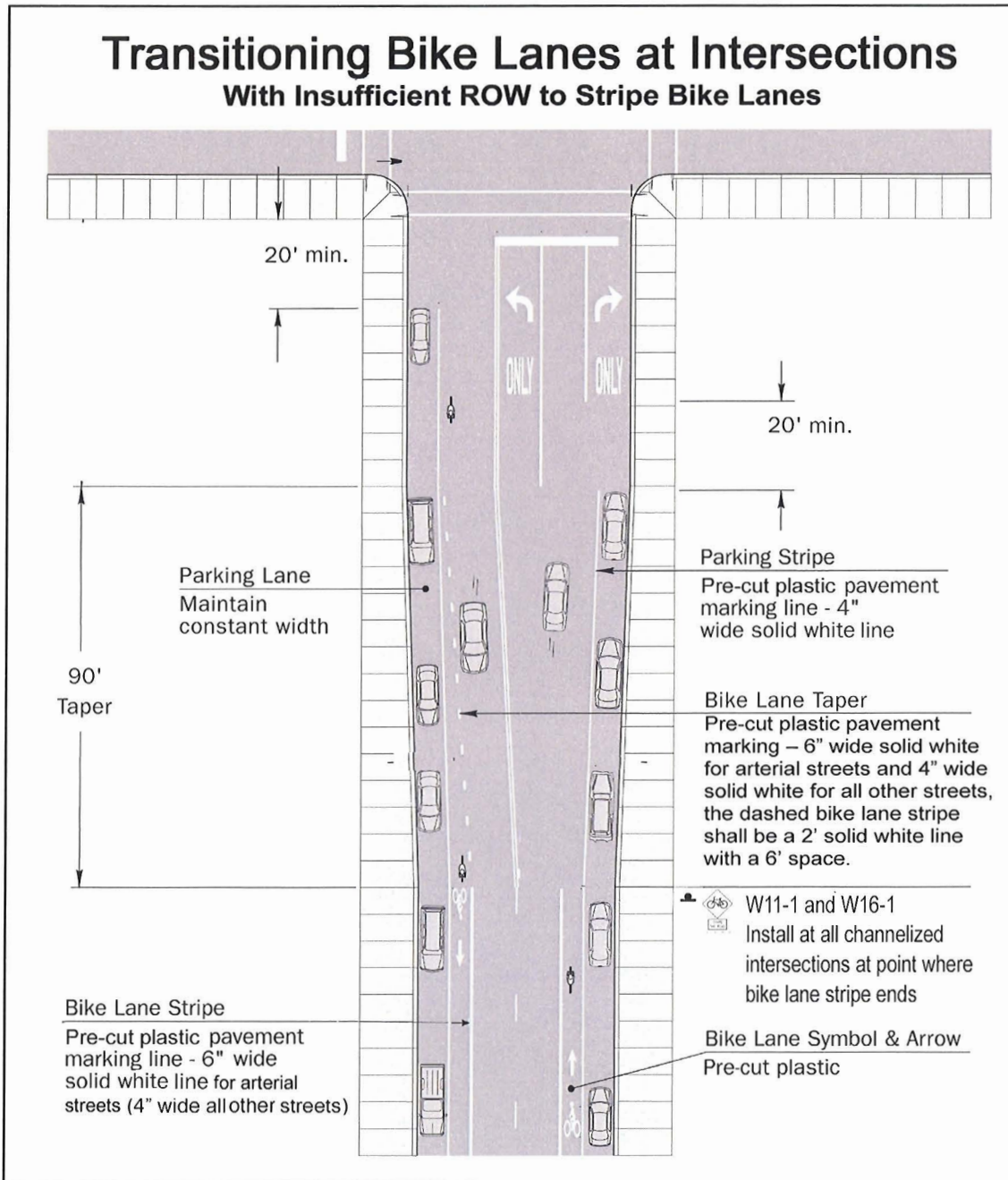


Figure 3.F Transitioning Bike Lanes at Intersections with Insufficient Right-of-Way

C. **Bike Lanes at Intersections without Dedicated Right Turn Lanes**

1. **74 Foot ROW 2-Lane Collector Street.** Intersection designs for this city street type require that on-street parking be discontinued in advance of intersections to allow for a center left turn lane. To accommodate the left turn lane, it is necessary that the bike lane alignment gradually transition from the point where on-street parking is discontinued to an alignment adjacent and parallel to the curb and gutter.
2. **62 Foot ROW Alternative 2-Lane Collector.** This street cross section is only permitted where there is at least 1,000 feet between intersecting streets. At intersections, the 62 foot Alternative 2-lane Collector is flared to allow for a center left turn lane. Since this street cross section has no on-street parking, the addition of the left turn lane does not affect the alignment of the bike lane relative to the curb. The bike lane remains adjacent and parallel to the curb up to the intersection as well as at the start of the bike lane at the far side of the intersection.
3. **84 Foot ROW Four-Lane Collector Street.**
 - a. **Generally.** This street cross section is not planned to have additional left or right turn lanes at intersections. Therefore the cross section illustrated in City Code Section 126-36 is the same cross section that will be used at intersections with no effect to the bike lane alignment.
 - b. **With Center Left Turn Lane.** If a center left turn lane is added, the extra ROW width shall come from flaring the intersection as is the case for the intersection design of the 62 Foot Alternative 2-Lane Collector described above with no effect on bike lane alignment.
 - c. **With Exclusive Right Turn Lane.** An exclusive right turn lane may be added to this street cross section at the intersection of collector and arterial streets. If this occurs, the additional ROW should come from flaring the intersection and **not** eliminating the bike lane through the intersection. In this instance a cyclist traveling straight ahead will need to perform a weave maneuver with motor vehicles turning right. The bike lane configuration for this scenario is the same as for the 4-Lane Arterial with Raised or Painted Medians shown in Figure 3.E, page 17.

D. Bike Lanes at Intersections with Dedicated Right Turn Lanes

114 Foot Four-Lane Arterial with Raised or Painted Median. The intersection designs for these street cross sections will include exclusive right turn lanes at collector and arterial streets and the additional ROW shall come from flaring the intersection. In these cases bike lane striping shall be configured as shown in Figure 3.E, page 17.

E. Bike Lanes and Bus Stops

Generally. When buses must cross the path of a striped bike lane to access a bus stop the 4-inch wide (6-inch wide on arterial streets) inside bike lane stripe shall be dashed and the 4-inch wide outside parking stripe shall be discontinued for a length of 100 feet. The dashed bike lane stripe and the discontinuance of the parking lane stripe shall begin 80 feet prior to the bus stop sign and continue for 20 feet beyond the bus stop sign at which point the solid bike lane stripe and solid parking lane stripe shall resume as shown in Figure 3.C, page 15.

3.8 Bike Lane Sign Types



R3-17



R3-17a



R3-17b

A. **R3-17 (Bike Lane Sign).** This sign shall only be used along roadways with striped bike lanes and should be provided at periodic intervals (intermittently) along the bike lane (see MUTCD Sec. 9B.04 and 9C.04 for engineering determinants for proper spacing). The R3-17 sign shall also be used in conjunction with R3-17a and R3-17b sign plates.

- **R3-17 Placement Criteria.** R3-17 bike lane signs should be provided at a rate of approximately four signs per mile of bike lane. Ideally they should be placed immediately following the intersection of streets with the highest traffic counts.

B. **R3-17a (AHEAD).** This sign plate shall be used in conjunction with the R3-17 sign and be installed at the beginning of the bike lane facility.

C. **R3-17b (ENDS).** This sign plate shall be used in conjunction with the R3-17 sign and be installed at the end of the bike lane facility and followed by sign W11-1 in combination with sign W16-1 (SHARE THE ROAD). **R3-17b** should not be used when a bike lane temporarily ends at intersections with insufficient ROW to accommodate a bike lane stripe and the bike lane resumes at the far side of the intersection.

- E. **R4-4 (Begin Right Turn Lane Yield to Bikes).** This sign shall be used at points where motor vehicle exclusive right turn lanes must weave across bicycle lanes (Figure 3.E, page 17).
- F. **W11-1 & W-16-1 (Share the Road).** This sign shall be placed immediately parallel to the point where a bike lane is temporarily discontinued prior to an intersection (Figure 3.F) because sufficient right-of-way does not exist to continue the bike lane up to and through the intersection, or immediately following the end of a bike lane along the full length of a street.



R4-4



W11-1 & W16-1

Chapter Four – Shared Use Paths

4.1 Purpose. The purpose of this section is to address design guidelines for shared use paths (off-street bicycle facilities) as they intersect and cross public and private streets. The guidelines below affect the design of the path as well as the street. Coordination between city departments is necessary to identify the best combination of on-street and off-street signs and pavement markings necessary to ensure safe and functional crossings of streets by the users of shared use paths.

4.2 Shared Use Paths Versus Sidewalks. It is important that a clear distinction be made between shared use paths and sidewalks. Shared use paths are characterized by long stretches of uninterrupted travel with relatively infrequent at-grade crossings with streets. Shared use paths contain informational and traffic control signs for users traveling in both directions. Although they are an important component of a bicycle network, shared use paths are not a substitute for on-street bicycle facilities. Both on-street and off-street bicycle facilities must be provided to fully meet bicyclists' transportation needs.

While it is generally accepted that children will bicycle on sidewalks for safety reasons, sidewalks are primarily designed for pedestrians. Sidewalks often include obstructions (utility poles, sign posts, fire hydrants, motor vehicle movements at access points, etc.) as well as pedestrian amenities (trees in grates, landscape planters, bus shelters and benches, newspaper racks, shop entrances, etc.) that block the travel path and make their functional use as a bicycle facility unsatisfactory. Increasing the width of sidewalks does not necessarily make them safer for cyclists. Extra sidewalk width encourages higher speeds by cyclists and increases the potential for conflicts with pedestrians and especially motor vehicles at street intersections and curb cuts. However, when necessary and for relatively short distances, sidewalks can provide a vital link between bicycle facilities.

4.3 Fundamental Design Principles of At-Grade Crossings.

- Provide advance notice to motorists and path users of the crossing.
- Communicate who has the obligation to yield at the crossing.
- Install designs that enable motorists and path users to safely fulfill their obligations with the least restrictive form of control.

4.4 Shared Use Paths and Street Crossings. Generally, there are three primary types of shared use path and street crossings:

- Midblock Crossings,
- Adjacent Path Crossings, and
- Complex Intersection Crossings.

A. **Midblock Crossings.** Below is a list of design considerations related primarily to midblock crossings although they are also pertinent to path crossings of any motorized or non-motorized transportation facility. These considerations in addition to the ones listed in subsections B & D below should form the framework for designing a midblock crossing, where allowed, for a shared use path.

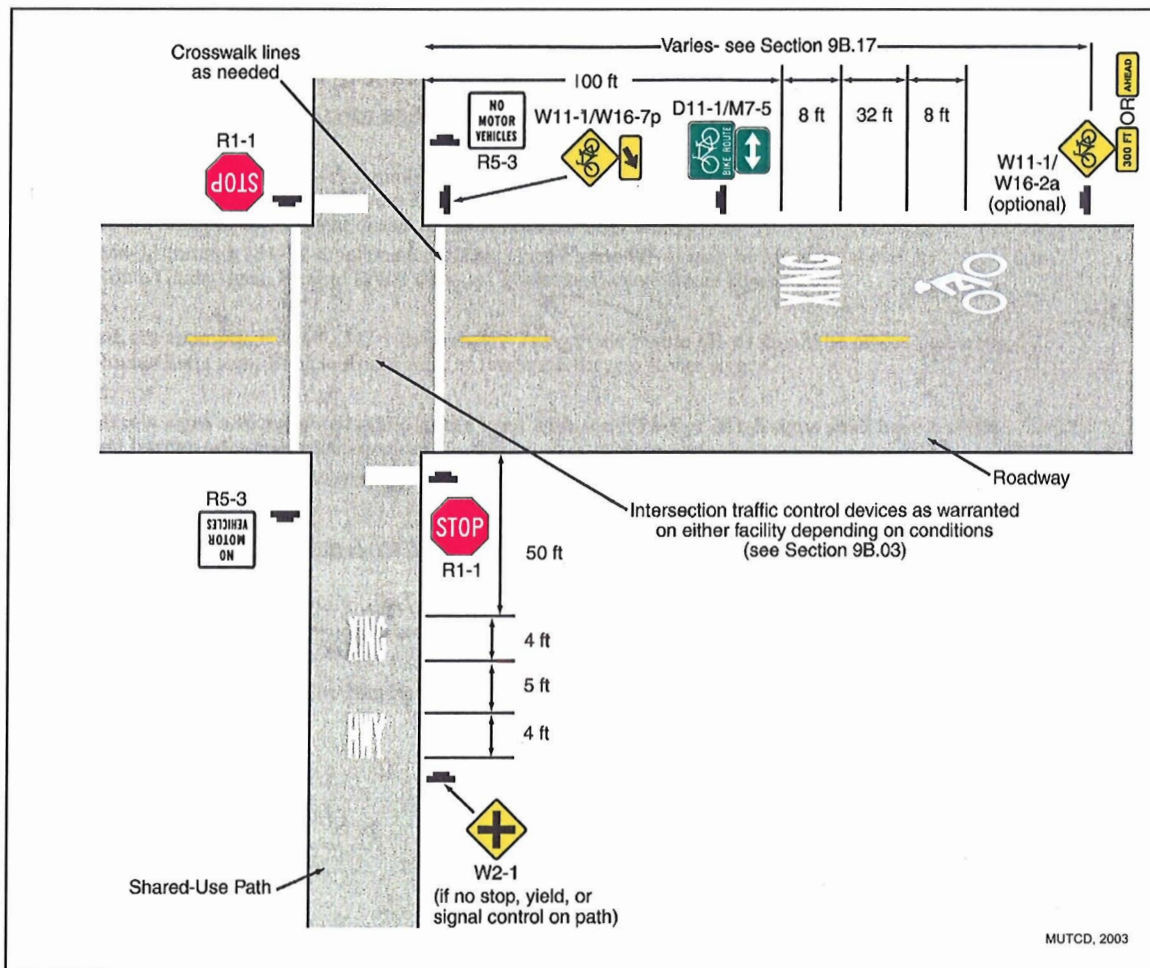


Figure 4.A – Signing Shared Use Path Crossings of a Street

1. **Adjacent Street Intersections.** The distance between a midblock crossing and nearby street intersection should be sufficient enough to ensure that motor vehicle activity associated with street intersection does not interfere with the safe functioning of the path's midblock crossing.
2. **Traffic Control Devices.** A detailed and coordinated assessment of the type, number and location of traffic control devices including signalization, signs, striping, crosswalks, and pavement markings should be performed for the path and the street. Figure 4.A, page 23 illustrates one potential treatment for a shared use path crossing of a street. See subsection D.1 & D.2, page 27 for more traffic control considerations.
3. **Sight Distances.** A thorough analysis of sight distances affected by design speed, horizontal and vertical alignment, and grades of the path and street should be undertaken and steps taken to alert motorists and path users of these conditions.
4. **Refuge Islands.** An assessment of the need and design for refuge islands should also occur. Figure 4.B, page 25 provides design guidance for refuge islands. Refuge islands should be designed to accommodate multiple users at one time including baby strollers, tandem bicycles, wheelchairs, and equestrians if allowed on the path. Refuge islands should be considered for streets under the following circumstances:
 - a) Traffic volumes, speeds and roadway width create real or perceived safety concerns for path users; or
 - b) The crossing is regularly used by school-aged children, the elderly and/or disabled persons.
5. **Angle of Crossing.** Skewed crossings of roadways should be avoided. Whenever possible, skewed shared use paths should be realigned in advance of the roadway to allow for a 90 degree crossing.

B. Adjacent Path Crossings. An adjacent path crossing is where a shared use path crosses a street at a T-intersection (including curbcuts) or a four-legged intersection. Figure 4.C illustrates the multiple motor vehicle conflicts the cyclist must be aware of to safely maneuver through this type of crossing. The following design factors, in addition to those identified in subsections A above and D below should also be taken into consideration when designing adjacent path crossings.

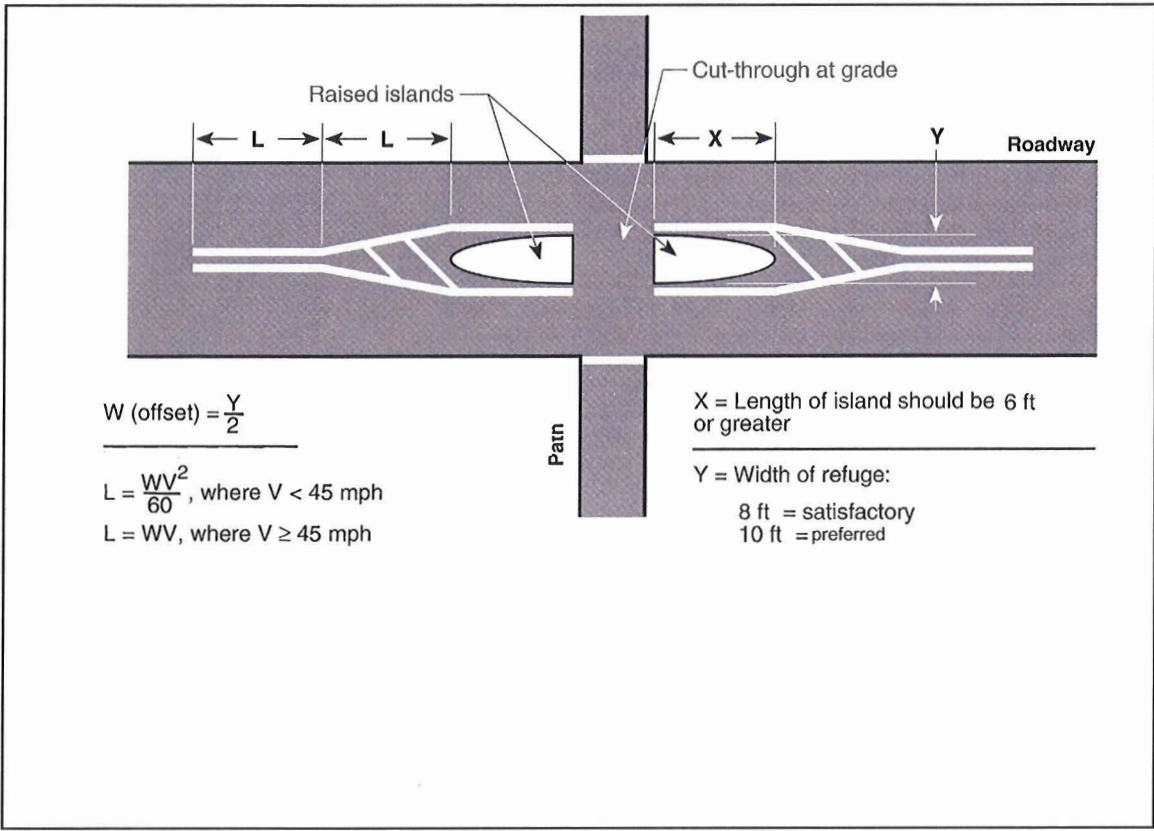


Figure 4.B – Refuge Island Design

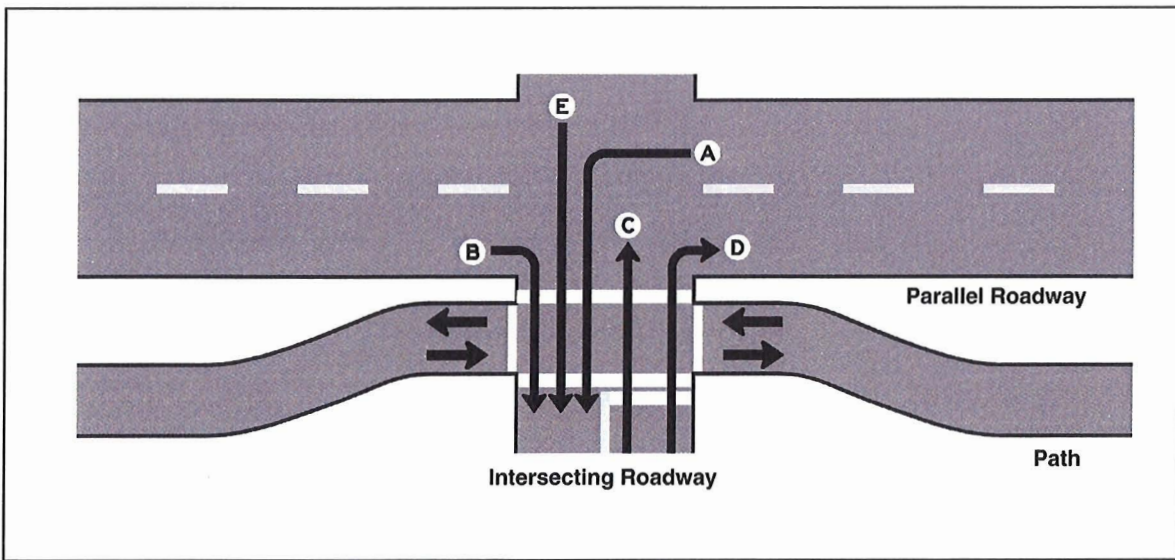


Figure 4.C - Path Users Face Multiple Conflict Points When Crossing Adjacent Path Intersections



W2-1

1. **Traffic Volumes and Traffic Control Devices.** As shown in Figure 4.C, there is the potential for numerous conflicts between motor vehicles and cyclists at adjacent path crossings. Consequently adjacent path crossings have the highest frequency of bicycle accidents and therefore require a high level of analysis regarding the appropriate number and location of traffic control devices. See subsection D.1. below for additional considerations.
2. **Path/Intersection Proximity.** When a shared use path parallels but does not immediately abut a street it is preferable that the path crossing occur very close to the parallel street to increase visibility for the motorist and cyclist. This may require the path be realigned closer to the parallel street as it approaches the crossing.
3. **Corner Radii.** Another technique to decrease conflicts between cyclists and motorists is to make the corner turning radii from the parallel street to the street being crossed by the path as small as reasonable to slow the speed of turning vehicles.
4. **Sight Distances.** Sight distances at adjacent path crossings are often reduced and therefore require an intersection warning sign (W2-1) and a stop sign (R1-1) for path users (Figure 4A, page 23). Care shall be given to the placement of the path stop sign to ensure it is not mistaken for a street stop sign.
5. **Other Safety Enhancements.** If high rates of motorist/cyclist conflicts continue to occur at the adjacent path crossing despite the use of other preventative measures, the situation may warrant the prohibition of right turns on red for motorists and the placement of a stop bar in advance of the path crossing on the intersecting street.

C. **Complex Intersection Crossings.** These include all other path-street or public/private driveway crossing combinations. Because of their unique characteristics these crossings should be designed on an individual basis to ensure adequate safety for the path user. If an acceptable level of safety can not be achieved, then these facilities should be considered as candidates for realignment.

D. **Other Street Crossing Design Considerations.** Below are additional street crossing design considerations that should be evaluated for all shared use paths.

1. **Traffic Signals.** When evaluating warrants for traffic signals, recall MUTCD Section 9D.01, “For the purpose of signal warrant evaluation, bicyclists may be counted as either vehicles or pedestrians.” Highly urbanized areas near major activity centers may warrant a traffic signal, however some path crossings may occur at remote locations associated with open space or along significantly lower volume and lower speed streets. In these instances a simple yield sign may be sufficient to control traffic movement and protect trail users.
2. **Traffic Signs.** Some type of regulatory traffic control device should be installed at every path/street intersection. Stop signs should always be used to control path user traffic except in the instances listed above when a yield sign may be sufficient. Four way stop signs are generally not recommended for path/street intersections.
3. **Push Button Activated Signals.** Push button activated signals for trail users at signalized crossings should be conveniently located on the right hand side of the path facing towards the center of the path, and placed 4 feet above grade. At signalized crossings of divided streets with significant traffic volumes and/or high speeds, the installation of a push button activated signal in the median may be prudent to assist trail users in crossing the street.
4. **Curb Ramps.** Curb ramps at intersections should be at least as wide as the path, not including any tapers in the curb head. The curb ramp shall meet ADA standards, shall not exceed a slope of 1:12 or 8.3%, and shall **not** have a lip at the flowline.
5. **Sight Distance:** There are two primary components of this issue related to shared use paths:
 - Stopping sight distance. This varies depending on design speed of the path but generally is recommended to be a minimum of 73 feet to account for 85% of users.
 - Intersection sight distance. Removing physical obstructions to allow motorists to see the path in advance of the intersection increases the likelihood that the motorist will see path users.



6. **Approach Treatments.** Approaches to intersections on shared use paths should have relatively flat vertical grades. Steep downgrades should include advance warning signs (W7-5). Intersecting streets shall have their street names stenciled on the shared use path just prior to the intersection. Unpaved paths should include a minimum 10-foot long paved apron extending from the paved street surface.
7. **Obstructions.** When obstructions, such as bollards, are placed within the path to keep motor vehicles from entering the path, they require special treatment. These types of obstructions shall be reflectorized and painted a bright color such as yellow. The material used to cover the obstruction should be very durable to reduce maintenance costs. The pavement surface surrounding each obstruction should also be striped as shown in Figure 4.D. Recommended on-center spacing for bollards is 5 feet.

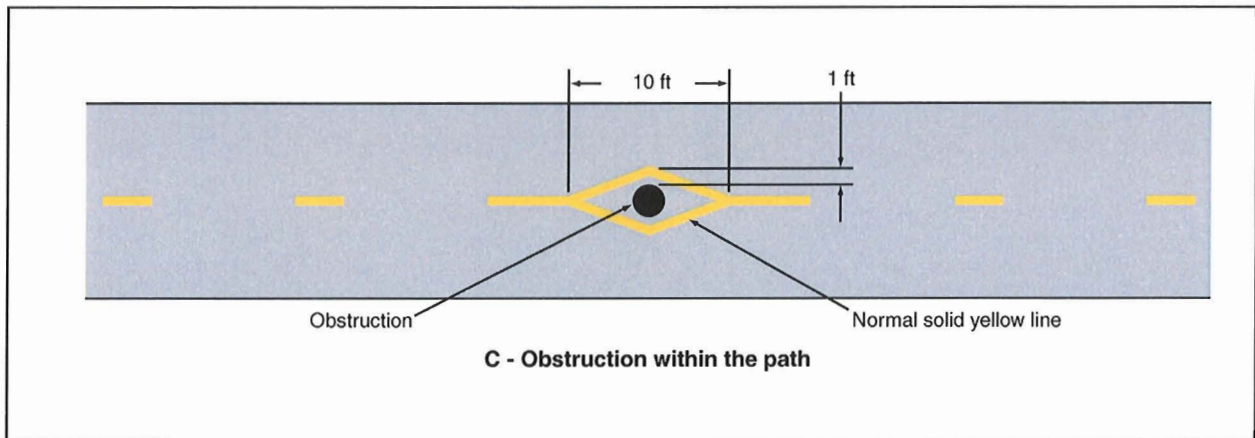


Figure 4.D – Pavement Marking Specification for Obstructions on Shared Use Paths

8. **Railroad Crossings.** All bicycle crossings of railroad tracks require special attention to ensure the safety of the cyclist. Ideally, crossings of railroad tracks should occur at right angles. Shared use path crossings of railroad tracks not at $90^\circ (\pm 5^\circ)$ shall require additional street shoulder width prior to and following the railroad tracks to give the cyclist additional room to maneuver and cross the tracks at a 90° angle without interfering with the flow of adjacent motor vehicles.

9. **Railing/Fence Heights.** In situations where a guardrail along side of the path is needed to protect path users from a hazard, the minimum height of guardrail shall be 42 inches.
10. **Lighting.** It is highly advisable that lighting be provided at all trail crossings of streets.