City of Waynesboro

BICYCLE PLAN




Adopted October 9, 2012

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Bicycle Plan

Purpose

This chapter establishes a bicycle plan with a clear, prioritized path for improving bicycle infrastructure and developing a network of bike routes that will create a safe and viable alternative transportation choice for a wide array of bicycle users. The overarching goal is to make Waynesboro the most bikeable City in the Shenandoah Valley.

Goals/Strategies

The Bicycle Plan focuses on developing an interconnected system of on-street and off-street bicycle routes that serve all of Waynesboro's neighborhoods. A special focus is placed upon creating connections between Downtown, parks, schools, and retail areas. Appendix A describes the methodology used to create the Bicycle Plan. The appendix also provides a compilation of nationally recognized best practices that will be used to design and implement the Bicycle Plan.

Goals

1. Encourage bicycle use as a safe and important part of the transportation system.
2. Provide safe and convenient bicycle access from neighborhoods to major destination areas.
3. Develop a complete bicycling network that meets the needs of different types of bicyclists.
4. Integrate bicycle planning in both public and private development activities.

Strategies

1. Develop policies and new programs to encourage more people to bike and to increase the use of bicycle as a mode of transportation.
2. Provide bike routes connecting to various destinations, such as Downtown, schools, parks, commercial centers, and major employment centers as streets are constructed or repaved.
3. Create safe biking linkages between neighborhoods and greenways/regional bike route system.
4. Improve biking safety by adding demarcated bike lanes, symbology, and by providing improvements at targeted intersections.
5. Provide bike parking facilities.

Current Status and Policies

Waynesboro's mild climate, relatively gentle topography, and beautiful scenery are conducive to bicycling. Additionally, because Waynesboro is a small city and distance between destinations is small, there is a great potential within Waynesboro to use biking to commute to work, to shopping and for recreation.

Existing Bicycle Usage

Although the City currently does not have separate bike lanes on roadways, the City has a significant number of cyclists and there is demand for such infrastructure.

- ***Biking for Recreation and Shopping***

  In the City of Waynesboro, the percentage of non-commute bicycle trips is much greater than commute trips. A large group of bicyclists ride bikes for exercise and recreation. Another group of bicyclists, especially those living in the neighborhoods bordering the Downtown, ride bicycles for errands or shopping. Finally, there is a segment of the population that is unable to afford a vehicle. They rely heavily upon the bicycle as their primary means of transportation.

A major bike supporter is the local Milepost Zero Bicycle Club. The Club sponsors on-road and off-road rides and generally promotes recreational cycling within the City of Waynesboro and its surrounding communities. Currently, the Club has 55 family memberships and a total of 115 individual members. It also hosts an annual regional riding event "Tour De Valley", which attracts 200 to 300 bicyclists to ride in the City and the Valley.

- ***Biking to Work***

  Data from 2000 U.S. Census shows that the mode split for bicycling in the City of Waynesboro is 0.4% of primary trips to work. Though still a small share of transportation, the implementation of this plan will make the routes more convenient and safe for bicyclists to ride to work. These facilities will overcome the barriers and lead to a significant increase in the number of bike commuters.

- ***Bike to School***

  Most of City students live relatively close to their neighborhood schools. Currently, about 1.5% of the total elementary and middle school students ride bicycle to school. Though not a large share of transportation mode, walking and biking to school offer a reasonable alternative to the rising cost to bus students. The schools are implementing Safe Routes to Schools (SRTS) programs designed to educate and encourage students to bike. Berkeley Glenn Elementary and Westwood Hills Elementary hold regular bike rodeos to educate students on bicycling skills and safety knowledge. In 2011, Wenonah Elementary School received a SRTS mini grant to host a bike rodeo conducting bicycling safety lessons and a bicycle helmet giveaway. These programs are also seen as a means of combating childhood obesity and reducing the cost of busing children to school.

Existing Bicycle Safety Conditions

Safety is always a concern. That said, according to 2007 to 2010 motor vehicle crash data collected from the Waynesboro Police Department, only four crashes happened in 2007, two in 2008, one in 2009, and three in 2010. None of these crashes were fatal. While this is not a large enough data set to draw any firm conclusions, bicycle safety is still an important factor considered in this plan. The bicycle routes and other infrastructure proposed in this plan have been specifically chosen because they provide for a safer riding environment for less experienced riders.

Table 4-1: Location of Bicycle-related Crashes

Location of Accidents	# of Bicycle Accidents
Broad Street	3
Main Street	2
Lyndhurst Road	2
Ivy Street	1
Market Avenue	1
Fir Street	1
Augusta Avenue	1
Meadowbrook Road	1

Current Policies and Regulations

Existing bicycle-related policies and regulations are an important element in formulating this plan. The 2001 *Greenway Plan* supports the steady development of a recreational trail system and calls for a series of multi-use paths for bicyclists and pedestrians. Several of these multi-purpose trails have already been built and more will be completed in the upcoming years. The 2005 *Central Shenandoah*

*Valley Bike Pla*n was adopted by the Central Shenandoah Planning District Commission, subsequentially adopted by Waynesboro City Council. This plan proposed a series of bicycle routes which link to potential regional routes in Augusta County and beyond. The *2008 Comprehensive Plan Land Use Guide* also recommended new bicycle routes in key areas of the City for increasing connectivity between parks, the South River, and area destinations. Next, the 2010 update to *Zoning Ordinance* required new commercial and multi-family developments to provide bicycle racks. Finally, the City's Safe Routes To School (SRTS) Travel Plans call for bicycle safety education and bicycle rodeo programs to teach safe riding habits and to promote biking.

Recommended Bike Infrastructure and Biking Programs

The Urban Design Section of the Comprehensive Plan establishes the goal of "Enhancing alternative modes of transportation, such as bicycle and pedestrian, with improved connectivity." Furthermore, it specifically establishes a strategy of "Modify[ing] standards for streets to ensure the provision of 'complete streets' in appropriate locations." Complete Streets are designed and operated to enable safe access for all users. Pedestrians, bicyclists, motorists and transit riders of all ages and abilities should be able to safely move along and across a complete street. In short, by adopting a Complete Streets policy, Waynesboro is striving to make our town a better place to live because our streets will accommodate more than just motorists' needs. This chapter serves to reinforce the Complete Streets goal by establish a specific set of bicycle routes, other bike infrastructure improvements, and biking programs that will advance the needs of bicyclist in a very targeted manner.

Proposed Bicycle Route Network and Bicycle Facilities

This plan proposes a bicycle network that is a combination of on-street biking facilities and off-street greenways and multi-use paths.

The on-street bike facilities fall into the following categories:

1. Bike Lanes. Four to five foot wide striped areas reserved only for cyclist. Implemented on busier streets where the street is wide enough to accommodate the travel lanes and on-street parking.
2. Sharrows. Lanes that are shared between motorists and cyclists, which are demarcated with a "Sharrow" symbol. Implemented on busier streets where there is insufficient room for a bike lane.
3. Paved Shoulders. Extensions of asphalt beyond the white line demarcating a vehicle travel lane. The facilities are typically used on streets without a curb and provide a relatively low cost way to create a bike facility on a narrow and/ or busy road.
4. Shared Lanes or Wide Curb Lanes: These facilities with typically lower traffic levels. Usually signage demarcating a bike route is the only infrastructure for this type of facility.

Off-street facilities include:

Greenway/Multi-use Path: These facilities are usually designed for two-way travel and accommodate a variety of nonmotorized users, including bicyclists, joggers, and pedestrians.

The map in Figure 4-1 shows the proposed system for the on-street biking facilities and off-street greenways/multi-use paths. A summary of bicycle facility types and locations is in Table 4-3. (Note: In some locations, road conditions/constraints may require deviations from what is proposed in Figure 4-1 and Table 4-3). Additionally, the methodology for selecting the bicycle network is outlined in Section 2 of Appendix A. To facilitate the implementation of bicycle accommodations, Section 4 of Appendix A provides design guidelines to assist in the implementation of this plan.

Figure 4-1

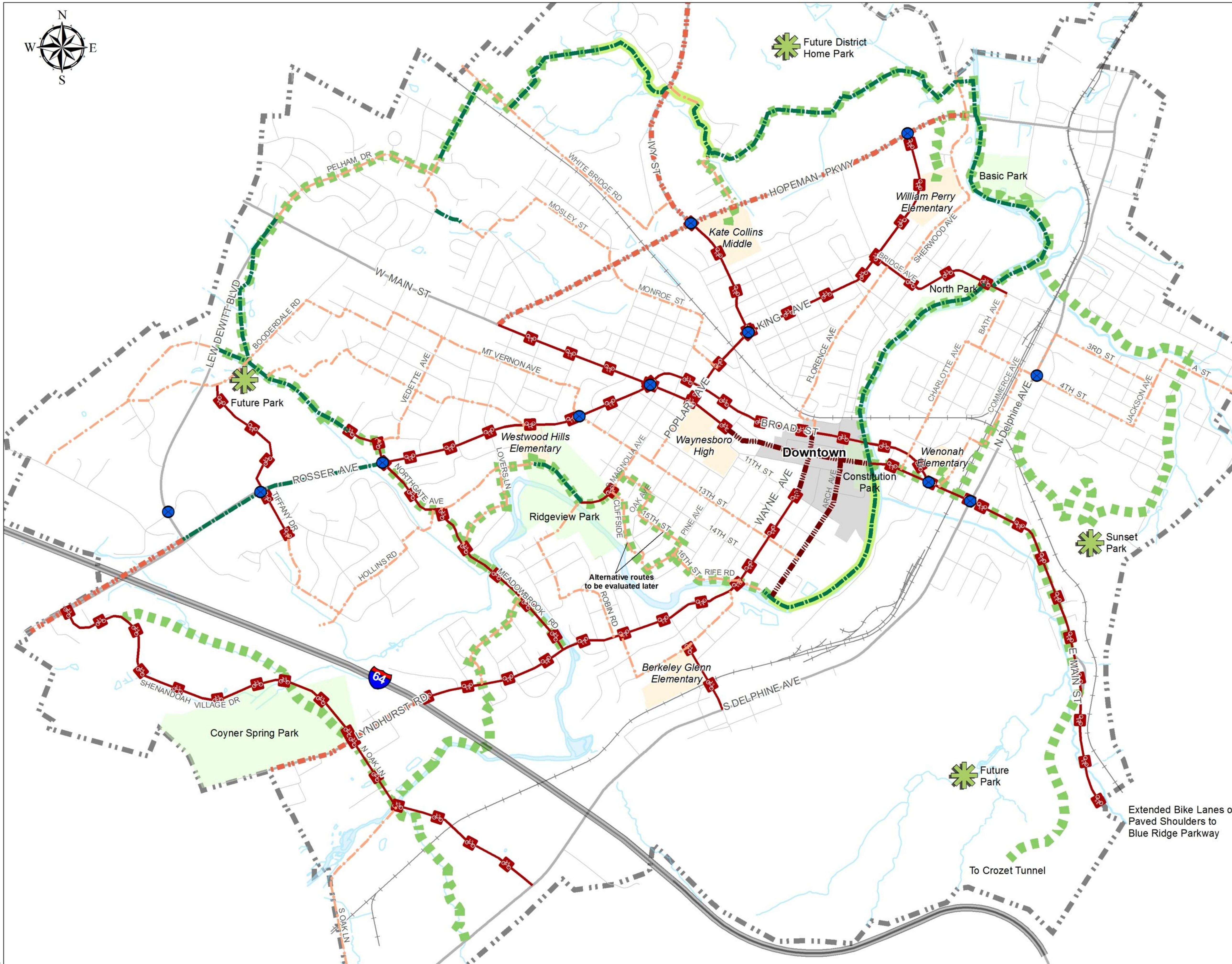
City of Waynesboro Bicycle Plan

PROPOSED BICYCLE ROUTE NETWORK

On Road Bicycle Facilities
- Bike Lane
- Sharrow
- Paved Shoulder
- Shared Lane (with Signage)

Off Road Bicycle Facilities
- Multi-use Path
- Built Greenway
- Plan Proposed Greenway

Intersection Improvements
- Intersection Improvements



- Proposed Future Parks
- Existing Parks
- Schools
- Downtown

0 0.25 0.5 1 Miles

Programs to Encourage Biking and Safety

In addition to implementing bicycle network, the other way to increase bicycle travel is through encouragement programs, educational efforts, and enforcement strategies. The following is a summary of programs that the City of Waynesboro will employ to promote bicycle travel.

Table 4-2: Proposed Programs

Type	Program	Objectives
Education	Bicycle Campaign	An annual educational program to improve the overall perception of bicycling and educate the general public about rights and responsibilities of bicyclists and motorists, especially when a new bicycle facility is added to a street or a new type of facility, such as a sharrow is first introduced. Tactics include printed brochures, maps, and online information, press release etc.
Education/ Encouragement	Safe Routes To School	Safe Routes To School program encourages walking and biking to school through parent and student education and incentives. The City has already developed a Travel Plan for all City elementary schools and the middle school. Individual schools should implement this program through their Physical Education class and actively involve parents. The primary focus is making it safer for students to bicycle and walk to school.
Encouragement	Local Bicycle route Maps	Produce a local bicycle route user map. The map can provide information to riders, such as: designated the bicycle route network, local bike stores, and bicycle parking facilities. Such map should clearly show the type of facilities as well as include basic safety information.
Encouragement	Branding and Bike Logo/Wayfinding System	Consider formally adopting an official bike logo to help City residents and visitors recognize the bicycle system. Place the logo on relevant bicycle signs, website, brochures, maps, and other promotional items distributed to the general public.
Encouragement	Employer Incentives Programs	In addition to physical amenities such as quality long-term bicycle parking and shower/locker facilities, government agencies or employers can provide several policy incentives, such as discount at bike shops, subsidized bike repair, special bicycling events, friendly competition, and cash incentives in order to increase bicycle ridership.
Encouragement	Bike Race and Competition	In cooperation with local and regional bike clubs and non-profit organizations, the City should support and encourage bike fairs or races to be held in the City. Events such as Bike Virginia, and Tour De Valley, can raise the profile of bicycling and increase tourism.
Encouragement	Bike-to-Work and Bike-to-School Day	Institute an annual program encouraging residents and students to bike to work and schools on a particular day.
Enforcement	Targeted Enforcement	Develop a program target increased safety in particularly dangerous intersections or stretches of roads. Intense enforcement of speeding and stop signs can positively affect driver behavior.

Implementation

Prioritizing Sections of the Bike Network for Implementation

Funding for bike facilities, even in the best of fiscal times, can be difficult to obtain. To ensure that the City builds the most critical sections of the on-street bike route network first; the Bicycle Plan prioritizes which sections of the network should be implemented first. These on-street facilities are grouped into a higher "Tier A" and a lower priority "Tier B" group (as shown in Figure 4-2). As new subdivisions or commercial projects are proposed or as the City repaves its streets, any of the projects in Tiers A or B should be built. However, when deciding on which projects to spend public moneys upon, Tier A projects should be considered first.

The two primary factors influencing whether a bike facility is a high priority or Tier A project are: if a bike route links to Downtown or if the project links to the regionally planned bike network. Tier B projects constitute the remainder of the bike network system. (Note: unlike the sidewalk plan, cost of construction/ implementation is not included as a factor in prioritizing the routes because the cost to implement bike facilities is significantly lower than the cost to build sidewalks.)

Funding Sources

Funding that can be used for bicycle projects, programs and plans come from all levels of government.

Local funding sources include General Revenue Funds or VDOT Urban Maintenance Funds. It is recommended that the City Council adopt a Bike/Pedestrian CIP and each year dedicate 2-5% of Urban Maintenance Funds towards new bike route striping, delineation, construction and existing facility maintenance.

Potential sources of State and Federal funding that may be used to target specific projects in Waynesboro include Safe Routes To School (SRTS), Transportation Enhancement Program (TE Program), Highway Construction Program, Recreational Access Program, Scenic Byways Program, Bicycle and Pedestrian Safety Program, local fundraising, and Virginia Recreational Trails Fund Program.

Future Bicycle Route Network Maintenance

After installation, bicycle facilities required regular maintenance and repair. On-street bicycle routes will be maintained as part of the normal roadway maintenance program. Emphasis should be placed on keeping bike lanes and roadway shoulders clear of debris, keeping vegetation from blocking visibility, and maintaining the bicycle route signage system.

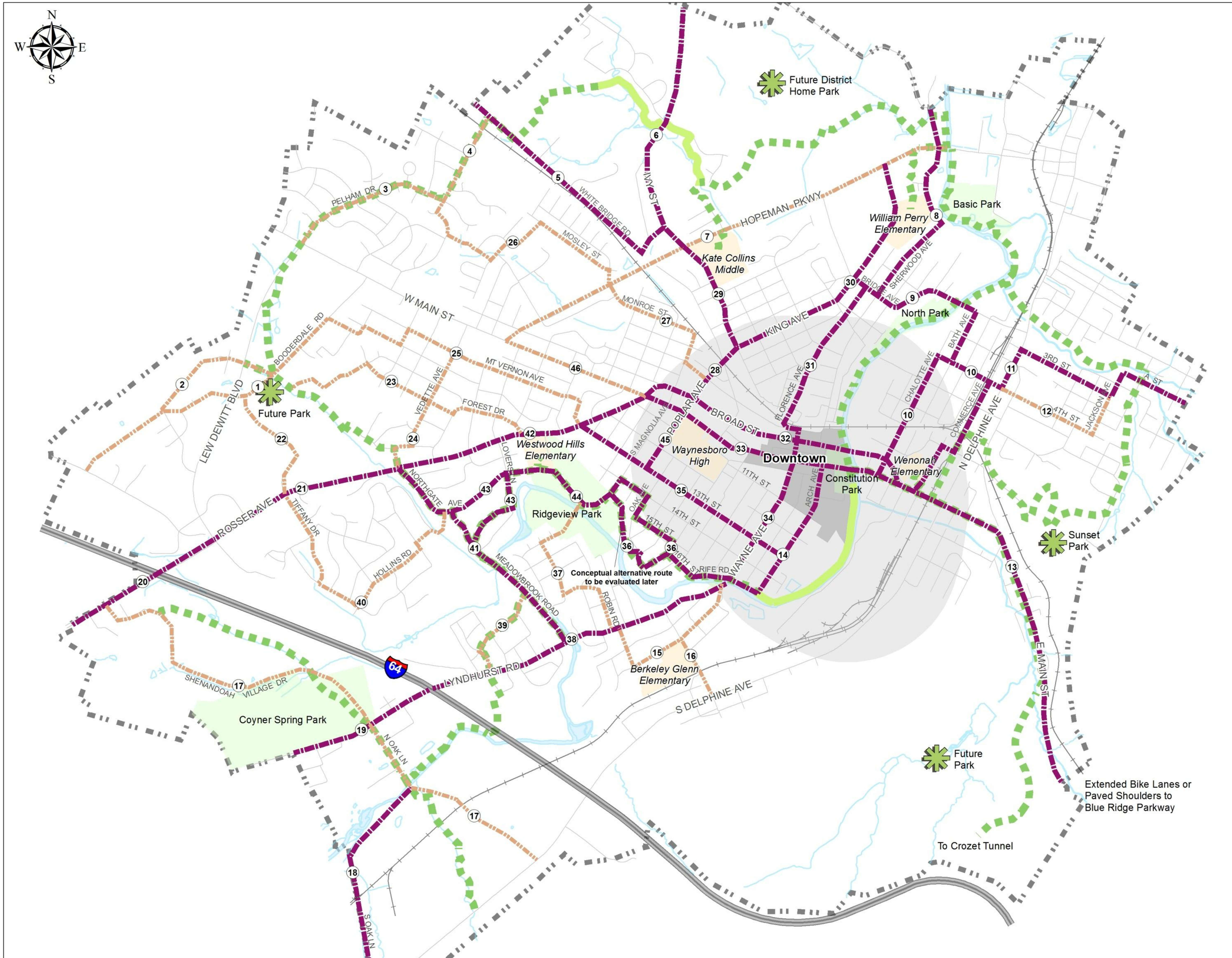
Table 4-3: Bicycle Facility Project List

Tier	Bicycle Facility Project	Bicycle Facility Type	Map Ref. #
A	13th Street/Poplar Avenue - Rosser Avenue to Arch Avenue	Shared Lane w/ Signage	35
	16th/Rife Road - S Wayne Avenue to Ridgeview Park	Shared Lane w/ Signage	36
	2nd Street/Bridge - King Avenue to Bath Avenue*	Bike Lane	9
	Arch Avenue - East Main Street to Arch Avenue	Sharrow	14
	Bayard Street/Commerce Avenue/Delphine Avenue/Jackson Avenue/A Street - N Delphine Avenue to City Limit	Shared Lane w/ Signage	11
	Broad Street - East Main Street to West Main Street	Bike Lane	31
	Charlotte/4th/Bath Avenue - East Main Street to 2nd Street	Shared Lane w/ Signage	10
	East Main Street - South River to City Limit	Bike Lane	13
	Greenway Circle/Northgate Avenue - Lovers Lane to Meadowbrook	Shared Lane w/ Signage	43
	Ivy Street - Hopeman Parkway to City Limit	Paved Shoulder	6
	Ivy Street - Poplar Avenue to Hopeman Parkway	Bike Lane	29
	King Avenue - Poplar Avenue to Hopeman Parkway	Bike Lane	30
	Lyndhurst Road - I-64 to City Limit	Shared Lane w/ Signage	19
	Lyndhurst Road - Wayne Avenue to I-64	Bike Lane	38
	Meadowbrook Road/Northgate - Rosser Avenue to Lyndhurst Road*	Bike Lane	41
	North Wayne Avenue/Florence Avenue - West Main Street to Bridge Avenue	Shared Lane w/ Signage	31
	Poplar Avenue - 13th Street to West Main Street	Shared Lane w/ Signage	45
	Poplar Avenue - West Main Street to Ivy Street	Bike Lane	28
	Ridgeview Park - Westwood Hills Elementary to Woodland Shelter*	Multi-use Path	44
	Rosser Avenue - Northgate Avenue to Windigrove Drive*	Multi-use Path	21
	Rosser Avenue - West Main Street to Norghgate Avenue	Bike Lane	42
	Rosser Avenue - Windigrove Drive to City Limit	Paved Shoulder	20
	South Oak Lane - North Oak Lane to South Delphine Avenue	Shared Lane w/ Signage	18
	South Wayne Avenue - West Main Street to Lyndhurst Road	Bike Lane/Sharrow	34
	Sherwood Avenue - Bridge Avenue to City Limit	Shared Lane w/ Signage	8
	West Main Street - South River to West Broad Street	Bike Lane/Sharrow	33
	Whitebridge Road and Guilford Lane - Ivy Street to City Limit	Shared Lane w/ Signage	5
B	4th Street/Jackson Avenue - Delphine Avenue to A Street	Shared Lane w/ Signage	12
	Bookerdale Road and extension - Fireglow Avenue to Laurel Wood Run	Shared Lane w/ Signage	1
	Brunswick Road/Crofton Avenue - Meadowbrook Road to Lyndhurst	Shared Lane w/ Signage	39
	Davis/Vedette - Northgate Avenue to West Main Street	Shared Lane w/ Signage	24
	Forest Drive/Belvue Road and extension - Rosser Avenue to the xx	Shared Lane w/ Signage	23
	Hollins Road - Rosser Avenue to Meadowbrook Road	Shared Lane w/ Signage	40
	Hopeman Parkway - West Main Street to Sherwood Avenue	Paved Shoulder	7
	Jefferson Avenue - Binford Road to Lyndhurst Road	Shared Lane w/ Signage	15
	Monroe Street/North Magnolia Avenue/Ohio Street - Hopeman Parkway to Poplar Avenue	Shared Lane w/ Signage	27
	Mosley Street/Winding Way/Haley Drive extension - Hopeman Parkway to Village Drive	Shared Lane w/ Signage	26
	Mt Vernon Street - Rosser Avenue to Bookerdale Road	Shared Lane w/ Signage	25
	Pelham Drive - West Main Street to Pelham Knolls	Shared Lane w/ Signage	3
	Pelham Knolls Drive extension - Pelham Knolls Drive to Whitebridge Road (off-road)	Multi-use Path	4
	Robin Road/Lynn Lane/Brookwood Lane - Lyndhurst Road to Ridgeview Park	Shared Lane w/ Signage	37
	Shenandoah Village Drive extension - Rosser Avenue to Lyndhurst Road (future road)	Bike Lane	17
	Sheppard Court and Extension - Bookerdale Road to Red Top Orchard Road	Shared Lane w/ Signage	2
	Tiffany Drive - Hollins Road to proposed greenway (future road extension/off-road)	Bike Lane	22
	West Main Street - West Broad Street to Hopeman Parkway	Bike Lane	46
	Windsor Road - Jefferson Avenue to South Delphine Avenue	Bike Lane	16

* Exceptions are given to projects that are away from Downtown and disconnected to the regional routes

Note: Map Reference # is listed as a reference tool and should not be considered as a ranking or prioritization of the bicycle route project

Figure 4-2
City of Waynesboro Bicycle Plan
IMPLEMENTATION



Tier A Projects	
Tier B Projects	
Built Greenway	
Plan Proposed Greenway	
①	Map Reference Number (As found in Table 4-3)

0 0.25 0.5 1 Miles

APPENDIX A: Retrofitting Bicycle Facilities in the City of Waynesboro, VA

A-1.0 Purpose

This appendix establishes guidelines for bicycle route selection and the design standards for bicycle facilities. These guidelines are a detailed resource for both the private and public sectors when there is a need to designate a street or design a bicycle facility.

The following are key principles for these guidelines:

1. ***Complete Network*** - The City of Waynesboro will have a network that is a combination of on-street bicycling facilities and greenway trails. These two systems will be interconnected to make it possible for all destinations in Waynesboro to be accessible by bicycle.
2. ***Availability*** – While it is legal for a bicyclist to use any road in Waynesboro except Interstate 64, it is not advisable for lower skill-level cyclists to use all roads within the City. Therefore, it is important to provide facilities that reach into all neighborhoods within the City in order to provide as much access to the widest number of citizens as possible.
3. ***Design Flexibility*** - Design guidelines are intended to be flexible and can be applied, with professional judgment, by designers according to field conditions. Specific national and VDOT guidelines are identified in this Appendix, as well as design treatments that may exceed these guidelines.
4. ***Conformity*** - Where a facility is intended to be designated as a "bicycle facility," it is essential the design conform to the guidelines in this document or the AASHTO Guide to the Development of Bicycle Facilities 1999 (or any later revisions/versions) Guidelines .

A-2.0 Factors in Designing a Bicycle Route Network

The identification of a bicycle route network is a significant element of the City's Bicycle Plan. The bicycle route network proposed in Figure 4-1 seeks to integrate different types of bike facilities in a safe, convenient system that meets a widest array of users. In addition to using local knowledge, engineering judgment, and inputs from local bicyclists, the following factors are important to consider during development of the proposed network:

1. Different types of bicyclists;
2. Connectivity;
3. Bicycle level of service (BLOS);
4. The proposed regional bike system; and,
5. Alternative routes through neighborhoods.

Different Types of Bicyclists

Bicyclists are not a homogeneous group. They have a wide range of skills and perceptions of safety and risk depending on their experience in city traffic and their overall health. In addition, not all bicyclists travel for the same reasons or during the same time of a day or with the same frequency. Thus, the routes and facilities must be selected in a way that addresses these differences. Bicyclists generally fall into three categories, as described below:

Type A: Advanced Bicyclists (Experienced Bicyclists)
This group is comfortable in most traffic situations, even riding on arterial streets with high traffic volumes. Where Type A cyclists travel frequently on busy arterial streets, bike lanes or sharrows should be used to increase safety and to alert motorists to potential presence of bicyclists.

Type B: Intermediate Bicyclists (Average Bicyclists)
This group includes adolescents and adults who are not experienced cyclists. This group represents the largest number of potential cyclists within Waynesboro. These riders have basic bicycle skills, but lack experience and skill necessary to ride in city traffic. These riders desire greater protection from vehicular traffic than Type A cyclist. Type B bicyclists benefit from bicycle facilities along demarcated bike lanes on arterial streets, on lower traffic volume street, or completely separated greenway trails.

Type C: Beginner Bicyclists (Inexperienced Bicyclists)
These riders are mostly child bicyclists, but also include adult riders with little to no bicycle skills. Child bicyclists' unpredictable behavior, limited bicycle skills, and lack of awareness of the danger surrounding cause them require substantial protection from motor vehicles and often can ride only with adult supervision. Usually, this group is typically confined to neighborhood streets, parks and greenway trails.

Because Type A rides will ride almost anywhere regardless of whether there is a bike facility or not and because Type C riders are primarily restricted to parks and greenways, the majority of the propose bike network is geared towards meeting the needs of the Type B rider. It is also expected that an increase in bike facilities will see a corresponding increase in Type B cyclists and thus returning the highest benefit for the limited funds available.

Connectivity

The proposed system provides connections between residential areas, schools, parks, public facilities, shopping centers, and employment centers. The Bicycle Plan has identified the major destinations within the City and uses the bike routes to link these destinations. A major emphasis has been place on creating connections to Downtown because it is centrally located and is well suited to attract bicyclist.

Bicycle Level of Service Model

The Bicycle Level of Service Model (BLOS) Model evaluates a bicyclist's perceived safety and comfort with respect to motor vehicle traffic while traveling in a roadway corridor. The model establishes a bicycling suitability or compatibility index based upon factors such as roadway width; bike lane widths and striping combination; traffic volume; pavement surface condition; motor vehicle speed and type, and the presence of on-street parking. The Bicycle Plan used Annual Average Daily Traffic (AADT) data and motor vehicle type count data (4-tire, bus, axle-truck, trail-truck) from VDOT. Road width, pavement condition, speed limit and on-street parking data were collected from GIS aerial maps and the City's Engineering Department. Figure A-1 shows five levels of biking suitability ranging from A (most suitable) to E (least suitable). This map shows that collector streets with lower traffic volume and wider pavement width, or arterials with lower speed limit and on-street parking, have a higher biking suitability. As a general rule, the Bicycle Plan seeks to avoid bike routes on the "less" and "least suitable" streets, especially routes targeted towards Type B cyclists.

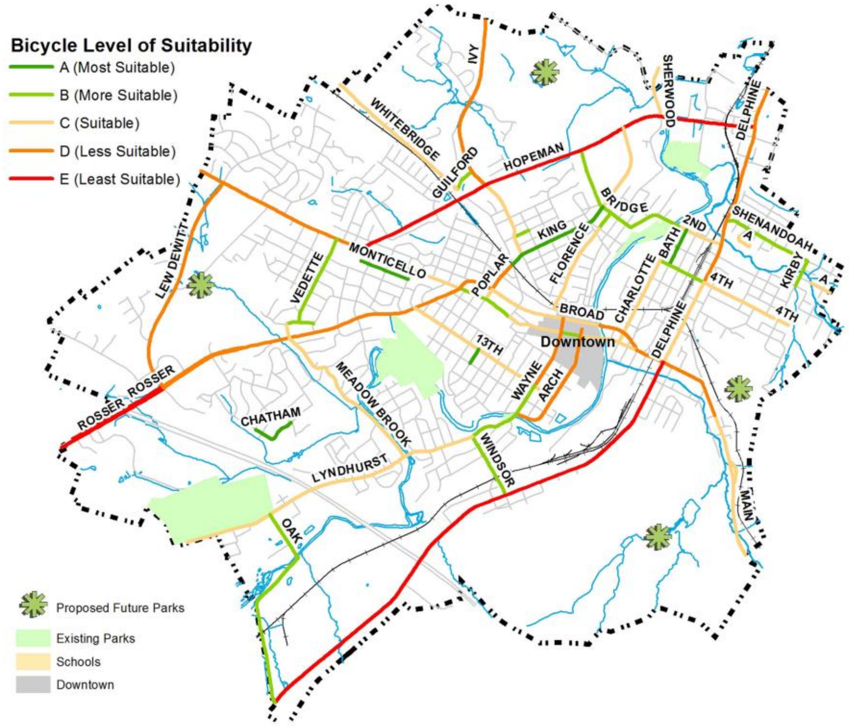


Figure A-1: Bicycle Road Suitability Assessment

Regional Significance

According to the Bicycle User Survey conducted in August 2011, a large group of City cyclists enjoy access to regional bicycle routes and to use them for long, uninterrupted rides. In 2005, the Central Shenandoah Planning District Commission developed a region-wide bike plan in order to encourage bicycling in the Shenandoah Valley. Within Waynesboro, this regional plan proposed bicycle routes on primary arterials and collectors. (Figure A-2). Where feasible, the City's Bicycle Plan seeks to make connections from destinations within the City to these regionally planned bike routes.

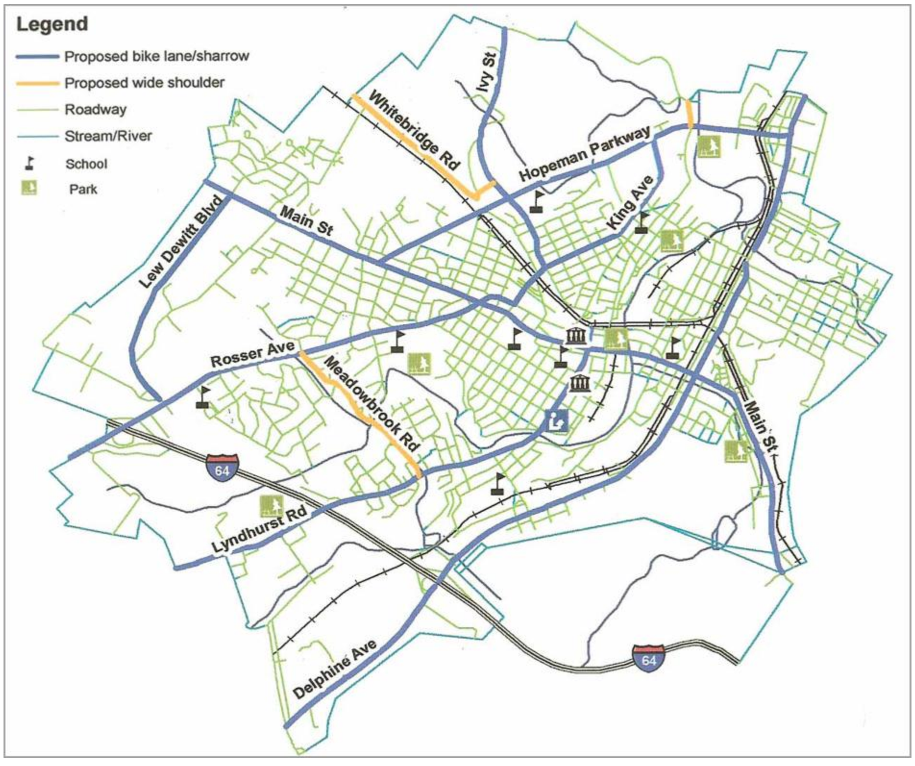


Figure A-2: 2005 Central Shenandoah Valley Proposed Bicycle Route Network

Alternative Routes through Neighborhoods

Finally, because the Bicycle Plan (A) is geared towards Type B riders, (B) it tends to avoid the less suitable/ higher traffic volumes, and (C) it seeks to connect residents to shopping, park, school and Downtown destination, the City's Bicycle Plan, unlike the Planning District's plan, seeks to find routes within neighborhoods which run parallel to the major arterial streets.

A-3.0 Selecting a Specific Type of Bike Facility

To determine the appropriate bicycle facility options, several factors associated with the specific route or project must be assessed:

- What are the current and anticipated traffic operations and design characteristics of the route?
- Is the project new construction, reconstruction, or retrofit?
- What types of bicyclist is the facility intended to serve?

A-3.1. Design Options to be Considered in Selecting the Appropriate Treatment

Safely accommodating bicyclists on urban roadways may require efficient use of space within existing rights-of-way. There are a number of ways to more efficiently use rights-of-way space in order to safely accommodate bicyclists (and pedestrians). The best options depend on the operating characteristics of the road space, the context of the urban area, and the most appropriate bikeway treatment. These options also apply when considering a separated greenway/ multi-use trail in an urban area.

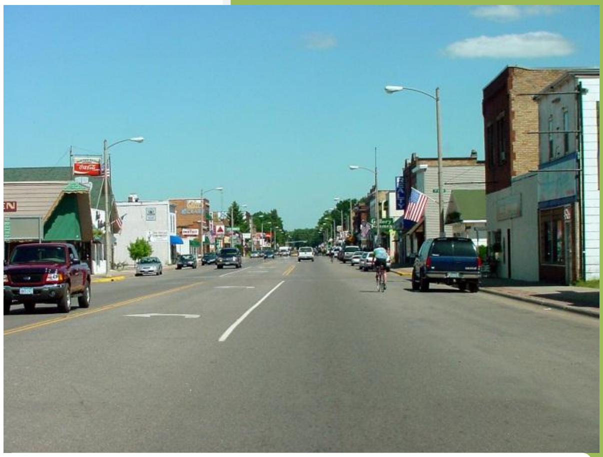


Figure A-3: Typical Urban Road

Options for efficiently accommodating bikeway treatments such as bike lanes may include the following: changing travel lane widths, changing the number of travel lanes, removing obstructions, changing parking amounts or arrangements and traffic calming.

1. **Changing travel lane widths.** In speed zones of 25 mph, travel lane widths of 10 ft are be acceptable. In zones of 30 - 40 mph, 10.5 ft travel lanes and 12 ft center turn lanes are be acceptable. In zones of 45 mph or greater, 12 ft outside travel lanes and 14 ft center turn lanes are desirable.
2. **Changing the number of travel lanes.** On streets with four travel lanes and a significant number of left-turn movements, re-striping for a center turn lane, two travel lanes and two bike or wide curb lanes may actually improve traffic flow.
3. **Removing obstructions.** Paved or landscaped traffic islands often reduce available roadway space. If not needed for access control, traffic calming, or as refuges, raised islands may be eliminated, narrowed or replaced with pavement markings, which may add increased useable width. Relocating utility poles and light standards, signs, guardrails and other obstructions away from the edge of the roadway may also increase useable width.

4. **Changing parking amounts or arrangements.** Removing parking does not always improve safety and, in some locations, it may actually decrease safety. Careful study is needed before making changes regarding parking. This may include counting the number of businesses/residences, the availability of both on- and off-street parking and counting the average use of this parking.

5. **Traffic calming the street and considering the above alternatives.** On streets with restricted space and appropriate traffic operation factors, traffic calming techniques by themselves or combined with other alternatives may be the most effective option to safely accommodate bicyclists and pedestrians. Traffic calming also has the benefit of increasing overall traffic safety and improving the quality of the street environment.

A-3.2. New Construction, Reconstruction and Retrofitting

The recommended design treatments described in Tables A-1.0 A and B are most easily implemented when new construction or reconstruction is at the early planning stages.

When implementation involves retrofitting an existing roadway to accommodate bicycle use, the project can be more complex. Existing curb and gutter streets will often be viewed as having a fixed width and improvements will likely be limited to narrowing existing travel and parking lanes. Guidelines for acceptable lane minimum widths are discussed in Section A-3.1.

When working with existing streets and highways, planners should investigate making at least minor or marginal improvements. However, where the need is to serve Type B cyclists, it is essential to commit the resources necessary to provide facilities that meet the recommended design treatments. Only then can routes and facilities be designated for bicyclists and provide the desired access to the community.

A-3.3. What Types of Bicyclists is the Facility Most Likely to Serve?

Because use by Type B cyclists is likely and is encouraged, design treatments for Type B should be used. The Type B design treatments will also accommodate Type A cyclists. Where a planning process has determined a given route, the best choice is to form part of a bikeway network and the recommended design treatment appropriate to Type B should be implemented.

A-3.4. Traffic Operations and Design Factors Used In Determining the Appropriate Design Treatment

Five traffic operation and design factors are used to define the recommendations contained in Tables A-1.0 A and B. Each of these factors is discussed below along with the ranges of values used to differentiate levels of need. The tables should be used as a "guide" and adjustments be considered to reflect, for instance, different values for the ranges for ADT.

The five major factors are as follows:

Traffic Volume

The higher the traffic volume, the more important it becomes to provide bicyclists a dedicated bicycle lane. Higher motor vehicle traffic volumes represent greater potential risk for bicyclists and the more frequent overtaking situations are less comfortable for Type B cyclists unless special design treatments are provided.

Roadway Design Speed

The higher the design speed, the more important it becomes to provide bicyclists a dedicated bicycle lane. Design speed is more important than the posted speed limit and better reflects local conditions. Motor vehicle speed has a negative impact on risk and comfort unless mitigated by design treatments.

Traffic Mix

The regular presence of trucks, buses, and/or recreation vehicles (i.e., at approximately 25 mph or more) may increase risk and have a negative impact on comfort for bicyclists unless special design treatments are provided. The higher the percentage of these types of vehicles, the more important it becomes to provide a dedicated bicycle lane.

Figure A-4: Mixing of Bicycle and Vehicular Traffic

On-Street Parking

The presence of on-street parking increases the width needed in the adjacent travel lane. The extra width is by bicyclists to maneuver around car doors opened in their travel path. This is primarily a concern associated with streets and highways built using urban design standards.

Sight Distance

"Inadequate sight distance" relates to situations where bicycles are being overtaken by motor vehicles and/or where the sight distance is likely less than that needed for a motor vehicle operator to either change lane positions or slow to the bicyclist's speed. This problem is associated with rural highways, and urban streets having sight distance problems due to design issues and/or visual obstructions.

The most effective response to the problem is to correct it. Viable approaches are providing for bicycle operation to the right of the designated motor vehicle lane (i.e., on a bicycle lane or shoulder) or, at speeds greater than 30 mph, by adding extra delineated width to a wide outside lane.

A-3.5. Using the Tables to Determine the Recommended Option

Recommended roadway design options and widths to accommodate Type B cyclists are presented in Tables A-1.0 A and B. There are separate tables for the two basic types of roadway sections: urban (with curb and gutter) and rural (without curb and gutter).

Table A-1.0 A
Roadway Design Options for Average Bicyclist, Urban Road Cross Section

Motor Vehicle ADT (2 Lane)		<500	500-1,000	1,000-2,000	2,000-5,000	5,000-10,000	>10,000
Motor Vehicle ADT (4 Lane)		N/A	N/A	2,000-4,000	4,000-10,000	10,000-20,000	>20,000
Posted Speed	<=30 mph	SL	SL	WCL	BL	BL	BL
	30 mph	SL with signage	WCL	BL	BL	BL	BL
	35-40 mph	WCL	BL	BL	BL	BL	BL
	>40 mph	BL	BL	BL	BL	BL	BL or SUP

Table A-1.0 B
Roadway Design Options for Average Bicyclist, Rural Road Cross Section

Motor Vehicle ADT / LANE		<1000*	1,000-2,500	2,500 – 5,000	5,000 – 10,000	>10,000
Posted Speed	<=30 mph	PS = 4 ft	PS = 4 ft	PS = 4 ft	PS = 4 ft	PS = 6 ft
	30-35 mph	PS = 4 ft	PS = 6 ft	PS = 6 ft	PS = 6 ft	PS = 8 ft
	35-45 mph	PS = 6 ft	PS = 6 ft	PS = 6 ft	PS = 8 ft	PS = 10 ft and/or SUP
	>45 mph	PS = 6 ft	PS = 6 ft	PS = 8 ft	PS = 10 ft	PS = 10 ft and/or SUP

*When ADT is less than 500, shoulders are not a necessity unless the roadway is heavily used by truck or heavy commercial vehicles in these situations bikes should be accommodated with a wide curb lane or shared lane.

The tables indicate the recommended design option given various sets of traffic operations and design factors. The recommended dimensions should be considered as "desirable widths". Any option specifically designated for bicycle use should desirably meet the design guidelines presented here or at a minimum the guidelines in the AASHTO Guide for the Development of Bicycle Facilities 1999 (or any later revisions/versions) Guidelines.

SL = SHARED LANE: Any roadway upon which a bicycle lane is not designated and which may be legally used by bicycles whether or not such facility is specifically designated as a bikeway. Travel lanes are typically less than 12 ft.

WCL = WIDE CURB LANE OR WIDE OUTSIDE LANE: The right-most through traffic lanes that are wider than 12 ft.

PS = PAVED SHOULDER: "Shoulder" means that part of a highway which is contiguous to the regularly traveled portion of the highway and is on the same level as the highway, but is to the right of the vehicular travel lane.

BL = BICYCLE LANE (BIKE LANE): “Bicycle Lane" means a portion of a roadway or shoulder designed for exclusive or preferential use by bicyclist. Bicycle lanes are to be distinguished from the portion of the roadway or shoulder by striping, marking, or other similar device.

SUP = SHARED-USE PATH (MULTI-USE or GREENWAY TRAIL) Refers to a bikeway that is physically separated by a roadway or shoulder by the use of an open space buffer or physical barrier. A shared-use path can also be used by a variety of non-motorized users such as pedestrians, joggers, skaters and wheelchair users.

A-4.0 Bicycle Facility Design Standards

For the purpose of this manual, on-road facility designs have been subdivided into three categories: streets, intersection design, and additional design considerations. Design of bikeways for each of these facility types is described below.

A-4.1. Bikeway Facility Design for Streets

Six(6) types of bikeway facilities are used to accommodate bicycle traffic on streets:

1. Bicycle Lanes
2. Paved Shoulders
3. Wide Curb Lane
4. Shared Lanes
5. Shared Lane Markings (Sharrows)
6. Jersey Barrier Protected Shoulders

A-4.1.1.Bicycle Lanes

Bicycle lanes are a section of the roadway designated by striping, signing and pavement markings for the preferential or exclusive use of bicycles. Bicycle lanes are one-way facilities carrying bicycle traffic in the same direction as adjacent motor vehicle traffic.

Bicycle lanes shall be used on arterials and major collector roadways with average motor vehicle speeds greater than 30 mph, and when average daily traffic exceeds 10,000 ADT. The traffic mix may include a significant number of heavy trucks and or buses. Research indicates that bicycle lanes have a strong channelizing effect on motor vehicles and bicycles. Bicycle lane stripes can increase bicyclists' confidence that motorists will not stray into their path of travel if they remain in the bicycle lane. Bicycle lanes offer a designated and visible space for bicyclists and can be a significant factor in route choice, especially for Type B cyclists.

Bicycle lanes may be added onto existing streets with enough paving width. Bicycle lanes may also be implemented by narrowing or eliminating travel, turning or parking lanes. Figure A-5 illustrates recommended bike lane widths for various roadway conditions.

Figure A-5: Typical Roadways with Bike Lanes

A-4.1.1.A   Bicycle Lanes with Standard Gutter Pan

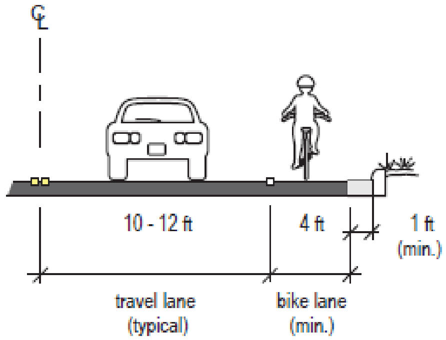
The joint between the gutter pan (the curb and gutter) and roadway surface can be hazardous to a -bicyclists. Where a standard gutter pan is present, the minimum bicycle lane width should be 5 ft; a minimum of 3 ft (desirable width of 4 ft) should lay to the left of the gutter pan seam.

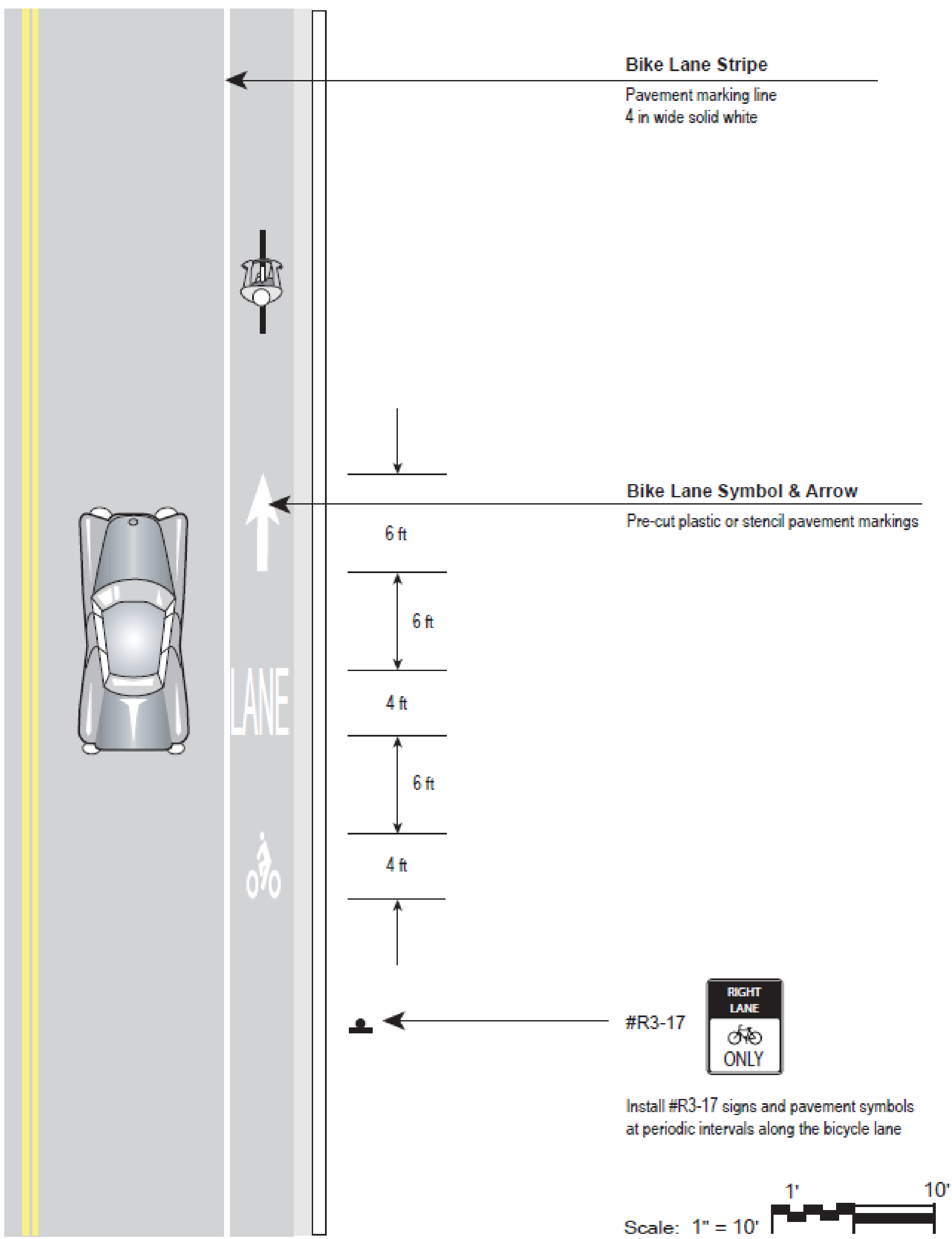
When average daily traffic volumes exceed 10,000 ADT or when average motor vehicle speeds exceed 30 mph, 6 ft or more bicycle lanes are recommended.

Figure A-6: Bicycle Lane on a Roadway with Curb and Gutter

Figure A-7:

BICYCLE LANE WITH STANDARD GUTTER PAN





A-4.1.1.B Bicycle Lanes with Curbs but no Gutter Pan

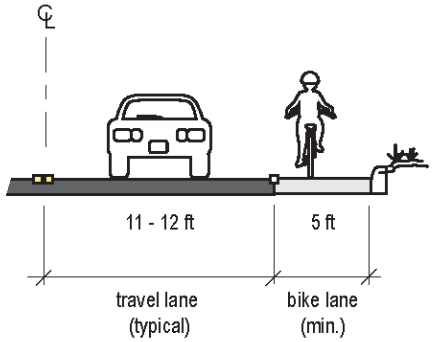
Minimum width for a bicycle lane not adjacent to on-street parking for a curbed section is 4 ft provided that no gutter joint exists. If the joint is not smooth, a minimum 4 ft of rideable surface should be provided. In locations where there is substantial truck traffic a width of 5 ft or more is preferred.

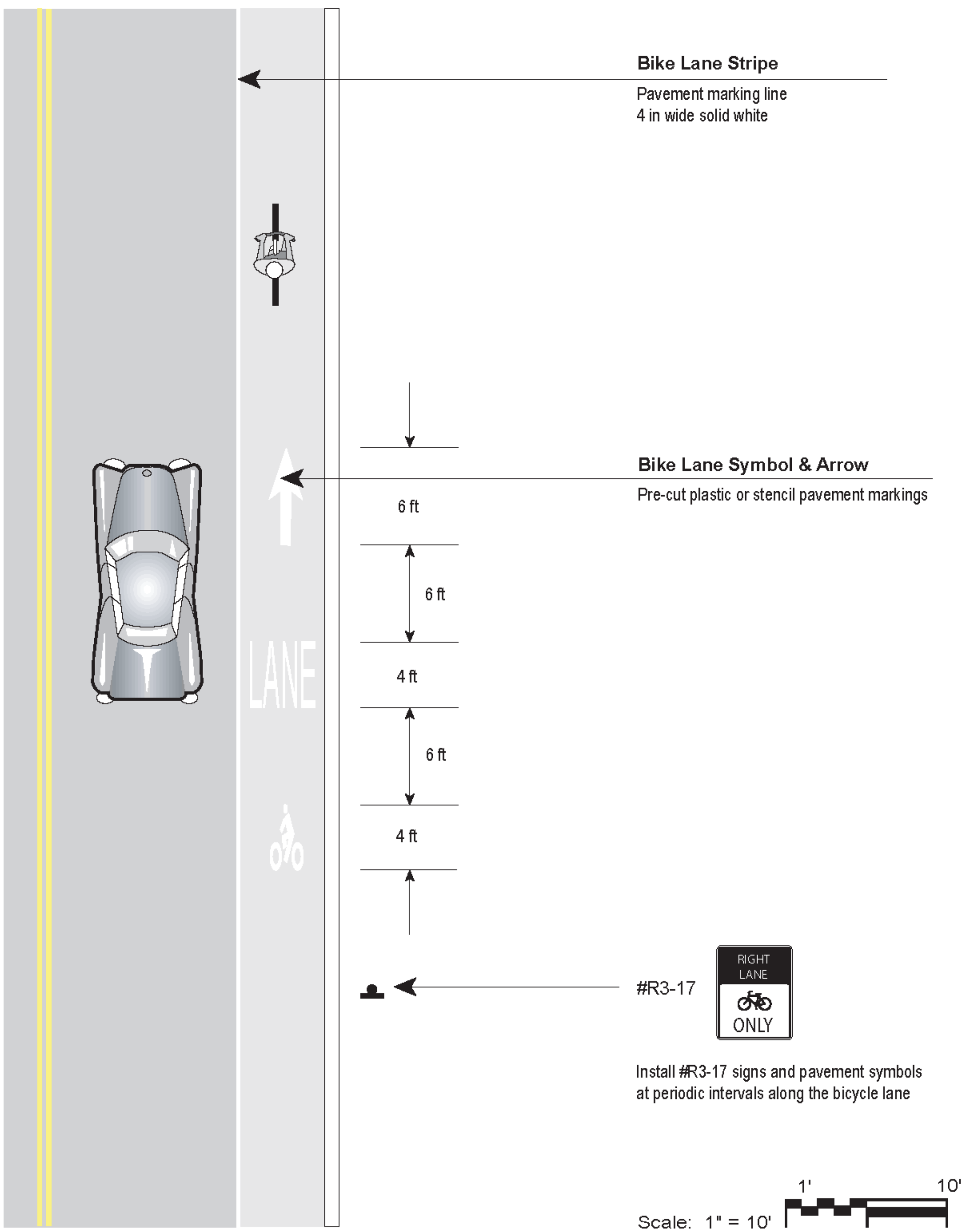
Bicycle lanes on roadways with no gutter pan seams are illustrated in Figure A-9.

Figure A-8: Bicycle Lane on a Roadway with Curb but no Gutter

Figure A-9:

BICYCLE LANE WITH NO GUTTER PAN





A-4.1.1.C Bicycle Lane with On-Street Parking

Parking movements and car door openings have the potential to cause crashes. Bicycle lanes should be designed to minimize these conflicts. On streets with parking lanes, bicycle lanes should be at least 5 ft wide and placed between the motor vehicle lane and the parking lane. Where space is available, bicycle lanes wider than 6 ft are preferred adjacent to parallel parking to provide increased clearance from opening car doors. When provided adjacent to parallel parking, both sides of the bicycle lane should be marked.

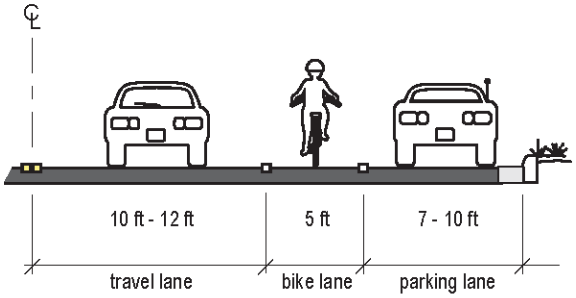
Decisions to designate bicycle lanes adjacent to angled parking should be accompanied by a full engineering review. In these cases, current practice recommends parking spaces should be a “back in” configuration in order to increase the visibility of bicyclists to motorists. Width of the parking lane is dependent upon parking angle.

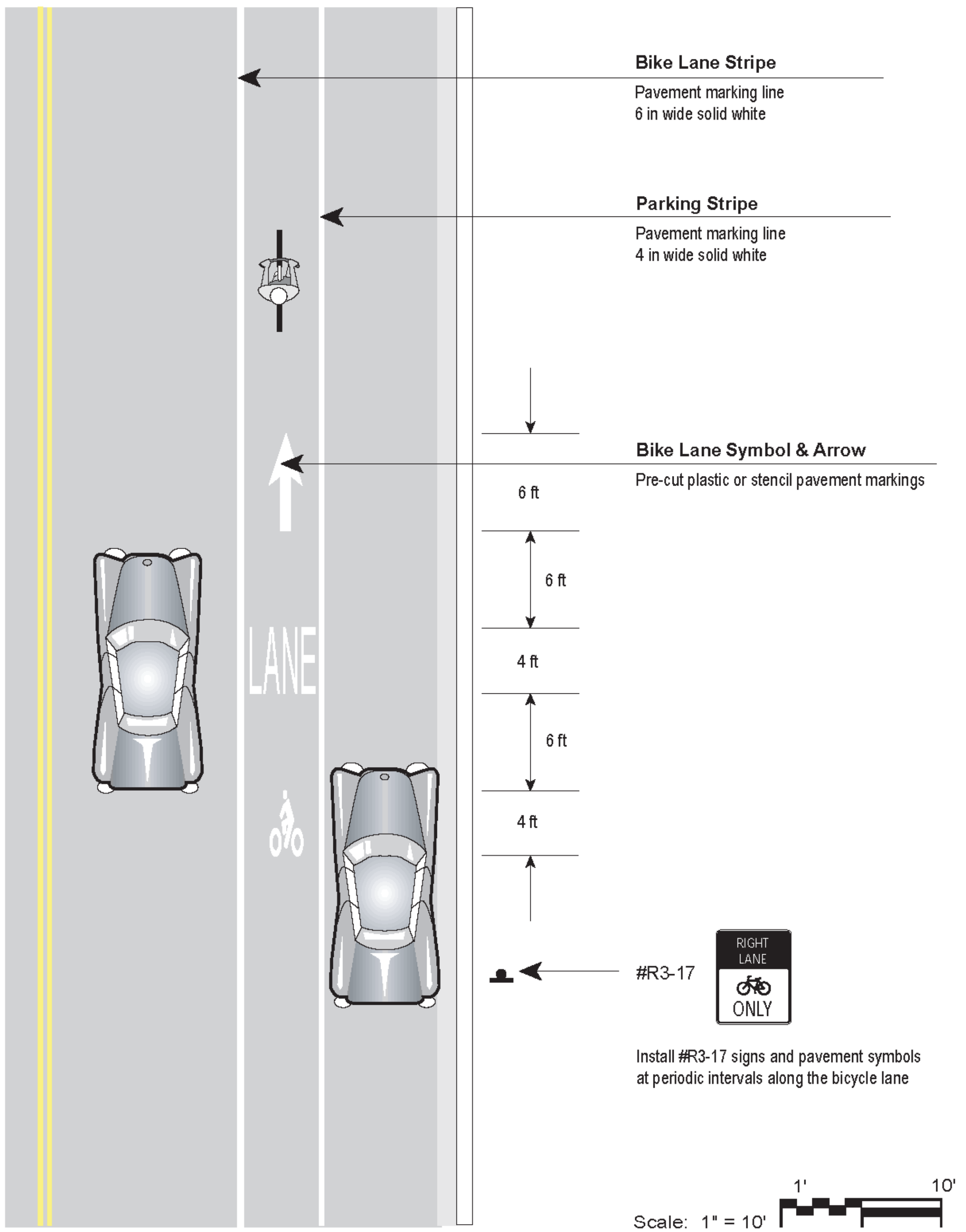
The design of bicycle lanes on roadways with on-street parking allowed is pictured in Figure A-10 and illustrated in Figure A-11.

Figure A-10: Bicycle Lane with On-Street Parking

Figure A-11:

BICYCLE LANE WITH ON-STREET PARKING





A-4.1.1.C.1 Constrained Bicycle Lane with Parking "A" (24’ Pavement)

To designate a bicycle lane on a constrained-width roadway can pose a design challenge. A portion of the roadway is designated for bicycle usage by striping, signing and pavement markings for preferential bicycle use. The designer shall reduce the width of the travel and parking lanes as described below. Bicycle lanes shall be well marked.

This type of constrained condition may also apply on city streets when street parking is limited on one side only.

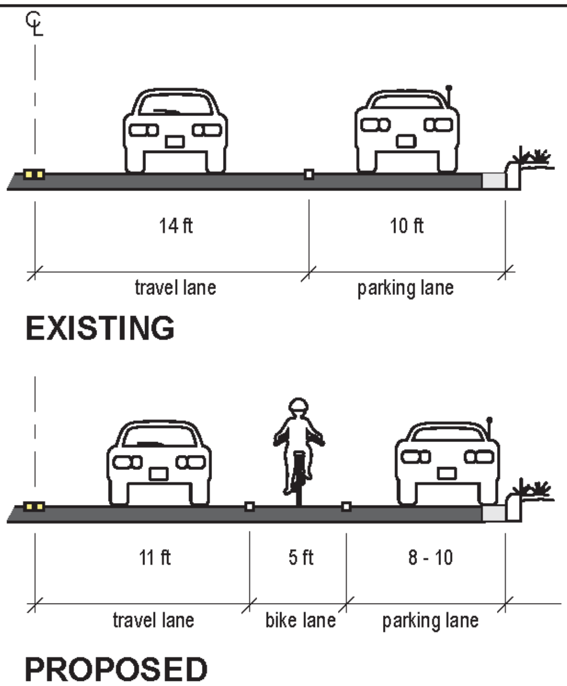
The use of this technique is appropriate when the following conditions exist:

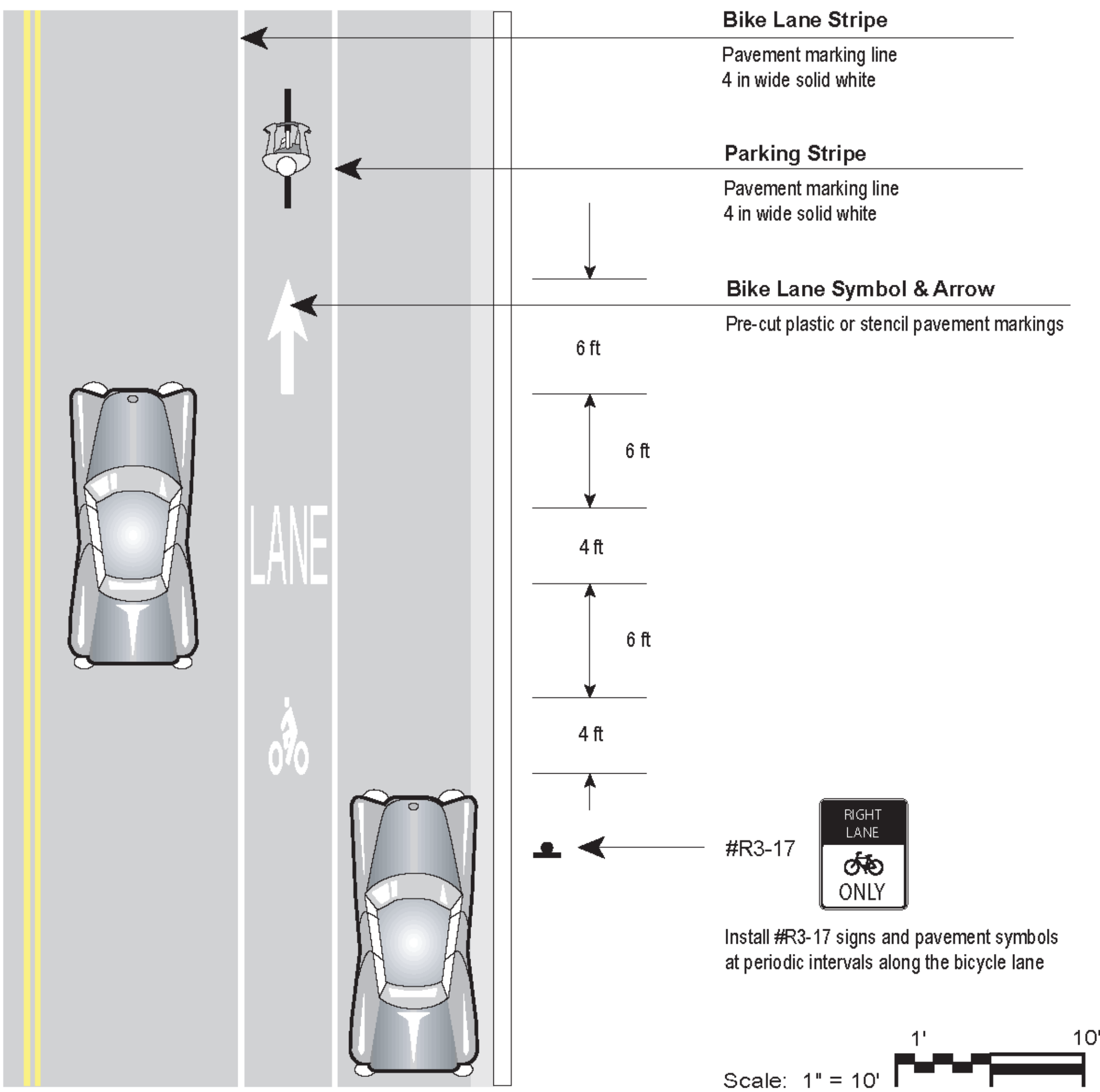
- Traffic lane plus parking lane = 24 ft wide
- Traffic lane ≥ 14 ft wide
- Posted vehicle speeds = 30 mph

Bicycle lanes on roadways with constrained parking “A” (or a 24-foot pavement width) are illustrated in Figure A-12.

Figure A-12:

BICYCLE LANE WITH CONSTRAINED “PARKING A” CONDITION





A-4.1.1.C.2 Constrained Bicycle Lane with Parking "B" (22' Pavement)

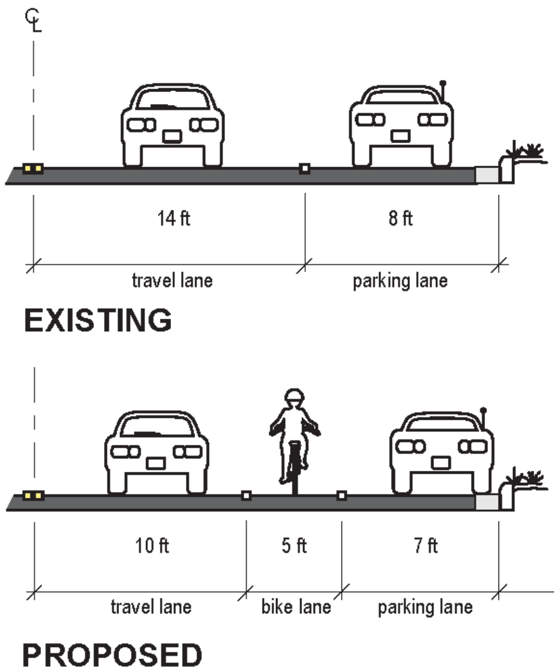
Designating a 5 ft wide bicycle lane in a 22' pavement is possible because in residential areas, a parallel parking lane from 7 to 8 ft is acceptable and travel lanes 10 ft are acceptable on low-speed facilities (A Policy on the Geometric Design of Highways and Streets, AASHTO, 2001).

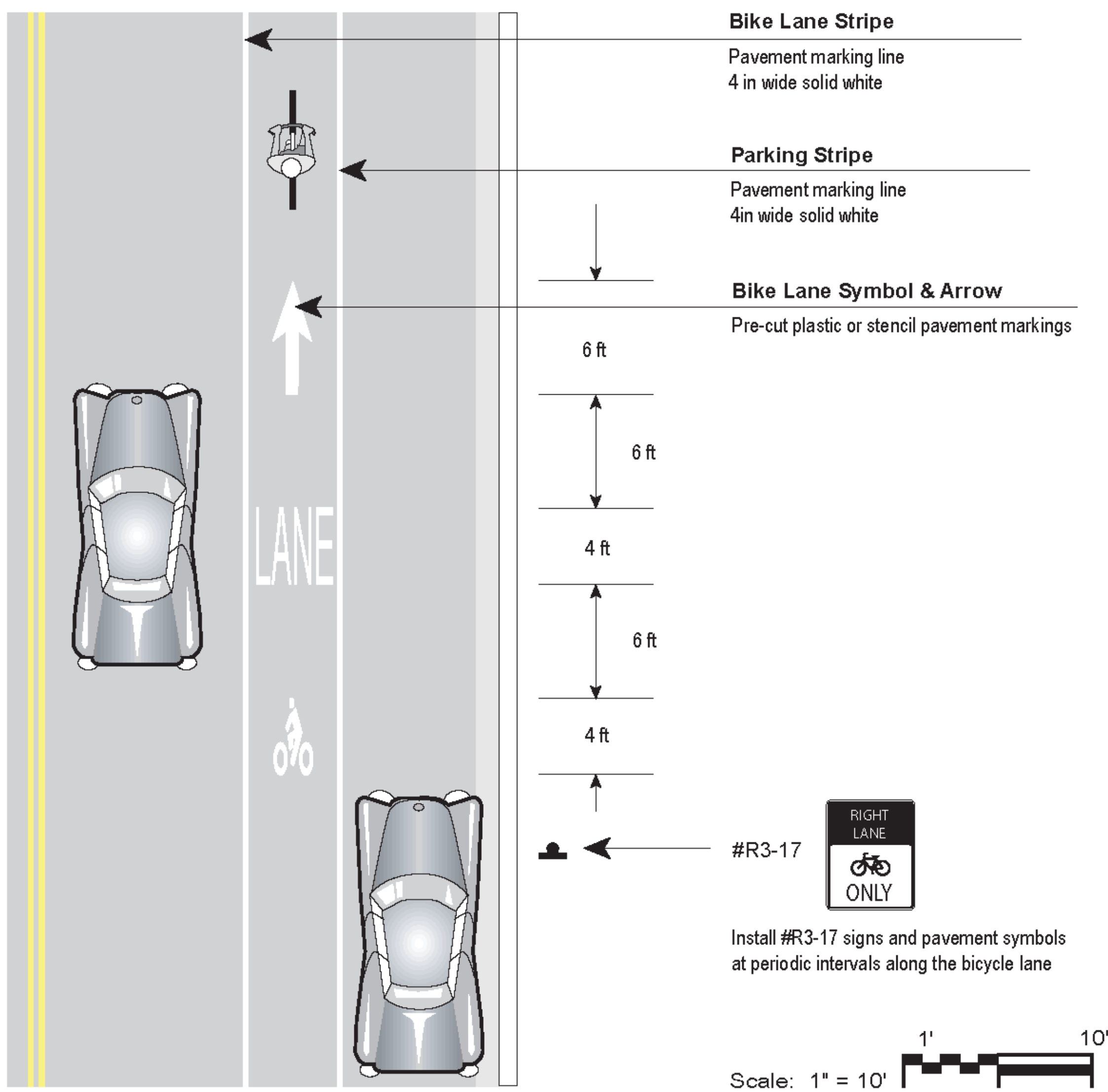
The designer shall reduce the width of the travel and parking lanes as illustrated in Figure A-13 to create a bicycle lane. The use of this technique is appropriate when the following conditions exist:

- Traffic lane plus parking lane = 22 ft wide
- Traffic lane ≥ 14 ft wide
- Posted vehicle speeds = 30 mph or less

Figure A-13:

BICYCLE LANE WITH CONSTRAINED "PARKING B" CONDITION





A-4.1.2. Paved Shoulders

Figure A-14: Shoulders as a Bikeway Facility

Bicycle lanes are more appropriate on urban streets, while paved shoulders are more appropriate on rural highways. Shoulders 4 ft wide are considered the minimum width to accommodate bicycle traffic. Shoulders must be paved in order to accommodate bicyclists. As traffic speeds increase, traffic mix includes heavier vehicles and trucks, and traffic volumes rise, shoulder width greater than 4 ft is desirable (See Table A-1.0 B). Where average traffic speeds are greater than 50 mph, a minimum shoulder width of 6 ft should be provided.

Avoid surface irregularities, such as rumble strips, textured paving, and raised lane markers and reflectors on routes intended for bicyclists. Shoulder rumble strips are typically located from 6 in to 1 ft from the road edge and are typically 1 ft wide. Where shoulder rumble strips are necessary, pave shoulders wide enough 8 ft min. to leave at least 5 ft of the smooth shoulder surface for bicyclists. See Figures A-14 through A-16. For more information on rumble strips, see Section A-4.3.1.

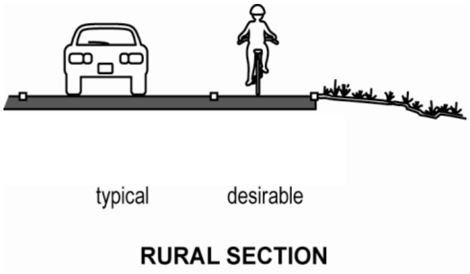
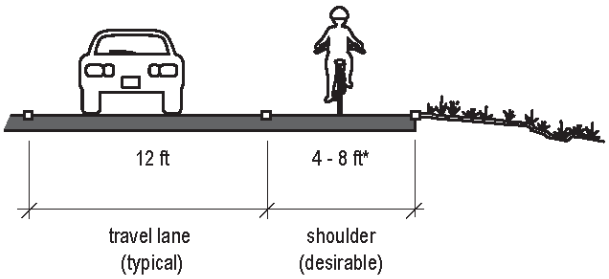


Figure A-15: Typical Roadway with Shoulder

Figure A-16:

SHOULDER AS A BIKEWAY FACILITY

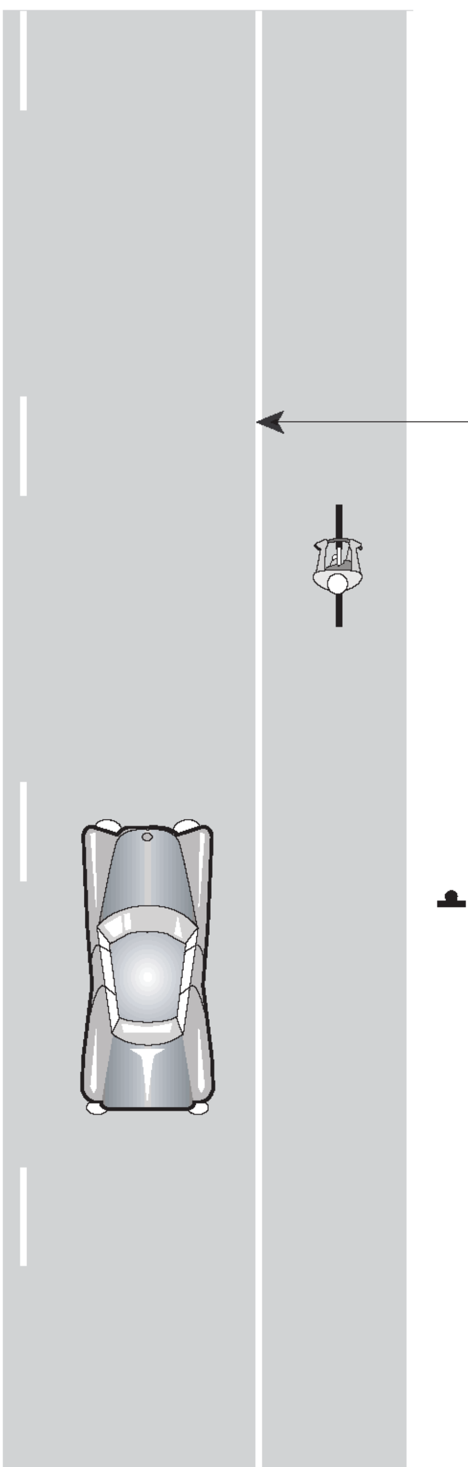


* Shoulder widths should be 4 ft min. typical.

5 ft from the face of a guardrail, curb or other roadside barrier.

8 ft if motor vehicle speeds exceed 50 mph or if the percentage of trucks, buses and recreation vehicles is high.

Shoulders should be wider where higher volumes of bicyclists are expected.



Shoulder Lane Stripe

Pavement marking line
4 in wide solid white

#R9-X

Optional:
Sign shoulders as a bikeway on designated bicycle routes and/or popular bicycling roadways when ADT > 2,000, average vehicle speeds >35 mph, and when there is inadequate sight distance (e.g. corners and hills)

Scale: 1" = 10' (1' – 10')

A-4.1.3. Wide Curb Lane

Wide curb lanes should primarily be considered when there is insufficient width to provide striped bicycle lanes. Wide curb or outside lanes can accommodate Type A cyclists who ride comfortably and safely in high traffic volumes and speeds. However, for Type B cyclists, wide curb or outside lanes generally do not provide the same degree of comfort and safety as bicycle lanes and will do little to encourage them to bicycle.

Wide curb lanes, or wide outside lanes, are the rightmost, through traffic lanes that are a minimum of 14 ft to minimize conflicts and better accommodate bicycles and motorists in the same lane. In most cases, motorists will not need to change lanes to pass a bicyclist. Wide curb lanes (14 ft) also provide bicyclists more maneuvering room at driveways, in places with limited sight lines, and steep grades.

Caution should be used when designating wide curb lanes because the effect of wider outside lanes may be contrary to the goals of traffic calming and pedestrian safety. Wider roads may encourage increased traffic speeds.

On popular bicycling streets, it may be appropriate to mark wide curb lanes with shared lane marking. Pavement marking should be placed at least 3 ft from the edge of the rideable surface.

Figure A-17 illustrates roadway cross sections with wide curb lanes.

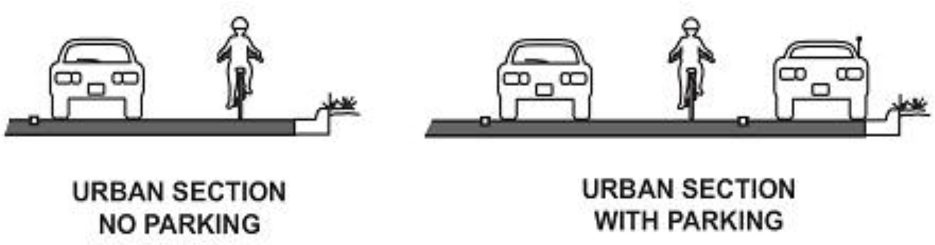


Figure A-17: Typical Roadways with Wide Curb Lanes

A-4.1.3.A Wide Curb Lane on Urban Roads with no Parking

Most practitioners agree that on urban streets with no on-street parking, 14 ft, (measured from the lane stripe to the edge of the gutter pan, rather than the curb face), is the minimum space necessary to allow a bicyclist and motorist to share the same space without coming into conflict, changing lanes, or potentially reducing the motor vehicle capacity of the lane.

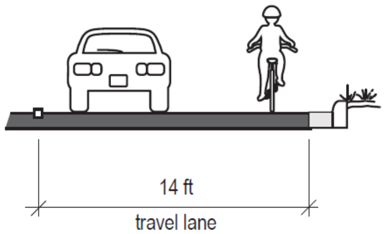
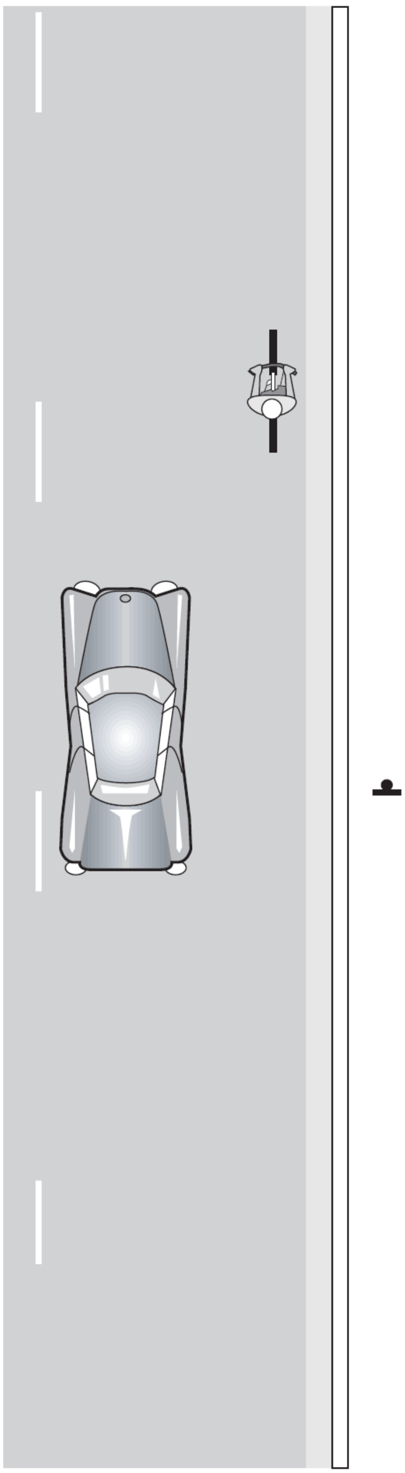


Figure A-18:

WIDE CURB LANE URBAN SECTION WITH NO PARKING



14 ft of usable width is desirable on sections of roadway where bicyclists need more maneuvering room (e.g., steep grades, limited sight distance)

If traffic speeds exceed 40 mph and ADT exceeds 10,000, 15 - 16 ft wide curb lanes are desirable

#W11-1 & W16-1

Optional:
Install Share the Road signs to warn drivers to watch for bicyclists traveling along urban streets with wide curb lanes of 14 ft or greater, but no bicycle lane.

Space signs approximately every 0.5 mile on urban routes frequently used by bicyclists.

Scale: 1" = 10'

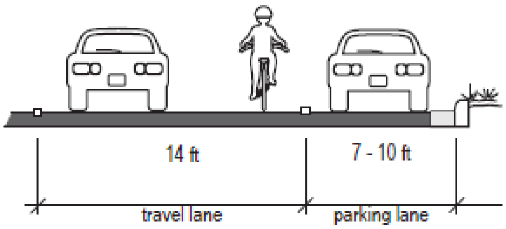
A-4.1.3.B Wide Curb Lane on Urban Roads with On-Street Parking

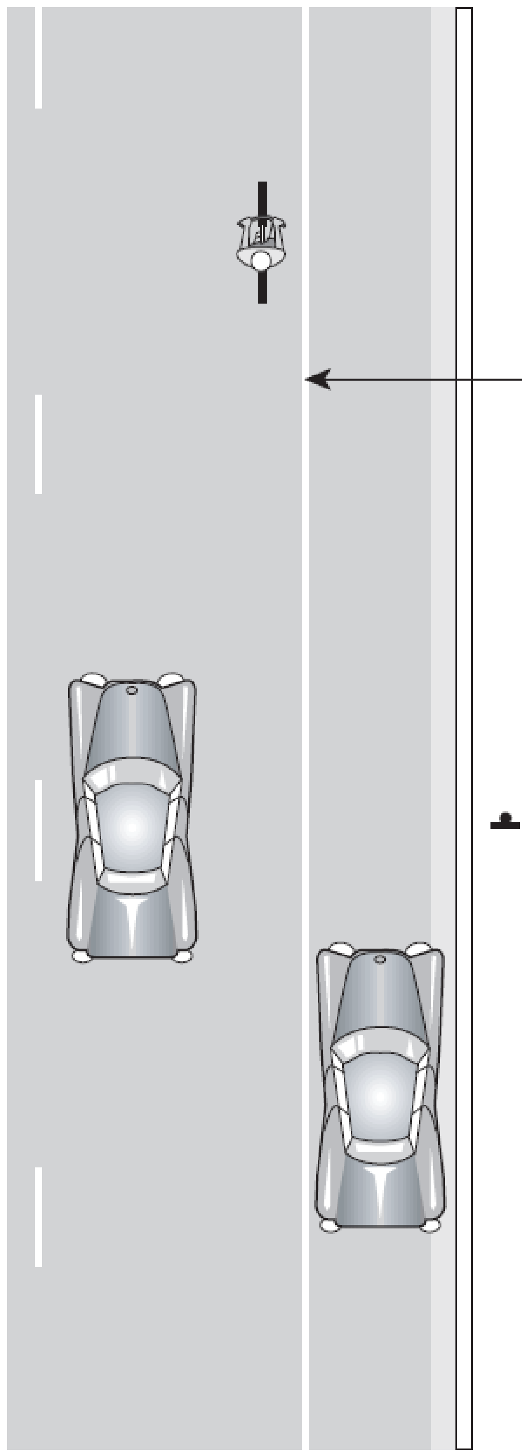
An open car door may take up the extra space in a bicycle travel lane. As a result, the effective width of the outside travel lane in such cases may not be as great as the measured width. Typically, a 14 ft, curb lane is adequate to accommodate bicyclists in a wide curb lane. However, to keep clear of on-street parking, extra space is required for maneuvering and a 15 ft curb lane is recommended.

If on-street parking is provided along with the wide outside travel lane, the parking lane should be standard width. Narrowing a parking lane to provide the space for bicyclists may or may not encourage motorists to park closer to the curb.

Figure A-19:

WIDE CURB LANE URBAN SECTION WITH PARKING





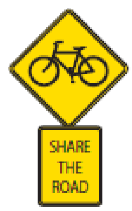
* 14 ft of usable width is desirable on sections of roadway where bicyclists need more maneuvering room (e.g., steep grades, limited sight distance)

If traffic speeds exceed 40 mph and ADT exceeds 10,000, 15-16 ft wide curb lanes are desirable

Parking Stripe

Pavement marking line
4 in wide solid white

#W11-1 & W16-1



Optional:
Install Share the Road signs to warn drivers to watch for bicyclists traveling along urban streets with wide curb lanes of 14 ft or greater, but no bicycle lane.

Space signs approximately every 0.5 mi on urban routes frequently used by bicyclists.

Scale: 1" = 10'   1'   10'

A-4.1.4. Shared Lanes

Shared lanes are streets and highways with no special provision for bicyclists. Shared lanes often feature 12 ft lane widths or less with no shoulders, allowing cars to pass bicyclists only by crossing the centerline or moving into another traffic lane. In residential areas with low motor vehicle traffic volumes and average speeds of less than 25 mph, shared lanes are normally adequate for bicyclists to use. With higher speeds and traffic volumes, shared lanes become less attractive to Type B cyclists.

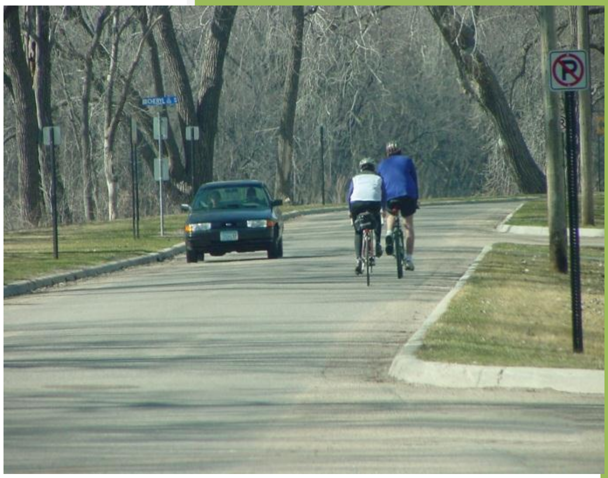


Figure A-20: Non-Marked Shared Lane

Shared lanes are not typically signed as bicycle routes. Exceptions include when specific destinations or potential alternate routes for bicyclists need to be shown or when a gap exists between facilities such as between two paths, and bicyclists require signing to lead them to the next facility. Figure A-21 illustrates shared lanes on three typical roadway types. Figure A-22 details a shared lane on an urban roadway with no on-street parking.

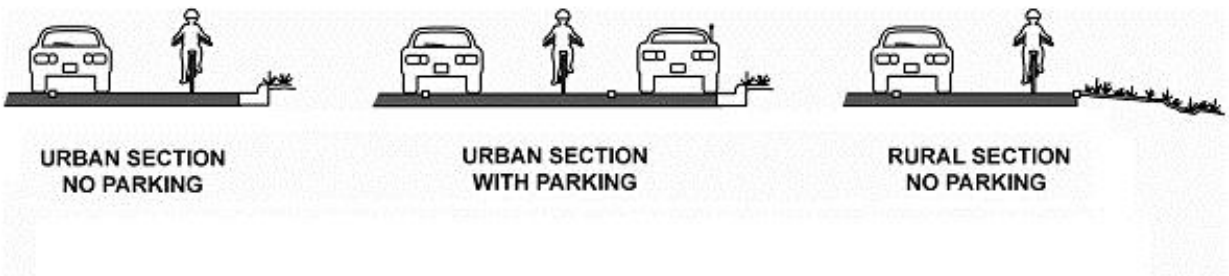
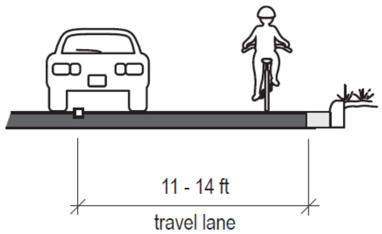
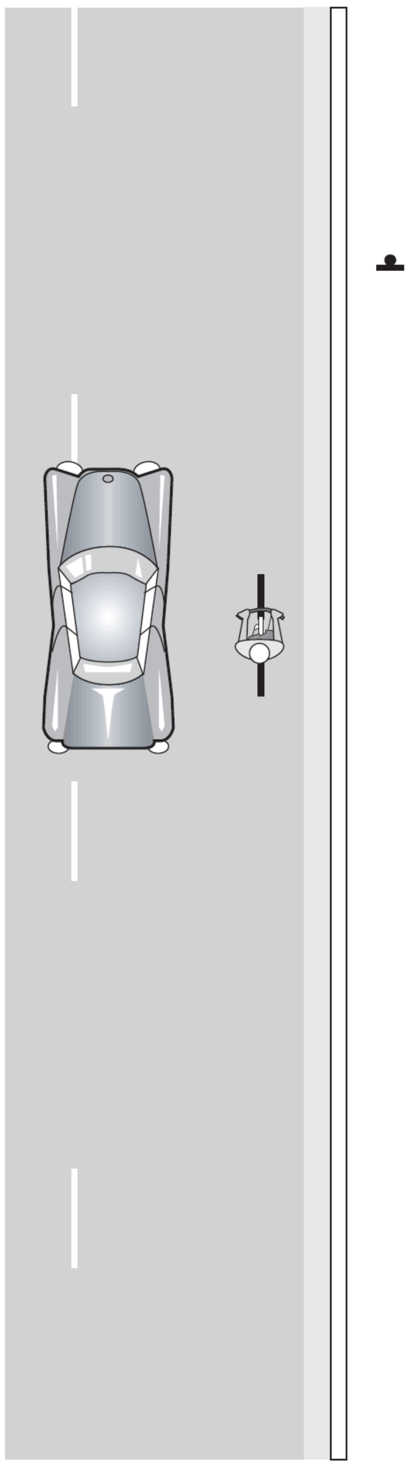


Figure A-21: Typical Roadways with Shared Lanes

Figure A-22:

SHARE LANE
URBAN SECTION
WITH NO PARKING





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Optional:
Install Bike Route signs with destination plaques if street is needed to connect specific destinations, establish a potential alternate route, or provide a link between other bicycle facilities.

Install signs at every major intersection, intersections with other bicycle routes, confusing junctions, or every 1000 ft.

Scale: 1" = 10'

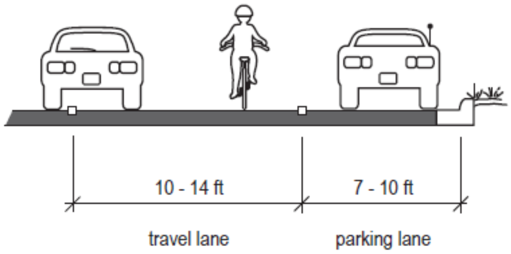
A-4.1.4.A Shared Lane -- Urban Section with Parking

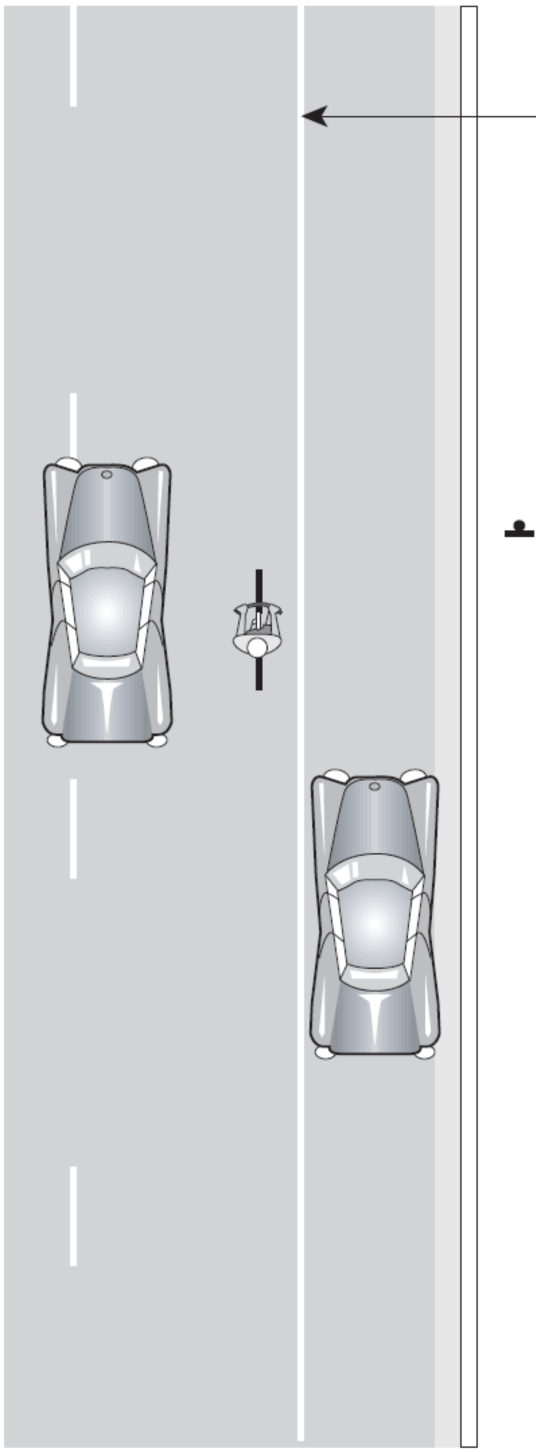
When shared lanes are used along a parallel parking lane, extra space (lane width) for maneuvering is recommended to keep clear of on-street parking. A 14 ft lane provides some extra clearance with the ability of vehicular traffic to have maneuverability space to avoid potential collisions in the “door zone” of parked vehicles. In addition, use of signage can clarify the right of the bicyclist to share the road and provide an expectation to motorists to be aware of the possible presence of bicyclists.

Where more than 15 ft of pavement width exists, consideration should be given to striping bike lanes. See Figure A-23.

Figure A-23:

SHARED LANE URBAN SECTION WITH PARKING





Parking Stripe

Pavement marking line
4 in wide solid white

#D11-1 & D1-1

Optional:
Install Bike Route signs with destination plaques if street is needed to connect specific destinations, establish a potential alternate route, or provide a link between other bicycle facilities.

Install signs at every major intersection, intersections with other bicycle routes, confusing junctions, or every 1000 ft.

Scale: 1" = 10' (1' ... 10')

A-4.1.4.B Shared Lane -- Rural Road with No Parking and No Curb & Gutter

The travel lanes for shared lanes on a rural road with no parking should be 11-14 ft wide. Motorists may have to cross the centerline of the road to pass bicyclists. On low-volume rural roads, this is acceptable.

Installing “Share the Road” signage to increase driver awareness of the presence of bicyclists is optional.

See Figure A-24 for the design of a rural roadway with no parking and shared lanes.

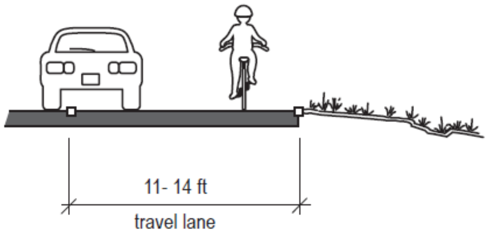
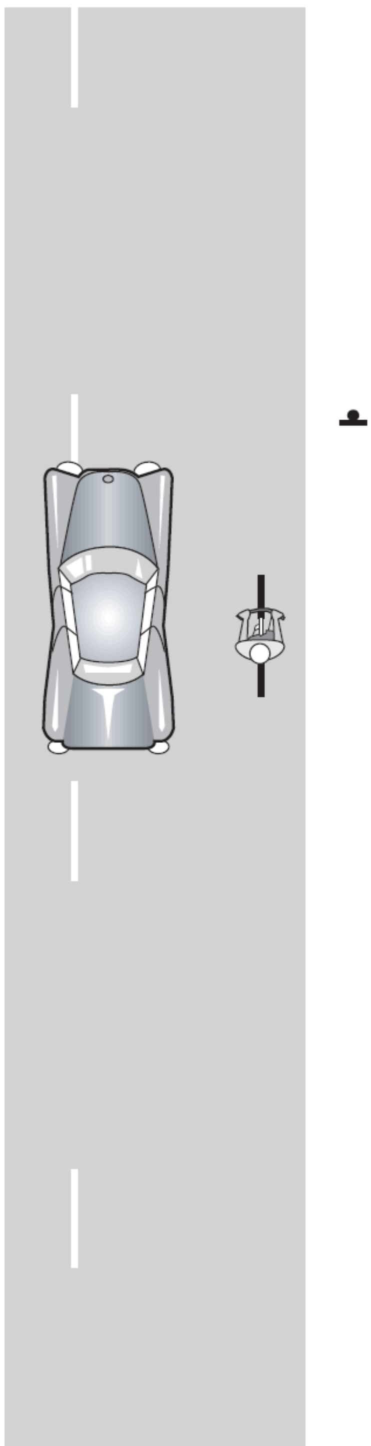


Figure A-24:

SHARED LANE
RURAL SECTION
WITH NO PARKING



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Optional:
Install Share the Road signs to warn drivers to watch for bicyclists traveling along the road in rural situations where there is no paved shoulder and a large number of bicycles use the roadway.

Space signs every 1 - 2 mi, and/or on corners, hills, or other places with limited sight distances.

Scale: 1" = 10'

A-4.1.5.Shared Lane Marking (Sharrows)

An effective modern tool used to incorporate on-road bicycle accommodations into the build environment is the use of shared lane marking, commonly referred to as "sharrows". Shared Lane Markings accomplish the following:

1) Assist bicyclists with lateral positioning in a shared lane with on-street parallel parking in order to reduce the chance of a bicyclist's impacting the open door of a parked vehicle,
2) Assist bicyclists with lateral positioning in lanes that are too narrow for a motor vehicle and a bicycle to travel side by side within the same traffic lane,
3) Alert road users of the lateral location bicyclists are likely to occupy within the traveled way,
4) Encourage safe passing of bicyclists by motorists, and
5) Reduce the incidence of wrong-way bicycling.

Figure A-25: Sharrows on Urban Street

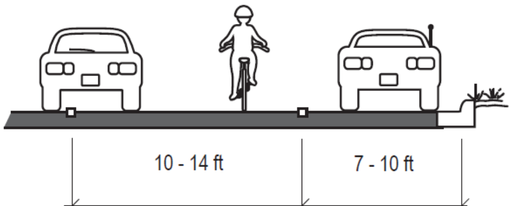
The Shared Lane Marking should not be placed on roadways that have a speed limit above 35 mph. Also, they shall not be used on shoulders or in designated bicycle lanes. If used in a shared lane with on-street parallel parking, Shared Lane Markings should be placed so that the centers of the markings are at least 11 feet from the face of the curb, or from the edge of the pavement where there is no curb. If used on a street without on-street parking that has an outside travel lane that is less than 14 feet wide, the centers of the Shared Lane Markings should be at least 4 feet from the face of the curb, or from the edge of the pavement where there is no curb. If used, the Shared Lane Marking should be placed immediately after an intersection and spaced at intervals not greater than 250 feet thereafter.

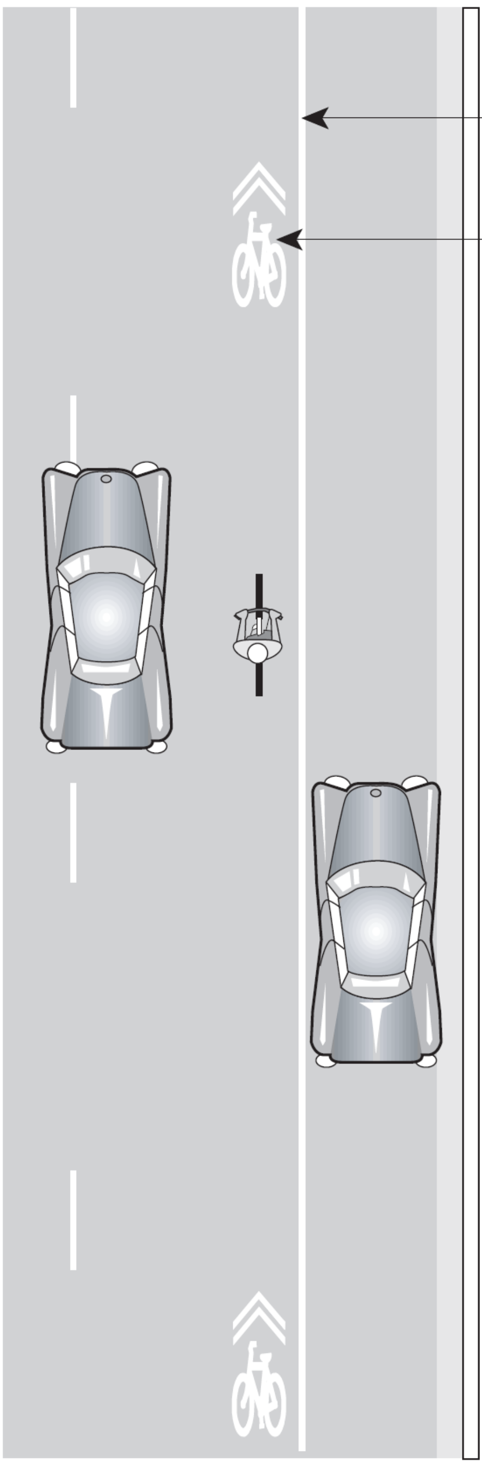
Figure A-26: Bicycle May Use Full Lane Sign (R4-11)

Section 9B.06 of the 2009 MUTCD describes that a Bicycle May Use Full Lane sign (R4-11) may be used in addition to inform road users that bicyclists might occupy the travel lane.

Figure A-27:

SHARED LANE MARKING (SHARROW) WITH PARKING





Parking Stripe

Pavement marking line
4 in wide solid white

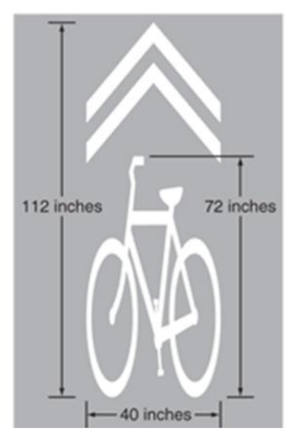
Shared Use Lane Marking (SHARROW)

Installed 11 ft from face of curb (or edge of pavement)
Should be placed immediately after and intersection
and spaced at intervals not greater than 250 ft thereafter
If used on street with no on-street parking that has outside travel lane less than 14 ft wide, the centers of sharrow should be at least 4 ft from the face of curb, or from the edge of pavement where there is no curb.

#D11-1 & D1-1

Optional:
Install Bike Route signs with destination plaques if street is needed to connect specific destinations, establish a potential alternate route, or provide a link between other bicycle facilities.

Install signs at every major intersection, intersections with other bicycle routes, confusing junctions, or every 1000 ft.



Shared Lane Marking

Scale: 1" = 10' 1' 10'

A-4.1.6. Jersey Barrier Projected Shoulders

Although providing additional shoulder width can provide an added measure of comfort for bicyclists on roads with relative high traffic speeds and/or volumes, not all types of riders will feel safe. On a high volume/high speed roadway, a physical separation from traffic lanes may be desirable. Shoulders can be partitioned with a concrete Jersey-type barrier to provide this type of separation.

Figure A-28: Jersey barrier-protected shoulder design, Seattle

(Photo Credit: Dan Burden)

Bikeway facilities using Jersey barrier-protected shoulders are also recommended in highway construction zones where vehicle travel lanes and shoulders have been shifted or eliminated. Connections should be well marked with signage, especially in construction/detour zones

The recommended barrier height between a bikeway and the roadway is 4 ft. A bikeway created through the construction of a Jersey barrier-protected shoulder is pictured in Figure A-28 and illustrated in Figure A-29.

The installation of concrete barriers on the shoulder needs to allow enough room for emergency/distressed vehicles 6 ft and at least 6 ft of one-way bicycle travel

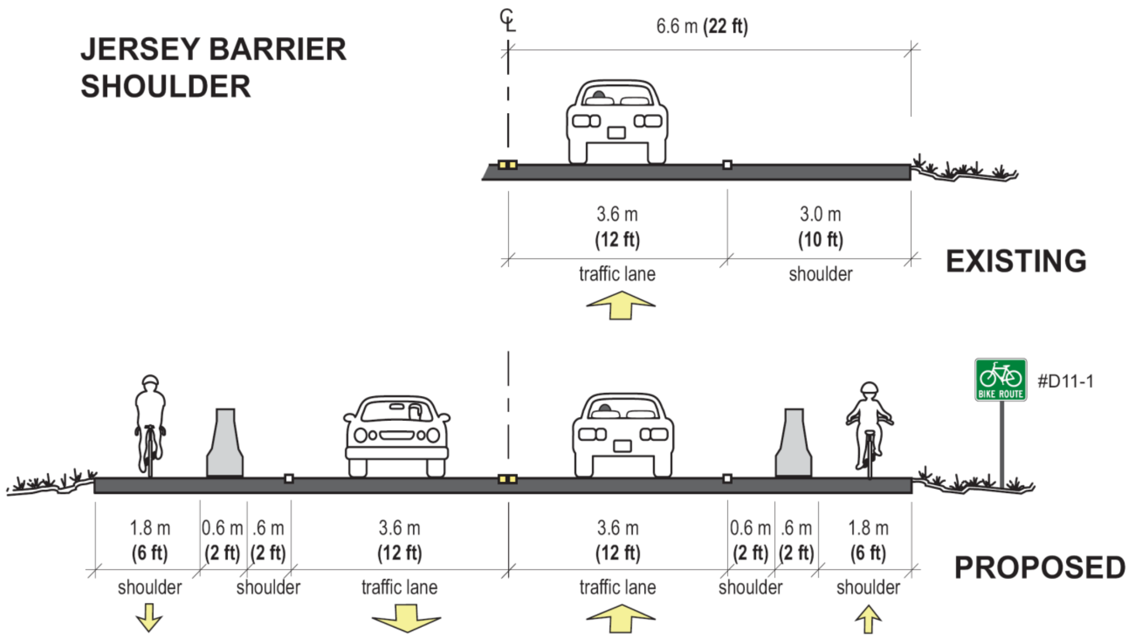


Figure A-29: Jersey Barrier-Protected Shoulders

A-4.2. At-Grade Intersections

In urban areas, more than three-fourths of all car/bike crashes occur at intersections. The causes of these crashes are numerous; no single measure will provide a primary solution to the intersection problem. Almost one-fifth of all car/bike collisions are caused when a bicyclist runs a stop sign or red light. In addition, motor vehicle drivers in both left and right turning situations have a tendency to overlook bicyclists riding (improperly) against the normal flow of traffic. Safety at intersections depends on the functions of the roads and bikeways, motor vehicle and bicycle traffic volumes and speeds, the crossing distances, and the amount of space available at the crossing.

A-4.2.1. Factors to be Considered for Intersection Design

Factors to be taken into consideration to achieve safe, workable intersection design include:

Safety

- Bicycles and motor vehicles must be able to easily see each other
- Bicyclist's movements must be predictable and understandable to motorists
- Intersection design should be simple and avoid the need for complex maneuvers
- Motor traffic speed should be low where bicycles cross at grade
- There must be sufficient maneuvering or waiting space

Bicycle Delay

- Minimize waiting times
- Maximize the possibility to cross without delay
- Give main bicycle routes priority over local motor vehicle routes

Convenience

- Bicyclists should have comfortable routes across the intersection
- Curb cuts and transitions should be flush with the road, and as wide as the approaching facility
- There should be no detours for bicyclists across intersections
- Give special attention to bicyclist turning movements (primarily left-turning bicycles)

Right Turn Lanes

Virginia law requires the bicyclist to keep as close as practicable to the right edge of the roadway. Therefore, the bicyclist may move toward the right edge of the right-turn lane. This is not a desirable position, especially if the bicyclist is intending to go straight ahead. On shared roadways with right turn lanes, providing a through bicycle lane to the left of the right-turn lane can minimize conflicts at the intersection. However, if the roadway carries enough traffic to warrant a right-turn lane, bicycle lanes are likely appropriate for the entire section of the roadway.

The recommended lane width for a right turn lane is 12 ft. In some cases eliminating right turn on red, slowing motor vehicle traffic and replacing the standard "RIGHT-TURN LANE" sign (R3-XI) with "BEGIN RIGHT-TURN LANE; YIELD TO BIKES (R4-4) is desirable.

Review traffic volumes and speeds in determining appropriate actions.

Right Turn on Red

Where "right turn on red" is permitted, the focus of right-turning motorists toward cross traffic approaching from the left is intensified. The straight-through bicyclists required to stop for the red light may find that vehicles turning right on red infringe into their storage area. Right turning motor vehicles may infringe less if the intersection curve radius is relatively small.

Consider prohibiting "right turn on red" on shared road bikeways.

Shared road bikeways can complicate turning movements at intersections. They can encourage bicyclists to keep right and motorists to keep left, regardless of their intentions. Bicyclists weaving left from a bicycle or shared-use lane and motorists weaving right are both maneuvering contrary to the usual rules of the road. Pavement markings can address this by various striping methods.

Two design characteristics are important for safe weaving of bicycle and motorized traffic. First, the speed difference between bicycles and motorists in the weaving or merge area is desirably no greater than about 6 mph (10 km/h). Second, the number of traffic lanes for a left-turning bicyclist to weave across should be kept to a minimum; they should not have to cross more than one lane if possible.

Intersection Crossing Distance

At intersections, it is desirable to keep the crossing distance and the number of lanes to cross at a minimum for the safety of crossing traffic. It is desirable to limit the number of lanes to cross at a time to three. If the number of lanes to be crossed is greater than three, a traffic or median island should be placed at the crossing.

Anticipated Bicyclist Turning Movements

Each intersection must be studied individually to plan for anticipated bicyclist turning movements. Both left and right turns present design considerations.

1. The Right-Turning Motorist and the Bicyclist Proceeding Straight Ahead

Conflicts with right-turning cars account for about one in ten of all urban car/bike collisions.

Right turns on green by motorists may be hazardous because the driver and the through-bicyclist may both perceive themselves to have clear right-of-way. Every effort should be made to encourage the right-turning motorist to slow down, and observe bicycle traffic, before reaching the intersection and turning right. The weaving of motor vehicles and bicycles is not desirable if the intersection approach or exit is on a curve. The most effective solution is to place a through bicycle lane to the left of the right turn lane, preceded by dashed lines. This will ensure that any weaving takes place in advance of the intersection and both bicyclist and motorists are correctly positioned to travel through the intersection without conflict.

Some bicyclists use right-turn-only lanes when traveling straight through an intersection. This causes difficulties because motorists expect the bicyclist to turn right. At right-turn only lanes, bicyclists should be encouraged to merge to the left side of the lane to complete the weave maneuver. However, this is often difficult for Type B cyclists to do. In lanes that allow both through and right-turn movements, it may be difficult for both the motorist and bicyclist to recognize the other's intent. At locations with identified accidents, bicycle lanes or designated bicycle route signage and pavement markings clarify who is responsible for yielding is recommended. Parking may be prohibited for a minimum of 100 ft or more from the intersection, depending on the design speed of the turn lane.

2. The Left-Turning Motorist and the Bicyclist Proceeding Straight Ahead

Conflicts with left-turning motorists account for almost one-quarter of all urban motor vehicle/bike collisions. This type of collision occurs because the left-turning motorist either does not see the approaching bicyclist or underestimates their speed. The motorist's field of view is limited to oncoming vehicles, so a bicycle traveling in the roadway will usually fall within view. However, if the motorist is trying to clear the intersection in the face of oncoming traffic, a bicycle may not be seen in time to yield. One way to eliminate this type of "panic" turn is to install a protected left turn phase. Well-positioned bicycle lanes at the intersection can also increase the visibility of bicyclists by placing them farther from the curb where they would be more visible.

The Experienced Bicyclist will tend to follow the same maneuver that motor vehicles use. Type A cyclists may be encouraged to make the necessary weave movements for proper left turns. The tendency for bicyclists to "double-up" with turning vehicles, rather than fall in line, may also create sideswipe exposure. Opposing motorists may not see or fail to grant right of way to the turning bicycle.

A-4.2.2.Intersection Design Treatments

The following intersection design treatments will be described in greater detail:

A. Bicycle Lane Treatments at Intersections

B. Bicycle Lanes and Left Turning Bicycle Traffic

C. Bike Lane Continuation at T-Intersections

D. At-Grade Railroad Crossings

A-4.2.2.A Bicycle Lane Treatments at Intersections

Providing well-designed bicycle lanes at intersections can reduce conflicts by alerting both motorists and bicyclists of correct lane position and recommended safe weaving areas. At intersections where there are bicycle lanes and traffic signals, detection loops may be adjusted to detect bicycles. Installation of bicycle-sensitive loops within the bicycle lane is desirable. This is particularly important where signals are vehicle-actuated and may not change for a bicycle unless a car is present, or unless the bicyclist leaves the lane to trip the signal within the traffic lane. If used for bicycle traffic, push button activators should be within reach so the bicyclist is able to remain on the bicycle in the bicycle lane.

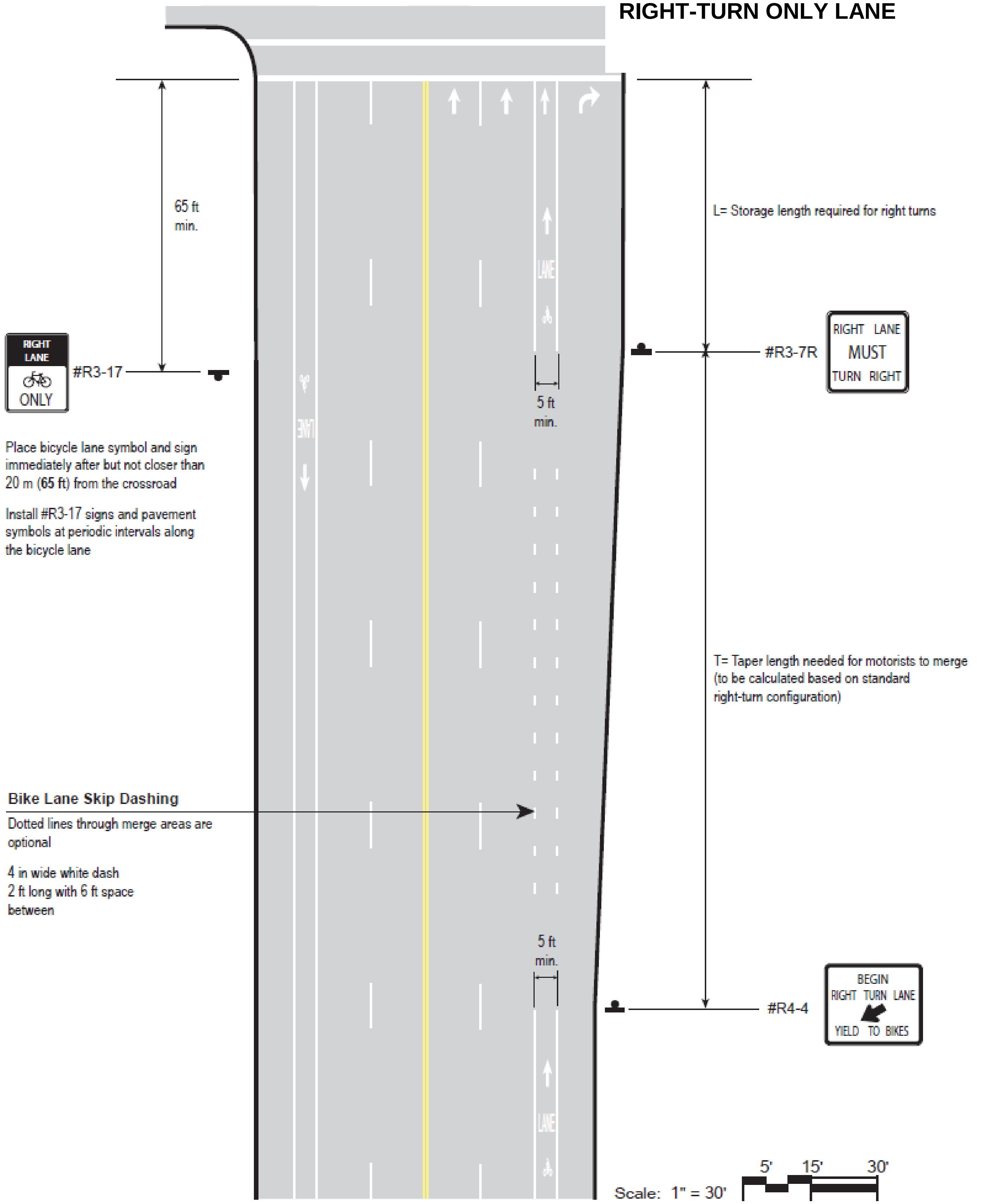
Where there is heavy bicycle traffic on bicycle lanes, a separate green phase for bicycle use only may be included. This allows bicyclists to cross the street and make turns without having to contend with motor-vehicle traffic. On multi-lane streets where the "stranding" of bicyclists is possible, consideration should be given to ensure that short clearance intervals are not used. A commonly used solution is an all-red clearance interval.

1. Parking Lane Becomes Right-Turn Only Lane with Bicycle Lanes

If there is a parking lane outside the bicycle lane, the bicycle lane stripe should be continued to the crosswalk (or extension of adjacent property line). The parking lane markings, however, should be dropped at an appropriate distance from the intersection to allow proper sight distances. A second dashed line may be used to delineate the right side of the bicycle lane. This type of intersection is illustrated in Figure A-30.

Figure A-30:

**BIKE LANE INTERSECTION
RIGHT LANE BECOMES
RIGHT-TURN ONLY LANE**



2. Bicycle Lane Intersection with Right-Turn Only Lane

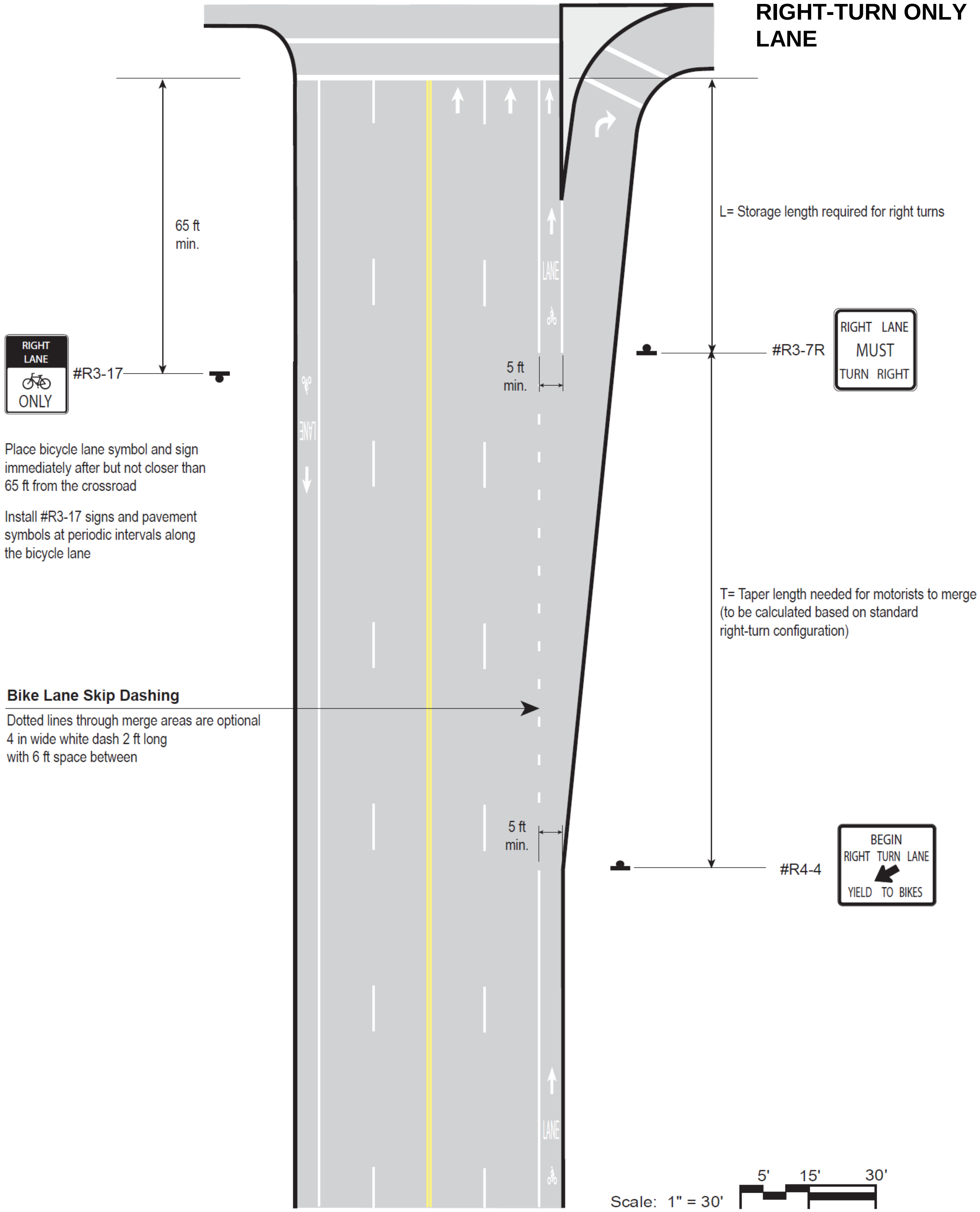
Intersections with right-turn lanes have always posed a challenge for bike lane designers. Moving the bicycle lane to the left of the right-turn lane, however, allowed designers to create a merging area ahead of the intersection. This gave bicyclists and motorists the opportunity to negotiate to the proper position before reaching the intersection.

Where there is a bike lane intersection with right-turn only lane, the bicycle lane should continue across with a dashed line. The length of the right-turn storage area and the taper will determine the length of the dashed line. A second dashed line may be used to delineate the right side of the bicycle lane.

See Figure A-31.

Figure A-31:

BIKE LANE INTERSECTION RIGHT-TURN ONLY LANE



A-4.2.2.B Bicycle Lanes and Left-Turning Bicycle Traffic

At busy intersections, pavement marking options may improve safety and comfort for left-turning bicyclists. When left-turn bicycle volumes are significant, a left-turn bicycle lane painted next to the right edge of a left-turn lane may be appropriate. This option is recommended at signalized intersections and stop-controlled intersections without right turn on red. Double left turns lanes are discouraged on streets with bikeways, bicyclists should be encouraged to make left turns by the two-step method if a double left-turn lane is present. (See Figure A-32)

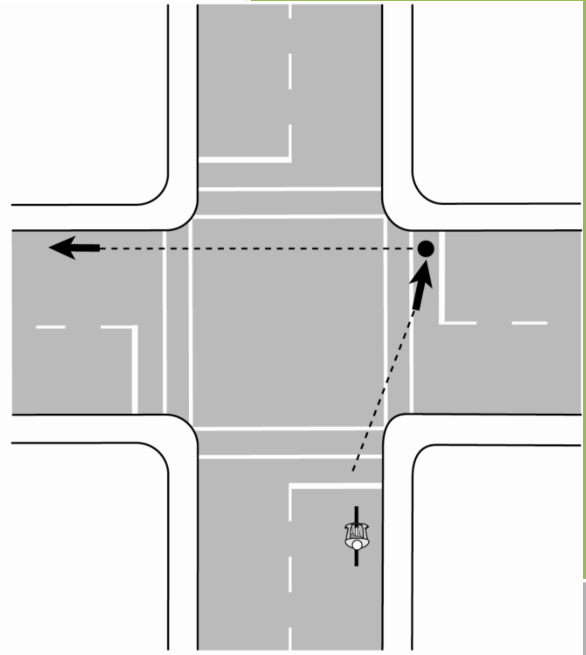


Figure A-32: Two-Step Left Turn

1. Painted Refuge Islands for Left-Turning and Straight through Bicycle Traffic.

Allowing right turn on red is not recommended with painted refuge islands. Where traffic is relatively light, painting a refuge island on the corner provides refuge space. Where traffic volumes are relatively high, providing a raised free right turn island that is easily reached by left-turning bicyclists also provides refuge space.

2. Advanced Stop Lines

Creating an advanced stop line (ASL) makes it possible for bicyclists to position themselves in front of waiting motorized traffic and cross the intersection first on the green light or when turning left on a separate green phase. Twenty-five bicycles or more per peak hour and good enforcement of stopping behavior are needed for effective use of ASL's. The ASL helps bicyclists turning left where there is one lane for motorized traffic. ASL's may also be applied on approaching road sections with a maximum of two lanes.

A separate ASL, inclusive of an approaching bicycle lane, is best introduced when there is a left-turn lane. If traffic turning left has a separate green phase, a separate ASL is necessary. If this is not the case, one ASL may suffice, however, bicyclists may choose to weave to the left turn lane anyway. For increased visibility and recognition, complete the ASL and a part of the approaching bicycle lane in a different color pavement, preferably red. Bicycle sensitive vehicle detectors (pavement loops or other devices) are desirable with ASL's.

A-4.2.2.C Bicycle Lane Continuation at T-intersections

It is preferred that bicycle traffic be allowed uninterrupted through-movement at T-intersections. Continuing the bicycle lane through the intersection as shown in the figure below is recommended. Even where there are no bicycle lanes, lane continuation could be added to the intersection if it is stop sign controlled. See Figure A-33.

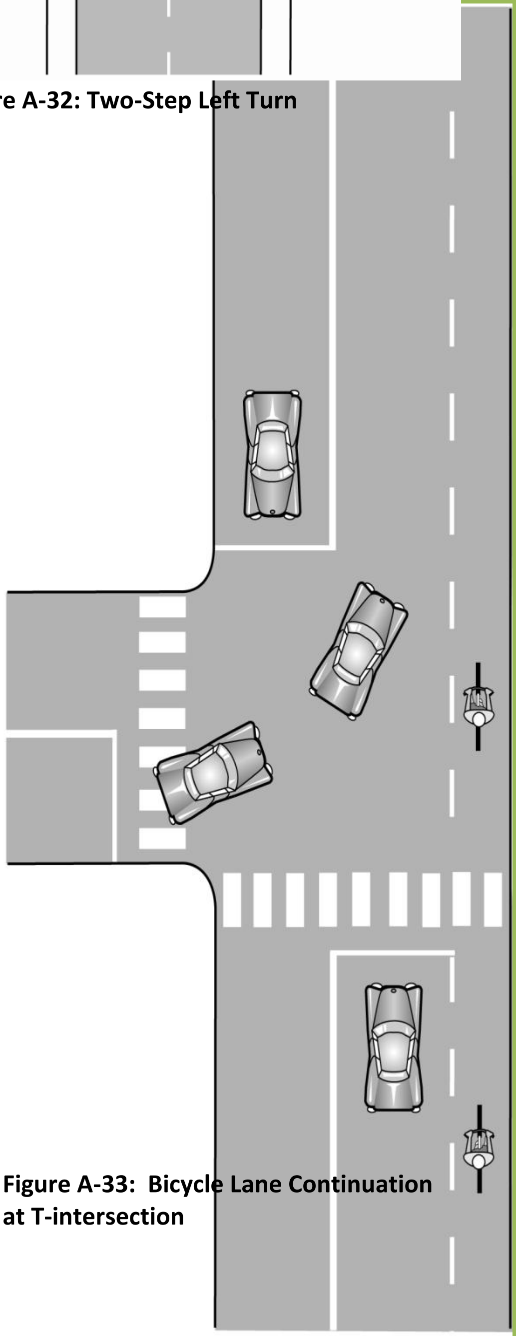


Figure A-33: Bicycle Lane Continuation at T-intersection

A-4.2.2.D At-grade Railroad Crossing Intersection

Special care should be taken wherever a bicyclist crosses railroad tracks at grade. The outside lane, shoulder, or bicycle lane should be widened to permit approaches to the tracks at 60 to 90 degrees.

Whenever possible, the bicyclist should be allowed a level crossing at right angles to the rails while traveling straight ahead. Depending on the features of the road, the bikeway may swing away from the roadway to allow this. The more the crossing deviates from 90 degrees, the greater is the potential for a bicyclist's front wheel to be diverted by the gap on either side of the rail — or even by the rail. Crossing angles of 30 degrees or less are considered hazardous, particularly when wet. See Figure A-34 for the design recommendation.

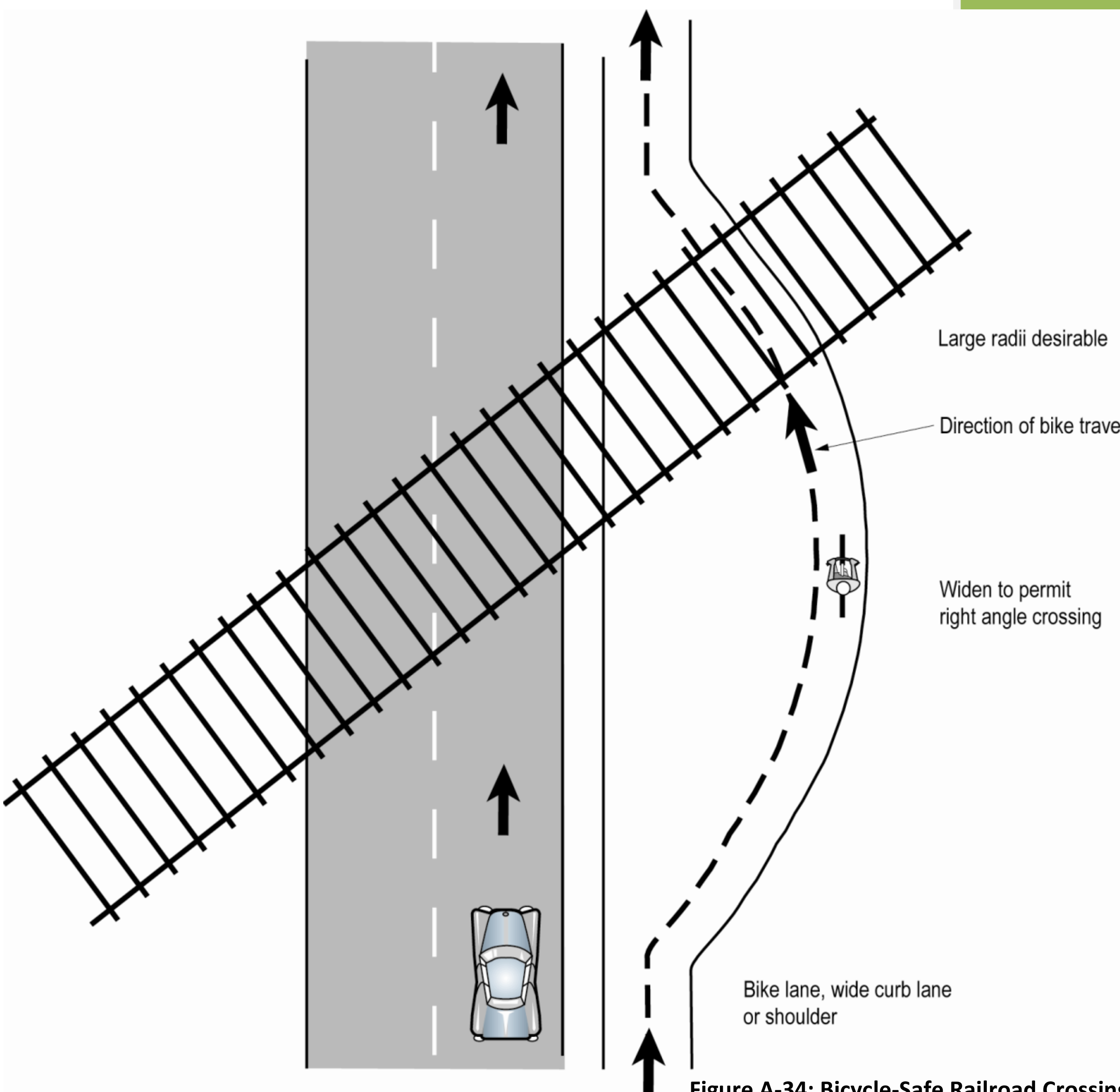


Figure A-34: Bicycle-Safe Railroad Crossing

The flangeway, or the gap on either side of the track's rail poses potential hazards to all trail users, but particularly those who rely on wheeled forms of mobility. A 90 degree crossing angle reduces the width of the flangeways, but flangeways at any angle can be a safety concern and should be minimized.

The gap on the outside of the rail, or the "field flangeway", is easy to reduce. Flangeway fillers made of rubber or polymer can be installed to eliminate the field flangeway almost entirely and provide a level surface.

The "gauge flangeway," or the gap on the inside of the rails where the train wheel's "flange" must travel, must be kept open. Federal regulations require public crossings to have at least a 2.5 in gauge flangeway. There are some commercially available products fill the gauge flangeway, but these may only be used in low-speed applications, such as on a track in a freight yard or manufacturing plant. At higher speeds, the filler will not compress and can derail the train.

The crossing should be at least as wide as the approaches of the bikeway. The desired type of surface between rails should be based on the planned uses of the roadway. Hot mix asphalt and rubber surfaces are generally acceptable for at-grade crossings. Wood surfaces are better suited to limited use; they are very slippery when wet and tend to wear faster than other surfaces. Abandoned tracks should be removed.

Roadways, paths and bicycle lanes should have signage and pavement markings installed in accordance with the Manual on Uniform Traffic Control Devices (MUTCD). Advance warning signs such as W10-X1 (Figure A-35) may be used at skewed railroad crossings to warn the bicyclist of the crossing. Consider sign and signal location design and installation when widening the approach bikeway; "pedestrian arms" may also be considered. Visibility of signals and installing signals with bells should be considered in case a path parallel to a road is constructed in the future.

Figure A-35: MUTCD Sign W10-X1

A-4.3. Other On-Street Bikeway Design Considerations

There are additional considerations that should be utilized in the design phase of on-street bikeway facilities. These other design considerations will promote a consistent and safe bicycling environment.

1. Rumble Strips
2. Drainage and Drainage Grates
3. Bypass Lanes
4. Changing Lanes
5. Lighting
6. Traffic Calming
7. Alternate Bike Routes

A-4.3.1. Rumble Strips

Research has documented that use of rumble strips on the shoulders of rural freeways and expressways has reduced the number of run-off-the-road (ROR) accidents by 40 to 70 percent. Rumble strips are bands of raised material or indentations formed or grooved in the traveled way or along the shoulder. They are intended to call the motorist's attention to standard warning or regulatory devices or otherwise alert inattentive drivers by transmitting sound and vibration through the vehicle. There are two basic types of rumble strips -- traveled way rumble strips and shoulder rumble strips.

Provisions should be made for bicyclists to safely traverse through or around rumble strips, regardless of their location. Potential for mishap arises when the bicyclist contacts rumble strips or attempts to avoid them by weaving. Care must be taken to ensure a stable riding surface. Concave rumble strips tend to fill with sand. In addition, sand and debris tend to gather along the outside shoulder edge. These two factors work from both sides of the shoulder, narrowing the available bicycling space.

Full-width shoulder rumble strips must not be used where bicyclists are permitted. When rumble strips are necessary on non-freeway routes, there should be a minimum clear path of 0.75 ft from the rumble strip to the travel lane, 4 ft from the rumble strip to the outside edge of the paved shoulder, or 5 ft to adjacent guardrail, curb or obstacle. They should be placed using an intermittent milled pattern alternating on and off in 10 ft lengths, which allows maneuverability of bicyclists onto the shoulder area.

A-4.3.2. Drainage and Drainage Grates

Figure A-36: Bicycle-Safe Rumble Strips

For bicycle travel, existing roadway drainage is normally adequate. However, on curb and gutter sections, a check of ponding depths should be made where a problem is identified and corrective action taken if depths are significant. This may entail improved drainage grates or wider lanes. Pavement overlays are troublesome where the surface material tapers into drainage outlets and manhole covers. In the years following the overlay, these tapers often loosen around inlets and manholes, leaving an unacceptable ridge that can be hazardous for cyclists. The existing pavement should be scarified or the inlets and manholes raised prior to the overlay.

When a new roadway is designed, all such grates and covers should be kept out of the bicyclists' expected path. Curb inlets are preferable to surface type inlets.

Drainage inlet grates on roadways shall have openings narrow enough and short enough to assure bicycle tires will not drop into the grates regardless of the direction of bicycle travel. Grates with bars parallel to the direction of bicycle travel should be replaced with bicycle safe and hydraulically efficient grates. "Vane" type grates are preferable surface type grates. Pavement marking to identify and warn cyclists about unsafe grates may be a temporary solution in some situations. However, a parallel bar grate should be replaced or physically corrected as soon as practicable after identification. Where it is not immediately feasible to replace existing grates with standard grates designed for bicycles, 1 in x ¼ in steel cross straps should be welded to the grates at a spacing of 6 in to 8 in on center to reduce the size of the opening. This should be considered a temporary correction, as snow plows can often scrape off such straps.

A-4.3.3. Bypass Lanes

A bypass lane is an expanded area of roadway shoulder that allows vehicles to bypass other vehicles attempting left turns. They are typically found at intersections on rural two-lane roads. Cars overtaking left turning vehicles move to their right, traveling in the shoulder area typically used by bicycles. An additional 4 ft of paved shoulder should be added to the bypass lane to provide space for cyclists.

The bypass lane should be clearly striped to ensure that the motorist does not drift into the bicyclist's path. Additional shoulder width is desirable if the percentage of trucks, buses and recreational vehicles is high.

A-4.3.4. Climbing Lanes

A climbing lane is an additional uphill lane that allows vehicles to overtake those vehicles that are unable to maintain satisfactory speeds. They are typically found where long roadway grades occur, causing slow moving vehicles to move to the right lane. A minimum 4 ft paved shoulder may be added next to the climbing lane for bicycle traffic.

Climbing lanes should be indicated to motorists and bicyclists by appropriate signage. The shoulder edge as well as the climbing lane must be clearly marked to insure that the motorist does not move into the bicyclist's path.

A-4.3.5. Lighting

On shared roadways and those with bicycle lanes, the area normally reserved for bicyclists may be illuminated in accordance with recommended design values in the AASHTO Guide "An International Guide for Roadway Lighting" and ANSI/IES Recommended Practices. The lighting system as a whole should provide adequate illumination along the entire length and width of the bikeway, without variations in luminous intensity to which bicyclists and motor vehicle drivers might experience difficulty adjusting.

All preliminary roadway lighting designs should be checked for conformance with luminance requirements prescribed for walkways adjacent to roadways and bicycle lanes.

A-4.3.6. Traffic-Calmed Roadways

Traffic calming employs a variety of techniques to reduce the dominance and speed of motor vehicles. In areas of traffic calming, it is rare to see special facilities for bicyclists because many of the benefits of traffic calming (slower vehicle speeds, better driver discipline, less traffic, and environmental improvements) directly benefit bicyclists, especially Type B cyclists. Benefits attributed to traffic calming include an average one-third reduction in road accidents, a greater feeling of security among vulnerable road users, and environmental improvements through landscaping and a reduction in the presence of motor vehicles. In addition to making traffic-calmed roads safer, slower vehicle speeds may create better driver discipline and reduce fuel consumption, vehicle emissions, and noise levels.

Traffic-calmed roadways are often used as routes in bicycle and pedestrian networks. Traffic calming is typically used on residential streets, but may apply to other roads based on the functional classification and use. Techniques applicable to main urban thoroughfares generally differ from those employed in minor residential streets. A greater variety of features has been developed for minor roads where stricter speed controls and reduced capacity will not create undue delay.

Some traffic calming treatments may be detrimental to bicycles. Care should be taken to ensure bicyclist, pedestrian and motorist safety when considering types of traffic calming. Bicyclists are susceptible to changes in surface height and texture or unexpected road narrowing. A design balance should be maintained whereby bicyclists traveling through traffic-calmed areas are able to maintain their momentum while not endangering other users, and at the same time, not be encumbered by speed-reducing measures that may discourage the use of those areas.

General Design Guidelines for Roadways with Traffic Calming:

1. Provide bicyclists with alternative paths (minimum width 4 ft) around physical obstacles such as ramps and through barriers such as cul-de-sacs.
2. Where roads are narrowed as a speed control measure, consideration should be given to how bicyclists and motorists can share the remaining space.
3. Surface materials should have good skid resistance. Textured areas should not be so rough as to create instability for bicyclists.
4. Smooth transition on entry and exit slopes on raised surfaces, with clear indication and transition gradients of no more than 1:6.
5. Design should take into consideration any overall gradients, noting that bicyclists are likely to approach them at different speeds uphill and downhill.
6. Appropriate signing can be combined with public awareness campaigns to remind drivers about traffic-calmed areas.

Measures employed to achieve this include physical changes in road alignment and grade and changes in priority. Typical types of traffic calming include curb extensions and pedestrian refuges

A-4.3.6.A Curb Extensions

Curb extensions involve narrowing the roadway by extending the curb. They serve to reduce crossing distances for pedestrians. When placed near an intersection, they tend to tighten turning radii and lessen vehicle speeds while preventing vehicles from parking too close to the intersection. They have a particular value in sheltering parked vehicles and ensuring that a pedestrian's view of approaching vehicles and bicyclists is not obstructed. To ensure curb extensions do not protrude into the bicyclists' path and therefore present a safety hazard to bicyclists, all curb extensions should not extend beyond the width of the parking lane.

A-4.3.6.B Pedestrian Refuges

Refuge islands allow pedestrians to cross fewer lanes at a time and judge conflicts differently. Pedestrian refuge islands should be 8 ft to ensure bicycles can use the island to cross the street. There are no impacts to on-street bicycle facilities unless the lanes are narrowed to provide adequate space for the island.

A-4.3.7. Alternate Bicycle Route

Whenever possible, bike facilities should be constructed to accommodate the entire range of cyclists with one facility. However, in some instances, it may be necessary to create an alternate, parallel bicycle route where a bicycle route along an arterial roadway is deficient for a large class of cyclists. A lower-volume roadway that parallels a high-volume arterial can provide a pleasant alternative for "through" bicyclists, as well as a higher level of mobility and safety. Figure A-37 illustrates an alternative bicycle route.

It is most appropriate to identify and designate an alternate route under the following conditions:

- the parallel -volume roadway is within 0.25 mi of the arterial;
- the arterial has on-street parking and/or multiple driveways and/or turning conflicts;
- the average daily traffic on the arterial road is greater than 10,000;
- the average vehicle speeds exceed 30 mph; and
- insufficient right-of-way to stripe a bicycle lane.

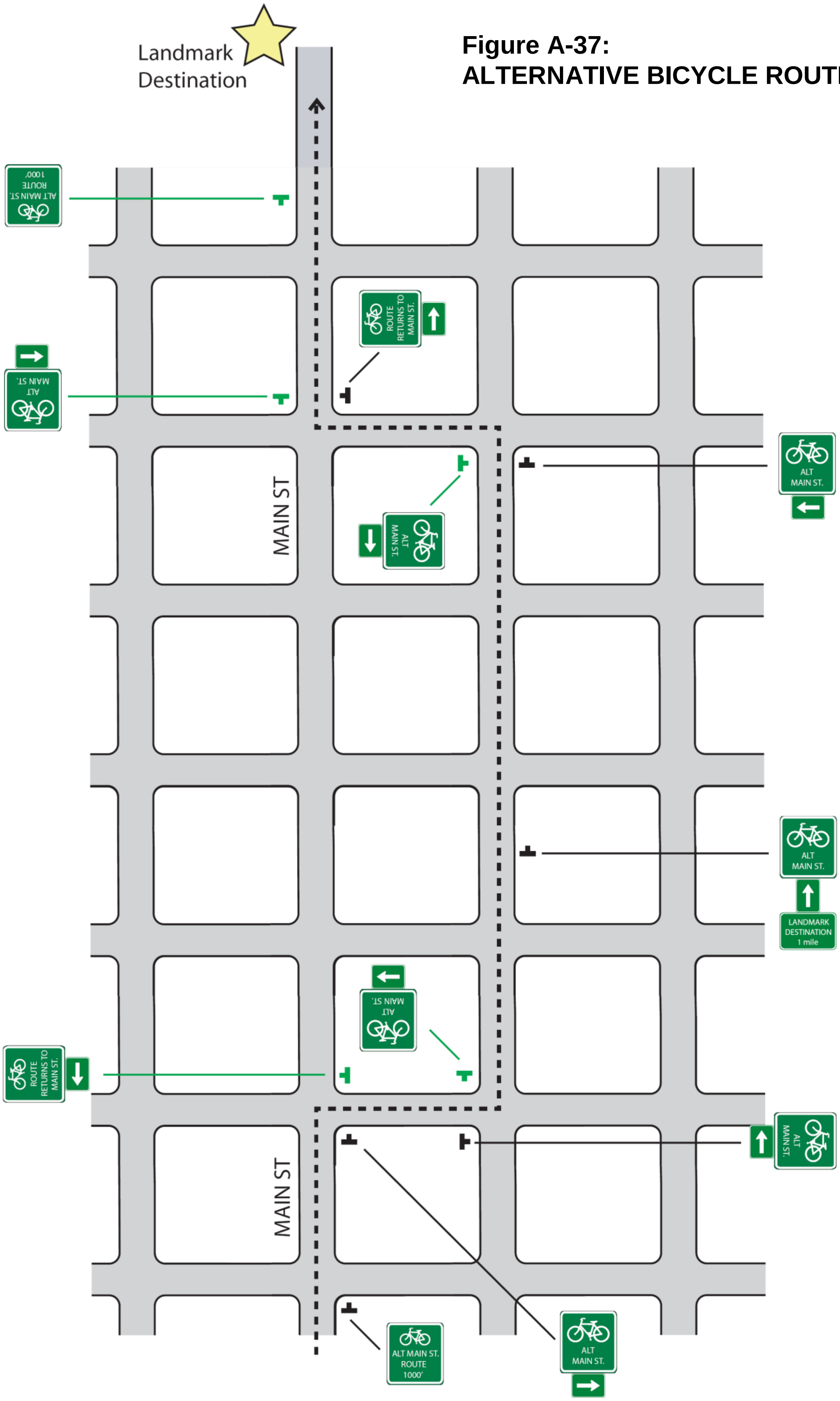
Designating an alternate bicycle route does not remove the need to improve the safety of the primary route for those bicyclists who still need to use the arterial -- especially if there are commercial or other public destinations along that arterial. However, it should decrease bicycle traffic on the arterial substantially.

The success of an alternate bicycle route is dependent on it having a high degree of convenience and legibility, or strong mental image in the minds of the bicyclists expected to use it. They are most successful when they connect points of interest and destination points, such as trails, schools, parks, churches, historical sites, downtown areas and other destination points.

To implement alternate routes, AASHTO recommends that directional and informational signs should be posted every 0.25 mi and at every turn to mark both the turn and to confirm that the rider has made the correct turn. If feasible, limit stop signs and signals to the greatest extent possible, except where they are needed to cross busy streets. Traffic-calming techniques should be used to enhance its attractiveness and safety for bicyclists.

Note that it is inappropriate to designate a sidewalk as an alternate route or designated bike route. To do so would prohibit bicyclists from using an alternate facility that might better serve their needs and prevent conflicts with pedestrians or motorists.

Figure A-37:
ALTERNATIVE BICYCLE ROUTE



A-5.0 Bicycle Parking

The City lacks bicycle parking at most destinations. Bicyclists visiting community retail centers, places of employment and schools do not have available bicycle parking and instead many lock their bikes to street fixtures such as light poles and sign poles. Well placed bicycle parking will not only prevent bicyclists locking to street fixtures but can also encourage bicycling activities.

Bicycle parking is an essential element of a bicycle route network. Bicycle parking should be provided in the Downtown area, schools, parks, and public facilities. Also, the city should work with commercial property owners to install bicycle parking for patrons. Generally, bicycle parking should be installed near main entrance with good visibility and close to primary service and attractions.

A-6.0 Typical Installation Costs

A-5.1 Retrofitting

Bicycle Lane Thermoplastic Pavement Line 4”
Cost per Lineal Foot: $1.30

Bicycle Lane Thermoplastic Marking
Cost per Marking: $65

Shared Lane Marking (Sharrow)
Cost per Marking: $175 initial template ($50 -$70 thereafter)
includes planning/engineering and paint shop labor and material

A-5.2. New Construction

Bicycle Lane (4' wide lane on left and right sides)
Base Cost Per Mile: $435,100

Wide Curb Lane (2' additional pavement on left and right sides)
Base Cost Per Mile: $217,600

Paved Shoulder (4' wide shoulder on left and right sides)
Base Cost Per Mile: $376,600

Shared Use Path (10' wide paved asphalt path)
Base Cost Per Mile: $719,100

Sign Panel
Cost per Square Foot: $34.50

Sign Post 4x4 wood or U-channel
Cost per Lineal Foot: $9.40

Sample Sign with Post
Bicycle Diamond with Share the Road: $300

Bike Rack
Bike rack purchase and installation: $150 to $300 (parks two bikes)
Bike locker: $1,000 to $4,000 (parks two bikes)
Covered Bicycle Parking: $3,000