

Context Sensitive Bike Facility Design Guide Matrix

Arlington BAC/TAC Roadway Restriping Working Group – December 2014

Introduction

Given the increasing number of bicycles on Arlington’s roads, it is the ABAC/TAC Roadway Restriping Working Group’s (RRWG) desire to find appropriate accommodations to enhance accessibility and safety for bicyclists and to reduce conflicts with other road users, including drivers of motor vehicles and pedestrians. With appropriate planning, opportunities for improvements arise when roadways are repaved by the Town. The intent of this memorandum to provide a guide for restriping the roadway that provides the appropriate facility for bicyclists depending on the traffic, topographic and land use context.

The various types of potential bicycle facilities include:

Type of facility	Considerations	Example
Shared use path	<ol style="list-style-type: none"> 1. Provides the greatest separation from motor vehicle (MV) traffic 2. May have some bicycle – pedestrian conflicts 3. Typically, a separate right-of-way is required, such as a rail bed 4. Rarely provides the same level of access to homes and businesses as roads. “The presence of a shared use path near a roadway does not eliminate the need to accommodate bicyclists within a roadway”¹ 	Minuteman Bikeway
Cycle Track	<p>A cycle track is a one or two-way bicycle facility located next to a road, either at road or sidewalk grade.</p> <ol style="list-style-type: none"> 1. On roads with few driveways or intersections, provides good separation from motor vehicle traffic 2. Substantial motor vehicle conflicts in areas with many driveways or intersections (for example, Route 16 at Fresh Pond Mall) 3. Busy road intersections require special design treatment, illustrated well in the NACTO Urban Bikeway Design Guide 4. Substantial right-of-way is required (minimum 8’ for two-way, 5’ for one-way plus a 3’ minimum buffer to parked cars) 	Vassar Street or Concord Avenue, Cambridge
Buffered bike lane	<p>A painted bike lane, parallel to traffic flow, with a painted or otherwise delineated buffer between the bike lane and MV traffic². A buffer might also be provided between the bike lane and parked cars</p> <ol style="list-style-type: none"> 1. Provides better MV-bike separation than a conventional bike lane 2. Useful where the space available for a bike lane is wide enough that it might be mistaken for a motor vehicle travel lane 	Congress Street, Downtown Boston
Bike lane	<ol style="list-style-type: none"> 1. The 2006 Mass Highway Design Guide stated that “Bicycle lanes are generally considered the preferred treatment for bicycle accommodation”³ 2. Minimum width of 5’ (minimum 12’ for combined parking and bike lane, 13-14’ preferred) 	Park Avenue, Arlington
Rideable shoulder	<ol style="list-style-type: none"> 1. A marked shoulder, typically at least 4’ wide 2. Useful where little parking is expected 3. Provides reasonable accommodation where available right-of-way is 	Lake Street, Arlington

¹ MassDOT Highway Design Guide, Section 5.3.2.4

² See <http://nacto.org/cities-for-cycling/design-guide/bike-lanes/buffered-bike-lanes>

³ MassDOT Highway Design Guide, Section 5.3.2.1

	limited, bike traffic is low to moderate, there is only occasional parking, and there is little truck / bus traffic.	
Wide curb lane	A wide curb lane is a travel lane that provides enough space for bikes and motor vehicles to share side-by-side ⁴ <ol style="list-style-type: none"> 1. Width is 14 – 15' 2. Requires somewhat less right of way than a marked bike lane (11' travel plus 5' bike lane) 3. Shared lane markings may be placed just to the right of normal MV travel path, at least 11' from the curb 4. In State-funded highway projects, may require a design exception 	Western portion of Mass Ave, Arlington
Shared Lane Markings (Sharrows)	<ol style="list-style-type: none"> 1. Used where there are moderate-to-high bicycle and motor vehicle traffic volumes sharing the same space 2. If not in a wide curb lane (i.e. <14'), place in the center of the travel lane 3. In State-funded highway projects, may require a design exception 	
No special accommodation	<ol style="list-style-type: none"> 1. Acceptable on local streets where traffic volumes and speeds are both low (< 3000 vehicles per day; < 25 mph) 	

Scope of this Design Guide

This design guide is intended to provide guidance for the Town on simple repaving and restriping projects, where, with the exception of curb extensions at crosswalks, curb lines and drainage are not changed. Therefore, the remainder of this document is focused on bike lanes, rideable shoulders, wide curb lanes and shared lane markings. It is not meant to preclude the consideration of cycle tracks and buffered bike lanes where they would be feasible (typically, on more extensive projects)

Restriping Decision Matrix and Design Guide

While in an ideal world, the Town of Arlington should continue to search for opportunities to develop additional shared-use paths and cycle tracks, realistically, new bicycle facilities are more-likely to include bike lanes, usable shoulders and sharrows. Where possible, the greatest number of users would benefit if space for striped bike lanes can be found on repaved and rebuilt roadways. The reconstruction of Mass Ave in East Arlington is a notable case-in-point of the latter.

Studies have shown that bike lanes encourage some cyclists to ride further from parked cars, can promote a more orderly and predictable traffic flow, signify to drivers that bicycles belong, and encourage potential cyclists to overcome their fears of traffic. Cities throughout the US with robust programs to introduce bike lanes and other infrastructure have seen both significant increases in ridership and reductions in crashes. Additionally, surveys both nationally and locally indicate that bike lanes are popular with both existing cyclists and those wishing to ride more often but are intimidated by traffic conditions. Therefore,



Bike lane along Mass Ave in Cambridge

⁴ <http://www.bicyclinginfo.org/engineering/facilities-widelanes.cfm>

along with other programs and policies to encourage bicycling in Arlington (bike parking, education, enforcement, road maintenance, etc.) the RRWG would like to support and promote the creation of well-designed bike lanes, especially along streets where the politically-charged removal of traffic lanes and/or parking is unnecessary. To implement this policy, the RRWG feels it is important to establish a procedure for evaluating streets and developing recommendations for specific bike lane applications in the Town.

The attached checklists were developed to 1) help DPW determine if bike lanes are the appropriate treatment for any particular street and 2) if so, help determine recommended dimensions for the restriping plan. For the latter, the attached checklist informs the design by adding or subtracting width to minimum travel, bike, and parking lane dimensions in 6" or 12" increments to accommodate vehicle and bike traffic under various contextual conditions.

The Guide acknowledges that bike-lane design need not be characterized as "one size fits all". Although AASHTO, NACTO and MassDOT and others have set standards for minimum and recommended bike-lane widths, the RRWG believes that flexible guidelines for travel-lane, bike-lane, and parking-lane dimensions should consider contextual issues such as typical traffic speed, topography, and adjacent land uses. For example, bike lanes need to offer a greater comfort level for cyclists when traffic is moving at a higher speed or if the street is a busy route for trucks and/or buses. Additionally, safe travel distance from parked cars, i.e. protection from the "door zone," should be flexible and respond to the rate of parking turnover and probability of the opening of the driver's-side door (keeping in mind that cyclists should be aware that motor vehicle doors could unexpectedly open at any time, and should keep a minimum of three feet between themselves and any parked vehicle).

Design of bike lanes should also take into account areas where motor vehicle traffic is likely to cross the painted bike lane line. In these areas, assume the following guidelines:

- Include dashed bike lane lines for a length of 50' on the approach to intersections with cross streets
- Include dashed bike lane lines for a length of 20' on the approach to, and departure from, bus bays
- Bike lane lines (or shoulder edge lines) should not "curl in" towards side streets and driveways. They should be discontinuous across intersections of side streets. At busy intersections, dashed bike lane lines should continue through the intersection to improve bicyclists' navigation and positioning, and to create greater level of awareness for motorists. At intersections where conflict is most acute, consideration for the use of green bike lane markings should be carefully considered as well.

Finally, it is important to note that many final recommendations may not fit within the existing or proposed curb-to-curb width for a particular street. When the recommendation exceeds the curb-to-curb width by 12" or less for the entire street, reduction of either the travel, bike or parking lane should be considered. When it exceeds the curb-to-curb width by more than 12", alternative methods to provide bike access such as shoulder stripes, or a wide outside lane with "sharrows" should be employed.

DRAFT Roadway Restriping Guide to Providing Bicycle Facilities

Arlington BAC/TAC Roadway Restriping Working Group

STREET _____	CURB-TO-CURB WIDTH _____	
	YES	NO
1. Is the roadway part of the designated bike network* in the Town?	<input type="checkbox"/> Go to Question #2-4	<input type="checkbox"/> Bike facility not necessary or appropriate
2. Parking allowed on both sides: is the roadway at least 44' in width	<input type="checkbox"/> Go to Bike Lane Design Guide	<input type="checkbox"/> See Shared Lane Marking Matrix
3. Parking allowed on one side: is the roadway at least 36' in width	<input type="checkbox"/> Go to Bike Lane Design Guide	<input type="checkbox"/> See Shared Lane Marking Matrix
3. Parking prohibited: is the roadway at least 28' in width	<input type="checkbox"/> Go to Bike Lane Design Guide	<input type="checkbox"/> See Shared Lane Marking Matrix

* - network includes: Mass Ave, Park Ave, Summer Street, Lowell Street, Gray Street, Mill Street, Jason Street, Pleasant Street, Mystic Street, Mystic Valley Parkway (DCR), Medford Street, Broadway, Warren Street, Bates Road, River Street and Lake Street

Shared Lane Marking Placement Matrix

Posted or 85 th percentile roadway speed (whichever is lower)	Shared lane marking placement	
	Curb-side travel lane < 13'	curb-side travel lane ≥ 13'
≤ 25 mph without parking	center of travel lane	4'-0" from curb
≤ 25 mph with parking	center of travel lane	11'-0" from curb
26 – 35 mph without parking	4'-0" from curb **	4'-0" from curb
26 – 35 mph with parking	11'-0" from curb **	11'-0" from curb
> 35 mph with or without parking	SLM not appropriate	SLM not appropriate

** - there is a certain trade off that will need to be acknowledged as SLM placement 4' or 11' from the curb within travel lanes <13' will suffer more wear and tear, but very few cyclists should be encouraged to ride in the center of the travel lane when speeds typically exceed 26 mph.

DRAFT Context-sensitive Bike Lane Design Guide

Arlington BAC/TAC Roadway Restriping Working Group

STREET _____ CURB-TO-CURB WIDTH _____

	NO	YES	
TRAVEL LANE _____ →		<input type="checkbox"/>	start with: 10'-0"
Limited* or no bus/truck traffic?	<input type="checkbox"/>	<input type="checkbox"/>	no change
Moderate** bus/truck traffic?	<input type="checkbox"/>	<input type="checkbox"/>	add 6"
Frequent*** bus/truck traffic?	<input type="checkbox"/>	<input type="checkbox"/>	add 12"
- OR -			
Typical traffic speeds <30 mph?	<input type="checkbox"/>	<input type="checkbox"/>	no change
Typical traffic speeds 30-40 mph?	<input type="checkbox"/>	<input type="checkbox"/>	add 6"
Typical traffic speeds >40 mph?	<input type="checkbox"/>	<input type="checkbox"/>	add 12"

SUB-TOTAL

BIKE LANE _____ →		<input type="checkbox"/>	start with: 5'-0"
Absence of curb-side parking?	<input type="checkbox"/>	<input type="checkbox"/>	OK to subtract 6"
Limited* or no bus/truck traffic?	<input type="checkbox"/>	<input type="checkbox"/>	OK to subtract 6"
Moderate** bus/truck traffic?	<input type="checkbox"/>	<input type="checkbox"/>	no change
Frequent*** bus/truck traffic?	<input type="checkbox"/>	<input type="checkbox"/>	add 6"
Typical traffic speeds <30 mph?	<input type="checkbox"/>	<input type="checkbox"/>	no change
Typical traffic speeds 30-40 mph?	<input type="checkbox"/>	<input type="checkbox"/>	no change
Typical traffic speeds >40 mph?	<input type="checkbox"/>	<input type="checkbox"/>	add 6"

SUB-TOTAL

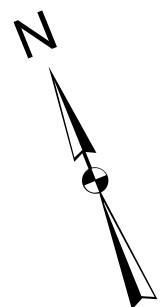
PARKING LANE _____ →		<input type="checkbox"/>	start with: 7'-6"
No storefront retail along street?	<input type="checkbox"/>	<input type="checkbox"/>	OK to subtract 6"
Some areas of storefront retail?	<input type="checkbox"/>	<input type="checkbox"/>	no change
Continuous storefront retail?	<input type="checkbox"/>	<input type="checkbox"/>	add 6-12" depending on level of turnover
Significant downhill stretch? (higher cycling speeds when >2%)	<input type="checkbox"/>	<input type="checkbox"/>	add 6"
Significant uphill stretch? (lower cycling speeds when >2%)	<input type="checkbox"/>	<input type="checkbox"/>	OK to subtract 6"

SUB-TOTAL <input style="width: 50px; height: 20px; background-color: #cccccc;" type="text"/>	IDEAL TOTAL <input style="width: 80px; height: 20px; background-color: #cccccc;" type="text"/>
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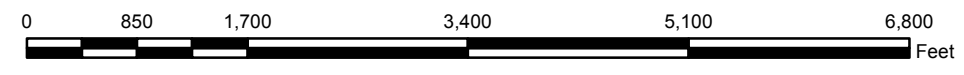
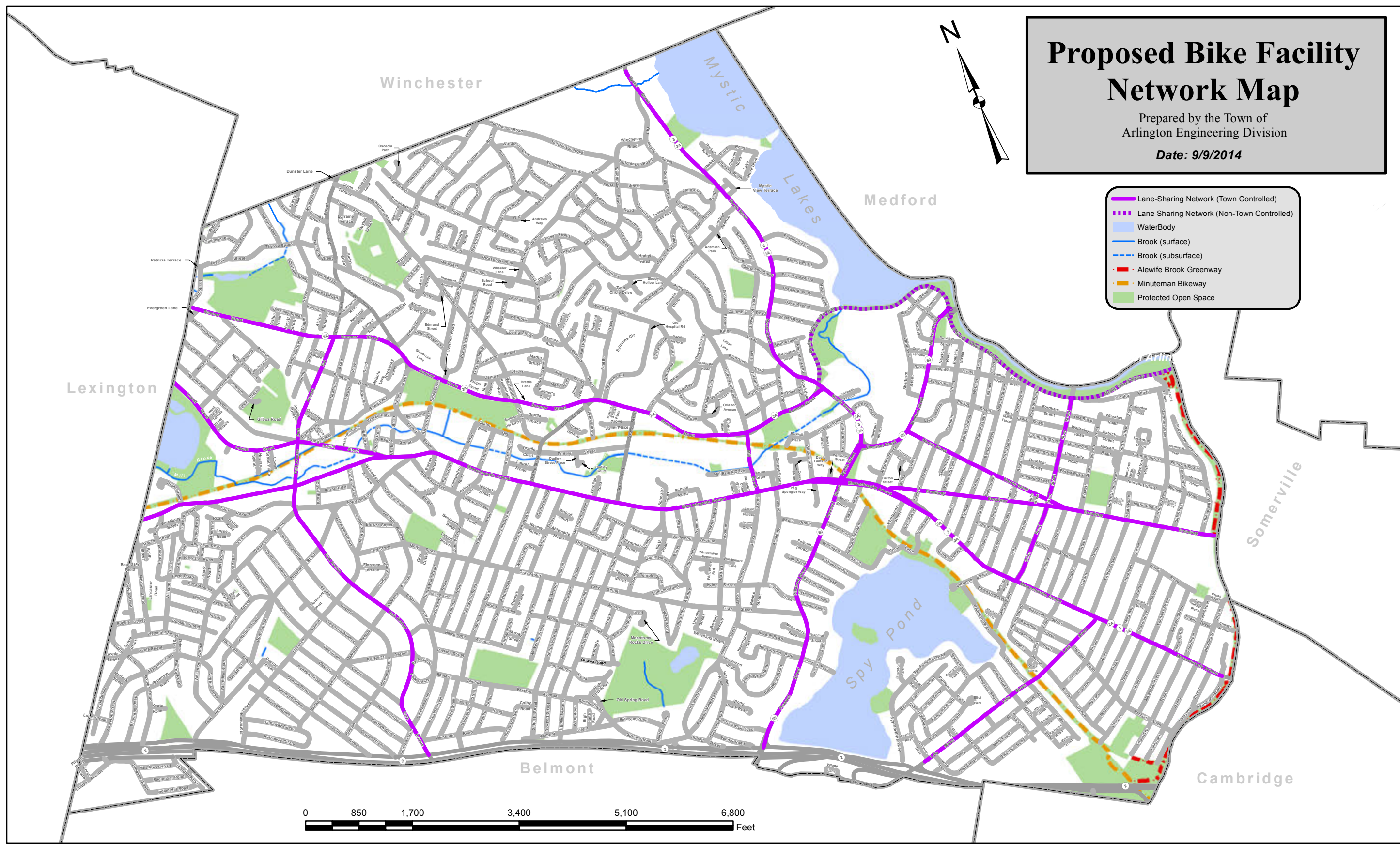
* - Limited bus/truck traffic: fewer than 10 buses and trucks in each direction per weekday peak hour
 ** - Moderate bus/truck traffic: between 10-40 buses and trucks in each direction per weekday peak hour
 *** - Frequent bus/truck traffic: more than 40 buses and trucks in each direction per weekday peak hour

Proposed Bike Facility Network Map

Prepared by the Town of
Arlington Engineering Division
Date: 9/9/2014



- Lane-Sharing Network (Town Controlled)
- - - Lane Sharing Network (Non-Town Controlled)
- WaterBody
- Brook (surface)
- - - Brook (subsurface)
- Alewife Brook Greenway
- Minuteman Bikeway
- Protected Open Space



APPENDIX

MUTCD Excerpts¹

These excerpts pertain to shared road accommodation. There are other excerpts, not included here, that pertain to shared-use paths.

For All Situations

Section 9A.02 Standard: The absence of a marked bicycle lane or any of the other traffic control devices discussed in this Chapter on a particular roadway shall not be construed to mean that bicyclists are not permitted to travel on that roadway.

Section 9B.13 Bicycle Signal Actuation Sign (R10-22)

Option: The Bicycle Signal Actuation (R10-22) sign (see Figure 9B-2) may be installed at signalized intersections where markings are used to indicate the location where a bicyclist is to be positioned to actuate the signal (see Section 9C.05).

Guidance: If the Bicycle Signal Actuation sign is installed, it should be placed at the roadside adjacent to the marking to emphasize the connection between the marking and the sign.



Figure 9C-7. Bicycle Detector Pavement Marking



For Bike Lanes

Section 9B.04 Bike Lane Signs and Plaques (R3-17, R3-17aP, R3-17bP)

Standard: The Bike Lane (R3-17) sign and the R3-17aP and R3-17bP plaques (see Figure 9B-2) shall be used only in conjunction with marked bicycle lanes as described in Section 9C.04.

Guidance: If used, Bike Lane signs and plaques should be used in advance of the upstream end of the bicycle lane, at the downstream end of the bicycle lane, and at periodic intervals along the bicycle lane as determined by engineering judgment based on prevailing speed of bicycle and other traffic, block length, distances from adjacent intersections, and other considerations.



Section 9B.05 BEGIN RIGHT TURN LANE YIELD TO BIKES Sign (R4-4)

Option: Where motor vehicles entering an exclusive right-turn lane must weave across bicycle traffic in bicycle lanes, the BEGIN RIGHT TURN LANE YIELD TO BIKES (R4-4) sign (see Figure 9B-2) may be used to inform both the motorist and the bicyclist of this weaving maneuver (see Figures 9C-1, 9C-4, and 9C-5).

Guidance: The R4-4 sign should not be used when bicyclists need to move left because of a right-turn lane drop situation.



Section 9C.04 Markings For Bicycle Lanes

Support: Pavement markings designate that portion of the roadway for preferential use by bicyclists. Markings inform all road users of the restricted nature of the bicycle lane.

Standard: Longitudinal pavement markings shall be used to define bicycle lanes.

Guidance: If used, bicycle lane word, symbol, and/or arrow markings (see Figure 9C-3) should be placed at the beginning of a bicycle lane and at periodic intervals along the bicycle lane based on engineering judgment

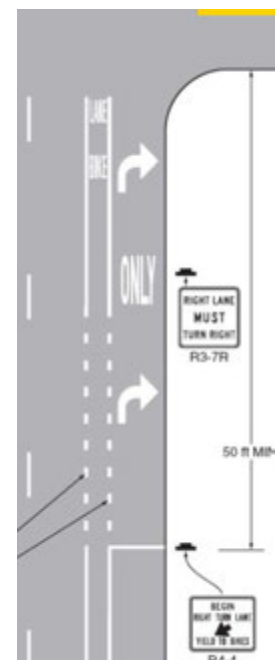
Standard: If the bicycle lane symbol marking is used in conjunction with word or arrow messages, it shall precede them.

Option: If the word, symbol, and/or arrow pavement markings shown in Figure 9C-3 are used, Bike Lane signs (see Section 9B.04) may also be used, but to avoid overuse of the signs not necessarily adjacent to every set of pavement markings.

Standard: A through bicycle lane shall not be positioned to the right of a right turn only lane or to the left of a left turn only lane.

Support: A bicyclist continuing straight through an intersection from the right of a right-turn lane or from the left of a left-turn lane would be inconsistent with normal traffic behavior and would violate the expectations of right- or left-turning motorists.

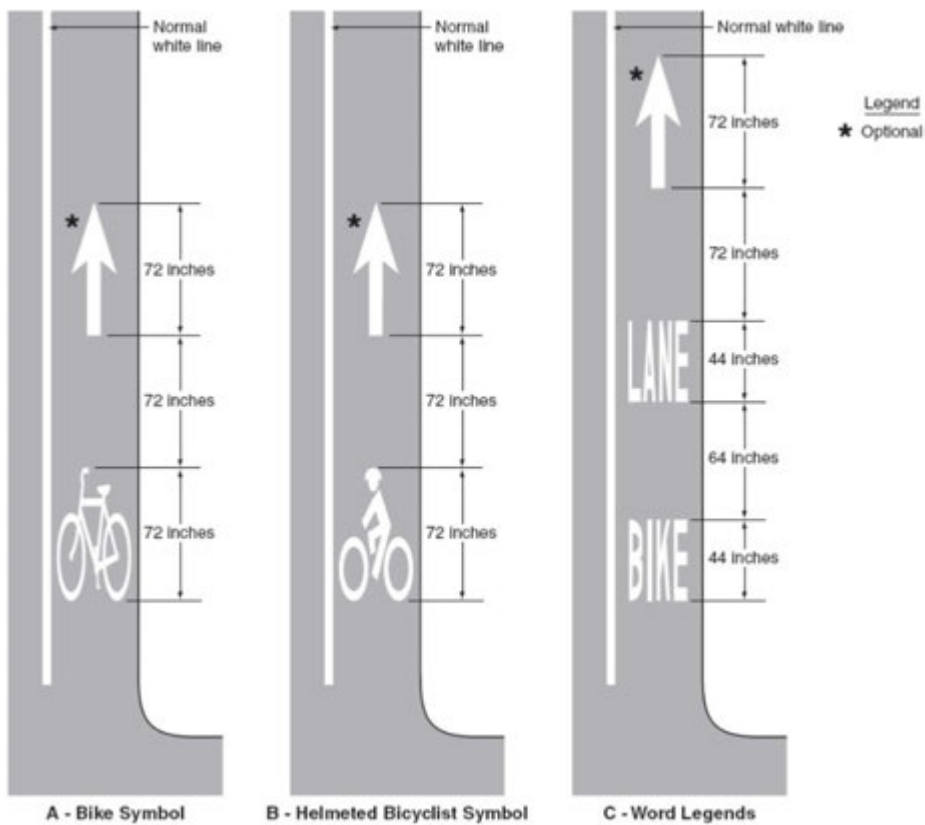
Guidance: When the right through lane is dropped to become a right turn only lane, the bicycle lane markings should stop at least 100 feet before the beginning of the right-turn lane. Through bicycle lane markings should resume to the left of the right turn only lane.



Treatment at Right Turn only lane

¹ From 2009 MUTCD, release 2: <http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/part9.pdf>

Figure 9C-3. Word, Symbol, and Arrow Pavement Markings for Bicycle Lanes



For Shared Lanes

Section 9C.07 Shared Lane Marking

Option: The Shared Lane Marking shown in Figure 9C-9 may be used to:

- 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,
- 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,
- Alert road users of the lateral location bicyclists are likely to occupy within the traveled way,
- Encourage safe passing of bicyclists by motorists, and
- Reduce the incidence of wrong-way bicycling.

Guidance: The Shared Lane Marking should not be placed on roadways that have a speed limit above 35 mph.

Standard: Shared Lane Markings shall not be used on shoulders or in designated bicycle lanes.

Guidance: 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.

Option: Section 9B.06 describes a Bicycles May Use Full Lane sign that may be used in addition to or instead of the Shared Lane Marking to inform road users that bicyclists might occupy the travel lane.

Section 9B.06 Bicycles May Use Full Lane Sign (R4-11)

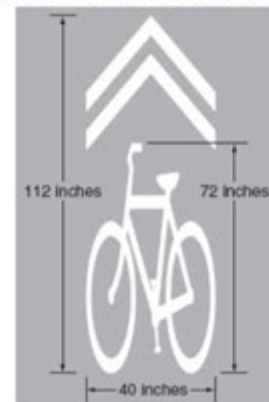
Option: The Bicycles May Use Full Lane (R4-11) sign (see Figure 9B-2) may be used on roadways where no bicycle lanes or adjacent shoulders usable by bicyclists are present and where travel lanes are too narrow for bicyclists and motor vehicles to operate side by side.

The Bicycles May Use Full Lane sign may be used in locations where it is important to inform road users that bicyclists might occupy the travel lane.

Section 9C.07 describes a Shared Lane Marking that may be used in addition to or instead of the Bicycles May Use Full Lane sign to inform road users that bicyclists might occupy the travel lane.

Support: The Uniform Vehicle Code (UVC) defines a "substandard width lane" as a "lane that is too narrow for a bicycle and a vehicle to travel safely side by side within the same lane."

Figure 9C-9. Shared Lane Marking



R4-11

References

<http://nacto.org/cities-for-cycling/design-guide/>

<http://www.bicyclinginfo.org/engineering>

<http://www.mhd.state.ma.us/default.asp?pgid=content/designguide&sid=about>

<http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/part9.pdf>