Countywide Transit Corridors Functional Master Plan

Appendix 11
BRT—Typical Sections

PARSONS BRINCKERHOFF

Tower 1, 10th Floor
100 S. Charles Street
Baltimore, MD 21201-2727
(410) 727-5050

Memorandum

To: Larry Cole, M-NCPPC

From: Monique Ellis, Parsons Brinckerhoff

CC: Mike Flood, Alan Danaher, Parsons Brinckerhoff

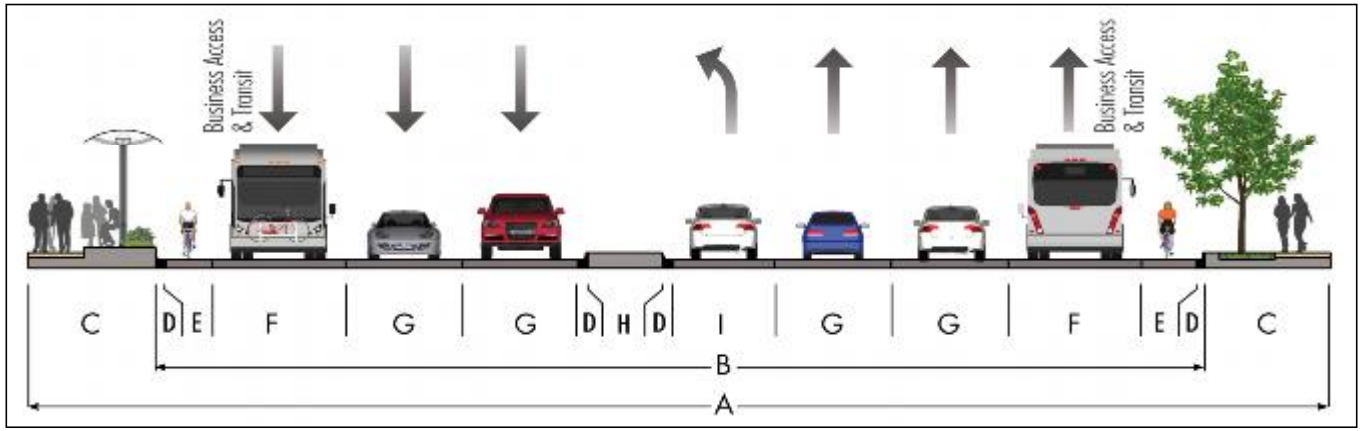
Date: November 30, 2012

Subject: BRT Typical Sections – Update (**FINAL**)

The following pages and accompanying spreadsheet named "ROW intersection envelope options 120418 (to MNCPPC).xlsx" contain minor revisions to the matrices BRT runningway matrices and intersection envelope widths submitted to M-NCPPC on March 16, 2012. These updated typical sections reflect the PB study team's recommendation to to increase the minimum width of the planting strips to eight feet to provide for stormwater management within the developed rights-of-way.

CONCURRENT FLOW CURB LANES

Intersection Right-of-Way - with Stations



Designation	A	B	C			D	E	F	G	G	D	H	D	I	G	G	F	E	I	D	C			
Description	Overall Right-of-Way	Face of Curb-to-Face of Curb Roadway Width	Maintenance Offset	Sidewalk	Station	Gutter	Bicycle Lane	Business Access and Transit (BAT) Lane	Through Travel Lane	Through Travel Lane	Gutter	Pedestrian Refuge	Gutter	Turn Lane	Through Travel Lane	Through Travel Lane	Business Access and Transit (BAT) Lane	Bicycle Lane	Turn Lane	Gutter	Curb	Planting Strip	Sidewalk	Maintenance Offset
Urban 2+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																								
Preferred	117	72	--	10.5	12	1	4	11	--	11	1	6	1	10	--	11	11	4	--	1	0.5	8	14	--
Constrained	102	65	--	7	10	1	--	13	--	10	1	6	1	9	--	10	13	--	--	1	0.5	8	11.5	--
Urban 4+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																								
Preferred	139	94	--	10.5	12	1	4	11	11	11	1	6	1	10	11	11	11	4	--	1	0.5	8	14	--
Constrained	122	85	--	7	10	1	--	13	10	10	1	6	1	9	10	10	13	--	--	1	0.5	8	11.5	--
Suburban 2+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																								
Preferred	126	85	2	6.5	12	1	5	11	--	11	1	6	1	10	--	11	11	6	10	1	0.5	10	8	2
Constrained	107.5	75	1	6	10	1	--	13	--	10	1	6	1	9	--	10	14	--	9	1	0.5	8	6	1
Suburban 4+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																								
Preferred	148	107	2	6.5	12	1	5	11	11	11	1	6	1	10	11	11	11	6	10	1	0.5	10	8	2
Constrained	127.5	95	1	6	10	1	--	13	10	10	1	6	1	9	10	10	14	--	9	1	0.5	8	6	1

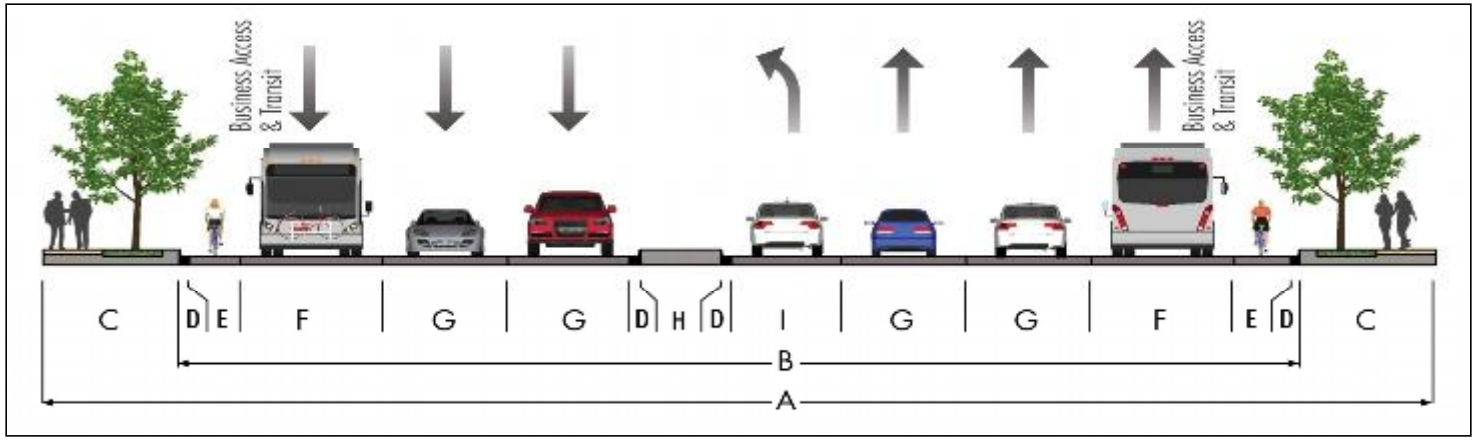
CONCURRENT FLOW CURB LANES

Intersection Right-of-Way – with Stations

Designation	Description	Notes
A	Overall Right-of-Way	• Typical section assumes one curb-side station on far side of intersection
B	Curb-to-Curb Pavement Width	• Typical section assumes transit corridors intersect arterial roadways at signalized intersections. • Urban constrained conditions reflect one exclusive left-turn lane and zero exclusive right-turn lanes • Suburban constrained conditions reflect one exclusive left-turn lane and one exclusive right-turn lane • Both urban and suburban preferred conditions reflect one exclusive left-turn lane and one exclusive right-turn lane
C	Streetscape—Maintenance Offset Sidewalk/Planting Strip/Curb	• Source: "Chapter 49. Streets and Roads – Regulation," Montgomery County (sidewalk and planting strip dimensions) • See Table 1 for detailed assumptions for maintenance offset, sidewalk, planting strip, and curb • When station platform is present within the streetscape, it is 10 feet wide under constrained conditions; all other placements of station platforms assume a 12-foot width.
E	Bicycle Lane	• Source: "Chapter 3: Bicycle Lane Design," Maryland SHA Bicycle and Pedestrian Design Guidelines • Assume smaller dimension when adjacent to gutter pan
F	Business Access and Transit (BAT) Lane	• Source: TCRP Report 118, TRB (for lane widths under preferred conditions) • For use by transit vehicles and other vehicles either entering and exiting adjacent properties or making right turns • BRT vehicles use full-time BAT lanes throughout the day • Wider 14-foot outside lane would be shared with bicycles in constrained areas • Assume smaller dimension when adjacent to gutter pan
G	Through Travel Lane	• Source: "A Policy on Geometric Design of Highways and Streets," AASHTO • Assume smaller dimension when adjacent to gutter pan
H	Pedestrian Refuge	• Provides for 6-ft median (inclusive of top of curbs)
I	Turn Lane	• Assume smaller dimension when adjacent to gutter pan • If BRT station is located near-side (before crossing intersection), right turn lane could be shared with BRT vehicles as a queue jump, as well as bicycles

CONCURRENT FLOW CURB LANES

Intersection Right-of-Way - without Stations



Designation	A	B	C				D	E	F	G	G	D	H	D	I	G	G	F	E	I	D	C			
Description	Overall Right-of-Way	Face of Curb-to-Face of Curb Roadway Width	Maintenance Offset	Sidewalk	Planting Strip	Curb	Gutter	Bicycle Lane	Business Access and Transit (BAT) Lane	Through Travel Lane	Through Travel Lane	Gutter	Pedestrian Refuge	Gutter	Turn Lane	Through Travel Lane	Through Travel Lane	Business Access and Transit (BAT) Lane	Bicycle Lane	Turn Lane	Gutter	Curb	Planting Strip	Sidewalk	Maintenance Offset
Urban 2+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																									
Preferred	117	72	--	14	8	0.5	1	4	11	--	11	1	6	1	10	--	11	11	4	--	1	0.5	8	14	--
Constrained	105	65	--	11.5	8	0.5	1	--	13	--	10	1	6	1	9	--	10	13	--	--	1	0.5	8	11.5	--
Urban 4+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																									
Preferred	139	94	--	14	8	0.5	1	4	11	11	11	1	6	1	10	11	11	11	4	--	1	0.5	8	14	--
Constrained	125	85	--	11.5	8	0.5	1	--	13	10	10	1	6	1	9	10	10	13	--	--	1	0.5	8	11.5	--
Suburban 2+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																									
Preferred	126	85	2	8	10	0.5	1	5	11	--	11	1	6	1	10	--	11	11	6	10	1	0.5	10	8	2
Constrained	106	75	1	6	8	0.5	1	--	13	--	10	1	6	1	9	--	10	14	--	9	1	0.5	8	6	1
Suburban 4+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																									
Preferred	148	107	2	8	10	0.5	1	5	11	11	11	1	6	1	10	11	11	11	6	10	1	0.5	10	8	2
Constrained	126	95	1	6	8	0.5	1	--	13	10	10	1	6	1	9	10	10	14	--	9	1	0.5	8	6	1

CONCURRENT FLOW CURB LANES

Intersection Right-of-Way – without Stations

Designation	Description	Notes
A	Overall Right-of-Way	• Typical section assumes one curb-side station on far side of intersection
B	Curb-to-Curb Pavement Width	• Typical section assumes transit corridors intersect arterial roadways at signalized intersections. • Urban constrained conditions reflect one exclusive left-turn lane and zero exclusive right-turn lanes • Suburban constrained conditions reflect one exclusive left-turn lane and one exclusive right-turn lane • Both urban and suburban preferred conditions reflect one exclusive left-turn lane and one exclusive right-turn lane
C	Streetscape—Maintenance Offset Sidewalk/Planting Strip/Curb	• Source: "Chapter 49. Streets and Roads – Regulation," Montgomery County (sidewalk and planting strip dimensions) • See Table 1 for detailed assumptions for maintenance offset, sidewalk, planting strip, and curb
E	Bicycle Lane	• Source: "Chapter 3: Bicycle Lane Design," Maryland SHA Bicycle and Pedestrian Design Guidelines • Assume smaller dimension when adjacent to gutter pan
F	Business Access and Transit (BAT) Lane	• Source: TCRP Report 118, TRB (for lane widths under preferred conditions) • For use by transit vehicles and other vehicles either entering and exiting adjacent properties or making right turns • BRT vehicles use full-time BAT lanes throughout the day • Wider 14-foot outside lane would be shared with bicycles in constrained areas • Assume smaller dimension when adjacent to gutter pan
G	Through Travel Lane	• Source: "A Policy on Geometric Design of Highways and Streets," AASHTO • Assume smaller dimension when adjacent to gutter pan
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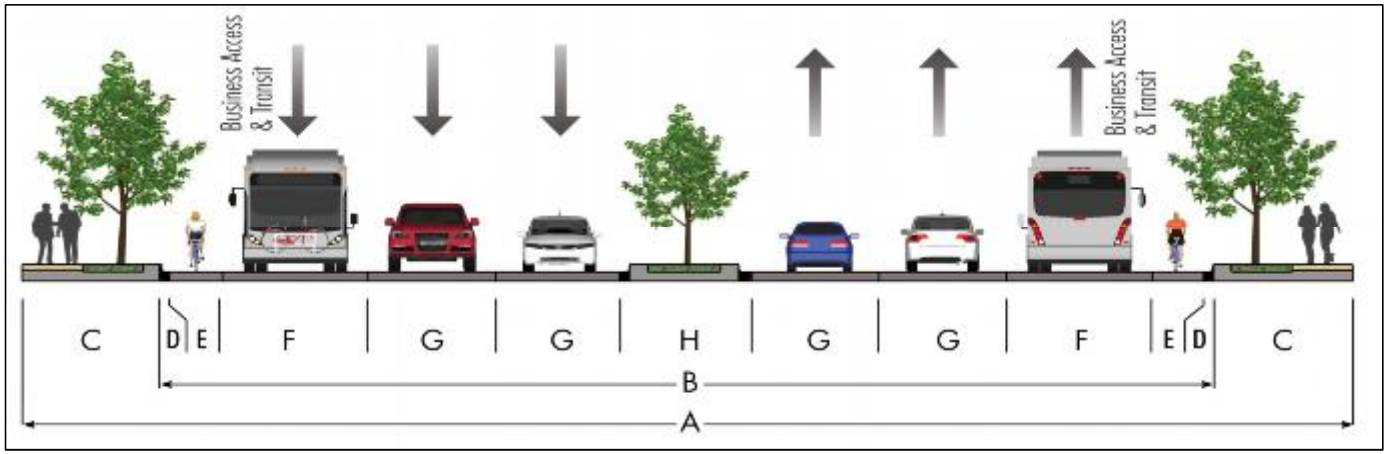
I	Turn Lane	• Assume smaller dimension when adjacent to gutter pan • If BRT station is located near-side (before crossing intersection), right turn lane could be shared with BRT vehicles as a queue jump, as well as bicycles

CONCURRENT FLOW CURB LANES

Unsignalized Intersection Right-of-Way



Designation	A	B	C				D	E	F	G	G	H	G	G	F	E	D	C			
Description	Overall Right-of-Way	Face of Curb-to-Face of Curb Roadway Width	Maintenance Offset	Sidewalk	Planting Strip	Curb	Gutter	Bicycle Lane	Business Access and Transit (BAT) Lane	Through Travel Lane	Through Travel Lane	Pedestrian Refuge and Gutter Pans	Through Travel Lane	Through Travel Lane	Business Access and Transit (BAT) Lane	Bicycle Lane	Gutter	Curb	Planting Strip	Sidewalk	Maintenance Offset
Urban 2+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																					
Preferred	117	72	--	14	8	0.5	1	4	11	--	11	18	11	--	11	4	1	0.5	8	14	--
Constrained	98	58	--	11.5	8	0.5	1	--	13	--	10	10	10	--	13	--	1	0.5	8	11.5	--
Urban 4+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																					
Preferred	139	94	--	14	8	0.5	1	4	11	11	11	18	11	11	11	4	1	0.5	8	14	--
Constrained	125	85	--	11.5	8	0.5	1	--	13	10	10	17	10	10	13	--	1	0.5	8	11.5	--
Suburban 2+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																					
Preferred	115	74	2	8	10	0.5	1	5	11	--	11	18	11	--	11	5	1	0.5	10	8	2
Constrained	89	58	1	6	8	0.5	1	--	13	--	10	10	10	--	13	--	1	0.5	8	6	1
Suburban 4+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																					
Preferred	137	96	2	8	10	0.5	1	5	11	11	11	18	11	11	11	5	1	0.5	10	8	2
Constrained	116	85	1	6	8	0.5	1	--	13	10	10	17	10	10	13	--	1	0.5	8	6	1

CONCURRENT FLOW CURB LANES

Unsignalized Intersection Right-of-Way

Designation	Description	Notes
C	Streetscape—Maintenance Offset Sidewalk/Planting Strip/Curb	• Source: "Chapter 49. Streets and Roads – Regulation," Montgomery County (sidewalk and planting strip dimensions) • See Table 1 for detailed assumptions for maintenance offset, sidewalk, planting strip, and curb
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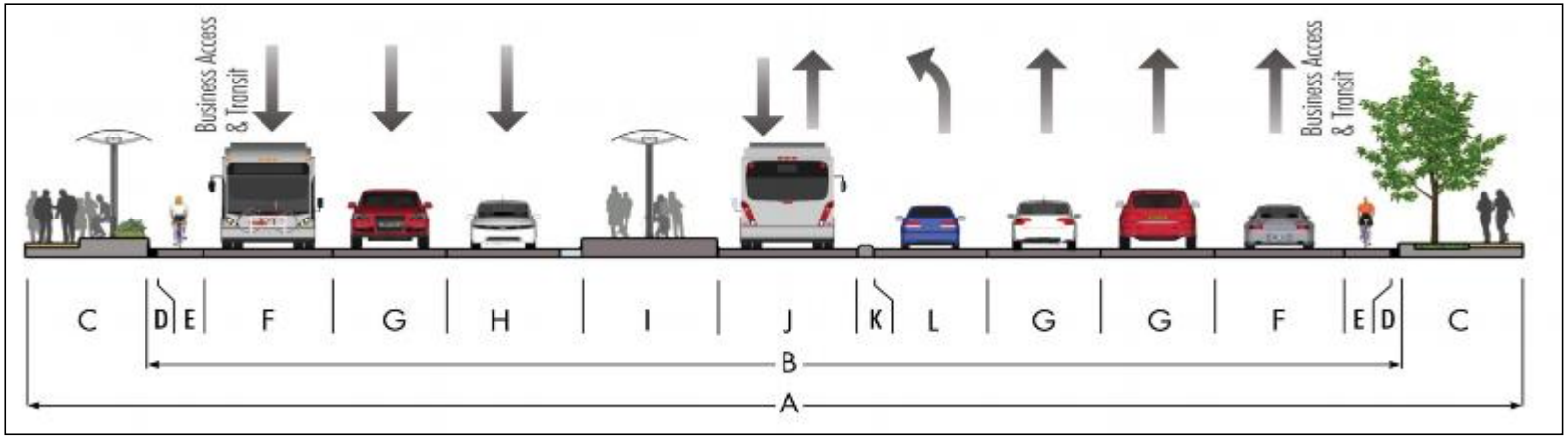
G	Through Travel Lane	• Source: "A Policy on Geometric Design of Highways and Streets," AASHTO • Assume smaller dimension when adjacent to gutter pan
H	Pedestrian Refuge and Gutter Pans	• Wide pedestrian refuge provides area for two 1-ft gutter pans, 6-ft median (inclusive of top of curbs), and 10-11-ft turn lane (inclusive of gutter pan) under constrained and preferred conditions, respectively, based on future traffic needs

REVERSIBLE ONE-LANE MEDIAN BUSWAY

Intersection Right-of-Way - with Stations



Designation	A	B	C			D	E	F	G	H	I	J	K	L	G	G	F	E	L	D	C			
Description	Overall Right-of-Way	Face of Curb-to-Face of Curb Roadway Width	Maintenance Offset	Sidewalk	Station	Gutter	Bicycle Lane	Business Access and Transit (BAT) Lane	Through Travel Lane	Inside Travel Lane	Station	BRT Lane	Mountable Curb	Turn Lane	Through Travel Lane	Through Travel Lane	Business Access and Transit (BAT) Lane	Bicycle Lane	Turn Lane	Gutter	Curb	Planting Strip	Sidewalk	Maintenance Offset
Urban 4+1 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																								
Preferred	138	93	--	10.5	12	1	4	11	--	13	12	12	2	11	11	--	11	4	--	1	0.5	8	14	--
Constrained	122	85	--	7	10	1	--	13	--	12	12	11	2	10	10	--	13	--	--	1	0.5	8	11.5	--
Urban 6+1 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																								
Preferred	160	115	--	10.5	12	1	4	11	11	13	12	12	2	11	11	11	11	4	--	1	0.5	8	14	--
Constrained	142	105	--	7	10	1	--	13	10	12	12	11	2	10	10	10	13	--	--	1	0.5	8	11.5	--
Suburban 4+1 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																								
Preferred	147	106	2	6.5	12	1	5	11	--	13	12	12	2	11	11	--	11	6	10	1	0.5	10	8	2
Constrained	127.5	95	1	6	10	1	--	13	--	12	12	11	2	10	10	--	14	--	9	1	0.5	8	6	1
Suburban 6+1 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																								
Preferred	169	128	2	6.5	12	1	5	11	11	13	12	12	2	11	11	11	11	6	10	1	0.5	10	8	2
Constrained	147.5	115	1	6	10	1	--	13	10	12	12	11	2	10	10	10	14	--	9	1	0.5	8	6	1

REVERSIBLE ONE-WAY MEDIAN BUSWAY

Intersection Right-of-Way – with Stations

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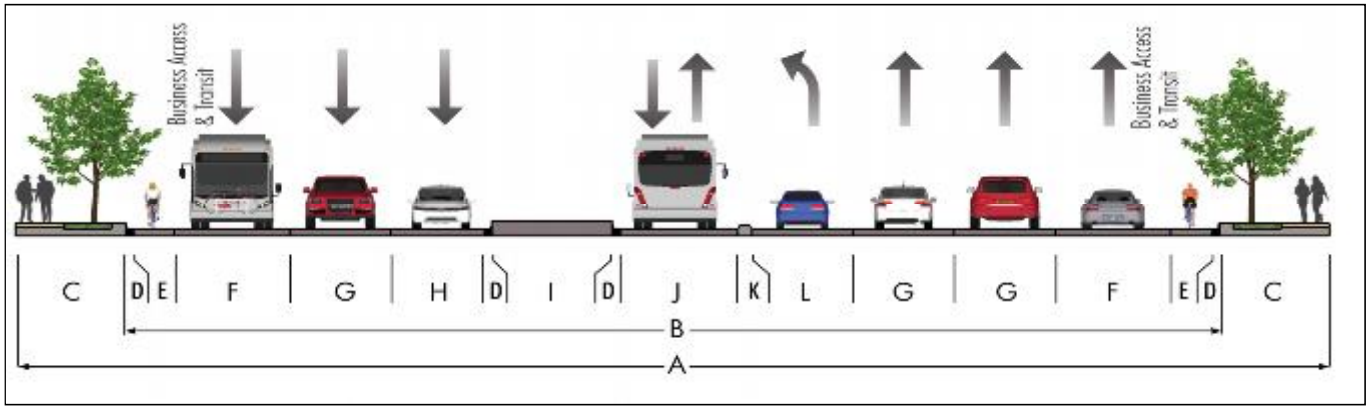
H	Inside Travel Lane	• Includes 2-ft separation distance when adjacent to BRT station
I	Station Platform	• Source: TCRP Report 118, TRB
J	BRT Lane	• Source: "Designing Bus Rapid Transit Running Ways: Recommended Practice," APTA • BRT lane width provides flexibility to design busway for physically guided or unguided operation
K	Mountable Curb	• Source: "Designing Bus Rapid Transit Running Ways: Recommended Practice," APTA • Includes separation distance • Should be mountable to allow access and egress to the lane (pass and service disabled vehicles). If tubular marking (pylon) is added atop mountable curb, its width should be 2 to 6 inches.
L	Turn Lane	• Assume smaller dimension when adjacent to gutter pan • If BRT station is located near-side (before crossing intersection), right turn lane could be shared with BRT vehicles as a queue jump, as well as bicycles

REVERSIBLE ONE-LANE MEDIAN BUSWAY

Intersection Right-of-Way - without Stations



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Urban 4+1 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																											
Preferred	132	87	--	14	8	0.5	1	4	11	--	11	1	6	1	12	2	11	11	--	11	4	--	1	0.5	8	14	--
Constrained	119	79	--	11.5	8	0.5	1	--	13	--	10	1	6	1	11	2	10	10	--	13	--	--	1	0.5	8	11.5	--
Urban 6+1 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																											
Preferred	154	109	--	14	8	0.5	1	4	11	11	11	1	6	1	12	2	11	11	11	11	4	--	1	0.5	8	14	--
Constrained	139	99	--	11.5	8	0.5	1	--	13	10	10	1	6	1	11	2	10	10	10	13	--	--	1	0.5	8	11.5	--
Suburban 4+1 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																											
Preferred	141	100	2	8	10	0.5	1	5	11	--	11	1	6	1	12	2	11	11	--	11	6	10	1	0.5	10	8	2
Constrained	120	89	1	6	8	0.5	1	--	13	--	10	1	6	1	11	2	10	10	--	14	--	9	1	0.5	8	6	1
Suburban 6+1 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																											
Preferred	163	122	2	8	10	0.5	1	5	11	11	11	1	6	1	12	2	11	11	11	11	6	10	1	0.5	10	8	2
Constrained	140	109	1	6	8	0.5	1	--	13	10	10	1	6	1	11	2	10	10	10	14	--	9	1	0.5	8	6	1

REVERSIBLE ONE-WAY MEDIAN BUSWAY

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J	BRT Lane	• Source: "Designing Bus Rapid Transit Running Ways: Recommended Practice," APTA • BRT lane width provides flexibility to design busway for physically guided or unguided operation
K	Mountable Curb	• Source: "Designing Bus Rapid Transit Running Ways: Recommended Practice," APTA • Includes separation distance • Should be mountable to allow access and egress to the lane (pass and service disabled vehicles). If tubular marking (pylon) is added atop mountable curb, its width should be 2 to 6 inches.
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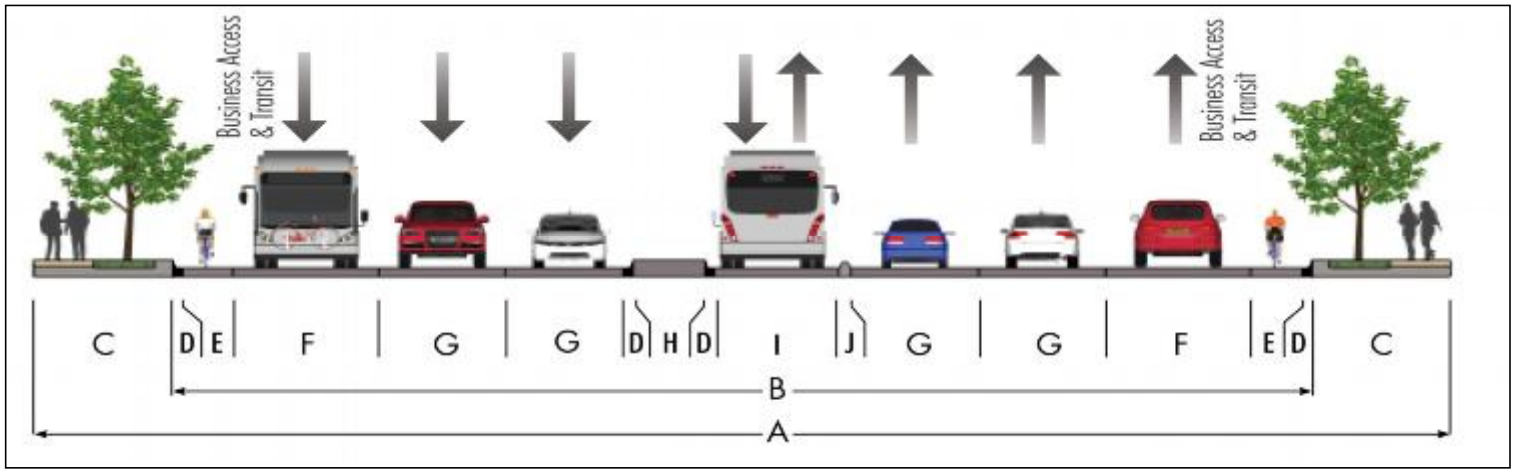
REVERSIBLE ONE-LANE MEDIAN BUSWAY

Unsignalized Intersection Right-of-Way



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Urban 4+1 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																									
Preferred	121	76	--	14	8	0.5	1	4	11	--	11	1	6	1	12	2	11	--	11	4	1	0.5	8	14	--
Constrained	109	69	--	11.5	8	0.5	1	--	13	--	10	1	6	1	11	2	10	--	13	--	1	0.5	8	11.5	--
Urban 6+1 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																									
Preferred	143	98	--	14	8	0.5	1	4	11	11	11	1	6	1	12	2	11	11	11	4	1	0.5	8	14	--
Constrained	129	89	--	11.5	8	0.5	1	--	13	10	10	1	6	1	11	2	10	10	13	--	1	0.5	8	11.5	--
Suburban 4+1 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																									
Preferred	119	78	2	8	10	0.5	1	5	11	--	11	1	6	1	12	2	11	--	11	5	1	0.5	10	8	2
Constrained	100	69	1	6	8	0.5	1	--	13	--	10	1	6	1	11	2	10	--	13	--	1	0.5	8	6	1
Suburban 6+1 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																									
Preferred	141	100	2	8	10	0.5	1	5	11	11	11	1	6	1	12	2	11	11	11	5	1	0.5	10	8	2
Constrained	120	89	1	6	8	0.5	1	--	13	10	10	1	6	1	11	2	10	10	13	--	1	0.5	8	6	1

REVERSIBLE ONE-WAY MEDIAN BUSWAY

Unsignalized Intersection Right-of-Way

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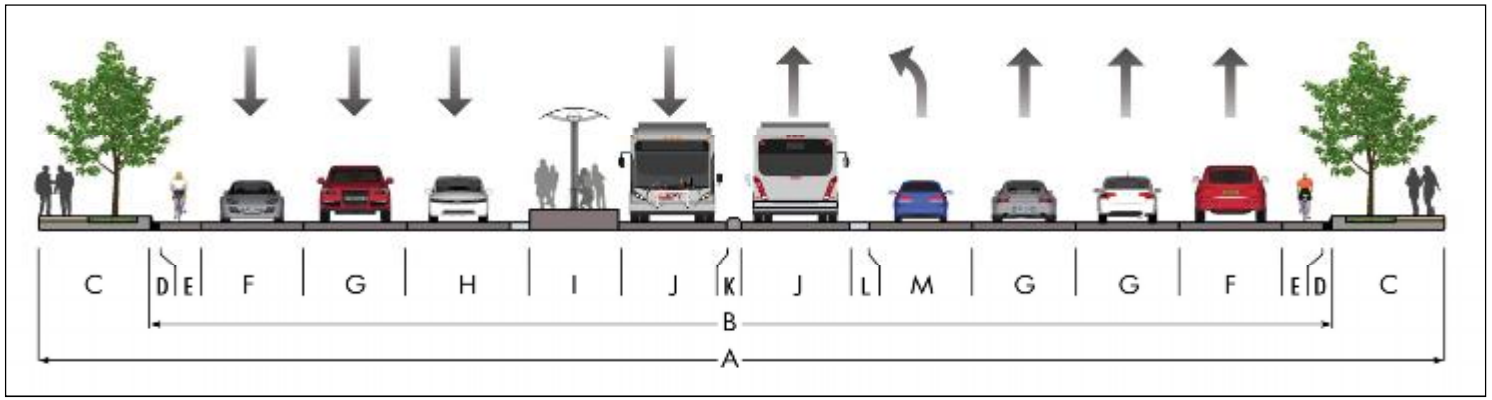
C	Streetscape—Maintenance Offset Sidewalk/Planting Strip/Curb	• Source: "Chapter 49. Streets and Roads – Regulation," Montgomery County (sidewalk and planting strip dimensions) • See Table 1 for detailed assumptions for maintenance offset, sidewalk, planting strip, and curb
E	Bicycle Lane	• Source: "Chapter 3: Bicycle Lane Design," Maryland SHA Bicycle and Pedestrian Design Guidelines • Assume smaller dimension when adjacent to gutter pan
F	Business Access and Transit (BAT) Lane	• Source: TCRP Report 118, TRB (for lane widths under preferred conditions) • For use by transit vehicles and other vehicles either entering and exiting adjacent properties or making right turns • BRT vehicles use part-time BAT lanes in the off-peak direction during peak periods • Wider 14-foot outside lane would be shared with bicycles in constrained areas • Assume smaller dimension when adjacent to gutter pan
G	Inside Travel Lane	• Source: "A Policy on Geometric Design of Highways and Streets," AASHTO • Assume smaller dimension when adjacent to gutter pan
H	Pedestrian Refuge	• Provides for 6-ft median (inclusive of top of curbs)
I	BRT Lane	• Source: "Designing Bus Rapid Transit Running Ways: Recommended Practice," APTA • BRT lane width provides flexibility to design busway for physically guided or unguided operation
J	Mountable Curb	• Source: "Designing Bus Rapid Transit Running Ways: Recommended Practice," APTA • Includes separation distance • Should be mountable to allow access and egress to the lane (pass and service disabled vehicles). If tubular marking (pylon) is added atop mountable curb, its width should be 2 to 6 inches.

TWO-LANE MEDIAN BUSWAY

Intersection Right-of-Way - with Stations



Designation	A	B	C				D	E	F	G	H	I	J	K	J	L	M	G	G	F	E	M	D	C			
Description	Overall Right-of-Way	Face of Curb-to-Face of Curb Roadway Width	Maintenance Offset	Sidewalk	Planting Strip	Curb	Gutter	Bicycle Lane	Outside Travel Lane	Through Travel Lane	Inside Travel Lane	Station	BRT Lane	Raised Curb	BRT Lane	Striped Buffer	Turn Lane	Through Travel Lane	Through Travel Lane	Outside Travel Lane	Bicycle Lane	Turn Lane	Gutter	Curb	Planting Strip	Sidewalk	Maintenance Offset
Urban 4+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																											
Preferred	154	109	--	14	8	0.5	1	4	11	--	13	12	12	4	12	2	11	11	--	11	4	--	1	0.5	8	14	--
Constrained	138	98	--	11.5	8	0.5	1	--	13	--	12	12	11	2	11	2	10	10	--	13	--	--	1	0.5	8	11.5	--
Urban 6+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																											
Preferred	176	131	--	14	8	0.5	1	4	11	11	13	12	12	4	12	2	11	11	11	11	4	--	1	0.5	8	14	--
Constrained	158	118	--	11.5	8	0.5	1	--	13	10	12	12	11	2	11	2	10	10	10	13	--	--	1	0.5	8	11.5	--
Suburban 4+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																											
Preferred	163	122	2	8	10	0.5	1	5	11	--	13	12	12	4	12	2	11	11	--	11	6	10	1	0.5	10	8	2
Constrained	139	108	1	6	8	0.5	1	--	13	--	12	12	11	2	11	2	10	10	--	14	--	9	1	0.5	8	6	1
Suburban 6+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																											
Preferred	185	144	2	8	10	0.5	1	5	11	11	13	12	12	4	12	2	11	11	11	11	6	10	1	0.5	10	8	2
Constrained	159	128	1	6	8	0.5	1	--	13	10	12	12	11	2	11	2	10	10	10	14	--	9	1	0.5	8	6	1

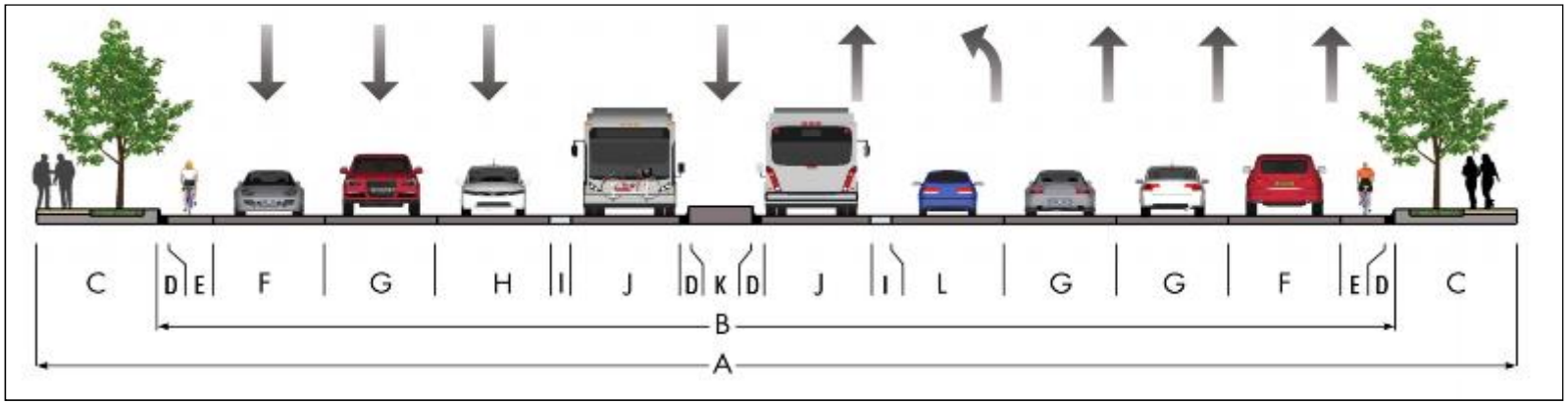
TWO-LANE MEDIAN BUSWAY

Intersection Right-of-Way – with Stations

Designation	Description	Notes
A	Overall Right-of-Way	• Typical section assumes one median station on far side of intersection
B	Curb-to-Curb Pavement Width	• Typical section assumes transit corridors intersect arterial roadways at signalized intersections. • Both urban preferred and constrained conditions reflect one exclusive left-turn lane and zero exclusive right-turn lanes • Both suburban preferred and constrained conditions reflect one exclusive left-turn lane and one exclusive right-turn lane
C	Streetscape—Maintenance Offset Sidewalk/Planting Strip/Curb	• Source: "Chapter 49. Streets and Roads – Regulation," Montgomery County (sidewalk and planting strip dimensions) • See Table 1 for detailed assumptions for maintenance offset, sidewalk, planting strip, and curb
E	Bicycle Lane	• Source: "Chapter 3: Bicycle Lane Design," Maryland SHA Bicycle and Pedestrian Design Guidelines • Assume smaller dimension when adjacent to gutter pan
F	Outside Travel Lane	• Source: "A Policy on Geometric Design of Highways and Streets," AASHTO • Wider 14-foot outside lane would be shared with bicycles in constrained areas • Travel lane could be up to 12 feet wide in suburban areas under preferred conditions • Assume smaller dimension when adjacent to gutter pan
H	Inside Travel Lane	• Source: "A Policy on Geometric Design of Highways and Streets," AASHTO • Travel lane could be up to 12 feet wide in suburban areas under preferred conditions • Includes 2-ft separation distance when adjacent to BRT station
I	Station Platform	• Source: TCRP Report 118, TRB
J	BRT Lane	• Source: "Designing Bus Rapid Transit Running Ways: Recommended Practice," APTA • BRT lane width provides flexibility to design busway for physically guided or unguided operation
K	Mountable Curb	• Source: "Designing Bus Rapid Transit Running Ways: Recommended Practice," APTA • Includes separation distance • Should be mountable to allow access and egress to the lane (pass and service disabled vehicles). If tubular marking (pylon) is added atop mountable curb, its width should be 2 to 6 inches.
L	Striped Buffer	• Provides 2-ft separation distance between BRT and travel lanes • Flush surface of striped buffer facilitates entering and exiting of busway during maintenance or emergency operations
M	Turn Lane	• Source: "A Policy on Geometric Design of Highways and Streets," AASHTO • Travel lane could be up to 12 feet wide in suburban areas under preferred conditions Assume smaller dimension when adjacent to gutter pan • If BRT station is located near-side (before crossing intersection), right turn lane could be shared with BRT vehicles as a queue jump, as well as bicycles

TWO-LANE MEDIAN BUSWAY

Intersection Right-of-Way - without Stations



Designation	A	B	C				D	E	F	G	H	I	J	D	K	D	J	I	L	G	G	F	E	L	D	C			
Description	Overall Right-of-Way	Face of Curb-to-Face of Curb Roadway Width	Maintenance Offset	Sidewalk	Planting Strip	Curb	Gutter	Bicycle Lane	Outside Travel Lane	Through Travel Lane	Inside Travel Lane	Striped Buffer	BRT Lane	Gutter	Pedestrian Refuge	Gutter	BRT Lane	Striped Buffer	Turn Lane	Through Travel Lane	Through Travel Lane	Outside Travel Lane	Bicycle Lane	Turn Lane	Gutter	Curb	Planting Strip	Sidewalk	Maintenance Offset
Urban 4+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																													
Preferred	146	101	--	14	8	0.5	1	4	11	--	11	2	12	1	6	1	12	2	11	11	--	11	4	--	1	0.5	8	14	--
Constrained	132	92	--	11.5	8	0.5	1	--	13	--	10	2	11	1	6	1	11	2	10	10	--	13	--	--	1	0.5	8	11.5	--
Urban 6+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																													
Preferred	168	123	--	14	8	0.5	1	4	11	11	11	2	12	1	6	1	12	2	11	11	11	11	4	--	1	0.5	8	14	--
Constrained	152	112	--	11.5	8	0.5	1	--	13	10	10	2	11	1	6	1	11	2	10	10	10	13	--	--	1	0.5	8	11.5	--
Suburban 4+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																													
Preferred	155	114	2	8	10	0.5	1	5	11	--	11	2	12	1	6	1	12	2	11	11	--	11	6	10	1	0.5	10	8	2
Constrained	133	102	1	6	8	0.5	1	--	13	--	10	2	11	1	6	1	11	2	10	10	--	14	--	9	1	0.5	8	6	1
Suburban 6+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																													
Preferred	177	136	2	8	10	0.5	1	5	11	11	11	2	12	1	6	1	12	2	11	11	11	11	6	10	1	0.5	10	8	2
Constrained	153	122	1	6	8	0.5	1	--	13	10	10	2	11	1	6	1	11	2	10	10	10	14	--	9	1	0.5	8	6	1

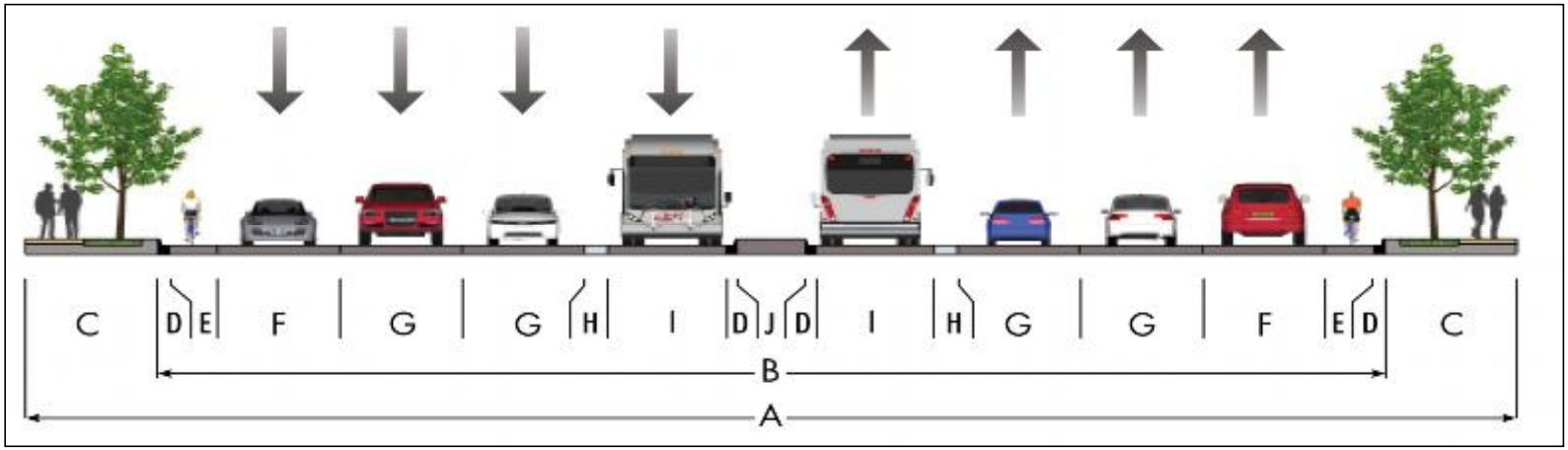
TWO-LANE MEDIAN BUSWAY

Intersection Right-of-Way – without Stations

Designation	Description	Notes
A	Overall Right-of-Way	• Typical section assumes one curb-side station and one median station, each on far side of intersection in each direction
B	Curb-to-Curb Pavement Width	• Typical section assumes transit corridors intersect arterial roadways at signalized intersections. • Both urban preferred and constrained conditions reflect one exclusive left-turn lane and zero exclusive right-turn lanes • Both suburban preferred and constrained conditions reflect one exclusive left-turn lane and one exclusive right-turn lane
C	Streetscape—Maintenance Offset Sidewalk/Planting Strip/Curb	• Source: "Chapter 49. Streets and Roads – Regulation," Montgomery County (sidewalk and planting strip dimensions) • See Table 1 for detailed assumptions for maintenance offset, sidewalk, planting strip, and curb
E	Bicycle Lane	• Source: "Chapter 3: Bicycle Lane Design," Maryland SHA Bicycle and Pedestrian Design Guidelines • Assume smaller dimension when adjacent to gutter pan
F	Outside Travel Lane	• Source: "A Policy on Geometric Design of Highways and Streets," AASHTO • Wider 14-foot outside lane would be shared with bicycles in constrained areas • Travel lane could be up to 12 feet wide in suburban areas under preferred conditions • Assume smaller dimension when adjacent to gutter pan
H	Inside Travel Lane	• Source: "A Policy on Geometric Design of Highways and Streets," AASHTO • Travel lane could be up to 12 feet wide in suburban areas under preferred conditions
I	Striped Buffer	• Provides 2-ft separation distance between BRT and travel lanes • Flush surface of striped buffer facilitates entering and exiting of busway during maintenance or emergency operations
J	BRT Lane	• Source: "Designing Bus Rapid Transit Running Ways: Recommended Practice," APTA • BRT lane width provides flexibility to design busway for physically guided or unguided operation
K	Pedestrian Refuge	• Provides for 6-ft median (inclusive of top of curbs)
L	Turn Lane	• Source: "A Policy on Geometric Design of Highways and Streets," AASHTO • Travel lane could be up to 12 feet wide in suburban areas under preferred conditions Assume smaller dimension when adjacent to gutter pan • If BRT station is located near-side (before crossing intersection), right turn lane could be shared with BRT vehicles as a queue jump, as well as bicycles

TWO-LANE MEDIAN BUSWAY

Unsignalized Intersection Right-of-Way



Designation	A	B	C				D	E	F	G	G	H	I	D	J	D	I	H	G	G	F	E	D	C			
Description	Overall Right-of-Way	Face of Curb-to-Face of Curb Roadway Width	Maintenance Offset	Sidewalk	Planting Strip	Curb	Gutter	Bicycle Lane	Outside Travel Lane	Through Travel Lane	Through Travel Lane	Striped Buffer	BRT Lane	Gutter	Pedestrian Refuge	Gutter	BRT Lane	Striped Buffer	Through Travel Lane	Through Travel Lane	Outside Travel Lane	Bicycle Lane	Gutter	Curb	Planting Strip	Sidewalk	Maintenance Offset
Urban 4+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																											
Preferred	141	96	--	14	8	0.5	1	4	11	--	11	2	12	1	12	1	12	2	11	--	11	4	1	0.5	8	14	--
Constrained	122	82	--	11.5	8	0.5	1	--	13	--	10	2	11	1	6	1	11	2	10	--	13	--	1	0.5	8	11.5	--
Urban 6+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																											
Preferred	163	118	--	14	8	0.5	1	4	11	11	11	2	12	1	12	1	12	2	11	11	11	4	1	0.5	8	14	--
Constrained	142	102	--	11.5	8	0.5	1	--	13	10	10	2	11	1	6	1	11	2	10	10	13	--	1	0.5	8	11.5	--
Suburban 4+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																											
Preferred	139	98	2	8	10	0.5	1	5	11	--	11	2	12	1	12	1	12	2	11	--	11	5	1	0.5	10	8	2
Constrained	113	82	1	6	8	0.5	1	--	13	--	10	2	11	1	6	1	11	2	10	--	13	--	1	0.5	8	6	1
Suburban 6+2 Lane Roadway with Exclusive Left Turn and Bicycle Lanes																											
Preferred	161	120	2	8	10	0.5	1	5	11	11	11	2	12	1	12	1	12	2	11	11	11	5	1	0.5	10	8	2
Constrained	133	102	1	6	8	0.5	1	--	13	10	10	2	11	1	6	1	11	2	10	10	13	--	1	0.5	8	6	1

TWO-LANE MEDIAN BUSWAY

Unsignalized Intersection Right-of-Way

Designation	Description	Notes
C	Streetscape—Maintenance Offset Sidewalk/Planting Strip/Curb	• Source: "Chapter 49. Streets and Roads – Regulation," Montgomery County (sidewalk and planting strip dimensions) • See Table 1 for detailed assumptions for maintenance offset, sidewalk, planting strip, and curb
E	Bicycle Lane	• Source: "Chapter 3: Bicycle Lane Design," Maryland SHA Bicycle and Pedestrian Design Guidelines • Assume smaller dimension when adjacent to gutter pan
F	Outside Travel Lane	• Source: "A Policy on Geometric Design of Highways and Streets," AASHTO • Wider 14-foot outside lane would be shared with bicycles in constrained areas • Travel lane could be up to 12 feet wide in suburban areas under preferred conditions • Assume smaller dimension when adjacent to gutter pan
H	Striped Buffer	• Provides 2-ft separation distance between BRT and travel lanes • Flush surface of striped buffer facilitates entering and exiting of busway during maintenance or emergency operations
I	BRT Lane	• Source: "Designing Bus Rapid Transit Running Ways: Recommended Practice," APTA • BRT lane width provides flexibility to design busway for physically guided or unguided operation
J	Pedestrian Refuge	• Provides for 6-ft median (inclusive of top of curbs)

Table 1: Assumptions for maintenance offset, sidewalks, planting strip, and curb

Urban Areas	Suburban Areas
○ Preferred (Maximum) ▪ Four lanes • 0ft maintenance offset • 14ft sidewalk • 8ft planting strip • 0.5ft curb ▪ Six lanes • 0ft maintenance offset • 14ft sidewalk • 8ft planting strip • 0.5ft curb ▪ At stations, accommodate 12-ft platform, using envelope for portion of sidewalk, planting strip and 6-in. curb and maintaining 10.5-ft sidewalk ○ Constrained (Min) ▪ Four lanes • 0ft maintenance offset • 11.5ft sidewalk • 5ft planting strip • 0.5ft curb ▪ Six lanes • 0ft maintenance offset • 11.5ft sidewalk • 5ft planting strip • 0.5ft curb ▪ At stations, accommodate 10-ft platform, using envelope for portion of sidewalk, planting strip and 6-in. curb and maintaining 7-ft sidewalk	○ Preferred (Maximum) ▪ Four lanes • 2ft maintenance offset • 8ft sidewalk • 10ft planting strip • 0.5ft curb ▪ Six lanes • 2ft maintenance offset • 8ft sidewalk • 10ft planting strip • 0.5ft curb ▪ At stations, accommodate 12-ft platform, using envelope for portion of sidewalk, planting strip and 6-in. curb and maintaining 8.5-ft sidewalk/maintenance offset ○ Constrained (Min) ▪ Four lanes • 1ft maintenance offset • 6ft sidewalk • 5ft planting strip • 0.5ft curb ▪ Six lanes • 1ft maintenance offset • 6ft sidewalk • 5ft planting strip • 0.5ft curb ▪ At stations, add 4.5 ft to overall width to accommodate 10-ft platform, using envelope for planting strip and 6-in. curb and maintaining 7-ft sidewalk/maintenance offset

INTERSECTION ENVELOPE WIDTH

NOTE: ROW OF TYPICAL SECTIONS ASSUMES ARTERIAL CROSS STREET AS BASE CONDITION

Geography	Runningway Type	Preferred or Constrained	Number of Lanes (Planned or Existing) (Select with drop-down)	Station (Select with drop-down)	Base ROW (based on station presence)	Cross street (Select with drop-down)	Intersection ROW (based on cross-street function)
Urban area (assume to be Urban for typical sections)	Concurrent Flow Curb Lane (CFCL)	C	2+2, 4+1, or 4	Yes	102	Collector/local	102
Urban area (assume to be Urban for typical sections)	Concurrent Flow Curb Lane (CFCL)	P	4+2, 6+1, or 6	Yes	139	Collector/local	139
All other areas (assume to be Suburban for typical sections)	Reversible One-Lane Median Busway (1LMB)	C	4+2, 6+1, or 6	Yes	147.5	Major highway	147.5
All other areas (assume to be Suburban for typical sections)	Reversible One-Lane Median Busway (1LMB)	P	2+2, 4+1, or 4	Yes	147	Collector/local	136
All other areas (assume to be Suburban for typical sections)	Two-Lane Median Busway (2LMB)	C	4+2, 6+1, or 6	Yes	159	Collector/local	149
All other areas (assume to be Suburban for typical sections)	Two-Lane Median Busway (2LMB)	P	2+2, 4+1, or 4	Yes	163	Collector/local	152

Assumptions: Exclusive Turns Lanes along BRT URBAN Corridors

	Constrained		Preferred	
	2+2, 4+1, or 4	4+2, 6+1, or 6	2+2, 4+1, or 4	4+2, 6+1, or 6
Cross street				
Major highway	1 left turn, 1 right turn (CFCL) 1 left turn, 0 right turns (1LMB, 2LMB)	1 left turn, 1 right turn (CFCL) 1 left turn, 0 right turns (1LMB, 2LMB)	2 left turns, 1 right turn (1LMB, 2LMB) 1 left turn, 1 right turn (CFCL)	2 left turns, 1 right turn (CFCL, 1LMB, 2LMB)
Arterial	***1 left turn, 0 right turns (CFCL, 1LMB, 2LMB)***	***1 left turn, 0 right turns (CFCL, 1LMB, 2LMB)***	***1 left turn, 0 right turns (CFCL, 1LMB, 2LMB)***	***1 left turn, 0 right turns (CFCL, 1LMB, 2LMB)***
Collector/local	1 left turn, 0 right turns (CFCL, 1LMB, 2LMB)	1 left turn, 0 right turns (CFCL, 1LMB, 2LMB)	1 left turn, 0 right turns (CFCL, 1LMB, 2LMB)	1 left turn, 0 right turns (CFCL, 1LMB, 2LMB)

Assumptions: Exclusive Turns Lanes along BRT SUBURBAN Corridors

	Constrained		Preferred	
	2+2, 4+1, or 4	4+2, 6+1, or 6	2+2, 4+1, or 4	4+2, 6+1, or 6
Cross street				
Major highway	1 left turn, 1 right turn (CFCL, 1LMB, 2LMB)	1 left turn, 1 right turn (CFCL, 1LMB, 2LMB)	2 left turns, 1 right turn (1LMB, 2LMB) 1 left turn, 1 right turn (CFCL)	2 left turns, 1 right turn (CFCL, 1LMB, 2LMB)
Arterial	***1 left turn, 1 right turn (CFCL, 1LMB, 2LMB)***	***1 left turn, 1 right turn (CFCL, 1LMB, 2LMB)***	***1 left turn, 1 right turn (CFCL, 1LMB, 2LMB)***	***1 left turn, 1 right turn (CFCL, 1LMB, 2LMB)***
Collector/local	1 left turn, 0 right turns (CFCL, 1LMB, 2LMB)	1 left turn, 0 right turns (CFCL, 1LMB, 2LMB)	1 left turn, 0 right turns (CFCL, 1LMB, 2LMB)	1 left turn, 0 right turns (CFCL, 1LMB, 2LMB)

Station
Yes
No

Number of Lanes
2+2, 4+1, or 4
4+2, 6+1, or 6

Intersection Envelope Lengths (by speed limit and width of offset)

	Single Turn Lane				Dual Turn Lanes			
	Mainline Transition Taper Length (TL_L)		**Turn Bay Transition Taper Length (TB_L)**		**Mainline Transition Taper Length (TL_L)**		**Turn Bay Transition Taper Length (TB_L)**	
	Offset (W_L, feet)		*Offset (W_L, feet)*		*Offset (W_L, feet)*		*Offset (W_L, feet)*	
	constrained	*preferred*	*constrained*	*preferred*	*constrained*	*preferred*	*constrained*	*preferred*
Speed (V, MPH)	*10*	*11*	*10*	*11*	*20*	*22*	*20*	*22*
25	105	115	100	100	210	230	150	200
30	150	165	100	110	300	330	150	220
35	205	225	100	130	410	450	150	260
40	400	440	100	145	800	880	150	290
45	450	495	100	165	900	990	150	330
50	500	550	100	185	1000	1100	150	370

Assumptions:

- Speeds less than 40 MPH: $TL_L = W_L * V^2/60$
- Speeds of at least 40 MPH: $TL_L = W_L * V$
- Turn bay taper length: $TB_L = W_L * V/3$

environments, based on guidance from AASHTO's 2004 *Green Book* (pg. 715)

Intersection Envelope Lengths (by speed limit and width of offset)

	Preferred				Constrained			Assumptions
	Cross street curb-to-curb	*Crosswalk and stop bar*	*Storage Length (one turn lane)*	*Storage Length (two turn lanes)*	*Cross street curb-to-curb*	*Crosswalk and stop bar*	*Storage Length*	
Major Highway	133	17	250	125	120	17	200	- Face of curb-to-face of curb roadway width = 100 ft, based on avg cross sections for major highways found in Montgomery County Road Code - Length of crosswalk/stop bar area = sum of width of stop bar (1 ft), offset from crosswalk (4 ft), width of crosswalk (8 ft), and setback from face of curb (4 ft); based on information from MD MUTCD (2011) - Storage length for single turn lane = 1.25*(200 assumed left turns during peak hour) - Storage length for dual turn lanes under preferred conditions = 1/2 storage length for single turn lane (AASHTO's 2004 *Green Book* , pg. 715) - For preferred: Assumes cross street has 2 exclusive left turn and 1 exclusive right turn lanes - For constrained: Assumes cross street has 1 exclusive left turn and 1 exclusive right turn lanes
Arterial	87	17	190	--	75	17	150	- Face of curb-to-face of curb roadway width = 65 ft, based on avg cross sections for arterials found in Montgomery County Road Code - Length of crosswalk/stop bar area = sum of width of stop bar (1 ft), offset from crosswalk (4 ft), width of crosswalk (8 ft), and setback from face of curb (4 ft); based on information from MD MUTCD (2011) - Storage length for single turn lane = 1.25*(150 assumed left turns during peak hour) - For preferred: Assumes cross street has 1 exclusive left turn and 1 exclusive right turn lanes - For constrained: Assumes cross street has 1 exclusive left turn lane
Collector/ local	35	17	125	--	35	17	100	- Face of curb-to-face of curb roadway width = 35 ft, based on avg cross sections for collectors and local roadways found in Montgomery County Road Code - Length of crosswalk/stop bar area = sum of width of stop bar (1 ft), offset from crosswalk (4 ft), width of crosswalk (8 ft), and setback from face of curb (4 ft); based on information from MD MUTCD (2011) - Storage length for single turn lane = 1.25*(100 assumed left turns during peak hour) - For preferred and constrained: Assumes cross street has 0 exclusive turn lanes

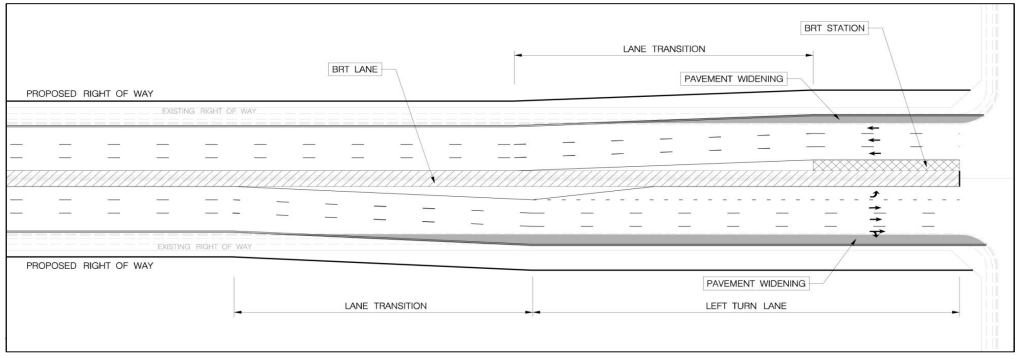
Intersection Envelope Lengths (by speed limit and width of offset)

Option 1: Includes Mainline Transition Taper Length

	Major highway			Arterial			Collector/local		
	Preferred (single turn lane)	Preferred (dual turn lane)	Constrained		Preferred	Constrained		Preferred	Constrained
Speed (MPH)				Speed (MPH)			Speed (MPH)		
25	1097	1277	964	25	931	819	25	749	679
30	1217	1517	1054	30	1051	909	30	869	769
35	1377	1837	1164	35	1211	1019	35	1029	879
40	1837	2757	1554	40	1671	1409	40	1489	1269
45	1987	3057	1654	45	1821	1509	45	1639	1369
50	2137	3357	1754	50	1971	1609	50	1789	1469

Assumptions:

- Total intersection envelope length = sum of 2*(mainline taper length, turn bay transition taper length, storage length, crosswalk and stop bar widths) and face of curb-to-face of curb width of cross street
- Majority of transit corridors would operate along major highways



Option 2: Excludes Mainline Transition Taper Length

	Major highway			Arterial			Collector/local		
	Preferred (single turn lane)	Preferred (dual turn lane)	Constrained		Preferred	Constrained		Preferred	Constrained
Speed (MPH)				Speed (MPH)			Speed (MPH)		
25	867	817	754	25	701	609	25	519	469
30	887	857	754	30	721	609	30	539	469
35	927	937	754	35	761	609	35	579	469
40	957	997	754	40	791	609	40	609	469
45	997	1077	754	45	831	609	45	649	469
50	1037	1157	754	50	871	609	50	689	469

Assumptions:

- Total intersection envelope length = sum of 2*(turn bay transition taper length, storage length, crosswalk and stop bar widths) and face of curb-to-face of curb width of cross street
- Majority of transit corridors would operate along major highways