

# Active Transportation Programs Design Guide

## **Session 2 – Crossings and Intersections, Grade-separation, Illumination, and ADA Improvements**

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# Safe Routes to School and Pedestrian/Bicyclist Programs

- Aim to improve safety for pedestrians and bicyclists
- All roads
- All public agencies & Tribal governments are eligible
- Projects must:
  - Comply with funding requirements
  - No match is required

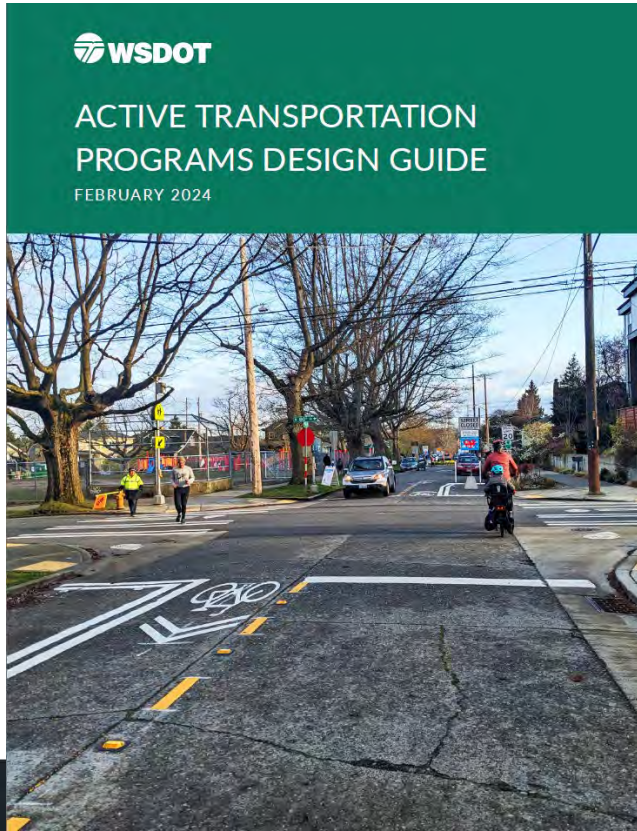


# Training on Applications

- Overview Webinar
  - March 11 (recording available)
- Design Guide Trainings
  - March 13
  - **March 20**
  - March 27
- Application Process Workshop
  - April 15
- For more information about the funding programs, visit:
  - [Safe Routes to School Program](#)
  - [Pedestrian & Bicycle Program](#)



# The Design Guide



# Guide Outline

1 <sup>st</sup> Session	<ul style="list-style-type: none"><li>• Part 1 – Guide overview<ul style="list-style-type: none"><li>– Introduction</li><li>– How to use this guide</li><li>– Additional guidance</li></ul></li><li>• Part 2 – Treatment toolbox<ul style="list-style-type: none"><li>– Speed management treatments</li></ul></li></ul>
Today	<ul style="list-style-type: none"><li>– Crossing and intersection treatments</li><li>– Grade-separated treatments</li><li>– Illumination</li><li>– ADA improvements</li></ul>
3 <sup>rd</sup> Session	<ul style="list-style-type: none"><li>– Linear treatments designed for bicyclists</li><li>– Linear treatments designed for pedestrians</li><li>– Linear treatments designed for pedestrians and bicyclists</li></ul>

# Part 2 – Crossing and Intersection Treatments

15. Raised crosswalk
16. Reduced corner radii
17. Pedestrian refuge island
18. Physical barrier to restrict parking near crossings
19. Curb extension
20. Protected intersection for linear bicycle facilities
21. Roundabout with pedestrian/bicyclist facilities and crossings
22. High-visibility crosswalk
23. Stop line at a controlled crosswalk
24. Stop line at an uncontrolled crosswalk
25. In-street, “stop for pedestrian” sign
26. “Turning vehicles stop for pedestrians” sign
27. Pedestrian countdown signal
28. Stop sign
29. Flashing stop sign
30. Prohibit turn-on-red
31. Rectangular rapid flashing
32. Pedestrian hybrid beacon
33. Half signal for pedestrians and bicyclists
34. Pedestrian traffic signal
35. Full traffic signal
36. Leading pedestrian interval
37. Pedestrian-only phase
38. Pedestrian signal phase separated from left-turn “protected” phase
39. Bike detection at traffic signals
40. Bike detection confirmation light and signage
41. Bike-signal face
42. Leading bike interval
43. Bicycle intersection crossing markings
44. Bicycle box
45. Two-stage bicycle turn box



Bike box, neighborhood diverter



Roundabout



Pedestrian traffic signal



Pedestrian refuge island



Protected intersection



ADA ramps and marked crosswalk



Physical barrier to restrict parking



Rectangular rapid flashing beacons

## 17. Pedestrian refuge island

### DESCRIPTION

Pedestrian refuge islands reduce the exposed crossing distance and provide a place for pedestrians to evaluate their ability to cross traffic one direction at a time. They may also provide a place to stand and wait either for a gap in traffic or for drivers to stop. They are in the middle of a street at an intersection or midblock locations. At mid-block locations, pedestrian refuge islands also increase driver awareness of the crossing. FHWA considers this treatment a proven safety strategy. Pedestrian refuge islands can provide a 32-percent reduction in pedestrian crashes.

### DESIGN GUIDANCE

Install pedestrian refuge islands at midblock or intersection crossing locations. Provide a 6-foot minimum transverse width for pedestrians only or 10 feet preferred, 8 feet minimum for pedestrians and bicyclists. Construct islands with concrete, asphalt, or other materials. Consider low-level landscaping, planters, or other physical barriers in the island while also maintaining sight lines for pedestrians and drivers. Cut throughs of existing continuous medians may also function as pedestrian refuge islands if they include all other design features mentioned here. Consider an angled cut-through to position bicyclists and pedestrians to face oncoming traffic.

Provide sufficient [pedestrian-scale lighting](#) at the crossing locations to ensure drivers can see pedestrians at the crossing. Install the pedestrian refuge island with high visibility crosswalks and consider an [advance-stop line at an uncontrolled crosswalk](#). If at an uncontrolled crossing location, include advanced warning signage. Restrict parking 20-50 feet in advance of the crossing. Determine the appropriate parking restriction and advance-stop line placement based on stopping sight distance and the roadway geometry at the crossing. Pedestrian refuge islands may also be used in conjunction with [rectangular rapid flashing beacons](#) or [pedestrian hybrid beacons](#).



FIGURE 22. PEDESTRIAN REFUGE ISLAND ON MERCER ISLAND, WA.



### DESIGN APPLICABILITY

- Appropriate on roads with two or more travel lanes, at least one lane in each direction.
- Consider at shared-use path crossings of roads for pedestrians and bicyclists.
- Highly desirable for midblock pedestrian crossings on roads with the following characteristics:
  - Roads with 2-5 travel lanes where a pedestrian won't cross more than two travel lanes before reaching the sidewalk or pedestrian refuge island for both stages of the crossing.
  - Roads with 35 mph speeds or greater.
  - Roads with 9,000 vpd or higher.<sup>76</sup>

<sup>76</sup> FHWA. 2018. "Pedestrian Refuge Island." *Safe Transportation for Every Pedestrian*.

## COMPLEMENTARY TREATMENTS

- [Curb extension](#)
- [Rectangular rapid flashing beacon](#)
- [Pedestrian hybrid beacon](#)
- [In-street "stop for pedestrian" sign](#)

## MORE INFORMATION

- [FHWA Safe Transportation for Every Pedestrian – Pedestrian Refuge Island](#)
- [NCHRP 926 Guidance to Improve Pedestrian and Bicyclist Safety at Intersections](#)
- [WSDOT Standard Plan F-45.10-03 Detectable Warning Surface](#)

## PLAN SHEET DETAILS

- [17 - Pedestrian Refuge Island](#)



# Part 2 – Crossing and Intersection Treatments Characteristics

- Crossing features for pedestrians and bicyclists should aim to:
  - Decrease pedestrian/bicyclist **exposure** to points of conflict with motor vehicle traffic
  - Decrease motor vehicle **operating speed**
  - Increase pedestrian/bicyclist user **conspicuity**
  - Increase the **predictability** of movements of different user groups through the intersection
  - Increase **separation in space** between motorists and pedestrians/bicyclists
  - Increase **separation in time** between motorists and pedestrians/bicyclists

# Part 2 – Crossing and Intersection Treatments Selection

- Context dependent
- Many sources for selecting appropriate treatments
  - FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
  - NCHRP 926 Guidance to Improve Pedestrian and Bicyclist Safety at Intersections
  - WSDOT Design Manual, Section 1310.03
  - FHWA Crosswalk Marking Selection Guide

Countermeasure	Effectiveness			Public Process	Motorist Traveling Straight							Motorist Turning			
	Tier 1: Supports motorist yielding	Tier 2: Requires intervention to induce motorist yielding	Tier 3: Separate modes or require motorists to stop		1 to 5 scale: 1 = no public process and 5 = extensive public process	Motorist failed to yield to pedestrian	Pedestrian failed to yield	Pedestrian dash	Bike crossing paths with uncontrolled motorist	Bike rides through/out - STOP sign	Motorist drives out into bike - STOP controlled	Bike rides through/out - signalized intersection	Motorist left turning into pedestrian parallel path	Motorist right turning into pedestrian parallel path	Motorist right turning into bike - same direction
Active Warning Beacons	M	M	L	1	●	●	●	●	●			●	●	●	●
Advance Stop/Yield Lines	H	M	L	1	●	●	●	●	●						
All-Walk Phase	M	H	H	3	●	●	●					●	●		
Bicycle Lane Extension through Intersections	M	L	L	1				●		●				●	●
Bicycle Signals	M	M	H	1							●			●	●
Bike Boxes	M	M	M	1										●	
Continuous Raised Medians	H	H	H	4	●	●	●	●	●		●	●			●
Hardened Centerlines	H	H	H	1								●			●
Crossing Barriers	L	M	H	5	●	●	●	●							

Note: H = High, M = Medium, L = Low

Roadway Configuration	Posted Speed Limit and AADT								
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
<b>2 lanes</b> (1 lane in each direction)	① 2 4 5 6	① 5 6 7 9	① 5 6 7 9	① 4 5 6 7 9	① 5 6 7 9	① 5 6 7 9	① 4 5 6 7 9	① 5 6 7 9	① 5 6 9
<b>3 lanes with raised median</b> (1 lane in each direction)	① 2 3 4 5	① ③ 5 7 9	① ③ 5 7 9	① 3 4 5 7 9	① ③ 5 7 9	① ③ 5 7 9	① ③ 4 5 7 9	① ③ 5 7 9	① ③ 5 9
<b>3 lanes w/o raised median</b> (1 lane in each direction with a two-way left-turn lane)	① 2 3 4 5 6 7 9	① ③ 5 6 7 9	① ③ 5 6 9	① 3 4 5 6 7 9	① ③ 5 6 7 9	① ③ 5 6 9	① ③ 4 5 6 7 9	① ③ 5 6 9	① ③ 5 6 9
<b>4+ lanes with raised median</b> (2 or more lanes in each direction)	① ③ 5 7 8 9	① ③ 5 7 8 9	① ③ 5 8 9	① ③ 5 7 8 9	① ③ 5 7 8 9	① ③ 5 8 9	① ③ 5 7 8 9	① ③ 5 8 9	① ③ 5 8 9
<b>4+ lanes w/o raised median</b> (2 or more lanes in each direction)	① ③ 5 6 7 8 9	① ③ 5 6 7 8 9	① ③ 5 6 8 9	① ③ 5 6 7 8 9	① ③ 5 6 7 8 9	① ③ 5 6 8 9	① ③ 5 6 7 8 9	① ③ 5 6 8 9	① ③ 5 6 8 9

Given the set of conditions in a cell,

- # Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.
- Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.
- Signifies that crosswalk visibility enhancements should always occur in conjunction with other identified countermeasures.\*

The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.

- 1 High-visibility crosswalk markings, parking restrictions on crosswalk approach, adequate nighttime lighting levels, and crossing warning signs
- 2 Raised crosswalk
- 3 Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line
- 4 In-Street Pedestrian Crossing sign
- 5 Curb extension
- 6 Pedestrian refuge island
- 7 Rectangular Rapid-Flashing Beacon (RRFB)\*\*
- 8 Road Diet
- 9 Pedestrian Hybrid Beacon (PHB)\*\*





# WSDOT Design Manual Continued

Intersection Treatments	Reference	Corridor Linear Bike/Ped Facility Types <sup>15</sup> (Evaluate Bicycle and Pedestrian Needs Together Based on Facility Types)							Pedestrian
		Bicycle Facility Type							
		Separated Bike Lane	Buffered Bike Lane	Striped Bike Lane	Neighborhood Greenway	None <sup>16</sup>	Shared Use Path	Buffered Sidewalk	
Pavement Marking/Geometric Treatments									
Green Pavement Markings <sup>15</sup>	DM 1520.09(1)(a)	Yes	Yes	Yes	Yes (see specific treatments)	No	Not Typical	N/A	
					Shared bike lane at all facilities	No	Not Typical	N/A	
					Typical	Yes	Not Typical	N/A	
						Yes	Yes	Yes	
						N/A	N/A	Yes	Yes
						N/A	N/A	Yes	Yes
					Yes	Yes	Yes	Yes	
					No	No	N/A	N/A	
					Yes	Yes	Yes	Yes	
					Yes	Yes	Yes	Yes	
					Yes	Yes	Yes	Yes	
					Yes	Yes	Yes	Yes	
					Shared bike lane at all facilities	N/A	N/A	N/A	
					No	N/A	Yes	Yes	
					Yes	Yes	Yes	Yes	
					N/A	N/A	Yes	Yes	
					Yes	Yes	N/A	Yes	
					Yes	Yes	Yes	Yes	
Signalization/Beacon Treatments									
Signal Phase Separation	(none)								
Pedestrian Signal Heads	DM 1330.06(5)								
Signalization/Beacon Treatments									
Pedestrian Signal	TM 4-6.5, 4-6.6	(?)	(?)	(?)	Yes	N/A	Yes	Yes	
Pedestrian Hybrid Beacon	TM 4-6.5, 4-6.6	(?)	(?)	(?)	Yes	N/A	Yes	Yes	
Leading Pedestrian Interval (LPI)	TM 4-6.5	(?)	(?)	(?)	Yes	N/A	Yes	Yes	
Rectangular Rapid Flashing Beacon (RRFB, use with Marked Crosswalk)	TM 4-6.3, A	N/A	N/A	N/A	Yes	N/A	Yes	Yes	

KEY: "Yes" = treatment is appropriate for this facility type; "No" = treatment is not appropriate for the facility type; "N/A" = treatment is not applicable in the evaluation for this facility type—use other determinants for use of treatment; "Not Typical" = not a typical treatment for this facility type, but can be considered if applicable.

Intersection Treatments Applied At All Intersections Throughout Corridor<sup>15</sup>

Pavement Marking/Geometric Treatments	
Green Pavement Markings <sup>15</sup>	DM 1520.09(1)(a)
Bikecross Markings (Bike Lane Extension Through Intersection)	DM 1520.04(1)
Two-Stage Bicycle Turn Box (at signalized intersections only)	DM 1520.04(3)
Physical Parking Restriction Near Pedestrian Crossings	DM 1510
Reduced Turn Radii	DM 1310.03(1) and (2)
Signalization/Beacon Treatments	
Signal Phase Separation	(none)
Pedestrian Signal Heads	DM 1330.06(5)

Intersection Treatments Applied at Individual Intersections<sup>16</sup>

Pavement Marking/Geometric Treatments	
Curb Extensions	
Corner Island for Bike Lane	See Protected Intersection, DM 1520
Pedestrian/Bicycle Refuge Island	TM 4-6.6, H and I
Mountable Truck Aprons	DM 1510.09(6)
Raised Intersection	DM 1510
Raised Crosswalk	TM 4-6.6, N
Marked Crosswalks	DM 1510.09(2)(b)
Leading Bike Box (at signalized intersections only)	DM 1520.04(2)
"Turning Vehicles Stop for Peds" sign	DM 1510
In-Street Pedestrian Crossing Sign	TM Exhibit 4-2.3, 4-6.6
Prohibit Turns on Red Light	TM 2-7.14
Hardened Centerline (use with Marked Crosswalks)	DM 1510, Ohio DOT Guide 7.2.7 <sup>19</sup>
Median Diverter <sup>16</sup>	DM Exhibit 1520-11
Slip Lane Elimination	DM 1310
Signalization/Beacon Treatments	
Pedestrian Signal	TM 4-6.5, 4-6.6
Pedestrian Hybrid Beacon	TM 4-6.5, 4-6.6
Leading Pedestrian Interval (LPI)	TM 4-6.5
Rectangular Rapid Flashing Beacon (RRFB, use with Marked Crosswalks)	TM 4-6.3, A

# Intersection Improvement Example 1

## Legion Way and Washington St in Olympia



Before



After



# Intersection Improvement Example 2

## Plaza Way/Dalles Military Rd and S 9<sup>th</sup> Ave (SR 125) in Walla Walla



Before



After

# Part 2 – Grade-separated

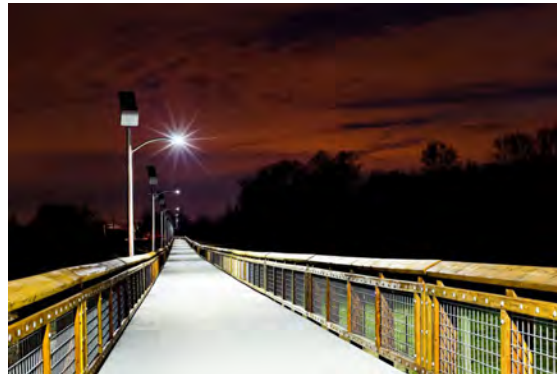
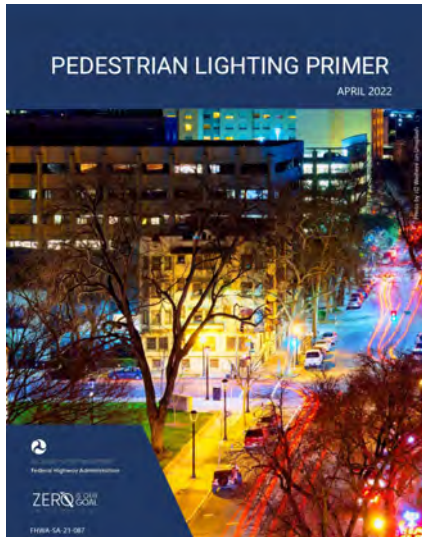
46. Pedestrian/bicyclist overpass

47. Pedestrian/bicyclist underpass

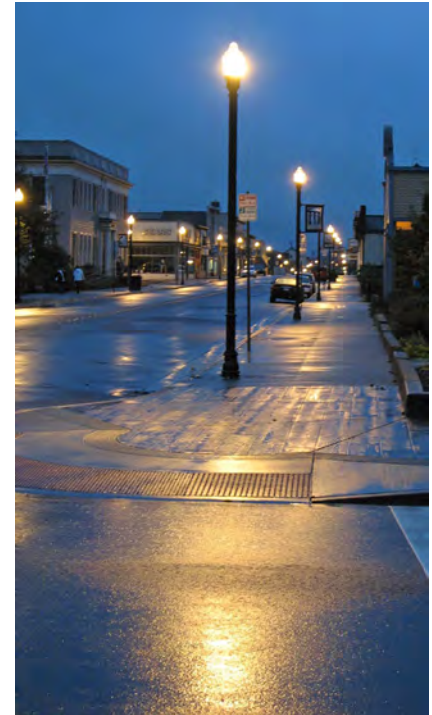


# Part 2 – Illumination

- 48. Pedestrian and bicyclist illumination at a crossing or intersection
- 49. Pedestrian and bicyclist segment illumination



Source: Sol



Source: Ron Bloomquist, PedBike Images

# Part 2 – ADA Improvements

50. ADA curb ramp retrofit

51. Accessible pedestrian signal



Source: Carl Sundstrom,  
PedBike Images

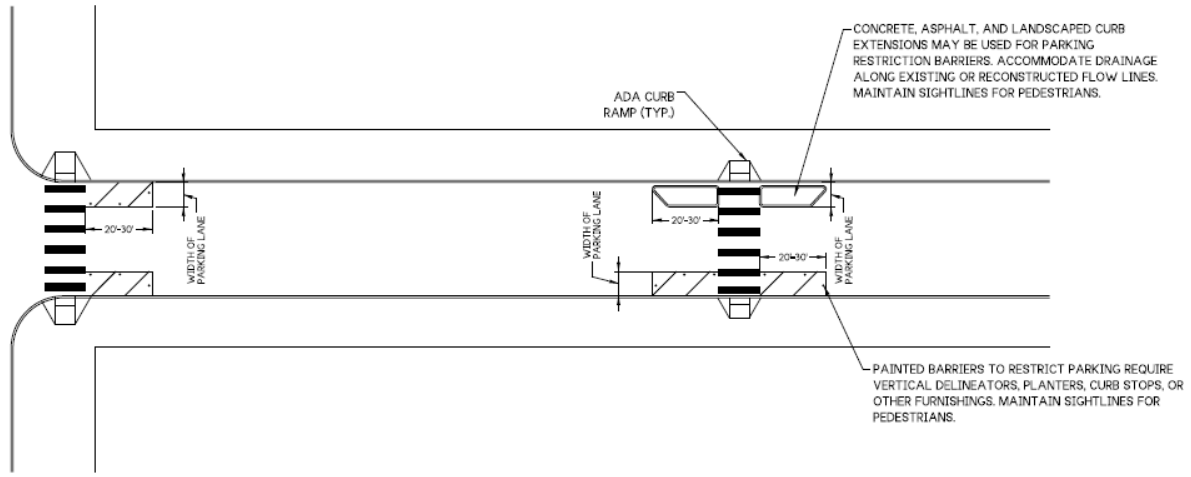


# Plan Sheet Details





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PHYSICAL BARRIER TO RESTRICT PARKING AT INTERSECTION CROSSINGS

PHYSICAL BARRIER TO RESTRICT PARKING AT MIDBLOCK CROSSINGS

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REVISION		DATE	BY				



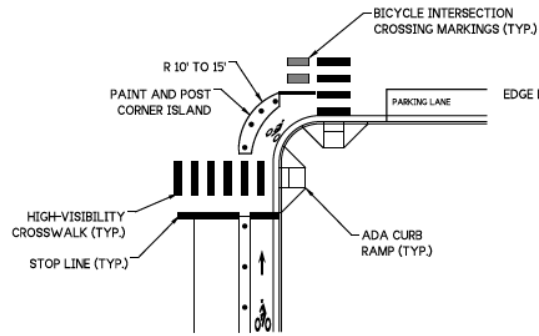
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18 - Physical Barrier to Restrict  
 Parking Near Crossing

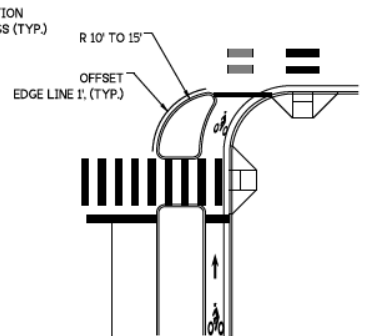
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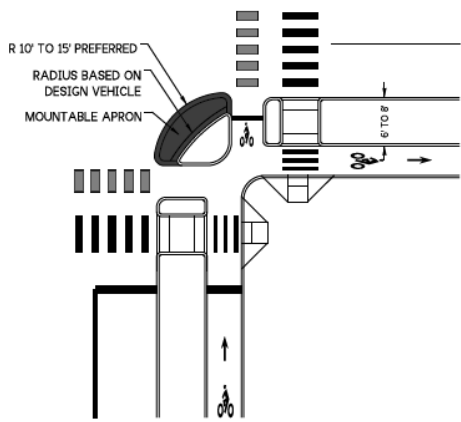
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RETROFIT PROTECTED CORNER ISLAND WITH PAINT AND POST



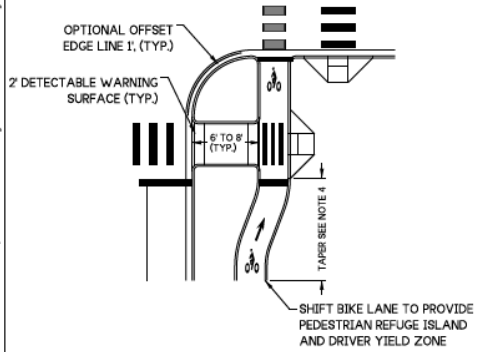
RETROFIT PROTECTED CORNER ISLAND WITH CONCRETE



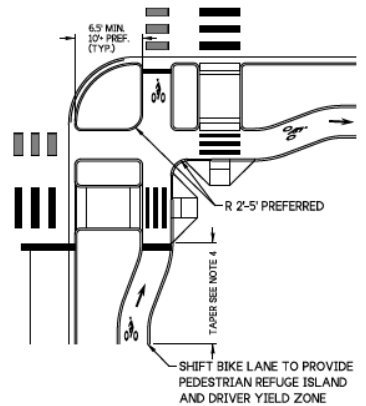
RECONSTRUCTED PROTECTED CORNER ISLAND WITH CONCRETE AND MOUNTABLE APRON

NOTES

1. CONSULT DESIGN PLANS FOR VARIATIONS.
2. SIZE AND SHAPE OF CORNER TREATMENTS ARE DEPENDENT ON INTERSECTION CHARACTERISTICS
3. 6' BIKE LANE WIDTH PREFERRED, 5' MIN.
4. BIKE LANE TAPERS PREFERRED AT 7:1 SHIFT, MINIMUM 3:1 SHIFT IN CONSTRAINED LOCATIONS WHERE BIKE SPEED IS ≤ 13 MPH.



RECONSTRUCTED PROTECTED CORNER ISLAND WITH CONCRETE



RECONSTRUCTED PROTECTED CORNER ISLAND WITH CONCRETE AT INTERSECTION OF BIKE FACILITIES

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DRAWN BY	
CHECKED BY	
PROJ. ENGR.	
REGIONAL ADM.	
REVISION	
DATE	
BY	

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JOB NUMBER		
CONTRACT NO.		LOCATION NO.

PRELIMINARY PLAN

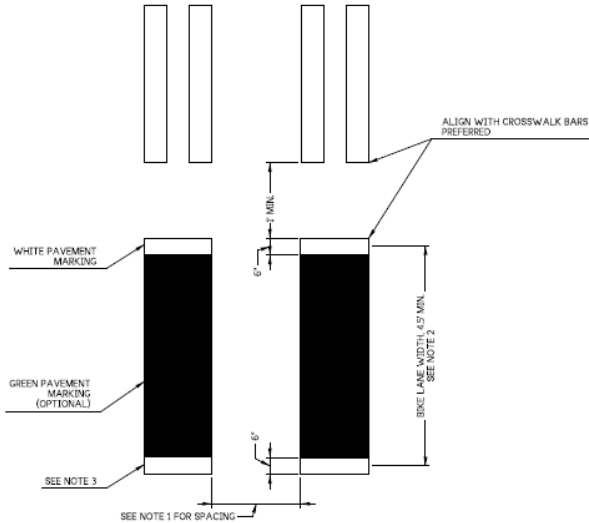
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WSDOT Active Transportation Programs  
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 Plan Sheet Details  
 20 - Protected Intersection for  
 Linear Bicycle Facilities

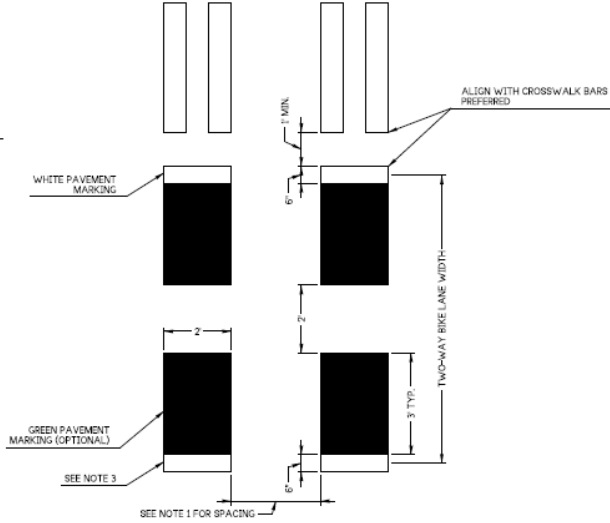
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SHEET 21 OF 52 SHEETS







ONE-WAY BIKE LANE LAYOUT



TWO-WAY BIKE LANE LAYOUT

NOTES

1. AT LOCATIONS WITHOUT AN ADJACENT STRIPED CROSSWALK, PLACE BIKE INTERSECTION CROSSING MARKINGS AT LANE LINE AND 1/2 LANE WIDTH CONSISTENT. AT LOCATIONS WITHOUT AN ADJACENT STRIPED CROSSWALK OR LANE LINE, PLACE BIKE INTERSECTION CROSSING MARKINGS AT 5' ON CENTER.
2. WHEN CONNECTING BIKE LANES OF VARYING WIDTH SIZE THE BIKE INTERSECTION CROSSING MARKINGS TO THE NARROWER OF THE TWO FACILITIES.
3. PAVEMENT MARKINGS EXTENDED INTO OR CONTINUED THROUGH AN INTERSECTION SHALL BE THE SAME COLOR AS THE LINE MARKINGS THEY EXTEND.

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LOCATION NO.		

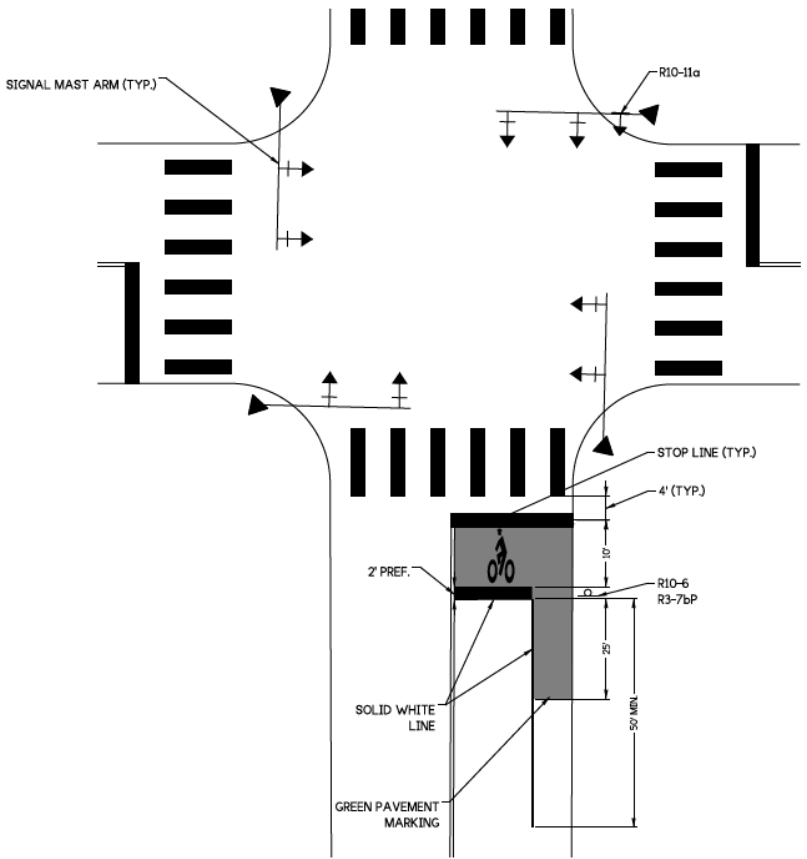

  
 PRELIMINARY PLAN

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43 - Bicycle Intersection Crossing Markings

PLAN SHEET NO.
SHEET 36 OF 52
SHEET 19



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PRELIMINARY PLAN

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WSDOT Active Transportation Programs Design Guide Plan Sheet Details	
44 - Bicycle Box	

PLAN SHEET NO.
SHEET 37 OF 52
SHEET 18

# Summary

- Programs aim to improve safety for pedestrians and bicyclists
- Review design guide for selected treatments
- Consider ways to achieve the functional characteristics at intersections and crossings
- Plan sheet details can support project development and implementation

# Future Training Sessions

- Session 1 – March 13
- Session 2 – Today
- Session 3 – March 27
- All are virtual and will be recorded and posted to the [LTAP website](#) and the funding program webpages

# Questions, Additional Training, and Project Photos



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