
BANKING
CAPITAL
OF THE
WORLD
30

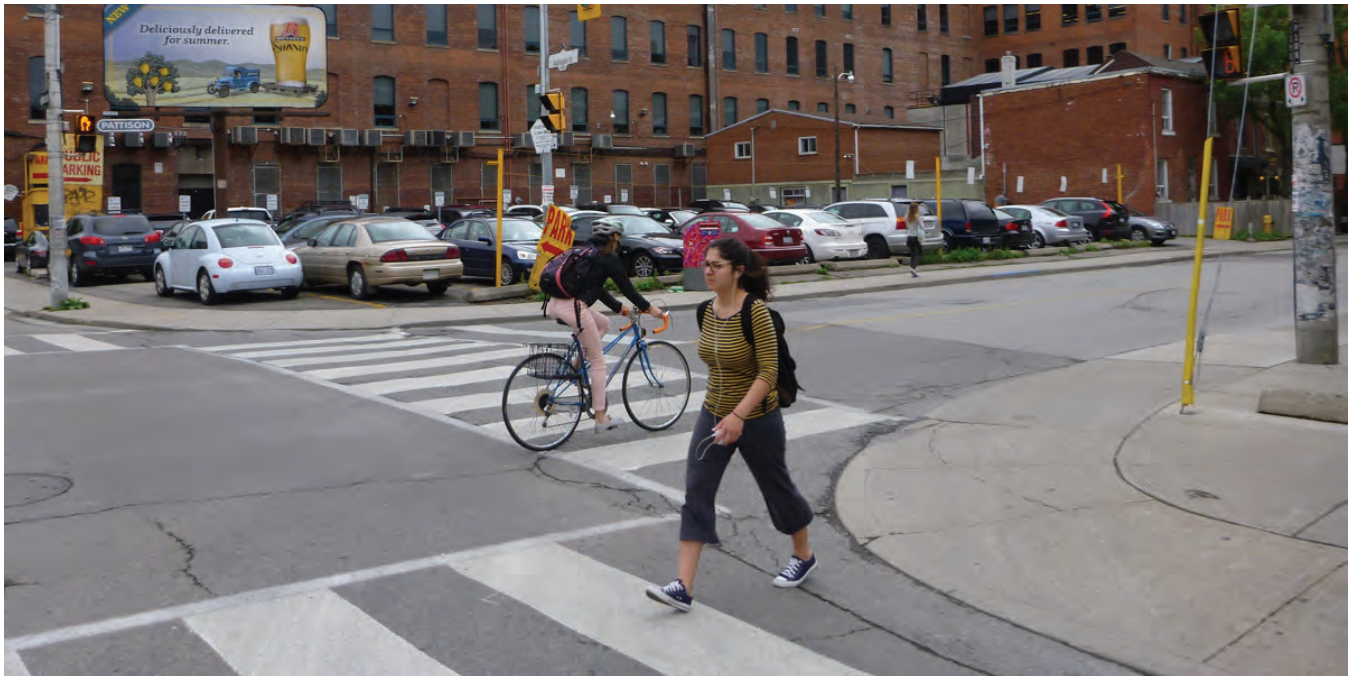
5.0 Intersection Treatments


PEDESTRIANS OBEY
YOUR SIGNAL
TWO STAGE CROSSING
Highway 7

5.1 PRINCIPLES OF INTERSECTION DESIGN

The design of intersections is a balancing act between the safety and convenience of users of different modes with the desire to provide a high quality public realm. Intersections present the highest concentration of conflict points along a roadway. The design of intersections must address the potential for conflict through appropriate context-sensitive design choices.

As noted in York Region's Designing Great Streets guidelines, "intersections are shared spaces, and should be designed to ensure that users are aware of one another and move predictably in order to reduce the number and severity of collisions."



The following principles underlie the intersection concepts presented in these guidelines:

MAXIMIZE VISIBILITY

Vulnerable road users are smaller, travel more slowly and react differently than those in motorized vehicles. As a result, intersection design should seek to enhance the visibility between users to allow sufficient perception & reaction time to avoid each other at conflict points. Several different approaches can be used to maximize visibility, depending on the context. For example, simplifying the surrounding environment to such an extent that the vulnerable user becomes the focus, or applying enhanced pavement markings & signage to highlight the travel paths of cyclists & pedestrians.

MINIMIZE EXPOSURE

Depending on the geometry of the intersection and the type of intersection treatments, pedestrians may experience different levels of exposure to conflicts with motor vehicles, and each other. Wherever possible, conflicts should be eliminated or consolidated through modifications to intersection geometry, pavement markings, signage or signals. This should be coupled with on-going work at the Region to separate cyclists and pedestrians from conflicts in time (through signal phasing) and in space (i.e. grade separation) as applicable. Increased exposure can be a major deterrent to walking and cycling where users perceive that intersections create major risks.

PROMOTE CONSISTENCY

One of the key objectives of these guidelines is to standardize treatments and to provide guidance as "one size does not fit all" across the Region. This will help to make interactions between users of different modes more predictable and less stressful. Designs are intended to be intuitive and easy to use. It should be noted that promoting consistency does not mean applying the identical treatment at every intersection – rather, it is about creating clear expectation through similar treatments and clear design choices that reflect the land use and roadway context, while creating a high quality public realm experience.

ACHIEVE DESIRED TURNING SPEEDS

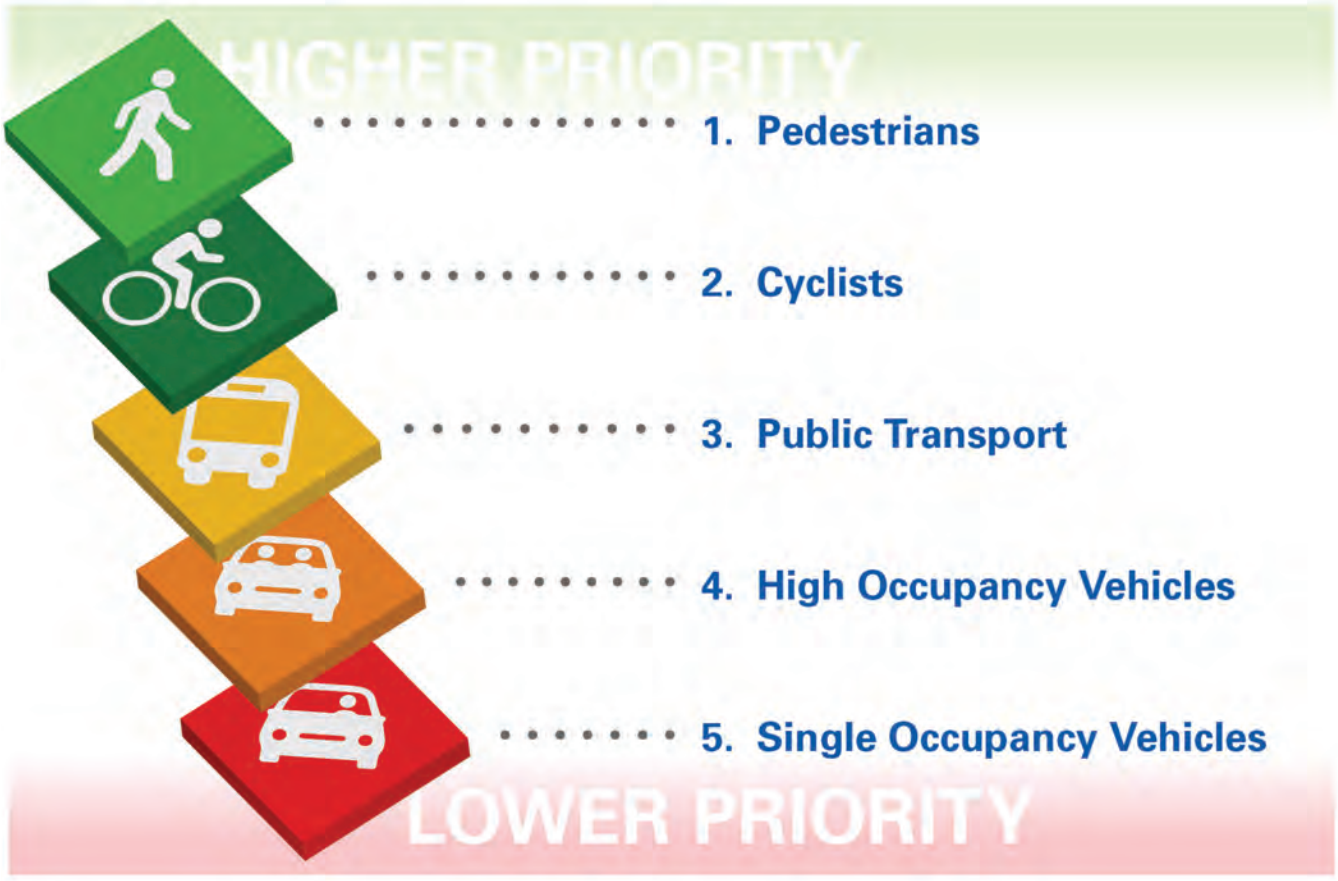
Lower motor vehicle operating speeds can reduce the likelihood and severity of collisions, and can increase pedestrian and cyclist comfort. This increased comfort can, in turn, help to attract new cyclists and pedestrians. Speeds through intersections can be lowered through careful selection of geometric elements such as corner radii and turn lane width, or by adding physical traffic calming measures such as raised crosswalks. While the Region has clear objectives to support efficient motor vehicle travel, particularly for goods movements and employment purposes, intersections with current or future high pedestrian & cycling volumes are primary locations for focusing efforts to reduce speeds. A balanced approach based on the needs of the corridor should be used when developing project-specific design criteria.

In addition to these safety-focused principles, it is important to also recognize the need to provide a **high quality public realm**, which is attractive and comfortable for pedestrians and cyclists alike.

The hierarchy for improved pedestrian and cycling treatments through intersections is clearly articulated in the Regional context-sensitive design guidelines, Designing Great Streets (refer to Exhibit 5-1).

This hierarchy drives the development of these guidelines.

Exhibit 5-1. Hierarchy for users at Intersections



5.1.1 Overview

Similarly to the guidance on cross-sections, the intersection treatments presented in these guidelines incorporate minimum and preferred elements in an attempt to prioritize design choices, reflect budgetary limitations, and provide flexibility for designers.

Note that all signage and pavement markings identified in the following sections are referenced in more detail in Chapter 7 – Pavement Markings & Signage, including standard dimensions of pavement markings from various Ontario Traffic Manuals.

5.2 URBAN INTERSECTIONS

Urban intersections are typified by higher volumes, the convergence of many paths of travel, and multi-modal conflicting movements. Demands for operational efficiency are often in conflict with right-of-way constraints and surrounding development. These intersections must address the needs of pedestrians and cyclists in a way that invites safe and comfortable crossings, while clarifying right-of-way and priority for vulnerable users. The desire to accommodate high quality streetscaping and to create attractive places to be must also be considered at the project outset.

There are several strategies for minimizing exposure of pedestrians and cyclists at urban intersections where turning vehicles may have conflicting paths of travels with vulnerable users. In particular, the higher travel speeds of cyclists compared to pedestrians requires specific interventions to enhance safety.

In the context of Regional roads, two categories of treatments are generally applicable, as shown in Exhibit 5-2.

Exhibit 5-2. Strategies for Minimizing Conflicts between Cyclists and Turning Motorists

STRATEGY	APPLICATION	PROS	CONS
Separation in Time	Signals: separate conflicting movements in time (protected phases and leading intervals)	• Eliminates almost all turn conflicts (some potential for conflicts remain due to signal violations)	• May increase cycle length or decrease length of other phases • Associated increase in delay to some or all movements and/or modes • Associated increase in queue lengths that may interfere with adjacent intersections or driveways
Separation in Space	Bend in (towards the parallel roadway): positions cyclists/ pedestrians closer to the parallel roadway, with the distance between the crossing and the parallel roadway measuring between 0.5-2m	• On low speed roadways, provides optimal views and sightlines for motorists to see cyclists/pedestrians at the crossing when speeds are low • Motorists must give way to traffic and pedestrians/cyclists in the crossing at the same location so right-of-way may be more clear • Requires less space than bend-out	• Motorists on parallel roadway yield to cyclists/pedestrians in crossing before completing turn, increasing the potential for collisions • Motorists on the side street may block the crossing when making a right-turn on a red signal • Longer but narrower sight triangle required with associated no stopping zone • Provides less space for cyclists/pedestrians to queue at the intersection crossings within the right-of-way
	Bend-out (away from the parallel roadway): positions cyclists/ pedestrians farther from the parallel roadway, with the distance between the crossing and the parallel roadway measuring between 4-7m	• On higher speed roadways, provides space for slower turning motorists to give way at the crossing outside of the higher speed through traffic on the parallel roadway • Motorists on the parallel roadway turn out of through traffic then yield to cyclists / pedestrians in the crossing, reducing the potential for collisions on the parallel roadway • Motorists on the side street will not block the crossing when making a right-turn on a red signal • Provides more space for cyclists/ pedestrians to queue at the intersection crossings within the right-of-way	• Requires more space than bend-in • Wider but shorter sight triangle required affecting the placement of bus stops, shelters and other objects that may interrupt sightlines • Motorists give way to traffic at a different location than to pedestrians / cyclists in the crossing so right-of-way may be less clear

Source: Adapted from FHWA's Separated Bike Lane Planning & Design Guide, MassDOT Separated Bike Lane Planning & Design Guide & CROW Record 25: Design manual for bicycle traffic

Exhibit 5-3. Bend-in Design

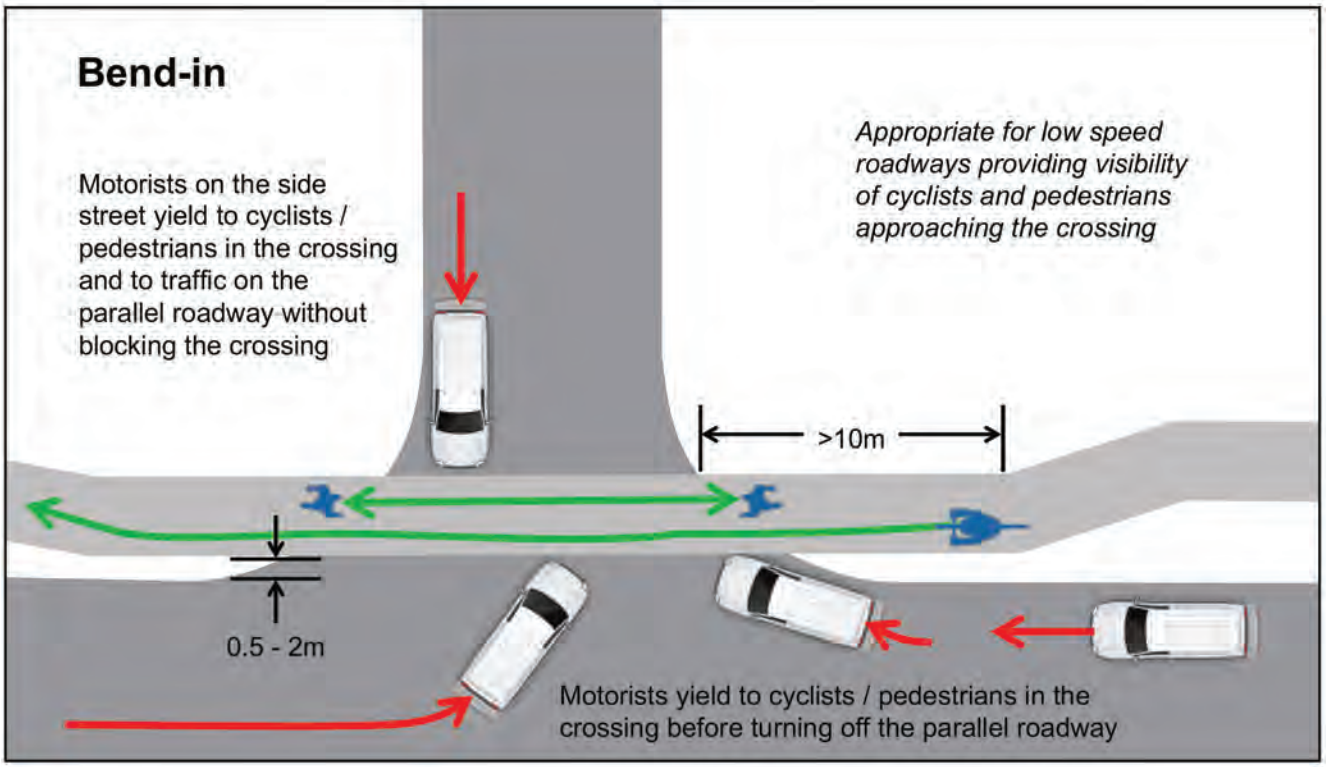
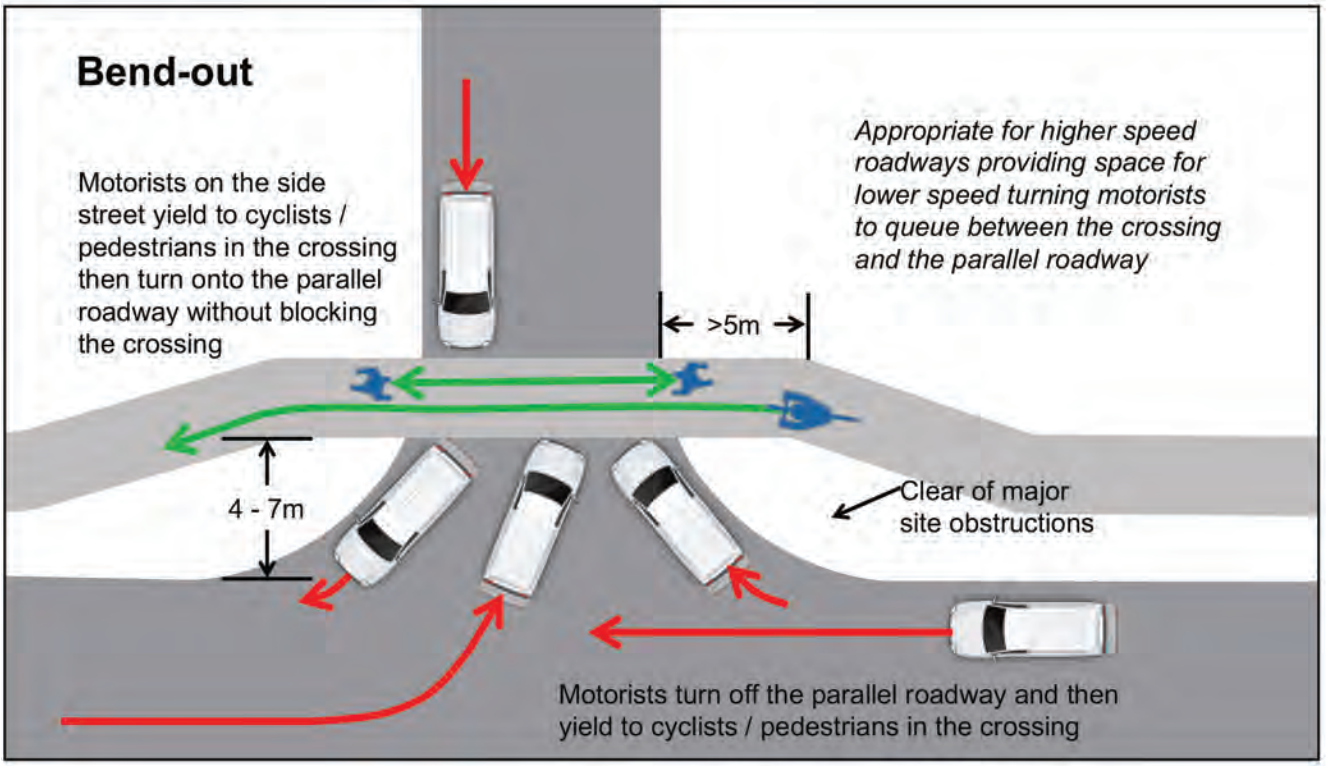


Exhibit 5-4. Bend-out Design



A third category of intervention – the application of mixing zones and lateral shifts - is generally not appropriate along Regional roads in urban settings due to the higher expected speeds and volumes of motorized vehicles.

Whenever possible within the constraints of signal timing, designers are encouraged to pursue signal phasing separation of pedestrian and cyclists from crossing motorists (refer to Chapter 8) in combination with bend-in or bend-out designs.

In instances where signal changes are not feasible (either due to operational challenges or at unsignalized intersections), facilities should be bent-in or bent-out at intersections as a minimum treatment. Generally, the decision to bend a facility in or out as presented in these intersection examples is based largely on the approaching facility type of the standardized cross-sections developed in Sections 4.9 & 4.10.

A summary of preferences for bend-in and bend-out designs is provided in Exhibit 5-5.

Exhibit 5-5. Preferred Bend-in & Bend-out Design Strategies for Intersections

	Raised Cycle track	In-Boulevard Cycle Track	Multi-use Path
City Centre Street	Bend-in	Bend-in or Bend-out	N/A
Avenue	Bend-out (preferred) or Bend-in	Bend-out	N/A
Connector	N/A	Bend-out	Bend-out
Main Street	Bend-in	N/A	N/A
Rural Hamlet Road	N/A	N/A	Bend-in
Rural Road	N/A	N/A	Bend-out

Note that where on-street parking is provided (as illustrated for some of the sample cross sections along City Centre Streets and Rural Hamlets in Section 4.10), parking must be setback sufficiently far from the intersection to ensure visibility of pedestrians and cyclists, approaching based on sight distance calculations, regardless of whether a bend-in or bend-out design is selected.

As urban intersections often represent the most challenging intersection in terms of competing right-of-way demands and land use contexts, trade-offs must often be made.

Some strategies which can be employed to make trade-offs at intersections include the following:

- Look for compromises on vehicular and median lane widths in order to provide additional space for pedestrian and cycling facilities. The difference between a lane width of 3.3 or 3.5 m is generally imperceptible to the average motor vehicle, while a sidewalk width of 1.5 compared to a width of 1.8 m can drastically improve accessibility and pedestrian comfort.
- Where sufficient boulevard space is not available for a bend-out design, consider a bend-in design. If there is insufficient space to bend the facility out, it is important to avoid an 'in-between' intersection offset (i.e. 2-4 m from edge of intersecting roadway to the crossing cycling facility) and instead provide a high quality bend-in design.
- Reduce the width of walking and cycling facilities to minimum widths approaching the intersection. This can be an acceptable treatment as pedestrians and cyclists are intended to slow down approaching controlled crossings. Where widths are reduced, they must still accommodate those waiting at an intersection and not compromise on accessibility.
- Where it is impossible to accommodate both high-quality walking and cycling facilities, **pedestrians** must take priority in intersection design. A transition to a shared space crossing can be employed in low volume areas, even where the approaching facilities are separated, although this is not a preferred design approach.

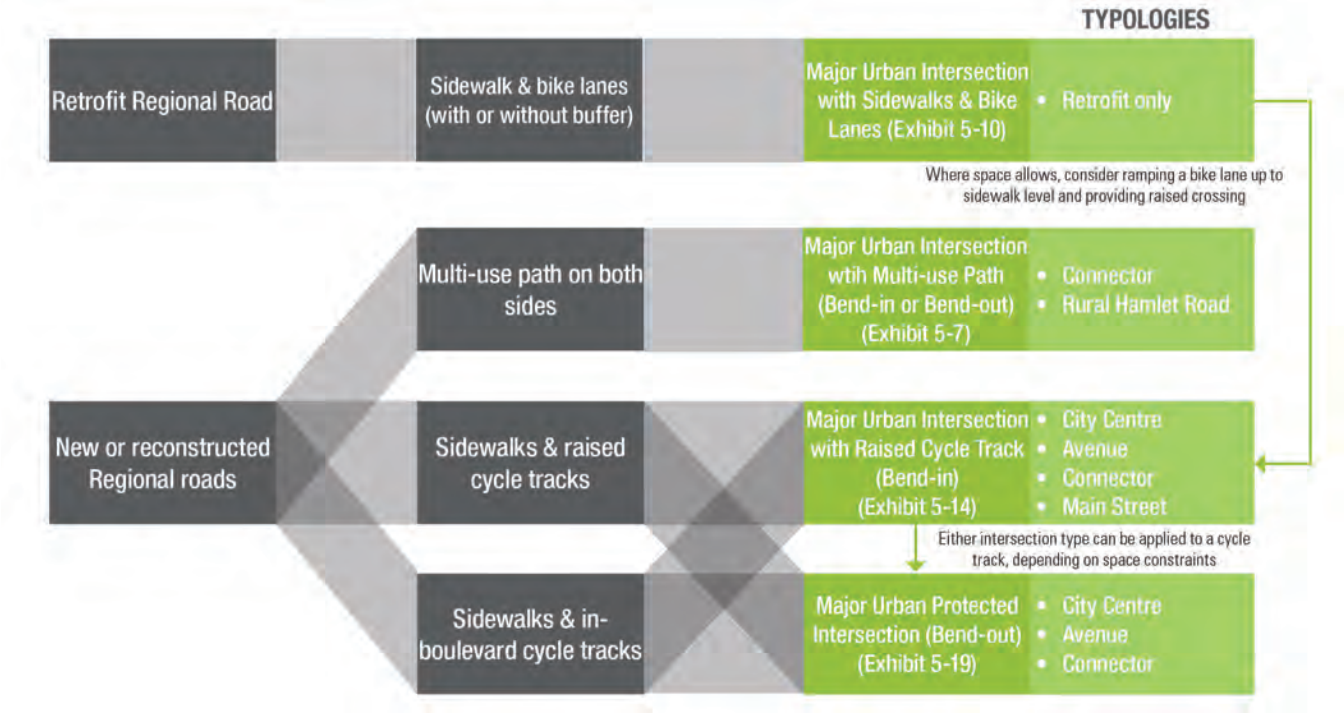
Photo Source: IBI Group

5.2.1 Signalized Intersections

As noted in Section 5.2, the general assumption behind the urban signalized intersection treatments presented in this chapter is that the approaching facility & associated road classification will, for the most part, govern the intersection treatment. The corresponding intersection treatments are summarized in Exhibit 5-6.

Rural intersection treatments are discussed in Chapter 5.3.

Exhibit 5-6. Intersection Treatment Selection Tool



As shown in Exhibit 5-6 above, there are a few instances where the facility can be upgraded at the intersection, if space allows.

In particular, consider opportunities to implement the following intersection upgrades:

- Ramp a bike lane up into the boulevard to transition to a raised cycle track or in-boulevard cycle track through the intersection
- Bend a raised cycle track out in advance of an intersection in order to provide a protected intersection

Major Urban Intersection with Multi-use Path

Historically, the design of multi-use paths has largely neglected intersection treatments, impacting the overall quality and continuity of the facility. The intersection concept presented here integrates the concept of bend-in/bend-out and appropriate conflict zone markings to the design of multi-use paths.

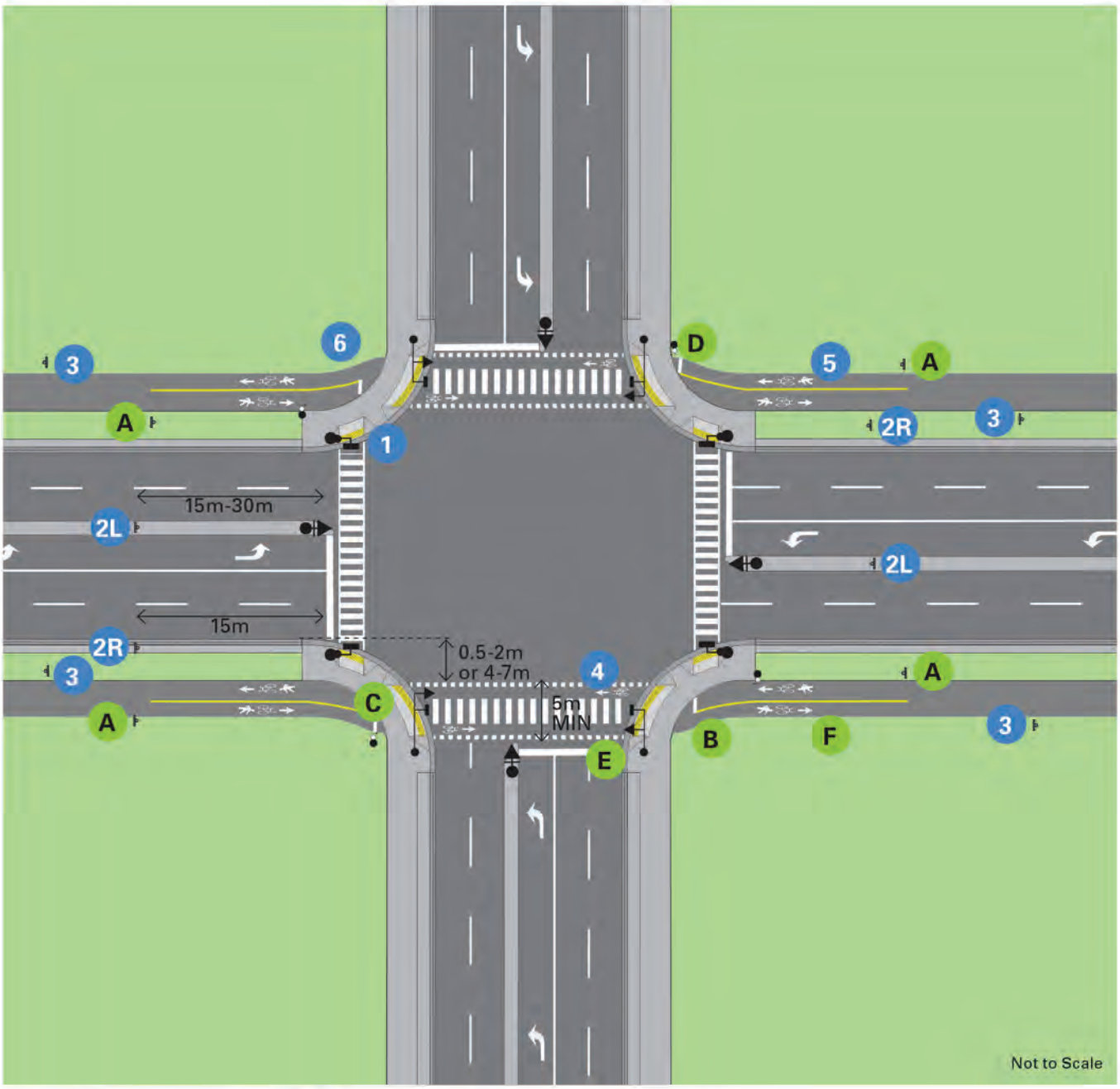
Minimum

1. AODA – compliant curb ramps and tactile plates per York Region Standard DS-400 series drawings (See section 7.2.4)
2. 'Bicycle Trail Crossing Side Street Sign' signage and optional 'Trail Crossing' tab (WC-44 + WC-44T – TAC) alerting drivers to the potential presence of cyclists crossing the intersecting street. WC-44L should be placed in the median to alert left turners about a crossing to their left, and WC-44R should be placed on the right side of the roadway to alert right turning traffic
3. 'Shared Pathway' signage (RB-93 – TAC) should be applied 5-30 m downstream of the intersection.
4. Intersection crossing of the multi-use path should be designed as Combined Pedestrian and Cyclist Crossride (refer to Sections 7.0 for details of pavement markings). In some instances, cyclists may be likely to cross the road to use the multi-use path on the other side (for example, to reach a major destination). Where this is anticipated, a crossride may be added to the perpendicular legs of the intersection in addition to the parallel legs (refer to Section 5.2.3, Exhibit 5-29 for an illustration of an intersection with crossrides on all legs)
5. A yellow dividing line should be applied to the multi-use path approaching the intersection to reduce conflicts.
6. Multi-use paths should be bent-in (0.5-2 m) or bent-out (4-7 m) from parallel edge of roadway, depending on roadway context & right-of-way availability – refer to Exhibit 5-8 and Exhibit 5-9.

Preferred

- **A** 'Cyclists Yield to Pedestrians' signage (Rb-73-OTM) can be applied where there are challenges with interactions between users.
- **B** Optional stop bar for cyclists located at the top of the curb ramp.
- **C** Multi-use path should be made of a different construction material than the sidewalk to mark the beginning of a shared space and to emphasize pedestrian priority.
- **D** Separate pedestrian pole with pushbutton for cyclists approaching on the right side of the multi-use path preferred to reduce conflicts with pedestrians and improve ease of crossing
- **E** Separate bicycle signals are preferred to provide consistency along the corridor and to allow for leading phases for path users. Where phasing is identical to parallel vehicle heads, only one head is needed. Otherwise, two bicycle heads should be provided.
- **F** Pedestrian and bicycle markings following/approaching intersection

Exhibit 5-7. Major Urban Intersection with Multi-use Path



As the multi-use path approaches the intersection, it is important that the facility be positioned appropriately for safe crossings. In cases where the approaching multi-use path is located between 2-4 m offset from the face of curb, it should be bent-in or bent-out as illustrated in Exhibit 5-8 and Exhibit 5-9 below.

Exhibit 5-8. Multi-use Path Bend-in Approaching Intersection

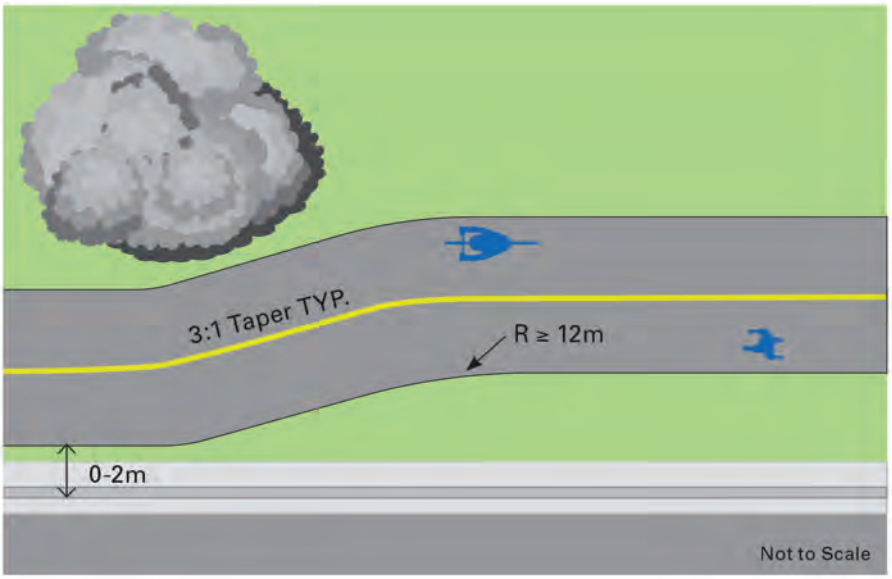


Exhibit 5-9. Multi-use Path Bend-out Approaching Intersection

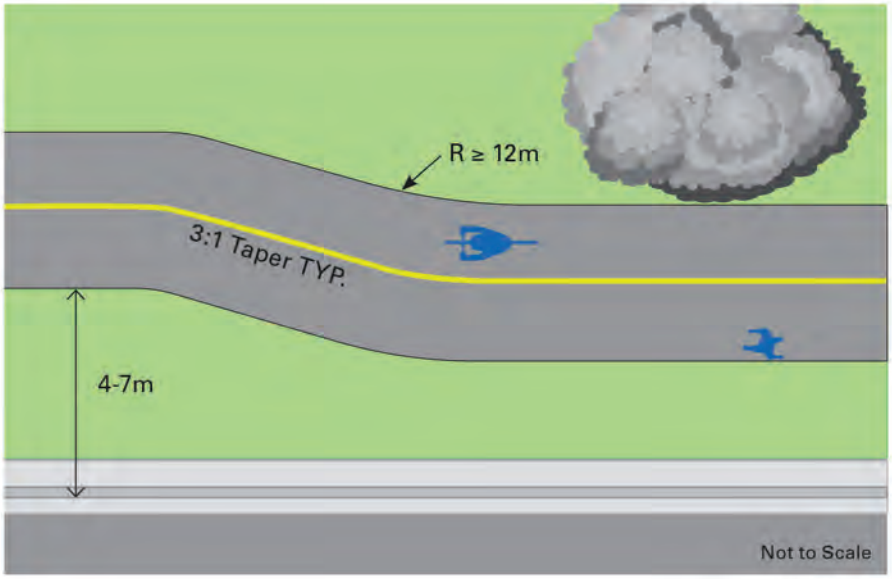


Photo Source: IBI Group

Urban Intersection with Sidewalks and Conventional Bike Lanes (Retrofit)

The application of conventional bike lanes will generally occur as a **retrofit of an existing roadway only along Regional roads**. For on-road cycling facilities, it is important to maximize the visibility of the cyclist to drivers and provide guidance on right of way at the intersection.

Where boulevard width and property allow, the bike lane should be ramped up into the boulevard to sidewalk level, and the bend in or bend out concepts applied (refer to Exhibit 5-14 or Exhibit 5-15).

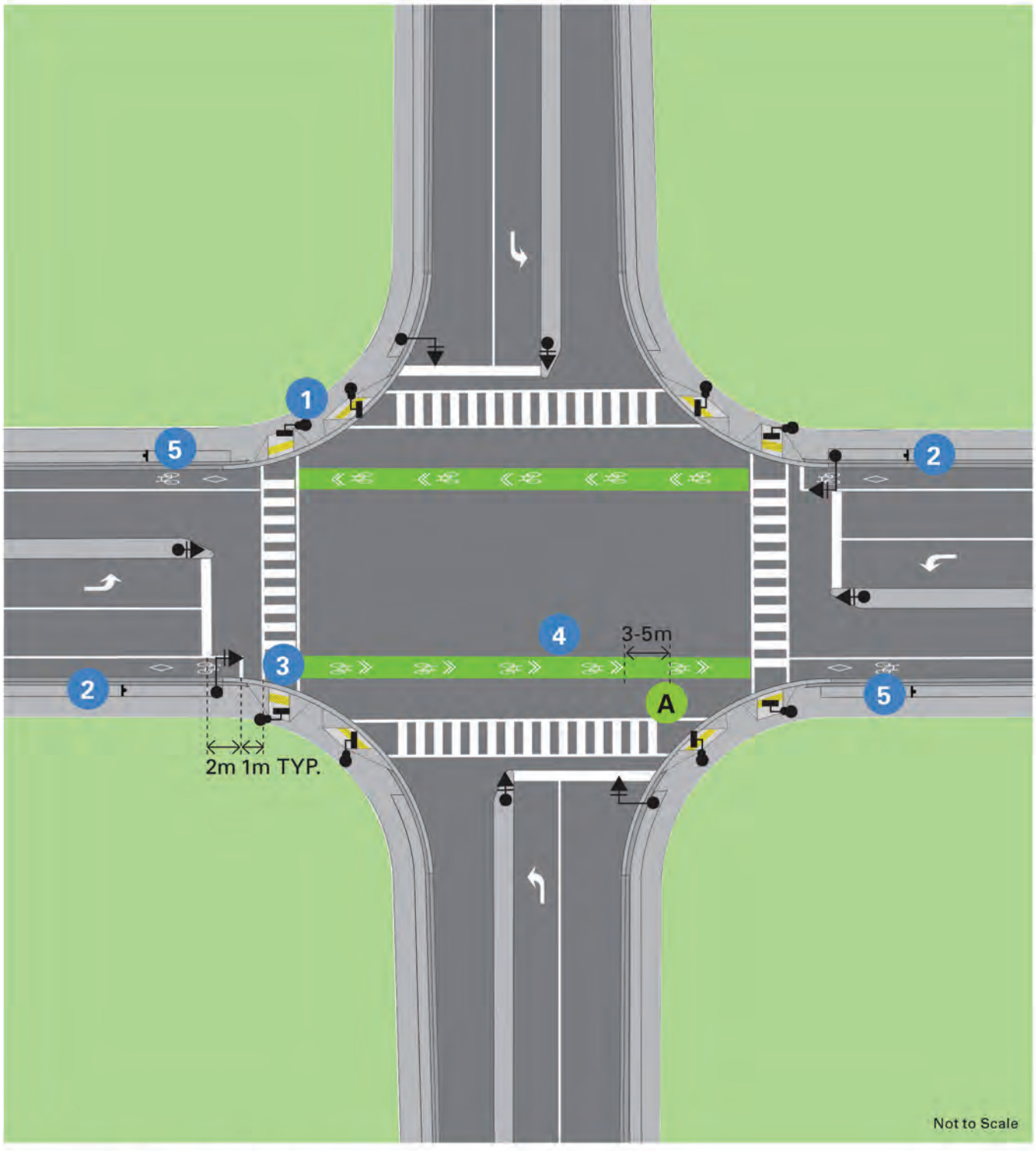
Minimum

1. AODA – compliant curb ramps and tactile plates per York Region Standard DS-400 series drawings (See section 7.2.4)
2. Customized 'Turning Vehicles Yield To Bicycles' (RB-37 – TAC) signage to alert turning drivers that they must yield to through cyclists
3. Advance cyclist stop bar provided 2 m ahead of vehicular stop bar to improve visibility of cyclists
4. Green conflict zone marking through intersection
5. Bicycle lane marking and 'Reserved Bicycle Lane' signage (RB-91 - TAC) to re-confirm the designation of the cycling facility after the intersection

Preferred

A. Sharrow markings to be applied with spacing of 3-5 m

Exhibit 5-10. Urban Intersection with Sidewalks & Conventional Bike Lane (retrofit)



Where a right turn lane is provided at an intersection, **a preferred approach to accommodating the turn lane is to ramp the cycling facility up into the boulevard (refer to Exhibit 5-11) and to transition to a raised or in-boulevard cycle track through the intersection. This can be coupled with separation in time (through signal phasing) or space (bend-out design). For additional details on the ramping, refer to Section 5.8.**

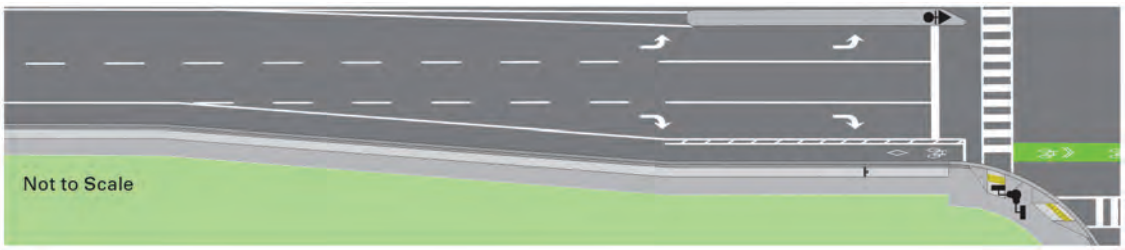
Exhibit 5-11. Bike Lane Ramping up into Boulevard

Where right-of-way or cost constraints do not allow for these alternatives, the following concepts may be considered.

Provide Advance Stop Bar & Buffered Bike Lane with Signal Separation (Retrofit)

This is a proposed treatment in which the bike lane is widened to accommodate a 0.5 m painted buffer with optional bollards. The vehicular stop bar is set back 2 m behind the cyclist stop bar to enhance visibility. This treatment should be implemented in concert with a separate bicycle signal which can be used to separate the vehicular right turn from the through cyclist movement (where a dedicated right turn lane is provided).

Exhibit 5-12. Bike Lane Right Turn Treatment with Advance Stop Bar



Conflict Zone Treatment (Retrofit)

This intersection treatment represents current practice. However, it is not preferred as many cyclists are likely to feel uncomfortable through conflict zones.

Exhibit 5-13. Dedicated Bikeway Right Turn Treatment with Conflict Zone

A conventional conflict zone with right turn lane can be intimidating for riders.

Major Urban Intersection with Sidewalks and Raised Cycle Tracks

This design illustrates an intersection treatment for cycle tracks which can be applied in constrained urban environments, to create a bend-in design.

Where additional boulevard width is available, the cycle track should be bent-out to provide a protected intersection (refer to Exhibit 5-144).

Minimum

1. AODA – compliant curb ramps and tactile plates per York Region Standard DS-400 series drawings (See section 7.2.4)
2. Customized 'Turning Vehicles Yield To Bicycles' (RB-37 – TAC) signage to alert turning drivers that they must yield to through cyclists
3. Cycle track and splash strip ramp down to road level (@ 5%) 3 m in advance of cyclist stop bar, and ramp back up following the intersection (refer to sample detail shown in Exhibit 5-15)
4. Advance cyclist stop bar provided 2 m ahead of vehicular stop bar to improve visibility of cyclists
5. Sharrow markings through intersection to be applied with spacing of 3-5 m
6. Green pavement markings illustrating the desired right turn path for vehicles should be added to assist motorists in avoiding the flush median
7. Bicycle symbol and arrow following intersection to confirm cycling facility

Preferred

A. Green conflict zone marking through intersection

B. Two stage left turn queue boxes should be considered in accordance with the warrants presented in Exhibit 5-16.

C. Optional bollard can be added to mark the beginning of the full height cycle track and to deter vehicles

D. Optional transition from in-boulevard cycle tracks (bend-in)

Where a dedicated right turn lane for motor vehicles is provided adjacent a raised cycle track, consideration should be given to separating pedestrian and cyclists movements from the conflicting right turning vehicles through signal phasing. This would require the addition of separate bicycle signals. For further discussion, refer to Chapter 8.

Exhibit 5-14. Major Urban Intersection with Sidewalks & Raised Cycle Tracks (Bend-in)

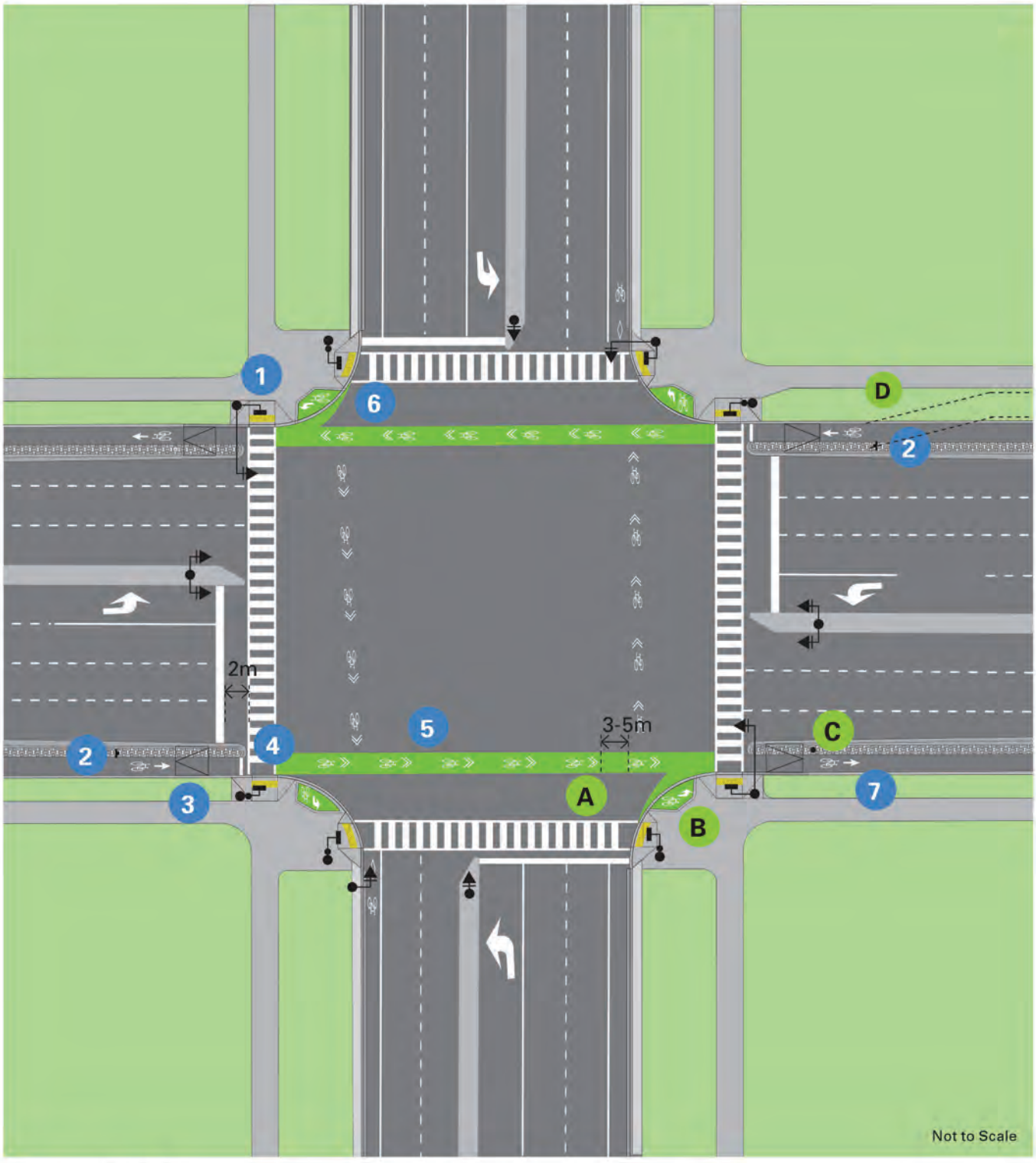
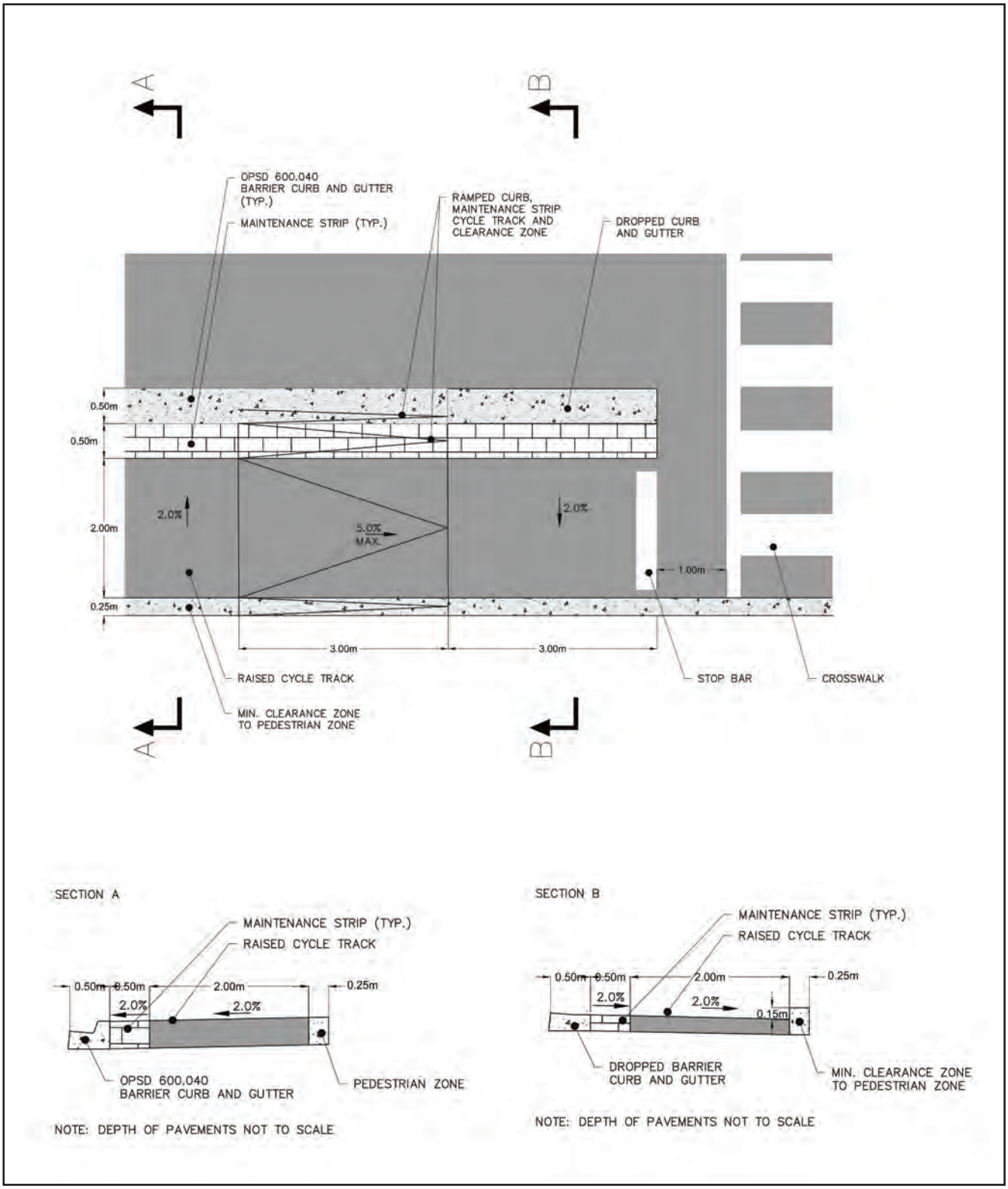


Exhibit 5-15. Sample Detail for Raised Cycle Track at Intersection



Two-stage Left Turn Queue Boxes

It is recommended that two-stage left turn queue boxes be applied along Regional roads where they will provide a benefit to cyclists, based on the approaching facility type, roadway and intersections context and the characteristics of the intersection roadway.

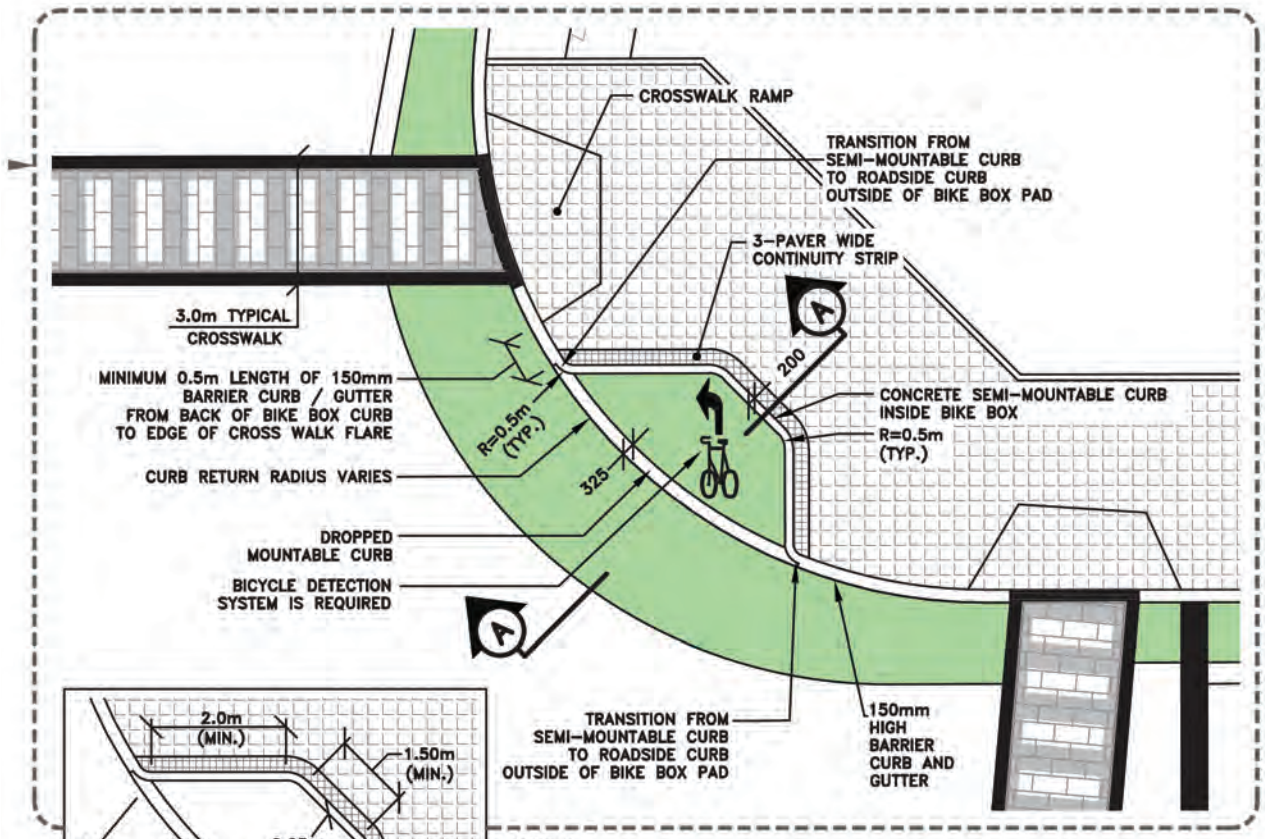
Exhibit 5-16. Two-Stage Left Turn Queue Box Warrant

In general, two stage left turn queue boxes should be considered where the following conditions are met:

- Should only be provided at signalized intersections along Regional corridors with cycling facilities appropriate for the street context
- Should be provided at signalized intersections in urban areas where any of the following conditions are met:
  - Where the intersecting street (municipal or regional) includes existing or planned cycling facilities appropriate for the street context
  - Where a two stage queue box could facilitate access to a major destination located within 500 m of an intersection regardless of whether cycling facilities are available on the intersecting roadway. A "major" destination may include a transit hub, school, community facility such as recreation centre or large commercial centre, or other destinations as determined by Regional staff. Note that where no receiving cycling facilities are provided, signage or other design interventions may be needed to ensure cyclists can safely merge into the intersecting roadway.
  - Where the Regional Road to be crossed is six lanes or wider, as a means of accommodating cyclists wishing to exit the Regional road. Note that where no receiving cycling facilities are provided, signage or other design interventions may be needed to ensure cyclists can safely merge into the intersecting roadway.

The Region has an existing standard two-stage left turn queue box design. Refer to York Region standard drawing D-10.04 in Exhibit 5-18.

Exhibit 5-17. Typical Bike Box D-10.04



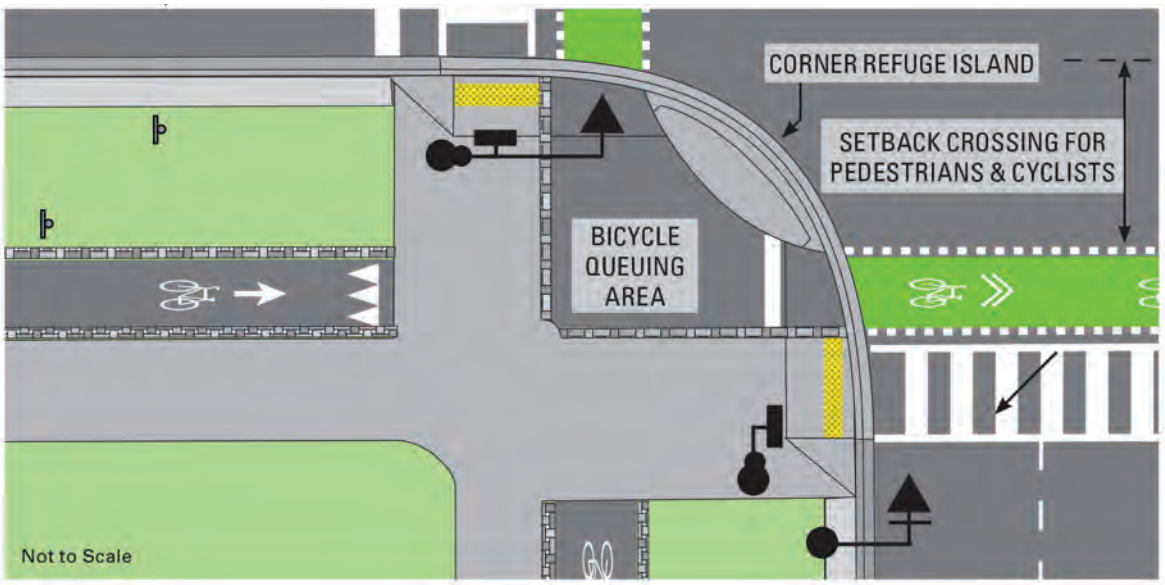
NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE NOTED.
2. CONCRETE SHALL BE 30MPa COMPRESSIVE STRENGTH AT 28 DAYS, WITH 5% TO 7% AIR ENTRAINMENT.
3. PAVER FOR CONTINUITY STRIP: MANUFACTURER: UNILOCK, ECO-PRIORA, SIZE: 120X120X80mm OR APPROVED EQUAL
4. BIKE DETECTION SYSTEM IS REQUIRED
5. INCLUDE TRANSVERSE CONTRACTION JOINTS ACROSS BIKE BOX PAD, IN LINE WITH CURB CUTS
6. BIKE BOX PAD TO HAVE LIGHT BROOM FINISH PERPENDICULAR TO STREET

N.T.S.

Major Urban Protected Intersection

The protected intersection is emerging in North America as a preferred higher-order intersection treatment with the potential to provide high quality crossings for both pedestrians and cyclists. Key elements of the protected intersection include the following: a corner refuge island which can be design to accommodate truck with use of a semi-mountable aprons, use of the bend-out design and appropriate crossing set back (4-7 m), and a bicycle queuing area of sufficient depth.



Several examples of protected intersections that have been implemented in North America are shown below in Exhibit 5-18.

Exhibit 5-18. Protected Intersections in Chicago, Salt Lake City and Vancouver

Source: IBI Group

Source: Google Streetview

The following are the minimum and preferred elements of a protected intersection.

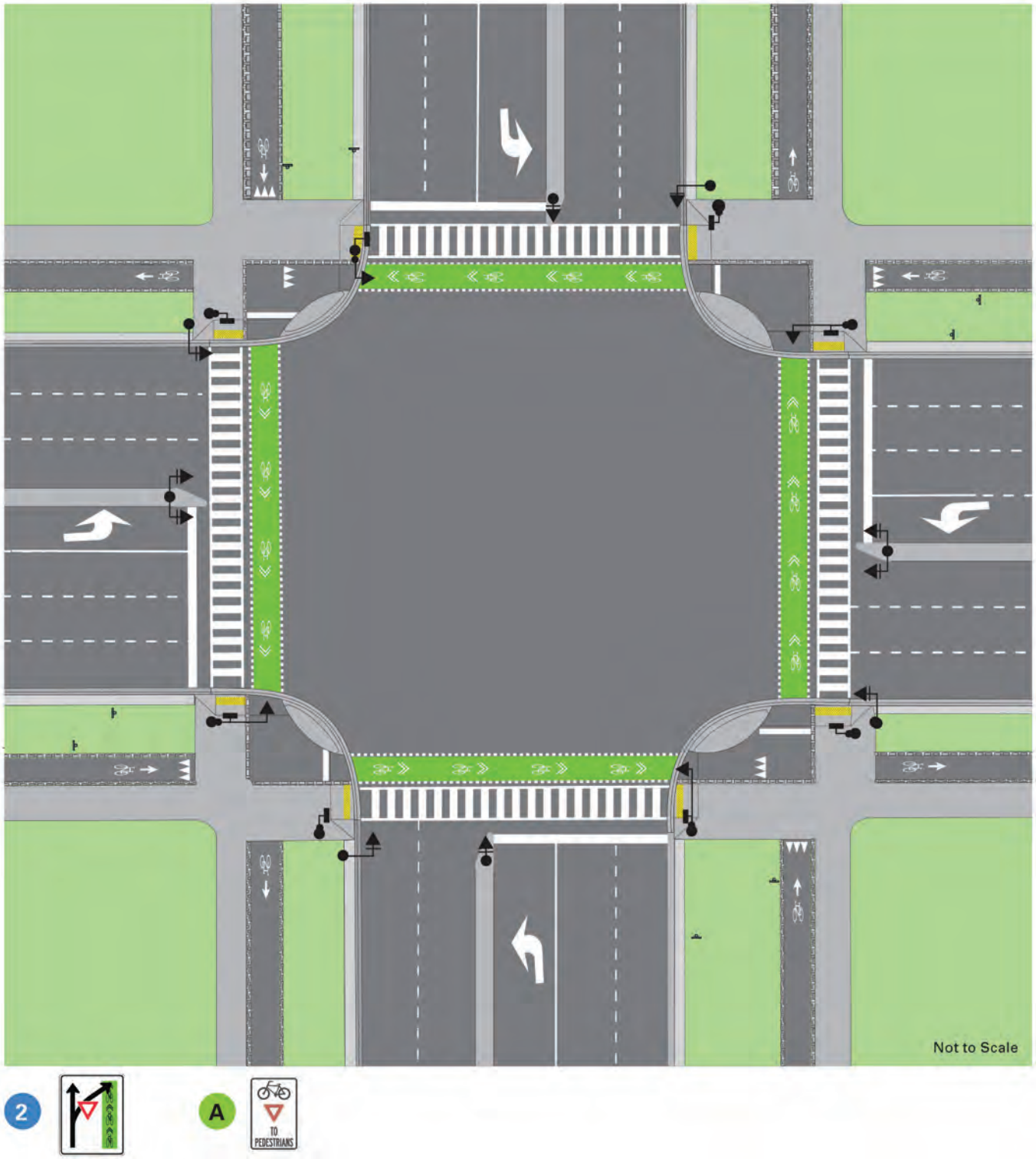
Minimum

1. AODA – compliant curb ramps and tactile plates per York Region Standard DS-400 series drawings (See section 7.2.4)
2. Customized 'Turning Vehicles Yield To Bicycles' (RB-37 – TAC) signage to alert turning drivers that they must yield to through cyclists
3. Yield markings alerting approaching cyclists of pedestrian priority should be applied to separated cycling facilities
4. Corner refuge island to provide physical protection to waiting pedestrians and cyclists (refer to details in Exhibit 5-22 & Exhibit 5-23)
5. Bicycle queuing area must be provide sufficient storage so that a waiting bicycle does not block or impede through pedestrian traffic
6. Motorist yield zone (minimum 4 m) which allows turning drivers to yield to crossing pedestrians and cyclists without risk of being rear-ended by through cyclists
7. Intersection crossing of the cycle track should be designed as a crossride for cyclists with elephant's feet markings and sharrows to indicate direction of travel
8. Bicycle marking should be applied following the intersection to re-confirm separated facilities

Preferred

- **A** 'Cyclists Yield to Pedestrians' signage (Rb-73-OTM) can be applied where there are challenges with interactions between users.
- **B** Optional stop bar for cyclists located at the top of the curb ramp.
- **C** Sidewalk should be carried across the cycle track crossing to emphasize pedestrian priority. Consideration maybe given to additional higher-order treatments (i.e. tactile plates or crosswalk markings).
- **D** Separate bicycle signals are preferred to provide consistency through the transition. Where phasing is identical to parallel vehicle heads, only one head is needed. Otherwise, two bicycle heads should be provided.
- **E** Optional transition from raised cycle tracks (bend-out)

Exhibit 5-19. Major Urban Protected Intersection (Bend-out)



The design of the corner refuge for the protected intersection is particularly important to the overall operations of the intersection. Corner radii need to be reduced in order to slow turning vehicles and encourage yielding behaviour. The area must also be kept free of obstructions which may reduce the visibility of approaching pedestrians and cyclists (clear space - refer to Exhibit 5-18).

Sample approach clear space and corner radii for various typologies are suggested in Exhibit 5-20 below. In all cases, these design criteria should be determined for each intersection based on site specific conditions.

Exhibit 5-21. Approach Clear Space

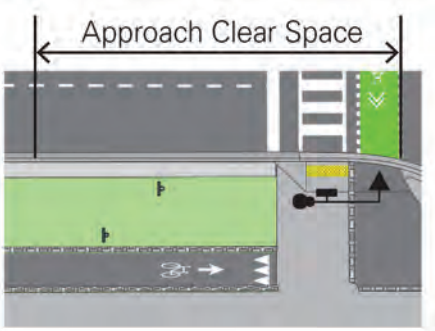


Exhibit 5-20. Suggested design criteria for protected intersections

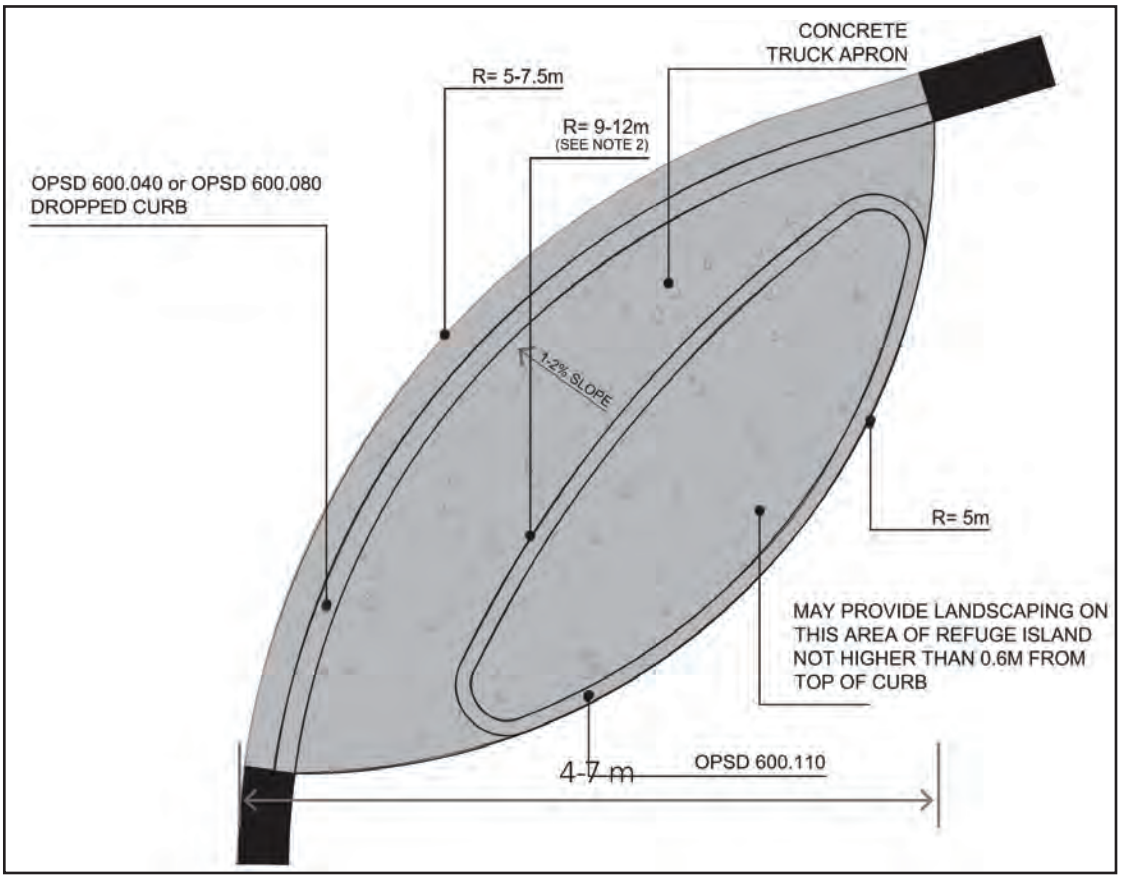
Right-Turn Travel Speed	Approach Clear Space	Corner Radius
18km/h	13m	5m (Min.YR Urban Avenue)
20km/h	14m	7.5 (Desirable YR Urban Avenue)
24km/h	15m	13m (TAC Bus)

While tighter corner radii are critical to the implementation of protected intersections, Regional roads must also accommodate transit vehicles and heavy vehicles. For this reason, the corner refuge island can be implemented with a semi-mountable truck apron. The recommended maximum radius for the inner edge of the apron is about 9-12 m. When facilities are designed, the path of the control vehicle must be traced to ensure that the vehicle clears the refuge island with sufficient setback to waiting pedestrians and cyclists.

Details of a sample corner island are illustrated in Exhibit 5-22 & Exhibit 5-23.

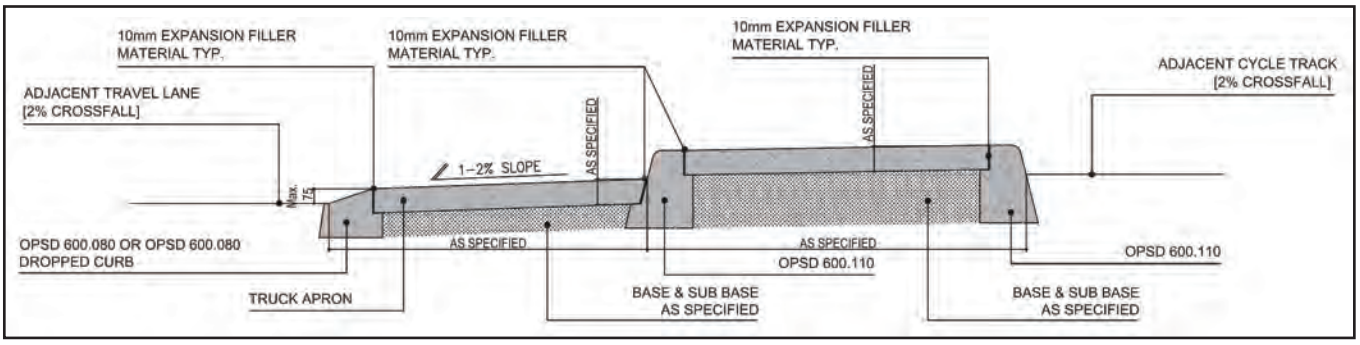
Where a dedicated right turn lane for motor vehicles is provided adjacent a protected intersection, consideration should be given to separating pedestrian and cyclists movements from the right turning vehicles through signal phasing. This would require the use of separate bicycle signals. Refer to Chapter 8 for additional discussion on signal operations.

Exhibit 5-22. Corner Refuge Island Detail



Note: Determine truck apron corner radius (R9-12m or two-centred curve) to suit the frequent user, control (heavy) vehicle, ensure control vehicle at "crawl speed" does not track beyond the drop curb of the cycle track / sidewalk ramp on the departure leg of the intersection.

Exhibit 5-23. Concrete Truck Apron Detail



5.2.2 Unsignalized Intersections

Pavement markings highlight cyclist path across an unsignalized intersection

Crossings at unsignalized intersections must include curb ramps or depressions with tactile walking surface indicators

Along Regional roads, unsignalized intersections are most likely to occur where a local or collector road intersects a Regional Road. In these cases, drivers on the intersecting street must stop and identify a gap in traffic on the Regional road in order to complete their movement through the intersection. As a result, enhancing the visibility of conflicting movements from cyclists and pedestrians is critical to ensuring the safety of these users. This is perhaps most important where cyclists and pedestrians will be travelling in the opposite direction of opposing traffic, since drivers will focus on selecting a gap in cross-traffic.

The following types of active transportation facilities at unsignalized intersections are illustrated in these guidelines:

- Conventional bike lanes with sidewalk
- On-road separated bikeway (i.e. raised cycle track or protected bike lanes) with sidewalk
- In-boulevard separated bikeway (i.e. in-boulevard cycle track) with sidewalk
- Multi-use facility

Conventional Bike Lanes with Sidewalk

Unsignalized Intersection

Minimum

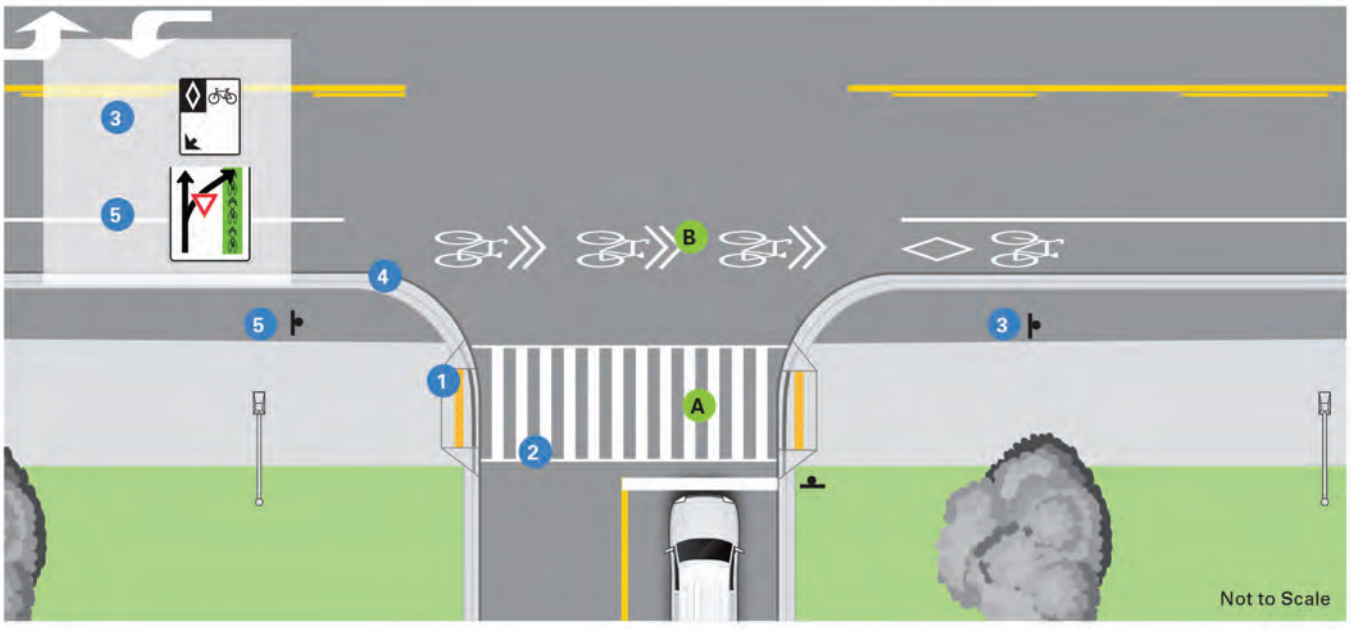
1. Accessible curb ramps per York Region Standard DS-100 series drawings
2. Transverse crosswalk markings
3. Bike and diamond pavement marking following intersection in addition to bike lane signage (RB-91 - TAC)
4. Corner radii will vary depending on control vehicles. Wherever possible, a reduced radii of 7.5 m can be used to slow turning vehicles.
5. Customized RB-37 signage to alert turning drivers that they must yield to thru cyclists - refer to Section 7

Preferred

A. Optional ladder crosswalk markings for improved visibility

B. Sharrows spaced at 3 - 5 m (urban areas) or 8-10 m (rural areas) to alert drivers to cyclist's path of travel. In special instances, a green conflict zone marking may also be considered in addition to the sharrow markings.

Exhibit 5-24. Conventional Bike Lane with Sidewalk at Unsignalized Intersection



Separated Bikeway with Sidewalk

Unsignalized Intersection

Minimum

1. Accessible curb ramps per York Region Standard DS-100 series drawings
2. Transverse crosswalk markings
3. Bike and diamond pavement marking following intersection in addition to bike lane signage (RB-91 - TAC)
4. Corner radii will vary depending on control vehicles. Wherever possible, a reduced radii of 7.5 m can be used to slow turning vehicles
5. Customized RB-37 signage to alert turning drivers that they must yield to thru cyclists - refer to Section 7

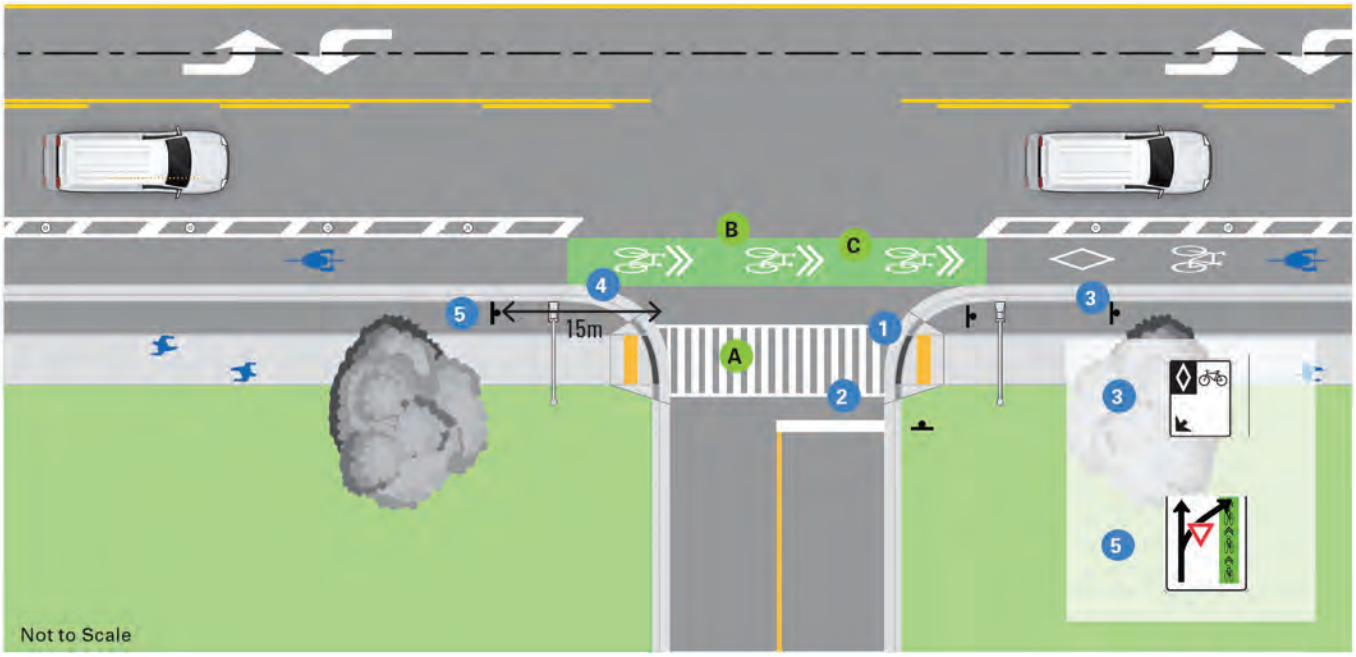
Preferred

A. Optional ladder crosswalk markings for improved visibility

B. Sharrows spaced at 3-5 m (urban areas) or 8-10 m (rural areas) to alert drivers to cyclist's path of travel

C. Green conflict zone marking through intersection

Exhibit 5-25. Separated Bikeway with Sidewalk at Unsignalized Intersection



In-Boulevard Separated Bikeway with Sidewalk

Unsignalized Intersection

The 'bend-out' design depicted in Exhibit 5-26 can be applied to cycling facilities located anywhere within the boulevard, including raised cycle tracks located adjacent the curb by beginning the 'bend-out' far enough in advance of the intersection. Where space constraints preclude the use of this treatment, the cycling facilities should be 'bent in' to between 0-2 m from the face of curb.

In-Boulevard Separated Bikeway with Sidewalk

Minimum

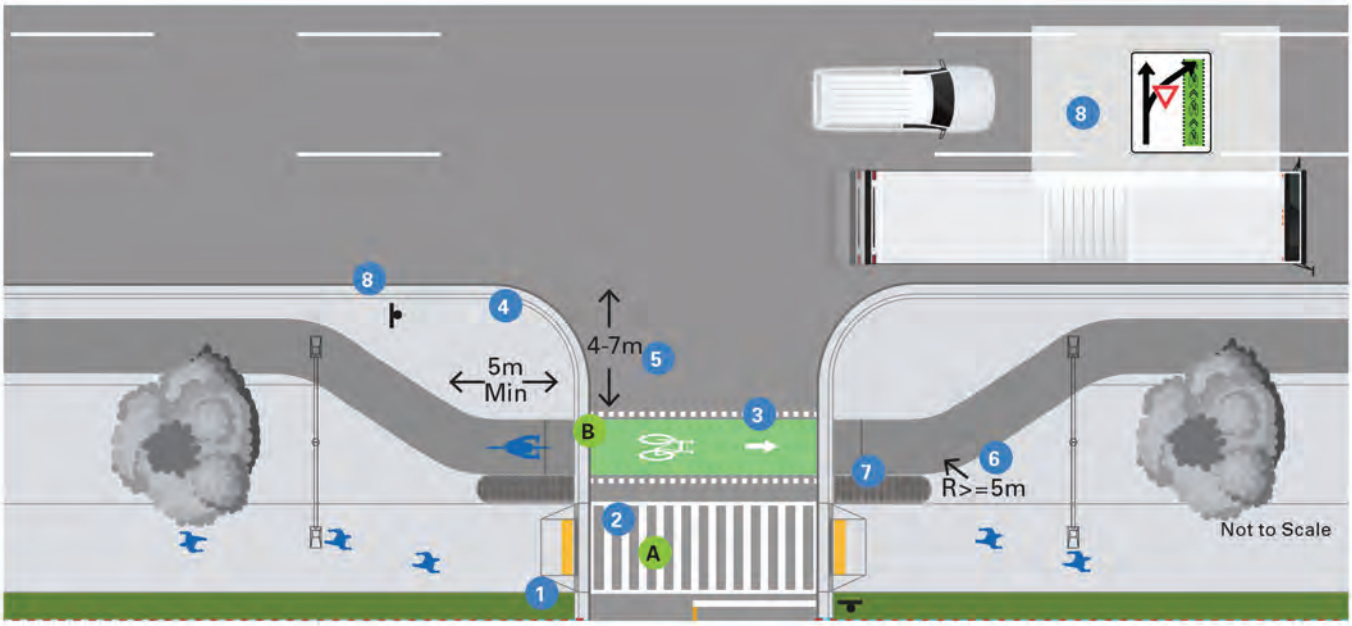
1. Accessible curb ramps per York Region Standard DS-400 series drawings (See section 7.2.4)
2. Transverse crosswalk marking
3. Crossride marking for cyclists must incorporate elephant's feet markings and bike symbol with arrow to indicate direction of travel
4. Corner radii will vary depending on control vehicles, but 7.5 m is preferred to reduce the speed of right turning vehicles
5. Crossride must be set back from the Regional road 4-7 m to allow a turning vehicle space to yield to crossing cyclists without risk of being rear-ended
6. To improve cycling comfort, cycle track radii should be ≥ 5 m
7. Delineation of cycling and pedestrian space where the two facilities approach each other through the application of paving stones or other high contrast treatment
8. Customized RB-37 signage to alert turning drivers that they must yield to thru cyclists - refer to Section 7

Preferred

A. Optional ladder crosswalk markings for improved visibility

B. Green conflict zone marking through intersection

Exhibit 5-26. In-boulevard Separated Bikeway with Sidewalk at Unsignalized Intersection



Multi-use Path

Unsignalized Intersection

This treatment should be applied where a boulevard multi-use path within Regional ROW crosses a minor stop-leg controlled street. For cases where a boulevard multi-use path crosses a driveway, please refer to Section 6.1.2.

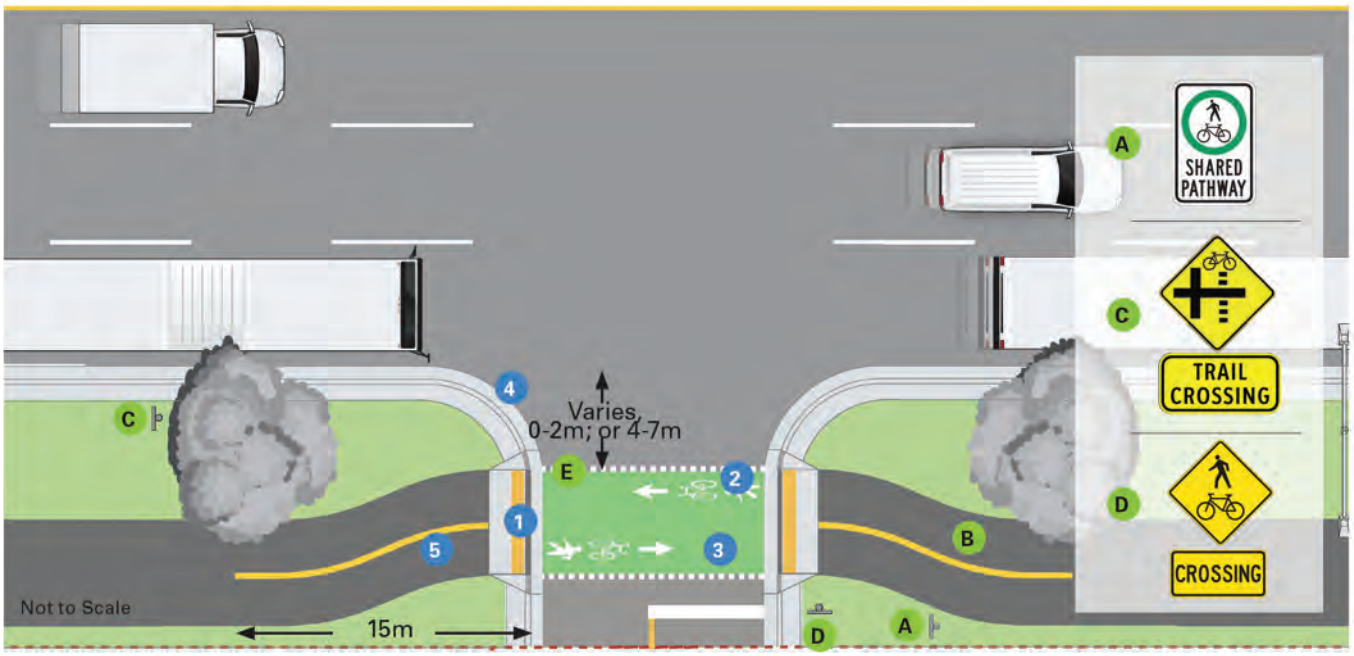
Minimum

1. Accessible curb ramps per York Region Standard DS-400 series drawings (See section 7.2.4)
2. Crossride marking for cyclists must incorporate elephant's feet markings
3. Marking through crossride include pedestrian and cyclist with an arrow. Markings should be placed to align with the centre of the vehicular curb lane
4. Corner radii will vary depending on control vehicles, but 7.5 m is preferred to reduce the speed of right turning vehicles
5. A yellow dividing line should be used approaching the intersection to reduce conflicts.

Preferred

- **A** 'Shared Pathway' signage (RB-93 - TAC) can be applied following the intersection for path users
- **B** Gentle curve in multi-use path may be used to slow cyclists approaching the intersection
- **C** 'Bicycle Trail Crossing Side Street' signage and tab (WC-44 - TAC & WC-44T - TAC) in advance of intersection along Regional road
- **D** Pedestrian – cyclist crossing ahead tab and signage (Wc-15 - OTM & Wc-32t - OTM) 15m in advance of path crossing along intersecting road
- **E** Green conflict zone marking through intersection

Exhibit 5-27. Multi-use Path at unsignalized intersection



5.2.3. Facility Transitions

Facility transitions occur where one facility meets or intersects another. These transitions are likely to occur where a roadway transitions from one classification to another, or where Regional roads intersect municipal roads. These transitions can present a challenge to users, particularly where uni-directional facilities meet bi-directional facilities. Designers should aim to reduce the inconvenience of these transitions wherever possible while ensuring that movements are controlled and predictable. Whenever possible, facility transitions should occur at signalized intersections in order to provide adequate opportunities for pedestrians and cyclists to safely cross roads, as needed.

Each facility transition will require detailed consideration of the context, however some generalized examples that are likely to have applications in York Region have been developed to assist designers in these instances.

The following types of facility transitions are illustrated in these guidelines:

- Separated bikeway on one side of an intersection transitioning to a multi-use path on the other side of the intersection
- Separated bikeway on major road intersecting a multi-use path on a cross road
- Multi-use facility on major road intersecting a multi-use path on cross road

Separated Bikeway on one side of an Intersection transitioning to a Multi-use Path on the other side of the Intersection

The scenario where a cycle track must transition to a multi-use path is likely to occur where a Regional road transitions from a highly urbanized area (i.e. Avenue or City Centre Street), to a or lower density area (i.e. Connector). The same treatment shown here can also be applied where an on-road (dedicated) facility meets a multi-use path by ramping the bike lane up into the boulevard and applying this treatment (refer to Exhibit 5-29).

For further details of the width of facilities, refer to Section 4.10, or for details of intersection geometry refer to Section 5.2.1.

Minimum

1. AODA – compliant curb ramps and tactile plates per York Region Standard DS-400 series drawings (See section 7.2.4)
2. Customized 'Turning Vehicles Yield To Bicycles' (RB-37 – TAC) signage to alert turning drivers that they must yield to through cyclists
3. 'Bicycle Route' marker signage (IB-23 - TAC) combined with right turn signage (IS-5R) and custom street signage (C-1) indicating that cyclists wishing to continue to along the Regional Road must turn right
4. 'Shared Pathway' signage (RB-93 – TAC) should be applied 5-30 m downstream of the intersection where the multi-use pathway begins.
5. Intersection crossing of the cycle track should be designed as a crossride for cyclists with elephant's feet markings and chevrons to indicate direction of travel
6. Yield markings alerting approaching cyclists of pedestrian priority should be applied to separated cycling facilities
7. A yellow dividing line should be applied to the multi-use path approaching the intersection to reduce conflicts.

Preferred

- **A** 'Cyclists Yield to Pedestrians' signage (Rb-73-OTM) can be applied where there are challenges with interactions between users.
- **B** 'Bicycle Route' marker signage (IB-23 - TAC) combined with right turn signage (IS-8R-TAC) and custom street signage (C-1) indicating that cyclists wishing to continue to along the Regional Road must turn right to reinforce the previous signage where wrong way riding is expected or has been observed
- **C** Shared use path and cyclist right turn slip lane should be made of a different construction material than the sidewalk to mark the beginning of a shared space and to emphasize pedestrian priority.
- **D** Separate bicycle signals are preferred to provide consistency through the transition. Where phasing is identical to parallel vehicle heads, only one head is needed. Otherwise, two bicycle heads should be provided.

Exhibit 5-28. Separated Bikeway transitioning to a Multi-use Path

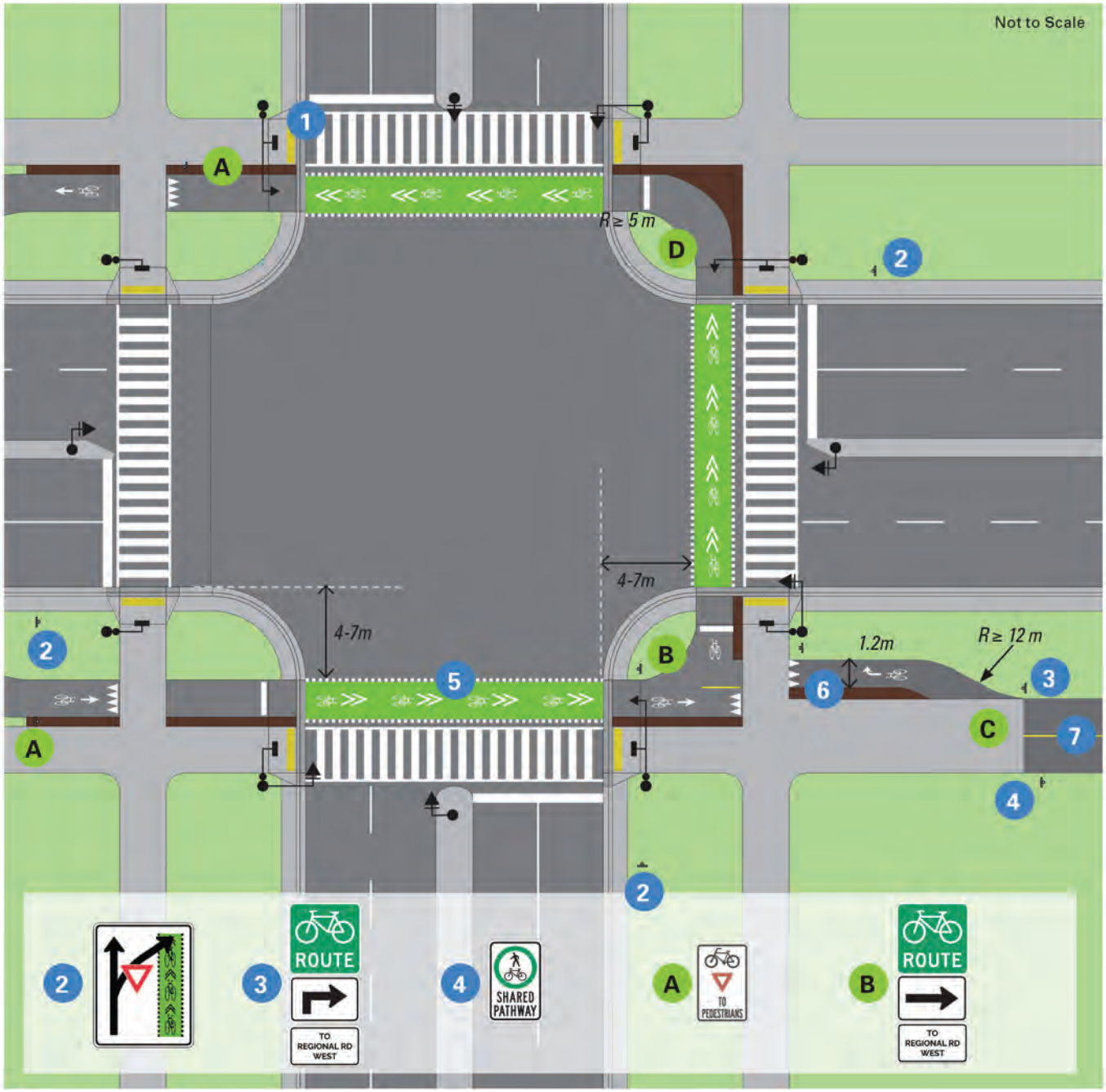
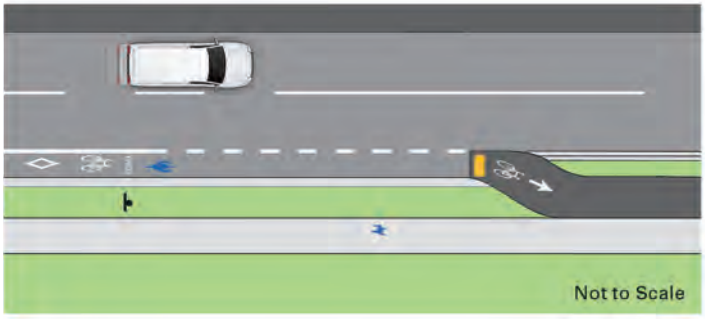


Exhibit 5-29. Optional transition from Bike Lanes into Boulevard



Separated Bikeway on Major Road intersecting a Multi-use Path on a Cross Road

For cases where a sidewalk and cycle track intersects a multi-use path, it is important to clarify pedestrian priority through a combination of material changes, signage and pavement markings. The same treatment shown here can also be applied where an on-road (dedicated) facility meets a multi-use path by ramping the bike lane up into the boulevard and applying this treatment. For further details of the width of facilities, refer to Section 4.10, or for details of intersection geometry refer to Section 5.2.1.

Minimum

1. AODA – compliant curb ramps and tactile plates per York Region Standard DS-400 series drawings (See section 7.2.4)
2. Customized 'Turning Vehicles Yield To Bicycles' (RB-37 – TAC) signage to alert turning drivers that they must yield to through cyclists
3. 'Bicycle Trail Crossing Side Street Sign' signage and optional 'Trail Crossing' tab (WC-44 + WC-44T – TAC) alerting drivers to the potential presence of cyclists crossing the intersecting street. WC-44L should be placed in the median to alert left turners about a crossing to their left, and WC-44R should be placed on the right side of the roadway to alert right turning traffic
4. 'Shared Pathway' signage (RB-93 – TAC) should be applied 5-30 m downstream of the intersection.
5. Intersection crossing of the cycle track should be designed as a crossride for cyclists with elephant's feet markings and chevrons to indicate direction of travel (refer to Section 5.2.1. for details)
6. Intersection crossing of the multi-use path should be designed as Combined Pedestrian and Cyclist Crossride (refer to Section 5.2.1. for details)
7. Yield markings alerting approaching cyclists of pedestrian priority should be applied to separated cycling facilities
8. A yellow dividing line should be applied to the multi-use path approaching the intersection to reduce conflicts.

Preferred

A. 'Cyclists Yield to Pedestrians' signage (Rb-73-OTM) can be applied where there are challenges with interactions between users.

B. Optional stop bar for cyclists located at the top of the curb ramp.

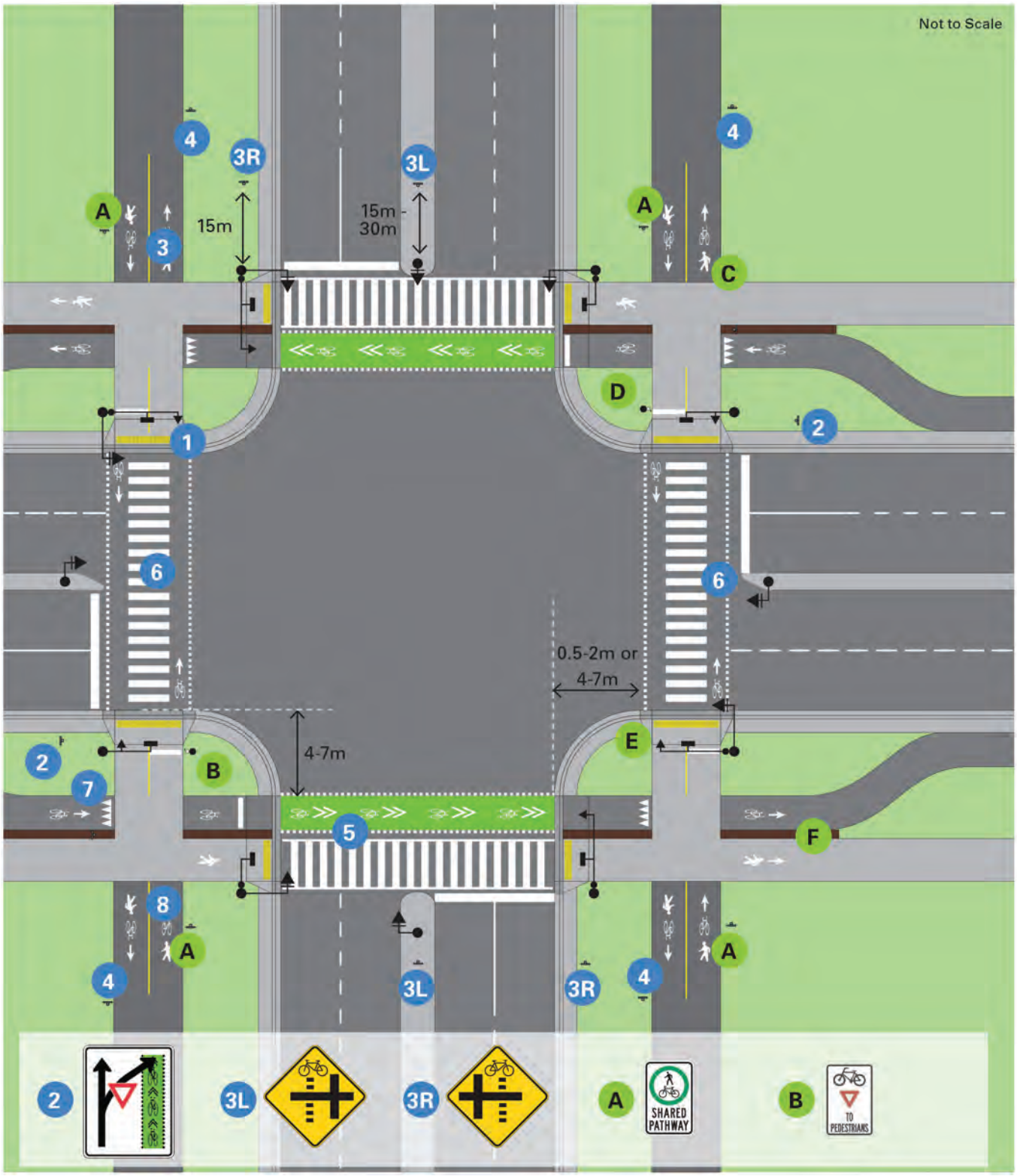
C. Shared use path should be made of a different construction material than the sidewalk to mark the beginning of a shared space and to emphasize pedestrian priority.

D. Separate pedestrian pole with pushbutton for cyclists approaching on the right side of the multi-use path preferred to reduce conflicts with pedestrians and improve ease of crossing

E. Separate bicycle signals are preferred to provide consistency through the transition. Where phasing is identical to parallel vehicle heads, only one head is needed. Otherwise, two bicycle heads should be provided.

F. Pedestrian and bicycle markings following intersection to re-confirm separated facilities

Exhibit 5-30. Separated Bikeway Intersecting a Multi-use Path



Multi-use Path on Major Road intersecting a Multi-use Path on a Cross Road

In the cases where two multi-use paths intersect, it is important to reiterate pedestrian priority within the shared space at the intersection.

For further details of the width of facilities, refer to Section 4.10, or for details of intersection geometry refer to Section 5.2.1.

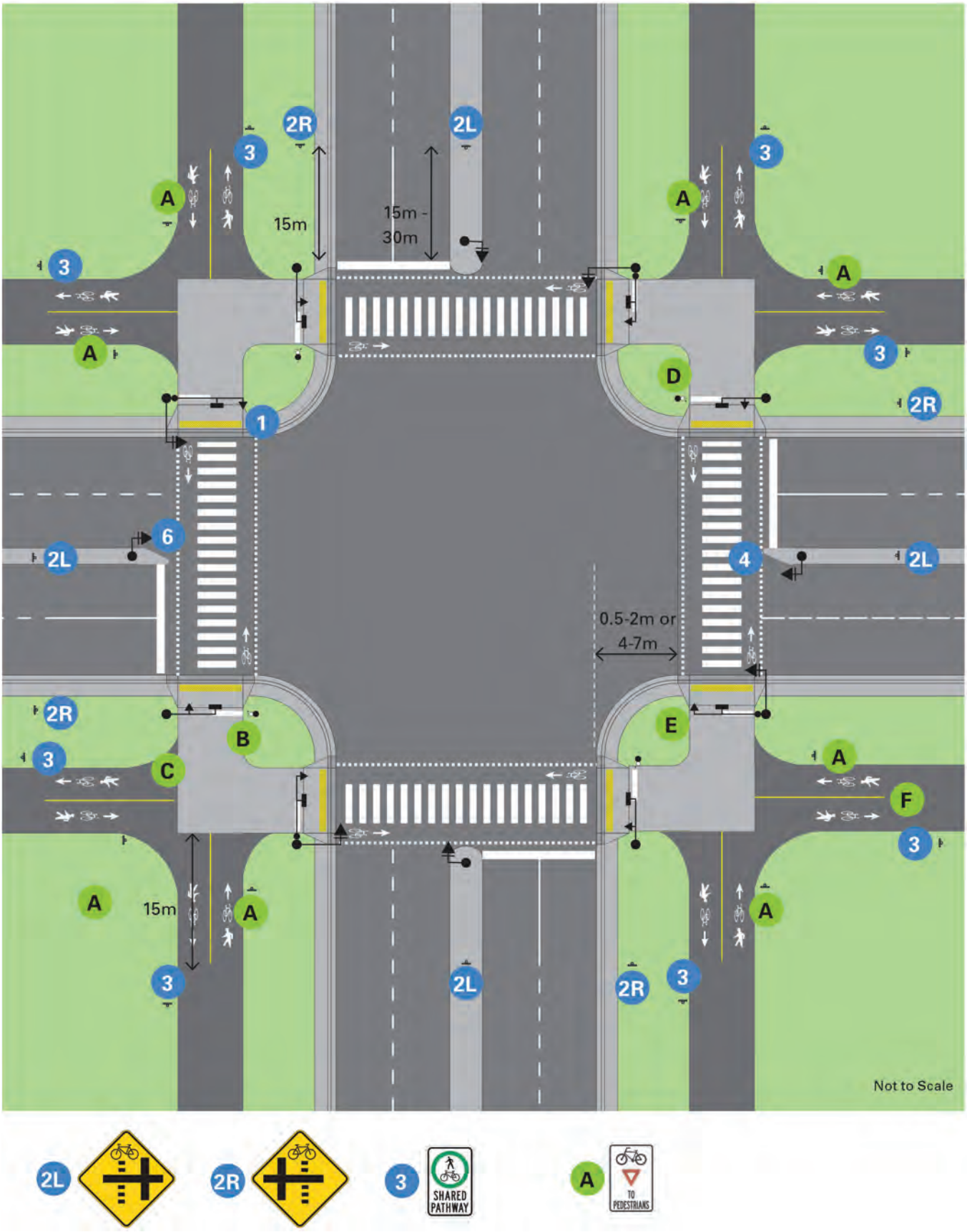
Minimum

1. AODA – compliant curb ramps and tactile plates per York Region Standard DS-400 series drawings (See section 7.2.4)
2. 'Bicycle Trail Crossing Side Street Sign' signage and optional 'Trail Crossing' tab (WC-44 + WC-44T – TAC) alerting drivers to the potential presence of cyclists crossing the intersecting street. WC-44L should be placed in the median to alert left turners about a crossing to their left, and WC-44R should be placed on the right side of the roadway to alert right turning traffic
3. 'Shared Pathway' signage (RB-93 – TAC) should be applied 5-30 m downstream of the intersection.
4. Intersection crossing of the multi-use path should be designed as Combined Pedestrian and Cyclist Crossride (refer to Sections 5.2.1. & 7 for details)
5) A yellow dividing line should be applied to the multi-use path approaching the intersection to reduce conflicts.

Preferred

- **A** 'Cyclists Yield to Pedestrians' signage (Rb-73-OTM) can be applied where there are challenges with interactions between users.
- **B** Optional stop bar for cyclists located at the top of the curb ramp.
- **C** Shared use path should be made of a different construction material than the sidewalk to mark the beginning of a shared space and to emphasize pedestrian priority.
- **D** Separate pedestrian pole with push button for cyclists approaching on the right side of the multi-use path preferred to reduce conflicts with pedestrians and improve ease of crossing
- **E** Separate bicycle signals are preferred to provide consistency through the transition. Where phasing is identical to parallel vehicle heads, only one head is needed. Otherwise, two bicycle heads should be provided.
- **F** Optional pedestrian and cyclist markings following/approaching intersection.

Exhibit 5-31. Multi-use Path Intersecting a Multi-use Path



5.3 RURAL INTERSECTIONS

Rural intersections present a unique set of challenges for vulnerable users. Although pedestrian and cycling volumes are expected to be lower than in urban areas, rural intersections must still provide a basic level of accommodation, including meeting AODA requirements for signalized intersections. In some cases, transit stops are provided at rural intersections, and the pedestrian environment should be enhanced beyond the minimum treatments in these instances.

A typical rural intersection is illustrated in Exhibit 5-32.

Minimum

1. AODA – compliant curb ramps and tactile plates per York Region Standard DS-100 series drawings
2. Customized 'Turning Vehicles Yield To Bicycles' (RB-37 – TAC) signage to alert turning drivers that they must yield to through cyclists
3. Ladder crosswalk markings
4. Inside of painted buffer on paved shoulder dropped as cross-section urbanizes
5. Rural cross-section urbanizes approaches the signalized intersection to accommodate signal equipment and provide space for transit passengers

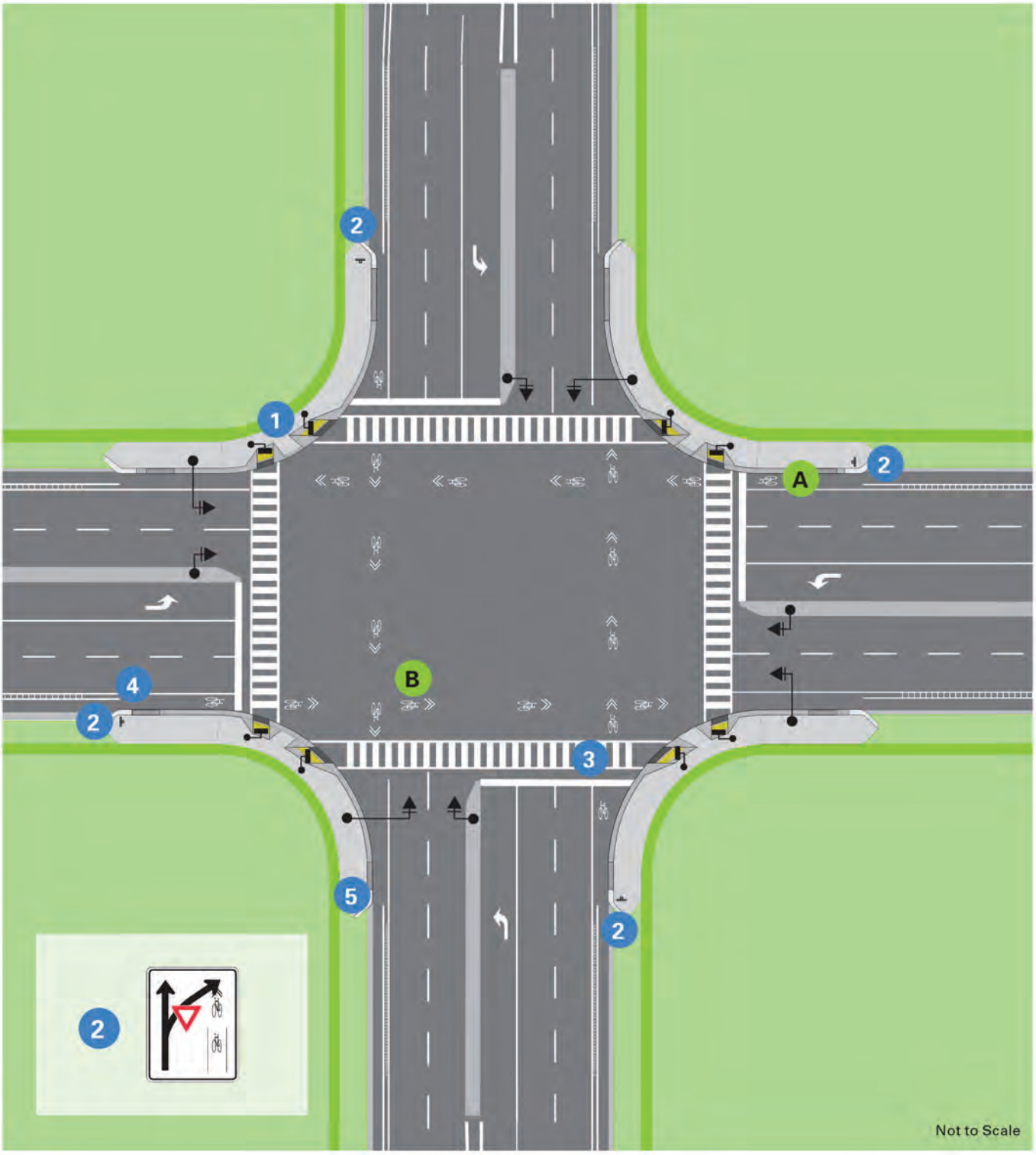
Preferred

A. Bicycle symbol can be applied on the near side of the intersection to reinforce the cyclist waiting area

B. Lower volumes of cyclists require minimal conflict zone treatments. Where desired, sharrows spaced at 8-10 m can be used to clarify the cyclists travel path through the intersection

In the rural context illustrated here, it is generally assumed cyclists will make vehicular left turns. However, in unique instances where there is a need to accommodate a specific heavy cyclist left movement, or where there is an anticipation of less experienced or confident cyclists, a two-stage left turn queue box could be considered as an additional feature.

Exhibit 5-32. Typical Rural Intersection



In the rural environment, a 'conflict-zone' style treatment is suggested for cyclists where dedicated vehicular right turn lanes are provided, as a review of York Region rural facilities found that most riders in the rural environment prefer to position themselves to the left of right turning vehicles.

A sample treatment is shown in Exhibit 5-33.

Rural Intersection with Dedicated RIght Turn lane

Minimum

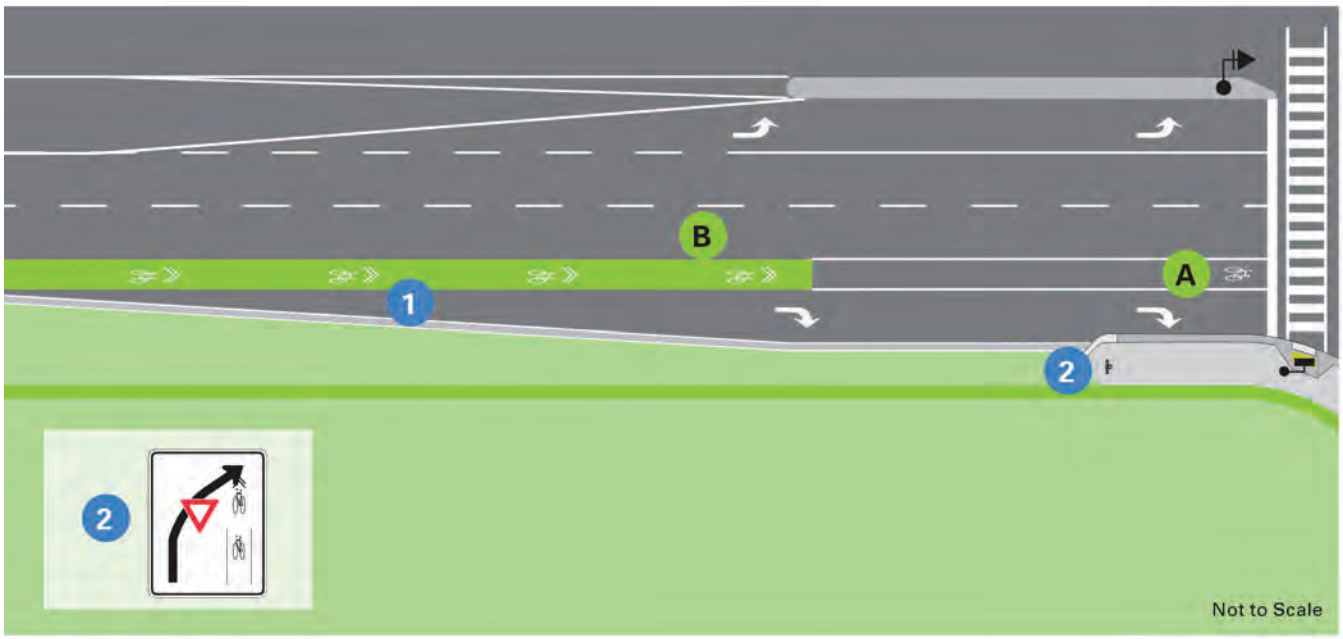
1. Sharrows spaced at 8-10 m through conflict zone
2. Customized 'Turning Vehicles Yield To Bicycles' (RB-37 – TAC) signage to alert turning drivers that they must yield to through cyclists

Preferred

A. Bicycle symbol can be applied on the near side of the intersection to reinforce the cyclist waiting area

B. Green pavement marking through conflict zone

Exhibit 5-33. Treatment for Dedicated Right Turn Lane at Rural Intersection



5.4 FREEWAY CROSSINGS

Freeways and highways often act as major barriers to active transportation networks. Where active transportation facilities must cross these barriers, the following strategies should be considered to avoid or mitigate potential conflicts (in decreasing order of preference):

1. **Provide grade separation of the active transportation facility** (refer to Exhibit 5-34 for an example and Chapter 5.7 for details on grade separated crossings). A separate bridge for vulnerable users located up or downstream of the interchange will help to eliminate potential conflicts with motorists as users remain within their own dedicated path or trail.

Exhibit 5-34. Proposed McKenzie Interchange Project with Multi-use Path Overpass

"McKenzie Interchange project – detail of Galloping Goose Trail" by Province of British Columbia (CC BY-NC-ND 2.0)

2. Where facilities cannot be grade separated and facilities must cross interchanges, **interchanges which restrict free flow vehicular movements by providing signal or stop controlled entry and exit legs** meeting an arterial perpendicularly **are preferred.**
3. **Where high-speed merge and diverge ramps must be provided, jughandle designs can provide safer crossings**. In a recent survey of the Highway 7 corridor in York Region, many cyclists noted their lack of comfort using conventional conflict zone treatments across these ramps, therefore jughandle treatments are generally preferred for applications in York Region.

In the case of high speed merge and diverge ramps, this chapter illustrates two jughandle design concepts (shown in Exhibit 5-35 to Exhibit 5-36).

Interchange ramps provide high stress environments for pedestrians, cyclists and drivers alike. Mixing relatively high speed, high volume motor vehicle traffic making frequent turning movements with vulnerable users is a challenge. To facilitate safe movements for cyclists and pedestrians, its critical provide ample time to select a gap when crossing merging and diverging traffic.

The jughandle designs provides clearly delineated space for cyclists, allowing ample time to choose when to cross merging and diverging traffic. Tactile plates are applied to the pedestrian ramps to improve accessibility. Although not shown in these concepts, there may be a possibility of introducing PXOS at ramps to provide controlled crossings.

Note these jughandle designs are conceptual only and any design of ramp crossings under MTO jurisdiction require consultation.

One of the major conflict areas between motorists and cyclists on Highway 7 is the interchange at Highway 404 where Highway 7 passes under Highway 404.

The conflict between cyclists and motorists entering the on-ramps or exiting the off-ramps poses one of the more common barriers to safe and comfortable cycling. Just 14% of respondents indicated that they feel safe with the conventional conflict zone design, while 45% indicated that they do not feel safe, and 40% indicated that the new facility has improved their sense of safety but that they are still concerned at this location.

Bike Lanes & Sidewalk with Diverging Ramp Crossing

Minimum

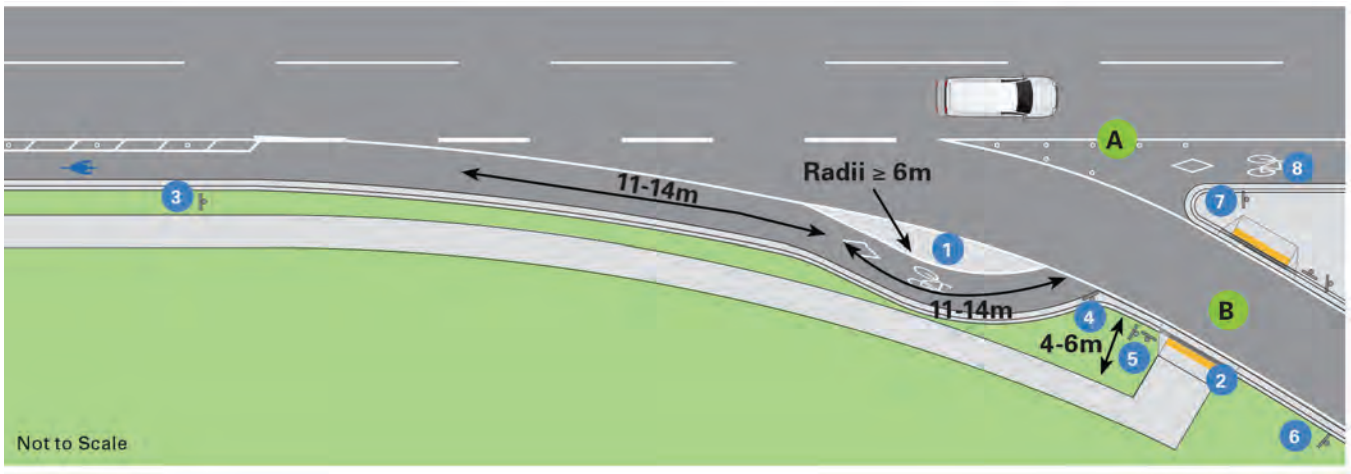
1. Jughandle design with reserved bike lane symbol slows cyclists and allows them to come closer to a perpendicular crossing to better evaluate gaps in vehicular traffic
2. Pedestrian crossing with tactile plates and AODA – compliant curb ramps
3. 'Pedestrian and Bicycle Crossing Ahead' signage and 'Crossing' tab (WC-46R + WC-7s – TAC) alerting drivers to the potential presence of cyclists and pedestrians crossing the ramp
4. 'Yield' signage (Ra-2 – OTM) indicating to cyclists that they are required to yield right of way to drivers merging onto the ramp
5. 'Wait for Gap' signage (Wc-28 – OTM) facing both directions indicating to pedestrians that they are required to yield right of way to drivers merging onto the ramp
6. 'No Pedestrians or bicycles' signage (Rb-68 – OTM) to indicate to cyclists and pedestrians that entry onto the freeway is prohibited.
7. 'Reserved Bicycle Lane' (RB-91 - TAC) to re-confirm the designation of the cycling facility after the merge ramp.

Preferred

A. Optional bollards in gore area to discourage late lane changes. Late lane changes can be particularly risky for vulnerable users who may be deciding to cross.

B. At present, there are no opportunities to formalize or control pedestrian crossings of ramps, so no pavement markings should be applied. However, as the use of pedestrian crossovers grows in Ontario, opportunities to introduce crossovers at ramps locations as appropriate should be considered.

Exhibit 5-35. Jughandle Design at a High-Speed Diverging Ramp with Bike Lanes & Sidewalk



Bike Lanes & Sidewalk with Merging Ramp Crossing

Minimum

1. Jughandle design with reserved bike lane symbol slows cyclists and allows them to come closer to a perpendicular crossing to better evaluate gaps in vehicular traffic
2. Pedestrian crossing with tactile plates and AODA – compliant curb ramps
3. 'Pedestrian and Bicycle Crossing Ahead' signage and 'Crossing' tab (WC-46L + WC-7s – TAC) alerting drivers to the potential presence of cyclists and pedestrians crossing the ramp
4. 'Yield' signage (Ra-2 – OTM) indicating to cyclists that they are required to yield right of way to drivers merging onto the ramp
5. 'Wait for Gap' signage (Wc-28 – OTM) facing both directions indicating to pedestrians that they are required to yield right of way to drivers merging onto the ramp
6. 'Reserved Bicycle Lane' (RB-91) to re-confirm the designation of the cycling facility after the merge ramp.

Preferred

A. Optional bollards in gore area to discourage cyclists from continuing straight through the crossing

B. At present, there are no opportunities to formalize or control pedestrian crossings of ramps, so no pavement markings should be applied. However, as the use of pedestrian crossovers grows in Ontario, opportunities to introduce crossovers at ramps locations as appropriate should be considered.

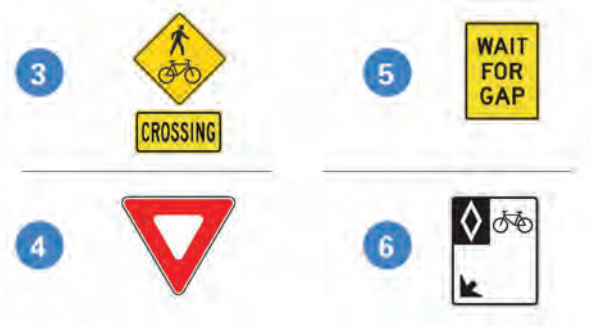
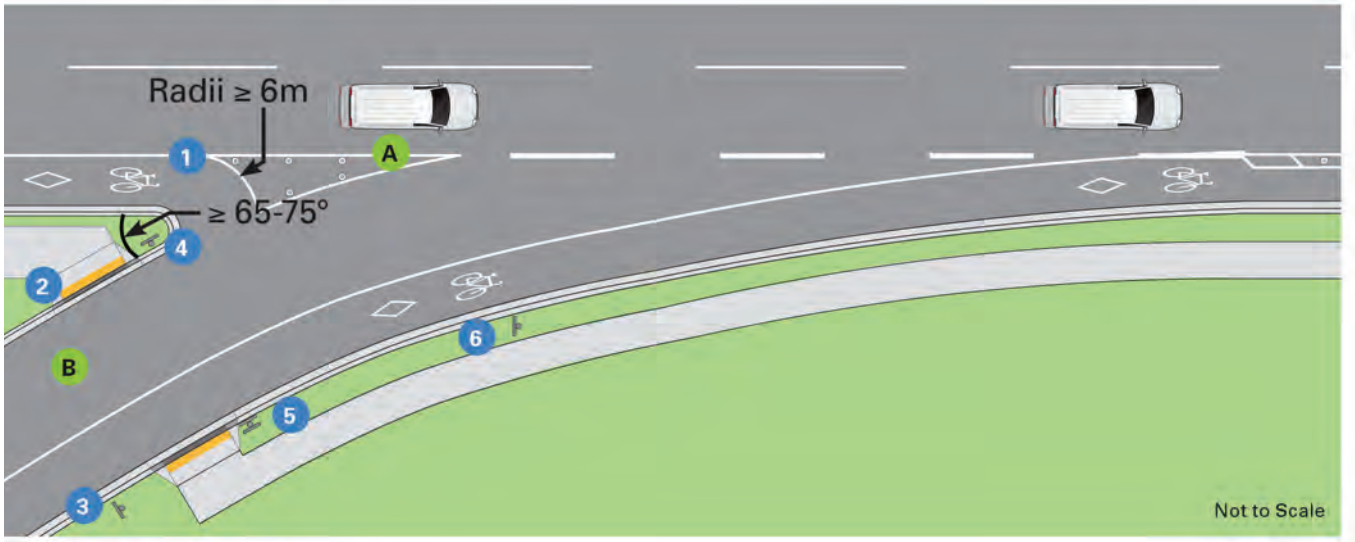


Exhibit 5-36. Jughandle Design at a High-Speed Merging Ramp with Dedicated Bikeway and Sidewalk



5.5 RAILWAY CROSSINGS

Railway crossings present risks for pedestrians and cyclists. Therefore, extra caution should be applied to assure their safe operation. In addition to standard pavement markings, rubber track guards are also recommended to improve friction between bike and wheelchair tires and the pavement, and also to narrow the rail gaps. Pavement crossing surfaces should be paved, and inspected regularly during road inspections for signs of deterioration around the tracks. Pavement deterioration adjacent to railway tracks can be a potential hazard, especially to those using mobility aids or devices, pushing strollers, or on bike, since wheels could get caught in the rails.

Details of requirements for barriers and gates for at-grade crossings can be found in Transport Canada's *Grade Crossings Regulations* and *Grade Crossings Standards*.

Crossings of railways should be designed close to right angles, both to enhance visibility and to prevent wheels getting caught in rails. In many situations, achieving this design may require widening in advance of the crossing, thereby allowing cyclists and pedestrians to reduce their speed and position themselves for crossing at right angles. Note that for extremely skewed rail crossings, it may be impractical to achieve a 90° crossing, and doing so may have unintended consequences as the reversing curves may be too sharp. In these instances, widening to 60° is sufficient.

The following series of exhibits illustrate jughandle design concepts for a widening to permit crossing at right angles for the following facilities:

- Dedicated Bikeway with Sidewalk
- Separated Bikeway with Sidewalk
- Multi-use Facility

Where the crossing is oriented such that a jughandle is not needed, similar pavement markings as shown in these examples will apply, save for markings and signage that are specific to the jughandle itself.

Jughandle Design at Rail Crossing – Dedicated Bikeway with Sidewalk

Minimum

1. 'Railway Crossing Ahead' signage (Wc-4 – OTM) should be applied upstream of the crossing in accordance with OTM Book 6 requirements
2. 'Automobiles and Motorcycles Prohibited Sign' (RB-89 - TAC) should be applied at the beginning of the jughandle.
3. 'X' Crossing pavement marking for cyclists, with its centre 9 m downstream of the railway crossing sign
4. Double stop bar for cyclists set back 4.5 m from the centerline of the nearest rail
5. Gore area should be marked per OTM Book 11, with 45-60 cm white chevrons spaced at 3-6 m (p. 129)
6. Rail crossing sign or warning device as required by Transport Canada regulations. A sidewalk, path or trail with a centre line more than 3.6 m from the centre of a vehicular warning device must have separate warning devices for each direction of travel for new crossings (refer to Transport Canada Grade Crossings Standards for details.)
7. Rubber (or similar) crossing pad to improve crossing surface extended 0.5 m or more beyond facility

Preferred

A. AODA – compliant ramps and tactile plates can be placed in advance of the crossings (1.8 m – light rail; 3.9 m – freight rail; measured to centerline of nearest rail). Although the use of tactile warning plates at rail crossings is not specifically referenced in current AODA standards, best practices in pedestrian safety for at-grade rail crossing suggest that they are an important element for accessibility. It is preferred to include a 1200 mm level area adjacent the tactile plate.

B. Railing for channelizing pedestrians to prevent unauthorized crossing, as needed

Exhibit 5-37. Jughandle Design for a Dedicated Bikeway with Sidewalk

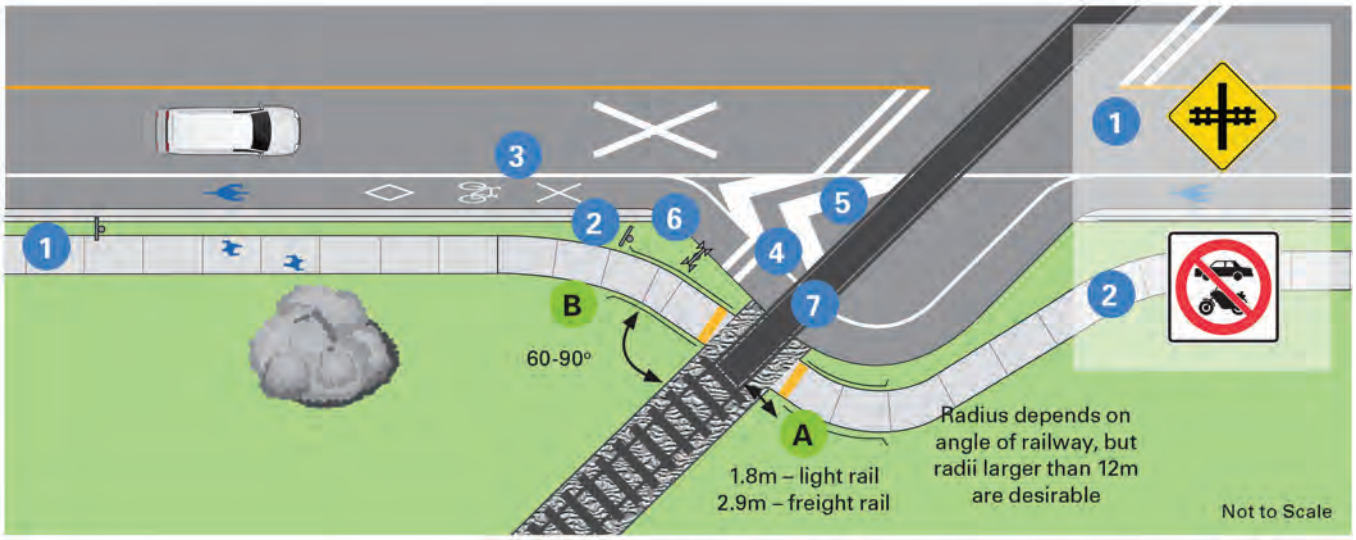


Exhibit 5-38. Jughandle Design for a Dedicated Bikeway with Sidewalk

Source: Cape Breton Regional Municipality

Jughandle Design at Rail Crossing – Separated Bikeway with Sidewalk

Minimum

1. 'Railway Crossing Ahead' signage (Wc-4 – OTM) should be applied upstream of the crossing in accordance with OTM Book 6 requirements
2. 'X' Crossing pavement marking for cyclists, with its centre 9 m downstream of the railway crossing sign
3. Double stop bar for cyclists set back 4.5 m from the centerline of the nearest rail
4. Rail crossing sign or warning device as required by Transport Canada regulations. A sidewalk, path or trail with a centre line more than 3.6 m from the centre of a vehicular warning device must have separate warning devices for each direction of travel for new crossings (refer to Transport Canada Grade Crossings Standards for details.)
5. Rubber (or similar) crossing pad to improve crossing surface extended 0.5 m or more beyond facility

Preferred

A. AODA – compliant ramps and tactile plates can be placed in advance of the crossings (1.8 m – light rail; 3.9 m – freight rail; measured to centerline of nearest rail). Although the use of tactile warning plates at rail crossings is not specifically referenced in current AODA standards, best practices in pedestrian safety for at-grade rail crossing suggest that they are an important element for accessibility. It is preferred to include a 1200 mm level area adjacent the tactile plate.

B. Railing for channelizing pedestrians to prevent unauthorized crossing, as needed

Exhibit 5-39. Jughandle Design for a Dedicated Bikeway with Sidewalk

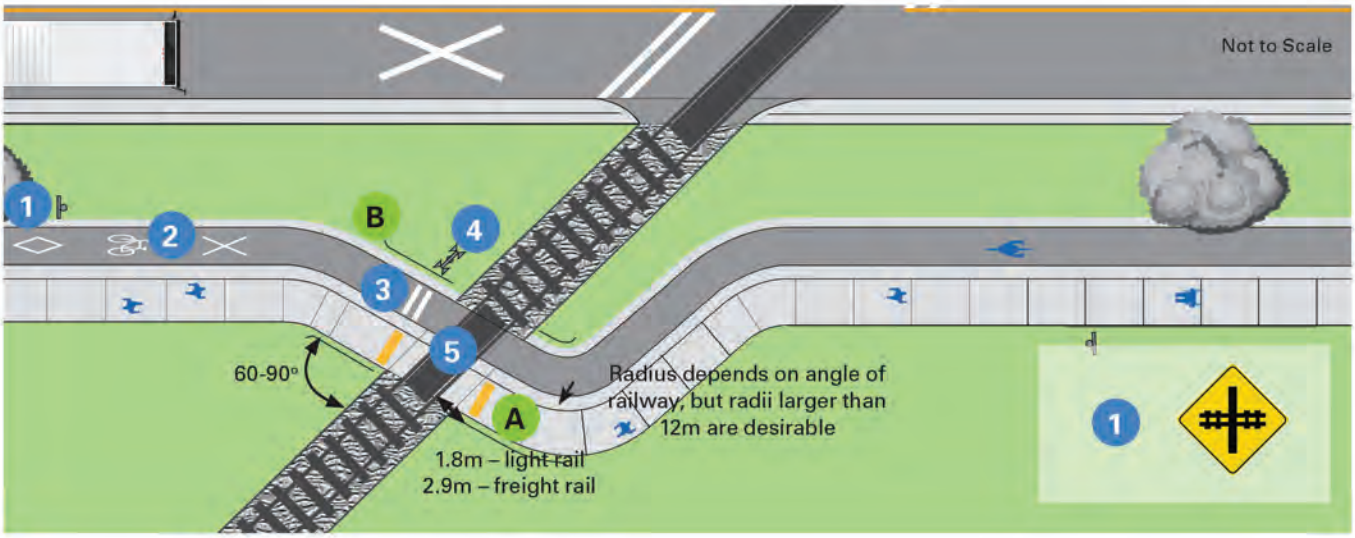


Exhibit 5-40. Jughandle Design with Separated Bikeway in London

Source: Google

Jughandle Design at Rail Crossing – Multi-use Facility

Minimum

1. 'Railway Crossing Ahead' signage (Wc-4 – OTM) should be applied upstream of the crossing in accordance with OTM Book 6 requirements.
2. Rail crossing sign or warning device as required by Transport Canada regulations. A sidewalk, path or trail with a centre line more than 3.6 m from the centre of the vehicular warning device must have separate light units for each direction of travel for new crossings (refer to Transport Canada Grade Crossings Standards for details.)
3. A yellow dividing line should be applied to the multi-use path approaching the intersection to slow users
4. Rubber (or similar) crossing pad to improve crossing surface extended 0.5 m or more beyond facility

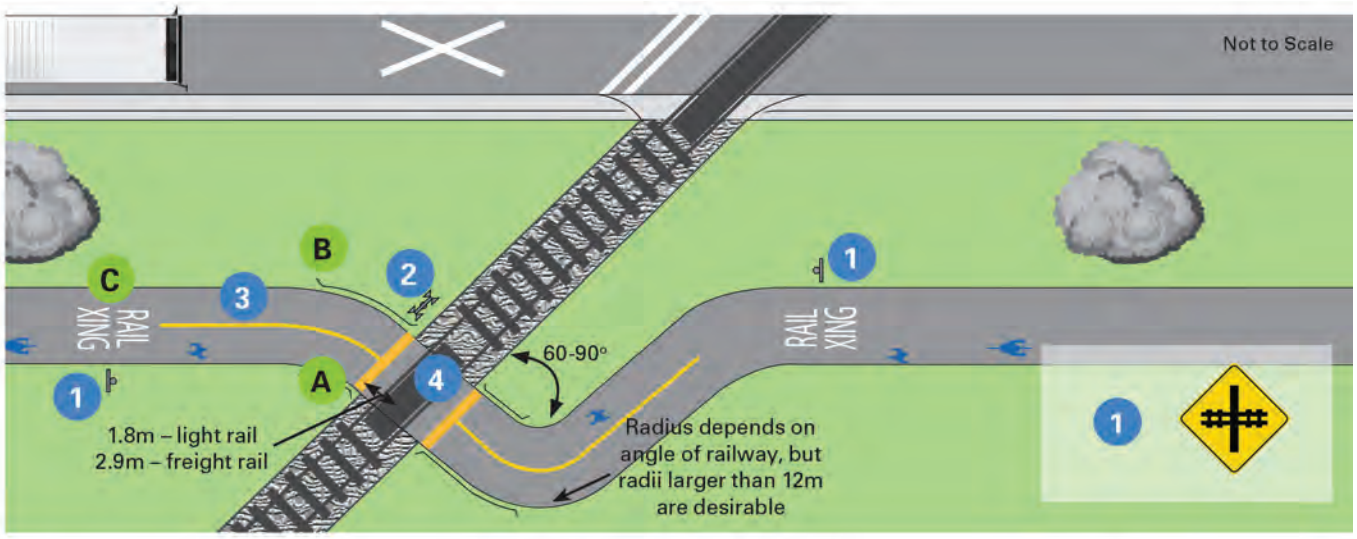
Preferred

A. AODA – compliant ramps and tactile plates can be placed in advance of the crossings (1.8 m – light rail; 3.9 m – freight rail; measured to centerline of nearest rail). Although the use of tactile warning plates at rail crossings is not specifically referenced in current AODA standards, best practices in pedestrian safety for at-grade rail crossing suggest that they are an important element for accessibility. It is preferred to include a 1200 mm level area adjacent to the tactile plate.

B. Railing for channelizing pedestrians can be used to prevent unauthorized crossing, as needed

C. Optional 'RAIL X-ING' pavement marking can be applied to the path

Exhibit 5-41. Jughandle Design for a Multi-use Facility



5.6 MIDBLOCK CROSSINGS

Midblock crossings allow pedestrians and cyclists to cross Regional roads at locations other than signalized intersections to access destinations, or make connections to facilities or paths. Pedestrians and cyclists are more sensitive to out-of-the-way travel than motorists. If midblock crossings are not formally designed were needed, they may choose to cross at random or informal locations. Such behaviour may compromise safety of everyone at the crossing. Thus, accommodating pedestrians and cyclists where there is demand with well-designed crossings is preferable to overlooking their needs and assuming they will divert to an out-of-the-way signalized intersection.

In the context of Regional roads, mid-block crossings may be considered under the following conditions:

- In cases where a major attraction (such as major transit hub, commercial development or community/recreational facility) create high midblock demand at roadway level
- In cases where a major trail, or other pedestrian or cycling facility crosses a Regional road midblock and grade separated options (i.e. tunnel, overpass) are not feasible due to cost or design constraints

Mid-block crossings are recommended to be located 200 m from signalized intersections. This distance is a guideline based on the length required to develop left-turn lanes at adjacent intersections, and is usually considered sufficient to allow motorists to recognize and react to each signal (but this distance does not consider optimal coordination). Consider the out-of-the-way travel for pedestrians when adhering to this minimum. For example, a typical pedestrian trip that is 1.5 km long "as the crow flies" that must divert 200 m to cross at a signal will result in an increase in the distance walked by 400 m or around 30%. Thus a stretch of Regional road with signals spaced as little as 400 m may be a good candidate for a mid-block crossing if there are major destinations located mid-block.

A signalized midblock trail crossing

Photo Source: IBI Group

The recommended designs of mid-block crossings of Regional roads are based on the Ontario Traffic Manual Book 15: Pedestrian Crossing Treatments. This guidelines aligns with the Ontario Highway Traffic Act with respect to the rights and responsibilities of drivers and pedestrians at such crossings.

Generally, the type of pedestrian crossings applicable to Regional roads based on this guideline include:

- Intersection and Mid-block traffic control signals (MPS) applicable to all Regional roads regardless of the number of lanes or posted speed. The warrant for traffic control signals for mid-block crossings is based on York Region's Pedestrian Crossing Warrant Criteria (Edocs No. 1818446). The warrant criteria takes into account a minimum pedestrian demand and pedestrian crossing opportunities for 2 or 4 hour periods. Refer to the approved York Region Policy for the full warrant.
- Pedestrian cross-overs (PXO) could apply to Regional roads 2 to 4 lanes wide with posted speeds of 60 km/h or less. The warrant for pedestrian cross-overs for mid-block pedestrian crossings could be based on Ontario Traffic Manual Book 15: Pedestrian Crossing Treatments, consisting of a minimum pedestrian volume and a vehicular volume; or pedestrian system connectivity or desire lines. Refer to OTM Book 15 for the full warrant. **At this time, the Region is not pursuing the application of PXOs, however the guidance included in this chapter may guide the Region in implementation, should they be pursued in the future.**

On Regional roads that are 2 to 4 lanes wide with posted speed limits of 60 km/h or less, if the warrant for a mid-block traffic control signal is not met, then the warrant for a pedestrian cross-over is considered. On Regional roads that are 6 lanes wide, or with speeds over 60 km/h, only mid-block traffic control signals are applicable.

Median refuge islands can be incorporated into the design of mid-block crossings to provide a refuge for pedestrians and cyclists on wide streets. They also allow only one direction of traffic to be interrupted at a time with the delay shortened to the time it takes to cross the width of the traffic lanes in that direction only.

The mid-block crossing designs presented in this guideline are based primarily on the OTM Book 15: Pedestrian Crossing Treatments with additional signage and pavement markings incorporated from the OTM Book 18 Cycling Facilities. This recognizes that were there is a need for pedestrians to cross Regional roads, there is also likely a need for cyclists in the same location.

Mid-block Pedestrian Signal (MPS)

A midblock pedestrian signal can be applied on any Regional Road where warrants are met (refer to York Region's Pedestrian Crossing Warrant Criteria).

Minimum

1. AODA – compliant curb ramps and tactile plates per York Region Standard DS-100 series drawings
2. Pedestrian Control Indications with AODA compliant Pedestrian Signal Pushbuttons and 'Pedestrian Pushbutton Symbol' signage with directional arrow (Ra-12-OTM)
3. Advanced Stop Bar at crosswalk with mandatory 'Stop Here on Red Signal' signage (Rb-78 – OTM)
4. Crossing should be designed as Combined Pedestrian and Cyclist Crossride or a Separate Pedestrian and Cyclist Crossride (refer to Section 7 for pavement marking details)
5. Approach Markings (Stop Line, No-Passing zone, and Turn Lanes markings, as required by OTM Book 15)
6. Required illumination of pedestrian crosswalk and waiting area to be provided (refer to OTM Book 15
7. For layouts of traffic signals, location of pedestrian heads and poles, and relevant dimensions, refer to OTM Book 12
8. See Exhibit 5-48 to Exhibit 5-49 for crossing connections based on the type of approaching pedestrian and cycling facilities

Preferred

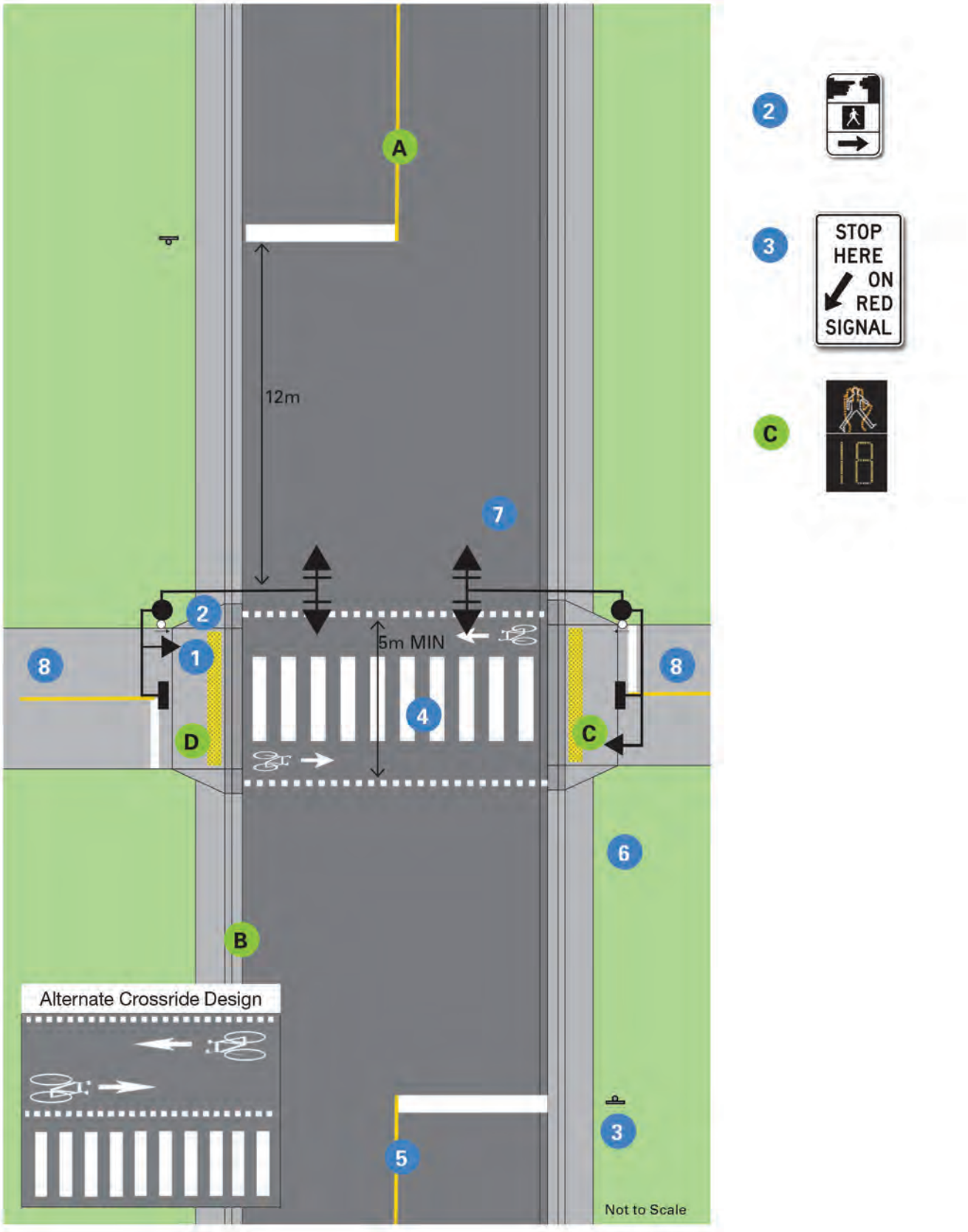
A. Consider adding a median refuge island, particularly for 4 and 6-lane wide Regional roads

B. Stopping prohibition for a minimum of 30 m on each approach to the crossing, and 15 m following the crossing, and parking and other sight obstructions prohibition within at least 30 m of crossings

C. Pedestrian countdown signals and bicycle signals

D. Optional stop bar for cyclist and yellow dividing line

Exhibit 5-42. Midblock Pedestrian Signal



Pedestrian Cross-over (PXO) without Median

This PXO could be applied to Regional roads with 2 to 4 lanes wide with posted speeds of 60 km/h or less, if the warrant for Mid-block Pedestrian Signal is not met. See Ontario Traffic Manual Book 15 - Pedestrian Crossing Treatments for warrants for the PXO. **Note that York Region currently is not pursuing PXOs on Regional roads.**

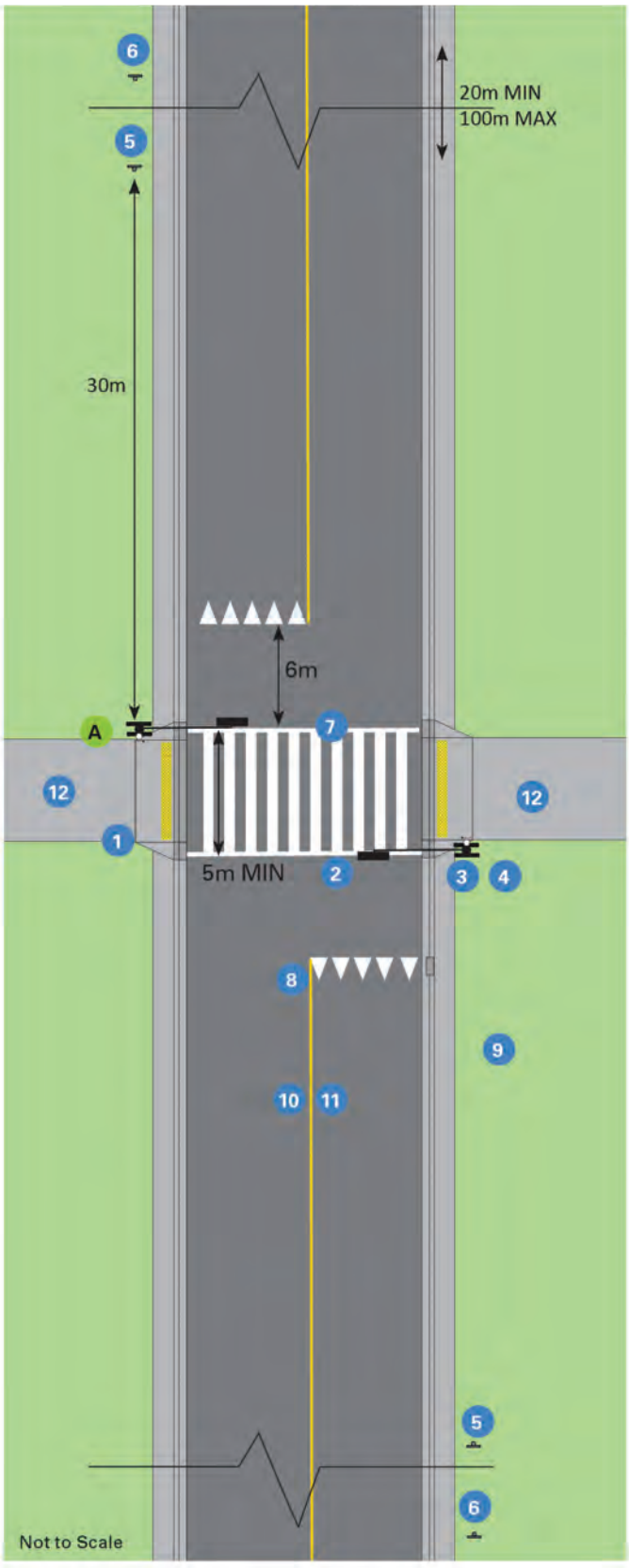
Minimum

1. AODA – compliant curb ramps and tactile plates per York Region Standard DS-100 series drawings
2. One over-head mounted pedestrian crossover signage showing a symbol of a person crossing on a road to the right (Ra-5R-OTM), for each direction of travel
3. Pedestrian actuated Double-sided Rectangle Rapid Flashing Beacon with Tell Tale and Pedestrian Pushbutton for pedestrians mounted above each set of side-mounted pedestrian crossover signs
4. Side-mounted 'Pedestrian Crossover' signage (Ra-5R and Ra-5L – OTM), together with a 'Stop for Pedestrians' tab (Ra-4t-OTM), on both sides of the road mounted back to back
5. 'No Passing Here to Crossing' signage (Ra-10-OTM), installed 30 m upstream of the crossride
6. Advanced 'Pedestrian Crossover Ahead' signage (Wc-27R/Wc-27L - OTM) installed 50.0 m upstream of the crossride
7. Crossing should be marked with a ladder crosswalk. Providing a wider crossing could accommodate a future crossride if changes to the HTA allow cyclists to ride through crossovers in the future
8. Yield to Pedestrians pavement markings located 6.0 m from crossride
9. Stopping prohibition for a minimum of 15 to 30 m on each approach to the crossing, and 10 to 15 m following the crossing
10. Passing restrictions for motor vehicles on single lane approaches should be implemented along 2-lane Regional roads approaching the PXO. For multi-lane Regional roads, lane changes should be prohibited using solid white lines.
11. Required illumination of pedestrian crossride and waiting areas to be provided (refer to Book 15)
12. See Exhibit 5-48 to Exhibit 5-49 for crossing connections based on the type of approaching pedestrian and cycling facilities

Preferred

A. 'Pedestrian Pushbutton' signage (Ra-11-OTM)

Exhibit 5-43. Pedestrian Cross-over (PXO) without Median



Pedestrian Cross-over (PXO) with Median

This PXO could be applied to Regional roads with 2 to 4 lanes wide with posted speeds of 60 km/h or less, if the warrant for Mid-block Pedestrian Signal is not met. See Ontario Traffic Manual Book 15 - Pedestrian Crossing Treatments for warrants for the PXO. **Note that York Region currently is not pursuing PXOs on Regional roads.**

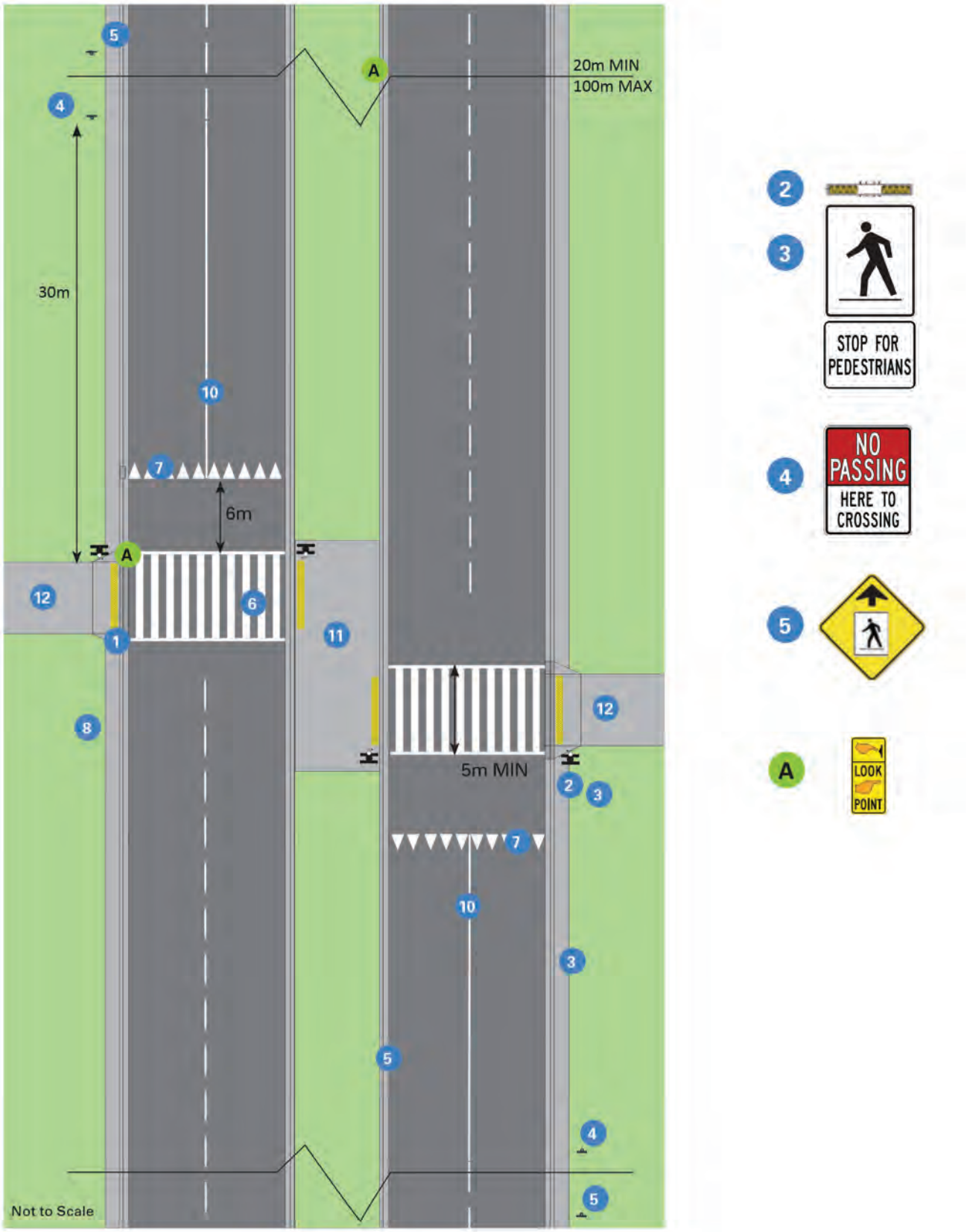
Minimum

1. AODA – compliant curb ramps and tactile plates per York Region Standard DS-100 series drawings
2. Pedestrian actuated Double-sided Rectangle Rapid Flashing Beacon with Tell Tale and Pedestrian Pushbutton for pedestrians mounted above each set of side-mounted pedestrian crossover signs
3. Side-mounted pedestrian crossover signage Ra-5R and Ra-5L on the right side and on the median, together with their Stop for Pedestrians tab signage Ra-4t on the right side of the road only
4. 'No Passing Here to Crossing' signage (Ra-10-OTM), installed 30m upstream of the crossride
5. Advanced 'Pedestrian Crossover Ahead' signage (Wc-27R/Wc-27L – OTM) installed 50m upstream of the crossride
6. Crossing should be marked with a ladder crosswalk. Providing a wider crossing could accommodate a future crossride if changes to the HTA allow cyclists to ride through crossovers in the future
7. Yield to Pedestrians pavement markings at 6.0 m from crossride
8. Required illumination of pedestrian crossrides and waiting areas to be provided
9. Stopping prohibition for a minimum of 15 to 30 m on each approach to the crossing, and 10 to 15 m following the crossing
10. Passing restriction for motor vehicles should be implemented approaching the PXO
11. See median refuge design details (refer to Exhibit 5-46)
12. See Exhibit 5-48 to Exhibit 5-49 crossing connections based on the type of approaching pedestrian and cycling facilities

Preferred

A. 'Pedestrian Pushbutton' signage (Ra-11-OTM)

Exhibit 5-44. Pedestrian Cross-over (PXO) with Median



Median Refuge

Median refuges should preferably incorporate an offset to encourage pedestrians and cyclists to orient themselves towards approaching vehicular lanes.

Minimum

1. Tactile walking surface indicator as per York Region Standard DS-100 series drawings
2. For raised concrete median island (B):
   - Pavement markings on approaches to obstructions
     - 'Keep Right' signage (Rb-25, Rb-125 - OTM)
     - 'Object Marker' signage (Wa-33L - OTM
3. Barrier curb to guide pedestrians and cyclist in lieu of railings which can be hazards in vehicle collisions

Preferred

A. Typical raised landscaped median 4 to 5 m wide, or raised concrete median island 3 to 5 m wide and minimum 5 m long. A sample detail is shown in Exhibit 5-47

Exhibit 5-45. Use of detectable curbs to guide pedestrians through median refuge island

Photo Source: IBI Group

Exhibit 5-46. Raised Median Detail

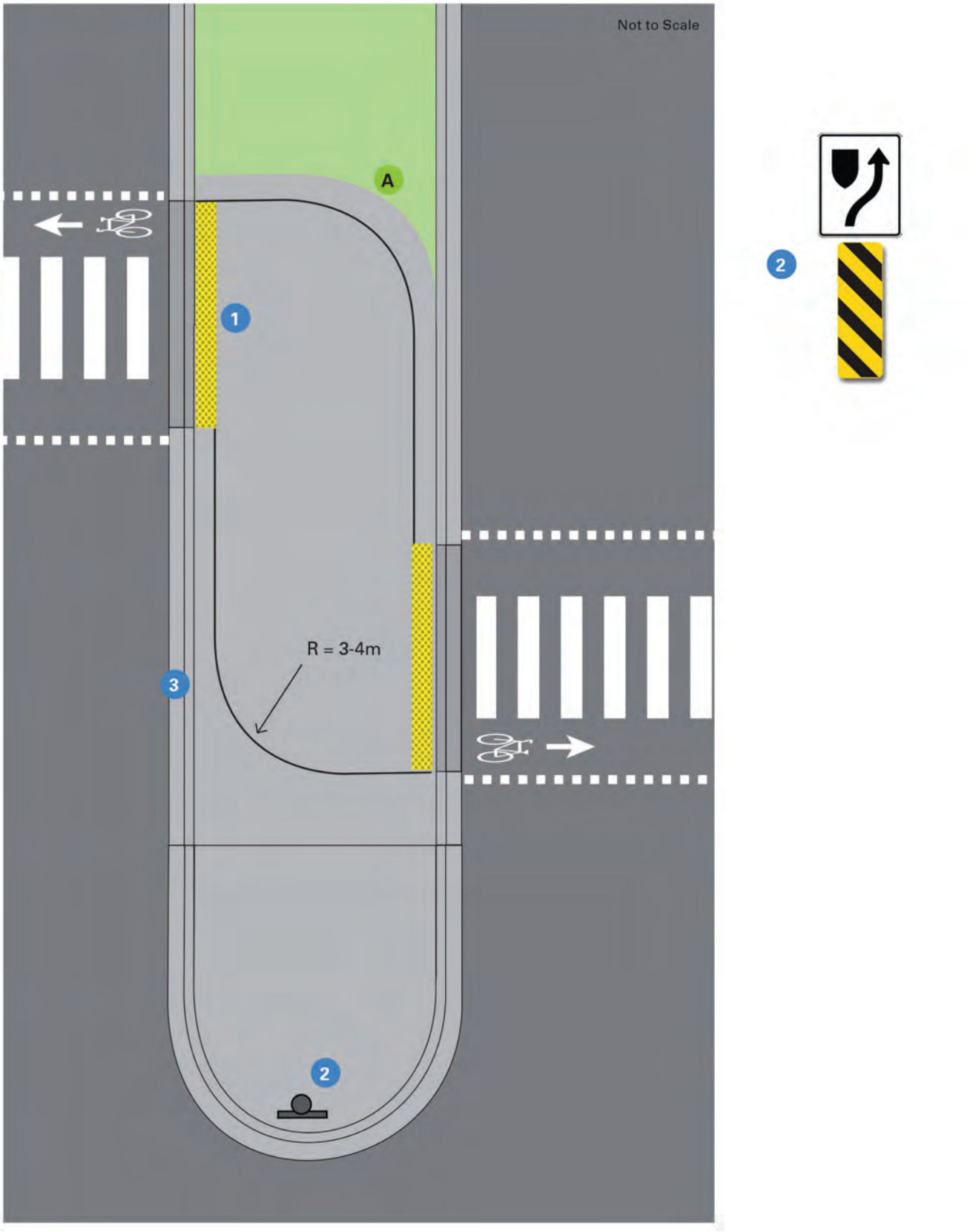
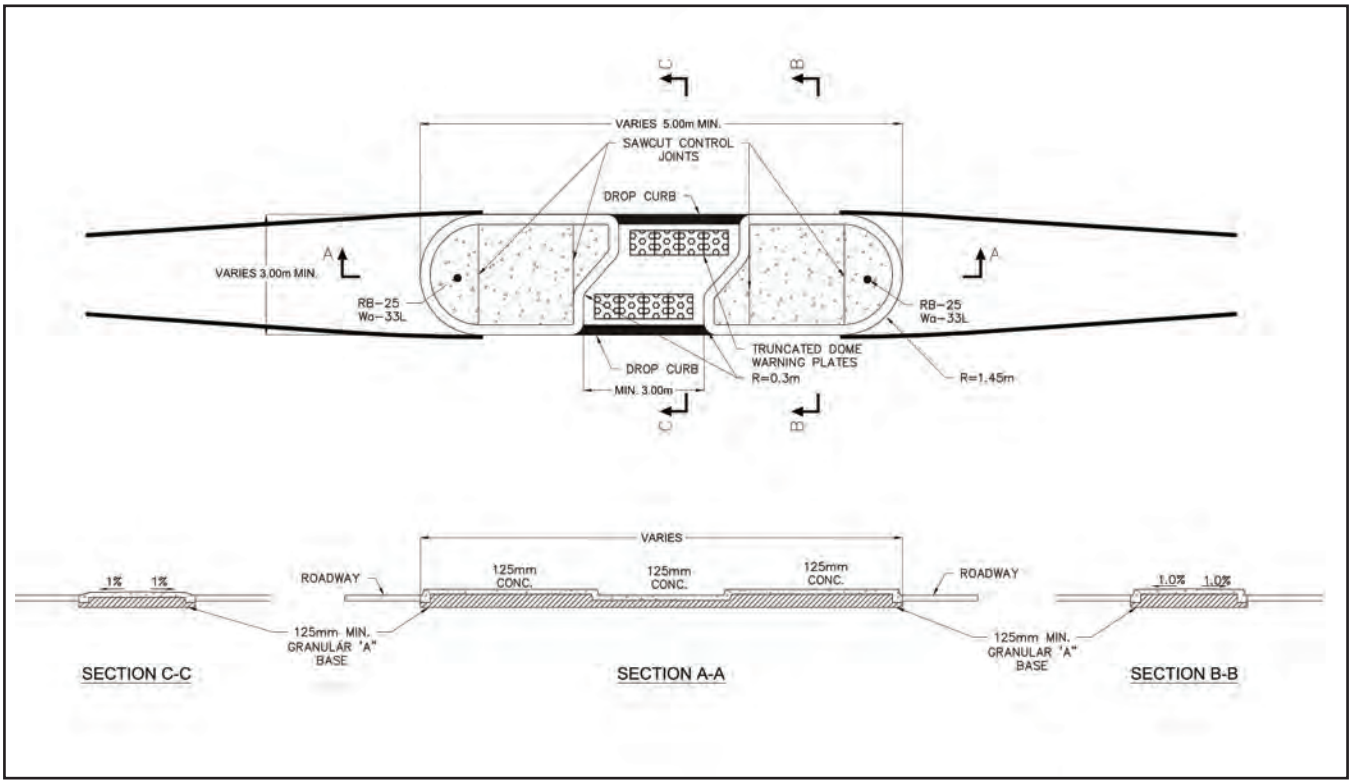


Exhibit 5-47. Sample Detail for Median Refuge Island



Connection to Crossings

These exhibits illustrate the approach to midblock crossings for the following facilities:

- In-boulevard Cycle Track (Exhibit 5-48)
- Multi-use Path (Exhibit 5-49)
- Raised Cycle Track (Exhibit 5-50)

Minimum

1. A yellow dividing line used on approach to reduce conflicts at crossing
2. To improve cyclists' comfort but slow them approaching the crossing, the intersection of the mid-block crossing connection to the cycling facility should accommodate a turning radius of 5 m
3. Yield to Pedestrian pavement markings (refer to Section 7 for details). Cyclists must yield to pedestrians when facilities are separate (pedestrian clearway with in-boulevard cycle track, or with raised cycle track)
4. For cycle track, bike and diamond pavement marking following crossing
5. 3:1 lateral taper applied where facility widens approach the crossing to facilitate right and left turns

Preferred

A. Width of connection to crossing to match width of adjacent facilities (width of multi-use path, or width of pedestrian clearway plus cycle track) but not to exceed 5.0 m

B. Optional stop bar and yellow dividing line on connection

Exhibit 5-48. Pedestrian Clearway and In-boulevard Cycle Track Connection to Midblock

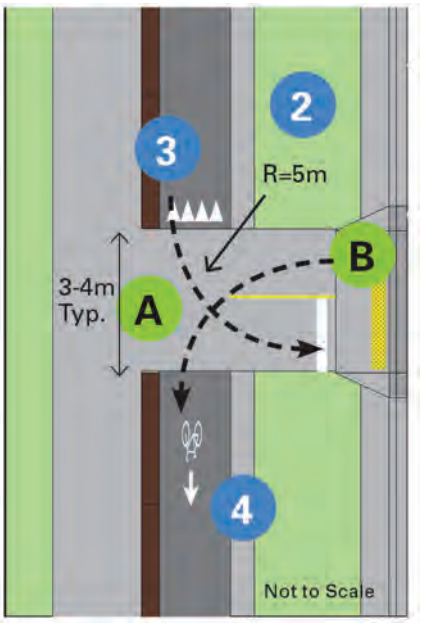


Exhibit 5-49. Multi-use Path Connection to Midblock Crossing

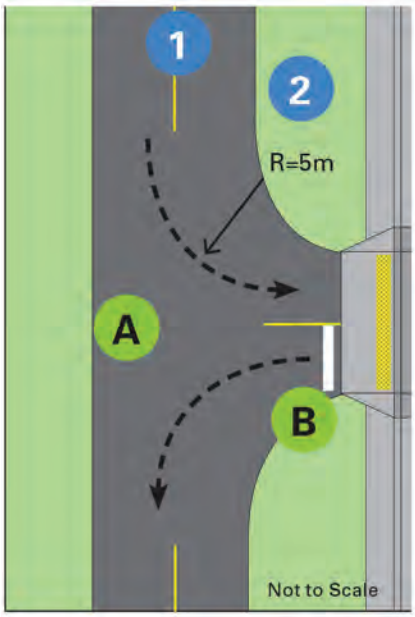
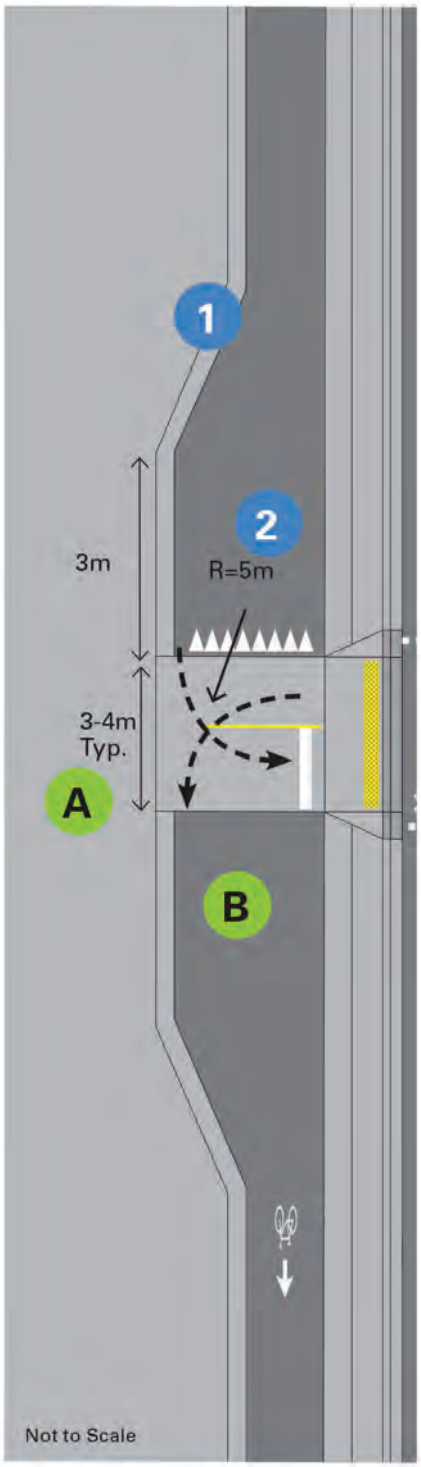


Exhibit 5-50. Pedestrian Clearway and Raised Cycle Track Connection to Midblock Crossing



5.7 GRADE-SEPARATED CROSSINGS

Bridges, overpasses, and underpasses make it possible for active transportation facilities to cross major barriers such as waterways, limited-access highways, and railways. These grade-separated crossings are required for the sake of continuity and directness. In their absence, users may be forced to make long detours to cross a barrier.

There are cases where a grade-separated crossing is not essential but may be preferable to a level crossing for the safety and convenience of users. This can be the case for crossing a high volume roadway where motorists are not likely to yield to crossing pedestrians and cyclists, where gaps in traffic are infrequent, and where the provision of a signalized crossing is not viable. In such a case, a grade-separated crossing is likely to be safer and can help pedestrians and cyclists avoid long delays.

Grade-separated crossings have some notable disadvantages. For users, the primary disadvantage is that they tend to require more physical effort to cross than a level crossing because they entail a change in elevation. For municipalities, they are more expensive to construct and maintain, particularly if the crossing is to be kept open through the winter. For this reason, locations for grade-separated crossings must be chosen strategically and the crossings must be designed carefully to meet the needs of pedestrians and cyclists.

Exhibit 5-51. Examples of Grade Separated Crossings in Ontario

QEW/Red Hill Valley Active Transportation Bridge

Hamilton

- 220 m long
- $7.6 M construction cost (2010 dollars)

Trans Canada Trail over Highway 401

Kitchener/Cambridge

- 102 m long
- $1.7 M (2007 dollars)

Radial Line/Chedoke Trail crossing Highway 403,

Hamilton

- 80 m long

5.7.1 Bridges and Overpasses

For road and rail crossings, overpasses are generally preferable to underpasses from a user comfort and safety perspective. They benefit from natural lighting and allow users to see and be seen. However, they tend to require a greater change in elevation than underpasses. An overpass must rise enough to provide a clearance of 5.3 m above a roadway or 7 m above a railway. In contrast, an underpass for pedestrians and cyclists requires a vertical clearance of only 3 m (refer to Exhibit 5-52). As a result, underpasses are typically more common than overpasses in York Region (refer to Section 5.7.2).

Design

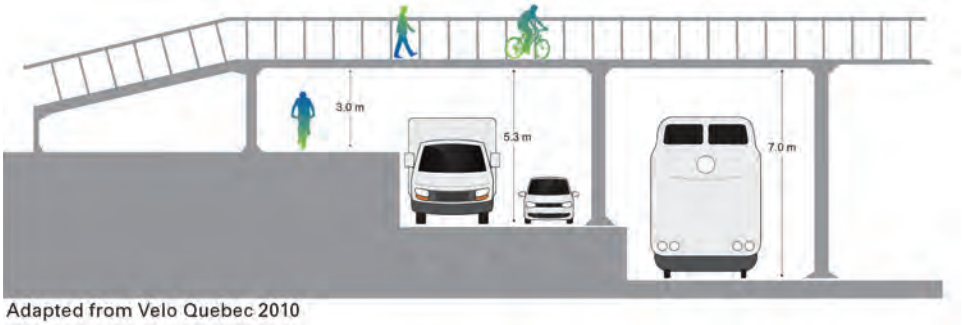
Bridges and overpasses for pedestrians and cyclists can be stand-alone structures or can be connected to larger bridges or viaducts. In either case, the preferred width for an elevated, mixed pedestrian and cyclist crossing is at least 4 m. A minimum width of 3 m is acceptable in cases where pedestrian traffic is limited.

If necessary, pedestrians and cyclists can be separated using a barrier curb, flexible posts, or a railing (refer to Section 9.2). This is only warranted when user volumes are high. In these cases, it is necessary that both sections have the minimum required widths—i.e., 1.8 m for pedestrians and 3 m for cyclists (for bidirectional use). It is important to avoid crossing the pedestrian and cycling paths at either end of the bridge or overpass, particularly at the foot of steep slopes.

Grades on access ramps should be limited to 5% to meet AODA requirements. To provide 5.3 m of clearance above a roadway with 0.7 m thick structure, a 120 m ramp would be required to meet the 5% maximum slope requirement. Ramps can be straight, curved or spiral in shape. Spiral or U-shaped ramps take up less space and have the advantage of forcing cyclists to slow down when descending. However, the continuous curve of a spiral ramp demands an extra effort on the part of wheelchair users.

If the road ROW that is being crossed includes active transportation facilities, a link between those facilities and the overpass is required to ensure that pedestrians and cyclists travelling along the roadway can access the overpass to cross the road.

Exhibit 5-52. Vertical clearances for road and railway overpasses



Adapted from Velo Quebec 2010

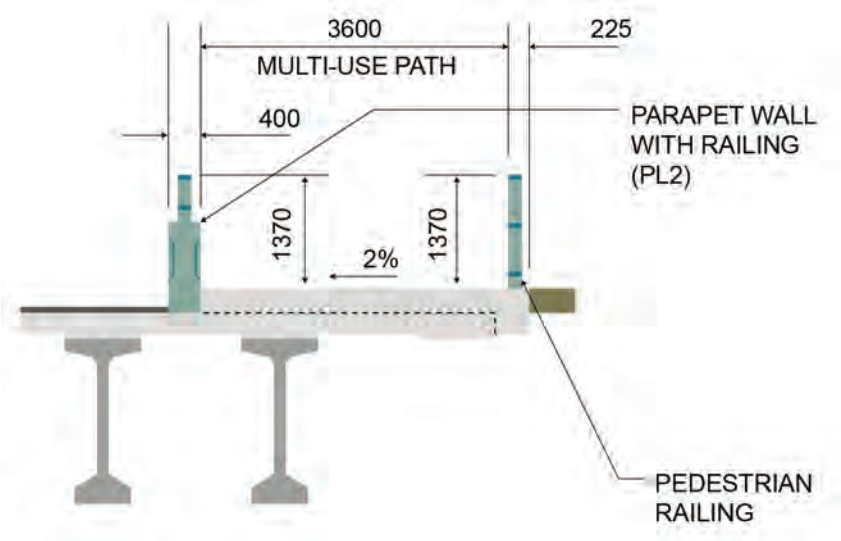
Construction

The common types of overpasses and bridges include:

- **Single spans**: These are the most common design for waterway crossings. Abutments on either side of the barrier to be crossed support single-span bridges.
- **Multiple spans**: These require several piles to support the spans. They are fairly easy to integrate into a road crossing but expensive for waterway crossings. When installed above a river, piles can impede water flow and catch debris. The use of precast concrete beams can help reduce cost but sometimes yield visually unappealing results.
- **Suspension bridges**: These are visually appealing and make it possible to span greater distances. They are most often used for river crossings but can be used over roadways as well.
- **Cantilever decks**: These are structures added onto an existing a bridge or viaduct or integrated into the structure by design. They benefit from the main structures carrying capacity while offering pedestrians and cyclists a separate space.

The deck surfacing can be concrete, asphalt or wood. In the case of wood, the planks must be placed crosswise, at a 45° or greater angle to the path of travel, to ensure bicycle and wheelchair wheels cannot get caught in the gaps in between. Metal surfacing such as plates or grating are not recommended because they are too slippery when wet. Expansion joints should be covered to prevent small wheels from being caught in the openings and provide a smoother ride.

Exhibit 5-53. Sample Cross-section of a Multi-use Path along a Bridge



5.7.2 Underpasses

Underpasses are rectangular or vaulted structures that make it possible to cross a man-made barrier such as a roadway or a railway. They particularly useful for crossing roadways and railways that atop an high embankments.

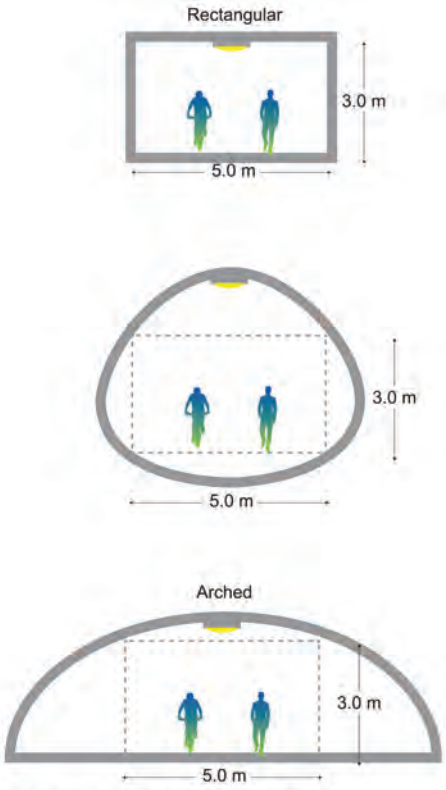
Design

An underpass must be wide and tall enough for pedestrians and cyclists travelling in both directions to pass through safely. Regardless of the shape, the recommended width is 5 m (refer to Exhibit 5-54). A narrower tunnel increases the risk of accidents due to a combination of descent speed, low light, and the presence of sidewalls. A vertical clearance of at least 3 m throughout the tunnel will help ensure user comfort and optimal natural light.

Vaulted or elliptical cross-sections are preferable to rectangular cross-sections for maximizing natural lighting. Artificial lighting is usually required at the centre of a tunnel to ensure visibility. If lighting fixtures are not recessed, their dimensions should be taken into consideration in the calculation of the overhead clearance. They should also be protected from vandalism, which is common in tunnels, by a metal cage or other device.

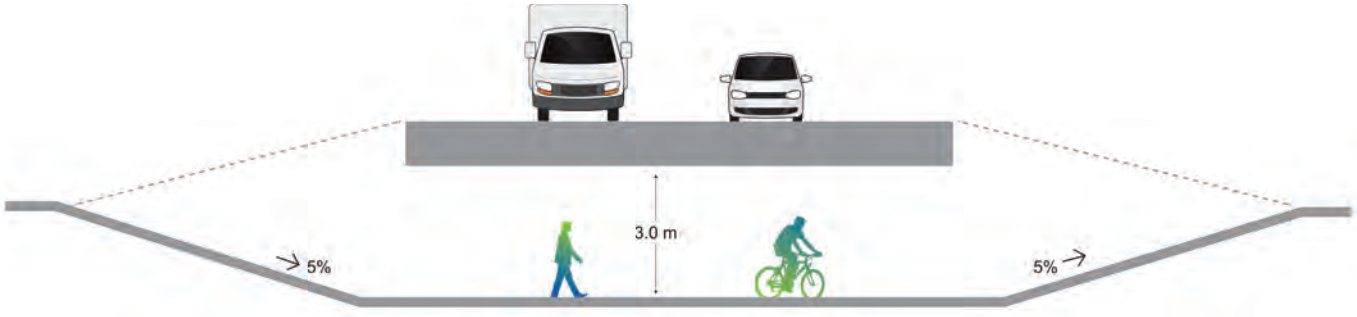
As with ramps for bridges and overpasses, the grade on the approaches to an underpass should be no greater than 5% to meet AODA requirements (refer to Exhibit 5-57). Ideally, the approaches to the tunnel entrance should not include tight curves. They must allow users to see the entrance before entering and perceive the end of the tunnel as soon as they are inside. However, when the tunnel is perpendicular to the route of a path or trail, an S-curve-shaped approach is useful for reducing speed before users enter the tunnel.

Exhibit 5-54. Typical Underpass Cross-sections



Adapted from Velo Quebec 2010

Exhibit 5-57. Underpass elevation profile



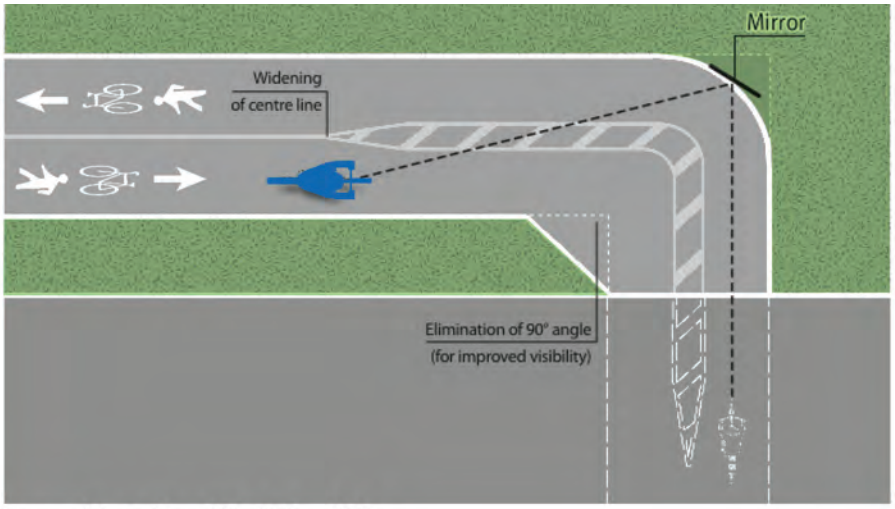
Adapted from Velo Quebec 2010

When the sightlines are not ideal—for example, when space constraints require an approach with a tight curve at the tunnel entrance—several measures can be used to improve the situation (refer to Exhibit 5-58):

- Vandal-proof convex mirrors
- Markings that clearly separate traffic in each direction and discourage passing, such as a yellow centreline or a double line with a hatched buffer zone
- No passing signs at critical locations

To meet AODA requirements, handrails must be installed on both sides of ramps providing access to underpasses. These are essential for mobility-impaired individuals, helping them manoeuvre and remain stable on slopes. They are also useful for in-line skaters, helping them to control their speed when descending.

Exhibit 5-58. Perpendicular underpass approach showing mitigation strategies



Source: Adapted from Vélo Québec 2010

Lighting is particularly important through underpasses, which typically are not served by street lighting. Exhibit 5-59 illustrates recommended lighting guidelines for cycling facilities, which should be maintained through underpasses.

Exhibit 5-59. Recommended illumination of Active Transportation Facilities

Level of Pedestrian or Cyclist Activity	Maintained Average Horizontal Illuminance (lux)	Maximum Horizontal Uniformity Ratio	Minimum Maintained Vertical Illuminance (lux)
High(>50/Hour)	*20.0*	*4.0:1*	*10.0*
Medium (10 to 50/Hour)	*5.0*	*4.0:1*	*2.0*
Low (<10/Hour)	*3.0*	*6.0:1*	*0.8*

Source: OTM Book 15

In some cases, the addition of CCTV cameras or emergency help stations to underpasses may be considered.

Construction

An underpass can be constructed either as a covered trench or a channel bored under the barrier being crossed. The inner structure is either a concrete box or a concrete or galvanized steel tube forming a circular or elliptical vault.

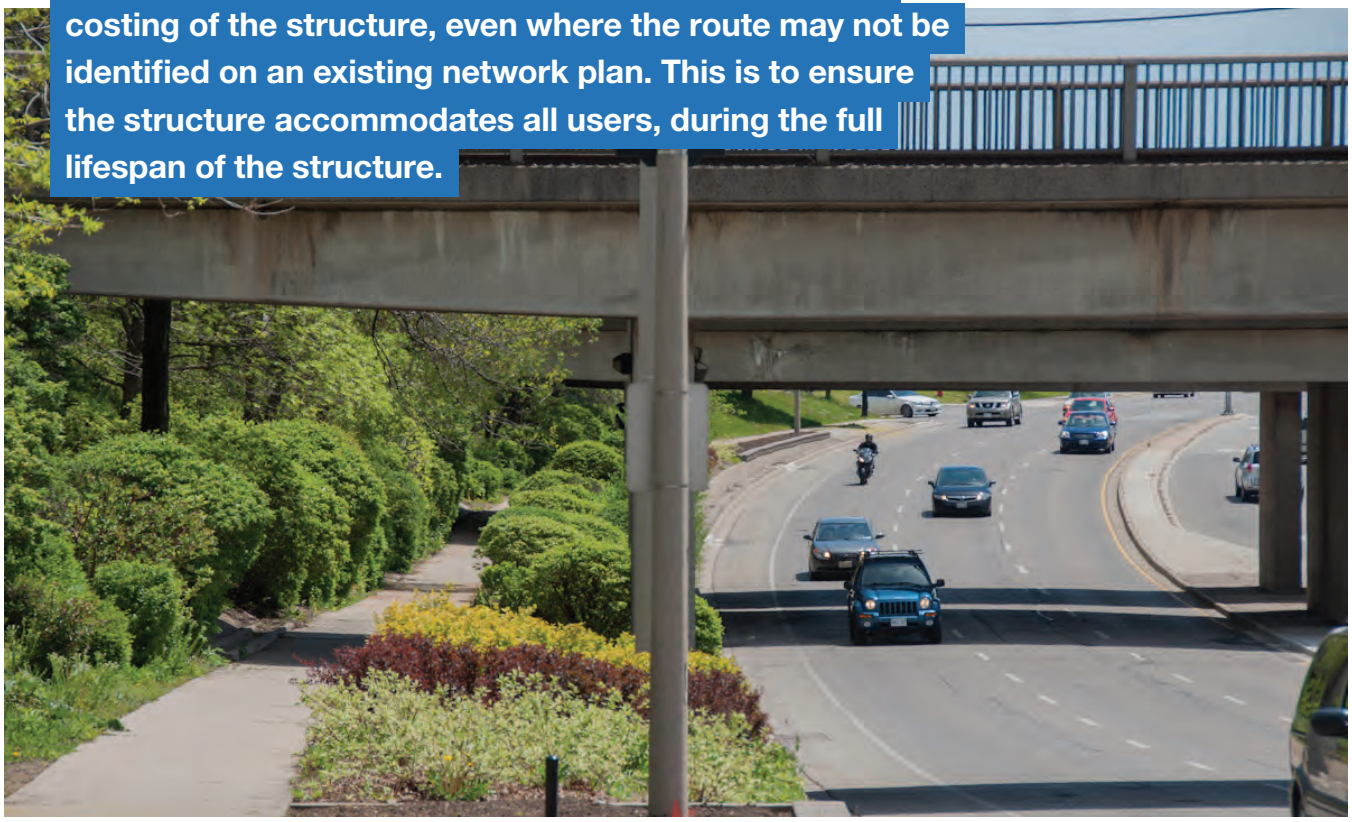
It is best to build a tunnel at the same time as the road or railway it crosses or during major roadwork. In addition to reducing construction costs, this can create the opportunity to slightly raise the road or railway in order to minimize the necessary change in grade along the active transportation path.

Under an existing road, when traffic can be rerouted, tunnel construction is facilitated by completely closing the road above. If road closure is not an option, creating temporary lanes and taking the necessary precautions to divert traffic around the work site will significantly increase project costs.

5.7.3 Road Underpasses

Pedestrians and cyclists can travel through road tunnels provided adequate facilities are in place: lightly coloured walls, ideally covered with ceramic tiles; adequate lighting; a sidewalk separated from the roadway by a railing or protective barrier; and appropriate cycling facilities for the road context.

When new road bridges, underpasses or overpasses are designed, the provision of high quality pedestrian and cycling facilities should be included in the design and costing of the structure, even where the route may not be identified on an existing network plan. This is to ensure the structure accommodates all users, during the full lifespan of the structure.



5.8 ROUNDABOUTS

Roundabouts are gaining increased acceptance as a form of intersection control in North America, and their use in York Region is growing. As a result, it is important to ensure that pedestrians and cyclists can be accommodated in roundabouts.

General Guidance

In an urban context, with respect to pedestrians, sidewalks are recommended along the outer edge of the entire roundabout. Crosswalks with AODA compliant approaches should be provided at all entry/exit legs of the roundabout. Deflector islands can be utilized used as spaces for pedestrian refuge. Refuge islands make crossing the entry/exit legs easier for pedestrians as they only have to concentrate on traffic moving in one direction at a time.

The design of the inner island of the roundabout should be discourage pedestrians from crossing through the centre of the roundabout. This may be accomplished through the use of landscaping or a knee wall.

5.8.1 Single Lane Roundabouts

While there are limited applications of single lane roundabouts along Regional roads in York Region, they may be considered in rural hamlets or through residential neighbourhoods where volumes are lower. Single lane roundabouts can have operational benefits for both cyclists and pedestrians - they tend to slow vehicular speeds, can reduce delays for all users and have fewer conflict points than conventional intersections. Despite these benefits, roundabouts can present crossing challenges for the visually impaired, and may not be appropriate in all situations. Per OTM Book 18 recommendations, cyclists can share the lane in single lane roundabouts as vehicular speeds are generally reduced to 30-40 km/hr through the roundabout. Sharrow markings are used in single lane roundabouts to help improve the positioning of cyclists. They should be placed at least 30 m in advance of a roundabout within the centre of the lane on the approach, and immediately on the exit leg within the centre of the lane (per the Canadian Roundabout Design Guide). For locations where speeds may be higher, a transition to a boulevard multi-use path may be provided (see section 5.8.2)

York Region currently has two single lane roundabouts located at York-Durham Line & Durham Road 5, and Keele/Lloydtown & Aurora Road. However, these roundabouts are provided in a rural context.

Exhibit 5-60. Example of a single lane roundabout with shared boulevard facilities through the roundabout

Source: PBIC – Carl Sundstrom

5.8.2 Multi-Lane Roundabouts

Multi-lane roundabouts are less desirable from the perspective of pedestrian and cyclists. The increased potential for conflicts for pedestrians must be considered in the application of roundabouts, particularly those with visual impairments. The audible and tactile cues provided by signalized intersections are not available with roundabouts, and multiple entry and exit lanes increases the level of difficulty and exposure time while navigating the crossing. For these reasons, multi-lane roundabouts are not recommended in areas of high expected pedestrian and cycling volumes.

In situations where other factors results in the implementation of multi-lane roundabouts, treatments at the roundabout should attempt to mitigate these challenges. Per OTM Book 18 recommendations, cyclists should be given the alternative to share a vehicular lane or to use an in-boulevard bypass facility (shared with pedestrians) for multi-lane roundabouts. The priority of the pedestrian over cyclists should be clarified in these shared areas through the application of signage and pavement markings. Some change in material should clearly delineate the beginning of the shared pedestrian and cyclist space.

A sample application of these treatments for a dedicated bikeway and sidewalk are shown in Exhibit 5-62.

Exhibit 5-61. Example of a multi-lane roundabout with shared boulevard facilities through the roundabout

Source: PBIC – Dan Burden

Multi-lane Roundabout Dedicated Bikeway with Sidewalk

At a multi-lane roundabout, cyclists should be provided with the opportunity to ramp-up into the boulevard. Pedestrian priority on the shared path must be emphasized through signage and pavement markings.

Minimum

1. As no cycling facilities should be provided within the circulatory lanes of the roundabout, the bicycle lane should be marked and signed as ending 30 m in advance of the roundabout
2. A ramp (<5%) should be provided between the on-road facility and the shared path to accommodate cyclists. A tactile warning plate must be applied at the bottom of this ramp to prevent pedestrians from mistakenly entering the travel way via this ramp. Bicycle lane markings must be dashed. A sample detail for this ramp is shown in Exhibit 5-63
3. Shared use path should be made of a different construction material than the cycling facility and sidewalk to mark the beginning of a shared space. The path should be minimum 3 m, with 4 m preferred. 'Shared Pathway' signage (RB-93 – TAC) should be applied
4. A combined crossride is shown through the roundabout legs to allow for use by both pedestrians and cyclists
5. Pedestrian crossing with tactile plates and AODA – compliant curb ramps must be provided at both entry and exit legs, and tactile plates must be provided at the refuge island
6. 'A 100 mm 1-1 dash yellow line should be used to provide directional guidance to cyclists and pedestrians as they navigate the shared path
7. 'Reserved Bicycle Lane' (RB-91 – TAC) should be applied after the roundabout to re-confirm the designation of the cycling facility

Preferred

A. 'Cyclists Yield to Pedestrians' signage (RB-73-OTM) can be applied where there are challenges with interactions between users

B. The crossing may be designed as a pedestrian crossover Type C per OTM Book 15, with yield markings in advance of each crossings, 'Pedestrian Crossing' signage (Ra-5r –OTM mounted back to back with Ra-5L – OTM and Ra-4t –OTM tabs), RRFBs and ladder crosswalk markings. Refer to OTM Book 15 for full details of pavement markings & signage. Note that if the crossing is designated as a PXO, crosswalk markings should be used in lieu of crossrides

Exhibit 5-62. Multi-lane Roundabout Concept - Dedicated Bikeway with Sidewalk

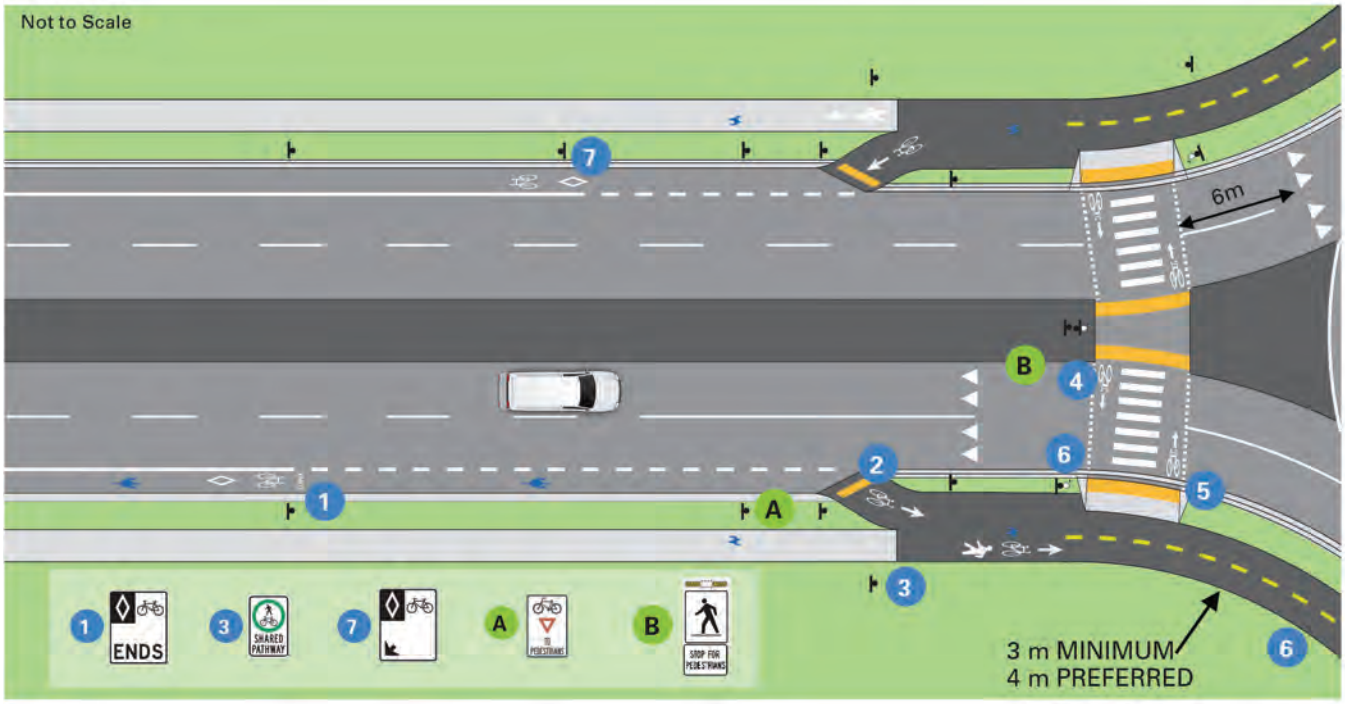
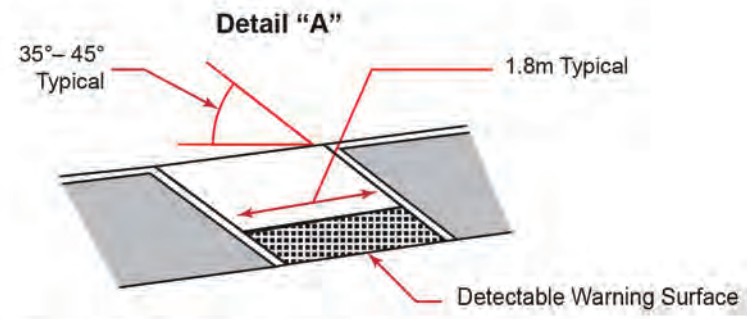


Exhibit 5-63. Example ramp treatment at a roundabout

Source: Steve Jorgenson

Although the geometry of the ramping will vary, a typical detail is shown in Exhibit 5-64.

Exhibit 5-64. Sample Ramp Detail from Bike Lane onto Boulevard



Source: Adapted from FHWA's Roundabouts Technical Summary

Treatments for different types of approaching cycling facilities can be the same through the roundabout as depicted in the example of the dedicated bikeway. In all cases, as volumes of pedestrians and cyclists are expected to be low where multi-lane roundabouts are applied, a shared pathway can be provided along the outside of the roundabout. Transitions to the shared pathway from other types of facilities are shown below.

Exhibit 5-65. Multi-use Path approaching Roundabout

Exhibit 5-66. Raised Cycle Track approaching Roundabout

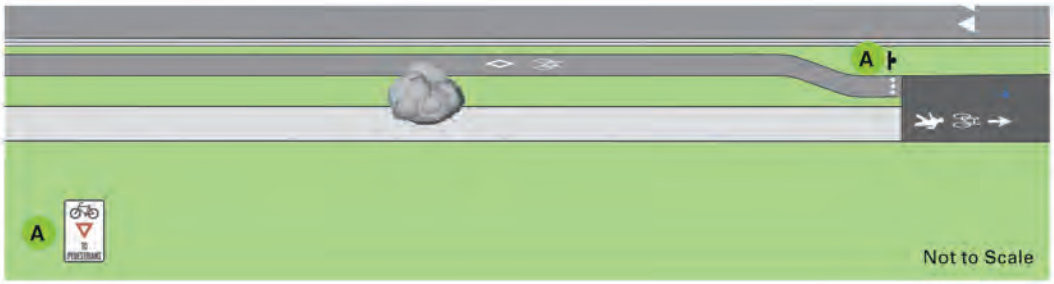
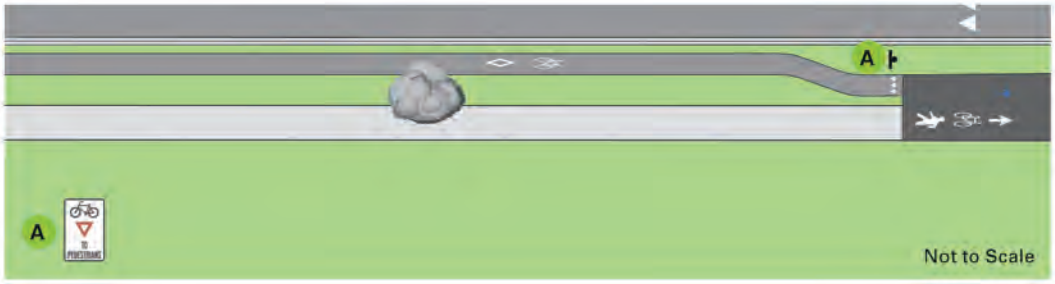
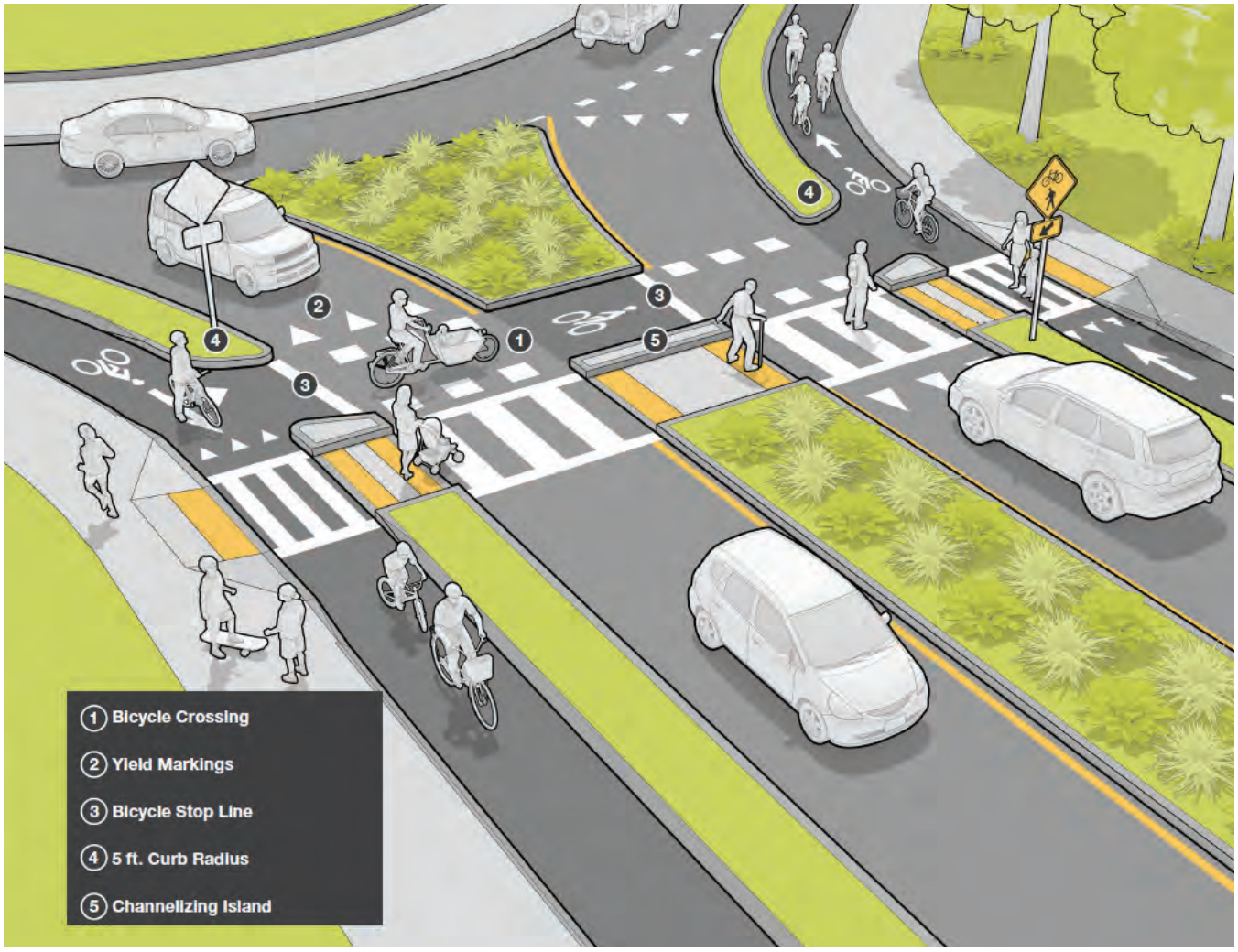


Exhibit 5-67. In-boulevard Cycle Track approaching Roundabout



In exceptional cases where high volumes of both cyclists and pedestrians are anticipated and a roundabout is selected as the preferred intersection treatment, consideration should be given to physically separating the cyclists and pedestrian streams through the intersection. An example application with fully separated streams from the MassDOT Separated Bike Lane Planning & Design Guide (2015) is shown below.

Exhibit 5-68. Sample application of roundabout with separated cycling facilities maintained through the roundabout



Source: MassDOT Separated Bike Lane Planning & Design Guide