

Guidelines for Pedestrian Crossing Facilities



Contents

1	Introduction	1
1.1	Background	1
1.2	Recommended Updates in Relation to OTM Book 15	2
2	Types of Pedestrian Crossing Treatments	2
2.1	Uncontrolled and Controlled Pedestrian Crossings	2
2.2	Pedestrian Crossing Treatment Types	2
2.2.1	School Crossings	3
2.2.2	Stop Controlled or Yield Controlled Intersections	4
2.2.3	Pedestrian Crossovers (PXO)	4
2.2.4	Signalized Pedestrian Crossings	5
2.3	Public Education	5
3	Assessment of Locations for Pedestrian Crossing Treatments	6
3.1	Context	6
3.2	Assessment Process and Criteria	8
3.2.1	Preliminary Investigation	8
3.2.2	Office Review	8
3.2.3	Field Investigation	9
3.2.4	Assessment Process	10
3.2.5	Considerations for Data Collection	14
3.2.6	Parameter Considerations	15
3.3	Interaction with Cycling Facilities	15
3.3.1	Signalized Intersections	15
3.3.2	Pedestrian Crossovers	16
4	Design Guidelines	17
4.1	Intersection Pedestrian Signal (IPS) and Mid-block Pedestrian Signal (MPS)	17
4.1.1	Important Considerations	17
4.1.2	Illumination Levels	18
4.1.3	Signal Head Placement	19
4.1.4	IPS and MPS Components and Restrictions	21

4.1.5	Pavement Markings.....	22
4.1.6	Infrastructure	23
4.1.7	Layout	29
4.1.8	Accessibility.....	33
4.2	Level 2 Type B PXO.....	34
4.2.1	Important Considerations	34
4.2.2	Illumination Levels.....	35
4.2.3	Rectangular Rapid Flashing Beacon (RRFB) Placement.....	36
4.2.4	Level 2 Type B PXO Components and Restrictions.....	36
4.2.5	Pavement Markings.....	37
4.2.6	Infrastructure	39
4.2.7	Layout	40
4.2.8	Accessibility.....	47
4.3	Level 2 Type C PXO.....	48
4.3.1	Important Considerations	48
4.3.2	Illumination Levels.....	49
4.3.3	Rectangular Rapid (RRFB) Flashing Beacon Placement.....	49
4.3.4	Level 2 Type C PXO Components and Restrictions	50
4.3.5	Pavement Markings.....	51
4.3.6	Infrastructure	51
4.3.7	Layout	52
4.3.8	Accessibility.....	59
4.4	Level 2 Type D PXO.....	60
4.4.1	Important Considerations	60
4.4.2	Illumination Levels.....	61
4.4.3	Level 2 Type D PXO Components and Restrictions	61
4.4.4	Pavement Markings.....	62
4.4.5	Infrastructure	62
4.4.6	Layout	63
4.4.7	Accessibility.....	69

1 Introduction

The purpose of these guidelines is to provide a process and set of criteria to assess candidate pedestrian crossing locations, an overview of the different types of pedestrian crossing facilities considered, and design guidelines for each pedestrian crossing facility considered. This document will serve to further support the installation of pedestrian crossing facilities as part of developing city-wide and neighbourhood-level active transportation connections, establishing pedestrian connections to transit, and supporting safe and active routes to school.

1.1 Background

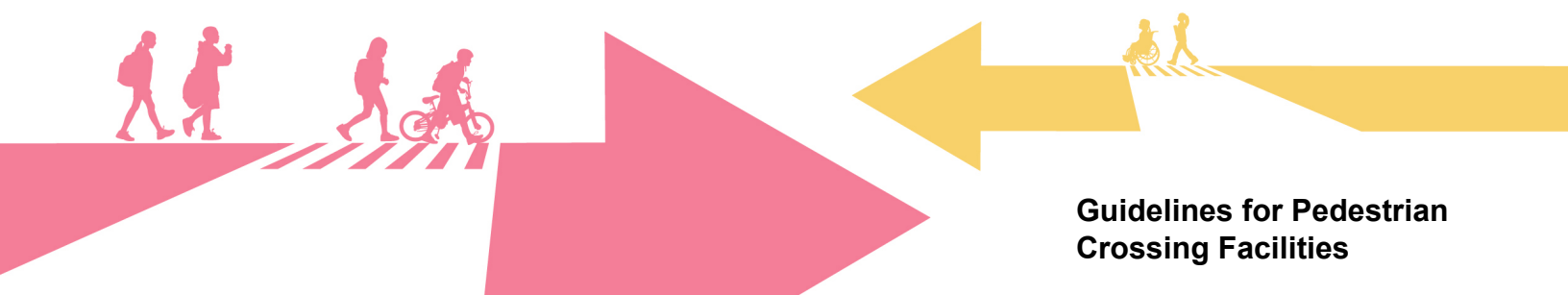
In 2008, the City of Kingston adopted its first set of Pedestrian Crossing Guidelines to provide direction on the installation of pedestrian crossings in the City. In 2016, provisions in the Highway Traffic Act (HTA) were updated, including a change that required motorists to stop and yield the entire roadway to pedestrians and school crossing guards at Pedestrian Crossovers (PXOs) and school crossings. The Pedestrian Crossing Guidelines were subsequently updated to reflect this change to the HTA, which enabled the City to upgrade existing courtesy crossings to PXOs.

In the fall of 2019, City Council adopted the Road Safety Plan (RSP) and Active Transportation Implementation Plan (ATIP), which directed staff to review the City's implementation-based transportation policies and guidelines.

CIMA+ Canada Inc. (CIMA+) was retained to update the 2016 Pedestrian Crossing Guidelines with the following objectives at the forefront:

1. Conduct a review of the content of the current Pedestrian Crossing Guidelines and determine necessary updates based on current best practices
2. Provide detailed strategies for the assessment and implementation of pedestrian crossing treatments that consider:
 - Data collected as part of assessing a locations' suitability for pedestrian crossing treatments
 - Connectivity of pedestrian infrastructure (i.e. existing sidewalks, crosswalks, and desire lines)
 - Pedestrian safety and accessibility

To accomplish these objectives, a review and update of the City's existing Pedestrian Crossing Guidelines was conducted that considers Ontario Traffic Manual Book 15 (i.e. the prevailing guiding document in Ontario) and design practices used by other jurisdictions.



1.2 Recommended Updates in Relation to OTM Book 15

Ontario Traffic Manual (OTM) Book 15 provides guidelines for the planning, design, and operation of pedestrian crossing treatments that are consistent with the intent of Highway Traffic Act and regulations related to pedestrian crossing applications. The purpose of OTM Book 15 is to promote uniformity of treatment in the design, application, and operation of traffic control devices across Ontario, while also providing a foundation for road authorities to generate their own guidelines and standards.

A review of City's 2016 Pedestrian Crossing Guidelines was conducted to identify gaps in relation to OTM Book 15. These gaps were addressed through the additional information and details that are included in this iteration of the guidelines.

2 Types of Pedestrian Crossing Treatments

2.1 Uncontrolled and Controlled Pedestrian Crossings

The Province of Ontario Highway Traffic Act (HTA) broadly classifies pedestrian crossings as "controlled" or "uncontrolled" based on the presence or absence of a traffic control device:

Uncontrolled crossings are those where pedestrians cross without the aid of traffic control measures or a dedicated pedestrian right-of-way.

Controlled crossings are those in which drivers are required to yield the right-of-way to pedestrians in specific conditions.

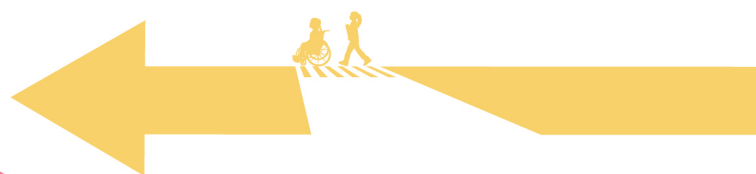
Locations that are designated as controlled crossings involve a combination of signage, pavement markings and in some instances signals or flashing beacons. The presence of a school crossing guard can also designate a location as controlled at an otherwise uncontrolled crossing.

For pedestrians to have the right-of-way (i.e. for the crossing to be considered a 'controlled crossing'), all components of a specified pedestrian crossing implementation are required to be constructed. The use of individual or 'partial' measures (i.e. a crosswalk marking without the other required components) is not recommended as it may create a false sense of security for pedestrians (and particularly children) who may enter the crossing expecting that approaching drivers will see them and stop. A crosswalk marking without the other required components would be considered an 'uncontrolled crossing' where pedestrians do not have a dedicated right-of-way.

2.2 Pedestrian Crossing Treatment Types

The following pedestrian crossing treatment types are considered as part of these guidelines:

- School Crossings
- Stop Controlled or Yield Controlled Intersections



- Pedestrian Crossovers (PXO)
 - Level 2 Type B
 - Level 2 Type C
 - Level 2 Type D
- Traffic Signals
 - Full Traffic Signal
 - Intersection Pedestrian Signal (IPS)
 - Mid-Block Pedestrian Signal (MPS)

A summary of each type of pedestrian crossing considered in these guidelines is presented below. Additional information can be found in OTM Book 5 (Stop or Yield Controlled Intersections), OTM Book 15 (Pedestrian Crossovers), and OTM Book 12 (Traffic Signals), Ontario Traffic Council's (OTC) School Crossing Guard Guide, and the City's All-way Stop Warrant.

2.2.1 School Crossings

School crossings are locations near elementary schools where school children cross on their way to or from school that are supervised by a school crossing guard on school days during specified hours. Traffic control at these locations is provided by the school crossing guard, who directs the movement of persons across a highway by creating necessary gaps in vehicular traffic to provide safe passage at a designated school crossing location. School crossing guards provide designated right-of-way for all persons as vehicles must yield to the raised stop paddle of the school crossing guard. Operation of school crossings and the role of school crossing guards are set out by the Highway Traffic Act's Regulations.

A school crossing in the absence of stop control, PXO, IPS, MPS or traffic signals is considered a controlled crossing only when the crossing is being supervised by a School Crossing Guard.¹ The presence of school crossing signs and markings only, in the absence of school crossing guards, do not require drivers to yield the right-of-way to pedestrians.

In some cases, school crossing guards are assigned to signalized and stop controlled intersections to assist students who may encounter conflicting vehicle turning movements. Under these conditions, the school crossing guard is treated as an additional component of the existing traffic control. In the presence of a school crossing guard, drivers and cyclists must stop and yield the whole roadway – only when pedestrians and the school crossing guard have crossed and are safely on the sidewalk can drivers and cyclists proceed.

¹ Municipal Policy – School Crossing Guard Program, City of Vaughan 19.C.04., November 17, 2020



2.2.2 Stop Controlled or Yield Controlled Intersections

Stop or Yield control intersections make use of regulatory signs as a form of traffic control. Vehicles approaching a STOP in advance of a crosswalk are required to stop at the stop bar, yielding to vehicular traffic and pedestrians (whose arrival preceded theirs) before proceeding.

It should be noted that vehicles approaching a YIELD Sign are required to slow down or stop when necessary, but are not required to complete a full stop before proceeding.²

2.2.3 Pedestrian Crossovers (PXO)

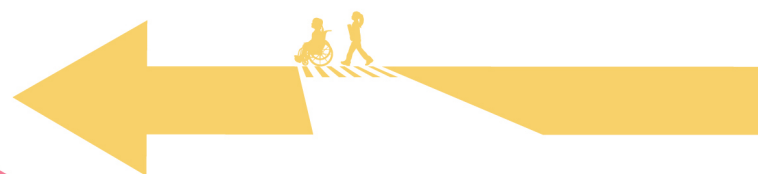
PXOs are a specific type of crossing where drivers and cyclists must stop and yield to pedestrians intending to cross the road, and wait for them to completely reach the other side before continuing. They are marked by regulatory and warning signs, pavement markings, and in some cases, pedestrian-activated rapid rectangular flashing beacons (RRFBs). Pedestrian-activated RRFBs can bring awareness to motorists when utilized at a PXO, but they are not required to be activated for a pedestrian to cross. Vehicles must yield to pedestrians attempting to cross, regardless of the presence or activation of these flashing lights.

At a PXO, motorists approaching and pedestrians attempting to cross each have specific responsibilities as outlined in the HTA:

- When a pedestrian is attempting to cross at a PXO, approaching motorists:
 - Shall stop before entering the crossover
 - Shall not overtake another vehicle already stopped at the crossover
 - Shall not proceed into the crossover until the pedestrian is no longer on the roadway
- Pedestrians attempting to cross:
 - Shall not leave the curb or other place of safety at a pedestrian crossover and walk, run or move into the path of a vehicle that is so close that it would be impracticable for the driver of the vehicle to comply with the requirements mentioned above.

In summary, all Level 2 PXOs operate in the same fashion, with the presence of a pedestrian being the traffic control, and the signs, pavement markings and other elements (i.e. RRFB when applicable) providing awareness to the driver regarding the presence of the PXO. Although a Type B PXO is equipped with a rapid rectangular flashing beacon (RRFB) and a push button, a pedestrian is not required to activate the device before attempting to cross the roadway.

² Ontario Traffic Manual Book 15 – Pedestrian Crossing Treatments, June 2016



2.2.4 Signalized Pedestrian Crossings³

Intersection Pedestrian Signals

Intersection Pedestrian Signals (IPS), also referred to as “half signals”, are installed at intersections and are controlled by traditional traffic signals with signalized pedestrian fixtures and a crosswalk that provide pedestrian right-of-way across a main street. Vehicles approaching an intersection with a IPS from a side street are typically controlled by a stop sign.

Mid-Block Pedestrian Signals

Mid-block Pedestrian Signals (MPS) are installed between intersections and are controlled by traditional traffic signals with signalized pedestrian fixtures and a crosswalk that provide pedestrian right-of-way across a main street.

Full Traffic Signals

Full traffic signals control the right-of-way between conflicting streams of vehicular traffic and conflicting movements between vehicular traffic and pedestrians crossing a road for all approaches of an intersection.

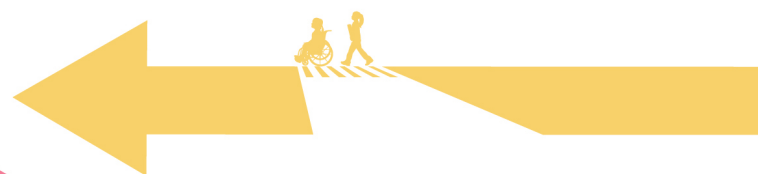
2.3 Public Education

Public awareness, communication, and education strategies play an important role in the implementation of new pedestrian facilities. It is important that messaging targets both pedestrians and drivers.

Ongoing communication and social media efforts are critical to creating city-wide awareness. This may include the use of infographics and videos to reach different audiences through a variety of formats and may include content geared towards younger students walking or cycling to school. Education efforts can also include on-site or neighbourhood-targeted messaging specific to new crossing facilities in the area, or demonstration days at new crossings to highlight how they work and the proper way for pedestrians and drivers to use them.

Specific attention is recommended for public education on Type D PXO's as part of their implementation. Messaging should highlight that the presence of a pedestrian attempting to cross requires motorists to stop and yield until pedestrians are completely off of the roadway. Signs, pavement markings and any other elements provide awareness to the driver regarding the presence of the PXO, but they do not serve as the traffic control. Pedestrians also have a role to play by providing sufficient time for motorists to be able to stop and yield the right-of-way before crossing.

³ Ontario Traffic Manual Book 15 – Pedestrian Crossing Treatments, June 2016



3 Assessment of Locations for Pedestrian Crossing Treatments

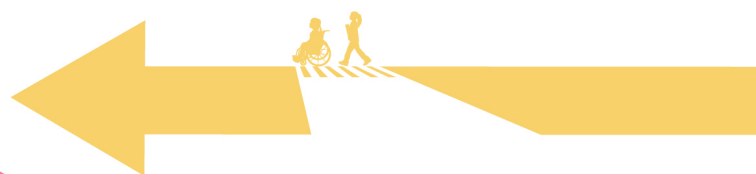
The assessment outline provided below considers the following guiding principles of the TAC Pedestrian Crossing Control Guide (Transportation Association of Canada, 2012), referenced in OTM Book 15:

- **Safety:** It is fundamental that the road system protect pedestrians and other vulnerable road users by achieving a high level of compliance from drivers, bicyclists and pedestrians, and by minimizing pedestrian exposure to vehicular traffic.
- **Delay:** As pedestrian delay increases, the likelihood of pedestrians making risky or non-compliant crossings also increases. This reduces the efficiency and safety of the crossing for both pedestrians and vehicle occupants.
- **Equity:** As the population changes, a “design pedestrian” should be considered to ensure the accessibility of road users of all ages and abilities. The design pedestrian will determine the walking and crossing speeds for the planning and design of these facilities.
- **Expectancy:** The presence of a pedestrian crossing system should not violate driver expectancy, thereby increasing the likelihood of drivers responding to situations correctly and quickly. The crossing location and any waiting or crossing pedestrian should be clearly visible.
- **Consistency:** The road authorities’ approach to pedestrian crossing facilities and control should be consistent and uniform across the transportation system. Consistency helps ensure that installations and devices are recognized, comprehended, and used effectively by all road users.
- **Connectivity:** Paying attention when pedestrians use unplanned routes in preference to or in the absence of a designated alternative (i.e. a desire path) will aid in providing appropriate pedestrian facilities. Facilitating connectivity between crosswalks and sidewalks, and/or trail networks involves understanding and monitoring pedestrian desire lines, which evolve as a function of land use, the location of pedestrian generators and attractors, and proximity to existing crossing facilities.
- **Pragmatism:** The pragmatic selection of pedestrian crossing control devices involves consideration of costs, effectiveness of the device in local conditions, ease of installation and maintenance of the device, particularly in winter, when maintenance due to snow and ice can be challenging.

Using this guidance as a foundation, the process for the selection of a suitable pedestrian crossing treatment is divided in two parts: **1) Preliminary Investigation**, and **2) Pedestrian Crossing Facility Assessment**. These tasks and sub-tasks do not necessarily take place sequentially. Iteration between tasks may be needed to gather additional information to complete the review.

3.1 Context

The proposed assessment process considers that City staff will require the identification of a suitable pedestrian crossing treatment as part of the following activities:



Guidelines for Pedestrian Crossing Facilities

- Safety and operational considerations identified by City Staff
- Reconstruction and/or improvements to roadway infrastructure
- Recommendations provided to proponents during the development approval process
- In response to a request submitted by general public, stakeholders (i.e. school boards and community organizations) as well as members of Council

The determination of the most suitable pedestrian crossing treatment, and the amount and type of information available to support the selection and implementation process may be different for each of the above contexts. As such, it is recommended that the screening process schematically presented in **Figure 1** will be carried out in advance of the Pedestrian Crossing Treatment Assessment Process.

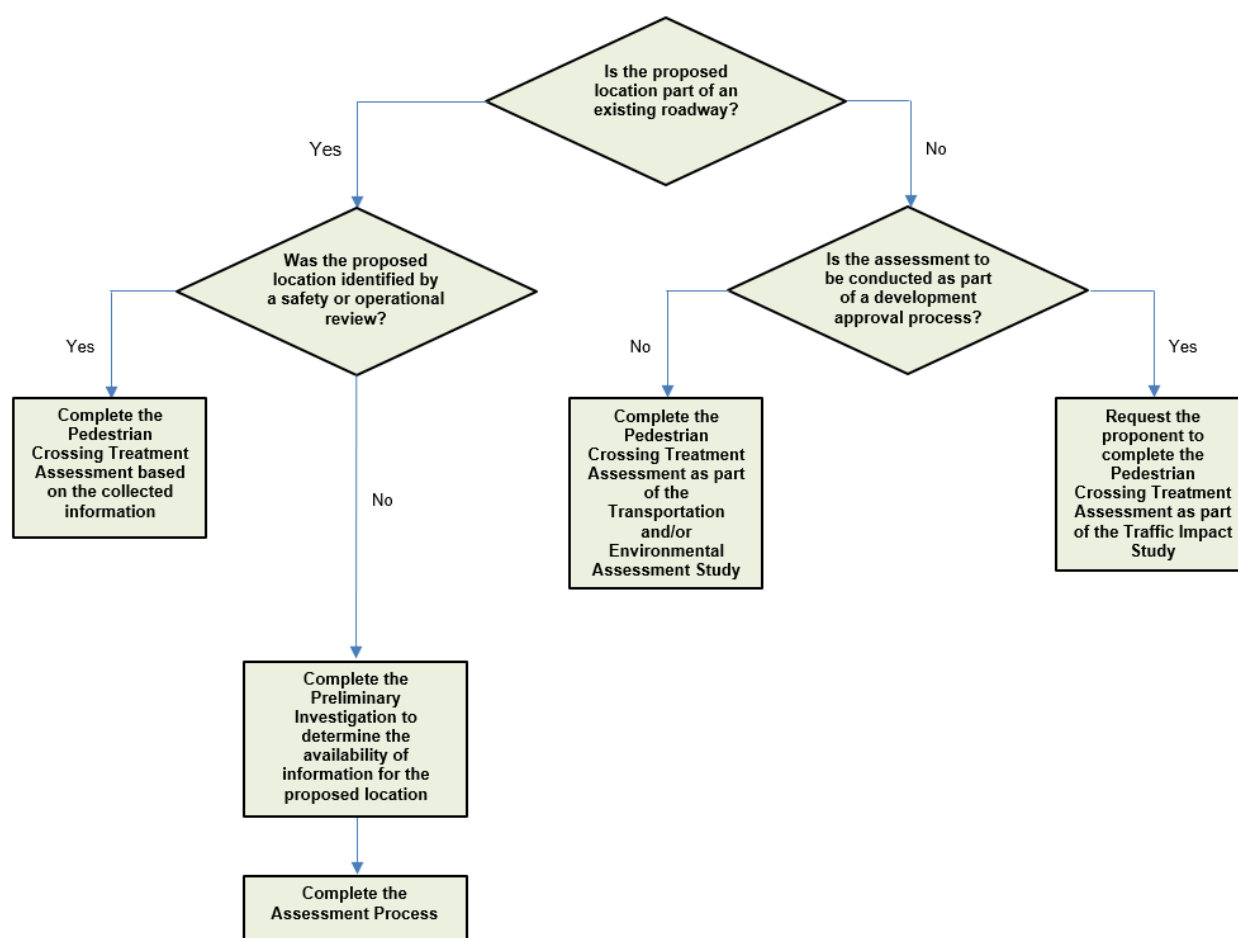


Figure 1: Preliminary Screening of Proposed Locations



3.2 Assessment Process and Criteria

3.2.1 Preliminary Investigation

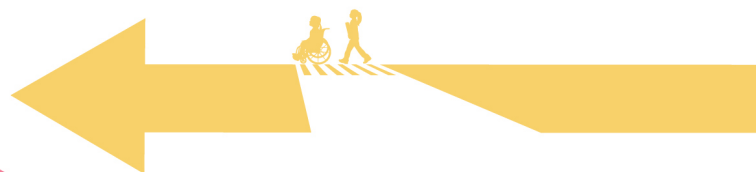
The purpose of the preliminary investigation is to collect information needed to (1) determine the type of pedestrian crossing treatment and (2) to determine the suitability of the location for implementing the crossing treatment. Office reviews and field investigations are needed to collect the required information. Where possible, the following data/information should be collected or made available before beginning the review:

- 8 or 4-hour peak pedestrian volumes, including breakdown of vulnerable pedestrians;
- 8 or 4-hour count of pedestrian delayed 10 seconds or more;
- 8 or 4-hour vehicle volumes taken during peak pedestrian hours;
- Vehicle 85th percentile speeds if there is a concern of speeding;
- Aerial Photography and/or CAD base plans, if available;
- Number of lanes, lane widths and divided or undivided road;
- Distance to nearest controlled or uncontrolled pedestrian crossing;
- Turning Movement Counts / Signal Timings of any nearby intersection or a driveway, if there is one (these may be required to review any queue build-up at the proposed location);
- Design and posted speeds of the roadway;
- Design vehicle for the main roadway including the type of vehicle turning from a nearby crossing road (e.g. waste collection vehicle, type of bus, etc.);
- Collision history;
- Presence of Kingston Transit and length of buses/design vehicles for Transit movements; and
- Presence of any Canada Post mailboxes, or any other maintenance areas.

3.2.2 Office Review

As part of the office review, the data noted above will be reviewed. Any gaps within the data will be addressed during the field investigation. The following reviews should be completed. As noted above, these reviews are not necessarily to be completed in a particular sequence.

- **Geometrical Review of Study Area** – A review of the study area should be conducted through mapping (e.g. Google Earth, Aerial Photography, etc.) to understand the land use, pedestrian and traffic generators, alignments, and other geometric features in the area.
- **Speed Studies** – This task requires reviewing and analyzing actual travel speeds to identify the operating speed or to verify concerns related to speeding.
- **Analysis of traffic / pedestrian volume** – The analysis of traffic and pedestrian volume provides a preliminary understanding of the type of pedestrian crossing treatment.
- **Road User Collision Analysis** – The analysis of the historical collision data provides an understanding of potential safety deficiencies of the study site.



- **Operational Issues** – This task may be required if there is a potential problem of queuing as a result of any nearby intersection or driveway. This task should be conducted using appropriate Highway Capacity Methods methodology as required.

3.2.3 Field Investigation

A detailed field investigation within the study area should be undertaken to identify the factors that may impact a crossing location as well the type of treatment. The review should be conducted during peak and off-peak hours and any other hours when pedestrian traffic is expected to be higher. A night review should also be considered to review illumination and conspicuity issues.

During the field investigation the following details should be observed:

- Roadway geometric characteristics including horizontal and vertical alignments (i.e. visibility for all road users including a sight line review as required), cross-section, medians, lane and intersection configuration, lane continuity, channelization, auxiliary lanes, pavement and shoulder condition, sight distances, driveway and side street accessibility, on-street parking and visibility (sight triangles). The sight distance (for both motorists and pedestrians) should be measured as per the guidance provided in TAC Geometric Design Guide for Canadian Roads. Any obstructions to sight lines should be reviewed further. In most cases, minimum stopping sight distance should be sufficient, however, in some critical situations, decision sight distances should be considered. The review of these elements should consider the implications on a pedestrian crossing. For example, a pedestrian crosswalk at a midblock location within a short left-turn lane to a driveway may not be ideal.
- The presence of existing traffic control devices (signs, and pavement markings etc.) should be reviewed. The location of existing signs will be needed during the design. For example, NO PARKING signs may need to be replaced with NO STOPPING signs, or an existing post may be needed to accommodate a PXO related sign.
- Since controlled pedestrian crossings are not recommended to be installed within 200 m of other traffic controls per Ontario Traffic Manual (OTM) Book 15, adjacent controlled pedestrian crossings of any type should be noted and reviewed. Any nearby intersections should be observed for potential queues extending towards the potential location of pedestrian crossing. An operational analysis may be required as part of the office review. Per OTM Book 15, the consideration for implementing controlled pedestrian crossings within a distance of less than 200 m of other traffic controls should be reviewed on a case by case basis by the municipality, in considering all of the office and field investigation data including potential justifications based on connectivity requirements, pedestrian desire lines, etc. Adjacent traffic controls may also require further review to assess potential impacts.
- Any driveways located near the potential crossing location should be reviewed. For example, a crosswalk should be avoided at a location where there is a potential of frequently blocking a busy driveway.



- The demographics of the pedestrians at the proposed location should be reviewed with a focus on identifying vulnerable pedestrians, such as school children, pedestrians that are elderly, and/or pedestrians with mobility needs. This is especially important for signalized crossings as an adjustment to pedestrian crossing time may be required.
- A review of pedestrian connectivity or pedestrian desire lines will be required. The site investigation should look for natural pedestrian paths and reasons for pedestrians need to cross at a location. Some examples are the presence of a trail on both sides of a road, school near a residential development, recreation centre, park, commercial plaza near on the opposite side of a commercial establishment, etc.
- A review of infrastructure elements at the potential pedestrian location will be required to identify improvement to available infrastructure, such as sidewalks, curb ramps, curb/gutter, etc.
- Illumination is a mandatory requirement for pedestrian crossings as per OTM Book 15. Illumination levels should be measured to ensure that minimum required illumination levels are available or implemented as part of the crossing construction. The presence of lighting and hydro poles should be noted. If the illumination levels are less than required, illumination will need to be considered in the detailed design.
- A utility investigation is very important. Information on underground and overhead utility infrastructure is required for placement of crosswalks. This is especially important for PXO Types B and C and traffic signals, as the concrete base for poles must be clear from any underground utility. Like underground utility infrastructure, overhead wiring may also be a constraint in some cases.
- Some other important considerations for the location of a pedestrian crosswalk include the presence of transit stops, whether or not the location is a school crossing, presence of raised island in the roadway, and any specific or unique design vehicle movements (e.g. bus, garbage truck, etc.).

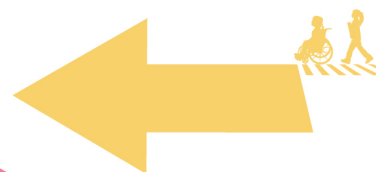
3.2.4 Assessment Process

The Pedestrian Crossing Treatment Assessment is designed to support the selection of a suitable type of pedestrian crossing treatment. The information collected in the preliminary investigation should be utilized as part of completing the assessment.

Supervised School Crossings

School Crossing assessments should be completed following the warrant guidelines outlined in the Ontario Traffic Council's School Crossing Guard Guide. Assessments should be conducted during morning and afternoon peak active school travel periods and may consider the following as part of the evaluation assessment:

- Percentage of 5-minute intervals with less than four safe gaps
- Pedestrian (student) count
- Vehicle count
- Sight distance issues



- Observed aggressive driving

Stop Controlled or Yield Controlled Intersections

The purpose of the STOP and YIELD sign is to clearly assign right-of-way between vehicles approaching an intersection from different directions when traffic signals are not warranted. As such, the user of this document should follow the Guidelines for Use established by the Ontario Traffic Manual Book 5 – Regulatory Signs and the Council-adopted All-way Stop Warrant for the assessment of this type of traffic control.

Pedestrian Crossovers

The following assessment should be used to determine whether a potential location for pedestrian crossing control is an appropriate candidate site for the installation of a Type B, C, or D PXO. For this type of pedestrian crossing, the process begins with the assessment of the following limitations for implementing PXOs:

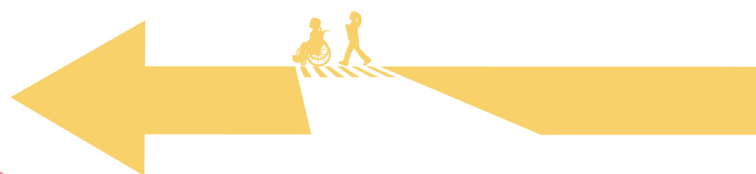
- PXOs are limited to road segments with a posted speed limit of 60 km/h or less;
- PXOs are limited to roadways with a maximum of 4 lanes;
- PXOs must not be used where the road volume exceeds 35,000 AADT (Average Annual Daily Traffic) or 17,500 vehicles in the highest 8-hour pedestrian interval; and
- PXOs are not recommended to be installed within 200 m of other traffic controls, although there are some exceptions relating to pedestrian connectivity, as discussed above in section 3.2.3.

The assessment involves the following steps with the use of Pedestrian Crossover Selection Matrix from OTM Book 15 as shown in **Table 1**.

Step 1: Check minimum pedestrian and vehicular volumes as the first step. If the total 8-hour (or 4-hour) pedestrian volume crossing the main road at an intersection or midblock location during the highest pedestrian traffic hours is greater than 100 (or 65 for 4-hour) and the 8-hour vehicular volume during the same time period is greater than 750 vehicles (or 395 for 4-hours), then proceed to Step 3. If not, proceed to Step 2.

Step 2: Check for connectivity requirements, such as existing sidewalks, walkways or trails to confirm pedestrian desire lines. The system connectivity and pedestrian desire lines should be assessed based on sound engineering judgement and should be appropriately documented. If the site does not satisfy the system connectivity requirement or it is not on a pedestrian desire line, the site is not a candidate for pedestrian crossing control. If the site is a candidate for pedestrian crossing control, proceed to Step 3.

Step 3: Use Table 1 to determine if the proposed location meets the criteria for a Type D PXO (i.e. 2 lane roadway or 4 lane with raised refuge island roadway and 50 km/h posted speed and less and < 4,500 vehicles during highest 8-hour pedestrian times). If a Type D PXO is warranted, then proceed to Step 4. If a Type D PXO is not warranted, then proceed to Step 5.



Step 4: If a Type D PXO is warranted, confirm minimum stopping sight distance for both motorists and pedestrians is available as well as verifying if excessive speeding is a concern and proceed to Step 7.

Step 5: If the criteria for a Type D PXO provided in Table 1 is exceeded, then consider a Type C PXO and proceed to Step 6. If the criteria for a Type C PXO provided in Table 1 is exceeded, then consider a Type B PXO and proceed to Step 6. If the criteria for a Type B PXO provided in Table 1 is exceeded, then the site is not a candidate for a pedestrian crossover and proceed to traffic signals assessment Step 8.

Step 6: If a Type C or B PXO is warranted, confirm if minimum stopping sight distance for both motorists and pedestrians is available as well as verifying if excessive speeding is a concern and proceed to Step 7.

Step 7: Address any findings related to sightlines issues, excessive speeds or to vulnerable road users such as adding a raised refuge island to the PXO and proper curb and ramps slopes for all PXO approaches.



Table 1: Pedestrian Crossover Selection Matrix (Source: OTM Book 15)

Two-way Vehicular Volume			Posted Speed Limit (km/h)	Total Number of Lanes for the Roadway Cross Section ⁴			
Time Period	Lower Bound	Upper Bound		1 or 2 Lanes	3 lanes	4 lanes w/ raised refuge	4 lanes w/o raised refuge
8 Hour	750	2,250	≤50	Level 2 Type D	Level 2 Type C ⁶	Level 2 Type D ⁵	Level 2 Type B
4 Hour	395	1,185					
8 Hour	750	2,250	60	Level 2 Type C	Level 2 Type B	Level 2 Type C ⁵	Level 2 Type B
4 Hour	395	1,185					
8 Hour	2,250	4,500	≤50	Level 2 Type D	Level 2 Type B	Level 2 Type D ⁵	Level 2 Type B
4 Hour	1,185	2,370					
8 Hour	2,250	4,500	60	Level 2 Type C	Level 2 Type B	Level 2 Type C ⁵	Level 2 Type B
4 Hour	1,185	2,370					
8 Hour	4,500	6,000	≤50	Level 2 Type C	Level 2 Type B	Level 2 Type C ⁵	Level 2 Type B
4 Hour	2,370	3,155					
8 Hour	4,500	6,000	60	Level 2 Type B	Level 2 Type B	Level 2 Type C ⁵	Level 2 Type B
4 Hour	2,370	3,155					
8 Hour	6,000	7,500	≤50	Level 2 Type B	Level 2 Type B	Level 2 Type C ⁵	N/A
4 Hour	3,155	3,950					
8 Hour	6,000	7,500	60	Level 2 Type B	Level 2 Type B	N/A	N/A
4 Hour	3,155	3,950					
8 Hour	7,500	17,500	≤50	Level 2 Type B	Level 2 Type B	N/A	N/A
4 Hour	3,950	9,215					
8 Hour	7,500	17,500	60	Level 2 Type B	N/A	N/A	N/A
4 Hour	3,950	9,215					

Type B
 Type C
 Type D

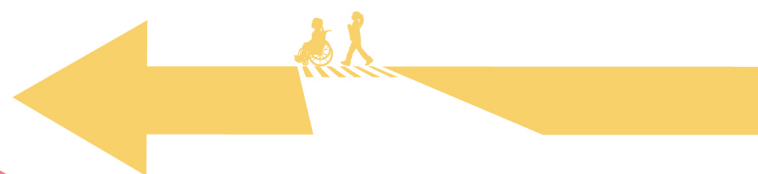
Approaches to roundabouts should be considered separate roadways.

⁴ The total number of lanes is representative of crossing distance. The width of these lanes is assumed to be between 3.0 m and 3.75 m according to MTO Geometric Design Standards for Ontario Highways (Chapter D.2). A cross sectional feature (e.g. bike lane or on-street parking) may extend the average crossing distance beyond this range of lane widths.

⁵ Use of two sets of side mounted signs for each direction (one on the right side and one on the median)

⁶ Use of Level 2 Type B PXO up to 3 lanes total, cross section one-way.

The hatched cells in this table show that a PXO is not recommended for sites with these traffic and geometric conditions. Generally, a traffic signal is warranted for such conditions.



Traffic Signals

The traffic signals assessment is used to check whether an IPS, MPS or Full Traffic Signal is a candidate for installation when the criteria for a PXO treatment have not been met. The preliminary assessment involves the following steps:

Step 8: Determine whether an IPS or MPS is warranted based on OTM Book 15 warrant methodologies for these devices (i.e. Justification 6A and 6B). If a pedestrian signal is warranted, then add to the City's traffic signal capital project prioritization list. If a pedestrian signal is not warranted, then proceed to Step 9.

Step 9: Determine if a full signal is warranted based on OTM Book 12 warrant methodologies.

3.2.5 Considerations for Data Collection

As stated in the OTM series of Books, the traffic practitioner's fundamental responsibility is to exercise engineering judgement and experience on technical matters in the best interest of the public and works. In some designs, applications, or operational features, the traffic practitioner's judgement is to meet or exceed a guideline, while in others, a guideline might not be met for sound reasons, such as space availability, yet still produce a design or operation which may be judged to be safe.

As indicated in **Section 3.1.** of this document, the user of these Guidelines may be required to assess a location in which some of the information required to complete the assessment process may be unavailable (i.e. if the proposed location is part of a new development) or difficult to collect due to operational or budgetary restrictions. Under those circumstances, the user of these Guidelines will need to exercise engineering judgement and apply their experience on technical matters to determine an alternative approach for data collection. The following is provided as a basis for consideration:

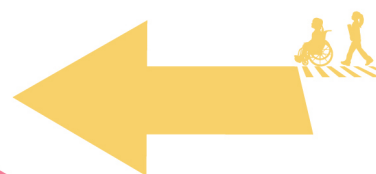
Lack of Vehicular Traffic and Pedestrian Volumes

To determine if a specific type of pedestrian crossing treatment is warranted or not, information regarding the current (or expected) vehicular traffic and pedestrian volumes is required. However, a PXO may be selected for further consideration if there is a requirement for system connectivity or if the proposed location is part of a pedestrian desire line without necessarily having the most accurate information regarding pedestrian volumes.

In the absence of vehicular traffic volumes (8-hour or 4 hour), Annual Average Daily Traffic (AADT) data can be used as surrogate for the estimation of two-way vehicular volume as described in Section 5.2.2. of OTM Book 15.

New or Future Development

If a potential generator of pedestrian traffic is expected to be part of a new or proposed development (i.e. a new school or community centre) the requirement for a future PXO should be considered as part of the development approval process. As part of this process, a preliminary identification of pedestrian desire line based on the proposed site plan may be



achievable. It can be expected that vehicular traffic and pedestrian volumes can be estimated as part of the preparation of the required Traffic Impact Study.

It should be noted that for signalized pedestrian crossings such as IPS, MPS and Full Traffic Signals, this alternative approach is not applicable, and the warrant methodologies described on OTM Book 15 and Book 12 respectively must be followed.

3.2.6 Parameter Considerations

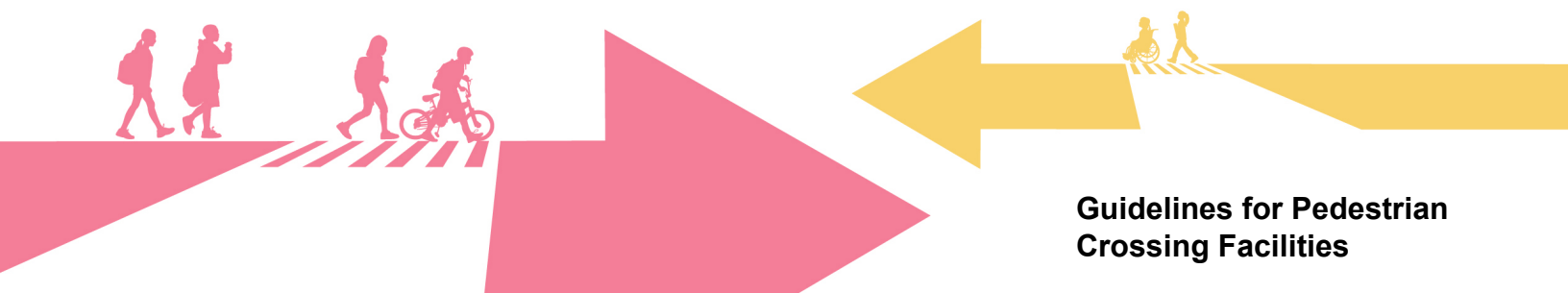
As previously described, the need and selection of the most suitable pedestrian crossing treatment depends on several factors such as roadway environment, vehicular traffic and pedestrian volumes. Though not an exhaustive list, the following highlights some of the elements that should be considered as relevant for each type of pedestrian crossing treatment:

- **Signalized Pedestrian Crossing** (i.e. Full Traffic Signal, Intersection Pedestrian Signal, Mid-Block Pedestrian Signal):
 - Minimum pedestrian volume
 - Minimum pedestrian delay criteria.
- **Pedestrian Crossover**
 - Vehicular Traffic
 - Roadway Cross-Section (number of lanes)
 - Sight distance
 - Distance from the proposed location to the nearest traffic control device
- **Stop and Yield Controlled Intersections**
 - Number of Collisions
 - Minimum Traffic Volumes
 - Sight distance
- **Supervised School Crossing**
 - Vehicular traffic and pedestrian volumes identified as part of a specific route to school

3.3 Interaction with Cycling Facilities

3.3.1 Signalized Intersections

As a result of modifications to Subsection 144 (29) of the Highway Traffic Act, the prohibition against riding or operating a bicycle along or beside a crosswalk was removed, permitting cyclists to ride adjacent to a crosswalk when crossing a road at a signalized intersection. Cyclists can also ride in a marked crossride facility (if present) that functions for cyclists similar



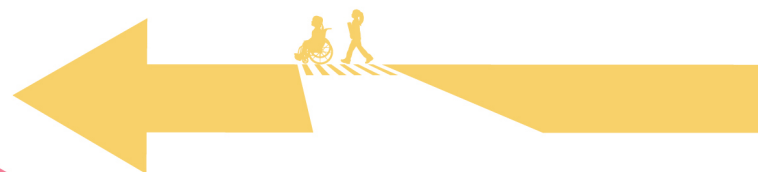
to how crosswalks do for pedestrians. However, it should be noted that cyclists are still not permitted to ride in a crosswalk – cyclists are required to dismount and walk through the crosswalk as a pedestrian.

3.3.2 Pedestrian Crossovers

Although a cyclist can ride alongside a crosswalk at a PXO, the traffic control of a pedestrian crossover is defined by the presence of a pedestrian attempting to cross the road. As such, a motorist is not legally required to allow the right-of-way of a cyclist who has not dismounted. Under these circumstances, a cyclist should dismount and complete the crossing as a pedestrian.

It should be noted that the use, design and applications of crossrides are discussed in extent in OTM Book 18.⁷

⁷ Up to the time of this document the final version of the Updated OTM Book 18 was not available for public consultation



4 Design Guidelines

This section is intended to provide guidance for the design of controlled pedestrian crossing types discussed in the sections above. These guidelines should be considered and used in concert with other relevant guidance for designers such as the Ontario Traffic Manuals (OTM), the Transportation Association of Canada (TAC) Guides and related regulations such as the Highway Traffic Act (HTA).

4.1 Intersection Pedestrian Signal (IPS) and Mid-block Pedestrian Signal (MPS)

4.1.1 Important Considerations

- For an IPS, the main street must be signalized and side streets must be stop-controlled.
- If cyclists are expected to be present in the area, proper guidance should be provided to inform cyclists that they must dismount when crossing the roadway at a dedicated pedestrian crossing.
- Location of poles – Poles with pushbuttons should be placed in such a way that they can be accessible by pedestrians, including those using assistive devices. Poles should not be placed in the sidewalk and should ideally be located within the boulevard or behind the sidewalk. Further details are provided in **Section 4.1.6**.
- Connectivity to sidewalks/trails – Pedestrian crossing facilities should be preferably located with a continuous sidewalk and/or a nearby trail network.
- Parking and no stopping restrictions – According to OTM Book 15, it is desirable to implement stopping prohibition for a minimum of 30 m on each approach to the crossing, and 15 m following the crossing. Further details are provided in **Section 4.1.4**.
- Location of transit stops – The crosswalk location will need to be coordinated with any existing transit stops. There may be situations where transit stops in the vicinity of the crossing may need to be relocated to comply with parking and no stopping restrictions.
- Refuge islands – At some locations where the roadway is wide and the crossing time may be significant, consideration could be given to provide a refuge island for pedestrians' safety. This is more important in areas with pedestrians who may not be able to cross the street in a single pedestrian signal indication (e.g. close to senior residents, committee centres).
- Demography of surrounding area – The demography near the pedestrian crossing should be identified to determine the most appropriate pedestrian walking speed that will be used to calculate the required crossing time. Further details are provided in **Section 4.1.8**.
- General utilities (i.e. fire hydrants, hydro poles) – The design process should review for the presence of existing utilities and potential conflicts and coordinate with the utility companies as may be required. Further details are provided in **Section 4.1.6**.
- Auxiliary lanes (left/right-turn lanes) – If a pedestrian crossing is being considered at a location where left/right-turn lanes are present, an operational analysis may need to be



conducted to determine an appropriate storage length for the auxiliary lane(s) to ensure that there is enough available storage length to accommodate left/right-turning vehicles when the pedestrian signal is activated.

- Source of power – IPS, MPS, and illumination poles will require access to electrical power. Further details are provided in **Section 4.1.6**.
- Proximity to driveways – Ensure that no driveways are present between the crosswalk and the stop line because the presence of a driveway may result in sudden movements by exiting drivers if vehicles are stopped while waiting for pedestrians to cross.
- Proximity to traffic signals – According to OTM Book 12, the minimum recommended distance between traffic signals for roads posted at 60 km/h or less is 215 m and for roads posted at 80 km/h is 350 m. There may be a desire to have pedestrian crossings at locations that do not meet these requirements. Under these situations, it may be desirable to conduct an operational analysis to evaluate any vehicle queues' impact on the crossing.
- Sightlines – Sight triangles for side street traffic waiting at the stop sign must be clear and should not be obstructed by vegetation, on-street parking, buildings, fences, etc. The visibility of all signs and signals at the crossing should be confirmed for road users. Sight distance requirements are detailed in TAC's Geometric Design Guide for Canadian Roads.

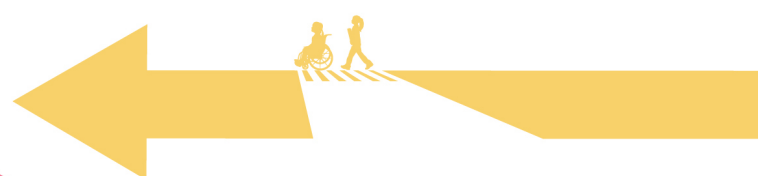
4.1.2 Illumination Levels

Illumination is an important aspect of road safety because it provides adequate visibility for road users when using the roadway system during periods of darkness. Illuminance is the measure of the light (lumens) falling on a surface. The unit of illuminance is commonly known as “lux” and is measured in lumens per square metre. The illuminance of horizontal and vertical surfaces is referred to as horizontal illuminance and vertical illuminance, respectively. Signalized intersections must be fully illuminated.

Intersection lighting requirements are provided in terms of the recommended minimum average maintained horizontal illuminance levels. **Table 2** lists the recommended minimum average maintained illuminance levels for full intersection lighting.

Table 2: Recommended Minimum Illuminance Levels for Full Intersection Lighting
(Source: TAC Roadway Lighting Guide)

Roadway Classification	Average Maintained Illuminance at Pavement by Pedestrian Conflict/Activity (lux)			Average-to-Minimum Uniformity Ratio
	High	Medium	Low	
Arterial/Arterial	34.0	26.0	18.0	3.0
Arterial/Collector	29.0	22.0	15.0	3.0
Arterial/Local	26.0	20.0	13.0	3.0



Collector/Collector	24.0	18.0	12.0	4.0
Collector/Local	21.0	16.0	10.0	4.0
Local/Local	18.0	14.0	8.0	6.0

As indicated in **Table 2**, the average maintained illuminance at pavement is recommended based on road classification and low, medium, or high pedestrian conflict/activity, which are classified as follows:

- Low pedestrian conflict/activity: less than 11 pedestrians per hour;
- Medium pedestrian conflict/activity: 11 to 99 pedestrians per hour; and
- High pedestrian conflict/activity: 100 or more pedestrians per hour.

Additionally, the table states the corresponding average-to-minimum uniformity ratio, which is the average level ratio (of either illuminance or luminance) to the minimum level, that should be met for the roadway classification. Generally, a high degree of roadway lighting uniformity is desirable because excessively high lighting levels prevents the eye from adapting to those high levels. This results in insufficient sensitivity for the viewing of the medium and lower lighting levels.

Pedestrian crosswalks at intersections must also consider vertical illuminance values to improve pedestrian visibility. The maintained average vertical levels of illuminance must meet or exceed the maintained average horizontal design levels for the intersection. For example, if the recommendations for the horizontal lighting levels at an intersection are 26.0 lux, then the vertical lighting level recommended in the crosswalk at a height of 1.5 m should be 26.0 lux or greater.

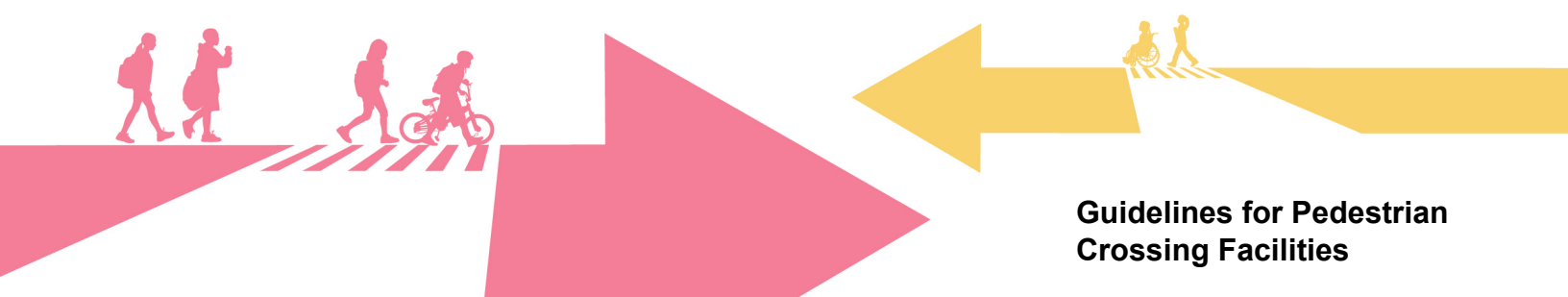
Mid-block crossings installed with traffic signals have the same illumination requirements as signalized intersections stated previously.

Full design procedures for intersection and mid-block crosswalk illumination, including warrant analysis, horizontal and vertical illuminance calculations, equipment selection, and pole layout, are detailed in TAC's Roadway Lighting Guide.

4.1.3 Signal Head Placement

As per OTM Book 12, typical three-section signal heads are used for the main roadway and pedestrian signals with pushbuttons are required for IPS and MPS crossings (pedestrian signals are controlled by pedestrian actuated two-phase operation). The signal heads may be mounted on the same poles (i.e. back-to-back) or independently. Additionally, the side roads must be controlled with stop signs for IPS crossings.

A minimum of two signal heads must face each main road approach of the crossing (including driveways within an intersection for public use). Typically, signal heads may be mounted on



poles with double arm brackets; suspended over the pavement on mast arms, gantry arms, or structural frames. Table 25 in OTM Book 12 details the minimum distance from which signals must be clearly visible based on the roadway's 85th percentile speed. If horizontal or vertical geometry prohibits visibility of at least one signal head within this minimum distance, an auxiliary signal head and potentially a continuous or activated flasher with a “signals ahead” sign is typically required.

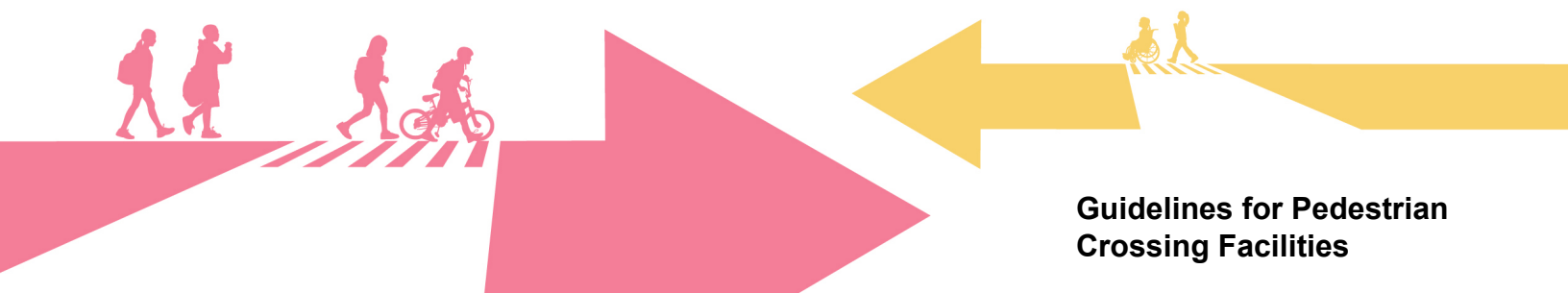
The primary signal head must be located on the far-right side of the crossing and should be oriented to be centred on the approach. If a median island is not present, the primary signal head should be located at the $\frac{1}{2}$ to $\frac{3}{4}$ point of the receiving curb lane and a minimum of 1.2 m into the lane. If a median island is present, the primary signal head should be located laterally at least at the pavement's edge (0.5 m over the receiving lane is preferred). Additionally, the primary signal head should be located a minimum of 15 m from the near side stop line.

The secondary signal head must be located on the left side of the approaching through lanes. If there is no median, the signal head may be placed on the far-left side of the crossing as far as the left edge of pavement. If a median is present, the signal head may be placed on the median. The secondary head (far-left side) should be located at or as close to the edge of the roadway as feasible. Additionally, secondary heads with left turn arrows should be located as close to the approach as possible. Typically, a minimum separation of 5.0 m between the primary and secondary head should be provided and a maximum (desirable) lateral distance of 15.0 m between the primary and secondary head (absolute maximum distance of 22 m).

Primary heads should be mounted at a minimum height of 4.5 m or higher, but it is desirable for them to be mounted at a height of 5.0 m regardless of the posted roadway speed. If the posted roadway speed is less than 80 km/h, secondary signal heads mounted on the far left and not over traffic lanes may be mounted at a minimum height of 2.75 m, but desirably at a height of 5.0 m. If the secondary head is installed where it is frequently obstructed (i.e. by large vehicles, other signal heads, bridges, etc.), auxiliary heads may be used on the far left of the crossing to improve visibility for drivers. Auxiliary heads may be mounted at a minimum height of 2.75 m (or as high as necessary to obtain good visibility), but desirably at a height of 5.0 m. For roads with a posted speed of 80 km/h and greater, all signal heads should be mounted at a height of at least 5.0 m.

Backboards are recommended for all primary heads and it is preferable to have them on all signal heads. In most circumstances, backboard faces and their rear surfaces are both ‘traffic yellow’ in colour.

Pedestrian signal heads at the crossing must be mounted at a minimum of 2.5 m from the finished grade at the edge of pavement to the bottom of the signal housing and should be recognizable within 30 m under normal conditions of visibility when illuminated. Pedestrian heads must not be mounted at the height of vehicle heads. If feasible, pedestrian heads should be mounted directly behind the sidewalk facing along the crosswalk. Where necessary, the heads may be mounted within 3.0 m of the edge of the sidewalk in the direction that faces the crosswalk, and within 1.5 m of the edge of the crosswalk laterally.



Further details regarding traffic and pedestrian signal head placement can be found in OTM Book 12 – Traffic Signals.

4.1.4 IPS and MPS Components and Restrictions

As per OTM Book 15 (unless otherwise stated), the minimum required components and desired components for IPS and MPS are as follows:

Minimum Required Components:

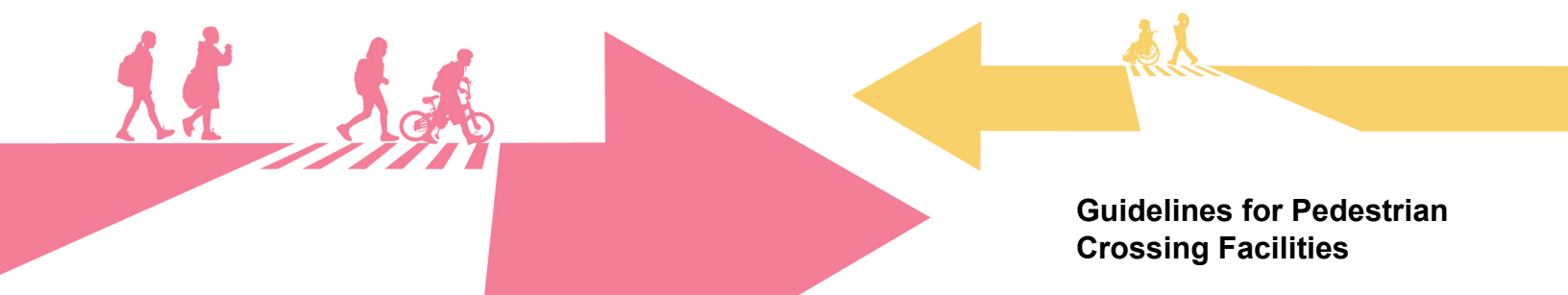
- Traffic Signal Heads as further detailed in **Section 4.1.3**
- Approach markings (stop line, advanced stop bar, no-passing zone, and turn lane markings, as required) and crosswalk markings as further detailed in **Section 4.1.5**
- Stop Here on Red Signal Sign (Rb-78) by stop bar(s) along the main roadway where IPS or MPS is present
- Pedestrian Control Indications with AODA compliant Pedestrian Signal Pushbuttons and Pedestrian Pushbutton Symbol Sign (Ra-12) as further detailed in **Section 4.1.8**
- Stop signs (Ra-1) on the cross streets for IPS

Desired Components or Additional Considerations:

- Raised refuge island (for road cross-sections with more than two lanes and two-directional traffic) with mandatory:
 - Pavement markings on approaches to obstructions;
 - Keep Right Sign (Rb-25, Rb-125); and
 - Object Marker Sign (Wa-33L).
- Stopping prohibition for a minimum of 30 m on each approach to the crossing, and 15 m following the crossing;
- Parking and other sight obstructions prohibition within at least 30 m of crossings;
- Raised crosswalk to reduce vehicle speeds and improve pedestrian visibility; and
- Curb extensions to reduce pedestrian crossing distance.

Details regarding sign location criteria for the aforementioned minimum required components and desired components can be found in OTM Book 5 – Regulatory Signs. Horizontal and vertical mounting offsets for signs can be found in OTM Book 1B – Sign Design Principles.

All IPS and MPS installations shall be accompanied by drawings reflecting the necessary details for the traffic signal installations (equivalent to PHM-125 format).



4.1.5 Pavement Markings

As per OTM Book 15, approach markings (stop line, advanced stop bar, no-passing zone, and turn lane markings, as required) and crosswalk markings are required components for IPS and MPS.

The stop line (also known as a stop bar) must be a solid white retro reflective line between 30 cm and 60 cm wide. Typically, stop lines are placed parallel to the edge of the crossing roadway or at least 1 m from the crosswalk line if a pedestrian crosswalk is present. An IPS requires the near side advanced stop bar to be placed a minimum of 15 m from the primary signal head. For a MPS, the stop bars must be set back a minimum of 12 m (15 m is preferable) from the primary signal head.

Crosswalk lines must be solid white parallel retro reflective lines 10 cm to 20 cm wide that extend entirely across the pavement. The crosswalk width must be at least 2.5 m wide, but widths of 3 m to 4 m are typical in urban areas with higher levels of pedestrian activity. Crosswalks should line up with any proposed sidewalks or dropped curbs. Ladder crosswalk markings may also be considered for the implementation of IPS and MPS crossings as per the OTM Books.

Design guidance for no-passing zones and turn lane markings are detailed in OTM Book 11 – Pavement, Hazard and Delineation Markings.

Section 4.1.7 provides illustrations of installation details for typical IPS and MPS pedestrian crossing treatments that indicate the recommended placement of pavement markings.

A typical crosswalk design with standard crosswalk markings is provided in **Figure 2**.

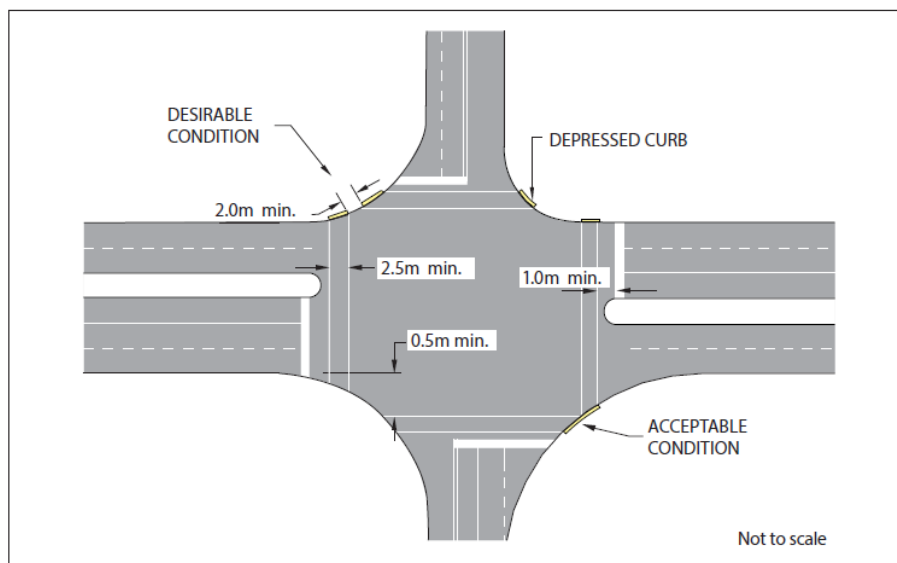
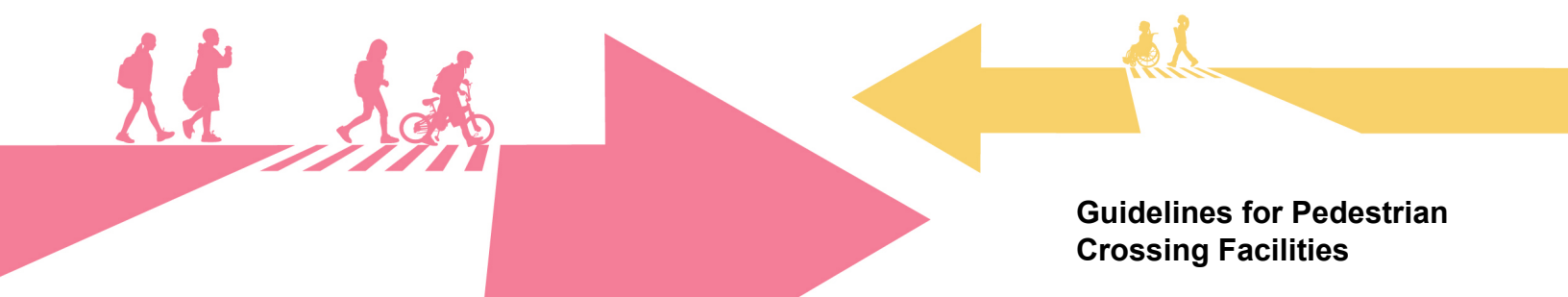


Figure 2: Typical Crosswalk Design with Standard Crosswalk Markings (Source: OTM Book 15)



4.1.6 Infrastructure

Traffic Signal Poles⁸

The typical practice is to install signal poles with a 3.0 m offset from the through edge of pavement. A minimum offset of 1.5 m from the face of the curb is recommended in urban areas with a speed of 50 km/h or less and 0.6 m is the absolute minimum offset at posted speeds of 40 km/h or 50 km/h. The choice of pole locations should consider pedestrian accessibility in terms of reaching the pushbuttons. The selection of location will also require the designer to consider utility clearances, aesthetic requirements, and mast arm length restrictions.

It is recommended that primary signal poles be located as close to the crossing as possible to allow space for other infrastructure such as secondary head mast arms and pedestrian equipment. If a median is present, the maximum recommended longitudinal distance of the primary signal pole is 10 m either way from the location of the median pole (measured along the centreline of the roadway).

Like primary signal poles, a maximum longitudinal distance of 10 m either way from the primary pole location (measured along the centreline of the roadway) should be maintained where possible.

The pole types that should be used to satisfy safety clear zone requirements are provided in the Ontario Ministry of Transportation Roadside Safety Manual and in municipal policy manuals (if available).

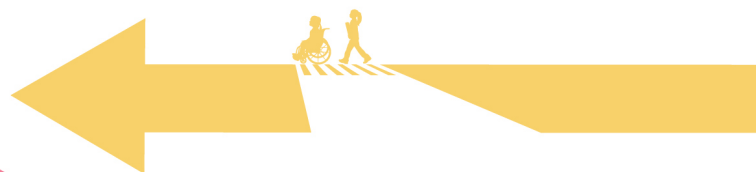
Poles with Pedestrian Pushbuttons⁹

Wherever possible, it is desirable that pedestrian pushbuttons be mounted on traffic signal poles. Where a separate pole is required, the pole should be installed near the crossing by the centrelines of the crosswalks and should include the pedestrian heads as well to avoid visual clutter. If this setup is not possible, a short pole with pushbuttons only may be used. Where a separate pole is required, consideration should be given to placing it at least 6.0 m from other poles to allow room for maintenance vehicles to operate and for aesthetic reasons.

The pushbuttons should be installed on the “through sidewalk” side of the pole at a height of 1.1 m (+/- 0.15 m) above finished grade. The pushbuttons should be in line, not perpendicular, with the crosswalk and if possible, poles with pushbuttons should be within the crosswalk lines. If this is not possible, the poles should be located within 1.5 m of the edge of the crosswalk it serves. It is important to ensure that these poles are accessible and user friendly (i.e. not located behind barriers, grassy/muddy areas, or areas where snow windrows may occur). **Section 4.1.8** provides details about accessible pedestrian signals (APS), curb ramps, and depressed curbs at crosswalks to assist pedestrians with visual and/or hearing impairments.

⁸ Ontario Traffic Manual Book 12 – Traffic Signals, March 2012

⁹ Ontario Traffic Manual Book 12 – Traffic Signals, March 2012



Poles with Pedestrian Heads⁹

Poles carrying pedestrian heads should ideally be located within the crosswalk lines. Pedestrian heads can be mounted on primary, secondary, or auxiliary poles as long as the heads are not located more than 10.0 m longitudinally from the end of the crosswalk. It is important to note that mounting pedestrian heads on the side of the pole nearest the pavement may result in damage by errant, large turning vehicles, snowplows, etc.

Illumination Poles¹⁰

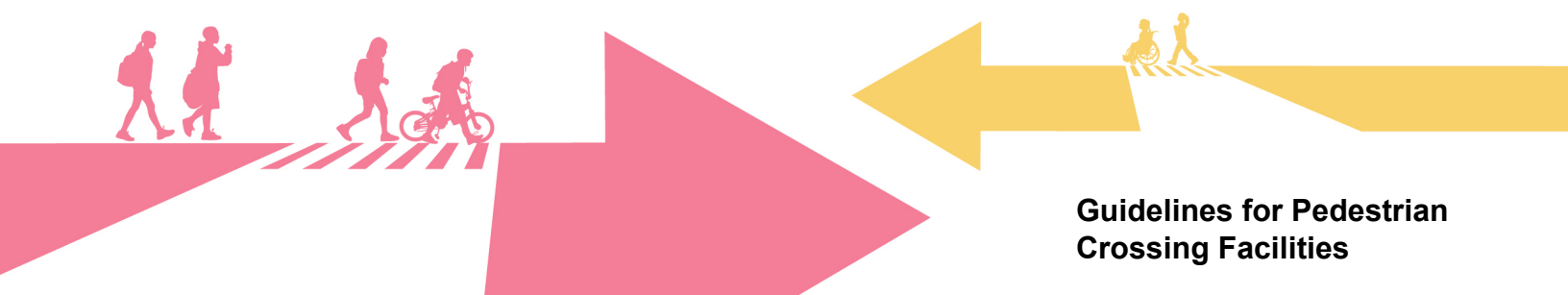
The recommended minimum horizontal illuminance levels for full intersection lighting can typically be achieved by using combination signal and luminaire poles. If full roadway lighting that ties into the intersection is present, the spacing of the poles on the approach should be designed to synchronize with the lighting for the intersection. Pole layout design typically begins by locating poles at obstructions (i.e. overpass structures or intersections) and then spacing the poles evenly according to calculations conducted by computer lighting design software until the next obstruction or intersection is encountered. Then, the last pole is adjusted relative to the obstruction or intersection, and the pole spacing is updated to provide even spacing between the obstructions/intersections. As a result of the new pole spacing, calculations are adjusted to ensure that minimum criteria values are still met.

The TAC Roadway Lighting Guide indicates that there is no exact formula for determining optimal pole heights and luminaire wattages for a given road. Factors such as pole spacing, luminaire photometrics, wattage, lighting levels and uniformity, power line conflicts, road geometrics, aesthetics, obtrusive lighting issues, etc., are all factors when defining the optimal mounting height. Therefore, computer lighting design software is utilized to determine pole height and luminaire wattage is by testing various scenarios through a “trial and adjustment” process.

All lighting is typically fed from an electrical power supply through wiring connected to an electric power grid.

Typical arrangements of full intersection lighting at four-legged and three-legged intersections are provided in **Figure 3** and **Figure 4**, respectively.

¹⁰ Transportation Association of Canada – Roadway Lighting Guide, January 2006



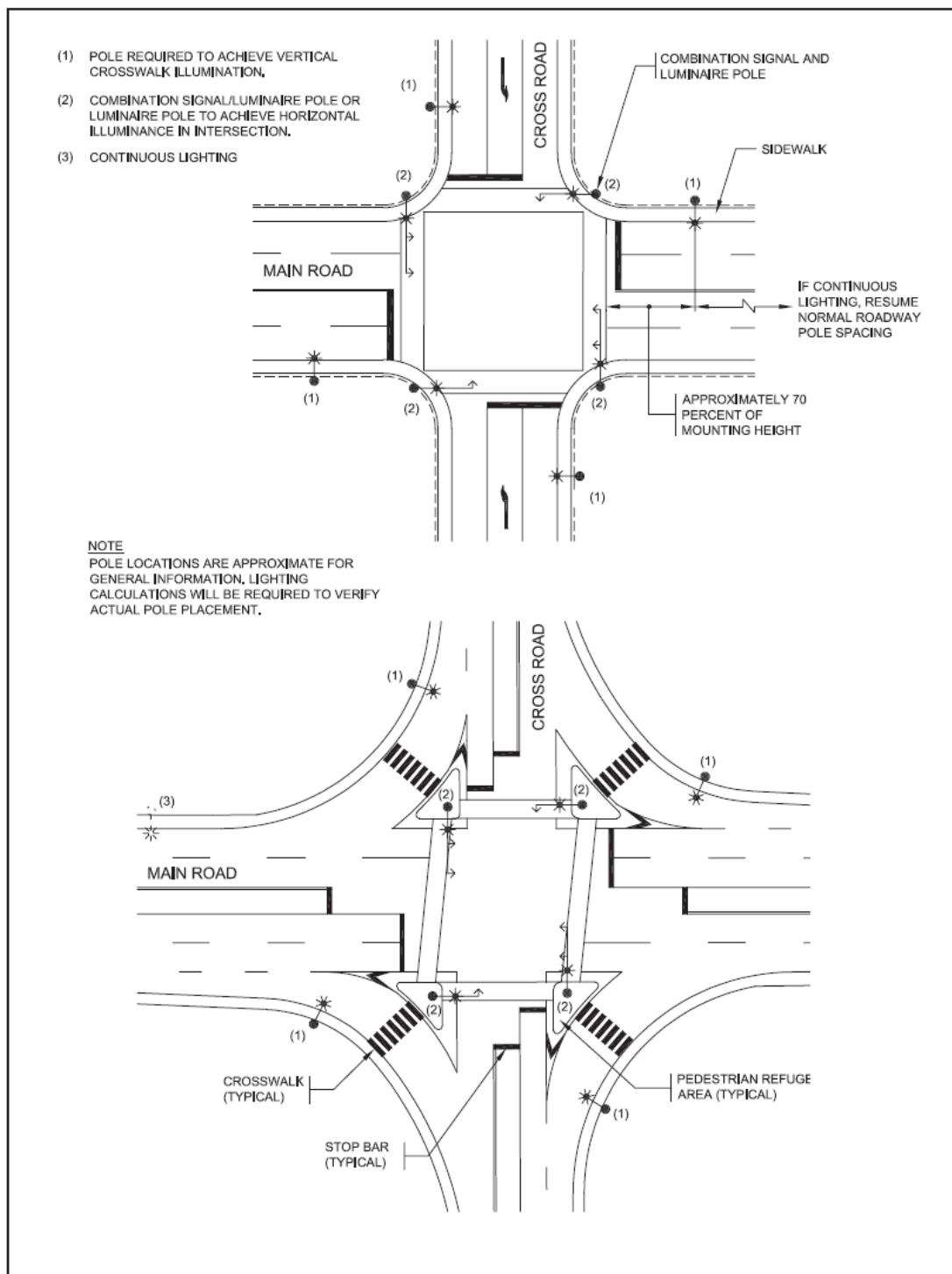


Figure 3: Typical Full Intersection Lighting for a Four-Legged Intersection (Source: TAC Roadway Lighting Guide)



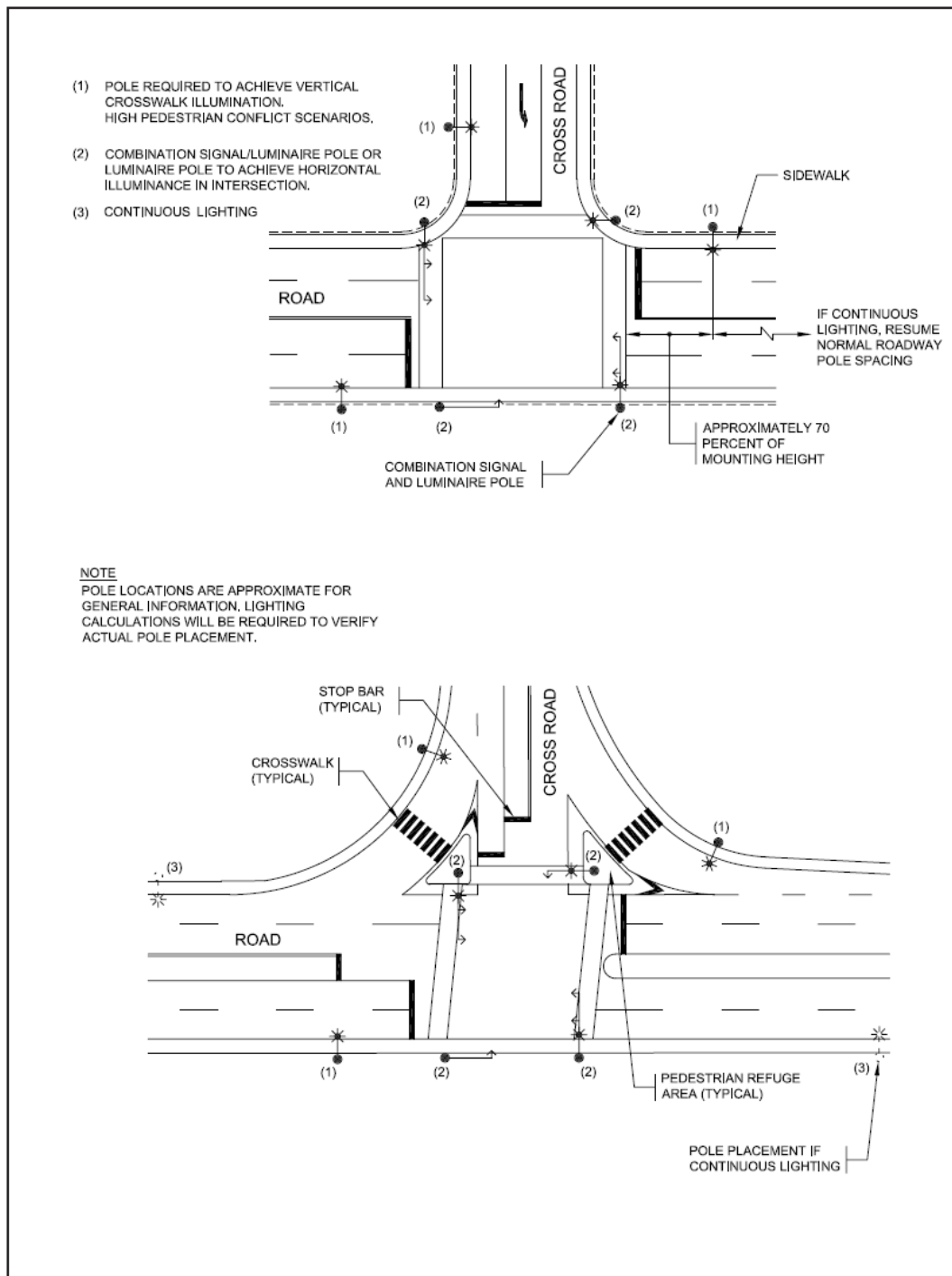
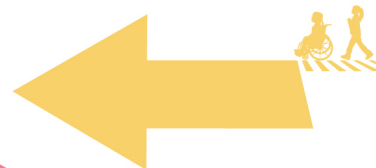


Figure 4: Typical Full Intersection Lighting for a Three-Legged Intersection (Source: TAC Roadway Lighting Guide)



Typical arrangements of partial intersection lighting at four-legged, three-legged, and “T” intersections are provided in **Figure 5**.

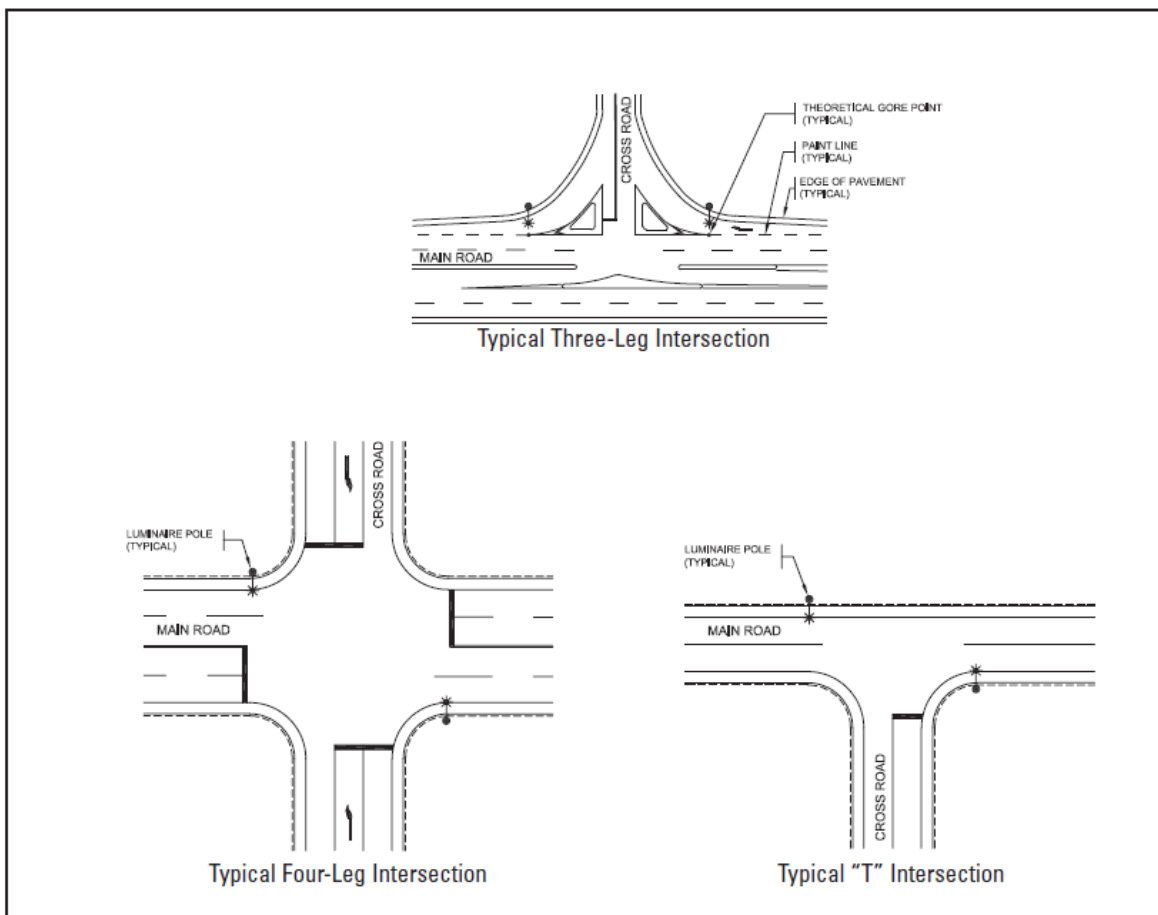
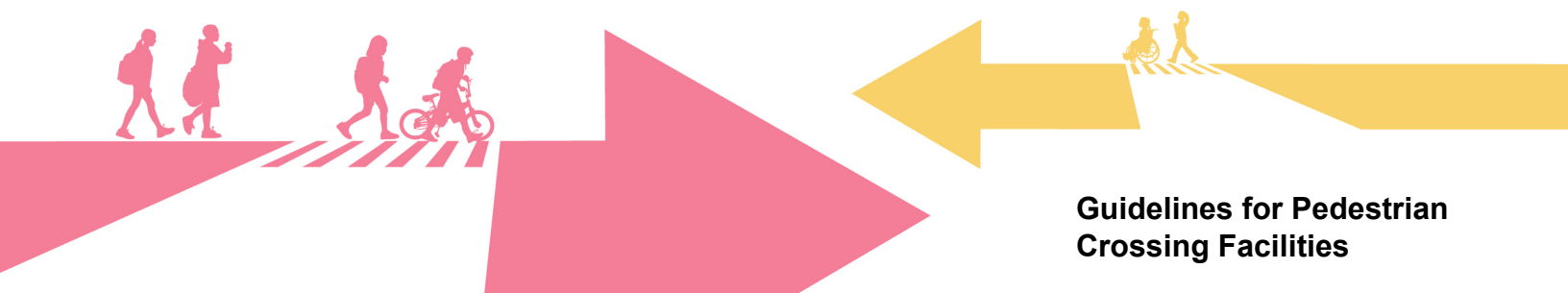


Figure 5: Typical Partial Intersection Lighting Pole Placement (Source: TAC Roadway Lighting Guide)

In order to meet recommended minimum illuminance levels at a midblock location, poles need to be placed in advance of the midblock crossing as illustrated in **Figure 6**. As discussed previously for illumination poles at intersections, the exact placement of poles depends on variables such as luminaire optics, lamp wattage, and mounting height. Additionally, if the roadway approaching the midblock crossing is illuminated, the pole spacing for the roadway should be designed to synchronize with the pole locations at the midblock crossing location. Combination signal and luminaire poles can also be used to achieve recommended minimum illuminance levels at a midblock location.



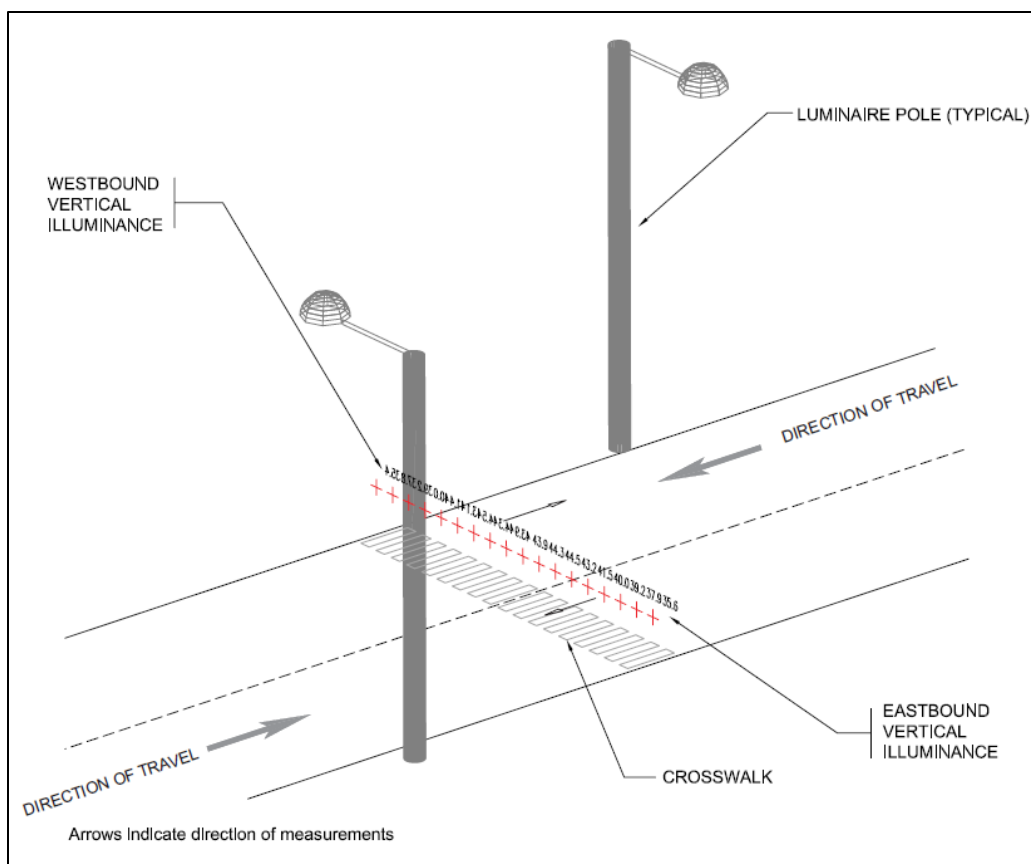


Figure 6: Typical Midblock Lighting Pole Placement (Source: TAC Roadway Lighting Guide)

Further details regarding illumination pole placement is provided in TAC's Roadway Lighting Guide.

Signal Controller and Power Supply Cabinets¹¹

Wherever possible, controller cabinets should be placed on the far-right corner of the main road at the crossing. Ideally, the head displays for 50% of the phases should be visible while standing at the controller.

If guiderails or barriers are not present, it is preferable to place the controller at a location that meets the clear zone requirements outlined in the Ontario Ministry of Transportation Roadside Safety Manual, from the edge, or projected edge, of through lanes. Controllers should not be mounted on slopes steeper than 6:1 nor at an elevation difference of more than 1.0 m from the pavement.

¹¹ Ontario Traffic Manual Book 12 – Traffic Signals, March 2012



Guidelines for Pedestrian Crossing Facilities

In congested urban areas where the posted speed is 70 km/h or less, a minimum clearance of 3.0 m from the edge of the pavement is desirable. If this is not feasible, controllers should be placed as close to buildings as possible while leaving at a minimum sidewalk width of 1.5 m and ensuring that they are clear of doors and store-front windows. In areas where the posted speed is 80 km/h or greater, a controller offset of 10 m from the through edge of pavement is desirable (a 6 m offset is considered acceptable).

The power supply cabinet should also be located within 75 m or less from the controller and at least 10 m from the edge of pavement if possible. Additionally, the controller should be located more than 11 m from the power supply pole.

Further details regarding considerations related to signal controller and power supply cabinets are provided in OTM Book 12 – Traffic Signals.

Utilities¹²

It is important to check the location of existing utilities (i.e. hydro, fibre optic cable, watermain, etc.) when installing signal poles, illumination poles, and signal controller cabinets. The design process should review for the presence of existing utilities, consider potential conflicts, and coordinate with utility companies as may be required.

The following guidelines are recommended for electric utilities:

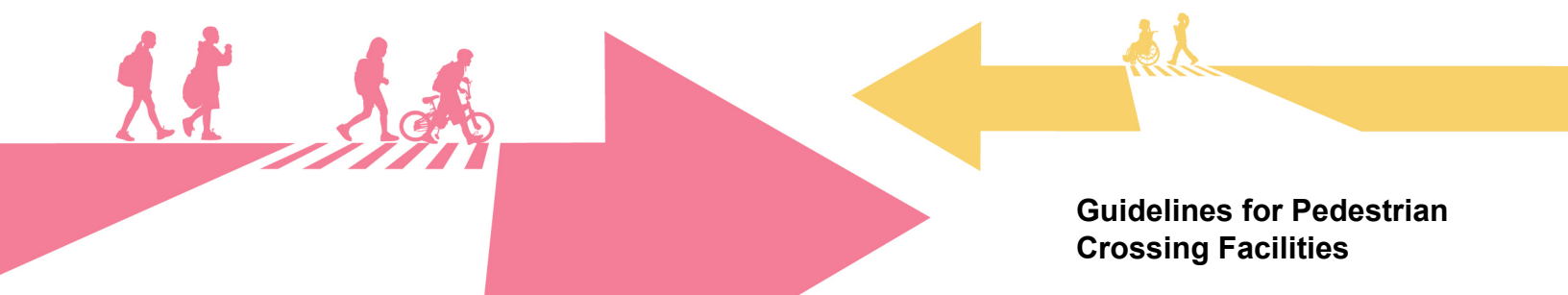
- Wherever possible, a plan layout should be developed by allowing a minimum of 5.0 m between horizontal centres of electrical pole lines and traffic signal poles
- Typically, as much clearance as possible is desirable. Good practice suggests that traffic signal poles should be located at least 5.0 m from overhead lines (measured horizontally) or the power lines should be relocated so that the signal equipment can be mounted on the utility pole
- Where lighting is required, the designer should use the electrical utility poles if adequate luminaire mounting height can be provided

Further details regarding considerations related to utilities are provided in OTM Book 12 – Traffic Signals.

4.1.7 Layout

The following figures from OTM Book 15 illustrate the typical installation layouts for IPS and MPS as pedestrian crossing treatments for two-way and one-way movements:

¹² Ontario Traffic Manual Book 12 – Traffic Signals, March 2012



Intersection Pedestrian Signal (IPS)

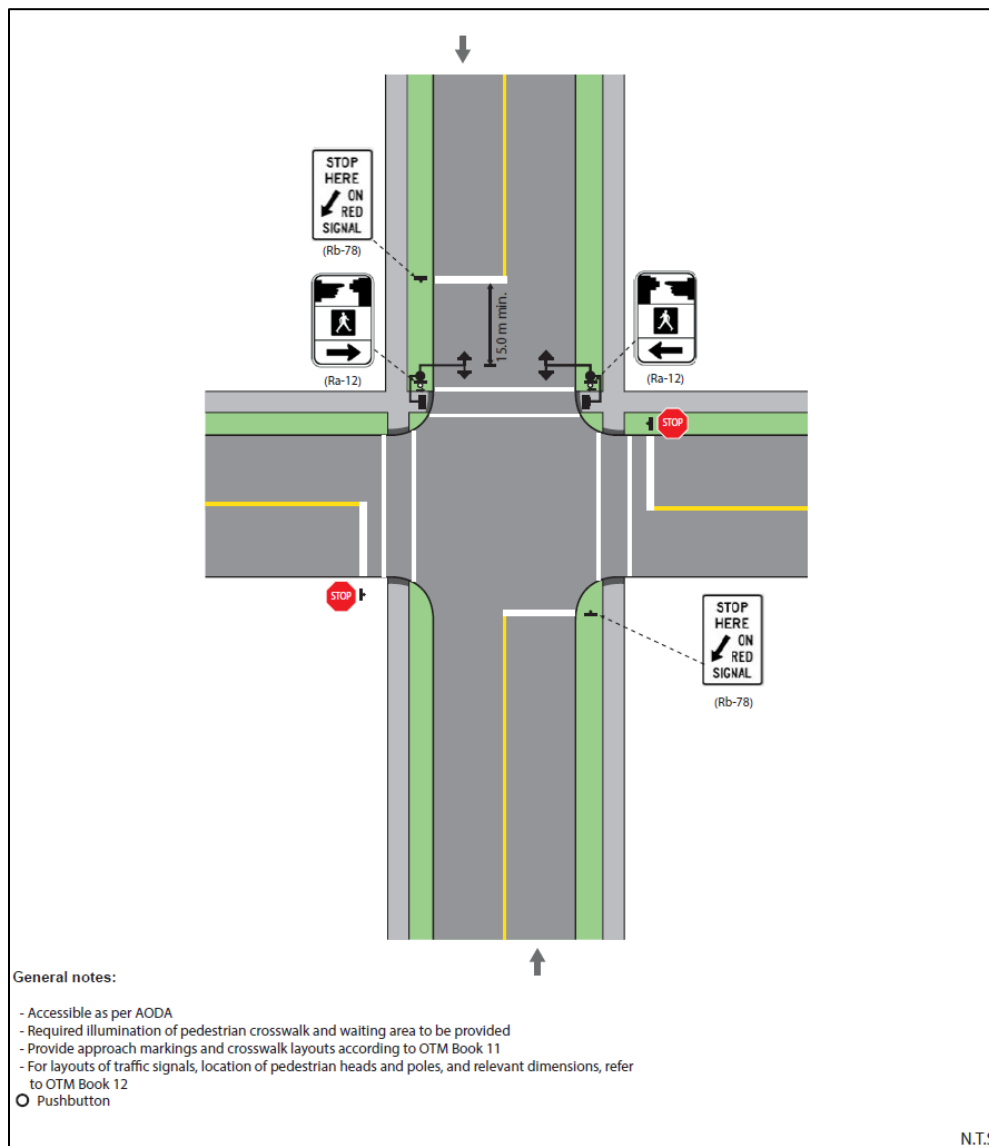
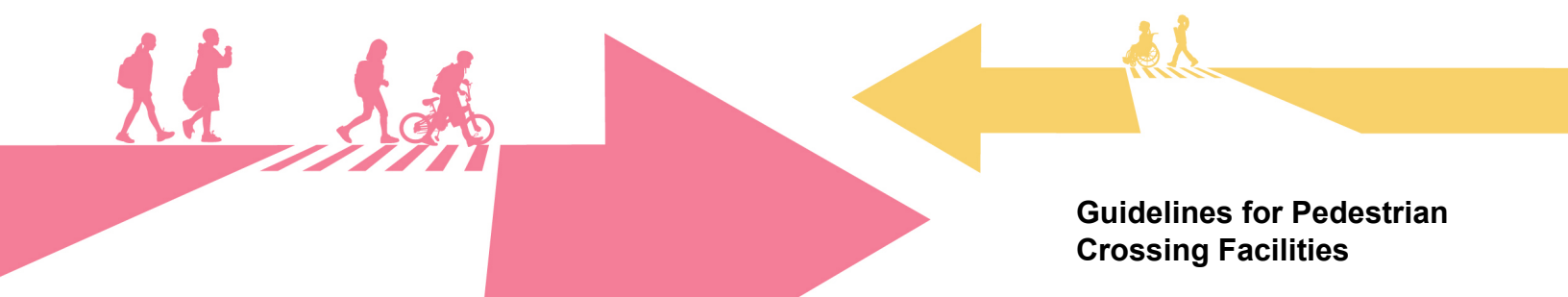


Figure 7: IPS Pedestrian Crossing Treatment for 2-lane, 2-way Roadways (Source: OTM Book 15)



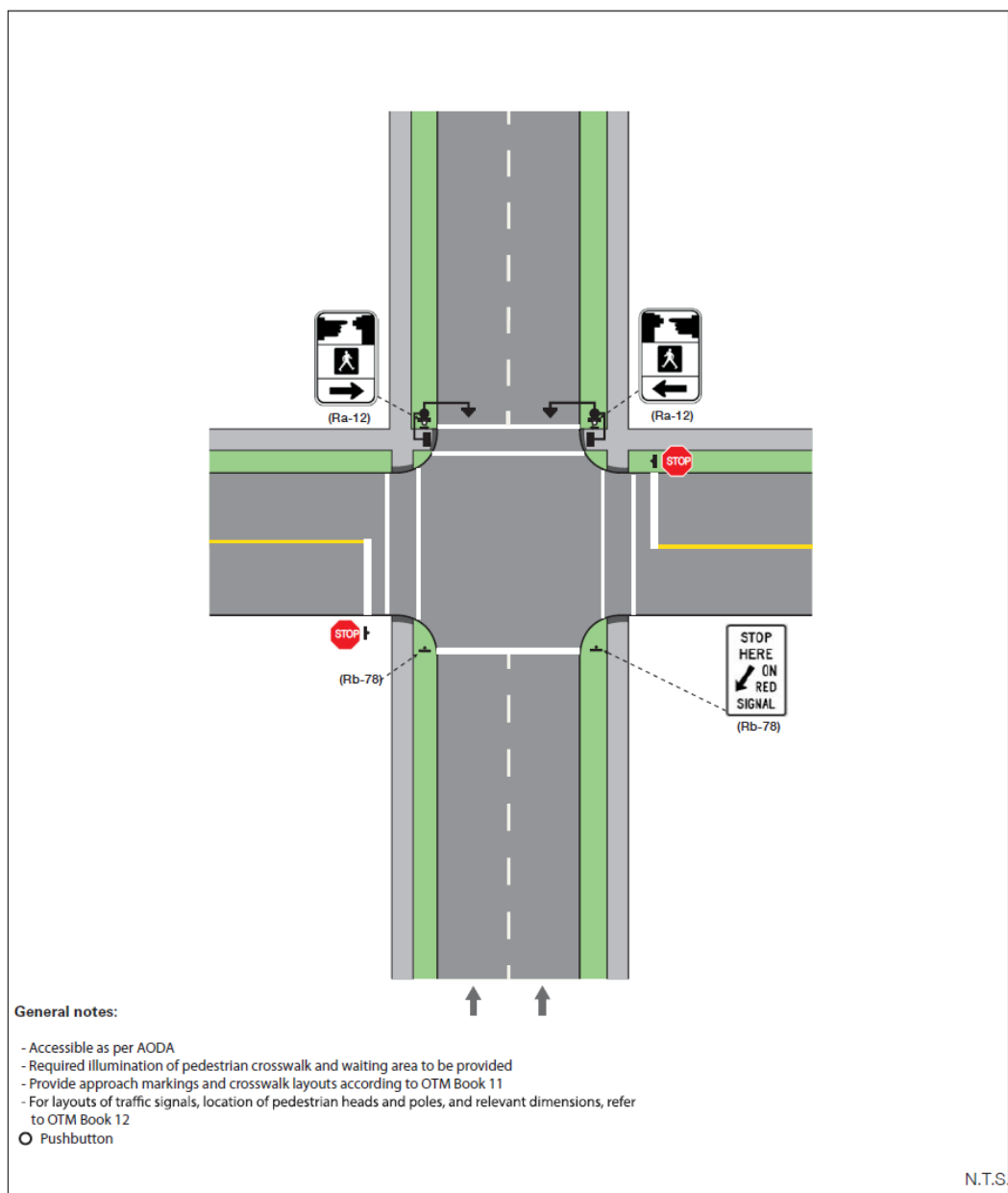
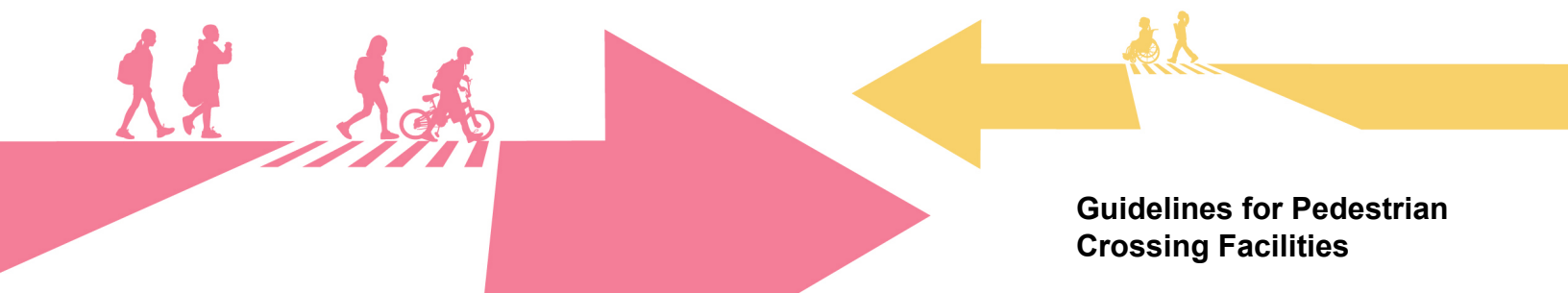


Figure 8: IPS Pedestrian Crossing Treatment for 2-lane, 1-way Roadways (Source: OTM Book 15)



Mid-block Pedestrian Signal (MPS)

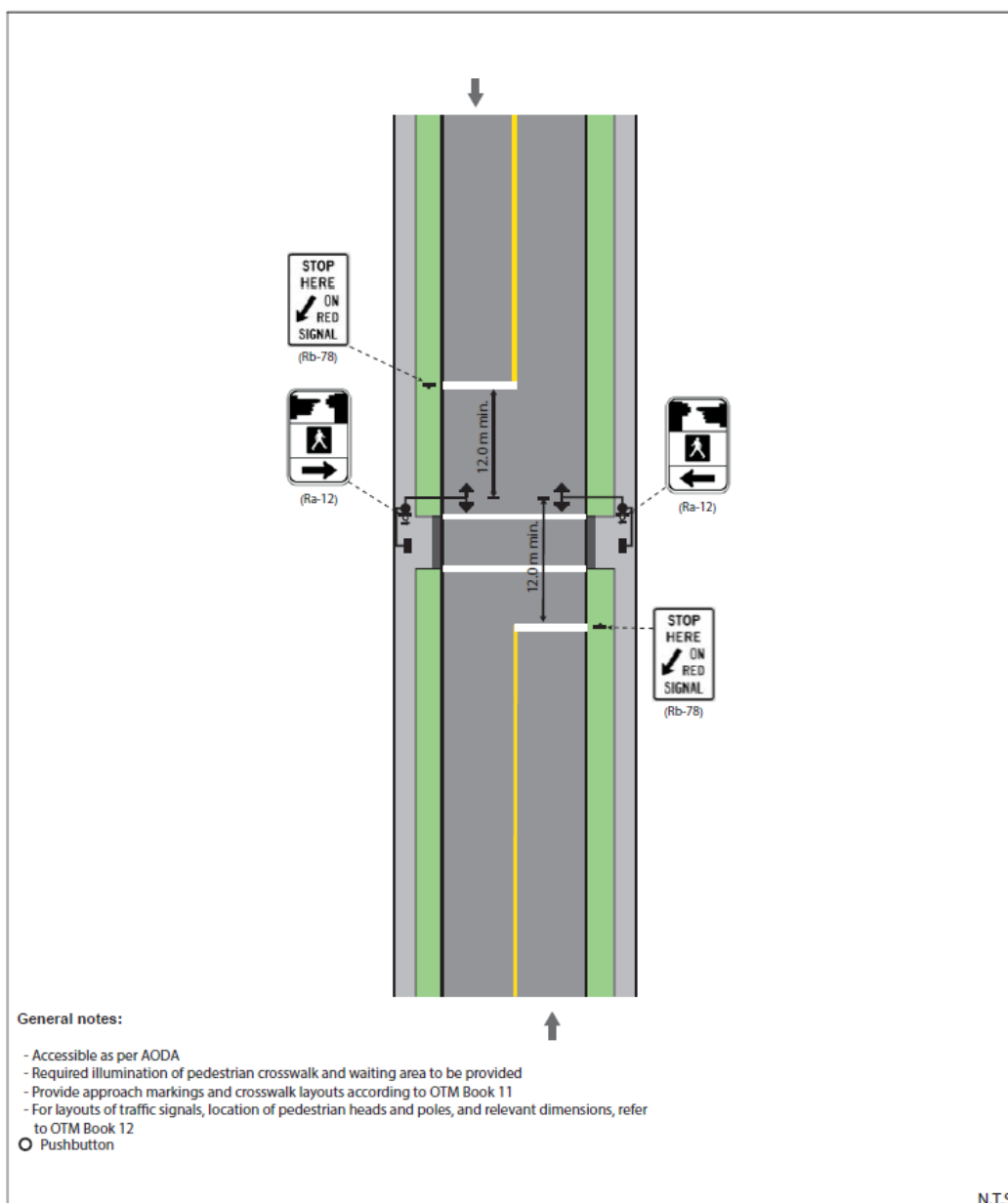
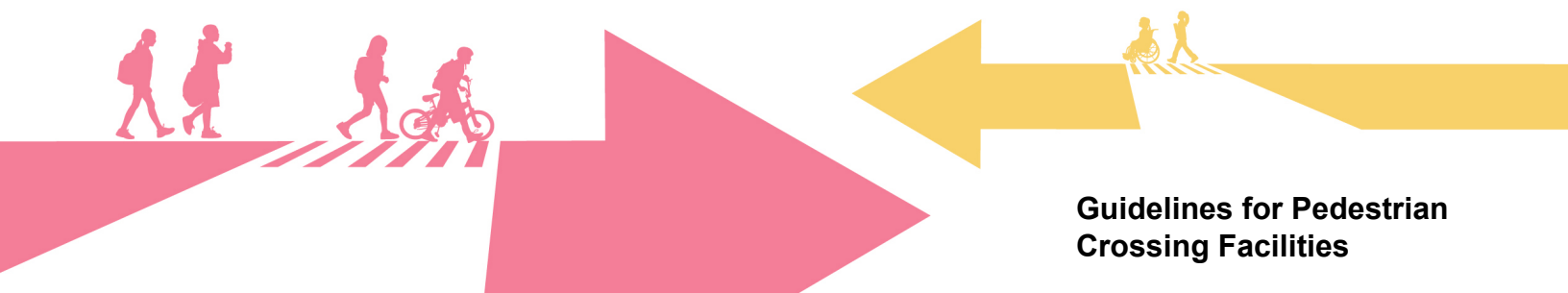


Figure 9: MPS Pedestrian Crossing Treatment for 2-lane, 2-way Roadways (Source: OTM Book 15)



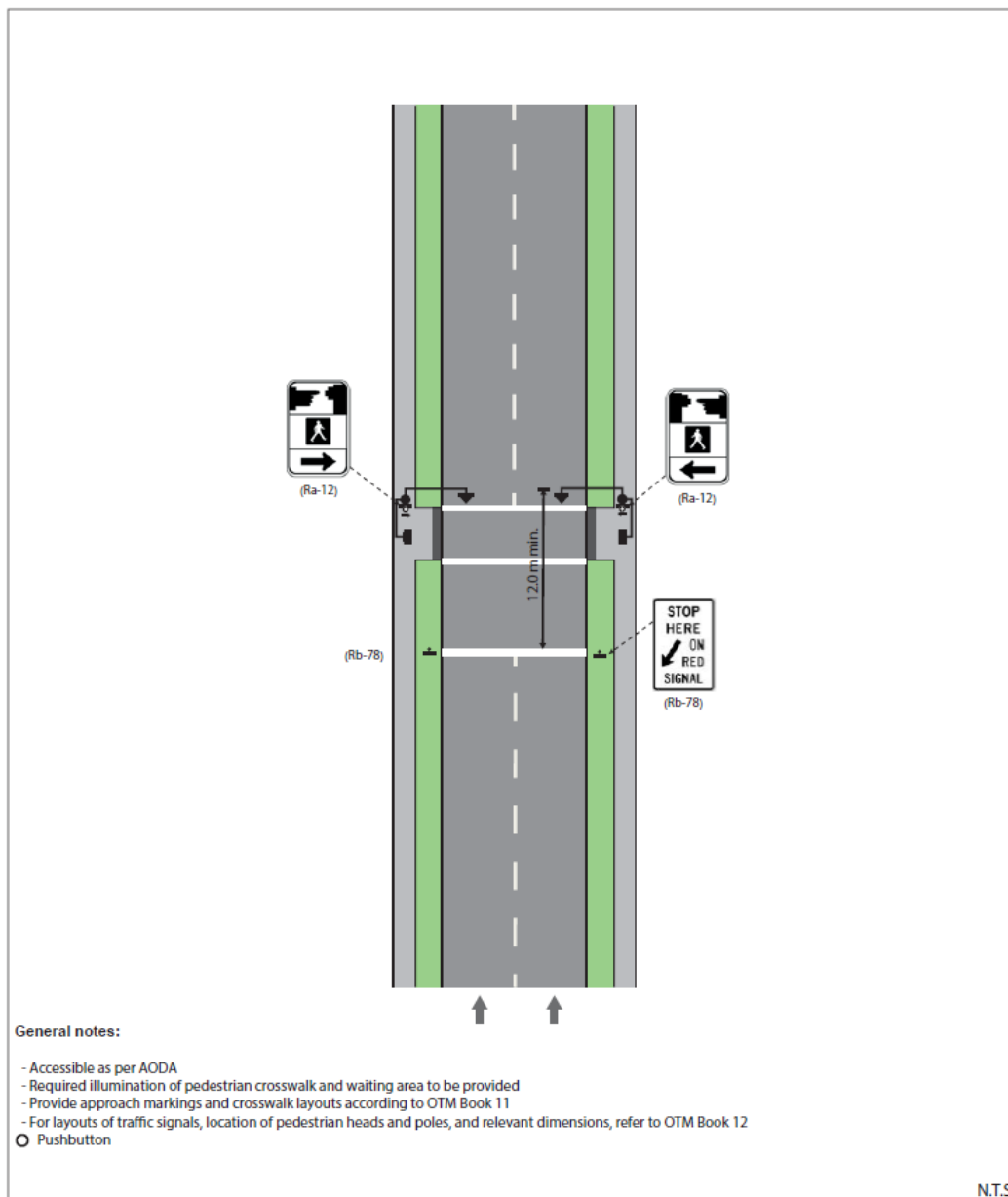
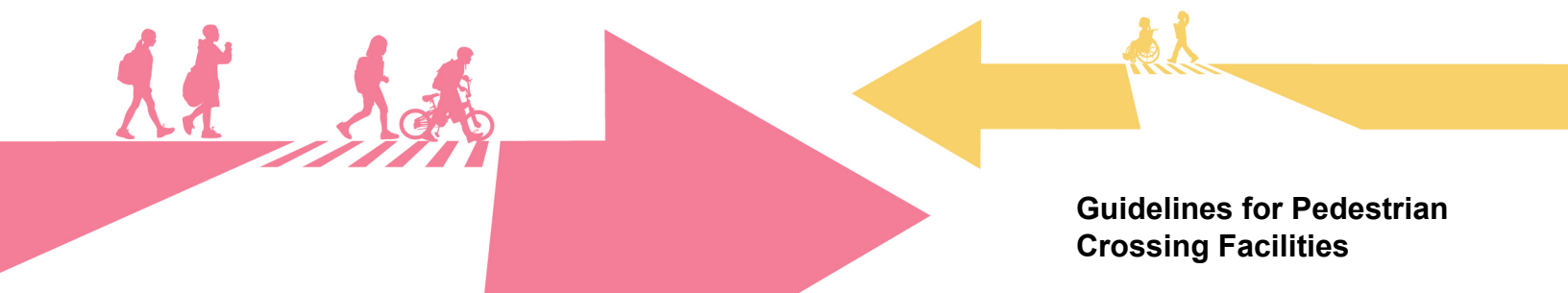


Figure 10: MPS Pedestrian Crossing Treatment for 2-lane, 1-way Roadways (Source: OTM Book 15)

4.1.8 Accessibility

As per OTM Book 15, treatments to enhance accessibility applicable to IPS and MPS include curb ramps, depressed curbs, and accessible pedestrian signals (APS).



When curb ramps and depressed curbs are provided at pedestrian crossings, they must have tactile walking surface indicators that have raised tactile profiles and a high tonal contrast with the adjacent surface as well.

APS devices must include both audible and vibro-tactile walk indicators to effectively communicate information in a non-visual format to provide cues for pedestrians with visual and/or hearing impairments at both ends of a crossing. APS devices that have speakers mounted in, on, or near pedestrian pushbuttons emit a sound such as a birdcall (typically cuckoo and chirp) during the WALK interval. The sound emitted by APS devices must be capable of being heard above ambient traffic noise.

Pedestrian walking speeds must also be considered when designing accessible pedestrian crossing facilities using the guidance from OTM Book 15.

However, the City must use standard practice in their own jurisdiction and engineering judgment to determine whether the walking speed values provided above should be used to calculate only the clearance interval or the entire duration of the walk and clearance phases.

Further details on designing for accessibility can be found in OTM Book 15 – Pedestrian Crossing Treatments.

4.2 Level 2 Type B PXO

4.2.1 Important Considerations

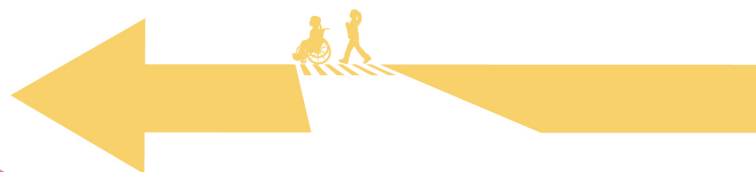
- Side streets must be stop controlled if a PXO is installed at an intersection.
- If cyclists are expected to be present in the area, proper guidance should be provided to inform cyclists that they must dismount when crossing the roadway at a dedicated pedestrian crossing.
- Location of poles – Poles with pushbuttons should be placed in such a way so that they can be accessible by pedestrians, including those using assistive devices (i.e. wheelchair users). Poles should not be placed in the sidewalk and should ideally be located within the boulevard or behind the sidewalk. Further details are provided in **Section 4.2.6**.
- Connectivity to sidewalks/trails – Pedestrian crossing facilities should be preferably located where there is a continuous sidewalk and/or a nearby trail network.
- Parking and no stopping restrictions – According to OTM Book 15, stopping must be prohibited for a minimum of 15 m on each approach to the crossing, and 10 m following the crossing. Further details are provided in **Section 4.2.4**.
- Location of transit stops – The crosswalk location will need to be coordinated with any existing transit stops. There may be situations where transit stops in the vicinity of the crossing may need to be relocated to comply with parking and no stopping restrictions.



- Refuge islands – At some locations where the roadway width is wide and the crossing time may be significant, consideration could be given to provide a refuge island for pedestrians' safety who may not be able to cross the street in a single activation of RRFBs.
- Demography of surrounding area – The demography near the pedestrian crossing should be identified to determine the most appropriate pedestrian walking speed that will be used calculate the required crossing time. Further details are provided in **Section 4.2.8**.
- General utilities (i.e. fire hydrants, hydro poles) – the design process should review and consider the presence of existing utilities for potential conflicts, and coordinate with the utility companies as may be required. Further details are provided in **Section 4.2.6**.
- Auxiliary lanes (left/right-turn lanes) – If a pedestrian crossing is being considered at a location where left/right-turn lanes are present, an operational analysis may need to be conducted to determine an appropriate storage length for the auxiliary lane(s) to ensure that there is enough available storage length to accommodate left/right-turning vehicles when pedestrians are occupying the crosswalk.
- Source of power – PXOs are typically powered by solar cells, but illumination poles require access to electrical power. Further details are provided in **Section 4.2.6**.
- Proximity to driveways – Ensure that no driveways are present between the crosswalk and the yield to pedestrians line because the presence of a driveway may result in sudden movements by exiting drivers if vehicles are stopped while waiting for pedestrians to cross.
- Proximity to pedestrian crossings – According to OTM Book 15, PXOs should not be installed within 200 m of other signal-protected pedestrian crossings. There may be a desire to have pedestrian crossings at locations that do not meet these requirements. Under these situations, an operational analysis should be conducted to evaluate any vehicle queues' impact on the crossing.
- Sightlines – Sight triangles for side street traffic waiting at the stop sign must be clear and should not be obstructed by vegetation, on-street parking, buildings, fences, etc. The visibility of all signs and RRFBs at the crossing should be confirmed for road users. Sight distance requirements are detailed in TAC's Geometric Design Guide for Canadian Roads.

4.2.2 Illumination Levels

If the roadway approaching the mid-block crosswalk is illuminated, the roadway's horizontal luminance levels must meet or exceed the recommended levels defined in Section 9.5.1 of TAC's Roadway Lighting Guide. Additionally, the vertical luminance levels of crosswalks at a height of 1.5 m must be 20 lux for areas with low pedestrian conflict (less than 11 pedestrians per hour), 30 lux for areas with medium pedestrian conflict (11 to 99 pedestrians per hour), and 40 lux for areas with high pedestrian conflict (100 or more pedestrians per hour).



Full design procedures for mid-block crosswalk illumination, including horizontal and vertical illuminance calculations, equipment selection, and pole layout, are detailed in TAC's Roadway Lighting Guide.

4.2.3 Rectangular Rapid Flashing Beacon (RRFB) Placement

As per OTM Book 15, rapid rectangular flashing beacons (RRFB) are used for the main roadway in each direction of travel for a Type B PXO. RRFBs must be activated manually by pushbuttons, which are required for the crossing. RRFBs consist of two rectangular yellow indications with two tell-tale end indicators to inform pedestrians that the beacon is flashing. The RRFB must be installed on the same support as the associated side-mounted pedestrian crossover sign (see **Section 4.2.7** for further details). A RRFB shall not be used where the crosswalk is controlled by yield signs, stop signs, or traffic control signals. Additionally, the side road must be controlled with stop signs if a Type B PXO is installed at an intersection.

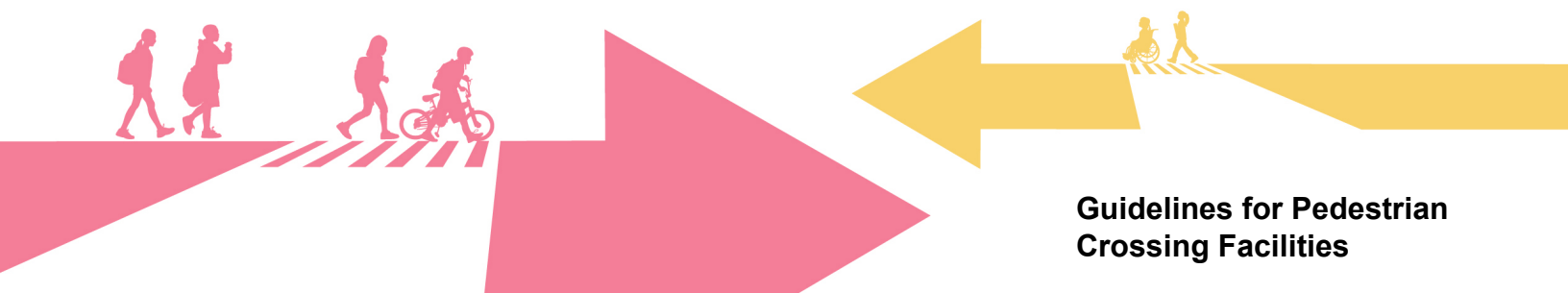
Each RRFB indication shall be a minimum of 125 mm wide and 50 mm high. The two RRFB indications shall be aligned horizontally, with the longer dimension horizontal and with a minimum space between the two indications of 175 mm, measured from inside edge of one indication to the inside edge of the other indication.

4.2.4 Level 2 Type B PXO Components and Restrictions

As per OTM Book 15 (unless otherwise stated), the minimum required components and desired components for a Type B PXO are as follows:

Minimum Required Components:

- Side-mounted pedestrian crossover signs, showing a symbol of a person crossing on a road (Ra-5R and Ra-5L), together with their Stop for Pedestrians (Ra-4t) tabs, on both sides of the road mounted back to back (For one-way applications, Stop for Pedestrians tab is required only for the direction of travel)
- One over-head mounted pedestrian crossover sign showing a symbol of a person crossing on a road to the right (Ra-5R), for each direction of travel
- Ladder crosswalk markings and yield to pedestrians line markings as further detailed in **Section 4.2.5**
- Actuated Double-sided Rectangular Rapid Flashing Beacon with Tell-Tale and Pedestrian Pushbutton for pedestrians mounted above each set of side-mounted pedestrian crossover signs installed at the pedestrian crossover as further detailed in **Section 4.2.3** and **Section 4.2.6**
- Advanced Pedestrian Crossover Ahead sign (Wc-27R/Wc-27L) at 50.0 m upstream of the crosswalk
- Stop sign (Ra-1) on the cross street if installed at an intersection
- Passing restrictions on single lane approaches



- Stopping prohibition for a minimum of 15 m on each approach to the crossing, and 10 m following the crossing
- Lane change prohibition on multiple lane approaches using solid white lines as further detailed in **Section 4.2.5**
- No Passing Here to Crossing sign (Ra-10) 30 m upstream of the crosswalk

Desired or Additional Considerations:

- Stopping prohibition for a minimum of 30 m on each approach to the crossing, and 15 m following the crossing.
- Curb extensions to reduce pedestrian crossing distance, either through curb work or through use of flexible bollards
- Consider use of a flexible centreline bollard to bring additional awareness to the crossing
- Raised crosswalk may be considered in some applications to reduce vehicle speeds and improve pedestrian visibility (applicability of this element would need to be reviewed for the crossing location)

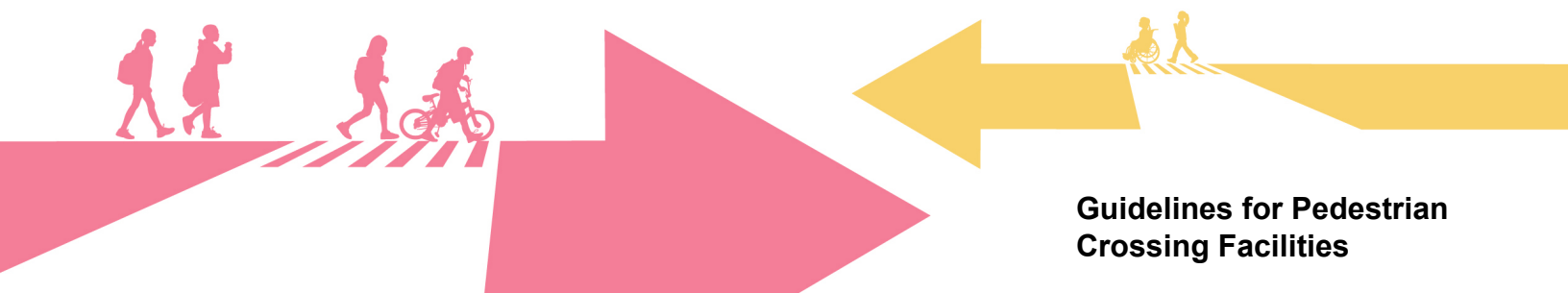
Details regarding sign location criteria for the aforementioned minimum required components and desired components can be found in OTM Book 5 – Regulatory Signs and OTM Book 6 – Warning Signs. Horizontal and vertical mounting offsets for signs can be found in OTM Book 1B – Sign Design Principles.

4.2.5 Pavement Markings

As per OTM Book 15, ladder crosswalk markings and yield to pedestrians line markings are required components for a Type B PXO.

Crosswalk lines must be solid white parallel retro reflective lines 10 cm to 20 cm wide that extend entirely across the pavement. The crosswalk width must be at least 2.5 m wide, but widths of 3 m to 4 m are typical in urban areas with higher levels of pedestrian activity. The outer edge of ladder crosswalks must be located at a distance of 6.0 m from the yield to pedestrians line. Crosswalks should line up with any proposed sidewalks or dropped curbs.

Figure 11 illustrates typical ladder crosswalk markings.



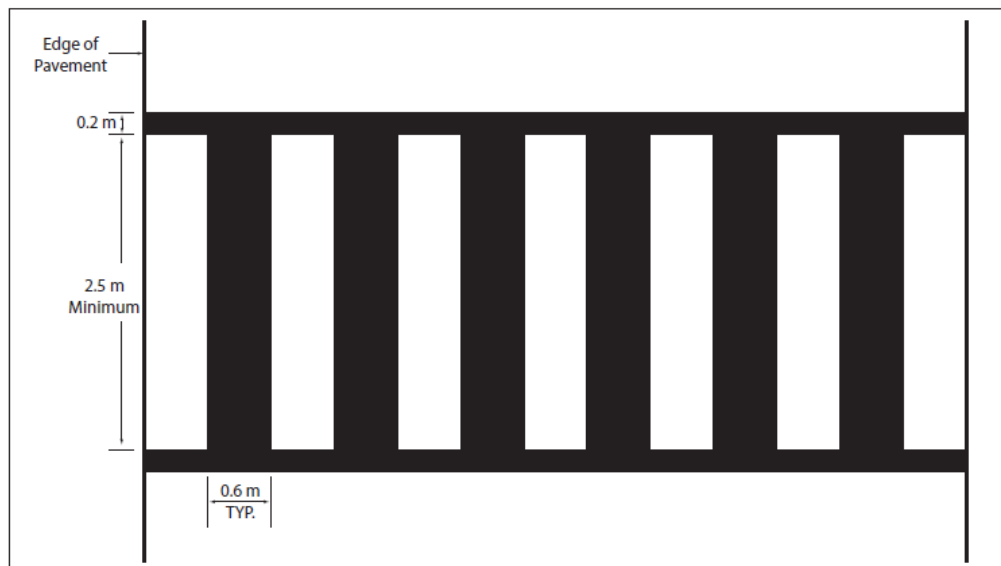


Figure 11: Pavement Markings for a Typical Ladder Crosswalk

A yield to pedestrian line must be located at a distance of 6.0 m in advance of the crosswalks in the direction of travel. **Figure 12** illustrates the specifications for a yield to pedestrians line.

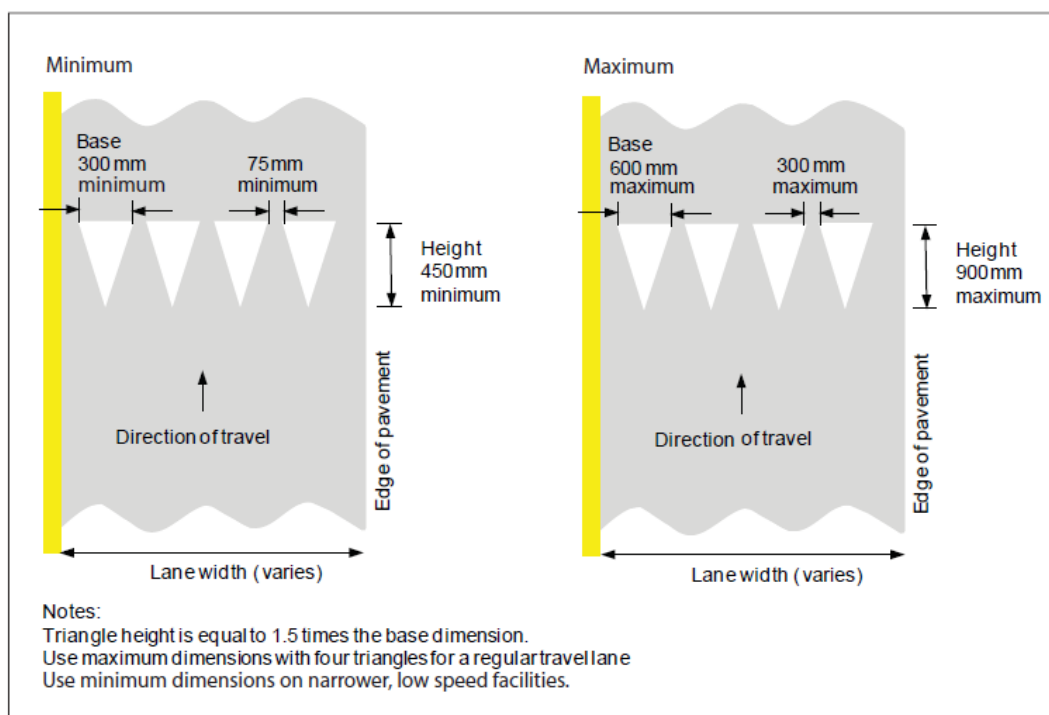
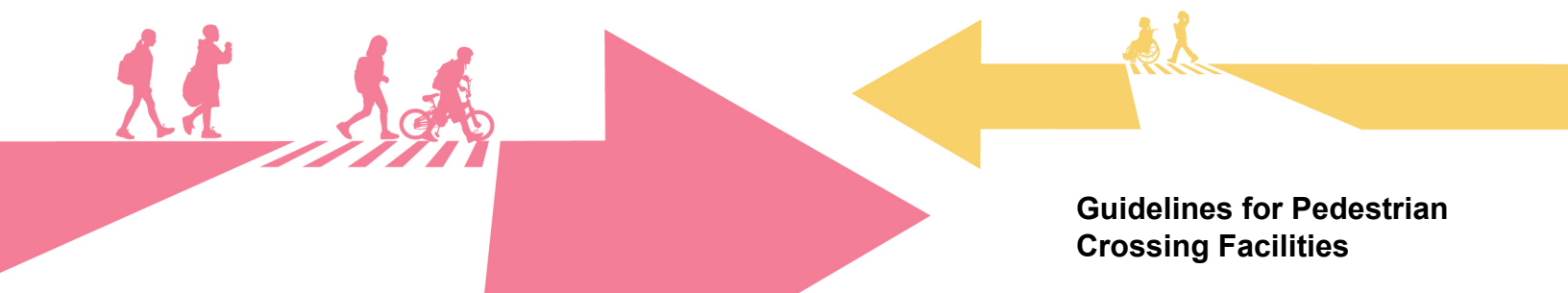


Figure 12: Specifications for Yield to Pedestrians Line



Lastly, solid white lines must be painted on road approaches with multiple lanes to prohibit lane changes within 30 m of the crosswalk.

Section 4.2.7 provides illustrations of installation details for a typical Type B PXO that indicate the recommended placement of pavement markings for various applicable environments.

4.2.6 Infrastructure

Pedestrian Crossover Signs with Pedestrian Pushbuttons and Rectangular Rapid Flashing Beacons¹³

The side-mounted pedestrian crossover signs should be placed at approximately 2.0 m from the face of the curb with a minimum of 0.30 m and a maximum of 4 m. They should be placed in such a way that they should not obstruct any pedestrian movements including those using assistive devices (i.e. wheelchair users), and not be installed within the sidewalk. The overhead pedestrian crossover signs are typically installed at a minimum height of 4.5 m (measured from the crown of the roadway to the bottom of the sign) aligning with the centre of the travel lane.

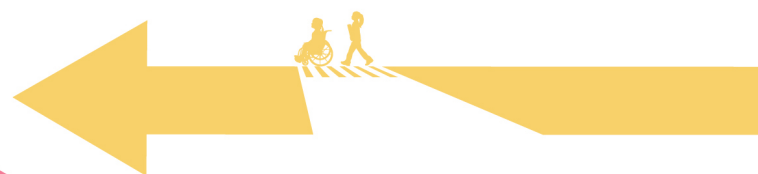
Like traffic signals, the Type B PXO infrastructure elements are installed on traffic poles. The selection of the location of poles will require the designer to consider utility clearances, aesthetic requirements, and mast arm length restrictions. An ideal location could be within the flare of the curb ramp.

Pedestrian pushbuttons should preferably be mounted on the same poles on which the side-mounted pedestrian crossover signs are installed. However, if it is not possible to place the traffic pole close to the crosswalk due to any physical constraints, a separate small pole just for pushbuttons may be used. The pushbuttons should be installed on the “through sidewalk” side of the sign at a height of 1.1 m (+/- 0.15 m) above finished grade. The pushbuttons should be in line, not perpendicular, with the crosswalk and if possible, pushbuttons should be aligned with the nearest edge of the crosswalk. It is important to ensure that the poles with pushbuttons are accessible and user friendly (i.e. not located behind barriers, grassy/muddy areas, or areas where snow windrows may occur).

As detailed previously in **Section 4.2.3**, actuated double sided rectangular rapid flashing beacons with tell-tale must be installed above each set of side-mounted pedestrian crossover signs.

Typically, a solar power unit is installed on the top of each side-mounted pedestrian crossover sign to sufficiently power the pushbutton and rectangular rapid flashing beacons (this configuration is used by many major jurisdictions).

¹³ Ontario Traffic Manual Book 15 – Pedestrian Crossing Treatments, June 2016



Illumination Poles¹⁴

When designing illumination for PXOs, the existing available illumination should be checked where the crosswalk is proposed. If illumination levels do not meet requirements, the designer may investigate whether simply changing the luminaires is enough to meet the illumination requirements.

If it is necessary to install new illumination poles, the lighting can be installed on the same poles as the rest of the PXO infrastructure or it can be installed on separate poles as necessary as per site conditions and based on the type of PXO. The recommended placement of illumination poles for PXOs are the same as for traffic signals in **Section 4.1.6**.

Utilities¹⁵

It is important to check the location of existing utilities (i.e. hydro, fibre optic cable, watermain, etc.) when selecting suitable locations for poles. The design process should review and consider the presence of existing utilities for potential conflicts, and coordinate with the utility companies as may be required.

Considerations regarding utility placement for PXOs are the same as for traffic signals in **Section 4.1.6**.

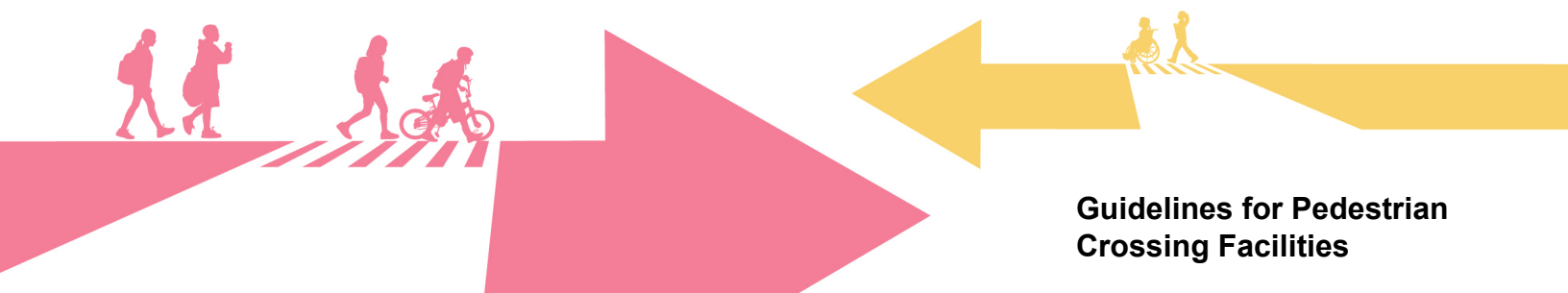
4.2.7 Layout

The following figures from OTM Book 15 illustrate the typical installation layouts for a Type B PXO for the following applicable environments:

- Midblock: up to 4 lanes total cross-section, 2-way
- Midblock: up to 3 lanes total cross section, 1-way
- Intersection: up to 4 lanes total cross-section, 2-way
- Intersection: up to 3 lanes total cross-section, 1-way

¹⁴ Transportation Association of Canada – Roadway Lighting Guide, January 2006

¹⁵ Ontario Traffic Manual Book 12 – Traffic Signals, March 2012



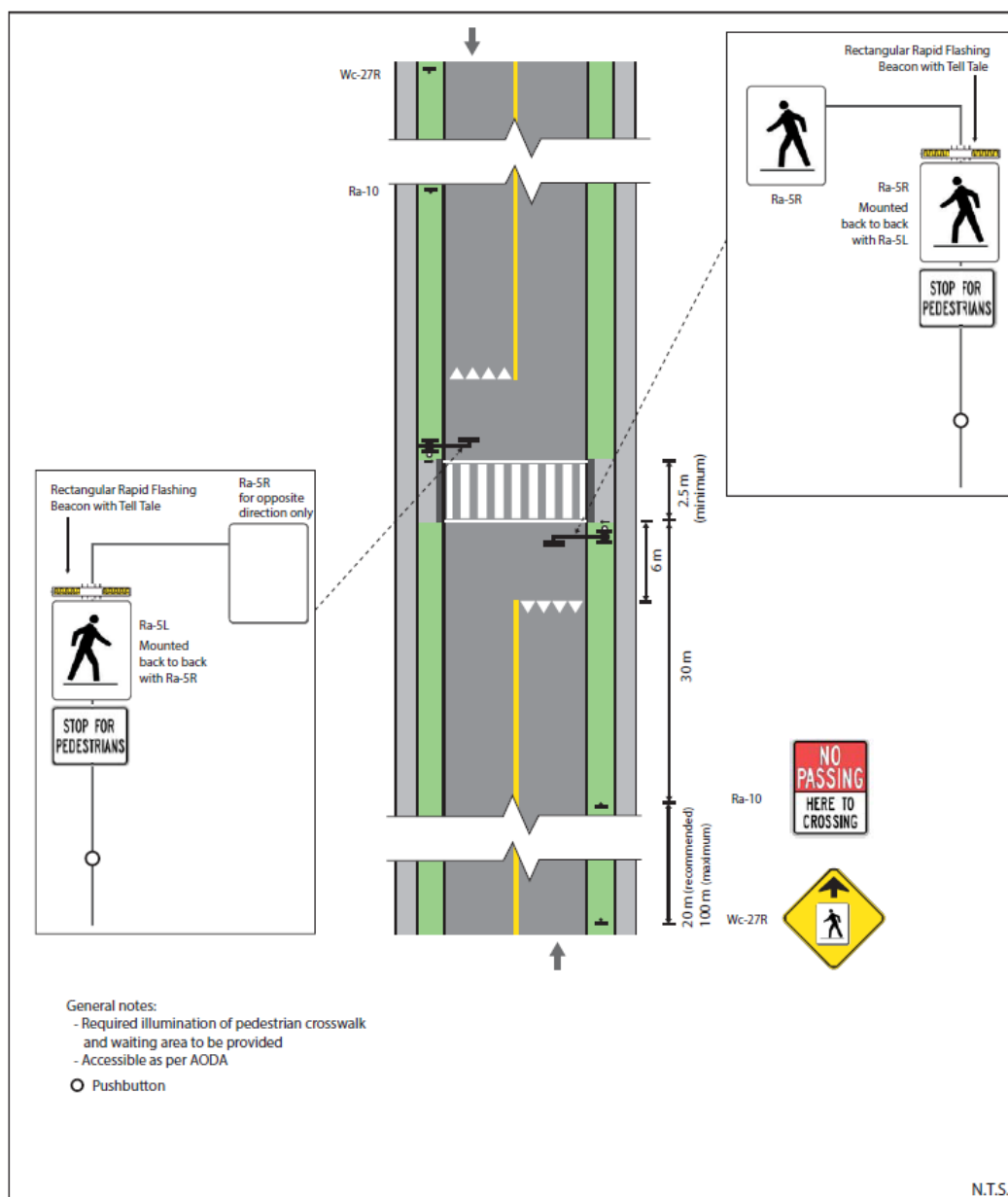
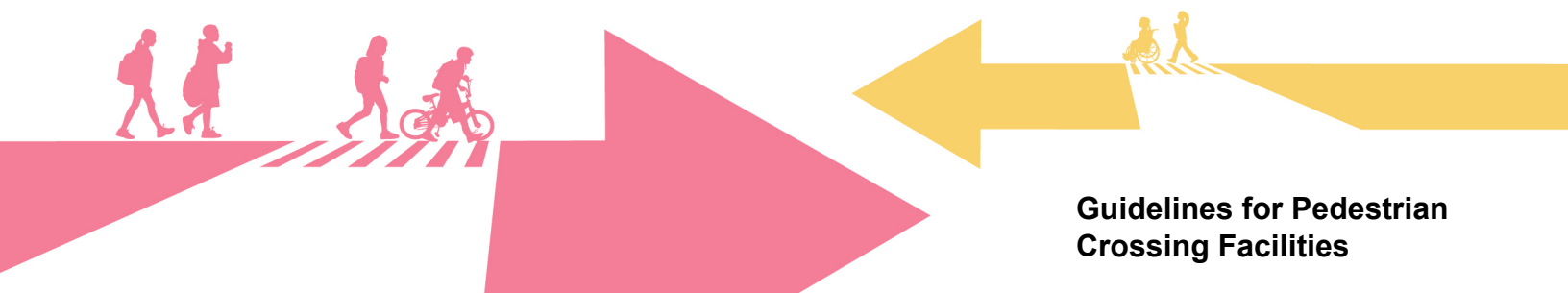


Figure 13: Level 2 Type B PXO Midblock Treatment for 2-lane, 2-way Roadways (Source: OTM Book 15)



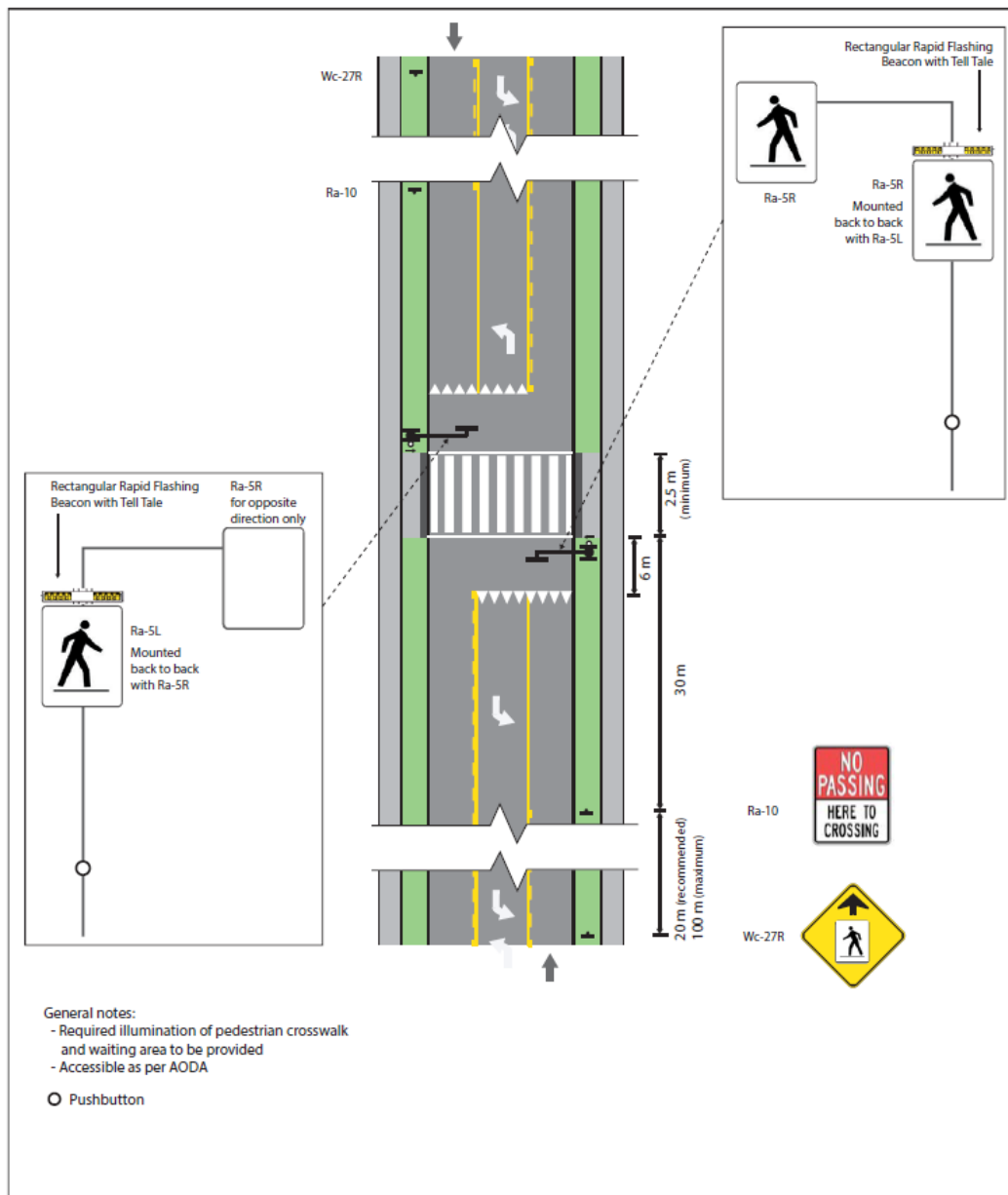
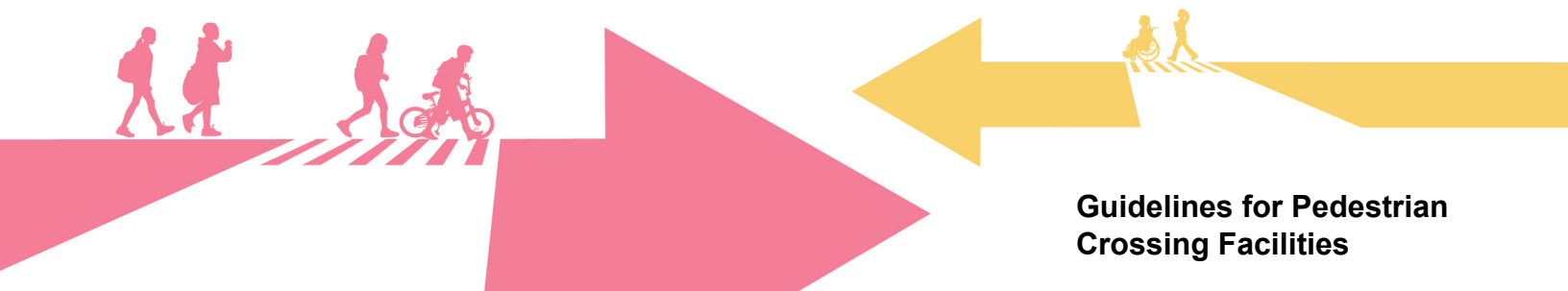


Figure 14: Level 2 Type B PXO Midblock Treatment for 3-lane with centre 2-way left-turn lane Roadways (Source: OTM Book 15)



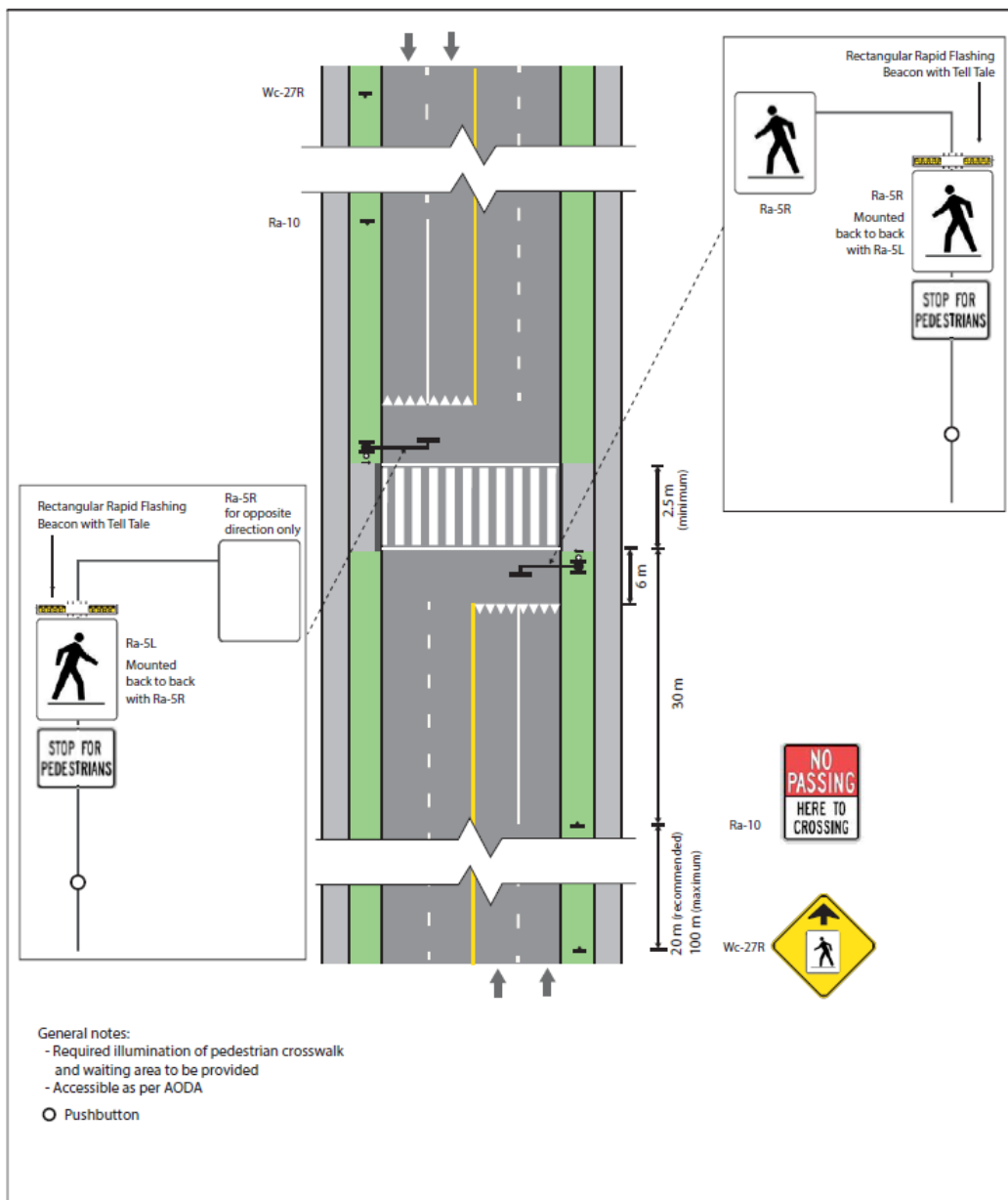
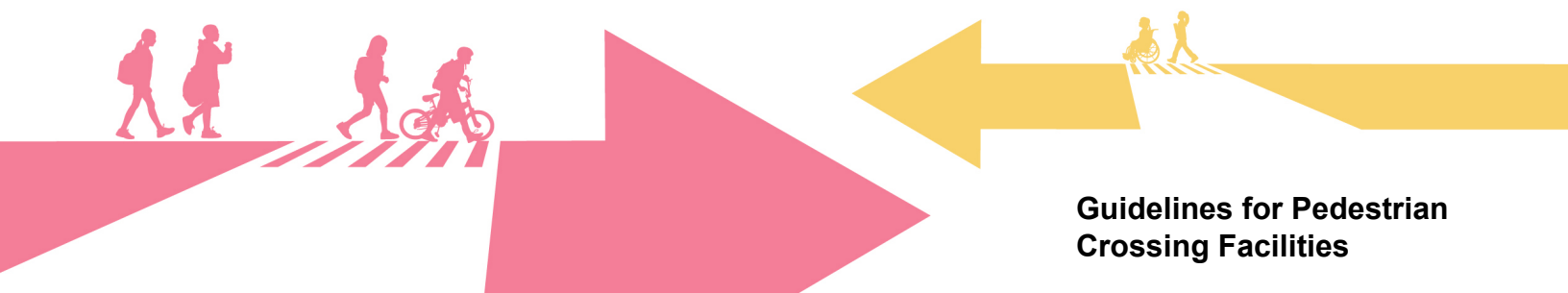


Figure 15: Level 2 Type B PXO Midblock Treatment for 4-lane, 2-way Roadways (Source: OTM Book 15)



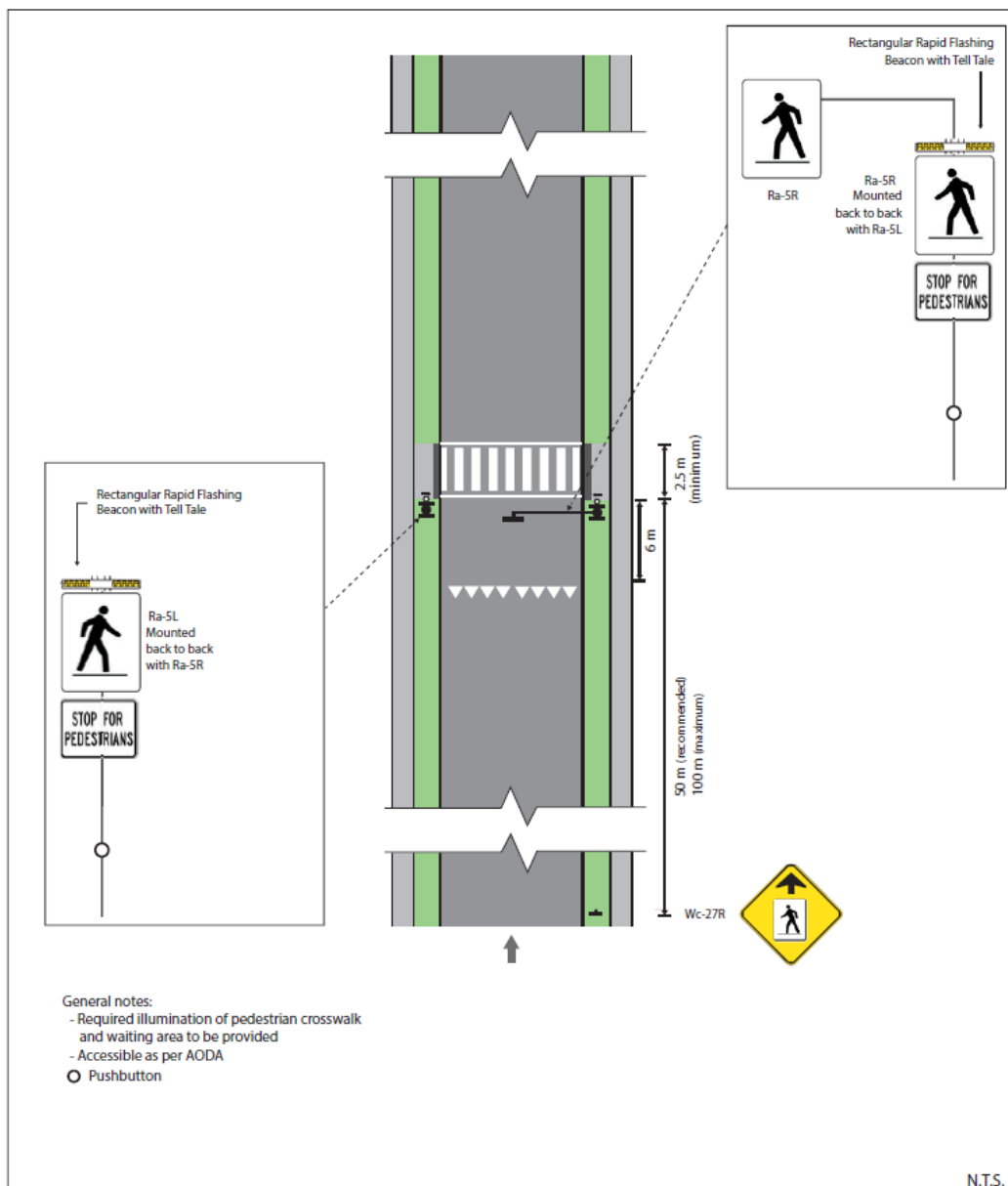
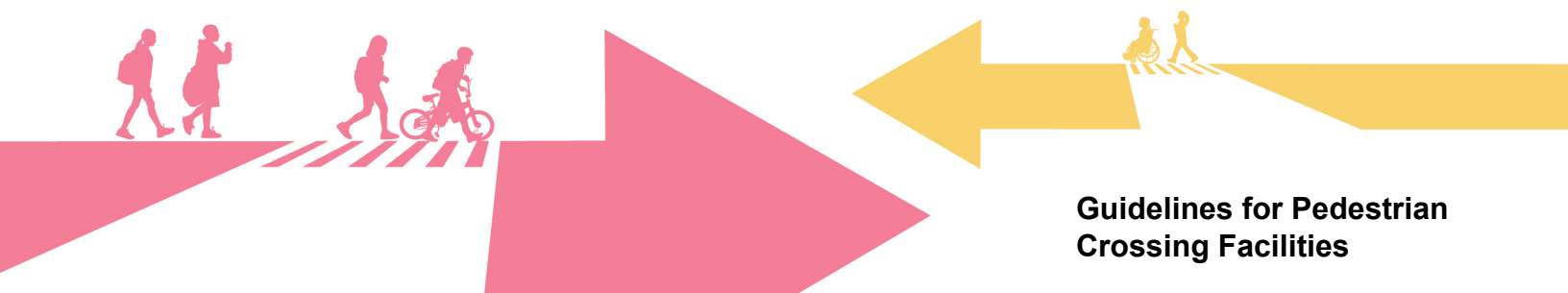


Figure 16: Level 2 Type B PXO Midblock Treatment for 1-lane, 1-way Roadways (Source: OTM Book 15)



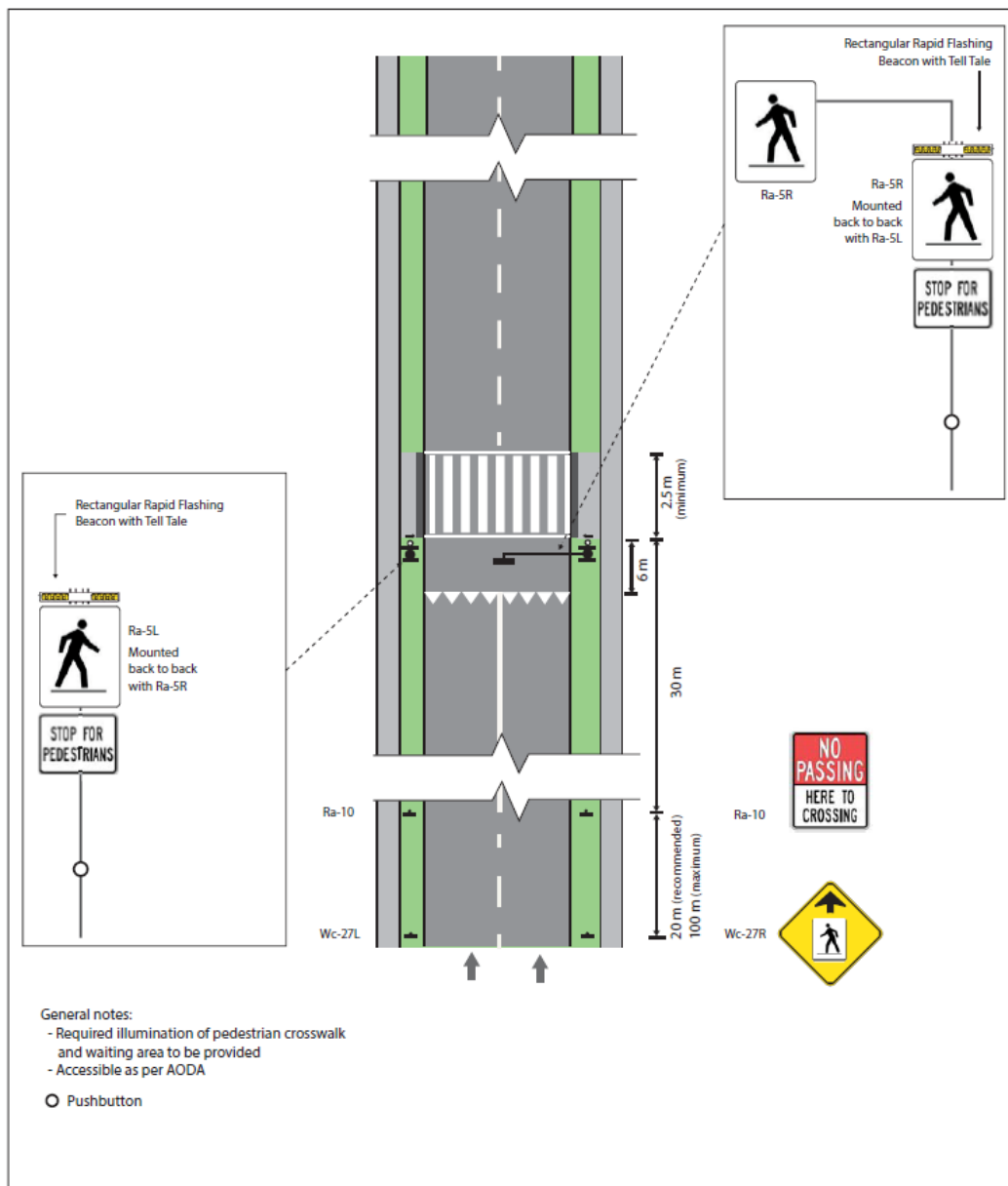
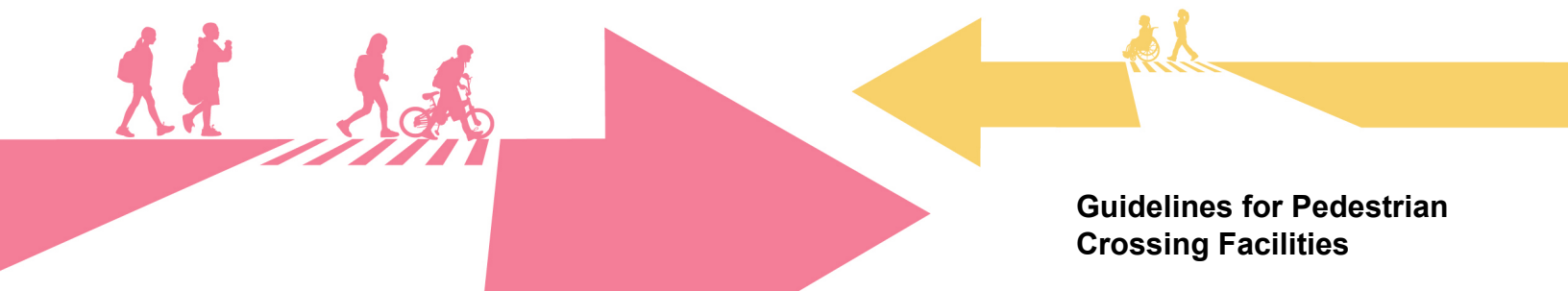


Figure 17: Level 2 Type B PXO Midblock Treatment for 2-lane, 1-way Roadways (Source: OTM Book 15)



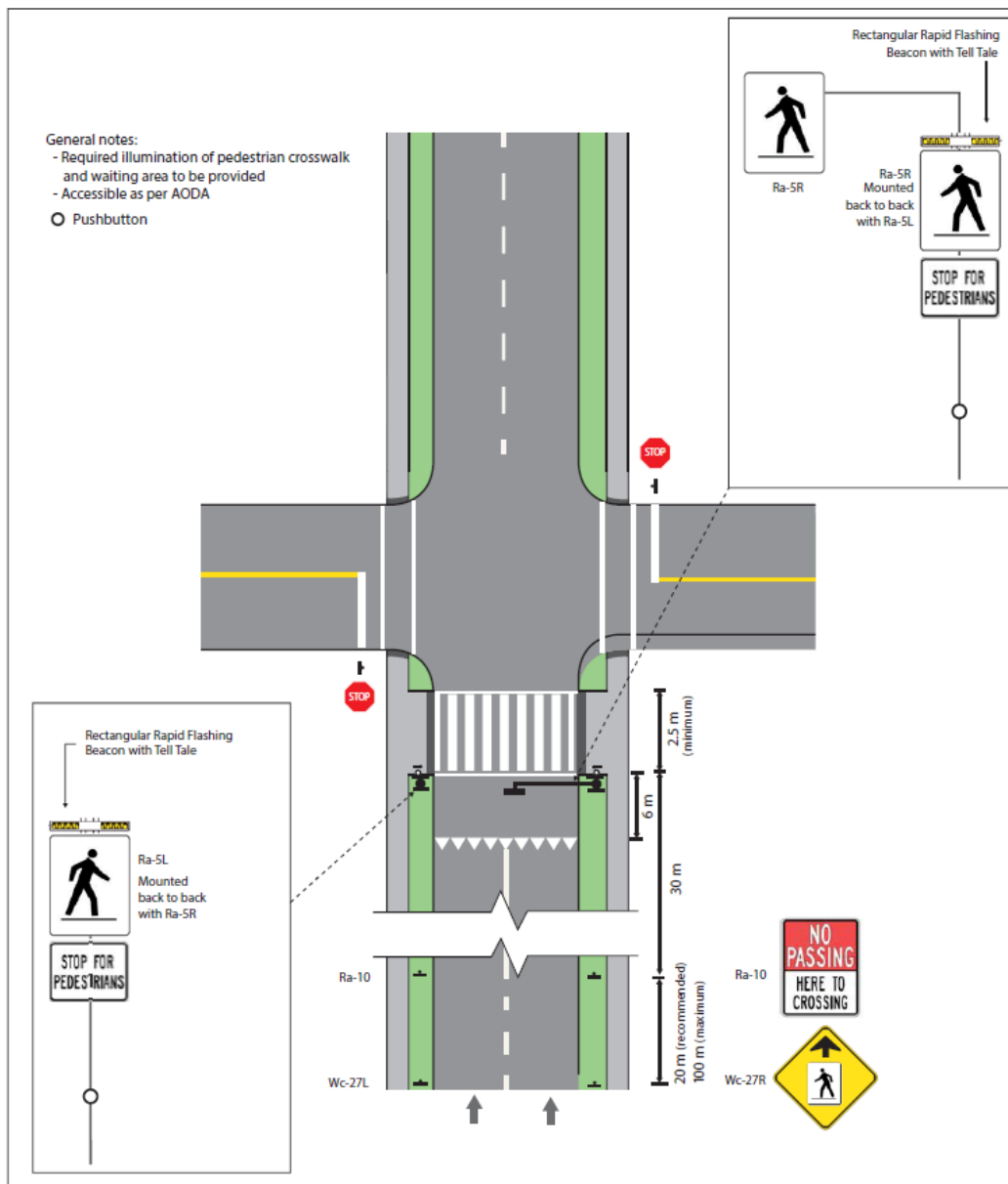
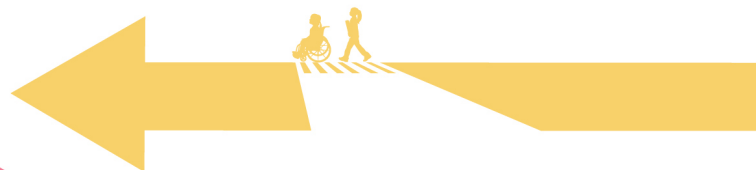


Figure 18: Level 2 Type B PXO Treatment at Intersection for 1-way Roadways (Source: OTM Book 15)



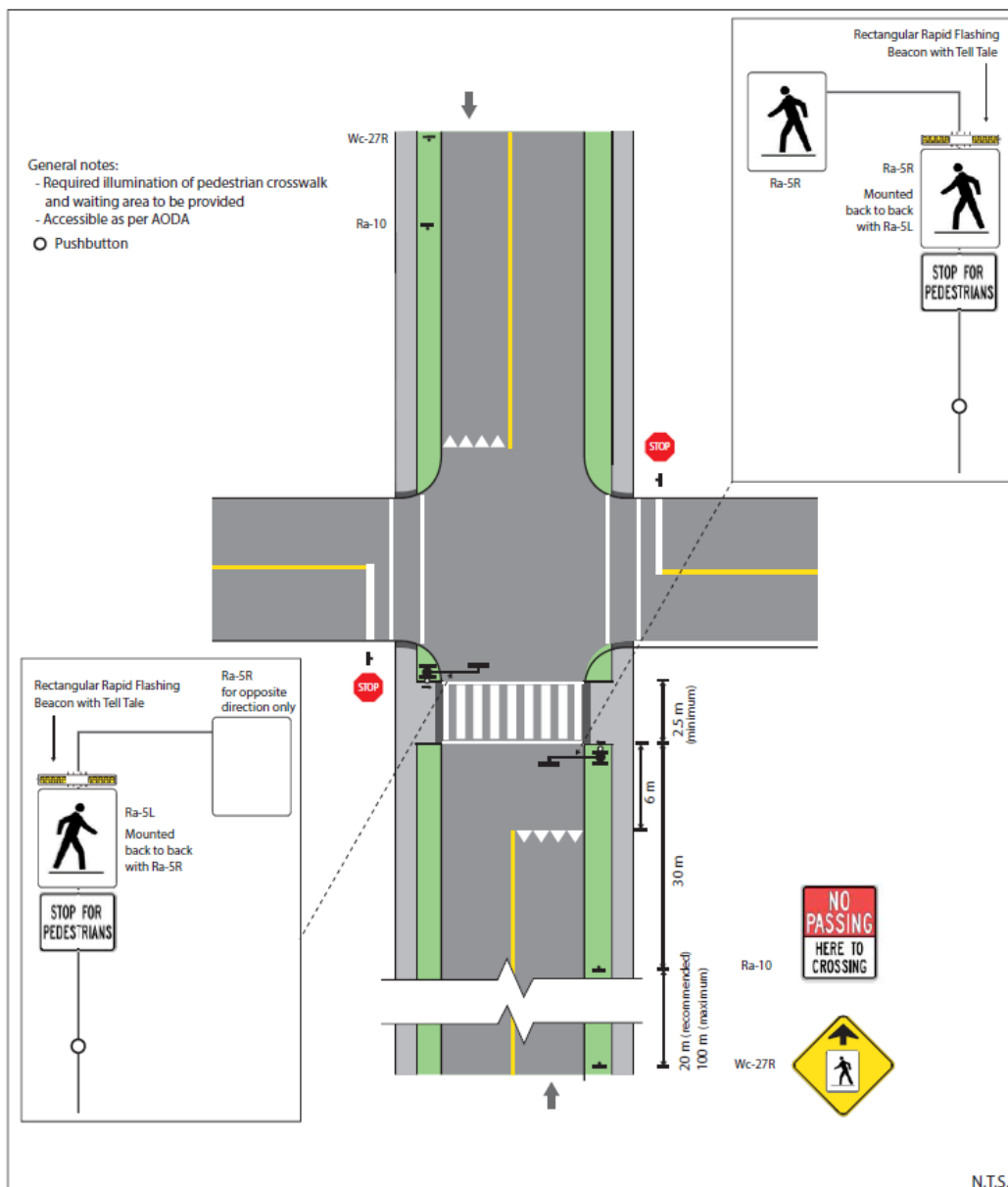


Figure 19: Level 2 Type B PXO Treatment at Intersection for 2-way Roadways (Source: OTM Book 15)

4.2.8 Accessibility

As per OTM Book 15, treatments to enhance accessibility applicable to Type B PXOs include curb ramps and depressed curbs.



Guidelines for Pedestrian Crossing Facilities

When curb ramps and depressed curbs are provided at pedestrian crossings, they must have tactile walking surface indicators that have raised tactile profiles and a high tonal contrast with the adjacent surface as well.

Pedestrian walking speeds must also be considered when designing accessible pedestrian crossing facilities using the following guidance from OTM Book 15 and outlined in **Section 4.1.8**. However, the City must use standard practice in their own jurisdiction and engineering judgment to determine whether the walking speed values provided above should be used to calculate only the clearance interval or the entire duration of the walk and clearance phases.

The time lapse between the pushbutton activation of a RRFB and the start of flashing should be less than 1 second and no greater than 3 seconds under any circumstances. RRFBs must flash for a minimum period, determined using the following calculation:

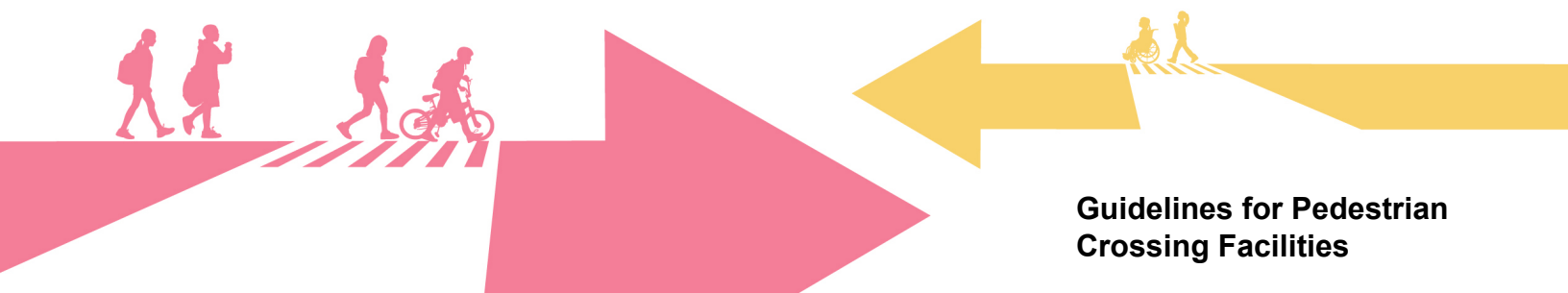
Minimum flashing time = (crossing distance / pedestrian walking speed) + 5 seconds

Further details on designing for accessibility can be found in OTM Book 15 – Pedestrian Crossing Treatments.

4.3 Level 2 Type C PXO

4.3.1 Important Considerations

- Side streets must be stop controlled if a PXO is installed at an intersection.
- If cyclists are expected to be present in the area, proper guidance should be provided to inform cyclists that they must dismount when crossing the roadway at a dedicated pedestrian crossing.
- Location of poles – Poles with pushbuttons should be placed in such a way so that they can be accessible by pedestrians, including those using assistive devices (i.e. wheelchair users). Poles should not be placed in the sidewalk and should ideally be located within the boulevard or behind the sidewalk. Further details are provided in **Section 4.3.6**.
- Connectivity to sidewalks/trails – Pedestrian crossing facilities should be preferably located where there is a continuous sidewalk and/or a nearby trail network.
- Parking and no stopping restrictions – According to OTM Book 15, stopping must be prohibited for a minimum of 15 m on each approach to the crossing, and 10 m following the crossing. Further details are provided in **Section 4.3.4**.
- Location of transit stops – The crosswalk location will need to be coordinated with any existing transit stops. There may be situations where transit stops in the vicinity of the crossing may need to be relocated to comply with parking and no stopping restrictions.
- Refuge islands – At some locations where the roadway width is wide and the crossing time may be significant, consideration could be given to provide a refuge island for



pedestrians' safety who may not be able to cross the street in a single activation of RRFBs.

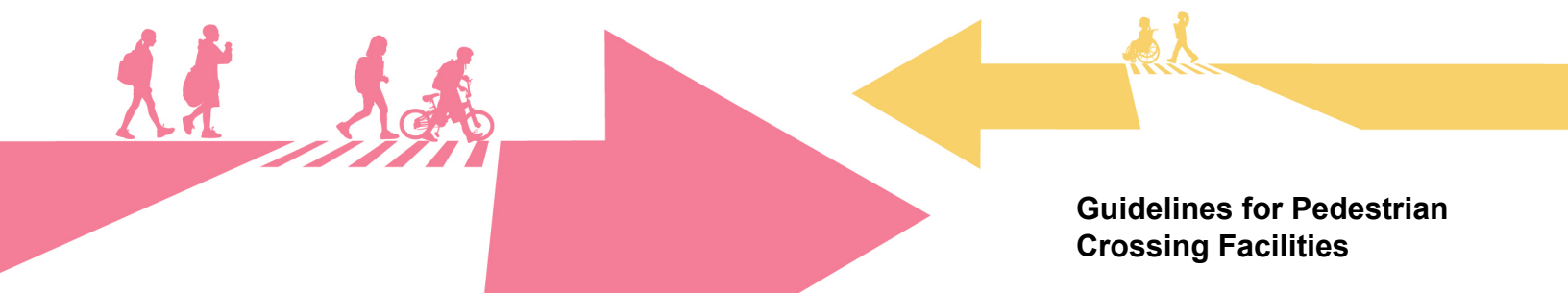
- Demography of surrounding area – The demography near the pedestrian crossing should be identified to determine the most appropriate pedestrian walking speed that will be used to calculate the required crossing time. Further details are provided in **Section 4.3.8**.
- General utilities (i.e. fire hydrants, hydro poles) – The design process should consider the presence of existing utilities for potential conflicts, and coordinate with the utility companies as may be required. Further details are provided in **Section 4.3.6**.
- Auxiliary lanes (left/right-turn lanes) – If a pedestrian crossing is being considered at a location where left/right-turn lanes are present, an operational analysis may need to be conducted to determine an appropriate storage length for the auxiliary lane(s) to ensure that there is enough available storage length to accommodate left/right-turning vehicles when pedestrians are occupying the crosswalk.
- Source of power – PXOs are typically powered by solar cells, but illumination poles require access to electrical power. Further details are provided in **Section 4.3.6**.
- Proximity to driveways – Ensure that no driveways are present between the crosswalk and the yield to pedestrians line because the presence of a driveway may result in sudden movements by exiting drivers if vehicles are stopped while waiting for pedestrians to cross.
- Proximity to pedestrian crossings – According to OTM Book 15, PXOs should not be installed within 200 m of other signal-protected pedestrian crossings. There may be a desire to have pedestrian crossings at locations that do not meet these requirements. Under these situations, an operational analysis should be conducted to evaluate any vehicle queues' impact on the crossing.
- Sightlines – Sight triangles for side street traffic waiting at the stop sign must be clear and should not be obstructed by vegetation, on-street parking, buildings, fences, etc. The visibility of all signs and RRFBs at the crossing should be confirmed for road users. Sight distance requirements are detailed in TAC's Geometric Design Guide for Canadian Roads.

4.3.2 Illumination Levels

Illumination requirements for a Level 2 Type C PXO are the same as IPS and MPS pedestrian crossings. Please refer to **Section 4.1.2** for additional details.

4.3.3 Rectangular Rapid (RRFB) Flashing Beacon Placement

Flashing beacon placement specifications for a Level 2 Type C PXO are the same as a Level 2 Type B PXO. Please refer to **Section 4.2.3** for additional details.



4.3.4 Level 2 Type C PXO Components and Restrictions

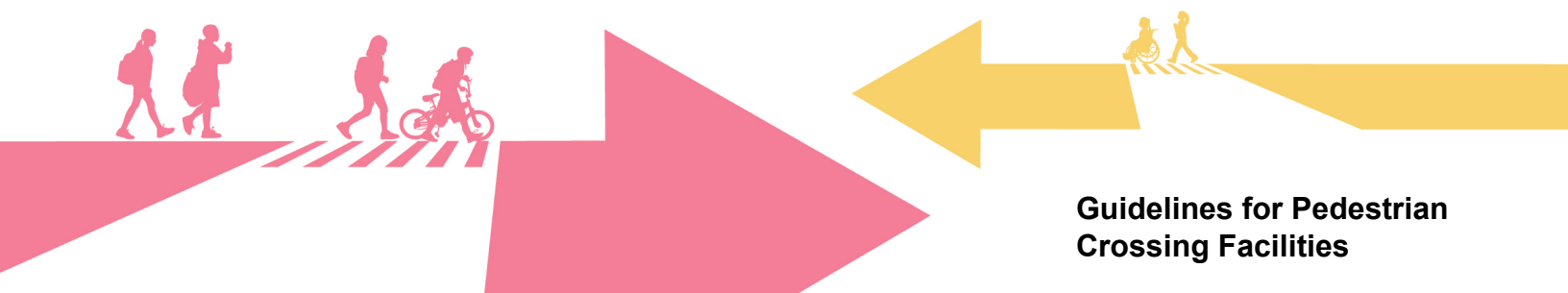
As per OTM Book 15 (unless otherwise stated), the minimum required components and desired components for a Level 2 Type C PXO are as follows:

Minimum Required Components:

- Side-mounted pedestrian crossover signs, showing a symbol of a person crossing on a road (Ra-5R and Ra-5L), together with their Stop for Pedestrians (Ra-4t) tabs, on both sides of the road mounted back to back (For one-way applications, Stop for Pedestrians tab is required only for the direction of travel)
- Ladder crosswalk markings and yield to pedestrians line markings as further detailed in **Section 4.2.5**
- Actuated Double-sided Rectangular Rapid Flashing Beacon with Tell-Tale and Pedestrian Pushbutton for pedestrians mounted above each set of side-mounted pedestrian crossover signs installed at the pedestrian crossover as further detailed in **Section 4.2.3** and **Section 4.2.6**
- Advanced Pedestrian Crossover Ahead sign (Wc-27R/Wc-27L) at 50.0 m upstream of the crosswalk
- Stop sign (Ra-1) on the cross street if installed at an intersection
- Passing restrictions on single lane approaches
- Stopping prohibition for a minimum of 15 m on each approach to the crossing, and 10 m following the crossing
- Lane change prohibition on multiple lane approaches using solid white lines as further detailed in **Section 4.2.5**
- No Passing Here to Crossing sign (Ra-10) 30 m upstream of the crosswalk

Desired or Additional Considerations:

- Raised refuge island with mandatory:
 - Pavement markings on approaches to obstructions
 - Keep Right Sign (Rb-25, Rb-125)
 - Object Marker Sign (Wa-33L)
- Stopping prohibition for a minimum of 30 m on each approach to the crossing, and 15 m following the crossing.
- Curb extensions to reduce pedestrian crossing distance, either through curb work or through use of flexible bollards
- Consider use of a flexible centreline bollard to bring additional awareness to the crossing
- Raised crosswalk may be considered in some applications to reduce vehicle speeds and improve pedestrian visibility (applicability of this element would need to be reviewed for the crossing location)



Details regarding sign location criteria for the aforementioned minimum required components and desired components can be found in OTM Book 5 – Regulatory Signs and OTM Book 6 – Warning Signs. Horizontal and vertical mounting offsets for signs can be found in OTM Book 1B – Sign Design Principles.

4.3.5 Pavement Markings

Pavement marking specifications for a Level 2 Type C PXO are the same as a Level 2 Type B PXO. Please refer to **Section 4.2.5** for additional details.

Section 4.3.7 provides illustrations of installation details for a typical Level 2 Type C PXO that indicate the recommended placement of pavement markings for various applicable environments.

4.3.6 Infrastructure

Pedestrian Crossover Signs with Pedestrian Pushbuttons and Rectangular Rapid Flashing Beacons

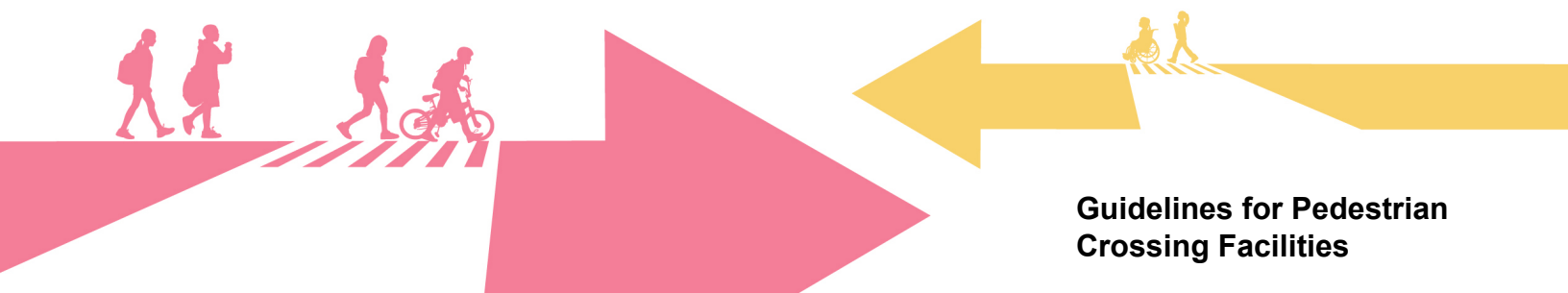
The required side-mounted pedestrian crossover signs for a Level 2 Type C PXO should be placed at approximately 2.0 m from the face of the curb with a minimum of 0.30 m and a maximum of 4 m. They should be placed in such a way that they should not obstruct any pedestrian movements including those using assistive devices (i.e. wheelchair users), and not be installed within the sidewalk.

Like Level 2 Type B PXOs, the Level 2 Type C PXO infrastructure elements are also installed on traffic poles. The selection of the location of poles will require the designer to consider utility clearances, aesthetic requirements, and mast arm length restrictions. An ideal location could be within the flare of the curb ramp.

Pedestrian pushbuttons should preferably be mounted on the same poles on which the side-mounted pedestrian crossover signs. However, if it is not possible to place the traffic pole close to the crosswalk due to any physical constraints, a separate small pole just for pushbuttons may be used.

The pushbuttons should be installed on the “through sidewalk” side of the sign at a height of 1.1 m (+/- 0.15 m) above finished grade. The pushbuttons should be in line, not perpendicular, with the crosswalk and if possible, poles with pushbuttons should be with the nearest edge of the crosswalk. It is important to ensure that these poles are accessible and user friendly (i.e. not located behind barriers, grassy/muddy areas, or areas where snow windrows may occur).

As detailed previously in **Section 4.3.3**, actuated double sided rectangular rapid flashing beacons with tell-tale must be installed above each set of side-mounted pedestrian crossover signs.



Typically, a solar power unit is installed on the top of each side-mounted pedestrian crossover sign to sufficiently power the pushbutton and rectangular rapid flashing beacons (this configuration is used by many major jurisdictions).

Illumination Poles

When designing illumination for PXOs, the existing available illumination should be checked where the crosswalk is proposed. If illumination levels do not meet requirements, the designer may investigate whether simply changing the luminaires is enough to meet the illumination requirements.

If it is necessary to install new illumination poles, the lighting can be installed on the same poles as the rest of the PXO infrastructure or it can be installed on separate poles as necessary as per site conditions and based on the type of PXO. The recommended placement of illumination poles for PXOs are the same as for traffic signals in **Section 4.1.6**.

Utilities

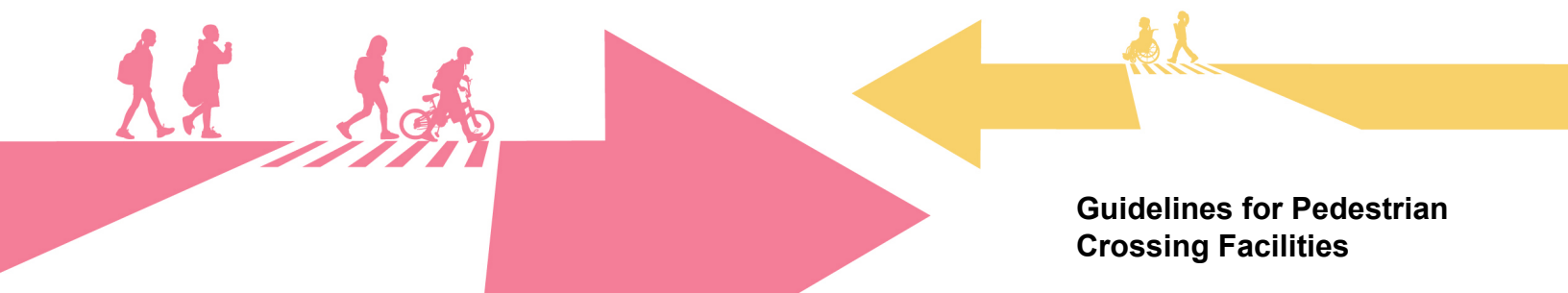
It is important to check the location of existing utilities (i.e. hydro, fibre optic cable, watermain, etc.) when selecting suitable locations for poles. The design process should review and consider the presence of existing utilities for potential conflicts, and coordinate with the utility companies as may be required.

Considerations regarding utility placement for PXOs are the same as for traffic signals in **Section 4.1.6**.

4.3.7 Layout

The following figures from OTM Book 15 illustrate the typical installation layouts for a Level 2 Type C PXO for the following applicable environments:

- Midblock: up to 3 lanes total cross-section, 2-way
- Midblock: 4-lane, 2-way with raised refuge only
- Midblock: up to 2 lanes total cross-section, 1-way
- Intersection: up to 3 lanes total cross-section, 2-way
- Intersection: 4-lane, 2-way with raised refuge only
- Intersection: up to 2 lanes total cross-section, 1-way



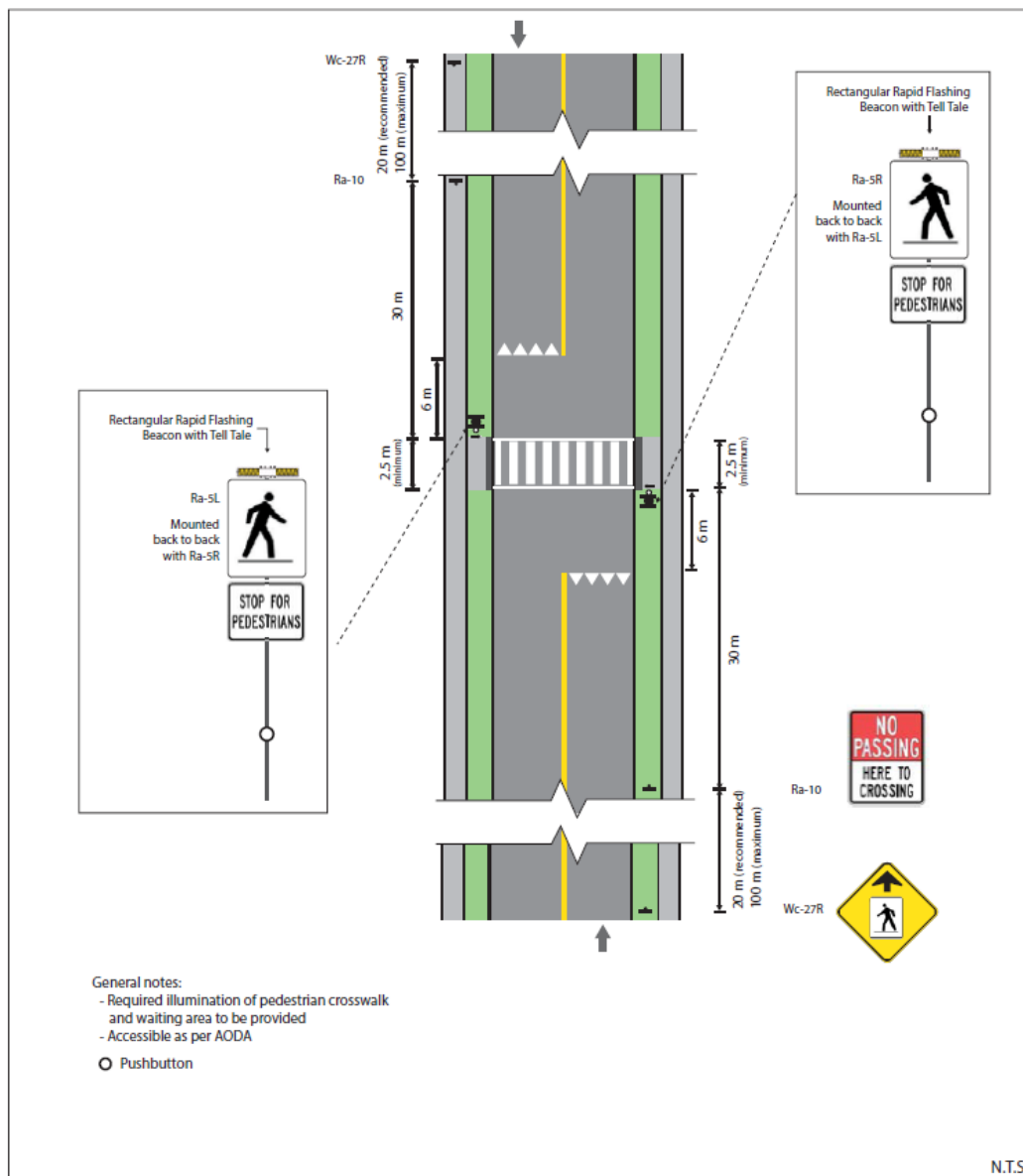


Figure 20: Level 2 Type C PXO Midblock Treatment for 2-lane, 2-way Roadways (Source: OTM Book 15)



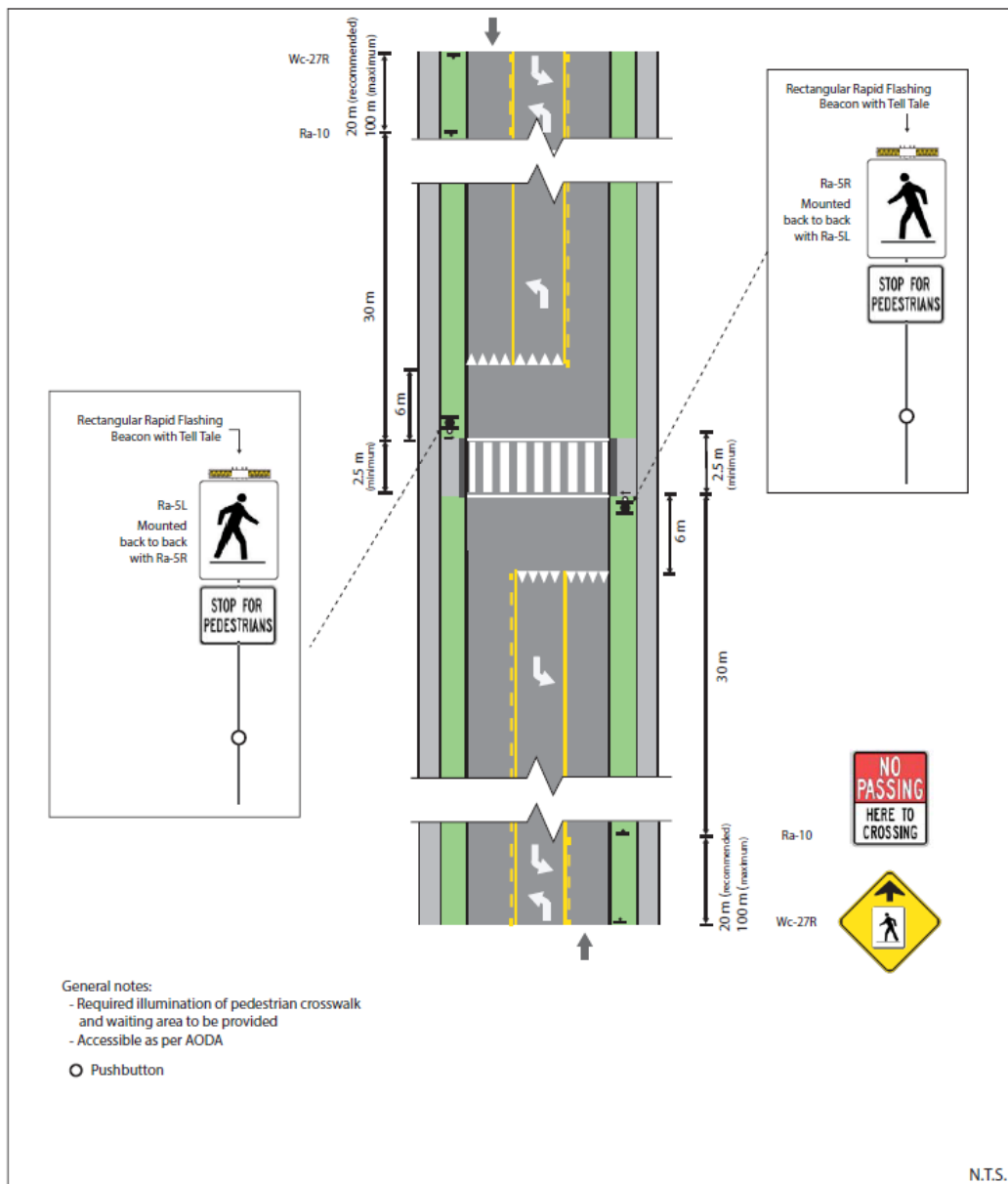
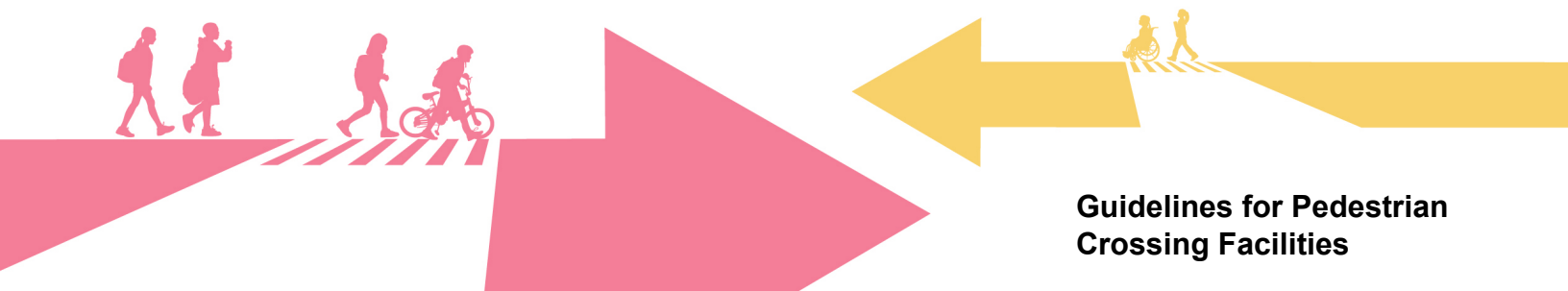


Figure 21: Level 2 Type C PXO Midblock Treatment for 3-lane with centre 2-way left-turn lane Roadways (Source: OTM Book 15)



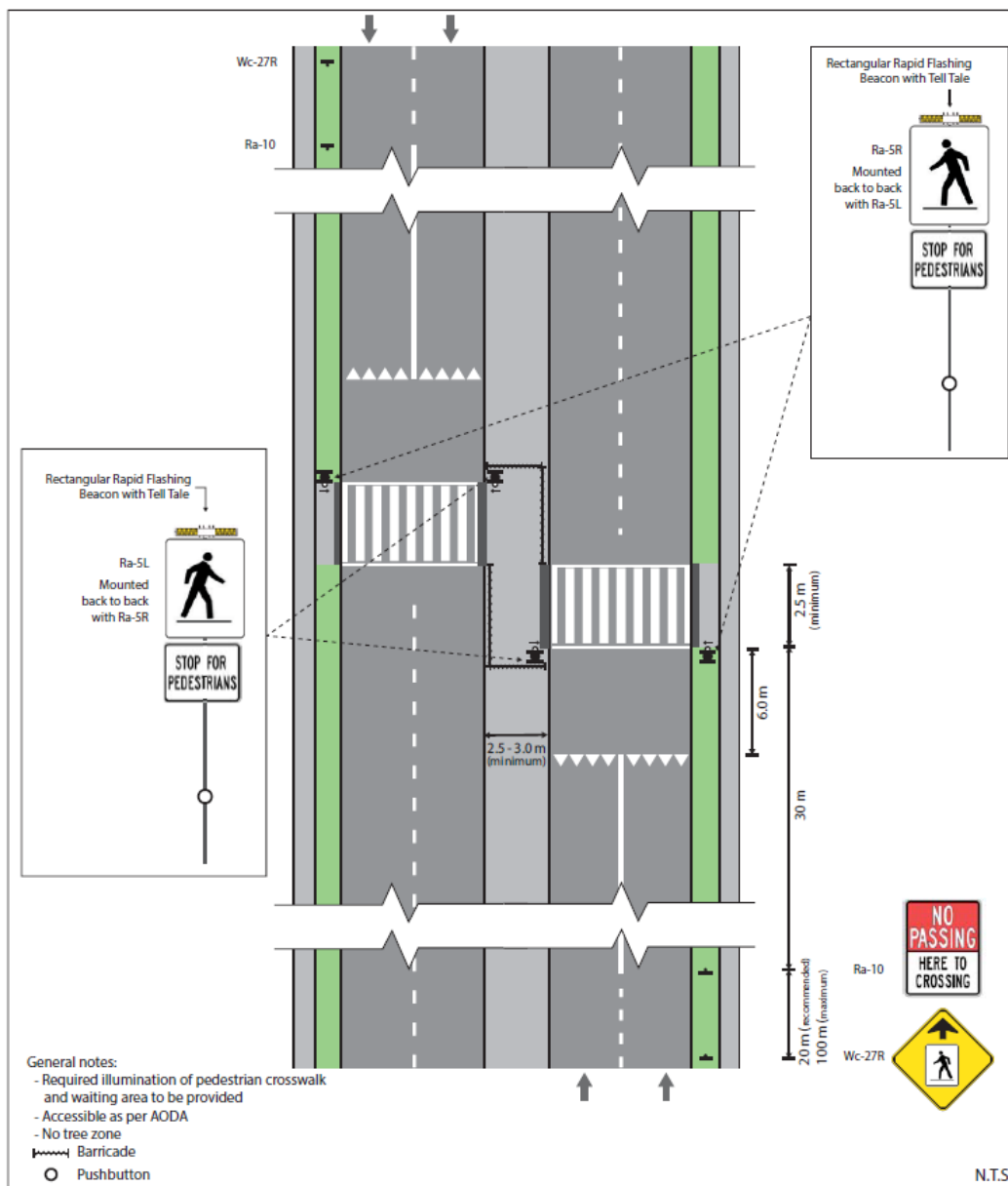
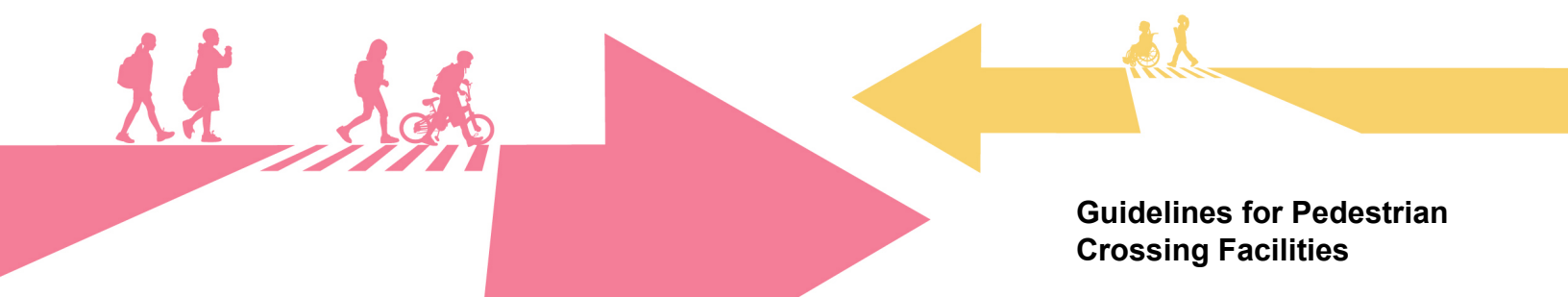


Figure 22: Level 2 Type C PXO Midblock Treatment for 4-lane, 2-way Roadways with Raised Refuge (Source: OTM Book 15)



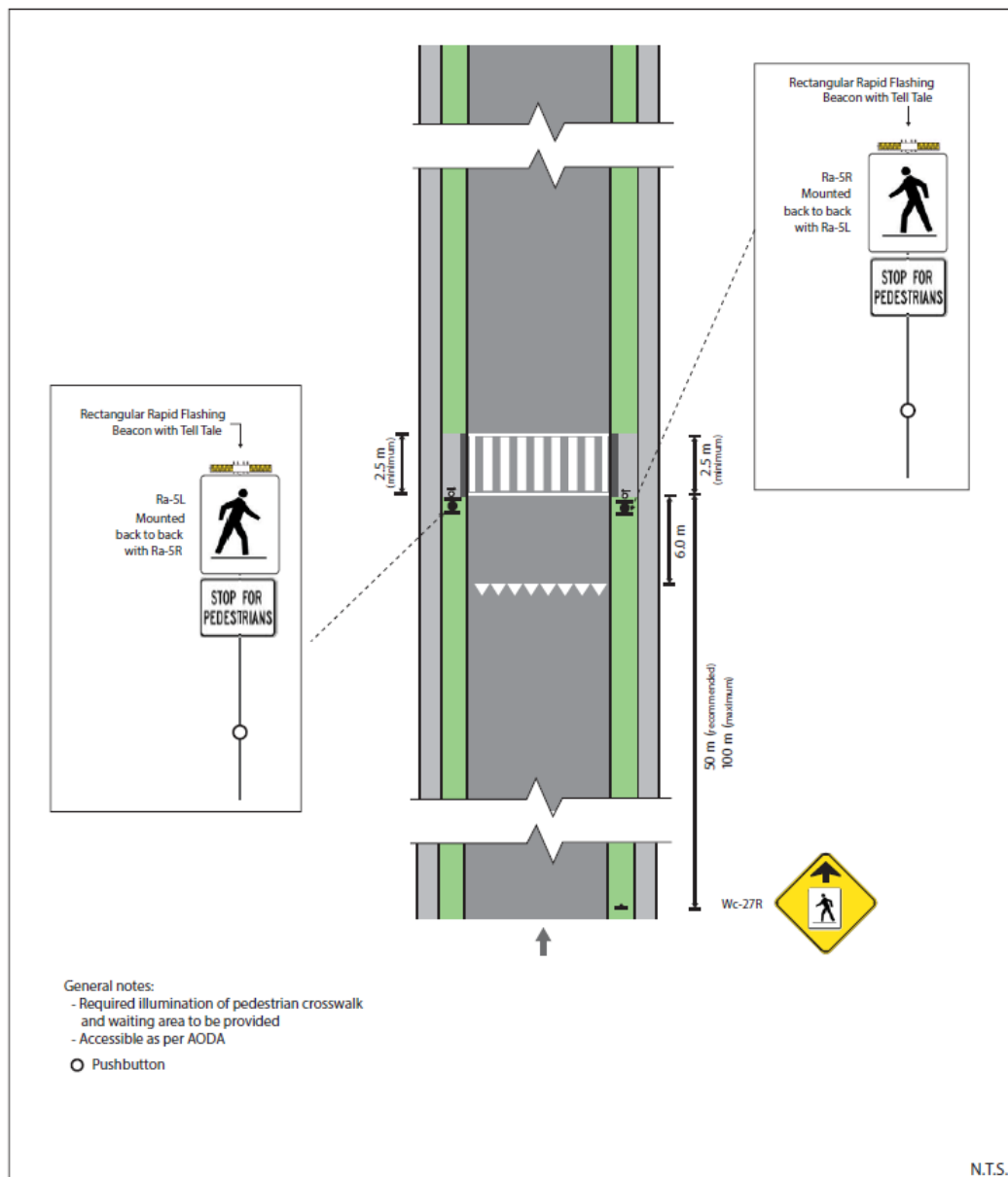
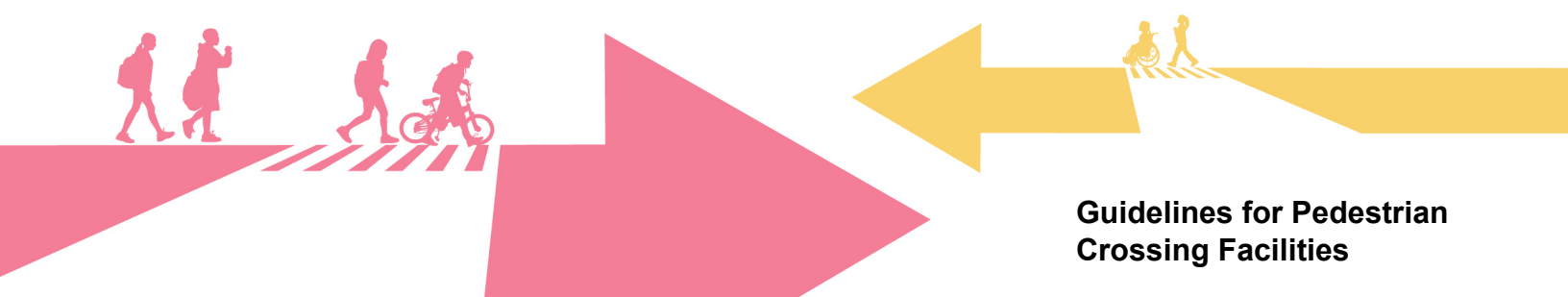


Figure 23: Level 2 Type C PXO Midblock Treatment for 1-lane, 1-way Roadways (Source: OTM Book 15)



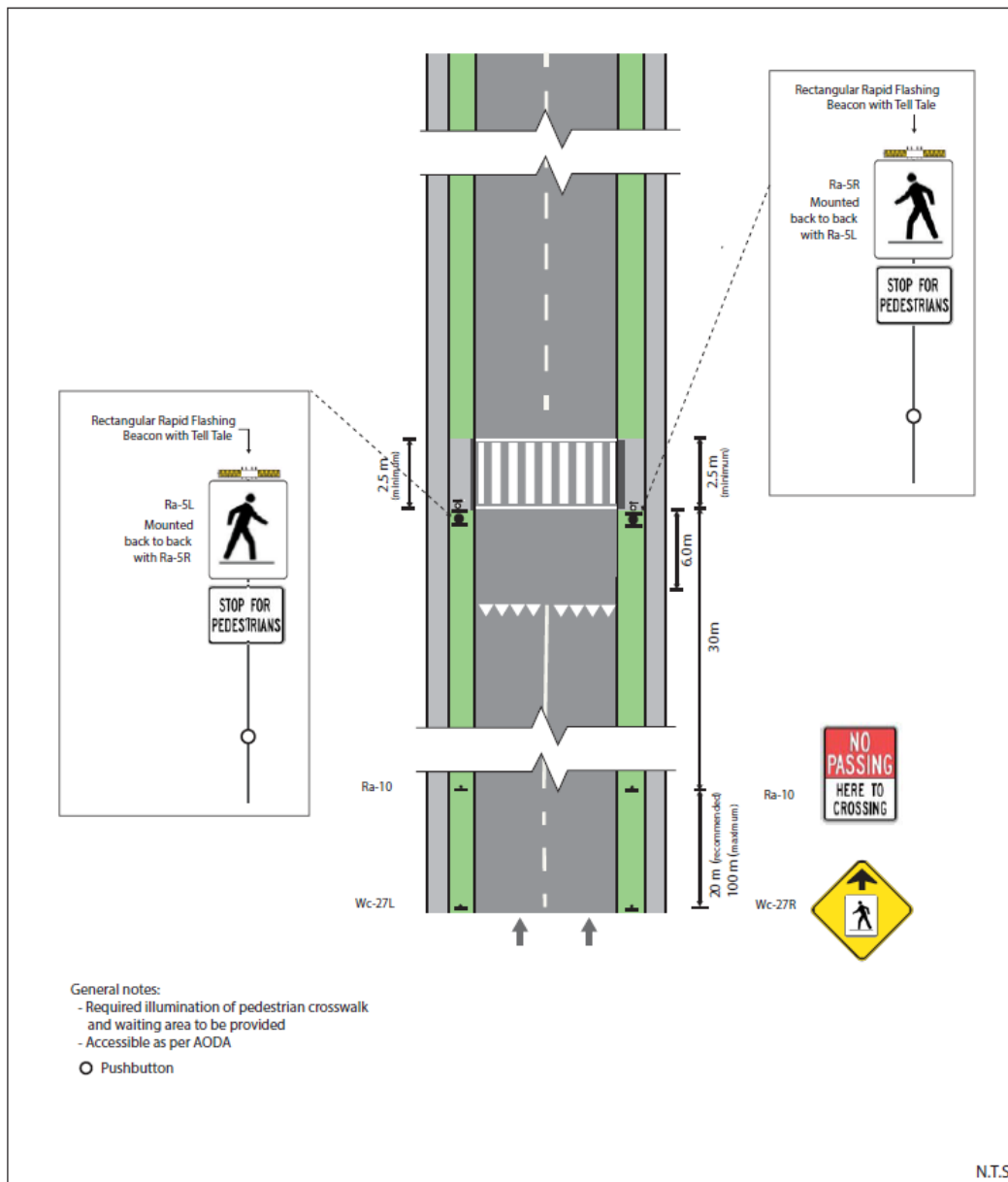
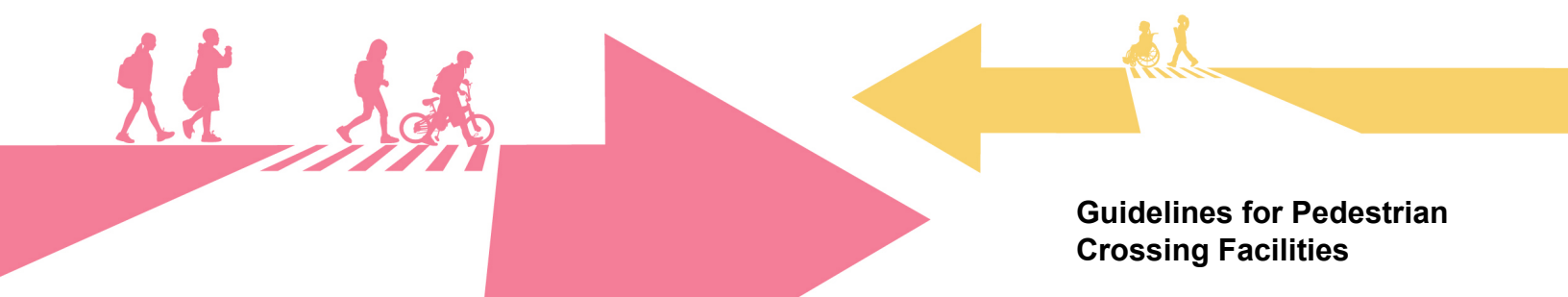


Figure 24: Level 2 Type C PXO Midblock Treatment for 2-lane, 1-way Roadways (Source: OTM Book 15)



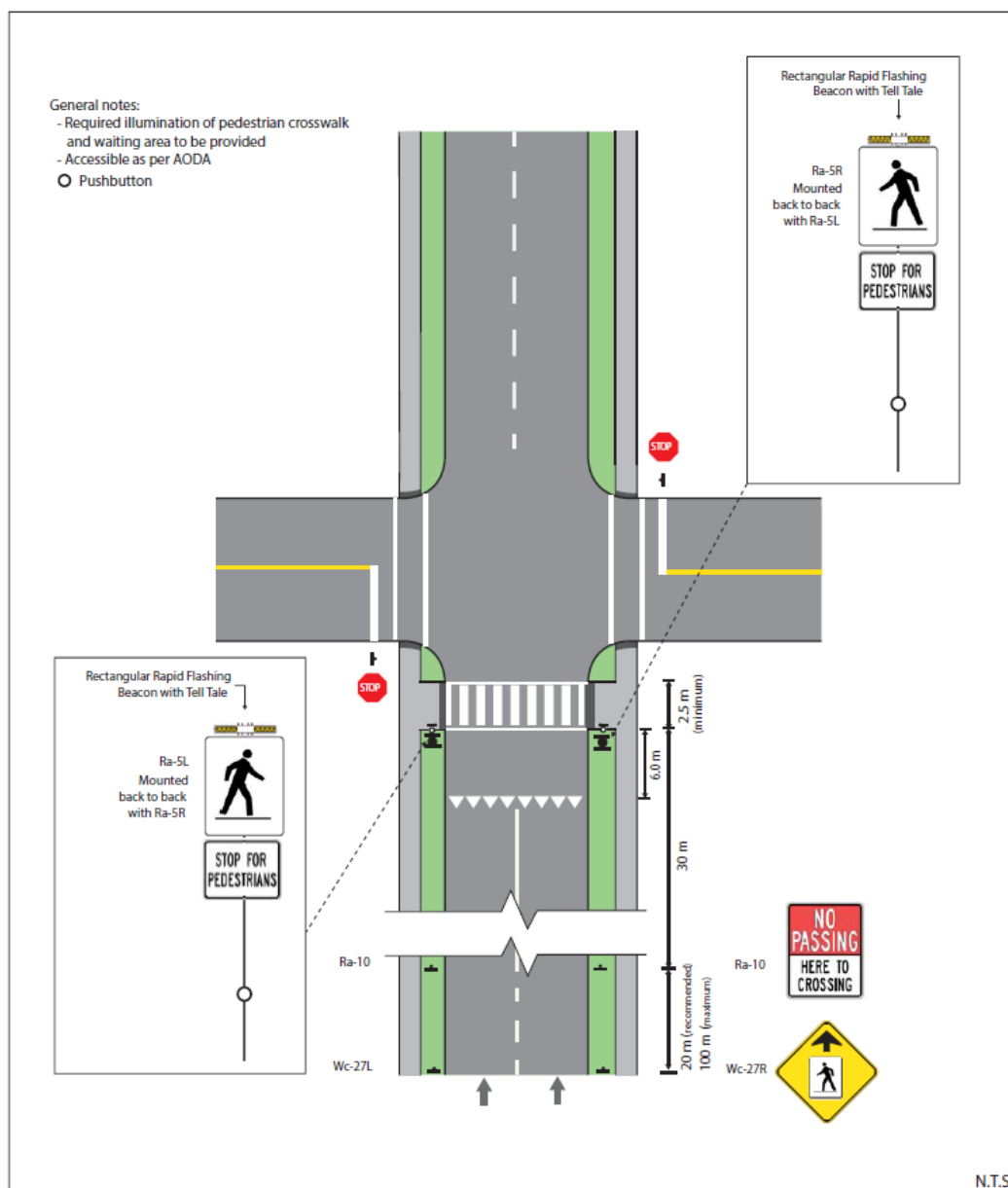


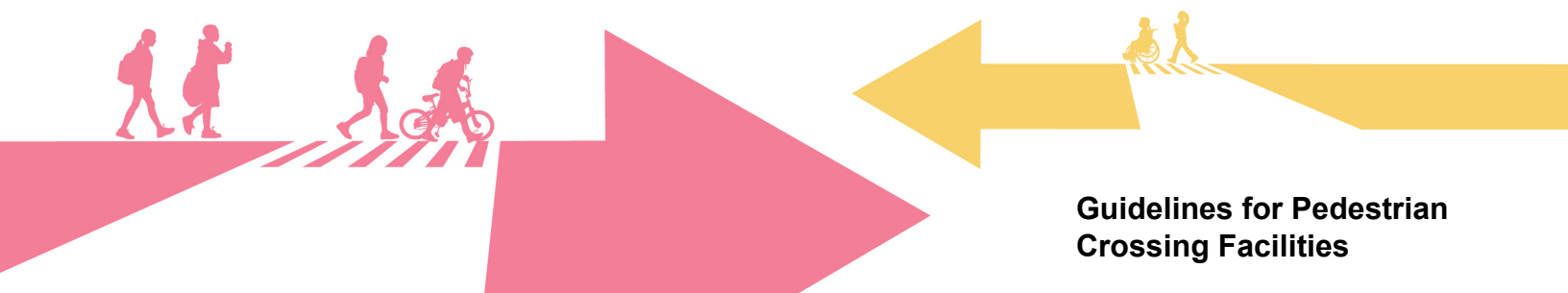
Figure 25: Level 2 Type C PXO Treatment at Intersection for 1-way Roadways (Source: OTM Book 15)



4.4 Level 2 Type D PXO

4.4.1 Important Considerations

- Side streets must be stop controlled if the PXO is installed at an intersection.
- If cyclists are expected to be present in the area, proper guidance should be provided to inform cyclists that they must dismount when crossing the roadway at a dedicated pedestrian crossing.
- Location of signposts – Signposts should not be placed in the sidewalk and should ideally be located within the boulevard. Further details are provided in **Section 4.4.5**.
- Connectivity to sidewalks/trails – Pedestrian crossing facilities should be preferably located where there is a continuous sidewalk and/or a nearby trail network.
- Parking and no stopping restrictions – According to OTM Book 15, stopping must be prohibited for a minimum of 15 m on each approach to the crossing, and 10 m following the crossing. Further details are provided in **Section 4.4.3**.
- Location of transit stops – The crosswalk location will need to be coordinated with any existing transit stops. There may be situations where transit stops in the vicinity of the crossing may need to be relocated to comply with parking and no stopping restrictions.
- Refuge islands – At some locations where the roadway width is wide, consideration could be given to provide a refuge island for pedestrians' safety.
- General utilities (i.e. fire hydrants, hydro poles) – Type D PXOs can be installed using simple signposts, which can be directly buried to a shallow depth. The design process will still require the review of existing utilities to determine optimal locations for illumination poles and/or coordinate mitigation of conflicts with utilities for pole and sign post installations as may be required. Further details are provided in **Section 4.4.5**.
- Source of power – Illumination poles will require access to electrical power. Further details are provided in **Section 4.4.5**.
- Proximity to driveways – Ensure that no driveways are present between the crosswalk and the yield to pedestrians line because the presence of a driveway may result in sudden movements by exiting drivers if vehicles are stopped while waiting for pedestrians to cross.
- Proximity to pedestrian crossings – According to OTM Book 15, PXOs should not be installed within 200 m of other signal-protected pedestrian crossings. There may be a desire to have pedestrian crossings at locations that do not meet these requirements. Under these situations, an operational analysis should be conducted to evaluate any vehicle queues' impact on the crossing.
- Sightlines – Sight triangles for side street traffic waiting at the stop sign must be clear and should not be obstructed by vegetation, on-street parking, buildings, fences, etc. The visibility of all signs at the crossing should be confirmed for road users. Sight



distance requirements are detailed in TAC's Geometric Design Guide for Canadian Roads.

4.4.2 Illumination Levels

Illumination requirements for a Type D PXO are the same as a Type B PXO. Please refer to **Section 4.2.2** for additional details.

4.4.3 Level 2 Type D PXO Components and Restrictions

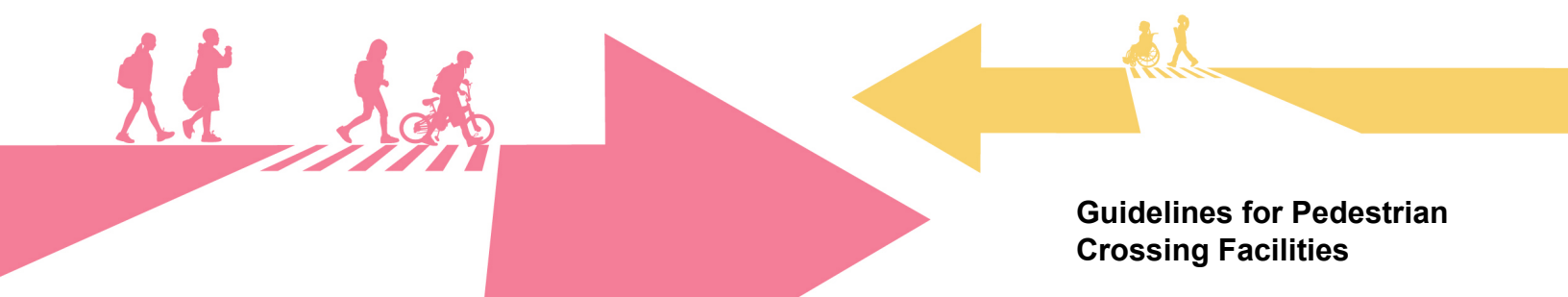
As per OTM Book 15 (unless otherwise stated), the minimum required components and desired components for a Type D PXO are as follows:

Minimum Required Components:

- Side-mounted pedestrian crossover signs, showing a symbol of a person crossing on a road (Ra-5R and Ra-5L), together with their Stop for Pedestrians (Ra-4t) tabs, on both sides of an undivided roadway, mounted back to back (For one-way applications, Stop for Pedestrians tab is required only for the direction of travel)
- Side-mounted pedestrian crossover signs, showing a symbol of a person crossing on a road (Ra-5R and Ra-5L) for each direction, on the right side and on the median of a four lane roadway with raised refuge mounted back-to-back with a Stop for Pedestrians (Ra-4t) tab in the direction of travel
- Ladder crosswalk markings and yield to pedestrians line markings as further detailed in **Section 4.4.4**
- Advanced Pedestrian Crossover Ahead sign (Wc-27R/Wc-27L) at 50.0 m upstream of the crosswalk
- Stop sign (Ra-1) on the cross street if installed at an intersection
- Stopping prohibition for a minimum of 15 m on each approach to the crossing, and 10 m following the crossing
- No Passing Here to Crossing sign (Ra-10) 30 m upstream of the crosswalk

Desired or Additional Considerations:

- Raised refuge islands and centre medians with mandatory:
 - Pavement markings on approaches to obstructions
 - Keep Right Sign (Rb-25, Rb-125)
 - Object Marker Sign (Wa-33L)
- Stopping prohibition for a minimum of 30 m on each approach to the crossing, and 15 m following the crossing
- Passing restrictions on single lane approaches using solid yellow centreline



- Curb extensions to reduce pedestrian crossing distance, either through curb work or through use of flexible bollards
- Use of a flexible centreline bollard to bring additional awareness to the crossing

Details regarding sign location criteria for the minimum required components and desired components can be found in OTM Book 5 – Regulatory Signs and OTM Book 6 – Warning Signs. Horizontal and vertical mounting offsets for signs can be found in OTM Book 1B – Sign Design Principles.

4.4.4 Pavement Markings

Pavement marking specifications for a Type D PXO are the same as a Type B PXO as per **Section 4.2.5**.

Section 4.4.6 provides illustrations of installation details for a typical Type D PXO that indicate the recommended placement of pavement markings for various applicable environments.

4.4.5 Infrastructure

Pedestrian Crossover Signs¹⁶

The pedestrian crossover signs for a Type D PXO should be placed at approximately 2.0 m from the face of the curb with a minimum of 0.30 m and a maximum of 4 m. They should be placed in such a way that they should not obstruct any pedestrian movements including those using assistive devices, and not be installed within the sidewalk.

Illumination Poles¹⁷

When designing illumination for PXOs, the existing available illumination should be checked where the crosswalk is proposed. If illumination levels do not meet requirements, the designer may investigate whether changing the luminaires is enough to meet the illumination requirements. The requirements for illumination poles for Type D PXOs are similar to the requirements for PXO Types B and C as well.

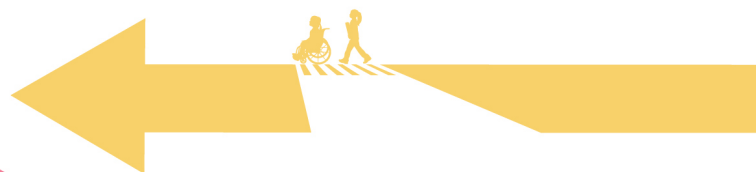
Utilities¹⁸

It is important to check the location of existing utilities (i.e. hydro, fibre optic cable, watermain, etc.) when selecting suitable locations for poles. The design process should review and consider the presence of existing utilities for potential conflicts and coordinate with the utility companies as may be required.

¹⁶ Ontario Traffic Manual Book 15 – Pedestrian Crossing Treatments, June 2016

¹⁷ Transportation Association of Canada – Roadway Lighting Guide, January 2006

¹⁸ Ontario Traffic Manual Book 12 – Traffic Signals, March 2012

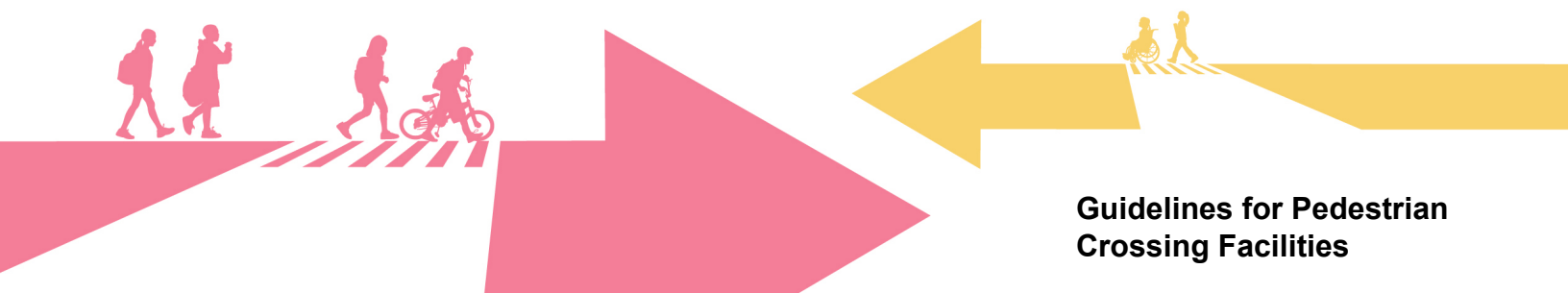


Considerations regarding utility placement for PXOs are the same as for traffic signals in **Section 4.1.6**.

4.4.6 Layout

The following figures from OTM Book 15 illustrate the typical installation layouts for a Type C PXO for the following applicable environments:

- Midblock: 2-lane, 2-way
- Midblock: 4-lane, 2-way with raised refuge only
- Midblock: up to 2 lanes total cross section, 1-way
- Intersection: 2-lane, 2-way
- Intersection: 4-lane, 2-way with raised refuge only
- Intersection: up to 2 lanes total cross section, 1-way



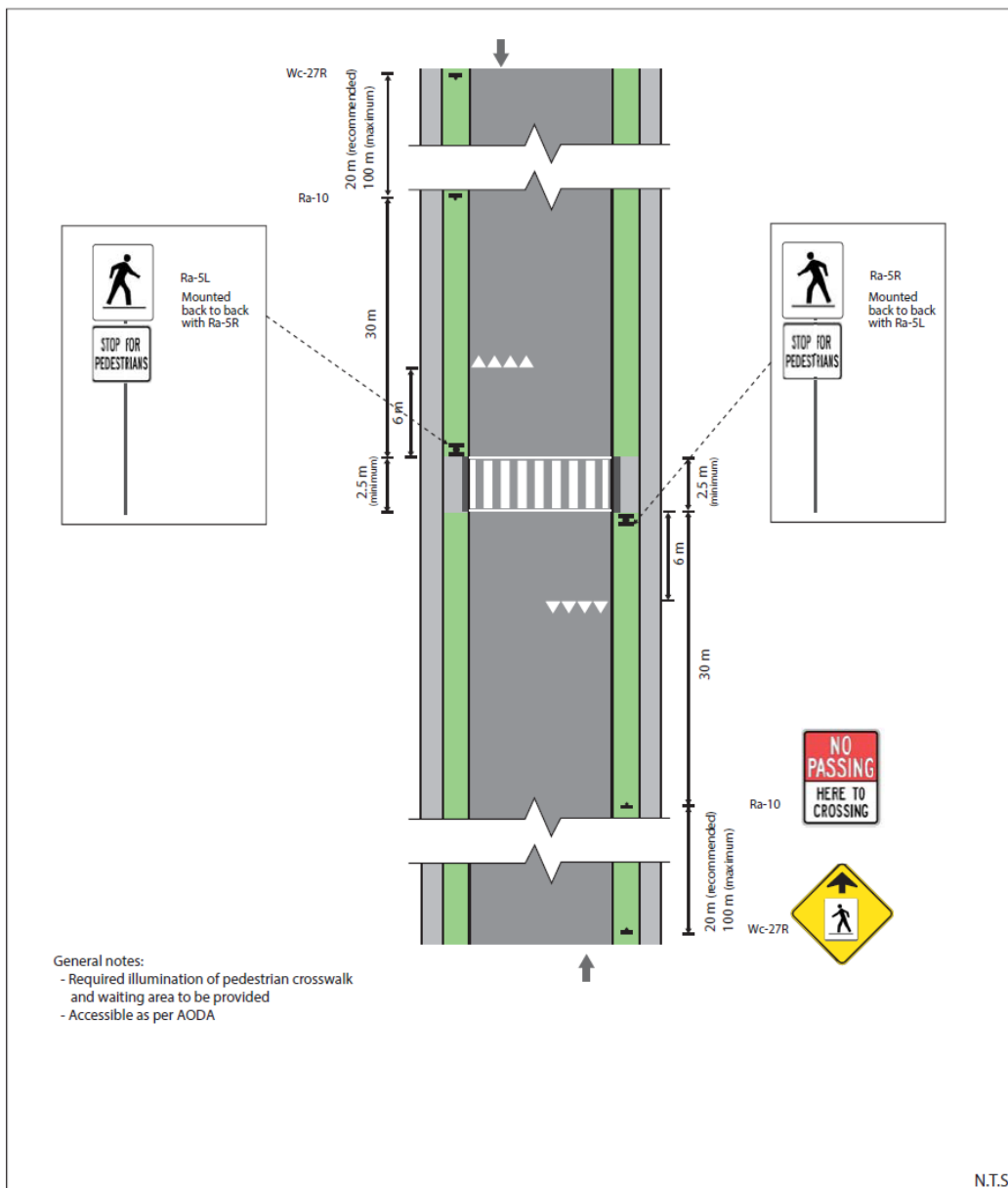
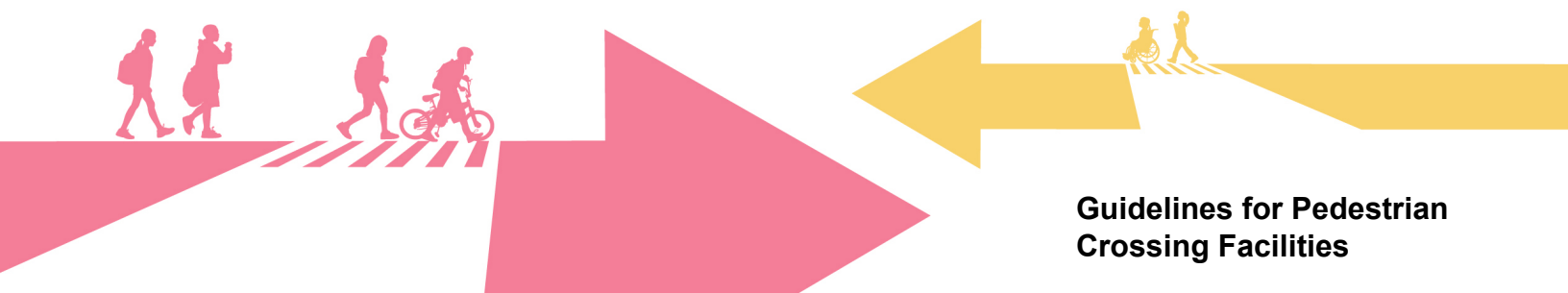


Figure 27: Level 2 Type D PXO Midblock Treatment for 2-lane, 2-way Roadways (Source: OTM Book 15)



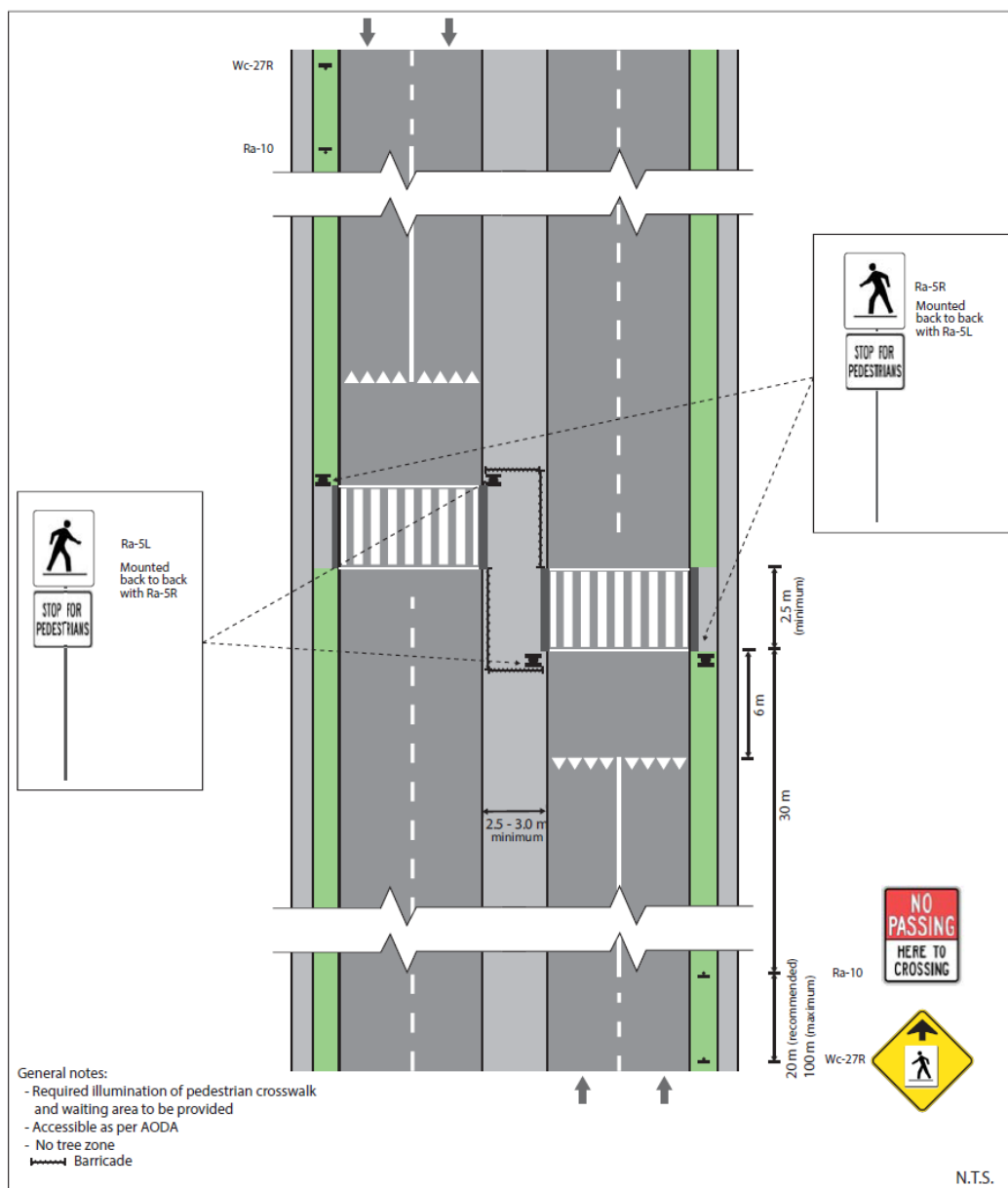
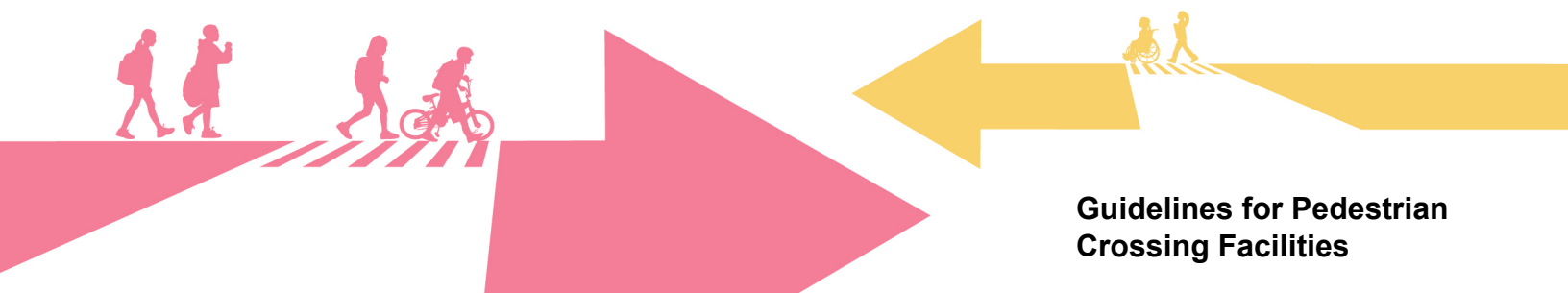


Figure 28: Level 2 Type D PXO Midblock Treatment for 4-lane, 2-way Roadways with Raised Refuge (Source: OTM Book 15)



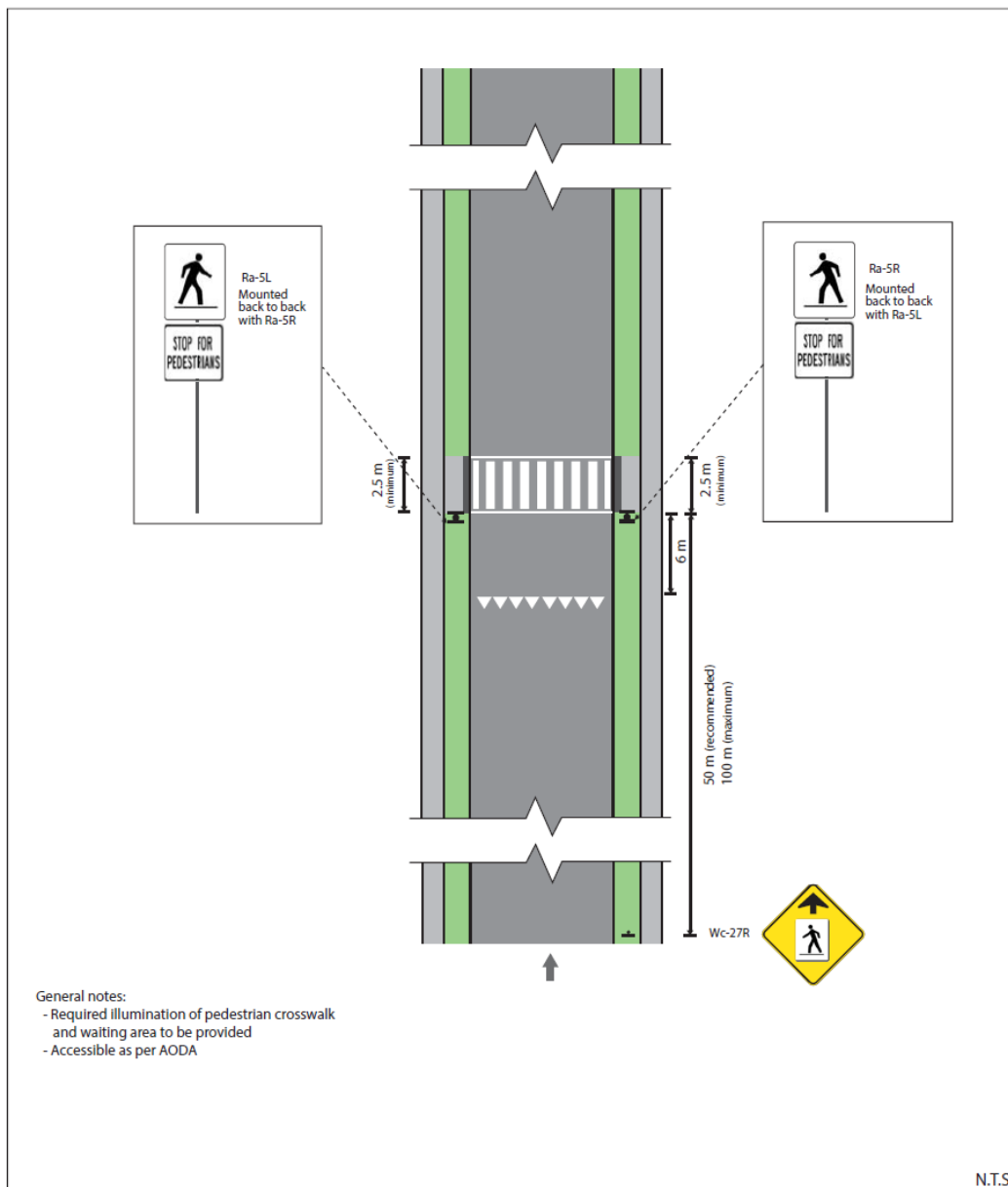
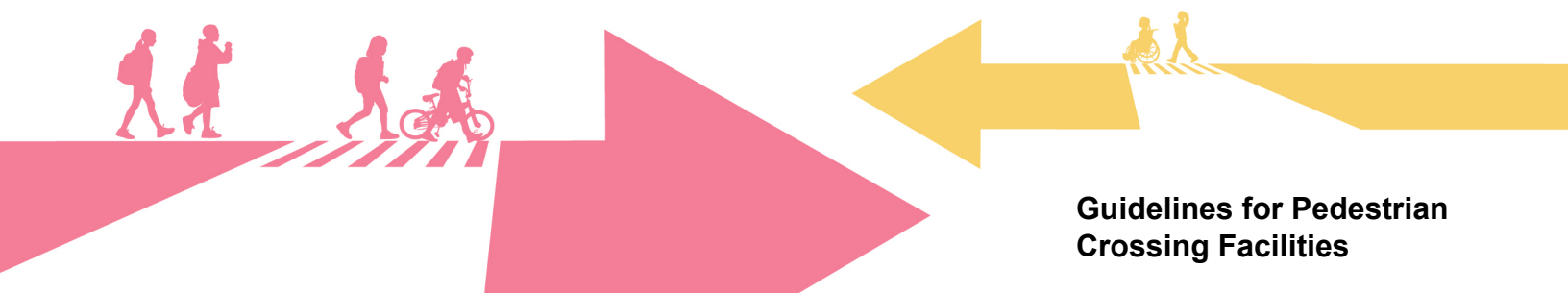


Figure 29: Level 2 Type D PXO Midblock Treatment for 1-lane, 1-way Roadways (Source: OTM Book 15)



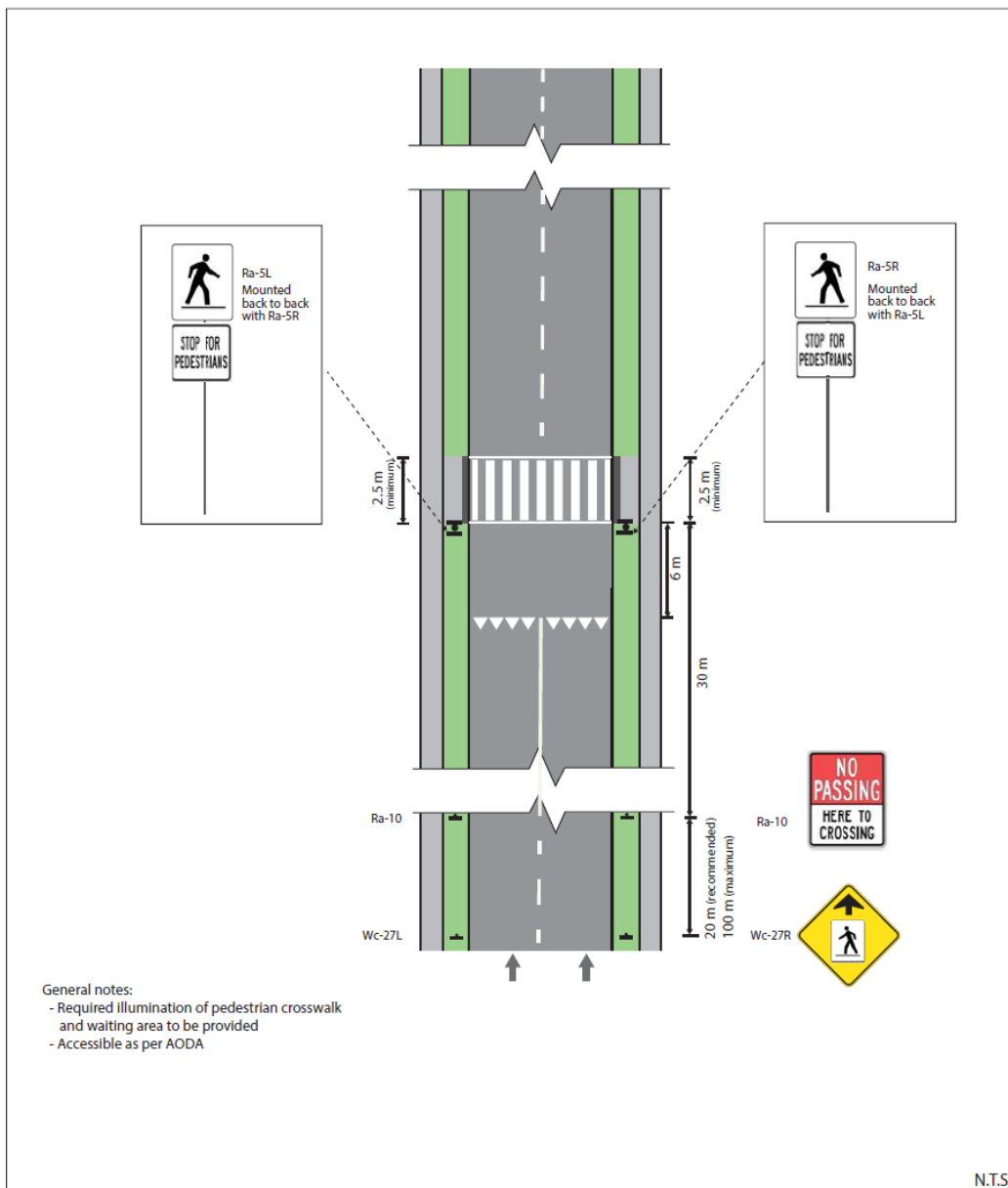
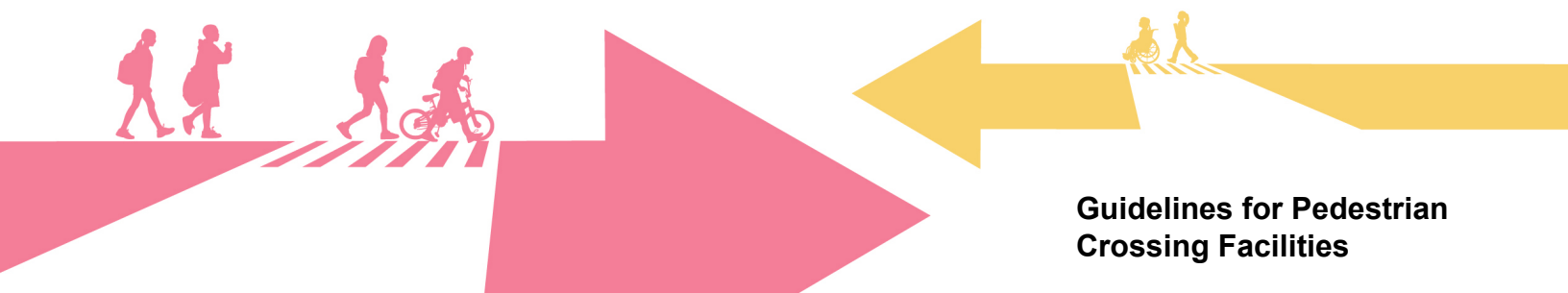


Figure 30: Level 2 Type D PXO Midblock Treatment for 2-lane, 1-way Roadways (Source: OTM Book 15)



Guidelines for Pedestrian Crossing Facilities

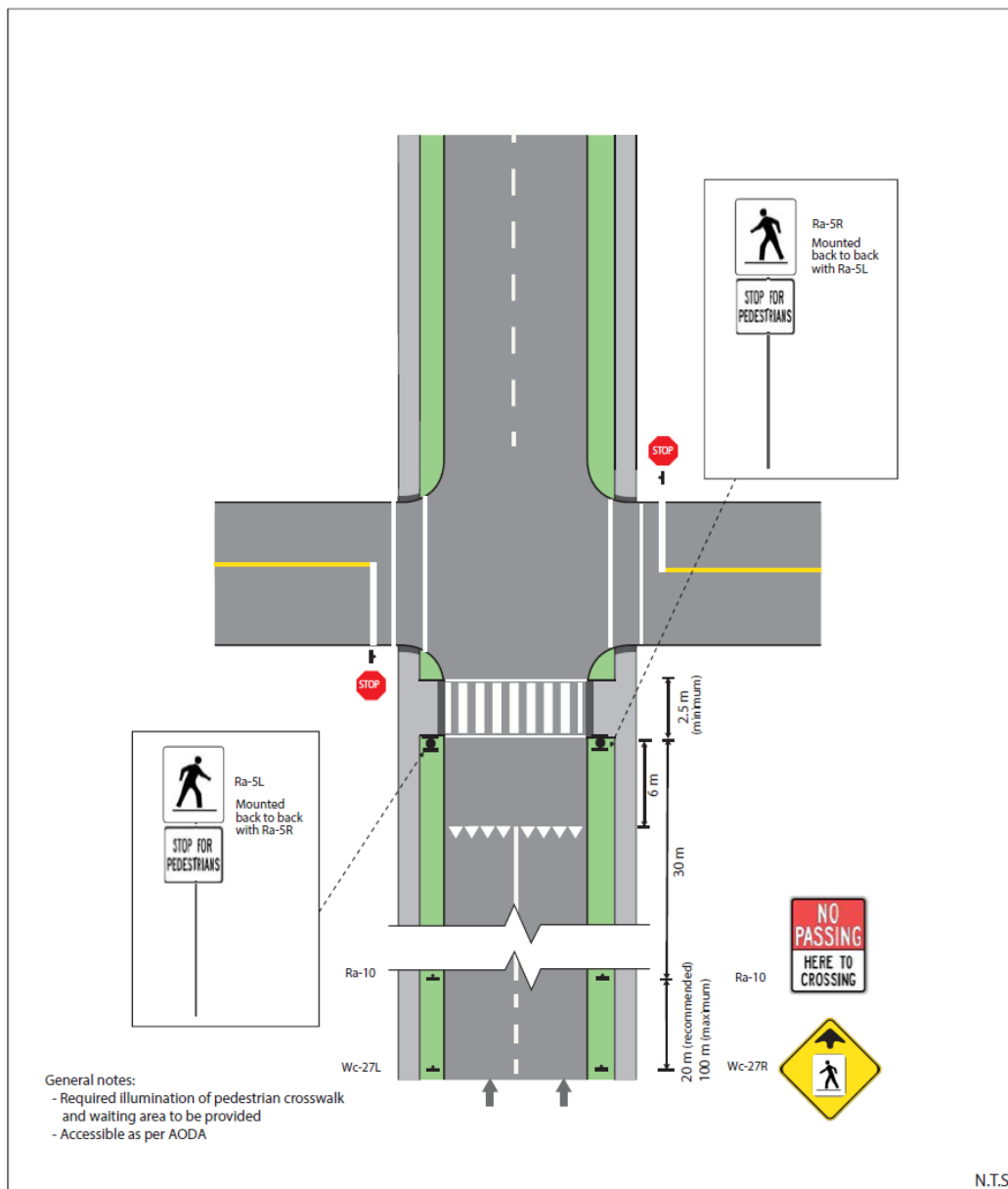
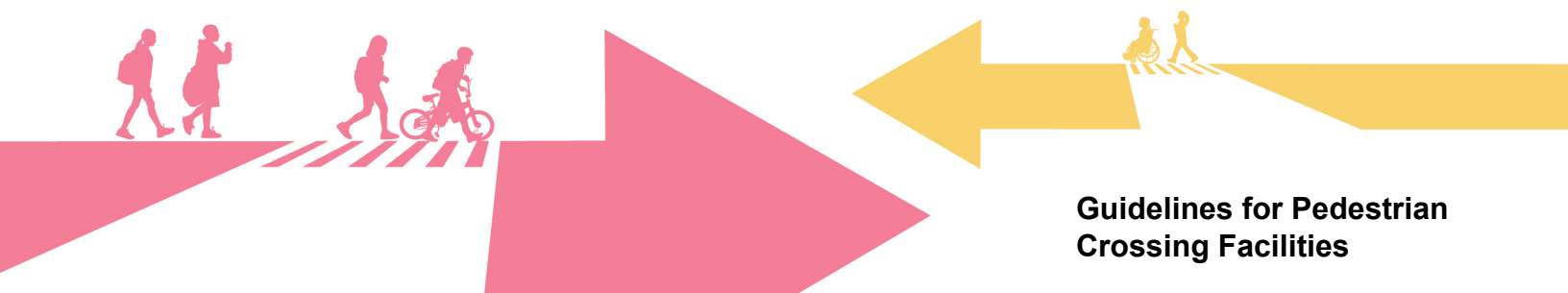


Figure 31: Level 2 Type D PXO Treatment at Intersection for 1-way Roadways (Source: OTM Book 15)



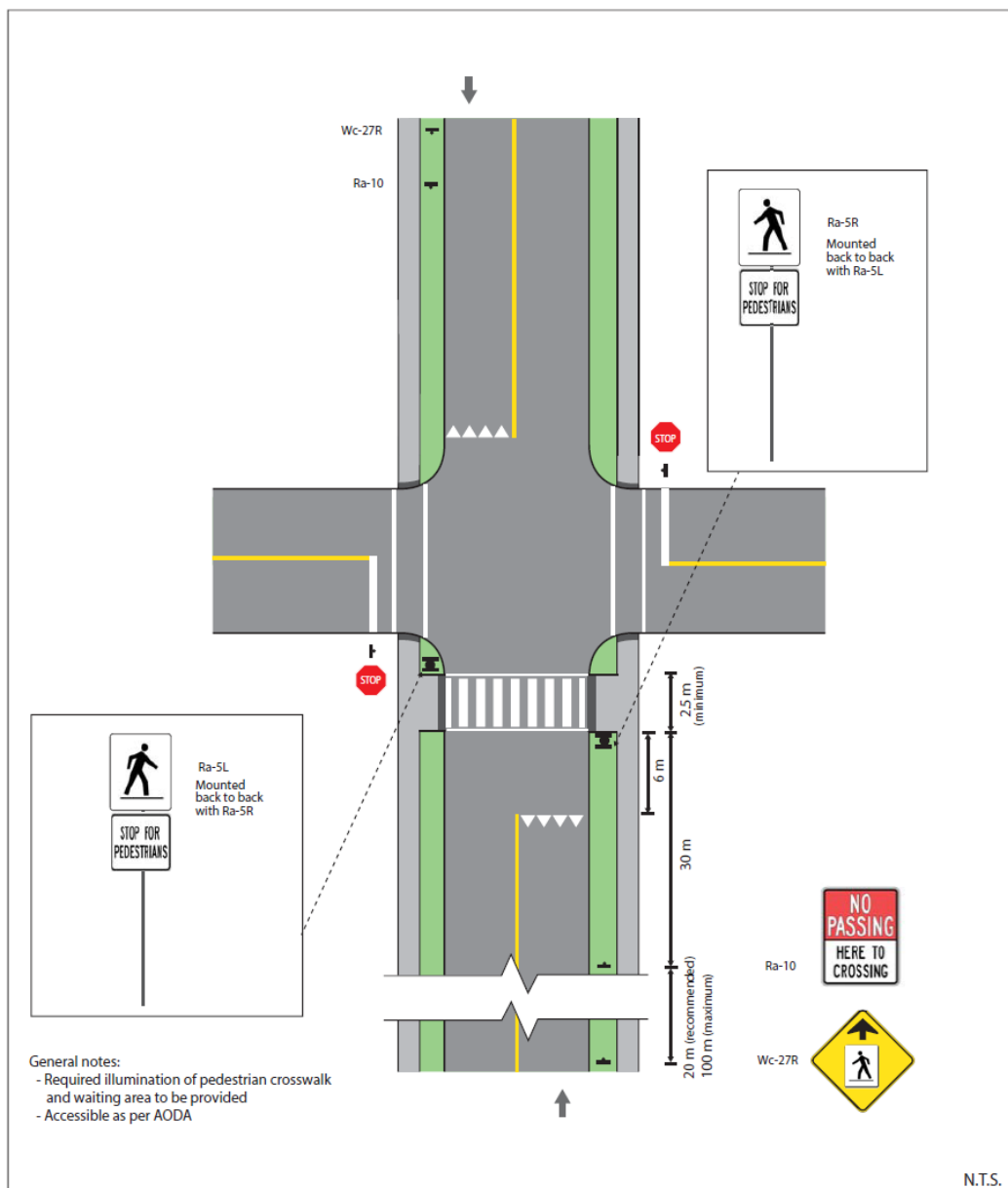
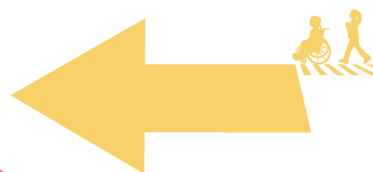


Figure 32: Level 2 Type D PXO Treatment at Intersection for 2-way Roadways (Source: OTM Book 15)

4.4.7 Accessibility

As per OTM Book 15, treatments to enhance accessibility applicable to Type D PXOs include curb ramps and depressed curbs.



Guidelines for Pedestrian Crossing Facilities

When curb ramps and depressed curbs are provided at pedestrian crossings, they must have tactile walking surface indicators that have raised tactile profiles and a high tonal contrast with the adjacent surface as well.

Further details on designing for accessibility can be found in OTM Book 15 – Pedestrian Crossing Treatments.

