Transportation

City of Mississauga

Class Environmental Assessment Study

Creditview Road Active Transportation and Transit Review – FINAL

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Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	OM	2013/12/13	Draft for review
2	OM	2015/11/10	Draft final: Revisions through Section 3.2; sections 3.3 through 5 added
3	OM	2015/11/23	Final Report

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1. Introduction

In support of the Class Environmental Assessment (EA) Study for Creditview Road, an Active Transportation and Transit Review was completed. This report documents conditions affecting walking, cycling, and transit along Creditview Road, including existing and future infrastructure, service requirements, and nearby land uses. This document informs the EA study team on non-auto elements within the corridor for incorporation into the evaluation of alternatives, the development of a preliminary design of the recommended solution, and considerations for detailed design.

This report contains the following sections:

- **Section 2** contains an existing conditions assessment, including a description of existing active transportation (walking and cycling) infrastructure, transit infrastructure, and transit service in the study area. This assessment also identifies areas of concern related to existing active transportation and transit infrastructure in the study area. The assessment concludes with an exploration of existing travel patterns in the areas adjacent to and near the corridor, including a review of existing peak hour travel demands and mode shares.
- **Section 3** is a background conditions assessment, reviewing currently planned active transportation and transit infrastructure in the area. This assessment includes a review of planning documents in Mississauga and Peel Region to identify recommendations and policy directions that affect the Creditview Road study area. The assessment includes a high-level estimate of potential active transportation and transit demands on the corridor by 2031 if mode shares were to increase.
- **Section 4** discusses design considerations for active transportation and transit infrastructure in the Creditview Road study area. These considerations include the type of infrastructure to be provided along the corridor and design elements that can improve safety for pedestrians, cyclists, and transit users, such as intersection treatments.

2. Existing Conditions Assessment

Currently, the study corridor contains a variety of active transportation and transit infrastructure along Creditview Road and connecting streets. The following sub-sections describe the current state of this infrastructure and how people travel in and around the area.

2.1 Existing Active Transportation Infrastructure

Within the study area, there is some active transportation infrastructure along and intersecting Creditview Road. A field study was completed on October 10, 2013 to collect site information and observe conditions. The active transportation infrastructure in the corridor includes:

- A concrete sidewalk on the west side of Creditview Road from Sir Monty's Drive / Bancroft Drive north to Argentia Road.
- A concrete sidewalk on the east side of Creditview Road from Sir Monty's Drive / Bancroft Drive north to Falconer Drive.
- Concrete sidewalks on all cross streets, except:
  - Both sides of Velebit Court;
  - South side of Kenninghall Crescent (east of Creditview Road);
  - Both sides of Rivergate Place; and
  - Both sides of Old Creditview Road.
- An asphalt multi-use trail[1] on the west side of Old Creditview Road.
- Crosswalks across all legs of all signalized intersections. Crosswalks were connected to sidewalks where sidewalks were otherwise present.
- Countdown pedestrian signals for all crosswalks at the Sir Monty's Drive / Bancroft Drive and Kenninghall Boulevard / Kenninghall Crescent intersections and the east-west crosswalks at the Argentia Road intersection.
- Non-countdown pedestrian signals for the north-south crosswalk at the Argentia Road intersection and all crosswalks, except the northeastbound right-turn channel, at the Old Creditview Road intersection.
- Pedestrian pushbuttons for all crosswalks across Creditview Road.
- Connection to the Culham Trail, the off-road multi-use trail along the Credit River, via Velebit Court.

Figure 2-1 shows the existing pedestrian and cycling infrastructure along and intersecting Creditview Road in the study area. **Figure 2-2** shows an excerpt of northwest Mississauga from the Existing Cycling Network map in the Mississauga Cycling Master Plan.

[1] *The term preferred in Ontario Traffic Manual Book 18 – Cycling Facilities for a separated, off-road pathway that accommodates walking and cycling is an "active transportation pathway". The term "multi-use trail" has different definitions throughout Ontario and does not always refer to a facility exclusively for active transportation. However, for consistency with the terminology used by the City of Mississauga, this report uses the term "multi-use trail" for this type of facility.*

Figure 2-1: Existing Active Transportation Infrastructure in the Study Area

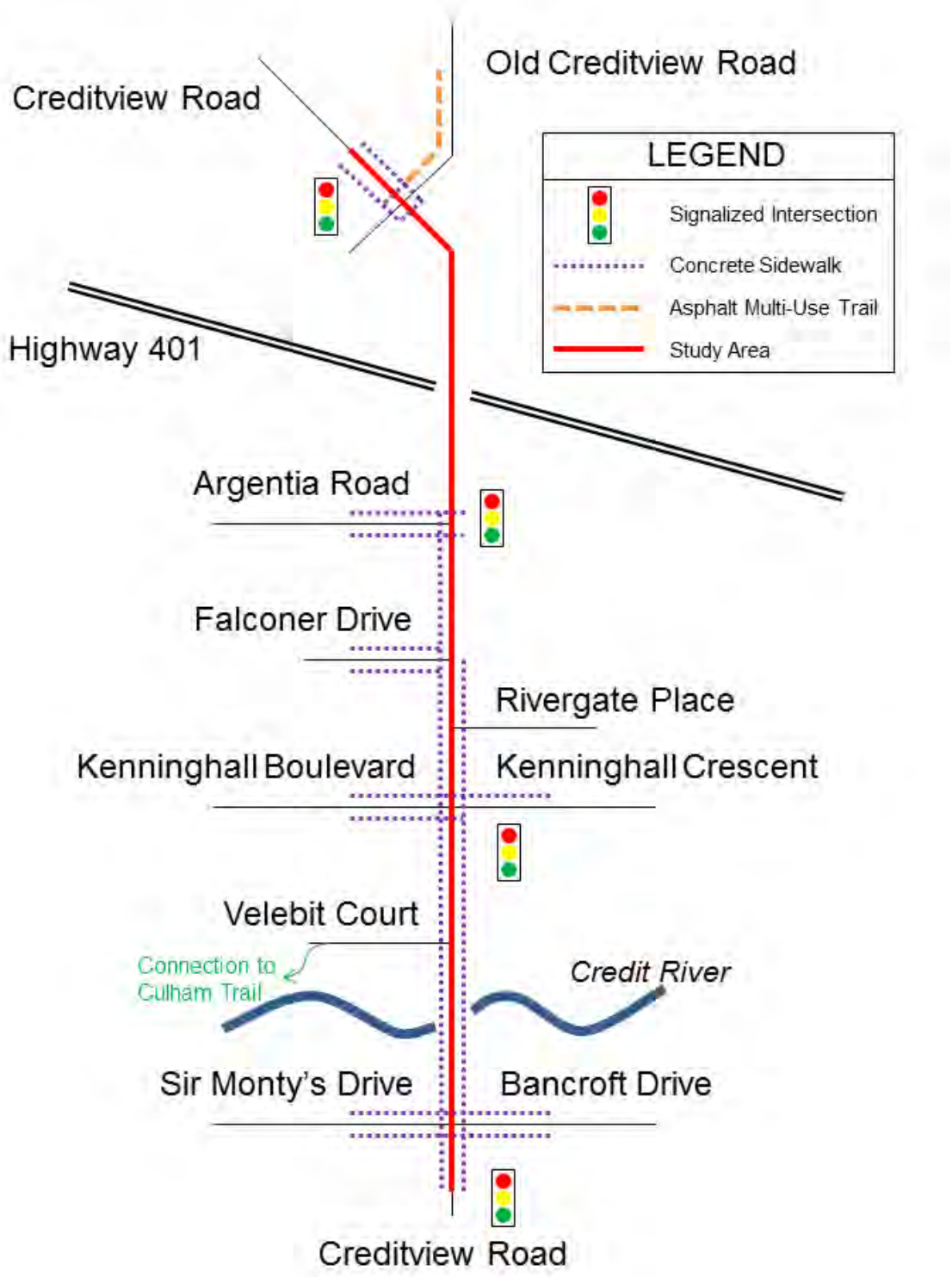
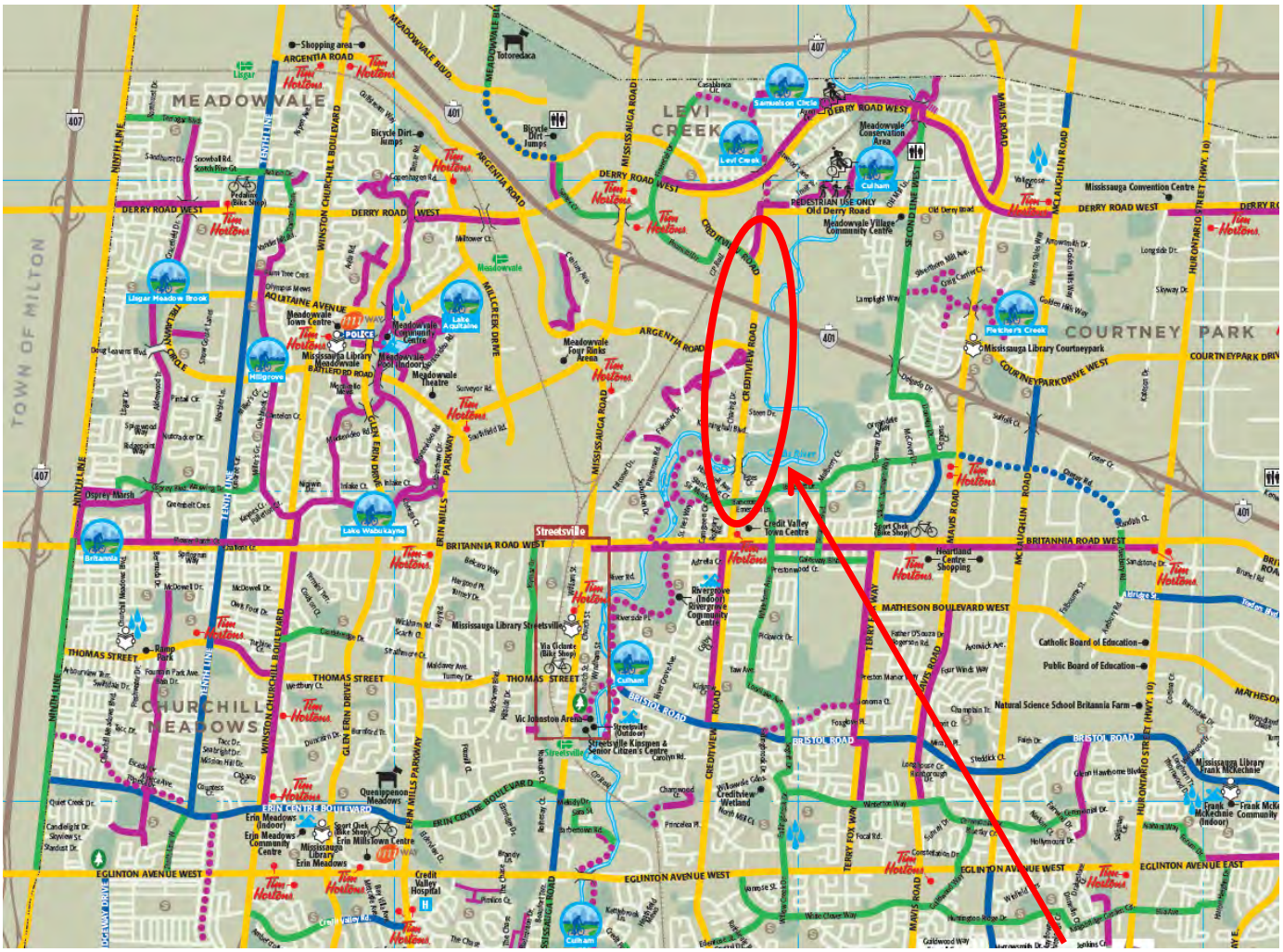


Figure 2-2: Existing Cycling Network in Northwest Mississauga



Source: 2014 Mississauga Bikeways and Trails Map

LEGEND:

- **Multi-Use Trail** — Paved path separate from the road, shared by pedestrians and bicycles
- **Multi-Use Trail** — Unpaved surface/crushed gravel or dirt trail, shared by pedestrians and bicycles
- **Park Path**
- **Signed Bicycle Routes** — Street signs indicate bike route, cars and bicycles share the road
- **Bicycle Lane** — Special pavement markings on street and signs identify lane reserved
- **Sharrow** — Shared use lanes by motorists and bicycles
- **Major Road**

2.2 Existing Transit Infrastructure and Service

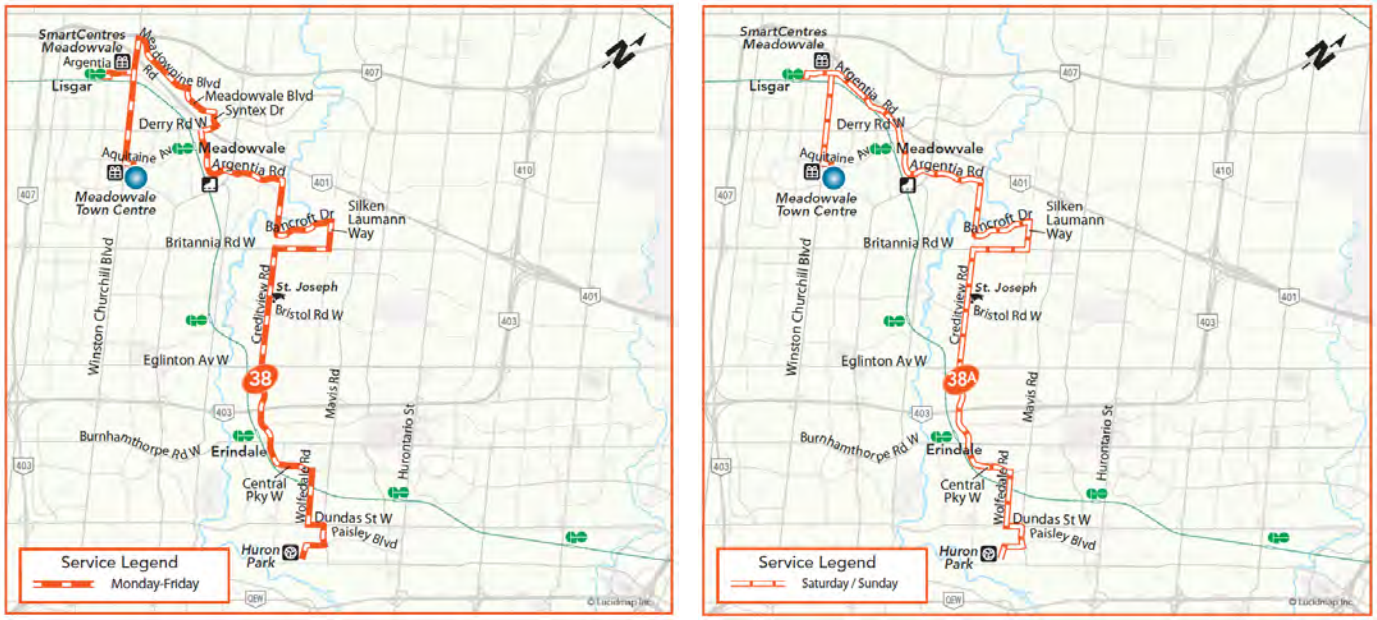
Transit infrastructure and service within the study area is limited. There are two MiWay transit routes, 38 and 38A Creditview–Argentia, which run along this section of Creditview Road. These routes follow the same routing through the study area, travelling on Creditview Road between Bancroft Drive and Argentia Road. The difference between the two routes is:

- Route 38 is the weekday service, and
- Route 38A is the weekend service.

South of the study area, Routes 38 and 38A follow the same routing, with the south terminus at Huron Park. Both routes share the same northern terminus at Meadowvale Town Centre, except the weekday Route 38 service and weekend Route 38A service follow different routes between Creditview Road and Meadowvale Town Centre. See **Figure 2-3** for further detail.

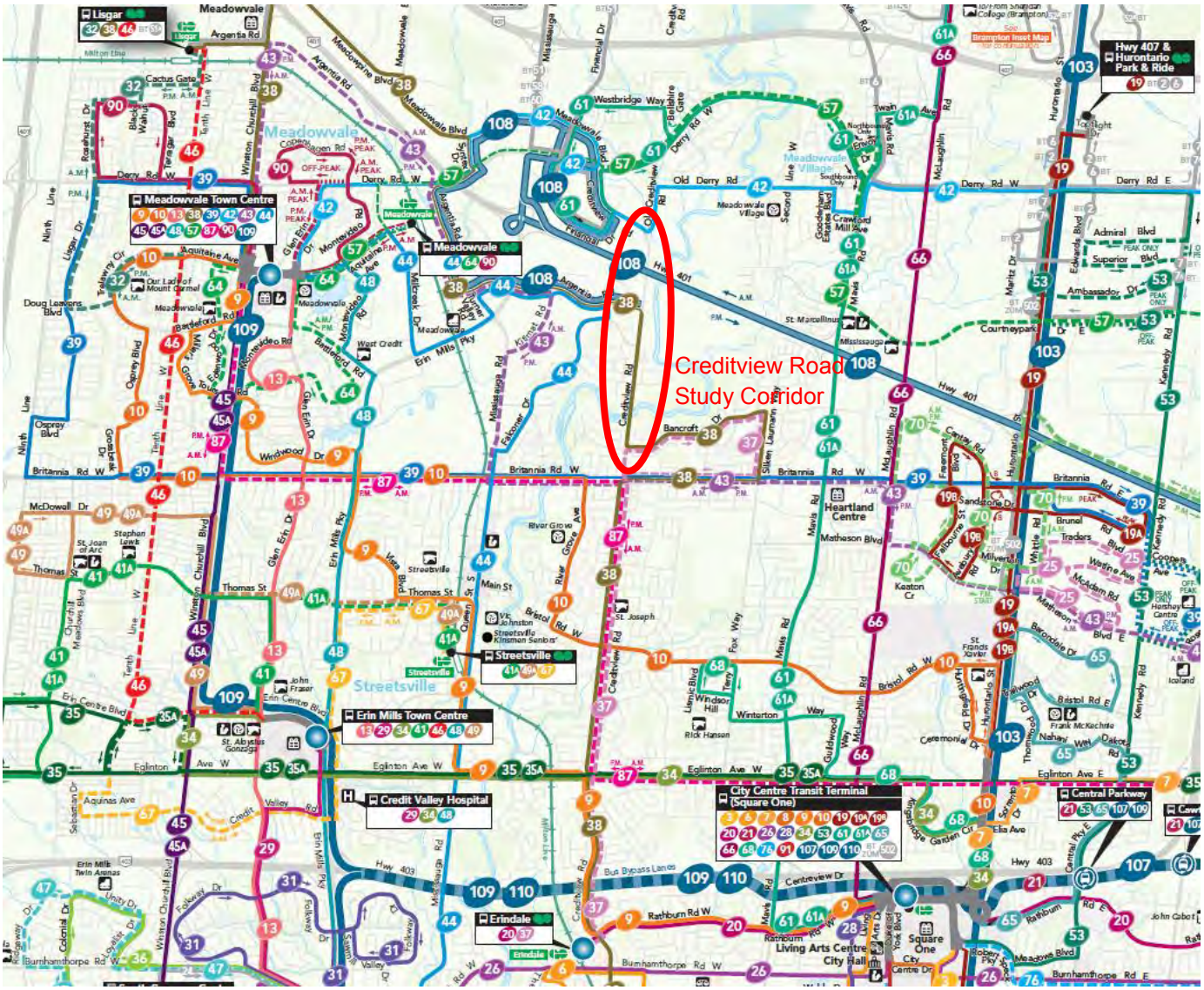
Figure 2-3 shows the route maps for MiWay Route 38 weekday and Route 38A weekend service. **Figure 2-4** shows the MiWay weekday route map for the vicinity of study area, showing connecting routes to the surrounding area.

Figure 2-3: MiWay Route 38 and 38A Route Maps



Source: MiWay website, retrieved October 2015

Figure 2-4: MiWay Weekday Route Map for Study Area Vicinity



Source: MiWay Weekday Service Map, September 2015

Route 38/38A currently provides a base level of service to the segment of Creditview Road under study. Headways on weekdays vary between 20 and 55 minutes, depending on the time of day. Saturday headways are 33 minutes and Sunday headways are 45 minutes. **Table 2-1** includes the approximate headways for all time periods during the week. The headways along Route 38/38A are too large for the route to be considered a "frequent" service; typically, headways must be approximately 10 minutes or less for a route to be considered frequent.

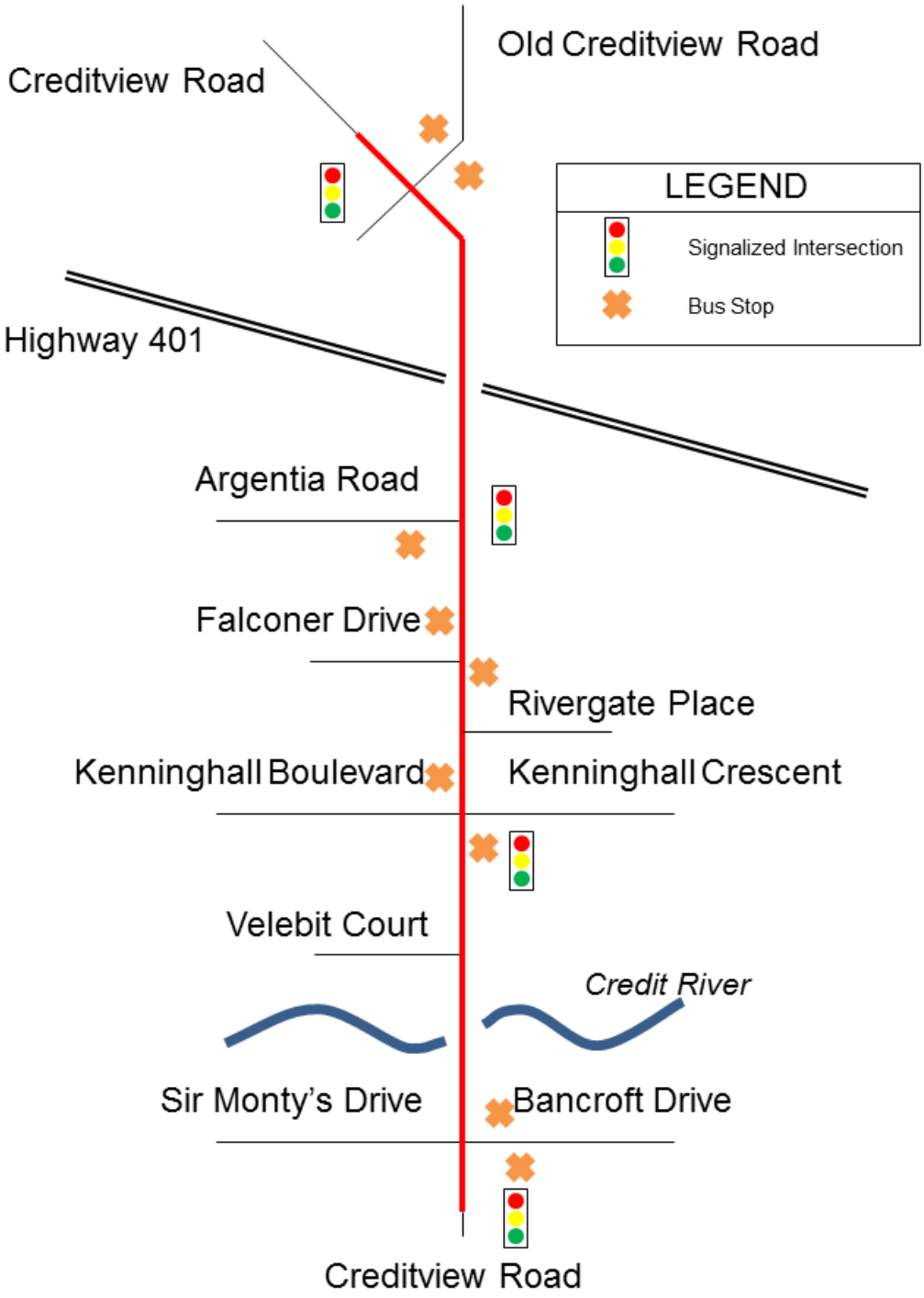
Table 2-1: Approximate Headways for Route 38/38A

Time Period (with approximate spans of service)	Weekday (Route 38)	Saturday (Route 38A)	Sunday (Route 38A)
Early AM (5:30 AM – 7:30 AM)	20–25 min	No service	No service
AM Peak (7:30 AM – 10:00 AM)	20–25 min	33 min	45 min *(service begins approx. 8:30 AM)*
Midday (10:00 AM – 3:00 PM)	30–40 min	33 min	45 min
PM Peak (3:00 PM – 7:30 PM)	20–25 min	33 min	45 min *(service ends approx. 8:00 PM)*
Evening (7:30 PM – 10:30 PM)	40–55 min	33 min	No service
Night (10:30 PM – 12:30 AM)	40–50 min	No service	No service

Source: Based on route schedules on MiWay website, retrieved October 2015

Transit infrastructure within the study area is limited to bus stops. There are no bus bays at any of the bus stops. None of the bus stops have shelters or other amenities for waiting passengers. **Figure 2-5** illustrates the locations of bus stops in the study area. All bus stops are for MiWay Route 38 / 38A except for the bus stops at the Creditview Road and Old Creditview Road intersection, which are for MiWay Route 42. The eastbound bus stop on Bancroft Drive just east of Creditview Road is also served by Route 37.

Figure 2-5: Bus Stops in Study Area



2.3 Condition of Existing Active Transportation and Transit Infrastructure

The existing active transportation and transit infrastructure in the study area limits varies in condition. In general, midblock sidewalk segments are in relatively good condition. The low number of midblock driveways along this section of Creditview Road provides uninterrupted sidewalk segments with few and localized conflict points between pedestrians and motorists. Bus stops are located in the vicinity of every signalized intersection in the study area, as well as at the Falconer Drive intersection.

Many of the active transportation infrastructure located at intersections has characteristics that do not reflect best practices. These conditions, primarily related to curb ramp or crosswalk position, are not necessarily contrary to a mandatory standard, but they would need to be modified to improve accessibility for people with disabilities and provide better guidance to drivers and sidewalk users about how to navigate or travel through the intersection. The preliminary design developed as part of this Environmental Assessment study should seek to improve these areas of concern. Further design considerations for active transportation and transit infrastructure have been provided in Section 4 of this document.

The following set of tables (2-2 through to 2-11) includes photos illustrating existing problems with active transportation and transit infrastructure along Creditview Road. The photos are organized by location, from south to north.

Table 2-2. Intersection with Sir Monty's Drive and Bancroft Drive

Area of Concern	Photo(s)
Westbound bus stop on Bancroft Drive just east of Creditview Road only has a concrete pad connecting the sidewalk and the curb at one door of the bus. This pad is acceptable for users of mobility devices that enter and exit through the front door of the bus. A full pad that provides a hard landing surface for users exiting the bus through the rear door increases the desirability of using the rear door (e.g., during or after storms when grass could be slippery or muddy).	
Inner edges of crosswalks at southwest (1) and northwest (2) corners intersect in the roadway. OTM Book 15 states that the desirable treatment is to have the two crosswalks intersect the curb separately and at least 2.0 m apart, with separate dropped curbs. An alternate, acceptable condition is to provide one dropped curb but to have the inner edges of the two crosswalks intersect at the curb.	

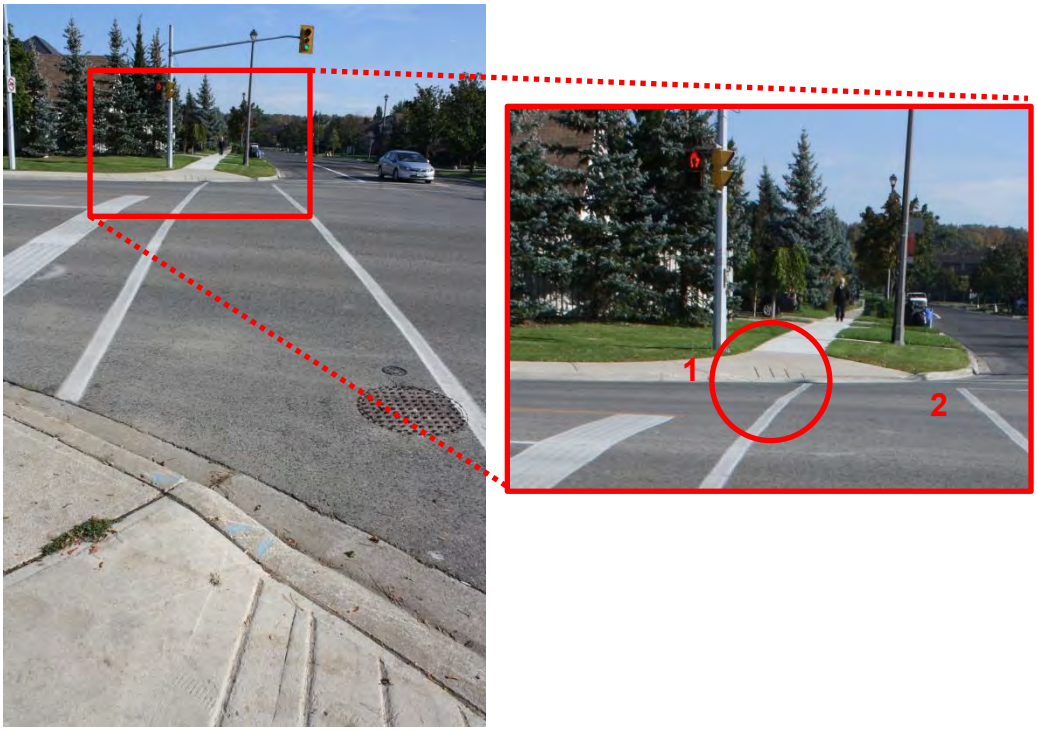
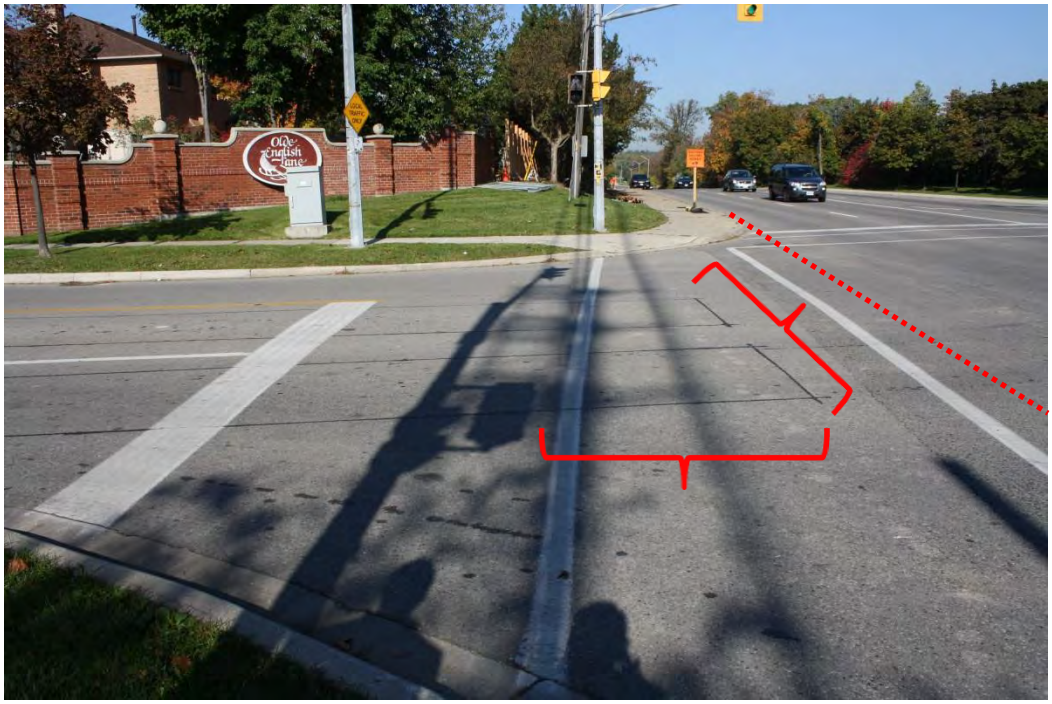
Tactile surface on northeast corner curb ramp (1) does not align with crosswalk. Inner edges of crosswalks at northeast corner (2) intersect in the roadway. The surface texture aiding people with visual impairments should be directed into the crosswalk to encourage crossing within the markings. As with the northwest and southwest corners describing in the previous row, the desirable treatment is to have the two crosswalks intersect the curb separately.	
Loop detectors on the eastbound (shown) and westbound approaches extend into the crosswalk. OTM Book 12 illustrates detectors extending into and through crosswalks and recommends that the loop detector begin no more than 4.5 m from the through edge of pavement (approximated by the dotted line). However, this arrangement rewards drivers who stop or needlessly creep in the crosswalk, obstructing north-south pedestrians. Locating detectors behind the crosswalk may minimize this behaviour.	

Table 2-3. Between Sir Monty's Drive / Bancroft Drive and Velebit Court

Area of Concern	Photo(s)
Sidewalk on east side of Creditview Road narrows to a substandard width (approximately 1.0 m) at the Credit River overpass. A similar narrowing occurs on the west sidewalk. These deficiencies will be addressed as part of the Credit River bridge reconstruction resulting from the separate Environmental Assessment for this bridge.	
Large gap in the west sidewalk (approximately 4 cm) at the south end of the Credit River bridge. Addressing of this deficiency falls within the scope of the completed Environmental Assessment for the Credit River bridge.	

Erosion on the west edge of the west sidewalk at the south end of the Credit River bridge has resulted in a steep dropoff that is a hazard to a pedestrian who accidentally steps off the sidewalk. Also, the guardrail is disconnected from the bridge parapet. If connected, the opportunity for pedestrians to step off the sidewalk would be decreased. Addressing of these deficiencies falls within the scope of the completed Environmental Assessment for the Credit River bridge.	

Table 2-4. Intersection with Velebit Court

Area of Concern	Photo(s)
North-south crosswalk markings missing across the Velebit Court approach (1). Also, there is no stop bar marked on Velebit Court (2). Adding crosswalk markings and a stop bar on the Velebit Court approach will increase visibility of the pedestrian crossing and improve guidance to drivers on Velebit Court about the appropriate place to stop at the intersection.	

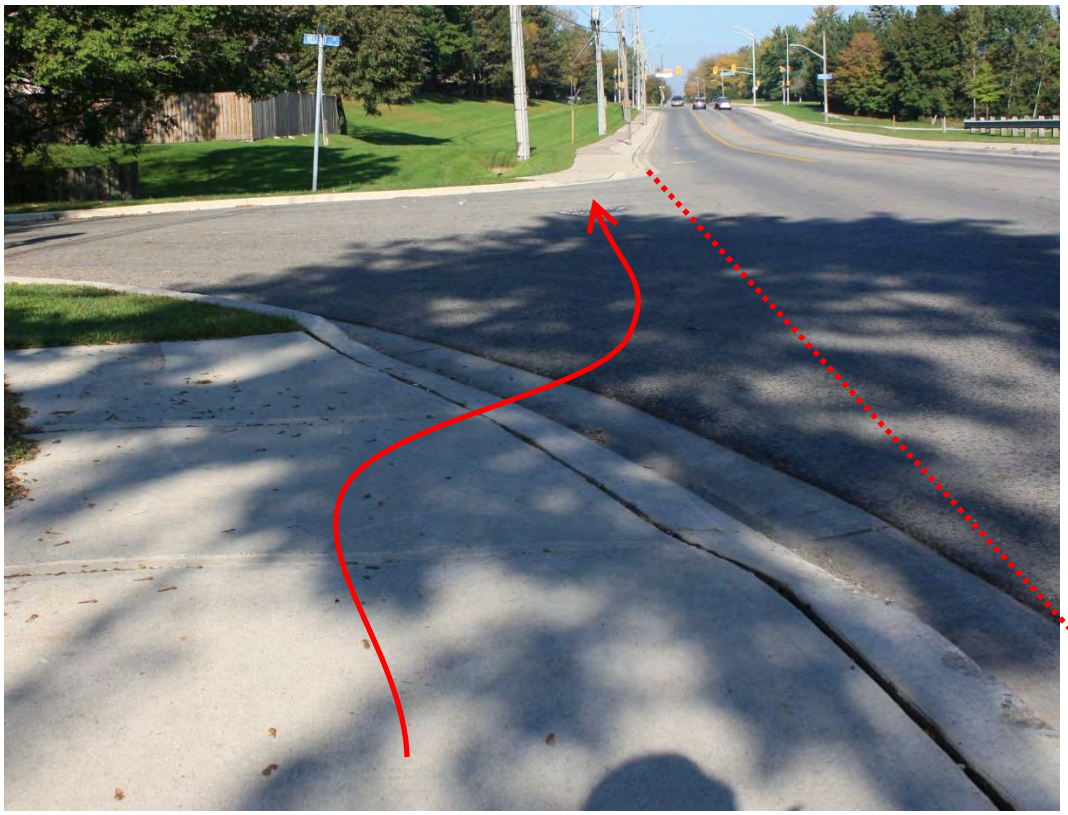
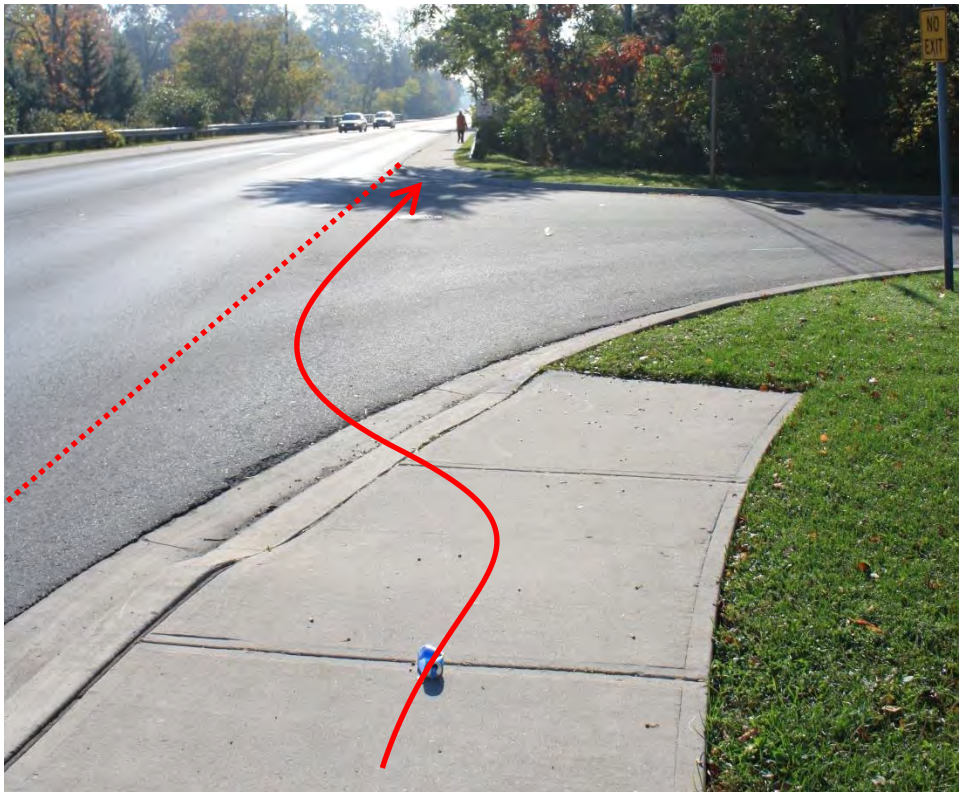
Dropped curb on southwest corner is nearly parallel to the direction of pedestrian traffic. A user of a mobility device would need to follow a zig-zag path (solid red arrow) to negotiate the dropped curb, placing the user close to the edge of the southbound lane on Creditview Road (edge marked with dotted line). Providing the dropped curb where it is more perpendicular to the direction of pedestrian traffic would permit less of a zig-zag, shorten the total crossing distance, and place pedestrians a little further away from traffic on Creditview Road.	
Dropped curb on northwest corner is nearly parallel to the direction of pedestrian traffic. A user of a mobility device would need to follow a zig-zag path (solid red arrow) to negotiate the dropped curb, placing the user close to the edge of the southbound lane on Creditview Road (edge marked with dotted line). Providing the dropped curb where it is more perpendicular to the direction of pedestrian traffic would permit less of a zig-zag, shorten the total crossing distance, and place pedestrians a little further away from traffic on Creditview Road.	

Table 2-5. Intersection with Kenninghall Boulevard / Kenninghall Crescent

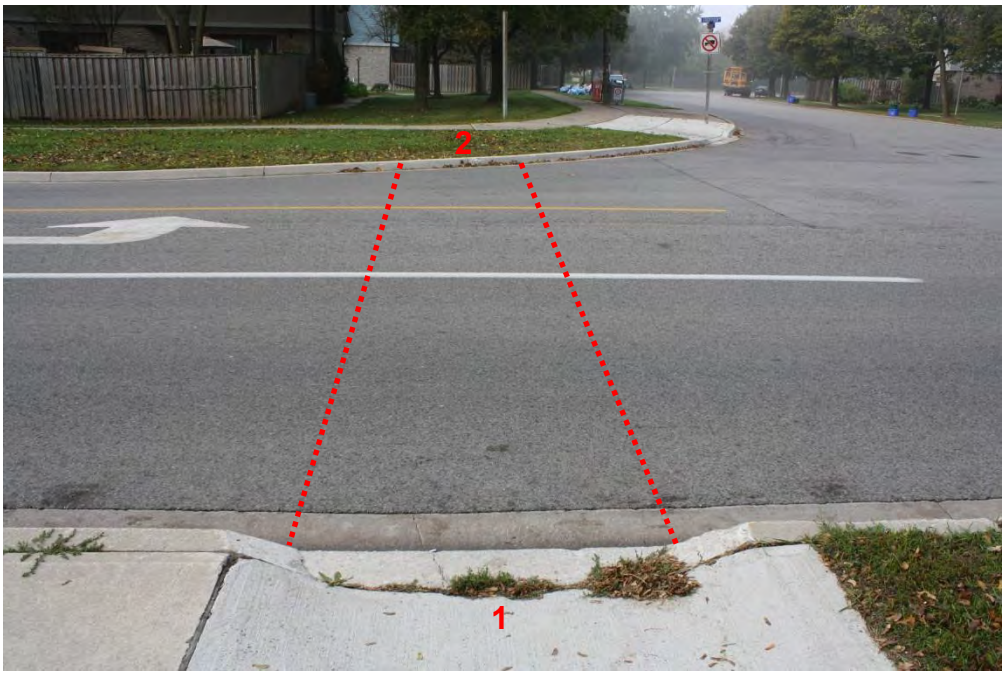
Area of Concern	Photo(s)
Raised curb between the south and east crosswalks (1) is less than 2.0 m. Inner edges of crosswalks at the northeast corner (2) intersect in the roadway. During the site visit, a person using a mobility scooter was observed traveling north in the east crosswalk (3). This person had to turn 90 degrees and wait in the roadway (4) until they received a "walk" indication to cross Creditview Road (5). OTM Book 15 states that the desirable treatment is to have the two crosswalks intersect the curb separately and at least 2.0 m apart, with separate dropped curbs. An alternate, acceptable condition is to provide one dropped curb but to have the inner edges of the two crosswalks intersect at the curb.	

Loop detectors on the westbound (shown) and eastbound approaches extend into the crosswalk. OTM Book 12 illustrates detectors extending into and through crosswalks and recommends that the loop detector begin no more than 4.5 m from the through edge of pavement (approximated by the dotted line). However, this arrangement rewards drivers who stop or needlessly creep in the crosswalk, obstructing north-south pedestrians. Locating detectors behind the crosswalk may minimize this behaviour.	

Table 2-6. Intersection with Rivergate Place

Area of Concern	Photo(s)
North-south crosswalk markings missing across the Rivergate Place approach (1). Also, there is no stop bar marked on Rivergate Place (2). Adding crosswalk markings and a stop bar on the Rivergate Place approach will increase visibility of the pedestrian crossing and improve guidance to drivers on Rivergate Place about the appropriate place to stop at the intersection.	

Table 2-7. Intersection with Falconer Drive

Area of Concern	Photo(s)
The east sidewalk along Creditview Road ends at the east side bus stop at Falconer Drive. At this point, there is no pedestrian crossing provided to the west side of Creditview Road to allow pedestrians to continue walking north on the west sidewalk. There is a curb ramp on the east side of the road (1) but no curb ramp on the west side (2); it is unclear whether an uncontrolled pedestrian crossing is intended here (marked in dotted lines). The lack of a pedestrian crossing at this intersection also increases the difficulty for people to walk between the east side bus stop and the Falconer Drive neighbourhood. Bus stops located across the street from development should have a controlled pedestrian crossing to accommodate transit users accessing or egressing the bus stop, with defined vehicle or pedestrian right-of-way. If a pedestrian crossing cannot be provided, the bus stop should be relocated.	  

North-south crosswalk markings missing across the Falconer Drive approach (1). Also, there is no stop bar marked on Falconer Drive (2). Adding crosswalk markings and a stop bar on the Falconer Drive approach will increase visibility of the pedestrian crossing and improve guidance to drivers on Falconer Drive about the appropriate place to stop at the intersection.	

Table 2-8. Between Falconer Drive and Argentia Road

Area of Concern	Photo(s)
Vegetation is overgrown near the west sidewalk between Falconer Drive and Argentia Road, causing many adults to duck or walk around in the boulevard to avoid walking into the vegetation.	

Table 2-9. Intersection with Argentia Road

Area of Concern	Photo(s)
The west sidewalk has segments in poor condition south of Argentia Road. Raised concrete slabs pose a tripping hazard to pedestrians who do not see the concrete lip.	
Loop detectors on the eastbound approach extend into the crosswalk. OTM Book 12 illustrates detectors extending into and through crosswalks and recommends that the loop detector begin no more than 4.5 m from the through edge of pavement (approximated by the dotted line). However, this arrangement rewards drivers who stop or needlessly creep in the crosswalk, obstructing north-south pedestrians. Locating detectors behind the crosswalk may minimize this behaviour.	 

Table 2-10. Between Argentia Road and Old Creditview Road

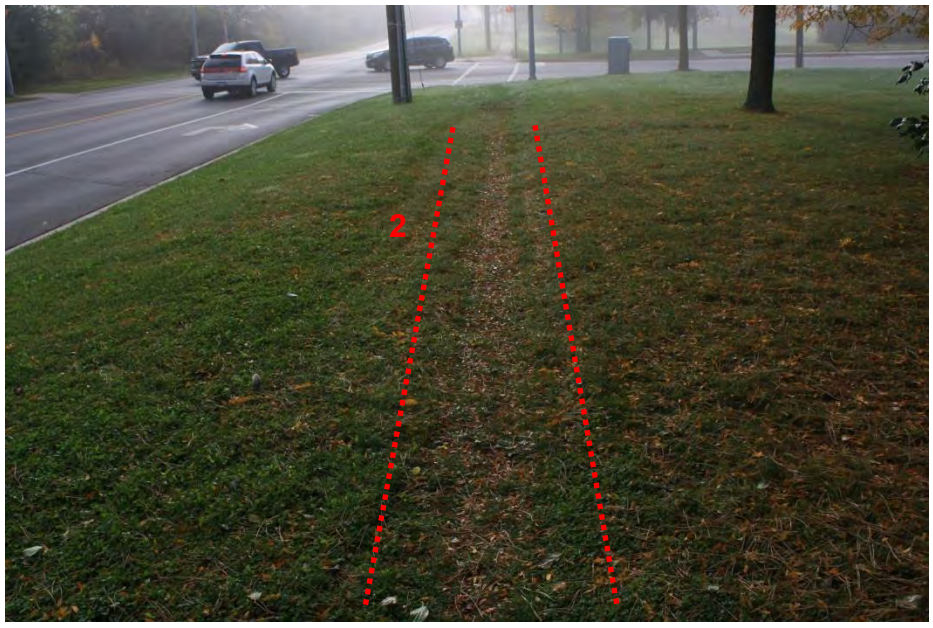
Area of Concern	Photo(s)
Bicycle tracks (1) and a bicycle or foot desire line, which has collected leaves due to the depression in the soil (2), are visible in the boulevard on the west side of Creditview Road north of Argentia Road. Despite the lack of a sidewalk along Creditview Road between Argentia Road and Old Creditview Road, there appears to be bicycle and pedestrian demand along this segment.	 

Table 2-11. Intersection with Old Creditview Road

Area of Concern	Photo(s)
The pedestrian push button on the southeast corner to cross Creditview Road is on the wrong side of the signal mast. The push button should be positioned on the other side of the signal mast, as indicated by the red arrow, so the button can be easily reached by pedestrians approaching the crosswalk.	
The concrete footing of the signal mast on the southeast corner is raised above the surface of the walkway. A manhole located in the walkway is also raised above the walkway surface. Both of these items are located in the walking path toward the west crosswalk. These raised objects are tripping hazards for pedestrians walking at this corner and should instead be flush with the surrounding walkway surface.	

Dropped curb on southwest corner is nearly parallel to the direction of pedestrian traffic. A user of a mobility device would need to follow a zig-zag path (solid red arrow) to negotiate the dropped curb, likely needing to leave the crosswalk. This situation is worsened by the narrow crosswalk width. Providing the dropped curb where it is more perpendicular to the direction of pedestrian traffic would permit less of a zig-zag, shorten the total crossing distance, and place pedestrians a little further away from traffic on Creditview Road. Also, OTM Book 15 states that crosswalks should be at least 2.5 m wide; this crosswalk is narrower than this minimum.	 
The west crosswalk across Creditview Road is not straight. The crosswalk bends in the middle of the road. Crosswalks should be straight and directly connect the curb ramp on each side of the road.	 

The pedestrian push button on the northwest corner is not able to be reached from the sidewalk by some pedestrians. This is evident from the bare area in the grass adjacent the sidewalk. Pedestrian push buttons should be easily accessible from the sidewalk or an extension of the sidewalk. Pedestrians should not have to leave the hard surface to reach the push button.	
The north approach from the multi-use trail on Old Creditview Road is poorly aligned with the crosswalks from this quadrant on Old Creditview Road. The solid line traces the proper path for someone wishing to cross Old Creditview Road. However, the most direct path for people walking follows the dashed line, which is well outside of the designated crosswalk. The trail approach should gently swing away from the roadway to encourage pedestrians to approach the edge of the road at the crosswalk. Also, the crosswalk should be pulled away from Creditview Road to decrease the crossing distance.	

The bus stop on the northeast corner is not connected to a sidewalk. A desire line is visible in the grass leading to the bus stop. The bus stop should connect to the crosswalks at the intersection with a sidewalk so that pedestrians can access the bus stop.	 
There is no sidewalk on the east side of Creditview Road south of Old Creditview Road. A desire line is visible in the grass boulevard, leading toward the gravel shoulder on the Highway 401 overpass approach. A sidewalk should be constructed along Creditview Road to allow people to walk on a hard surface instead of in the grass or on a shoulder.	 

2.4 Existing Trip Patterns and Mode Shares

2.4.1 Active Transportation Usage

The use of walking or cycling along the corridor is currently limited. The turning movement counts provided show very low volumes of pedestrians traveling along or crossing the Creditview Road corridor in the study area during the peak periods. The turning movement counts do not include cycling data. Anecdotal observations made during the site visit on October 10, 2013 indicate that there is a small volume of pedestrians that use or cross Creditview Road, typically to access bus stops or for recreational purposes. A very low volume of people were observed cycling along Creditview Road.

2.4.2 Peel Region GPS Cycling Survey

In the second half of 2012, the Region of Peel joined with the University of Waterloo to complete a survey of a group of people who cycle within Peel Region. This survey was intended to gain insight on trip purposes for cycling trips, rationale behind route selection and what infrastructure needs are observed by people who cycle frequently. Approximately 200 people were selected to participate in the survey. Though the sample group in this survey was small, the survey was important to gather the observations and opinions of existing cyclists in Peel Region that use existing infrastructure. Key findings from this survey that are pertinent to the Creditview Road corridor were as follows:

- Most households of survey participants owned at least one auto, though there are generally fewer autos in these households than licensed drivers.
- Existing cyclists tend to have incomes higher than average.
- The largest obstacle to cycling, as perceived by survey participants, is that cycling feels unsafe due to motorists and traffic. Five of the top six identified obstacles are related to discomfort and a poor feeling of safety due to auto traffic or road conditions.
- Cycling off-season (i.e., winter) has about one-quarter to one-third of the mode share that it has in-season. People who change modes change to either autos or public transport.
- Approximately 17% of all origin-destination pairs had a shortest roadway connection that is at least 50% greater than the “as the crow flies” distance. However, when the trail network is combined with the road network, only 7% of all origin-destination pairs had a shortest roadway connection that is at least 50% greater than the “as the crow flies” distance.

2.4.3 Existing Transit Usage

MiWay collects detailed trip- and stop-level information for its bus routes, including Route 38 Creditview–Argentia. Data was collected in autumn 2012 as part of the MiWay Autumn 2012 Ridership Count. The data collected included one weekday, one Saturday, and one Sunday. This data was compiled and analyzed for the segment of the route travelling between Bancroft Drive and Argentia Road. Within this segment, there are three northbound stops and four southbound stops (including stops adjacent to Creditview Road on Bancroft Drive or Argentia Road).

Table 2-12 contains a summary of the stop-level data for Route 38 and Route 38A for bus stops in the study area. Weekdays have the highest number of boardings, followed by Saturdays, then Sundays; this pattern is typical of many transit routes serving residential and employment areas. Throughout the week, trip patterns are oriented to and from the south; more boardings occur on southbound buses than northbound buses and more alightings occur on northbound buses than southbound buses.

Table 2-12: Summary of Route 38 / 38A Stop-Level Data in the Study Area

Northbound		Bancroft Dr at Creditview Rd		Creditview Rd at Kenninghall Cres		Creditview Rd at Falconer Dr		Total Study Area	
		Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
Weekday	Early AM	2	1	0	0	2	0	4	1
	AM Peak	2	4	1	3	1	1	4	8
	Midday	2	1	1	2	2	2	5	5
	PM Peak	0	2	0	0	0	2	0	4
	Evening	0	1	0	0	0	1	0	2
	Night	0	0	0	0	0	0	0	0
	TOTAL	6	9	2	5	5	6	**13**	**20**
Saturday	AM Peak	0	0	0	0	0	0	0	0
	Midday	0	1	0	1	2	3	2	5
	PM Peak	0	0	0	3	2	0	2	3
	Evening	0	1	0	0	0	1	0	2
	TOTAL	0	2	0	4	4	4	**4**	**10**
Sunday	AM Peak	0	0	0	0	0	0	0	0
	Midday	0	0	1	1	1	0	2	1
	PM Peak	0	0	1	0	0	0	1	0
	TOTAL	0	0	2	1	1	0	**3**	**1**

Southbound		Argentia Rd at Creditview Rd		Creditview Rd at Falconer Rd		Creditview Rd at Kenninghall Blvd		Bancroft Dr at Emerson Ln		Total Study Area	
		Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
Weekday	Early AM	1	0	1	0	0	0	0	1	2	1
	AM Peak	5	0	7	0	2	0	4	0	18	0
	Midday	5	0	1	0	3	0	0	1	9	1
	PM Peak	2	0	2	1	0	0	1	4	5	5
	Evening	0	0	0	0	0	0	1	1	1	1
	Night	0	0	0	0	0	0	0	0	0	0
	TOTAL	13	0	11	1	5	0	6	7	**35**	**8**
Saturday	AM Peak	0	0	2	0	2	0	0	1	4	1
	Midday	1	0	2	2	2	0	4	1	9	3
	PM Peak	1	1	2	0	1	0	0	0	4	1
	Evening	0	1	0	0	0	0	0	0	0	1
	TOTAL	2	2	6	2	5	0	4	2	**17**	**6**
Sunday	AM Peak	0	0	0	0	0	0	0	0	0	0
	Midday	4	1	1	0	4	0	2	0	11	1
	PM Peak	5	1	0	2	0	0	0	0	5	3
	TOTAL	9	2	1	2	4	0	2	0	**16**	**4**

Source: Route 38 ridership data, provided by MiWay

Table 2-13 contains a summary of the trip-level data for Route 38 and Route 38A. Consistent with the stop-level data, weekdays have the highest number of boardings, followed by Saturdays, then Sundays. Averaged per trip, weekdays also have the highest amount of boardings, though Sundays have an equal or slightly greater number of boardings per trip than Saturday. On weekdays, boardings per trip are highest during the AM peak, midday, and PM peak. Boardings per trip are fairly consistent through most of Saturday and throughout Sunday. Overall, approximately two to three percent of boardings along the route occur within the study area.

Table 2-13: Summary of Route 38 / 38A Trip-Level Data

		Northbound			Southbound		
		Boardings per Period	# of Trips per Period	Average Boardings per Trip	Boardings per Period	# of Trips per Period	Average Boardings per Trip
Weekday	Early AM	97	4	24	50	2	25
	AM Peak	368	8	46	418	8	52
	Midday	555	13	43	520	13	40
	PM Peak	406	8	51	369	8	46
	Evening	105	5	21	104	6	17
	Night	38	3	13	32	3	11
	TOTAL	**1569**	**41**	**38**	**1493**	**40**	**37**
Saturday	AM Peak	59	3	20	116	4	29
	Midday	261	10	26	255	9	28
	PM Peak	109	4	27	105	4	26
	Evening	69	5	14	64	4	16
	TOTAL	**498**	**22**	**23**	**540**	**21**	**26**
Sunday	AM Peak	23	1	23	0	0	N/A
	Midday	192	7	27	204	7	29
	PM Peak	89	3	30	61	3	20
	TOTAL	**304**	**11**	**28**	**265**	**10**	**27**

Source: Route 38 ridership data, provided by MiWay

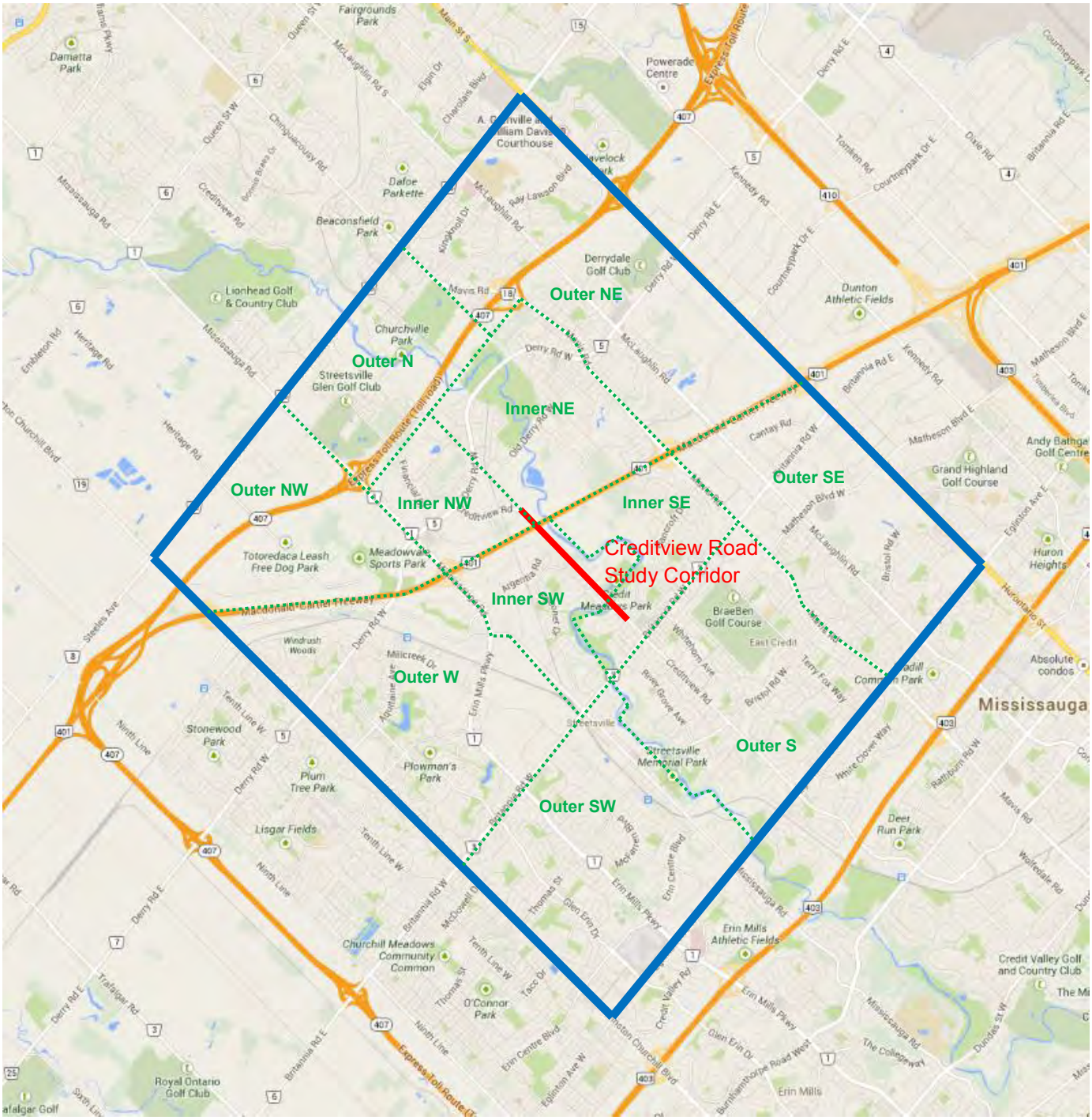
2.4.4 Study Area Trip Patterns

To further assess existing active transportation and transit usage in the corridor, data from the 2006 Transportation Tomorrow Survey (TTS) was analyzed for the study area. TTS data cannot provide direct information on the volumes of people walking or cycling along Creditview Road, since the trip data gathered does not include the routes used by people using these modes. Though TTS collects route choice data for transit trips, such data may not be representative for low-volume routes such as Route 38/38A. However, TTS data is useful in ascertaining the active transportation and transit mode shares in nearby aggregated traffic zones.

For the purposes of this report, a “multimodal study area” with an approximate radius of five to seven kilometres from the study area was selected for more comprehensive analysis. The boundary of this multimodal study area is Winston Churchill Boulevard, Steeles Avenue, Hurontario Street, and Eglinton Avenue. This multimodal study area is divided into two rings: an inner ring within approximately two kilometres of the segment of Creditview Road under study and an outer ring around the perimeter of the multimodal study area. The inner ring represents traffic zones

that are within a walking or short cycling distance of Creditview Road and the outer ring represents traffic zones that are within a moderate cycling distance of Creditview Road. The selection of these distances will be discussed further in Section 3. The inner ring is divided into four superzones and the outer ring is divided into seven superzones. Figure 2-6 illustrates the multimodal study area and included superzones.

Figure 2-6: Multimodal Study Area Used for this Report



Background Image Source: Google Maps, retrieved December 2013

The first step in the assessment of trip patterns was a look at peak period trips to and from the multimodal study area. (The AM peak period was selected as the primary peak period for analysis throughout this report because the future mode share targets are based on the AM peak period.) **Figure 2-7** and **Figure 2-8** show the existing peak period trips originating in and destined for, respectively, the multimodal study area. Approximately 40% of the AM peak period trips originating in or destined for either the inner ring or outer ring of the multimodal study area have both trip ends within the multimodal study area. For the PM peak period, this figure is about 35%; this figure is lower in the PM because the PM peak period includes few school trips, while the AM peak period includes most school trips. These figures demonstrate that approximately one-third of the travel demand beginning or ending in the multimodal study area stays within this study area and is a short- or medium-distance trip.

Figure 2-7. Existing Peak Period Trips Originating in the Multimodal Study Area

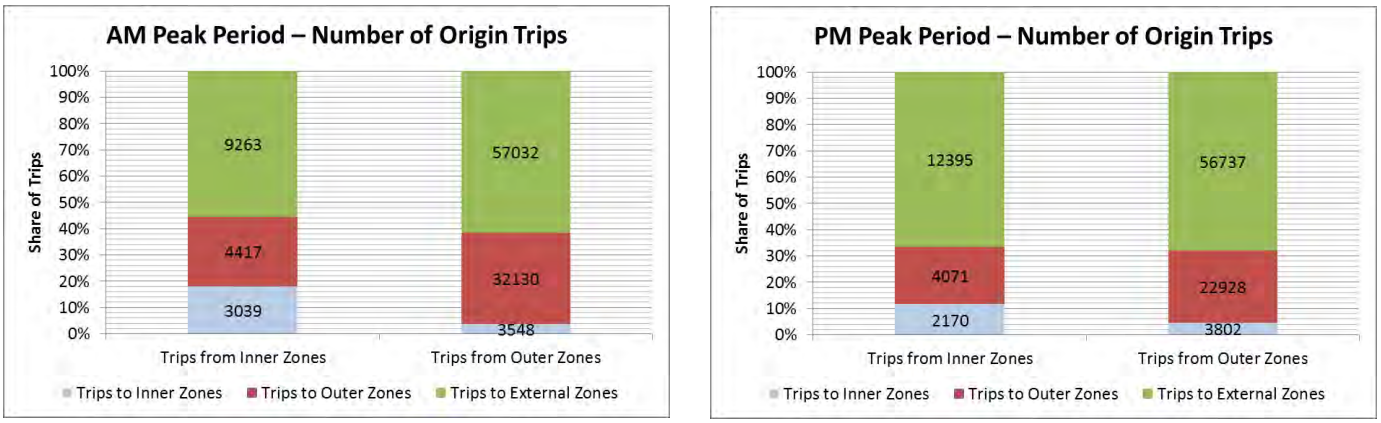
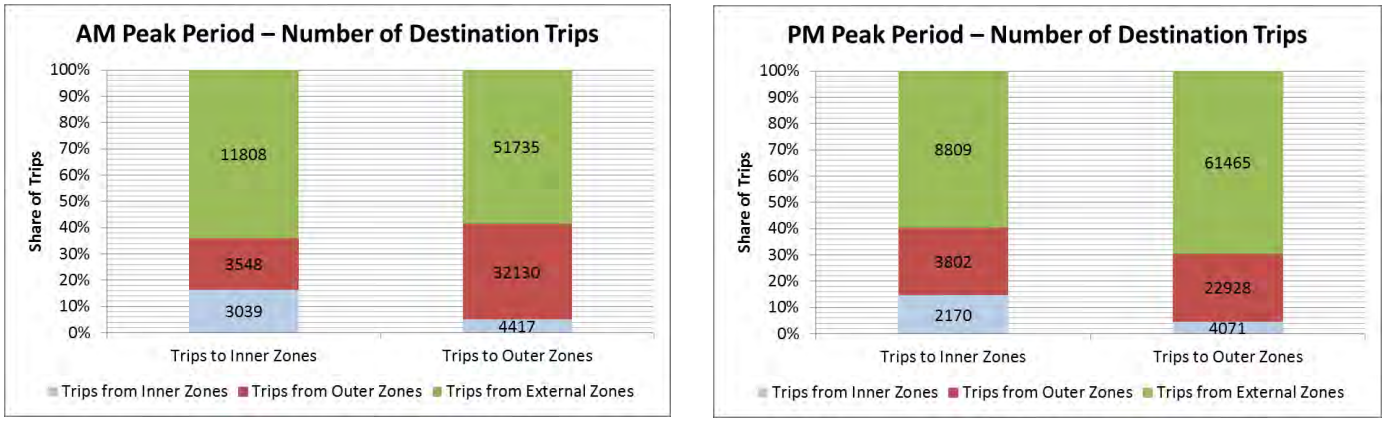


Figure 2-8. Existing Peak Period Trips Destined for the Multimodal Study Area



The next set of figures looks at the modal split for trips originating in or destined for the inner ring of the multimodal study area. **Figure 2-9** shows the mode splits for trips originating in the multimodal study area in the AM peak period and destined for the multimodal study area in the PM peak period. **Figure 2-10** shows the mode splits for trips destined for the multimodal study area in the AM peak period and originating in the multimodal study area in the PM peak period.

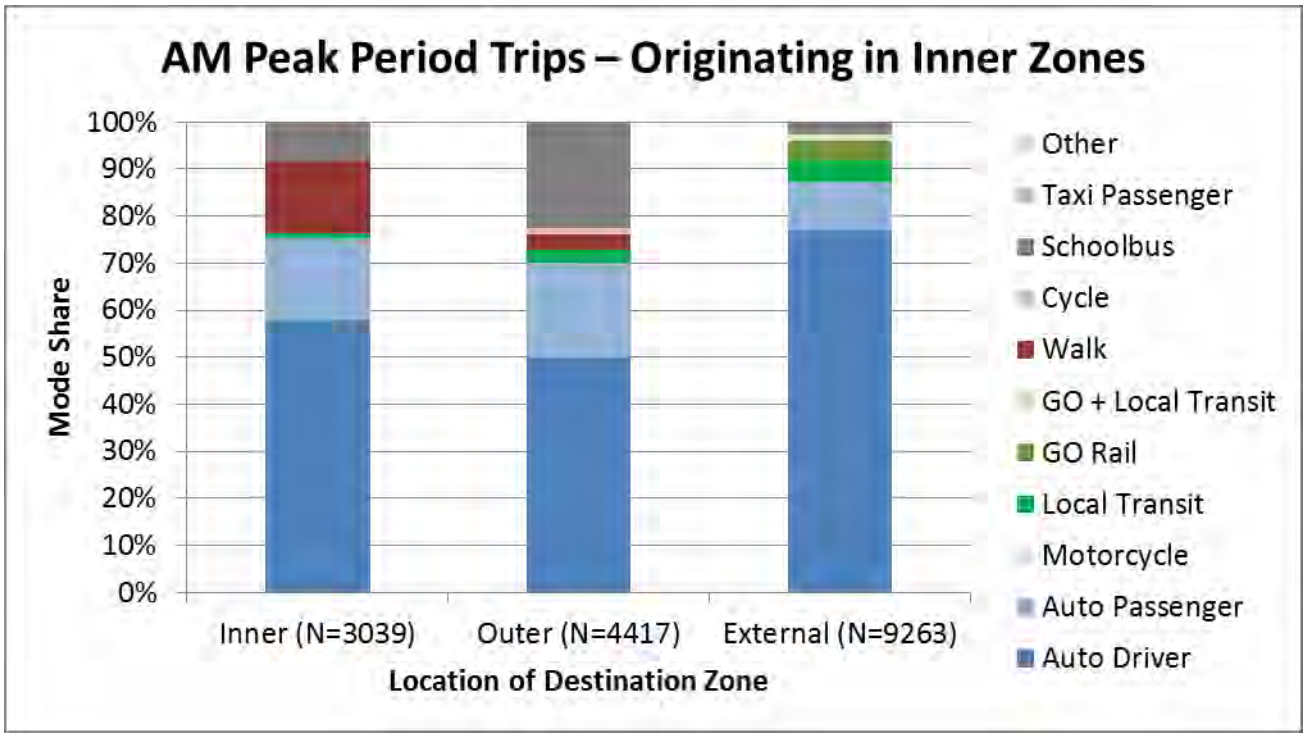
As can be seen in these two figures, the mode shares and trip volumes for trips in one direction in the AM peak period are similar to the mode shares for trips in the opposite direction in the PM peak period. This trip pattern makes sense because of the large presence of residential and office land uses within the inner ring, both of which typically generate AM peak period trips that return in the PM peak period. The main exception to this pattern is that

the school bus mode share is approximately five to ten percentage points higher in the AM than the PM for trips staying within the multimodal study area (inner or outer). This difference is consistent with the previous set of figures, as most school trips are included in the AM peak period but few school trips are included in the PM peak period.

The mode share figures clearly show the high level of auto usage within the inner ring of the multimodal study area. Trips within the inner ring, shown in the “inner” columns, have an auto driver mode share of approximately 60% and a total auto mode share of approximately 80%. Most trips within the inner ring are less than five kilometres, meaning that most trips are within a walking distance or within a short cycling distance of about 15 minutes for a typical person. Despite the short distances, most people are choosing to use cars, increasing the amount of auto traffic on streets within the inner ring; a portion of these trips likely use Creditview Road. Trips between the inner ring and outer ring, shown in the “outer” columns, have an auto driver mode share of approximately 70% and a total auto mode share of approximately 90%. Most of these trips are between two and ten kilometres, representing a maximum cycling distance of about 30 minutes for a typical person or a reasonable trip using local transit.

The TTS survey does not include any questions on why a person chooses to use the mode that they use. However, some inferences can be made when comparing the data to the built environment of the multimodal study area. The multimodal study area has been built in a suburban fashion with separated land uses and fairly low densities. Combined with a consistent grid of arterials and collectors, most with two or more lanes per direction, the multimodal study area is auto-oriented. The active transportation network is incomplete, particularly for cycling. People who wish to cycle within the multimodal study area typically have to share lanes with cars on high-speed arterials and collectors, which is an unattractive option for most people. The transit network is also weak; there is a complete lack of rapid transit within the multimodal study area and most bus routes do not run frequent service; resulting in long travel times if a transfer is required. The poor non-auto mode choices in the study area mean that this environment is not just auto-oriented, but also auto-dependent.

Figure 2-9: Mode Shares for Existing Multimodal Study Area Peak Period Trips: AM Outbound and PM Inbound



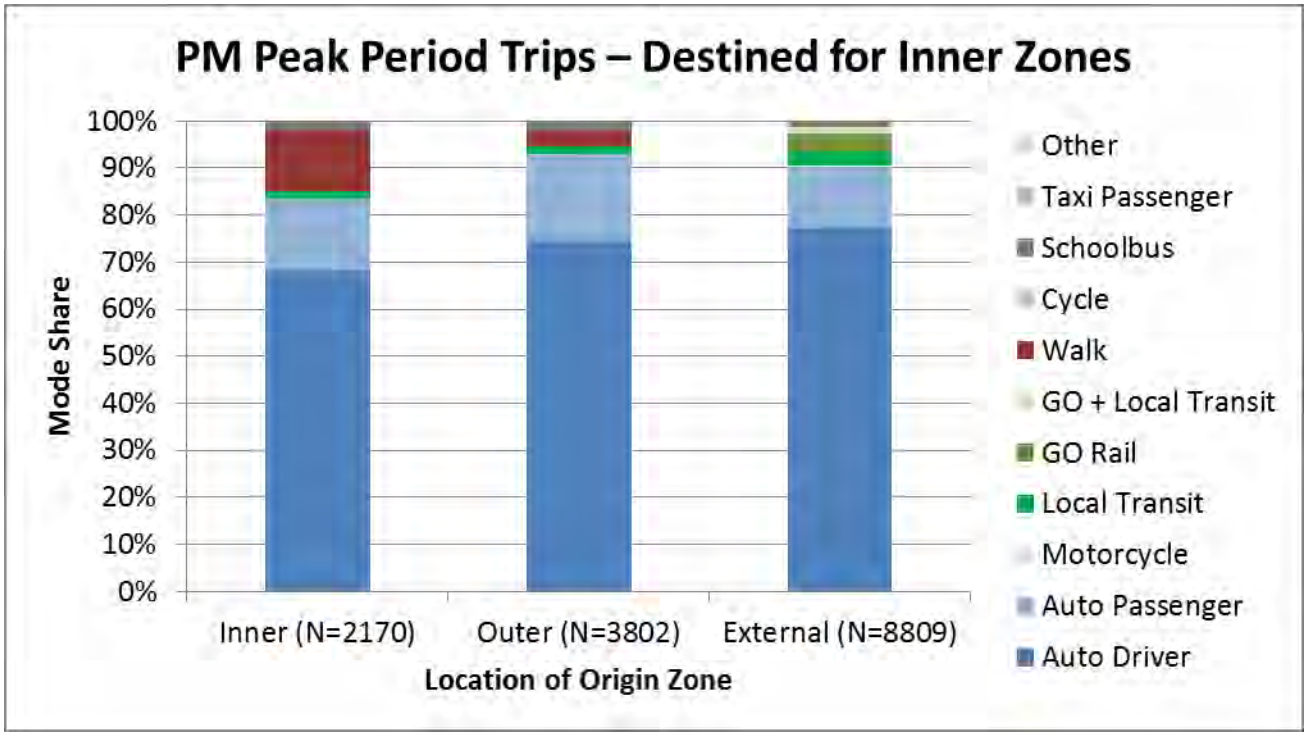
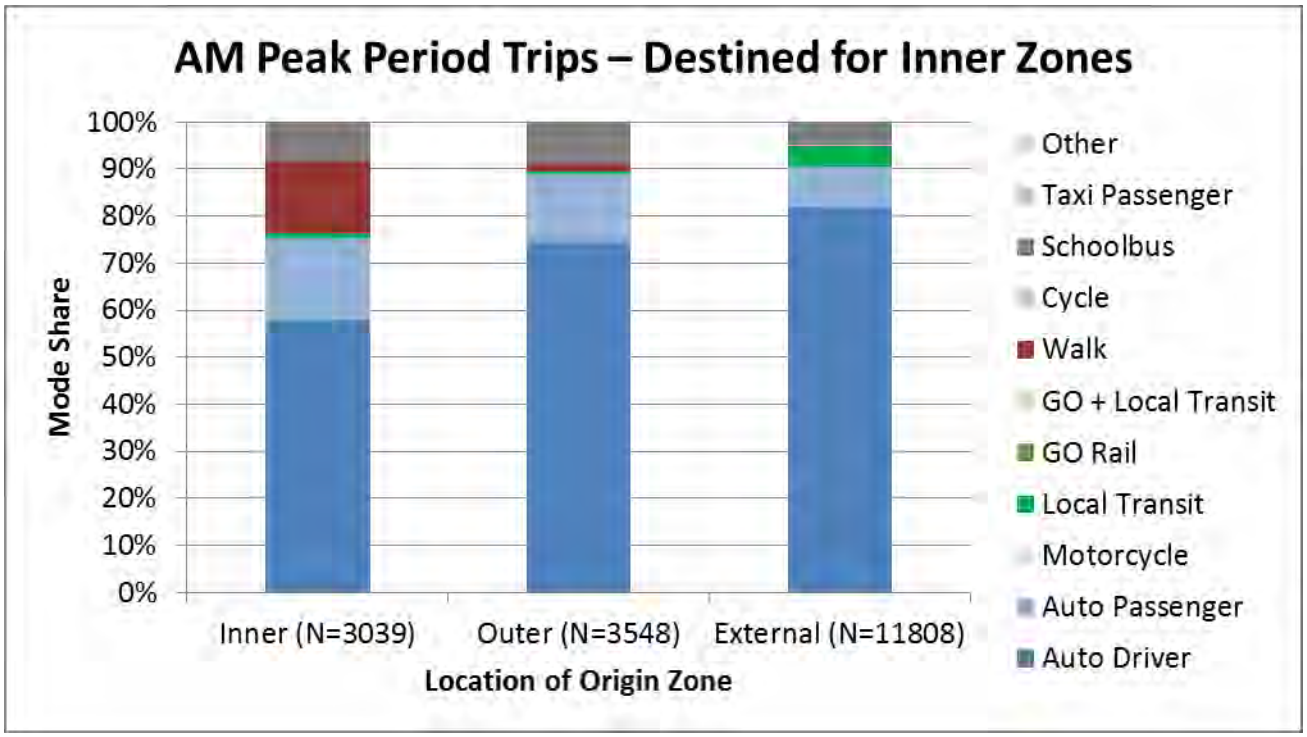
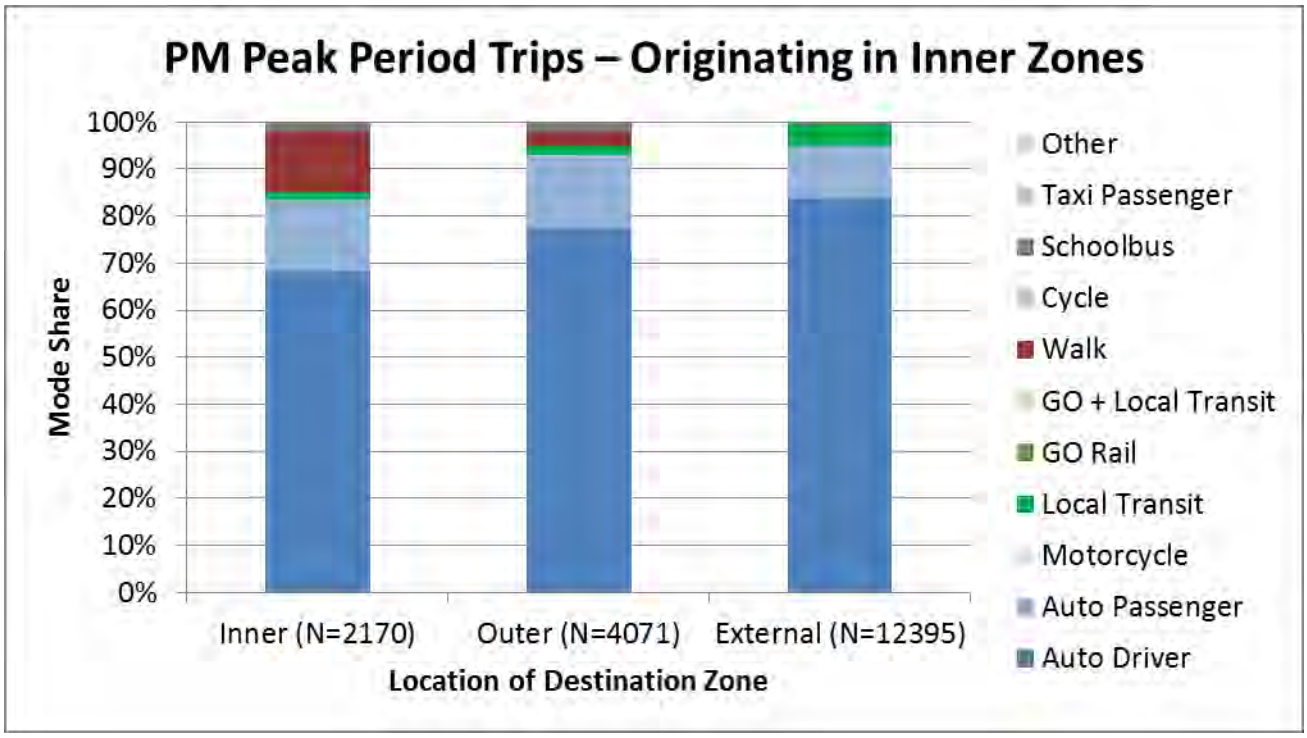


Figure 2-10: Mode Shares for Existing Multimodal Study Area Peak Period Trips: AM Inbound and PM Outbound





3. Background Conditions Assessment

Expansions and other improvements are planned for both the active transportation and transit networks in the vicinity of the Creditview Road corridor. These plans impact the type of infrastructure that should be considered and implemented as part of the corridor reconstruction and are discussed in the following sub-sections.

3.1 Planned Active Transportation Infrastructure

Active transportation infrastructure is planned both along the Creditview Road corridor and within the vicinity. Two major plans are currently in place that have defined planned future active transportation infrastructure; these plans are:

1. The Mississauga Cycling Master Plan (MCMP); and
2. The Peel Active Transportation Study (PATS).

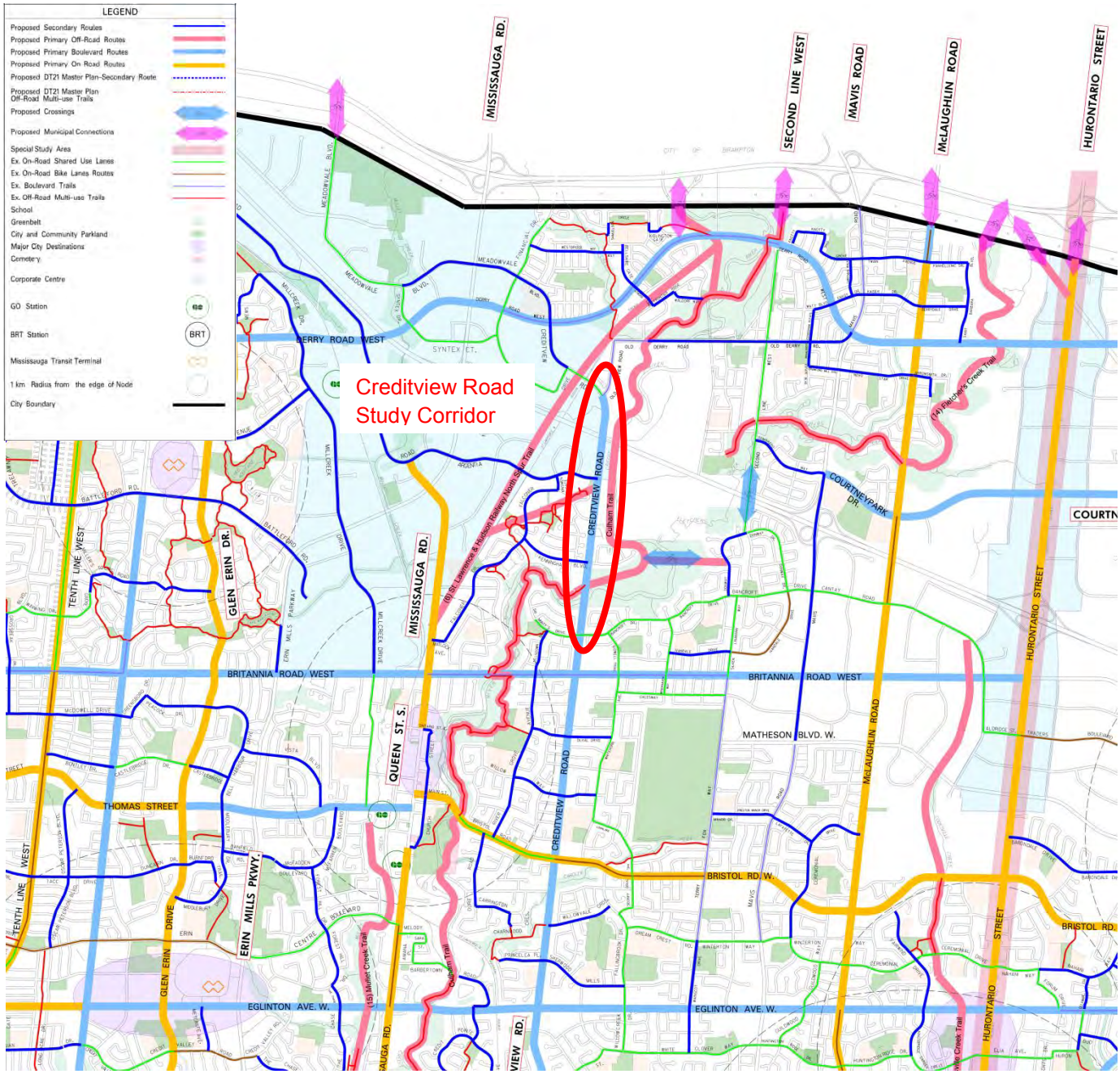
The MCMP covers facilities along city streets or off-road, while the Peel plan covers facilities along Regional roads.

3.1.1 Mississauga Cycling Master Plan

The Mississauga Cycling Master Plan was completed in 2010 to provide a comprehensive policy and infrastructure plan for improving cycling in Mississauga. The document discusses the existing policy and regulatory framework, current and potential cycling activity, the proposed network, design standards, bicycle parking, and cycling promotion.

Along Creditview Road, the MCMP proposes a multi-use trail from Rathburn Road to Old Creditview Road; the portion north of Sir Monty's Drive / Bancroft Drive falls within the study area of this corridor. This multi-use trail would connect to the existing multi-use trail along Old Creditview Road. The Creditview Road multi-use trail would also connect to the Britannia Road multi-use trail via a future planned extension of the Creditview Road multi-use trail south of Sir Monty's Drive / Bancroft Drive. The MCMP also proposes on-road cycling infrastructure along Argentia Road and Kenninghall Boulevard. **Figure 3-1** shows proposed cycling infrastructure in Northwest Mississauga from the MCMP.

Figure 3-1: Proposed Local Cycling Infrastructure in Northwest Mississauga



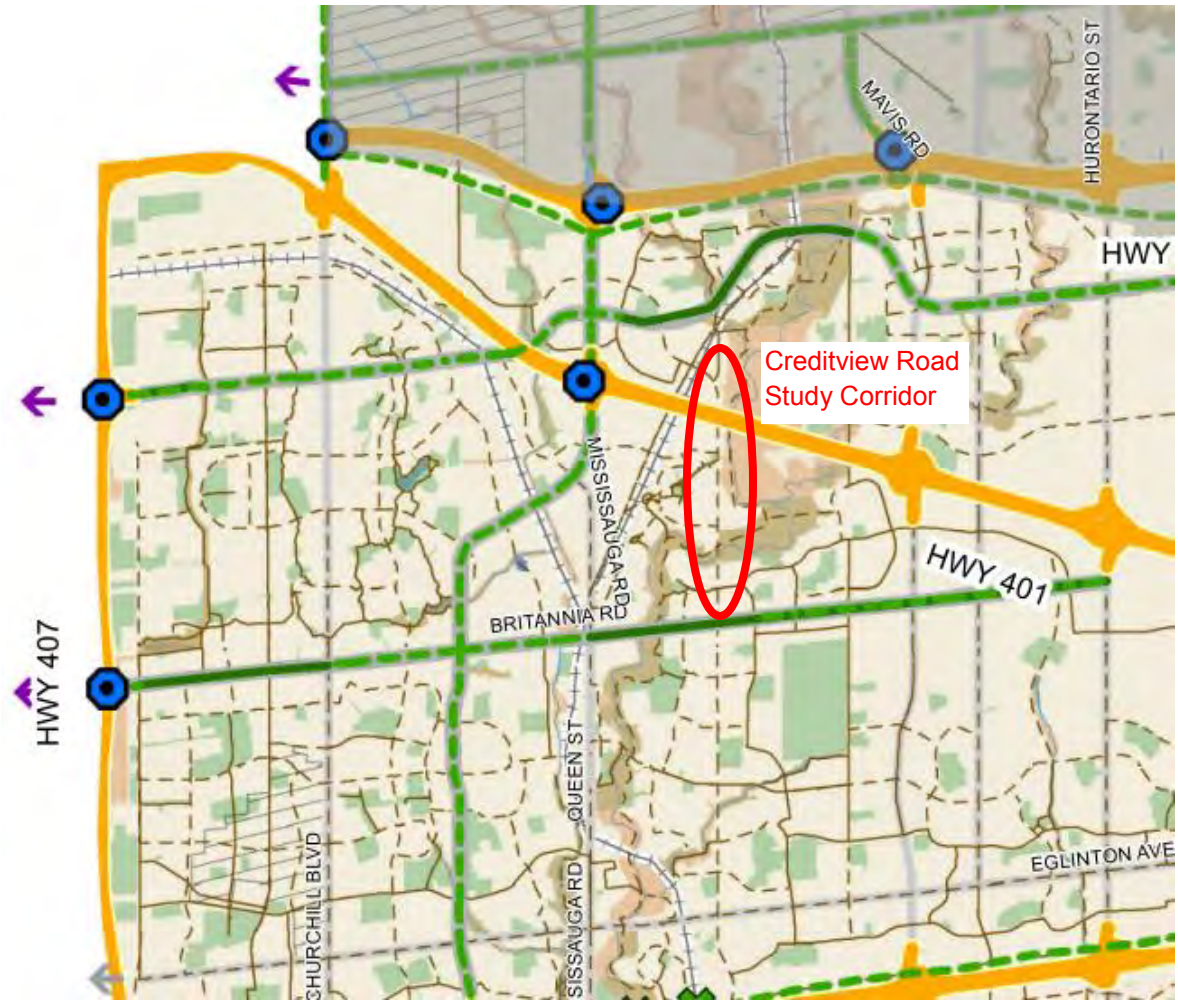
Source: Mississauga Cycling Master Plan, 2010

3.1.2 Peel Active Transportation Study

The Peel Active Transportation Study was completed in 2012 and is the Region of Peel's first regional active transportation plan. The PATS explores existing travel patterns and travel attitudes within Peel Region. The PATS recommends an integrated program of policies, programming, and infrastructure along regional roads. The PATS was developed with extensive public and stakeholder consultation.

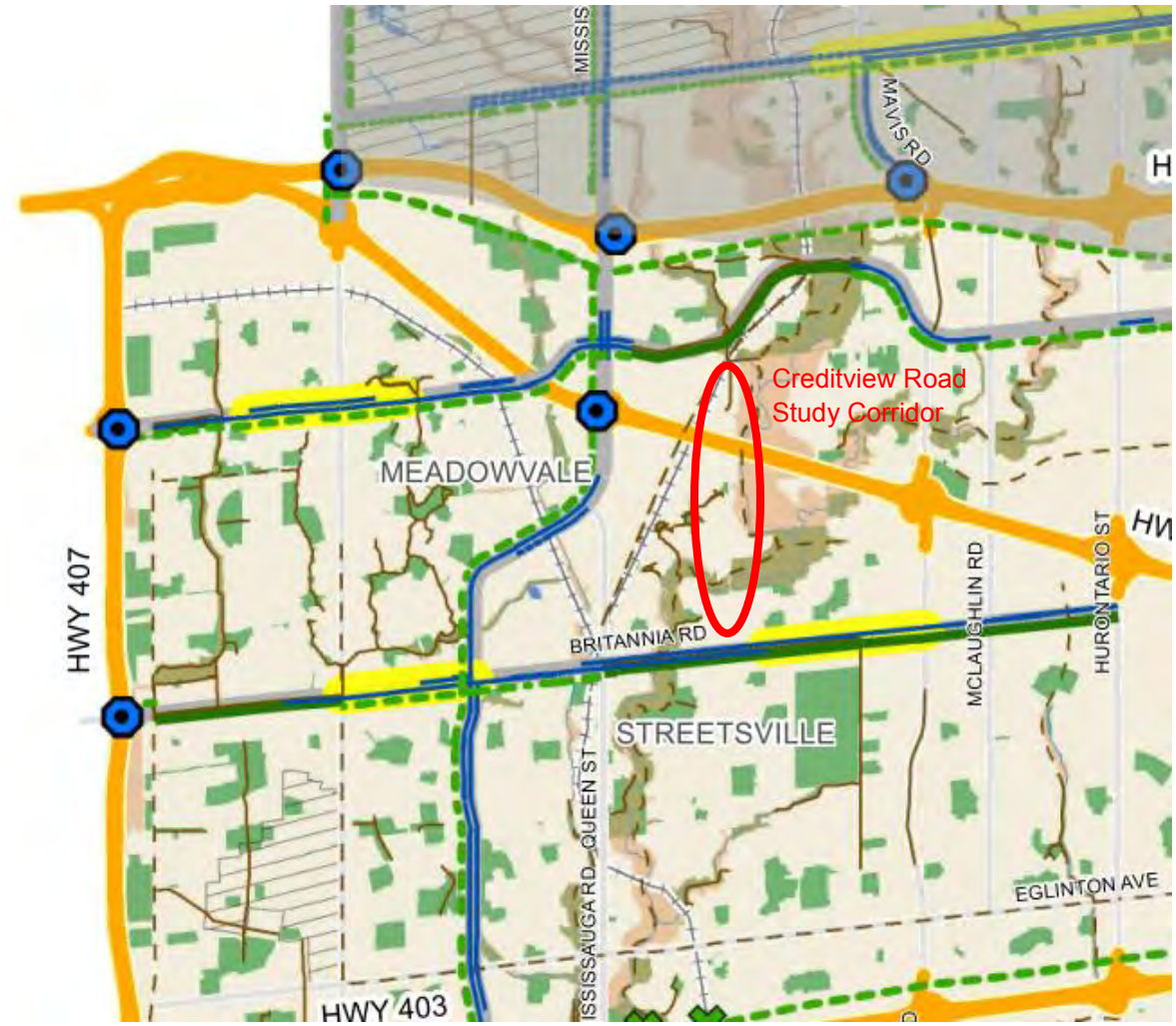
Figure 3-2 shows cycling infrastructure in Northwest Mississauga proposed in the PATS. **Figure 3-3** shows pedestrian infrastructure in Northwest Mississauga proposed in the PATS. No regional roads pass through the Creditview Road study area, though several regional roads are within a walking or cycling distance of the study area, including Britannia Road, Mississauga Road / Erin Mills Parkway, and Derry Road.

Figure 3-2: Proposed Regional Cycling Infrastructure in Northwest Mississauga



Source: Peel Active Transportation Study, 2012

Figure 3-3: Proposed Regional Pedestrian Infrastructure in Northwest Mississauga



Source: Peel Active Transportation Study, 2012

3.2 Planned Transit Infrastructure and Service

Along the segment of Creditview Road under study, there are no planned improvements to transit infrastructure or service. However, Route 38/38A provides connections to future transit infrastructure or transit services with planned improvements. Route 38/38A connects with Dundas Street approximately seven to eight kilometres south of the study area. A BRT (bus rapid transit) line is planned along Dundas Street from Kipling Station in Toronto to Brant Street in Burlington. Combined with Route 38/38A, the Dundas BRT will improve connections between residential and employment areas near the study area with much of southern Mississauga, southern Etobicoke, northern Oakville, and northern Burlington. Route 38/38A also connects with Hurontario Street south of Dundas Street. A LRT (light rail transit) line is planned along Hurontario Street from Port Credit to downtown Brampton.

The Milton GO rail line is located southwest of the Creditview Road study corridor and passes through the multimodal study area. This rail line currently has peak-direction service, with trains toward Toronto in the AM peak period and trains toward Milton in the PM peak period. Off-peak service is provided using buses. The Milton GO rail line is planned to have all-day, two-way rail service by 2031. Route 38 connects with the Milton GO rail line at Lisgar GO station, though using this station for trips to and from downtown Toronto would be out of the way for trips beginning or ending along Creditview Road. Other routes in the area, such as Routes 37 and 44, provide more direct connections to GO.

In addition to these direct connections, Route 38/38A connects with routes that serve major transit terminals, such as Routes 9, 10, 20, and 34 connecting to Square One Terminal, offering connections to most of the GTHA.

3.3 Potential Future Active Transportation and Transit Usage

As shown in Section 2.4, most trips in the study area are currently completed by car, reflecting the low-density, spread-out land uses in the study area. Travellers' preferences for using the car are reinforced by the disconnected walking network, missing cycling network, and infrequent transit network within the study area. However, future improvements in active transportation and transit in the area may provide an opportunity for increasing active transportation and transit use in the area.

Transit use may be able to increase in the future if improvements to Route 38 / 38A are made. Currently, Route 38 can accommodate up to 150 passengers per hour per direction (pphpd) during peak periods, though not all of this capacity is utilized. There are fewer than 80 boardings and alightings on Route 38 at the three stops in the study corridor. Very large increases in mode share are required to substantially increase transit ridership and reduce auto usage in the corridor. The highest existing transit mode shares in and out of the inner study area are for long-distance trips, likely for trips to and from downtown Toronto via GO. Future investments in the GO rail network, as well as the Mississauga BRT, Dundas BRT, and Hurontario LRT, will increase the attractiveness of using transit and may encourage more use of Route 38 along Creditview Road and other nearby routes. Given the distance that the study area is from these higher-order links, substantial investment in local bus service would be required to encourage many users of the corridor to shift to transit.

Active transportation, particularly cycling, likely has a greater opportunity for growth in the study area. The provision of cycling infrastructure along Creditview Road completes a key missing link in the cycling network in the area and would provide an interchange-free crossing of Highway 401. This crossing would likely attract cyclists from nearby crossings that are more hazardous to traverse, such as through the Mississauga Road interchange, and may encourage additional cycling for trips crossing Highway 401. A cycling facility along Creditview Road would bring the local cycling network to the doorstep of the Meadowvale employment area, particularly businesses on the east end of Argentia Road.

Mississauga does not have explicit mode share targets in their Official Plan or Cycling Master Plan. However, in the Regional Transportation Plan, there is a mode share target for the Greater Toronto and Hamilton Area (GTHA) of 20 percent for active transportation. No split by jurisdiction is provided, but it is reasonable to assume that suburban parts of the GTHA, where most trips in the GTHA occur, would likely need to achieve a 15 percent active transportation mode share, with higher mode shares in the urban centres.

Approximately 40 percent of existing trips in and out of the inner zones of the multimodal study area stay within the multimodal study area, most of which are less than 10 km. Most of the growth potential for active transportation in the study area comes from these shorter-distance trips. If the 15 percent suburban active transportation mode share is applied to the study area, nearly 40 percent of the trips within the multimodal study area would need to occur by active transportation. Due to the distances between land uses, most would need to be completed by bicycle.

A rough estimate of the potential active transportation demand would be to apply the 15 percent mode share to the projected auto traffic in the corridor. This would assume that the traffic on Creditview Road represents a mix of trip lengths consistent with general travel patterns in the area. This assumption is conservative because longer-distance trips are more likely to use arterial roads or freeways, such as Highway 401 or Mississauga Road / Erin Mills Parkway, meaning that Creditview Road may disproportionately carry shorter-distance trips that could be more easily converted to active transportation. The bidirectional peak hour traffic south of Argentia Road along Creditview Road is projected to be more than 2500 vehicles per hour. The bidirectional peak hour traffic north of Argentia Road along Creditview Road is projected to be between 2000 and 2500 vehicles per hour.

Therefore, if regional mode share targets are achieved, future active transportation volumes could be on the order of 300 to 400 people per peak hour (bidirectionally), most of whom would be expected to cycle instead of walk due to travel distances. This volume is substantial enough to affect traffic operations by increasing delay for turning vehicles, especially if these pedestrians and cyclists are congregated onto one side of the road.

4. Preferred Solution and Design Considerations

The overall environmental assessment has determined that the Preferred Solution for Creditview Road maintains the two-lane cross section from north of the Bancroft Drive / Sir Monty's Drive intersection to south of the Argentia Road intersection and widens to a four-lane cross section from south of the Argentia Road intersection to Old Creditview Road. The intersections along the corridor will have the following controls:

- Bancroft Drive / Sir Monty's Drive: Signal control
- Velebit Court: Two-way stop control
- Kenninghall Boulevard / Kenninghall Crescent: Single-lane roundabout
- Rivergate Place: Two-way stop control
- Falconer Drive: Single-lane roundabout
- Argentia Road: Double-lane roundabout
- Old Creditview Road: Signal control

The Preferred Solution is expected to support traffic operations in the study area until at least 2031. A Long-Term Solution has been developed for potential implementation after 2031; this solution includes widening Creditview Road to four lanes from Bancroft Drive to Argentia Road. This solution also includes the implementation of double-lane roundabouts at Kenninghall Boulevard and Falconer Drive, replacing the single-lane roundabouts in the Preferred Solution. It is understood that the City will implement a monitoring program on Creditview Road to ensure the Preferred Solution continues to meet the needs of the community. Additional information about the Preferred and Long-Term Solutions are included in the Environmental Study Report (ESR).

The following subsections describe the recommended active transportation and transit concepts along Creditview Road, as well as design features to be considered further in advance of project implementation.

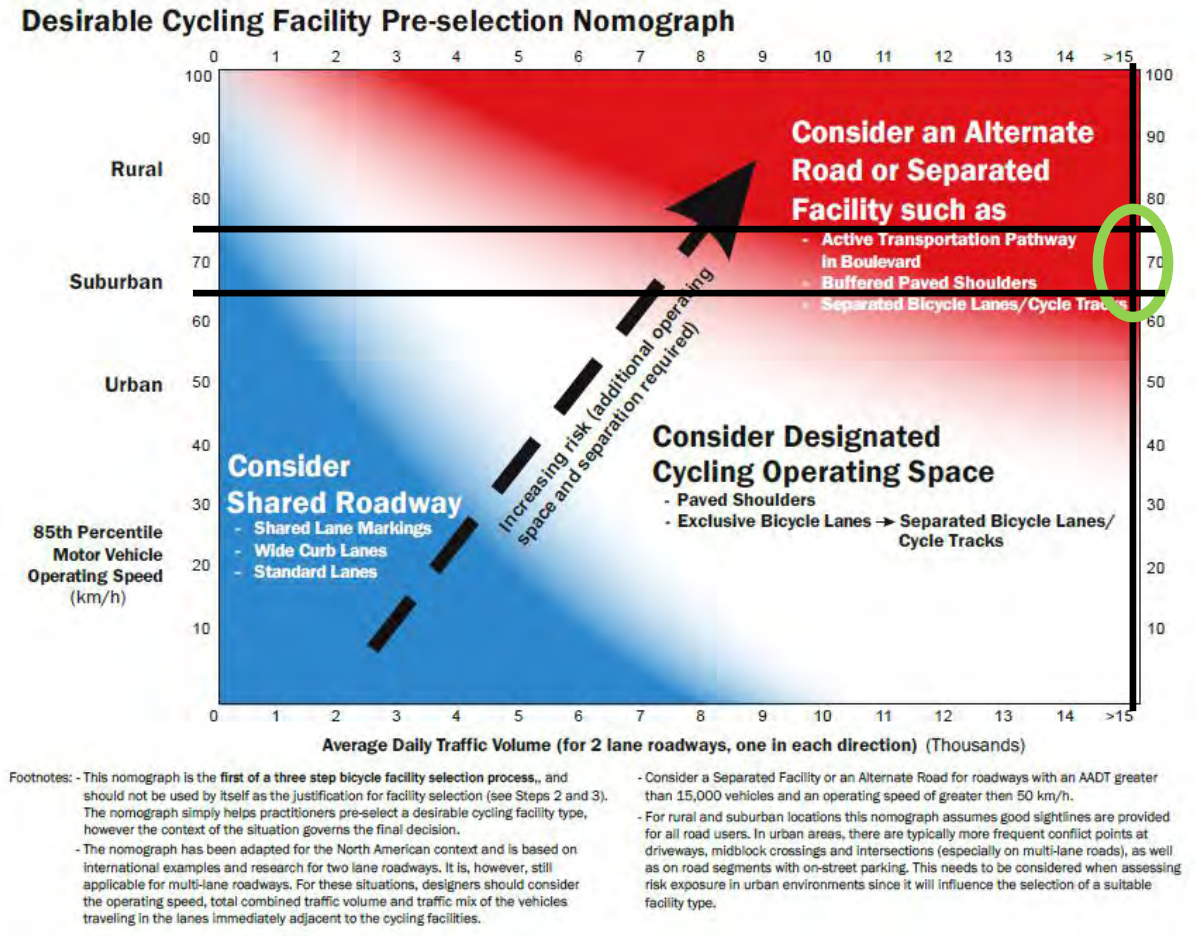
4.1 Recommended Active Transportation Concept for Creditview Road

Ontario Traffic Manual (OTM) Book 18 outlines a three-step process for selecting the most desirable cycling facility along a street. The first step uses a "pre-selection nomograph" based on auto speed and volume to determine the category of cycling infrastructure that may be appropriate: shared bicycle/auto lanes, designated bicycle space, or a physically separated facility. The second step incorporates site-specific conditions to refine the facility type selection. The third step is to justify the decision and identify design enhancements that help integrate the facility into the street.

4.1.1 Step 1: Facility Pre-Selection

Figure 4-1 illustrates the desirable cycling facility pre-selection nomograph for Creditview Road. The annual average daily traffic (AADT) is projected to be well over 20,000 by 2031. The nomograph is based on the AADT of the curb lanes. Creditview is planned to have two lanes along more than half of the corridor, with four lanes along the northern portion of the corridor; the pre-selection has been based on the two-lane section. Based on previous speed studies, Creditview Road has an existing 85th-percentile operating speed of approximately 65 to 75 km/h. The nomograph indicates that, at this volume and speed, a physically separated facility (such as an active transportation pathway [multi-use trail], separated bicycle lanes, or cycle tracks) or use of an alternate street is desirable.

Figure 4-1. Desirable Cycling Facility Pre-Selection Nomograph for Creditview Road



4.1.2 Step 2: Facility Selection Based on Site-Specific Conditions

The second step includes an inventory of site-specific conditions that may affect the choice of cycling facility. OTM Book 18 identifies six primary and seven secondary criteria to further consider when determining the appropriate type of bicycle facility. **Table 4-1** lists the primary criteria, site characteristics for each criteria, relevant supporting details for Creditview Road, and suggested facility type resulting from these conditions. In this corridor, most primary criteria suggest physically separated cycling infrastructure is appropriate.

Table 4-1. Review of Primary Criteria and Application to Creditview Road

Site Characteristic	Creditview Road	Suggested Facility Type
85th-Percentile Motor Vehicle Operating Speed		
High (70 to 89 km/h)	• Existing 85th-percentile speed is up to 75 km/h	Physical separation of bicycles and motor vehicles is most appropriate.
Motor Vehicle Volumes		
High volume (greater than 10,000 AADT on a two-lane road)	• 20,000+ AADT by 2031	Physical separation of bicycles and motor vehicles may be most appropriate.
Other Characteristic: Turning volumes	• Most turns are across the west side of Creditview Road, particularly at Argentia Road	Design treatments considered in Section 4.3.
Function of the Street or Road		
Mobility road such as arterial and major collector	• Major Collector as per City of Mississauga Official Plan	Some level of formal bicycle facility such as bicycle lanes or separated facility is appropriate.
Vehicle Mix		
Bus stops are located along the route	• Served by Route 38 • Two stops on each side • Low-frequency service	Facilities should be designed to minimize and clearly mark conflict areas with buses or pedestrians at stop locations.
Collision History		
Collision frequency	• No recorded bicycle collisions (likely due to very low bicycle volumes)	Facilities and crossings should be designed to minimize conflict between different types of users and the conflict area should be clearly marked.
Conflict areas exist between bicyclist and motor vehicles	• Conflict areas exist between cyclists and motor vehicles midblock (rear-end or side-swipe) and at intersections and driveways (turning vehicles and through cyclists) • Unidirectional facilities would have fewer conflict points than bidirectional facilities; bidirectional facilities may need additional design treatments, such as protected-only left turn phasing	
Conflict areas exist between bicyclist and pedestrians	• Conflict areas exist with pedestrians midblock if cyclists ride on sidewalks, at bus stops, and at intersections where travel paths intersect • Conflict potential concentrated at intersections due to higher pedestrian volumes there (due to bus stops)	

Table 4-1. Review of Primary Criteria and Application to Creditview Road (continued)

Site Characteristic	Creditview Road	Suggested Facility Type
Available Space		
Physical barriers include those created by steep grades, rivers, freeways, railways, narrow bridges.	• Two major bridges exist along the corridor: Credit River and Highway 401 • These bridges will be replaced with those with a multi-use trail on the west side and a sidewalk on the east side	Separated facilities should be considered to bypass or overcome barriers.
Curb-to-curb width is not adequate to provide sufficient operating space for both motorists and cyclists.	• The existing curb-to-curb width cannot accommodate bicycle lanes or other exclusive cycling infrastructure.	Provide separated facilities adjacent to the roadway or within an independent right-of-way, provide paved shoulders, widen roadway platform to accommodate bicycle lanes.

Table 4-2 lists the secondary criteria, site characteristics for each criteria, relevant supporting details along Creditview Road and suggested facility type resulting from these conditions. As with the primary criteria, most secondary criteria suggest physically separated cycling infrastructure is appropriate.

Table 4-2. Review of Secondary Criteria and Application to Creditview Road

Site Characteristic	Creditview Road	Suggested Facility Type
Anticipated Users in Terms of Skill and Trip Purpose		
Experienced cyclists (commuter or other utilitarian)	• Some existing cyclists observed cycling on-street • Creditview Road is a straight collector providing connections to east-west routes that connect to employment areas; the nearest continuously parallel route is 1.4 km away in both directions • Provides connections across Highway 401 without crossing interchange ramps	Experienced cyclists may prefer on-street bike lanes, or separated facilities where warranted. For novice cyclists, bike lanes (with or without buffer) or separated facilities should be considered. For child cyclists, separated facilities should be considered near schools, parks and neighbourhoods.
Novice cyclists (recreational / beginners)	• Some existing cyclists observed cycling on sidewalk • No parallel local streets exist as an alternate route	
Child cyclists	• No schools are on Creditview Road, but some children may cross or travel along Creditview Road to get to/from school, recreation, or other destinations	
Costs		
More than one type of bicycle facility appears appropriate	• Cost dependent on type of construction project • Sidewalk relocation or replacement may be required for boulevard facility (multi-use trail or cycle tracks)	Benefit / cost analysis of alternatives is recommended during functional or preliminary design.
Level of Bicycle Use		
Low bicycle volumes (< 10 cyclists per hour)	• Low bicycle volumes currently observed along length of corridor	Presence of residential and commercial along corridor likely indicates inadequacy of existing facilities (riding in mixed traffic or on sidewalks). Bicycle lanes or separated facilities should be considered to accommodate the anticipated volume of cyclists.
Significant bicycle traffic generators nearby	• Several major bicycle traffic generators are off Creditview Road, including the Meadowvale employment area along Argentia and north of Highway 401 and several residential neighbourhoods to the south and east	
Function of the Route within Bike Network		
New route provides a connection between adjacent existing facilities	• Existing trails along Old Creditview Road and further south on Creditview Road would be connected by this segment of Creditview	Facility selection should provide continuity with adjacent bicycle facilities to the extent possible. Bicycle lanes or separated facilities should be considered to encourage cycling for all users.
New route provides access to a neighbourhood, suburb or other locality	• Facility would improve access to Meadowvale employment area and provide interchange-free crossing of Highway 401	

Table 4-2. Review of Secondary Criteria and Application to Creditview Road (continued)

Site Characteristic	Creditview Road	Suggested Facility Type
Type of Roadway Improvement		
Reconstruction	• Reconstruction will occur in most of the corridor, particularly at intersections and north of Argentia, to resolve identified deficiencies	Major construction provides an opportunity to improve provisions for cyclists through redistribution of existing road space, increased road width, or increased off-road space.
On-Street Parking		
Parallel on-street parking is permitted but demand is low	• No explicit parking restrictions along Creditview Road, though no on-street parking observed due to few fronting land uses and no space on road (parking has to occur in boulevard to not block travel lane)	Opportunities to remove, restrict or relocate parking in favour of providing bicycle lanes should be considered.
Frequency of Intersections		
Limited intersection and driveway crossings are present along the route	• Major intersections are spaced 400 to 800 m apart • Limited number of minor driveways and residential side streets between major intersections	Separated facilities or bicycle lanes are well suited to routes with few driveways and intersections. Consider provision of bicycle lanes, bike boxes, intersection and conflict zone markings as well as special bicycle signal phases at major intersections. Consider indirect left-turn treatments if there is significant bicycle left turn demand conflicting with through motor vehicle traffic. If a separated facility is being considered, crossings should have bicycle traffic signals with exclusive phases, and conflicts should be clearly marked.
Major intersection with high speed and traffic volumes encountered	• Controlled crossing points limited to major intersections, to be controlled by signals or roundabouts • Argentia and Old Creditview intersections have higher turning volumes and higher speeds	

The thirteen criteria above affirm the pre-selection choice of separated infrastructure as the preferred type of cycling infrastructure. Several configurations of separated cycling infrastructure are possible:

- Unidirectional cycle tracks
- Bidirectional cycle track on one side (west side or east side)
- Bidirectional cycle tracks on both sides
- Multi-use trail on one side (west side or east side)
- Multi-use trails on both sides

The facility type that has been selected for incorporation into the Preferred Solution is a multi-use trail on the west side of Creditview Road. A sidewalk will be provided on the east side of Creditview Road. The trail will be 3.5 m wide and the sidewalk will be 1.5 m wide. The trail width is greater than the 3.0 m minimum width but less than the 4.0 m desired width specified in OTM Book 18. The desired width will not be implemented on Creditview Road because of the constrained right-of-way, particularly at bridges and intersections. It is anticipated that trail users would mainly be

cyclists with few pedestrians away from intersections, which reduces the speed differential and need for additional width that would exist on the trail.

4.1.3 Step 3: Justify the Decision and Consider Design Enhancements

The primary reason why the selected facility type is a multi-use trail on the west side is that the two major bridges on the corridor, at the Credit River and Highway 401, have approved designs with a multi-use trail on the west side and a sidewalk on the east side. Though this environmental assessment excludes the Credit River bridge, it is necessary for the Preferred Solution off the bridges to align with the design on the bridges so that continuous active transportation facilities are constructed.

The Credit River bridge has been designed to accommodate a four-lane cross section. Though only two of these lanes will be used with the Preferred Solution, leaving extra space for additional active transportation infrastructure (e.g., a second trail or cycle tracks), the two additional lanes would be required to support the four-lane cross section of the Long-Term Solution. The Highway 401 bridge has been design to accommodate a four-lane cross section, which will be provided as part of the Preferred Solution. No additional space is available for wider active transportation infrastructure beyond one trail and one sidewalk.

The pre-selection nomograph in Step 1 and various site-specific conditions described in Step 2 confirm the need for a separated facility, which the multi-use trail provides. Design enhancements to this trail to improve its integration into nearby infrastructure and the overall Preferred Solution are discussed further in Section 4.3.

4.2 Recommended Transit Concept for Creditview Road

No major changes are required to the existing transit infrastructure along Creditview Road. As part of the input to this study, MiWay has stated that they would like to keep all existing stops in the corridor. Current stop spacing is generally at least 400 m, which means that stop consolidation is not required along the corridor. Current service frequencies are too low to support fully or partially dedicated transit infrastructure, such as reserved bus lanes, high-occupancy vehicle lanes, or queue jump lanes. Creditview Road has not been designated as a Higher-Order Transit Corridor or Transit Priority Corridor in the Mississauga Official Plan, so it is not likely that transit frequencies on Creditview Road would increase to a level supporting additional transit infrastructure by 2031.

Minor relocation of bus stops will be required to accommodate the new roundabouts included in the Preferred Solution at Argentia Road, Falconer Drive, and Kenninghall Boulevard / Kenninghall Crescent. The roundabouts will provide crosswalks for pedestrians at all three of the stops, which is an improvement from existing conditions, where only two of these stops have crosswalks (there is no crosswalk at the Falconer Drive stop). Relocated bus stops should be designed with a full concrete pad usable by passengers entering or exiting from both doors of the bus and should be able to accommodate shelters and garbage / recycling cans.

4.3 Design Considerations

To enhance the design of the selected active transportation and transit infrastructure — west-side multi-use trail, east-side sidewalk, and maintenance of existing bus stops — a number of design elements should be considered when the project is going through detailed design. These elements may affect the safety performance and operations of the planned infrastructure.

4.3.1 Trails and Sidewalks around Roundabouts

The design of trails and sidewalks around roundabouts is key to ensure that pedestrians and cyclists can safely pass around them. Most roundabouts are designed so that cyclists can choose to either travel through the roundabout as a vehicle or around the perimeter of the roundabout. Since Creditview Road will have an off-road trail that should be preferred by most cyclists in the corridor, it is critical that provisions are included so that cyclists are able to travel around the roundabout to continue along the trail or to turn on or off intersecting streets. *Roundabouts: An Informational Guide, 2nd Edition* (NCHRP Report 672) provides extensive guidance on the design of walking and cycling infrastructure at roundabouts.

4.3.1.1 Perimeter Trail and Landscape Strip

The trail around the perimeter of a roundabout should be at least 3 m wide but a width of 4 m is desirable, according to OTM Book 18. Since the trail along Creditview Road is 3.5 m wide, the trails around the Creditview roundabouts should be 3.5 m wide for consistency. This trail should be set back from the curb of the roundabout with a landscape strip. This landscape strip should be at least 0.6 m but is preferred to be 1.5 m. The landscape strip provides an edge treatment that is detectable by pedestrians with visual impairments to guide them around the roundabout instead of into the roundabout. Hard surfacing from the curb to the trail edge should not be used, since these pedestrians would not be able to detect the change of direction until reaching the curb adjacent circulating traffic. The landscape strip also breaks the line of sight perceived by approaching cyclists. It creates a clear gap between the trail and the roundabout so that cyclists can follow the curve of the trail instead of missing the curb and riding into the roundabout.

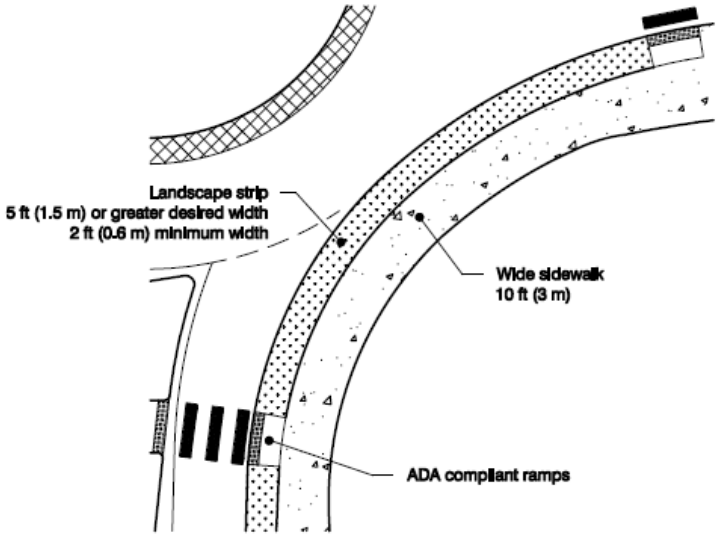
If a detectable edge treatment cannot be provided, then vertical barriers (e.g., fencing) should be provided to prevent people from walking and cycling into the roundabout. Any vertical barriers must be designed to be safe for passing cyclists by having a minimum 0.6 m lateral clearance from the edge of the trail.

A wider landscape strip that is closer to the 1.5 m preferred width provides the following additional benefits:

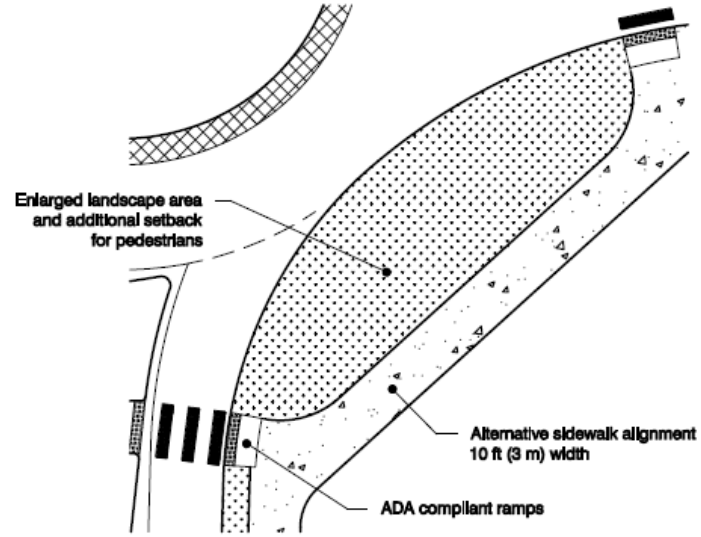
- The curb ramp to the crosswalk would be fully within the landscape strip, out of the way of the trail. This permits the curb ramp to be a single slope from the trail to the curb. If the curb ramp extends back into the sidewalk, then a compound slope is required, breaking the level surface of the trail and making construction and maintenance more difficult. Placing the curb ramp outside of the trail results in there being no interruption to the level surface of the trail, improving comfort for cyclists bypassing the crosswalk and facilitating snow clearing.
- Separating the curb ramp from the trail results in separation of vertical and horizontal curves for users. The vertical elevation change of the ramp would occur between the curb and the trail, while any horizontal turn would happen on a level surface on the trail. This design would ease negotiation of these curves by users of wheeled mobility devices and bicycles.
- A wider landscape strip creates a larger waiting area between the curb and the trail for pedestrians and cyclists waiting to cross the street. If the landscape strip is at least 1.8 m wide, standard bicycles would be able to wait fully outside of the path of trail users bypassing the crosswalk.
- Increasing the distance between the curb and the turn from the trail onto the curb ramp increases the available reaction time for a driver to determine whether a trail user is planning to cross the street. Having a narrow landscape strip can result in trail users effectively turning from the trail into the crosswalk, potentially leaving little reaction time for an approaching driver.

Figure 4-2 illustrates the two main options for the configuration of the sidewalk / trial bypass around a roundabout. The straight trail design is preferred where feasible because it results in corners that are less sharp when turning between the trail and the crosswalk. Also, in locations where the trail along the roundabout leg is intended for unidirectional cycling, the straight trail design discourages wrong-way cycling. The curved trail design is an option that can be used where there is less available right-of-way, which is the general case in most intersection quadrants of the Creditview roundabouts. It is less preferred because of the sharper turns for cyclists between the crosswalk and the trail and wrong-way cycling for cyclists heading away from the roundabout may be more likely.

Figure 4-2. Options for Sidewalk / Trail Bypass Around Roundabout



Curved trail design to be used at most locations along Creditview Road due to restricted right-of-way available within intersection corners.



Straight trail design preferred for use where right-of-way is available.

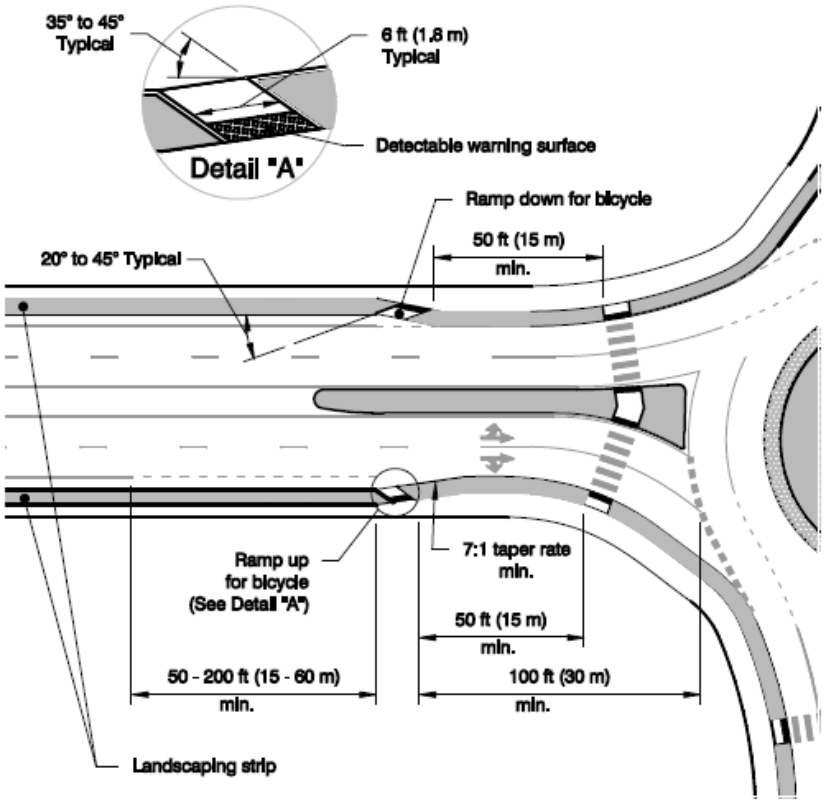
Source: Exhibits 6-63 and 6-64, Roundabouts: An Informational Guide, 2nd Edition, NCHRP Report

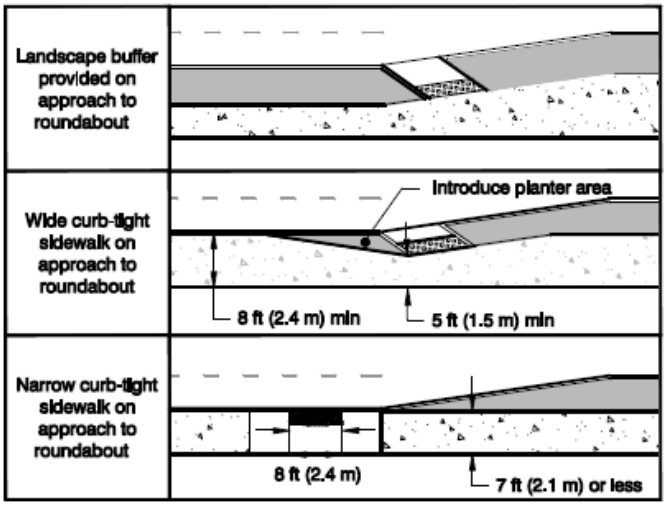
4.3.1.2 Connections to Cross Streets

The trail around the perimeter of the roundabout will connect to the sidewalks approaching on either side of each roundabout leg, providing pedestrian connectivity to intersecting streets. Providing cycling connectivity to intersecting streets requires the extension of trails along the roundabout legs to bicycle ramps that provide a transition to or from on-street bicycle infrastructure (shared lane with traffic or bicycle lane). These trail extensions are unidirectional for bicycles, as they provide access or egress to the roadway. The ramps are located at least 15 m outside of the crosswalk across the roundabout leg. Beyond the ramps, the trails revert to sidewalks that are not intended for cycling. These ramps can be provided even if there are not bicycle lanes on the connecting street, though an on-street transition of at least 15 m should be provided to enable cyclists to exit from or merge into the mixed-traffic lane. Where the “inbound” trail extension intersects the trail around the roundabout, signage and markings should be installed indicating that the trail is one-way for cyclists so that cyclists do not travel from the roundabout trail, onto the trail extension, and then onto the wrong side of the road. Geometry and signage associated with these connections should be determined during detailed design.

Figure 4-3 shows a conceptual pair of bicycle ramps with trails extending from the roundabout.

Figure 4-3. Bicycle Ramps Between Roundabout Trail and On-Street Bicycle Infrastructure





Source: Exhibits 6-67 and 6-68, Roundabouts: An Informational Guide, 2nd Edition, NCHRP Report 672 (2010).

Figure 4-13 in Section 4.4 shows the conceptual arrangement of sidewalks and trails in the vicinity of the three Creditview roundabouts. Note that, since the Argentia and Falconer roundabouts have no east leg, it is not necessary for a trail to be built around the whole roundabout. However, if an east leg is built at either of these roundabouts in the future, the trail should be extended around the entire roundabout to provide cycling connections to and from the east leg.

4.3.2 Pedestrian / Cyclist Crossings at Roundabouts

Unlike signalized intersections where pedestrian signals control crosswalks and generally limit conflicting movements to slower-moving turning vehicles, crosswalks at roundabouts require special design treatments to facilitate pedestrian and cyclist movement perpendicular to moving flows of through vehicles entering or exiting the roundabout. These design treatments should be incorporated when detailed design of the roundabouts is undertaken.

4.3.2.1 Selection of Crossing Treatment

The draft version of *Ontario Traffic Manual Book 15 – Pedestrian Crossing Facilities* provides guidance on the type of pedestrian crossing facility to provide at different crossing locations. This version of Book 15 is dependent on the implementation of Highway Traffic Act changes which were passed earlier in 2015, as it includes new types of crossing treatments not previously recognized in Ontario. The book has not yet been finalized, but it is expected that the book will be finalized prior to implementation of reconstructing Creditview Road. Therefore, at detailed design, these crossing treatment recommendations should be reviewed to ensure that they conform with planning guidance in effect at that time.

Book 15 provides a two-step Decision Support Tool (DST) to determine the type of treatment to use at a crossing. The first step is a preliminary assessment to determine the general type of treatment warranted: signal or pedestrian crossover (PXO). A flowchart is included in Book 15 to guide the preliminary assessment. The following steps through the flowchart were followed to determine the crossing treatments at the three roundabouts:

- **Traffic signal warranted for pedestrians?** Potentially. Though it is possible that the warrants may be met across some roundabout approaches, it is generally not preferred to provide signalized crosswalks (using intersection pedestrian signals or midblock pedestrian signals) across the legs of a roundabout. Though a small number of roundabouts in North America have pedestrian signals installed (though this treatment is more common in Europe), signals remove some of the operational advantage of a roundabout, particularly where crossing volumes are high. Adding pedestrian signals to roundabouts would increase capital and operating costs. OTM Book 15 does not consider a pedestrian signal as being applicable to a roundabout. Therefore, traffic signals have been excluded from further consideration.
- **8-hr ped volume at least 100 and 8-hr vehicle volume at least 750 OR 4-hr ped volume at least 65 and 4-hr vehicle volume at least 395?** Potentially yes at some locations. Though existing pedestrian volumes are very low and would not meet this warrant, it is likely that the west legs of the three roundabouts, which would be crossed by the multi-use trail, would have eight-hour pedestrian and cyclist volumes exceed 100 after completion of the trail. The west leg of the Argentia roundabout has eight-hour vehicle volumes well over 750 and the west legs of the other roundabouts likely have eight-hour vehicle volumes over 750.
- **Is the site <200 m from another traffic control device?** No. The nearest traffic control devices are at least 350 m from any roundabout.
- **Is there requirement for system connectivity or is this location on pedestrian desire lines?** Yes. All crosswalks at the roundabouts are on pedestrian desire lines and would be required for system connectivity.

Based on the preliminary assessment, all crosswalks at the three roundabouts are candidates for a PXO, even where the volume warrant may not be met.

The second step of the DST is to select the type of treatment to be implemented: the type of PXO, in this case. Four types of PXO have been defined in Book 15:

- PXO A: Consists of flashing amber beacons, internally illuminated overhead warning signs, pavement markings, and regulatory and warning signs. This type of PXO used to be the only type of PXO used in Ontario.
- PXO B: Consists of rapid rectangular flashing beacons (RRFBs), overhead- and side-mounted regulatory signs, and pavement markings.
- PXO C: Consists of rapid rectangular flashing beacons (RRFBs), side-mounted regulatory signs, and pavement markings.
- PXO D: Consists of regulatory and warning signs and pavement markings only.

Only PXO B, PXO C, and PXO D are acceptable for use at a roundabout. Three basic site conditions for PXOs include (excerpted from Book 15):

- A PXO can be installed on roadways with a maximum of 4 lanes.
- A PXO must not be used where the road volume exceeds 35,000 AADT.
- PXOs should not be installed within 200 m of other signal-protected pedestrian crossings.

All three of these site conditions are met at all crosswalks at the three roundabouts. To select the type of PXO, two-way vehicular volumes, the posted speed limit, and the total number of lanes in the roadway cross section are required. The crosswalks at the roundabouts fall into three categories; the DST results for these categories are as follows:

- **Low-volume and narrow:** These crosswalks are located across the minor legs at the Kenninghall and Falconer roundabouts. These crossings are two lanes with a posted speed limit of 50 km/h or less and future two-way, eight-hour vehicular volumes estimated to be between 750 and 2,250 (four-hour volumes estimated to be between 395 and 1,185). A PXO D is appropriate at these locations.
- **High-volume and narrow:** These crosswalks are located across the major legs (Creditview Road) at the Kenninghall and Falconer roundabouts. These crossings are two lanes with a posted speed limit of 60 km/h and future two-way, eight-hour vehicular volumes estimated to be between 7,500 and 17,500 (though four-hour vehicle volumes are estimated to be greater than 9,215). A PXO B would be appropriate based on eight-hour volumes, whereas no PXO would be appropriate based on four-hour volumes since the volumes are too high.
- **High-volume and wide:** These crosswalks are located across the three legs of the Argentia roundabouts. These crossings are four lanes with a raised refuge and a posted speed of 60 km/h and future two-way, eight-hour vehicular volumes estimated to be greater than 7,500 (four-hour volumes estimated to be greater than 3,950). No PXO would be appropriate because the volumes are too high.

The DST provides clear guidance suggesting use of a PXO D across the three low-volume and narrow roundabout crossings. The DST is somewhat less clear at the four high-volume and narrow roundabout crossings; a PXO B may be appropriate but the peaked nature of traffic in the corridor may result in a PXO B providing insufficient control during peak periods. However, the DST is clear that no PXO can provide sufficient control at the Argentia roundabout. This is likely because the high volumes on the multi-lane approaches create a higher chance for a

multiple-threat collision (vehicles stop in one lane to allow a pedestrian to cross while vehicles in the second lane do not stop).

At a mid-block location, a signal could be used in an instance when volumes are too high for a PXO. However, at North American roundabouts, signals are typically not installed due to the potential for queue spillback into the roundabout and the decrease in operational benefits provided by the roundabout (roundabouts were selected for Creditview Road because traffic delays and congestion levels would be much higher with typical signalized intersections). As a result, Book 15 provides no recommendation on the appropriate type of controlled crossing at the Argentia roundabout. The only remaining options available per Book 15 are either a grade separation, which has been determined to be infeasible due to right-of-way constraints, or an uncontrolled crossing, which is undesirable because of the pedestrian, cyclist, and vehicular volumes expected at these roundabouts.

Further study is recommended during detailed design to determine the appropriate crossing treatment at the Argentia roundabout. This study should consider whether a PXO B may be appropriate, despite the high traffic volumes, or whether supplemental or different design treatments are required. Two options for further investigation include:

- In some European countries, two-stage staggered crossings are used to divide the crossing into two distinct crossings. At these locations, a barrier-protected refuge is provided between the two directions of traffic to allow people crossing to cross one direction at a time and queue in the middle. The crossings of the two directions are offset by several metres to emphasize that the crossings are distinct and to provide additional queuing space. At Argentia, this staggered crossing could be combined with a PXO B.
- Pedestrian signals across one or more legs of the roundabout could be considered. Despite being uncommon in North America and considered as inapplicable in OTM Book 15, many high-volume, multi-lane roundabouts in Europe feature pedestrian signals. These signals may be combined with the staggered crossings discussed above to minimize the cycle length and vehicle delay. Pedestrian signals may require the crossing to be set back even further from the circulatory roadway so that vehicles exiting the roundabout do not queue into the roundabout.

4.3.2.2 Features of Selected Treatments

Though PXOs at roundabouts improve the crossing for pedestrians, pedestrian crossings at roundabouts remain challenging for people with visual impairments to use. Unlike signalized intersections, where a positive exchange of right-of-way occurs, roundabouts require pedestrians to observe traffic and ensure that it yields prior to crossing. This observation is challenging for pedestrians with visual impairments, especially across multi-lane approaches where multiple lanes of traffic need to stop. Signalized intersections can be fitted with audible pedestrian signals that identify when a crossing has the right-of-way. Audible signals are not able to be implemented at PXOs. The three Creditview roundabouts are not located near areas where a higher-than-average volume of pedestrians with visual impairments would be expected; however, low volumes of these pedestrians may still occasionally use these roundabouts.

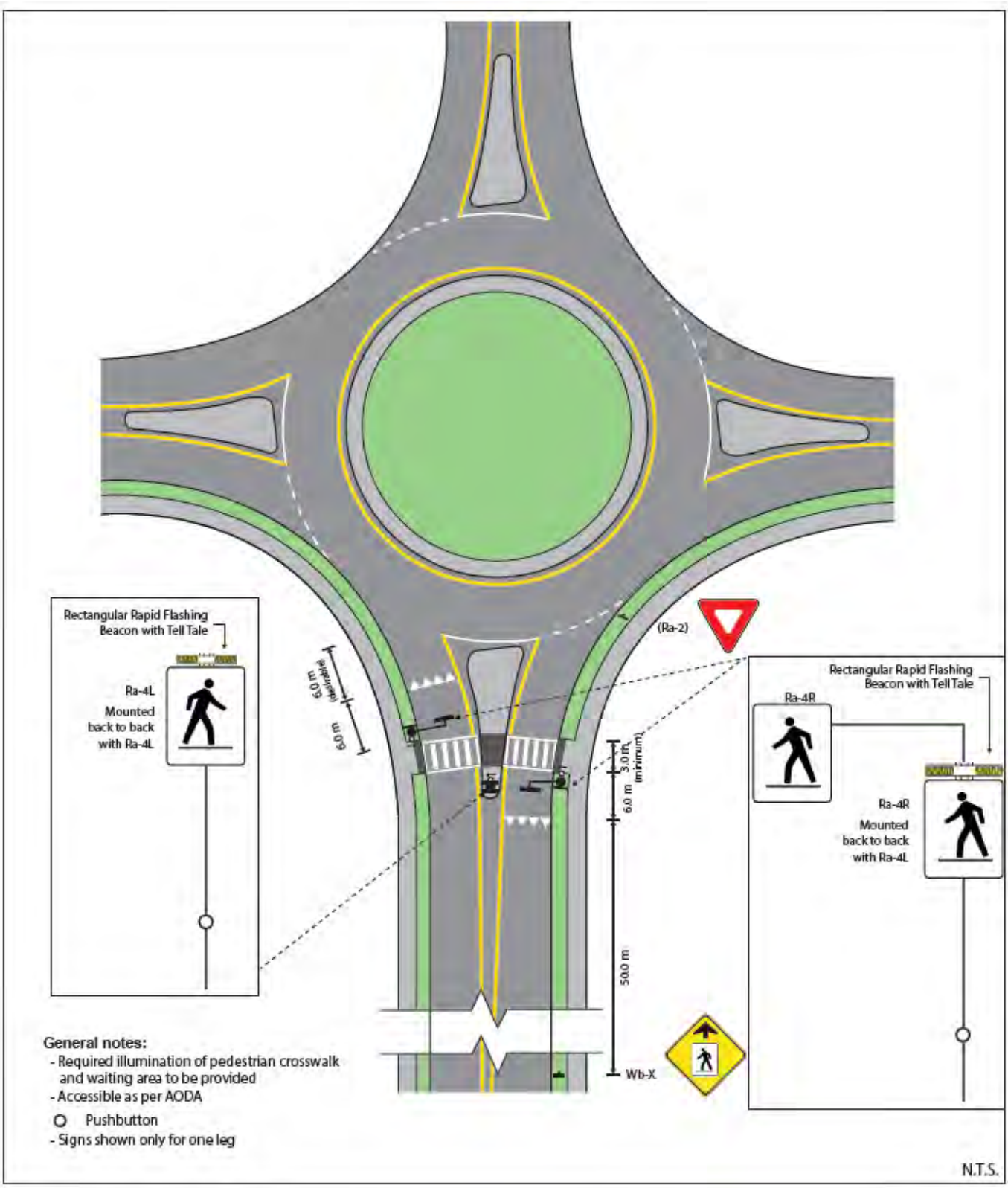
The features of a PXO B are listed in **Table 4-3** and a PXO B at a single-lane roundabout is illustrated in **Figure 4-4**. The features of a PXO D are listed in **Table 4-4** and a PXO D at a single-lane roundabout is illustrated in **Figure 4-5**.

Table 4-3. Components of a PXO B

Required Components	Desirable Components	Optional Components
• Side-mounted signs TAC (Ra-4) on both sides of the road for both directions, mounted back to back • One over-head mounted sign TAC (RA-4) for each direction of travel • Ladder Crosswalk Markings • Yield to Pedestrians line markings at 6.0 m from crosswalk • Actuated Double Sided Rectangle Rapid Flashing Beacon with Tell Tale and Pedestrian Pushbutton for pedestrians mounted above each set of side-mounted TAC (Ra-4) installed at the pedestrian crossover • Advanced Pedestrian Crossover Ahead sign (Wb-X) at 50.0 m upstream of the crosswalk • 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 • No Passing Here to Crossing sign (Ra-10) for multi-lane approaches	• Stopping prohibition for a minimum of 30 m on each approach to the crossing, and 15 m following the crossing • AODA compliant Pedestrian Pushbuttons	• School Crossing Guard • Textures Crosswalk Markings • Raised Crosswalk • Pedestrian Pushbutton (Ra-11) sign • Safety elements including Barricades, Pedestrian Fencing, Gates, Walls, Bollards, and Barriers

Source: Table 11, OTM Book 15 – Pedestrian Crossing Facilities (2014, draft).

Figure 4-4. Example of PXO B at Single-Lane Roundabout



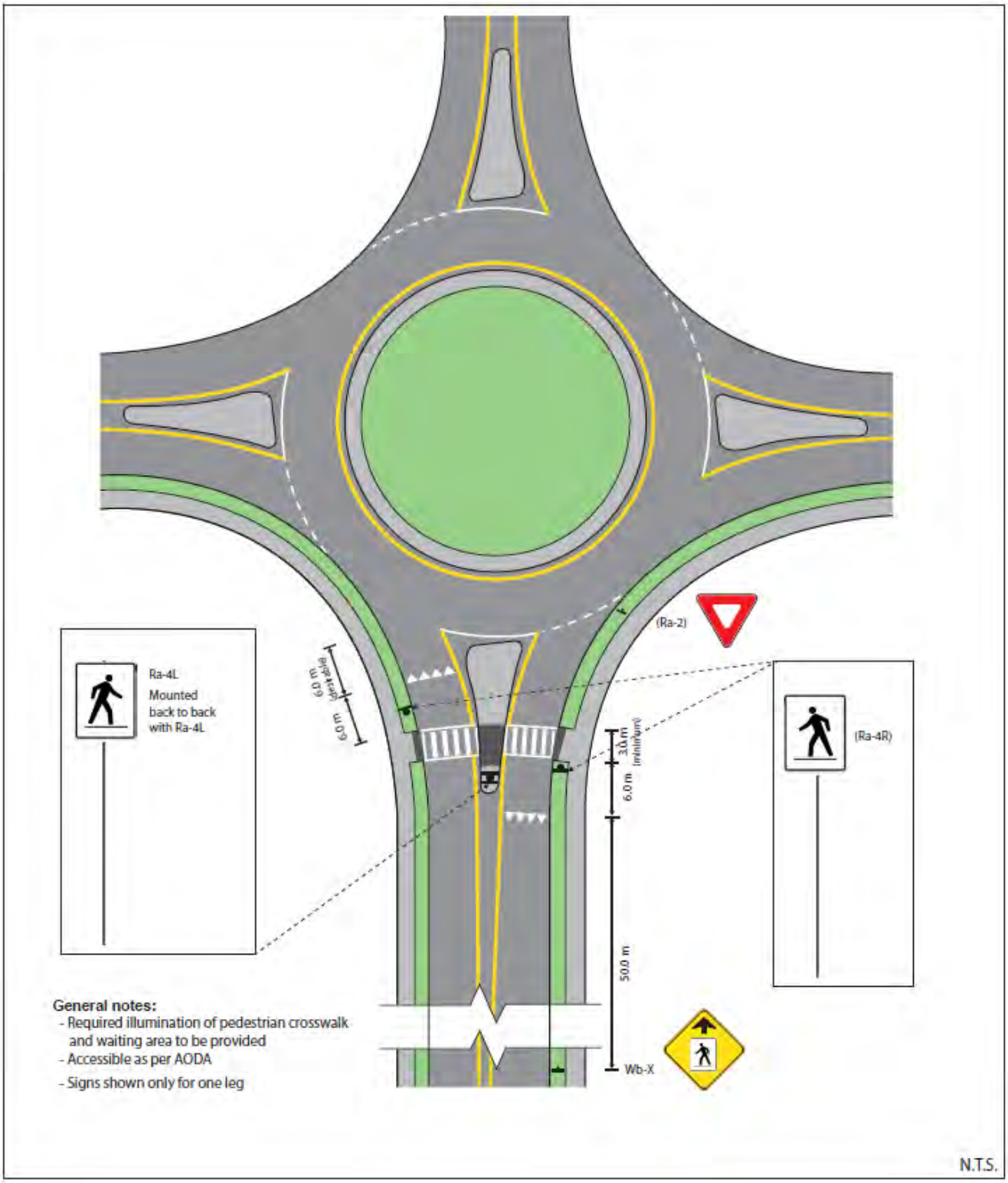
Source: Figure 29, OTM Book 15 – Pedestrian Crossing Facilities (2014, draft).

Table 4-4. Components of a PXO D

Required Components	Desirable Components	Optional Components
• Side-mounted signs TAC (Ra-4) on both sides of the road for both directions, mounted back to back, when there is no raised refuge • Two Side mounted signs TAC (Ra-4) for each direction, one on the right side and the other on the median mounted back to back with another TAC (Ra-4) sign for pedestrian crossovers for four lane roadways with raised median refuge • Ladder Crosswalk Markings • Yield to Pedestrians line markings at 6.0 m from crosswalk • Advanced Pedestrian Crossover Ahead sign (Wb-X) at 50.0 m upstream of the crosswalk • Stopping prohibition for a minimum of 15 m on each approach to the crossing, and 10 m following the crossing • Lane change prohibition on multi-lane approaches using solid white lines • No Passing Here to Crossing sign (Ra-10) for multi-lane approaches	• 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 • Barricades for pedestrian crossovers for four lane roadways with raised median refuge • Staggered design for crossings with raised refuge island	• School Crossing Guard • Textures Crosswalk Markings • Raised Crosswalk • Safety elements including Barricades, Pedestrian Fencing, Gates, Walls, Bollards, and Barriers for applications without raised refuge

Source: Table 13, OTM Book 15 – Pedestrian Crossing Facilities (2014, draft).

Figure 4-5. Example of PXO D at Single-Lane Roundabout



Source: Figure 46, OTM Book 15 – Pedestrian Crossing Facilities (2014, draft).

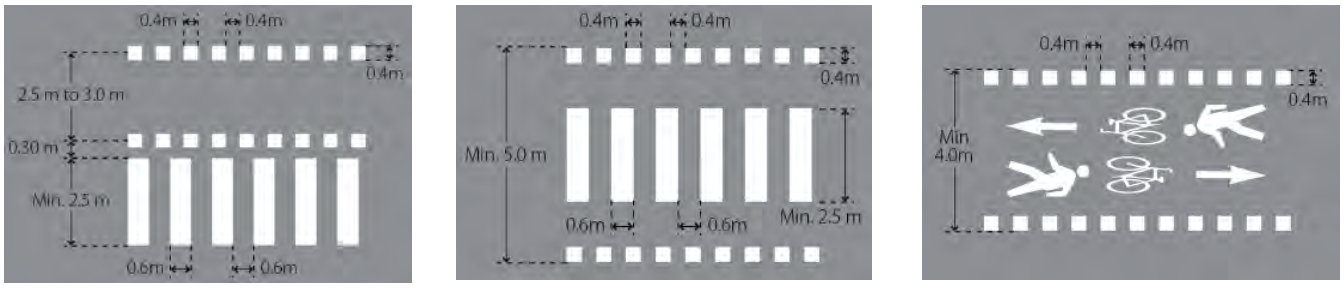
Additional design features of the pedestrian crossings at roundabouts that are recommended for inclusion at the detailed design stage include:

- Both PXOs require crosswalks set back approximately 12 m from the outside edge of the roundabout to provide a short queuing area between the roundabout and crosswalk for vehicles to queue, to shorten the length of the pedestrian crossing, and to separate the vehicle-vehicle conflicts at the roundabout from the vehicle-pedestrian conflicts at the crosswalk.
- Within the splitter island, a refuge should be provided, preferably as a cut through the splitter island that is level with the road surface. Providing a level cut-through bounded by curbs on either side is easier for people with mobility or visual impairments to traverse than a splitter island with a ramp up and a ramp down. The length of the walkway at the splitter island should be at least 2.5 m so that a bicycle with a child trailer can wait between the two directions of traffic within the splitter island.
- Two options are available for aligning the crosswalk. One option is to place each half of the crosswalk perpendicular to each direction of traffic being crossed, reducing the length of the crosswalk within vehicle lanes. This option results in an angle in the crossing within the splitter island. The other option is to place the crosswalk perpendicular to the centreline of the roadway, resulting in a straight crossing. The crossing of each direction may be skewed, but the walking distance for someone walking around the roundabout is reduced.
- Detectable warning surfaces must be applied across the full width of curb ramps and cut-through walkways.
- Push-buttons at RRFBs (as part of PXO B) should be within easy reach of both pedestrians and cyclists at the curb ramp.
- Raised crosswalks are an optional but desirable feature to reduce vehicle speeds at the crossings, improve driver yield rates, and increase driver awareness that pedestrians may be crossing at that location.

4.3.2.3 Crossrides and Crosswalks

The final element of the pedestrian crossing to be considered is the type of marking to use across the crossing. If only pedestrians are using the crossing, then Ladder Crosswalk Markings must be provided, in accordance with PXO guidance. However, the Highway Traffic Act prohibits cyclists from riding a bicycle within a crosswalk; cyclists must dismount instead. Since these crossings would be located on a multi-use trail, requiring cyclists to dismount increases travel time and inconvenience for cyclists; a requirement to dismount would likely be ignored by many cyclists. To permit cyclists to use the crossing without dismounting, a crossride should be provided at the crossing. Three types of crossrides are included in OTM Book 18, as shown in **Figure 4-6**.

Figure 4-6. Crossride Options



Separate Crossride | Combined Crossride | Mixed Crossride

Source: Figures 5.35, 5.36, and 5.37, OTM Book 15 – Pedestrian Crossing Facilities (2014, draft).

At the Creditview roundabouts, a combined crossride is preferred for use where pedestrians and cyclists will be using the PXO. This crossride provides high-visibility pedestrian markings (which could be converted to ladder markings to be consistent with PXO guidance) while providing space for cyclists travelling in each direction. Note that a combined crossride is at least 5 m in width, which is larger than the standard 3 m crosswalks provided at PXOs. Combined crossrides at these locations should be incorporated into the detailed design.

The separate and mixed crossrides should not be used at the Creditview roundabouts. A separate crossride provides high-visibility pedestrian markings, but requires cyclists and pedestrians to organize into “their” half of the crossing. There would likely be low compliance to this division because the trails approaching on either side are multi-use and not divided between pedestrians and cyclists. A mixed crossride would be compatible with the multi-use trails on either side but it does not provide high-visibility pedestrian markings, which is a critical element of a PXO.

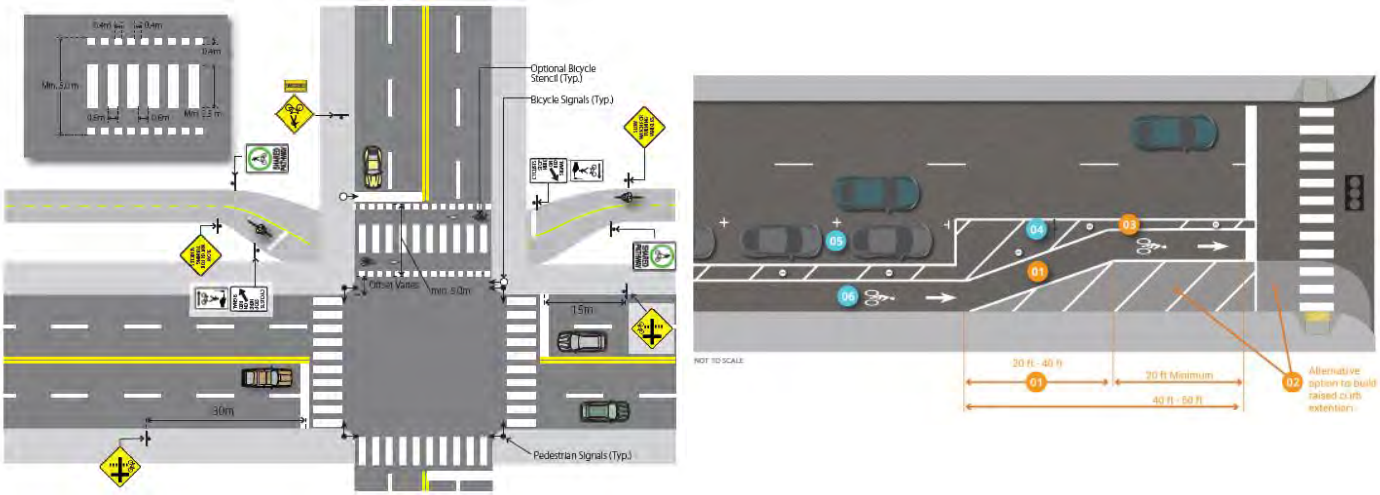
4.3.3 Trails at Signalized and Unsignalized Intersections

The multi-use trail along Creditview Road will pass through two signalized intersections (Bancroft Drive / Sir Monty’s Drive and Old Creditview Road) and one unsignalized intersection (Velebit Court) within the study area. It is important for these intersections to be designed so that the trail traverses the intersection in a visible manner with conflict minimized and with walking and cycling connections to intersecting streets.

4.3.3.1 General Intersection Design

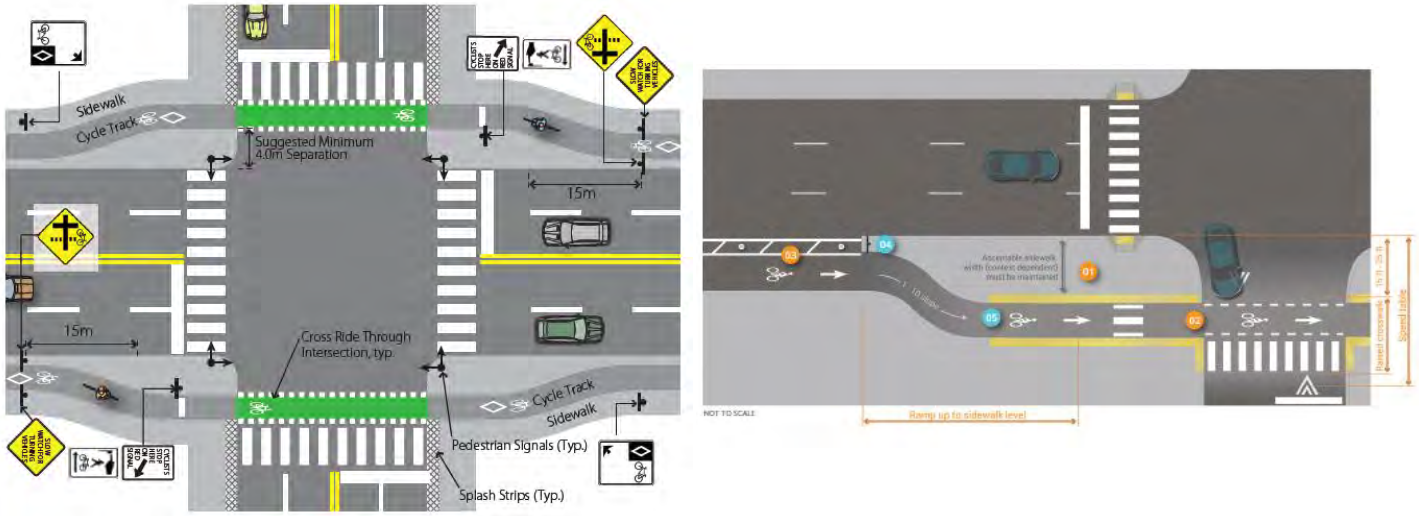
Ontario Traffic Manual Book 18 – Cycling Facilities outlines two main designs for separated cycling facilities at intersections. These designs are found in other cycling design guides from North America and abroad and have often been termed as “Bend In” and “Bend Out”, referring to the shape of the facility at its approach to the intersection. A Bend In design results in the edge of the crossing being set back approximately 1 m from the adjacent lane (the standard setback for a crosswalk at an intersection). A Bend Out design results in the edge of the crossing being set back at least 4 m, and preferably at least 6 m (one car length), from the adjacent lane. **Figure 4-7** shows an example of a Bend In intersection design and **Figure 4-8** shows an example of a Bend Out intersection design.

Figure 4-7. Examples of "Bend In" Cycling Facility Design at Intersection



Source: Left: Figure 4.102, Ontario Traffic Manual Book 18 – Cycling Facilities (2014), Right: Figure 25, Separated Bike Lane Planning and Design Guide (FHWA, 2015).

Figure 4-8. Examples of "Bend Out" Cycling Facility Design at Intersection



Note: Unidirectional cycle tracks shown but design is also compatible with bidirectional cycle tracks or multi-use trails.

Source: Left: Figure 4.87, Ontario Traffic Manual Book 18 – Cycling Facilities (2014), Right: Figure 26, Separated Bike Lane Planning and Design Guide (FHWA, 2015).

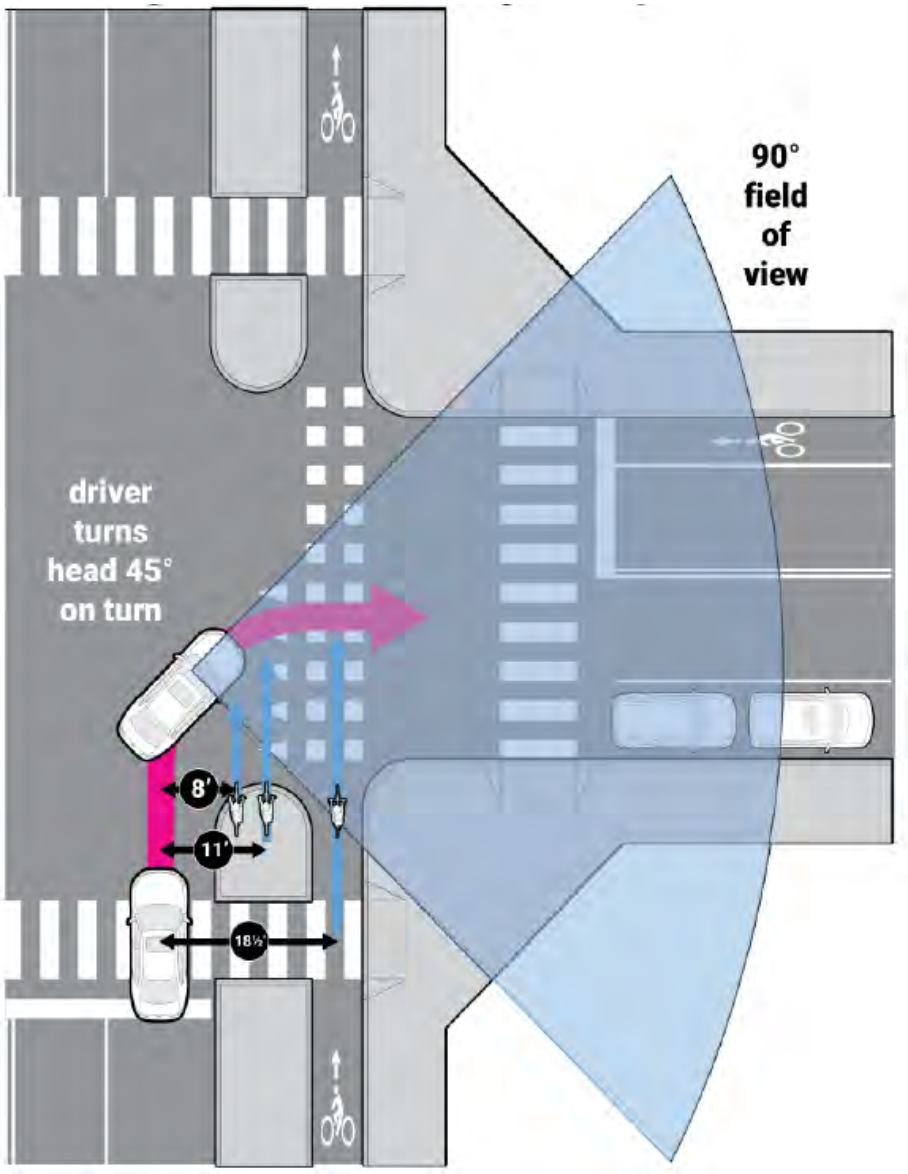
OTM Book 18 provides a basic description for both the Bend In and Bend Out designs, but it does not provide guidance on when a Bend In or Bend Out design may be preferable. Other design guides, including the Federal Highway Administration (FHWA) Separated Bike Lane Planning and Design Guide (2015), the CROW Design Manual for Bicycle Traffic (2007), and the Massachusetts Separated Bike Lane Planning and Design Guide (2015), provide some guidance on which design may be more suitable in certain locations. Some of this guidance is conflicting, but a general synthesis of the advantages and disadvantages of the two designs is shown in **Table 4-5**.

Table 4-5. Advantages and Disadvantages of the Bend In and Bend Out Intersection Designs

Intersection Type	Advantages	Disadvantages
Bend In	• Cyclists and pedestrians enter the intersection in a similar field of vision as motorized vehicles, potentially improving visibility for vehicles turning left across crossing • More common in the GTA and North America • Less space required at intersection corners: May be preferred in constrained locations • Stop bars would be closer to the intersection, potentially increasing available sight lines • Total pedestrian walking distance may be reduced if crosswalk is not set back	• Drivers looking for cyclists approaching from behind must look through right side-view mirror: Cyclists may be in blind spot of vehicle when approaching from the rear right, especially on a two-way facility • Vehicles turning right on red from cross street may block crossride and crosswalk • Cyclists may feel less comfortable due to being closer to parallel motorized vehicles • Left-turning maneuvers for cyclists are more awkward: if bike boxes are present, a sharp turn is required to exit bike box or cyclist may need to pick up bicycle and rotate 90 degrees so they can check over their shoulder for traffic • Vehicle that turns left but then yields to bikes and peds would be blocking oncoming traffic
Bend Out	• Improved forward visibility: Vehicle yields to bikes and peds midway through turn; crossing bikes and peds are visible through windshield and side windows instead of mirrors • Advanced stop bar for cyclists and pedestrians gives them head start and places them in forward view of queued vehicles • Provides space for a vehicle turning any direction across trail to queue between through lanes and crossing, which may mitigate some sight line issues • Provides more comfortable and convenient queuing location for left-turning cyclists: With corner deflection islands, queuing location is behind the curb and away from traffic • Spatially separates auto-auto conflicts from auto-bike and auto-ped conflicts • Placement of crossing further from corner shortens length of crossing, especially for pedestrians	• Generally requires more space in corners • Pedestrians may have to walk slightly further to reach setback crosswalk • Careful signal placement required, as distance from stop bars to signals may be long at large intersections (OTM max is 55 m) • Setback stop bars may reduce available sight distance for traffic approaching from the cross street • Less common locally and in North America

The Bend Out design is generally preferred over the Bend In design as it provides improved visibility between cyclists / pedestrians and right-turning vehicles, as well as between cyclists / pedestrians and vehicles exiting from the cross street. In a Bend In design, drivers must check the right side view mirror for cyclists approaching from the rear right. In instances where the cycling facility is a bidirectional cycling facility, such as the trail along Creditview Road, a cyclist approaching from the rear right is usually in the vehicle's blind spot and outside of the field of view of the side view mirror. This poor visibility may establish a "right-hook" conflict. By setting back the bicycle crossing by several metres, right-turning drivers can make a partial turn and look out the windshield and side windows to see cyclists approaching from the right. Because of the several additional seconds required to make the turn, approaching cyclists are more able to discern whether an adjacent vehicle is about to turn and whether that vehicle will yield. **Figure 4-9** shows how the field of view is improved by setting back the bicycle crossing so that vehicles can make a partial right turn and then check for cyclists (and pedestrians).

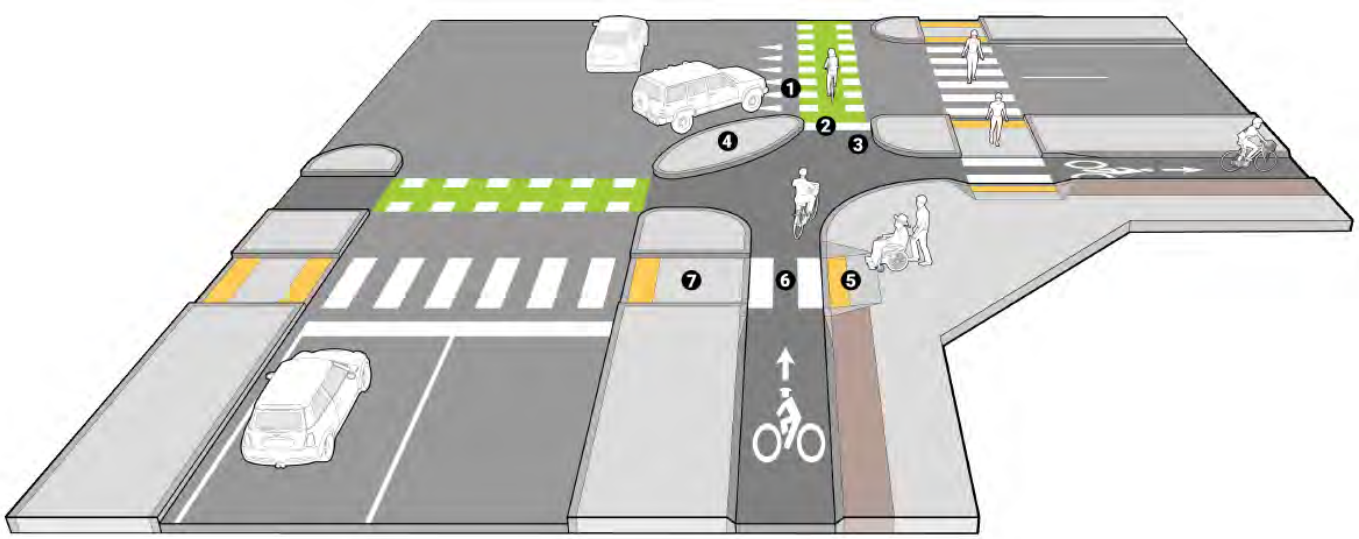
Figure 4-9. Illustration of Field of View for Right-Turning Vehicles



Source: Massachusetts Separated Bike Lane Planning and Design Guide, presentation by MassDOT (2015, draft).

By widening the buffer between the curb and the bicycle facility, the Bend Out design provides the ability to implement a “corner deflection island”, otherwise termed a “corner refuge island”. This island provides space for cyclists to queue at an advanced stop bar well in advance of adjacent vehicles (approximately 10 m). Space is also provided for left-turning cyclists to queue adjacent to the island, out of the way from through cyclists that can pass behind them. The horizontal deflection that the island provides encourages cyclists to pass through the intersection at a controlled speed, improving their visibility to other vehicles. Where two separated cycling facilities intersect, the corner deflection island permits cyclists to make a free right turn, avoiding the signal. **Figure 4-10** illustrates how two unidirectional cycle tracks intersect using the Bend Out design with a corner deflection island. Note that this design is also adaptable to intersections between bidirectional cycle tracks, trails, or a mix of separated cycling facilities.

Figure 4-10. Illustration of Bend Out Design at Intersection



1. Bicycle crossing
2. Bicycle stop line
3. Bicycle queuing area
4. Corner deflection island
5. Pedestrian curb ramp
6. Pedestrian crossing
7. Pedestrian refuge island

Source: Massachusetts Separated Bike Lane Planning and Design Guide, presentation by MassDOT (2015, draft).

Setting back the bicycle crossing also results in a setback of the pedestrian crossing. In the case of the multi-use trail along Creditview Road, the bicycle and pedestrian crossings should be combined using a combined crossride because the trail is mixed-use. The changes in the visibility of cyclists by drivers also apply to the visibility of pedestrians. The setback of the bicycle crossing provides space for a pedestrian refuge island between the bicycle facility and the curb to further increase pedestrian visibility and to shorten the pedestrian crossing. Bus stops are also able to be placed between the bicycle facility and the curb.

Stop bars for vehicles will also need to be set back, which may affect sight lines. However, the Bend Out design provides a space for one vehicle to queue between the bicycle crossing and the parallel travel lanes. A vehicle making a right turn on red or turning from a stop-controlled approach can first stop at the stop bar, let pedestrians and cyclists clear, advance to the queue space beyond the bicycle crossing where sight lines are improved, let cross traffic clear, then complete their turn. An example of this queuing space is shown in **Figure 4-11**.

Figure 4-11. Queuing Space for Turning Vehicles Exiting Two-Way Stop-Controlled Intersection

The Bend Out design can be challenging to implement where right-of-way is constrained. Though the right-of-way is constrained along Creditview Road, the Bend Out design should be able to be implemented within the right-of-way of the Preferred Solution where the multi-use trail crosses the west leg of the Bancroft Drive / Sir Monty's Drive interchange. Sufficient right-of-way also exists at the intersection with Velebit Court for the Bend Out design. The Bend Out design cannot be implemented across the west leg of the Old Creditview Road intersection (across the private driveway) due to right-of-way constraints. The feasibility of these designs should be confirmed and incorporated during detailed design.

4.3.3.2 Connections to Cross Streets

As at the roundabouts, bicycle connections to connecting streets should be provided. At Bancroft Drive / Sir Monty's Drive and Velebit Court, no dedicated cycling facilities are provided on adjacent streets. Short unidirectional cycle tracks or trails should be provided along these streets, transitioning into the mixed-traffic lanes approximately 15 m beyond either side of the Creditview intersection. At the Bancroft / Sir Monty's intersection, eastbound and westbound crossrides should be provided across Creditview Road to enable easy access between the multi-use trail and Bancroft Drive. At Old Creditview Road, the multi-use trail along the west side of Old Creditview Road should be carried across Creditview Road to connect with the Creditview multi-use trail. A Bend Out design should be implemented for this crossing, as sufficient right-of-way exists. These connections should be incorporated as part of the detailed design.

4.3.3.3 Traffic Signal Phasing

The design of traffic signals and signal phasing is critical to the safe provision of bicycle facilities. Pedestrian signals should be provided at all pedestrian crossings. Bicycle signals should be provided at all bicycle crossings where a bicycle flow is not adjacent to same-direction vehicle traffic or where the bicycle phasing differs from adjacent same-direction vehicle traffic. Therefore, all bidirectional bicycle crossings should have bicycle signal heads. The

unidirectional eastbound and westbound crossrides at the Bancroft / Sir Monty's intersection do not need separate bicycle signals unless they operate with different phasing from eastbound and westbound vehicle traffic.

Bidirectional cycling facilities along bidirectional streets create a higher number of conflicts than unidirectional cycling facilities. Two of these conflicts can be mitigated through signal phasing.

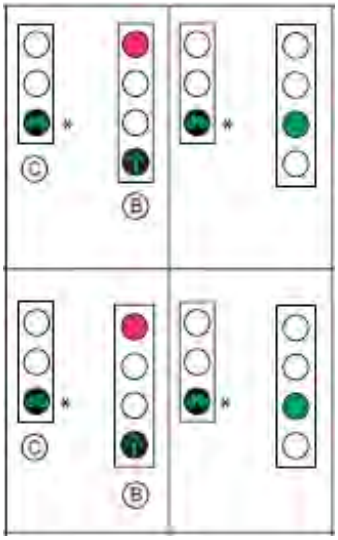
One conflict that can be mitigated through signal phasing is the left turn across a bicycle facility from the road parallel to it. Along Creditview Road, this would be the northbound left turn at the Bancroft / Sir Monty's and Old Creditview intersections. With permissive signal phasing, it is very difficult for a left-turning driver to see cyclists approaching from the rear left until they execute their turn, as they are approaching in the blind spot of the vehicle. By changing the signal phasing to protected-only, left-turning vehicles would be able to complete their turn without conflict with cyclists and pedestrians. Likewise, cyclists and pedestrians would be able to cross without conflict with left-turning vehicles. Exclusive left-turn lanes are required for implementing protected-only phasing; these lanes are included in the Preferred Solution. Though there is not a history of left-turning vehicle-pedestrian collisions along Creditview Road, this type of collision is very common in the GTA and can be almost entirely eliminated with implementation of protected-only left-turn phasing. The implementation of a multi-use trail while retaining permissive or protected-permissive phasing will likely increase the risk of left-turning collisions with pedestrians or cyclists in the future. Therefore, protected-only signal phasing should be implemented for these left turn movements. The risk of left-turn collisions with oncoming cyclists, pedestrians, and vehicles should also decrease. The downside of protected-only left-turn phasing is that delay for these movements would likely increase and left-turn capacity would likely decrease.

The other conflict that can be mitigated through signal phasing is the right turn across a bicycle facility from the road parallel to it. Along Creditview Road, this would be the southbound right turn at the Bancroft / Sir Monty's and Old Creditview intersections. This conflict can be reduced through the provision of protected-only right-turn phasing or a leading through interval. Since exclusive right turn lanes are not included in the Preferred Solution for these movements, it is not possible to provide protected-only right-turn phasing.

However, a leading through interval (LTI) could be implemented at these locations. An LTI is a special phase provided at the beginning of the through phase. Instead of displaying a circular green to drivers, a green through arrow is lit concurrent with a bicycle green and a walk signal. During this phase, vehicle turns are prohibited until the arrow ends and circular green begins. An LTI provides an opportunity for pedestrians and cyclists to begin to cross before vehicles begin to turn. Combined with the advanced stop bar provided with the Bend Out design, many bicyclists and pedestrians would have cleared the intersection by the time vehicles are turning. Much of the conflict with right-turning vehicles is reduced with the Bend Out design, but implementation of an LTI should still be considered further during detailed design.

These signal phasing options should be further considered at the detailed design stage.

Figure 4-12. Phasing Diagram for a Leading Through Interval



Source: Ontario Traffic Council Bicycle Traffic Signals Guide (2015).

4.3.3.4 Crossrides and Crosswalks

Bicycle crossings at signalized and unsignalized intersections should be marked with crossrides. As explained with roundabouts in Section 4.3.2.3, there are three options for crossride designs. At multi-use trail crossings, the combined and mixed crossrides are the more sensible options, since pedestrians and cyclists will not need to cross each other's paths to organize themselves for the crossing. A combined crossride would be preferred over a mixed crossride because it provides more visible pedestrian markings (zebra markings), though a mixed crossride could be used if space is constrained. Where separate bicycle and pedestrian crossings exist, notably at the suggested eastbound and westbound crossrides at the Bancroft / Sir Monty's intersection, a separate crossride should be used. Crossrides at these locations should be incorporated into the detailed design.

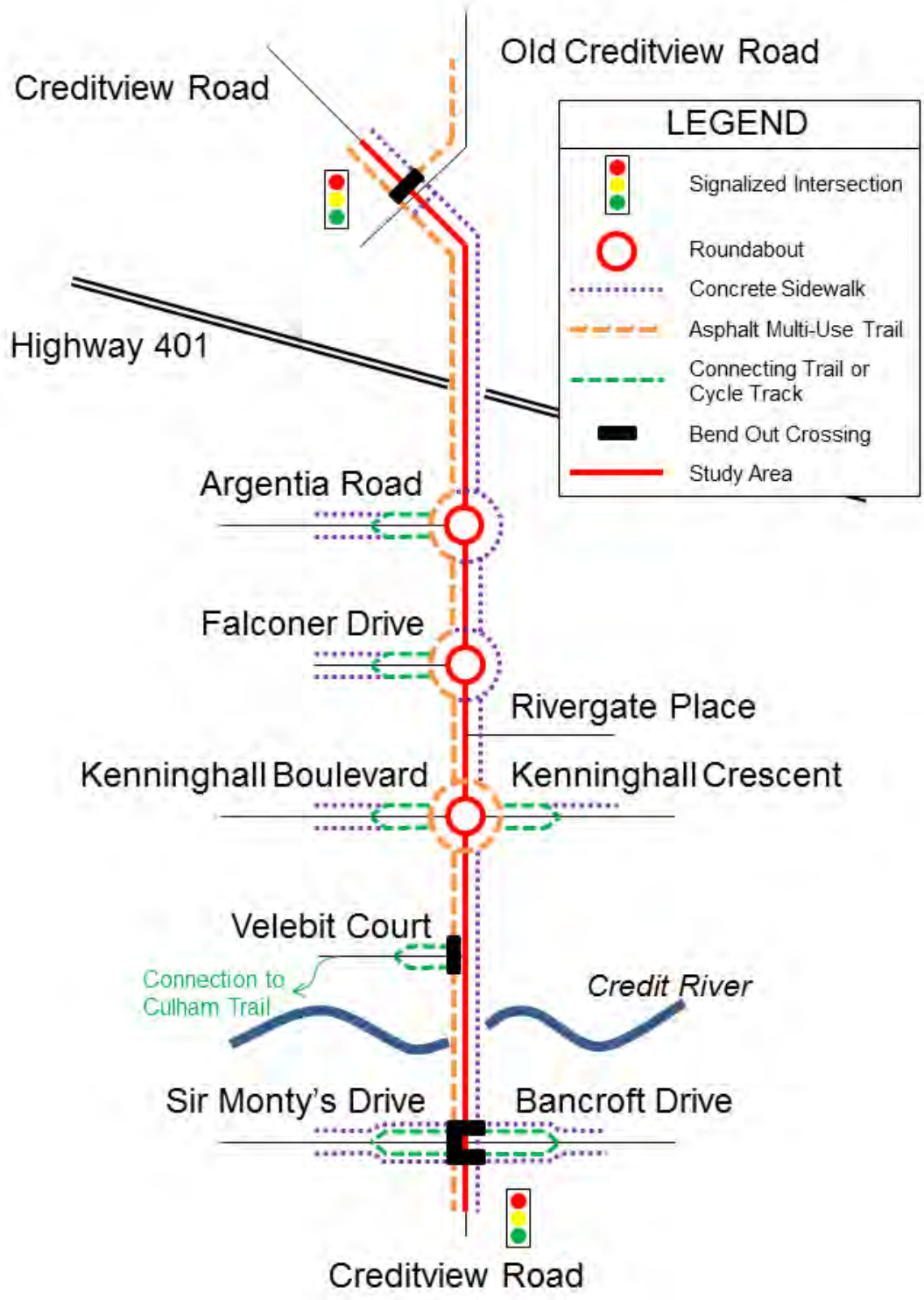
Crosswalks should be designed to end at the curb instead of at the perpendicular crosswalk within the intersection. Separate curb ramps should be provided for the two crosswalks radiating from a corner. These ramps should be as perpendicular as possible to the curb and aligned with the crosswalk so that pedestrians are guided across the street in the correct direction. A natural feature of the Bend Out design is that the setback crosswalks are located such that they do not intersect the perpendicular crosswalk. In addition, since the crosswalks are located further from the corner, the curb is more perpendicular to the curb ramp, resulting in improved alignment for users of mobility devices and people with visual impairments.

Push buttons for pedestrians and cyclists should be located adjacent the queuing area. These buttons should be within easy reach of a pedestrian or cyclist waiting on the sidewalk or trail and should reinforce the proper crossing location for pedestrians and cyclists.

4.4 Summary of Infrastructure Recommendations

Figure 4-13 summarizes all of the recommended active transportation design features along Creditview Road in the study area, including the location of roundabouts, trails, sidewalks, and Bend Out cycling / pedestrian crossings. Some of these features have been integrated into the preliminary design completed as part of this environmental assessment. Features that have not yet been integrated should be considered during detailed design.

Figure 4-13. Summary of Recommended Active Transportation Design Features Within Study Area



4.5 Maintenance of Active Transportation Infrastructure

Section 8 of OTM Book 18 provides information on how active transportation infrastructure should be maintained. Some of the key maintenance activities that should be accounted for in the detailed design of the infrastructure and should be performed regularly after project implementation include:

- Sweeping of leaves, trash, and other debris.
- Repairing surface damage, such as cracks, potholes, and heaves.
- Maintenance of vegetation, particularly tree trimming to ensure that cyclists do not collide with low-hanging branches.
- Maintenance of signage and pavement markings, particularly at intersections where road traffic may wear away markings.
- Winter maintenance, including snow clearing and surface treatment to minimize icy surfaces.
- Monitoring of drainage to ensure that puddling or ponding does not occur, which can result in discomfort for pedestrians and cyclists and contribute toward ice formation in winter.
- Maintenance of any bicycle parking that might be provided along the corridor, such as at bus stops.

5. Summary

The reconstruction and targeted widening of Creditview Road between Bancroft Drive / Sir Monty's Drive and Old Creditview Road will provide an opportunity to implement active transportation and transit improvements along the corridor. This report documents existing active transportation and transit conditions, potential future conditions, and recommended active transportation and transit infrastructure in the corridor, including identification of design treatments to be incorporated in the detailed design of the corridor that would improve the function, comfort, and safety of travellers through the corridor.

5.1 Existing Conditions

- The Creditview Road study area currently has fair to poor active transportation infrastructure. Sidewalks are present along some of the corridor, though they are not continuous. No cycling infrastructure is present on Creditview in the study area; cyclists must share lanes with traffic on Creditview.
- Local bus service is provided from Bancroft Drive / Sir Monty's Drive to Argentia Road by MiWay Route 38/38A. This service is a low-frequency local bus that operates seven days per week.
- A number of deficiencies exist with the infrastructure in the corridor, such as missing sidewalks and crosswalks, misaligned crosswalks and curb ramps, push buttons out of reach of the sidewalk, and maintenance issues.
- The vast majority of trips that occur in the study area are completed by car. Small shares of trips are completed by walking or transit; virtually no trips are done by bicycle. Approximately 40 percent of the trips in the study area around the corridor stay within this study area; most of these trips are less than 10 km in length.

5.2 Background Conditions

- The Mississauga Cycling Master Plan includes recommendations for a number of new segments of active transportation infrastructure in the area, including implementation of a multi-use trail along Creditview Road through the study corridor.
- No changes are planned for transit in the Creditview Road corridor, though new rapid transit and GO rail improvements are planned elsewhere in Mississauga.
- To contribute toward the regional (GTHA) target for active transportation, approximately 15 percent of trips in the area would need to be completed by walking or cycling. If these mode shares are achieved along Creditview Road, it is estimated that up to 400 people per hour would walk or cycle along Creditview Road. Due to the distances between land uses, most of these people would likely choose to cycle.

5.3 Recommended Active Transportation and Transit Infrastructure

- A 3.5 m multi-use trail is recommended to be installed along the west side of Creditview Road and a 1.5 m sidewalk is recommended to be installed along the east side.
- Existing bus stops should be kept near their current locations, though minor relocations may be required to accommodate relocated crosswalks.
- The three roundabouts require careful design of active transportation infrastructure around their perimeter. Trails should be provided where pedestrians and cyclists will travel around the roundabout; sidewalks can

be provided where only pedestrians are travelling around the roundabout. Infrastructure should be provided to connect the circulatory trail with intersecting streets to enable cyclists to travel between the trail and these streets; these connections should be considered further during detailed design.

- Pedestrian crossovers (PXOs) should be provided across all legs of the two single-lane roundabouts. A combined crossride should be used where both cyclists and pedestrians cross. Due to the higher vehicular volumes and additional vehicle lanes, further study is recommended to determine the appropriate crossing treatment(s) at the Argentia roundabout. At detailed design, these crossing treatment recommendations should be reviewed to ensure that they conform with planning guidance in effect at that time.
- The remaining signalized and unsignalized intersections should be designed to provide convenient and visible movement of pedestrians and cyclists across the intersection. Where space allows, the Bend Out design should be used to increase visibility of crossing cyclists and pedestrians, separate conflicts, and shorten crossing distances. Feasibility of these treatments should be confirmed during detailed design.
- Protected-only left turns should be implemented for the northbound left turn at the Bancroft / Sir Monty's and Old Creditview intersections to reduce conflicts between left-turning vehicles and trail users. This and any other signal phasing change should be confirmed during detailed design.
- Active transportation infrastructure should be designed to facilitate all-season maintenance and appropriate maintenance should occur regularly.