25th Side Road: Road Safety Review

A summary of findings from a road safety review of the proposed preliminary design for 25th Side Road between Innisfil Beach Road and Big Bay Point Road in the Town of Innisfil, Ontario.

July 26, 2022

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1 INTRODUCTION

1.1 Background

As part of the 25th Side Road design project, the WSP road safety team has conducted a plan-based road safety review of the proposed preliminary design for the 25th Side Road corridor between Innisfil Beach Road and Big Bay Point Road. In conducting this review, the following analyses were performed:

- Review of historical collision data
- Plan-base road safety review
- Quantitative risk assessment

The results from each analysis technique are summarized and discussed in the sections below.

1.2 Focus of the review

This review addresses road safety and operational issues only. In carrying out our work, we have conducted a review of plans and documents supplied by the design team. While the safety review required comment on various aspects of the geometrics of the roadway design, we have not carried out a detailed geometric design compliance check.

We have examined the various issues upon which we provide comment from a road safety, human factors, and operational perspective only, and do not attempt to deal with the question of cost-effectiveness. Readers of this report should recognize that road design and operational decisions necessarily encompass and must be influenced by the need to provide cost-effective overall solutions to design problems. While it is essential that safety be considered explicitly during the process – as is the intent with this review - it is not the only factor that will influence the final overall resolution of the road safety questions under consideration.

1.3 Basis of this review

Key documents used as a basis for this road safety review included the following:

- Innisfil 25h Side Road_Roll Plan – Sheet-1.pdf (Draft Preliminary Design, January 2022)
- Innisfil 25h Side Road_Roll Plan – Sheet-2.pdf (Draft Preliminary Design, January 2022)
- Innisfil 25h Side Road_Roll Plan – Sheet-2.pdf (Draft Preliminary Design, January 2022)
- Innisfil 25h Side Road_Roll Plan – Sheet-3.pdf (Draft Preliminary Design, January 2022)
- Design Criteria – Memo v3 2021.09.11.pdf (25th Side Road – Design Criteria, August 16, 2021)
- A five-year (2017 to 2021) summary of collisions reported within the study area prepared by the Town of Innisfil (25th Sideroad MVA's.xlsx).

2 COLLISION DATA REVIEW

2.1 Overview

Collision analysis consists of an evaluation of the available collision data and is particularly useful in examining the contributing factors and causes of the crashes that occur within a corridor. In addition to being useful at the diagnostic stage to identify specific areas of risk, historical collision data can also provide clues as to the most appropriate candidate countermeasures that should be considered for addressing any risk elements identified.

For this study we examined 5 years (2017 to 2021) of collision data summarized and provided by the Town of Innisfil.

2.2 Key findings

The following points summarize the key observations from the collision data summary provided:

- During the 5 -year analysis period a total of 43 collisions were reported within the study area. Of these collisions, 32 (74%) were reported as occurring at an intersection.

- 22% of the intersection related collisions were reported at the Innisfil Beach intersection. 22% of the intersection related collisions were also reported at the 9th Line intersection. It should be noted that many of the collisions reported at 9th Line involve angle type collisions. The roundabout proposed at this location will reduce the risk of this collision type that is typically associated with increase collision severity.

- Of particular concern, is that 53% of the collisions reported at the intersections consist of collision types typically associated with increased collision severity. This includes 8 turning related collisions, and 9 angle collisions.

- Based on the three points directly above, the road safety improvements focused on the study area intersections – particularly the Innisfil Beach and 9th Line intersections - appear to offer the greatest potential for road safety improvement.

- One pedestrian related collision was reported within the analysis period. This collision occurred at the Jack Crescent intersection.

- A total of 5 incidents involved collisions with roadside elements. These elements included ditch lines and fixed objects such a utility poles and trees.

3 PLAN-BASE ROAD SAFETY REVIEW

3.1 Overview

The road safety team conducted a plan-based road safety review of the preliminary design in accordance with the Transportation Association of Canada's Road Safety Audit Guide. The focus of this review was on identifying potential road safety risks to vulnerable road users within the corridor. Of particular concern was user comfort, routing and delay, minimizing conflicts with motor vehicles, and minimizing conflicts between pedestrians and bicycles.

As part of this review process, roadside design elements were examined using the MTO Roadside.xls analysis tool to determine the cost-effectiveness associated with the various roadside hazards identified. Locations at which this analysis technique has been applied are discussed in the comment table below.

3.2 Results

The following tables present a summary of the audit findings and suggested actions.

Comment ID	Observations	Suggested Action
General Comments		
G1	The proposed cross section for Context 1 and Context 3 suggests a 3.2m lane width. However, this lane width appears to incorporate a portion of the concrete gutter. As noted in the TAC Geometric Design Guide, lane widths are exclusive of any concrete gutter. As a result, the gutter is not typically considered part of the travel lane. This suggests that the effective lane width proposed for Context 1 and Context 3 is approximately 3.0 m which is the Recommended Lower Limit for the proposed 50 km/h design speed.	Confirm the intended lane width and adjust as necessary.
G2	Based on the point directly above, the narrow bioswale and buffer located between the travel lanes and the cycle track/sidewalk limits the available snow storage. As minimum lane widths are being proposed, careful consideration of snow clearing and removal practices will be required to avoid reducing the effective width of the travel lane during the winter months.	Review winter maintenance practices and requirements with Town Maintenance.
G3	The widening associated with the proposed cross section appears to impact the length of residential driveways. As several of these existing driveways currently appears to be short, there is a potential for parked cars to encroach onto the sidewalk. One example includes the driveway at 2189 25th Side Road.	Review driveways to confirm that adequate separation is provided between parked cars and the adjacent sidewalk.
G4	The cross section for Context 1 and Context 3 indicates several hazards located within the typical clear zone requirement for the proposed design speed and traffic volume present. These hazards include, but are not limited to,	Examine opportunities to provide the required clear zone where practical. If this cannot be achieved and the hazard cannot be made breakaway or traversable, ensure an appropriate lateral offset is provided.

	decorative trees, wooden utility poles, and the potential for exposed driveway culvert ends. Establishing a clear zone in a constrained low-speed urban environment is not always practical and sometimes not desirable from the perspective of street character and context, and the accommodation of active transportation modes. Shielding hazards with barrier is also not practical or desirable in this residential context and quantitative roadside analysis conducted by the road safety team using the MTO Roadside.xls tool has confirmed that shielding these hazards with barrier is not cost-effective. Research indicates that in low-speed urban environments, approximately 80% of roadside collisions involve objects with a lateral offset from the curb face equal to or less than 1.2 m, and approximately 90% of urban roadside collisions have lateral offsets less than or equal to 1.8 m. As a result, the provision of a lateral hazard offset of 1.2 m to 1.8 m often replaces the clear zone requirement in low-speed urban areas.	Other potential options for consideration may include: • Relocate utility poles to back of right-of-way • Limit mature tree caliper size • Make driveway culvert ends traversable
G5	Throughout the facility, the proposed sidewalks and cycle track crosses numerous commercial and residential driveways. At may of these locations, sightlines for drivers backing out of the driveways may be obstructed by decorative fences, and decorative hedges and trees. This is of particular concern due	Opportunities to removal these sightline restrictions and the provide cyclist/pedestrians with advanced warning should be examined.

	to the increased risk of collision between vehicles and vulnerable road users.	
G6	The adequacy of current lighting levels on the corridor should be assessed to determine the need for any upgrade. Of particular concern will be lighting levels at the proposed mid-block crossings.	Assess the existing lighting levels and adjust as necessary.
Context 1: Specific Comments		
1.1	Details on connecting the proposed cycle track to the existing on-street bike lanes on Innisfil Beach Road are not provided.	This information should be provided as the design process advances.
1.2	A review of the design criteria indicates an MSU design vehicle for Context 1. The presence of the Innisfil Water Treatment Plant may introduce the need to accommodate a larger design vehicle.	Confirm the necessary design vehicle in the vicinity of the Innisfil Water Treatment Plant.
1.3	The proposed cross section does not accommodate the current on-street resident only permitted parking north of Park Street. Appropriate signage will be required to restrict on-street parking (except in designated parking laybys) with the proposed cross section.	Restrict on-street parking as necessary.
1.4	Vehicles turning right onto the side roads may not see cyclists on the Cycle Track approaching from behind.	Consider the use of raised bike/ped crossings at side road intersections to slow vehicle turning speeds.
1.5	The two-way cycle track crosses driveways at the Innisfil Water Treatment Plant. Drivers exiting the plant may not cyclist to be approaching from the right. Signage should be	Signage should be provided to warn drivers exiting the plant to look both ways for approaching cyclists.

	provided to warn drivers exiting the plant to look both ways for approaching cyclists.	
1.6	Although details have not been provided, it appears the Town is considering crosswalks at the following locations: • Lebanon Drive Treatment measures focused on improving crosswalk conspicuity and the advanced warning offered to drivers will be required.	Treatment options for consideration may include the following: • Provide a median refuge island • High-visibility crosswalk markings • Parking restrictions on crosswalk approach • Adequate nighttime lighting levels • Crossing warning signs • Raised crosswalk • Rectangular Rapid-Flashing Beacon (RRFB) • Ensure the proposed landscaping (trees) do not obstruct sightlines to pedestrians and cyclists approaching the crosswalk.
1.7	Crosswalk have been proposed at the following locations: • Willow Avenue • Jack Crescent • 9th Line • Candaras Street • Rose Lane • Main Street • Pine Grove Avenue In addition to the median refuge indicated at these locations, the provision of supplemental treatment measures should be considered.	Additional treatment measures for consideration may include the following: • High-visibility crosswalk markings • Parking restrictions on crosswalk approach • Adequate nighttime lighting levels • Crossing warning signs • Raised crosswalk • Rectangular Rapid-Flashing Beacon (RRFB) • Ensure the proposed landscaping (trees) do not obstruct sightlines to pedestrians and cyclists approaching the crosswalk. • Provide any necessary signage for dismounting cyclists

	As no Cross Ride is indicated, positive guidance and signage may be necessary to inform cyclists that they must dismount to cross at these locations.	
1.8	In addition to the comment directly above, the size of the pedestrian storage/waiting area provided at many of these mid-block crossings appears limited and may result in pedestrians standing in the cycle track.	Opportunities to increase the storage/waiting area at the mid-block crossings should be examined.
1.9	Several commercial sites feature driveways with nose-in/back-out parking. Sightlines for drivers backing out of these locations may be limited by other parked cars. This is of particular concern as they are located adjacent to the sidewalk and cycle track. Examples include the Fork and Plate Restaurant and Main Street Hair Salon.	Examine opportunities to eliminate or reconfigure parking at these locations.
1.10	The Petro Canada features a wide driveway in close proximity to the proposed crosswalk at Joseph Street. This creates a potential for vehicles turning onto 25th Side Road to approach the proposed crosswalk at skew. The close proximity of the driveway to the crosswalk may also reduce the effectiveness of any advanced waring measures.	Opportunities to close this access or increase the separation between the access and crosswalk should be considered.
1.11	The Petro Canada features a wide uncontrolled access at the William Street intersection. This configuration may contribute to increased entry speeds and unusual vehicle orientations at the intersection.	Relocate the access away from the intersection and introduce positive control measures.
1.12	A roundabout is proposed at the 9th Avenue intersection. As no details are available, the audit team has not provided comment on this portion of the facility.	N/A

1.13	Opportunities to improve user safety at the signalized intersections at Innisfil Beach Road and Leslie Drive / Roberts Road should be considered.	Options for consideration may include the provision of fully protected left-turn, and pedestrian lead phases.
1.14	A short section of Two Way Left Turn Lane (TWLTL) is proposed between Lockhart Road and station 14+400. As details on the proposed development were not provided, the road safety team is not able to comment on the appropriateness of the proposed TWLTL configuration. However, opportunities to limit the number of driveways through effective access management should be considered to reduce the risk high driveway density can present to pedestrians and cyclists. Effective access management may also accommodate replacing the proposed TWLTL with more localized exclusive turning lanes.	Apply access management principles as necessary.
1.15	As detailed, the TWLTL transitions directly into the exclusive left-turn lanes at the intersections. This configuration may contribute to misuse and conflicts within the transition zones.	Appropriate pavement markings or divisional islands should be used to terminate the two-way left-turn lane in advance of the exclusive left-turn lane at intersections.
1.16	There appears to be an existing watercourse and structure in the vicinity of station 14+850. Details on any necessary barrier/railing protection have not been provided. As a result, the audit team is not able to provide comment.	As the design advances, details on the proposed barrier and bridge railing should be provided.
Context 2: Specific Comments		
2.1	Based on the proposed design speed and traffic volumes, TAC suggests a 1.5 m wide shoulder for a rural collector and 1.0m wide shoulder for a rural local road. Gravel shoulder widths of 1.0 m on the west side of the roadway and 0.5 m on the east	Parking restrictions will be required on the east side of the roadway.

	side of the roadway have been proposed. This limits the accommodation of disabled/parked vehicles.	
2.2	The proposed ditch line cross section on the west side of the roadway appears to consist of a 3:1 foreslope and 3:1 backslope. This combination of slopes is not considered traversable and may result in the front end of errant vehicles planting into the backslope.	Consider providing a traversable ditch line cross section.
2.3	The proposed clear zone to utility poles located in the backslope on the west side of the roadway appears to meet the requirements outlines in TAC (3.5m to 4.5m). However, a review of StreetView suggest the presence of anchor poles located on the east side of the roadway that appear to be located within the required clear zone.	Relocation of these anchor poles beyond the required clear zone should be examined.
2.4	A roundabout is proposed at the Big Bay Point intersection. As no details are available, the audit team has not provided comment on this portion of the facility.	N/A
2.5	Details on the multi-use trail beyond the Big Bay Point Road intersection are not provided.	This information should be provided as the design process advances.
Context 3: Specific Comments		
3.1	A two-way-left-turn-lane (TWLTL) is proposed between Cook Street and Lockhart Road. As details on the proposed development were not provided, the road safety team is not able to comment on the appropriateness of the proposed TWLTL configuration. However, opportunities to limit the number of driveways through effective access management should be considered to reduce the risk high driveway density can present to	Apply access management principles as necessary.

	pedestrians and cyclists. Effective access management may also accommodate replacing the proposed TWLTL with more localized exclusive turning lanes.	
3.2	Vehicles turning right onto the side roads may not see cyclists on the Cycle Track approaching from behind.	Consider the use of raised bike/ped crossings at side road intersections to slow vehicle turning speed.
3.3	Although detail have not been provided, it appears the Town is considering crosswalks at the following location: • Station 13+960 (2960 – 25th Side Road) Treatment measures focused on improving crosswalk conspicuity and the advanced warning offered to drivers will be required. Termination of the proposed TWLTL on the approaches to the crosswalk is also recommended.	Treatment options for consideration may include the following: • Terminate the TWLTL on the approaches to the crossing. • Provide a median refuge island • High-visibility crosswalk markings • Parking restrictions on crosswalk approach • Adequate nighttime lighting levels • Crossing warning signs • Raised crosswalk • Rectangular Rapid-Flashing Beacon (RRFB) • Ensure the proposed landscaping (trees) do not obstruct sightlines to pedestrians and cyclists approaching the crosswalk. • Terminate the TWLTL on the approaches to the crosswalk.
3.4	As detailed, the two-way left-turn lane transitions directly into the exclusive left-turn lanes at the intersections. This configuration may contribute to misuse and conflicts within the transition zones.	Appropriate pavement markings or divisional islands should be used to terminate the two-way left-turn lane in advance of the exclusive left-turn lane at intersections.

4 QUANTITATIVE RISK ASSESSMENT

4.1 Overview

To provide a quantitative assessment of the change in road safety risk resulting from the proposed preliminary design, the WSP road safety team applied the Intersection Control Evaluation (ICE) Stage 2 Process developed as part of NCHRP 948: Guide for Pedestrian and Bicyclist Safety at Alternative and Other Intersections and Interchanges. As a surrogate for quantitative performance measures, performance measures—also known as design flags—can help identify potential safety, accessibility, operational, or comfort issues for pedestrians and bicyclists. A design flag does not necessarily represent a fatal flaw for an alternative; rather, it presents a design issue that should be examined in the iterative development and evaluation of the design. The evaluation includes two types of design flags:

- Red Flags: Design elements directly related to a safety concern for pedestrians or bicyclists.

- Yellow Flag: Design elements negatively affecting user comfort (i.e., increasing user stress) or the quality of the walking or cycling experience.

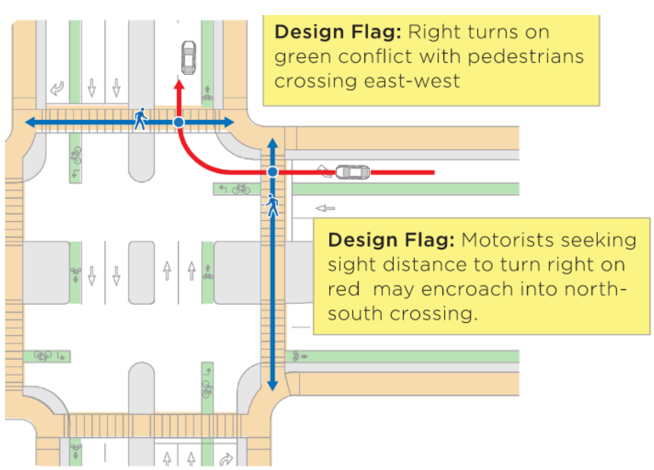
The results of this quantitative assessment help to identify intersection locations that exhibit the greatest level of road safety risk to pedestrians and bicycles.

4.2 Approach

For the purposes of this assessment, the following Design Flags and corresponding thresholds were applied to the study area intersections:

- **Design Flag: Motor Vehicle Right-Turns (Pedestrian and Bicycle):** Right-turning vehicles directly conflict with pedestrians and bicyclists (for off-road cycle track) crossing at intersections. For signalized intersections, pedestrians and cyclists often find that their path of travel is impeded by drivers inching forward to see traffic moving left to right, in preparation to making either a right-turn-on-red movement or a right-turn during a permissive green phase.

Figure 1: Design Flag - Motor Vehicle Right-Turns

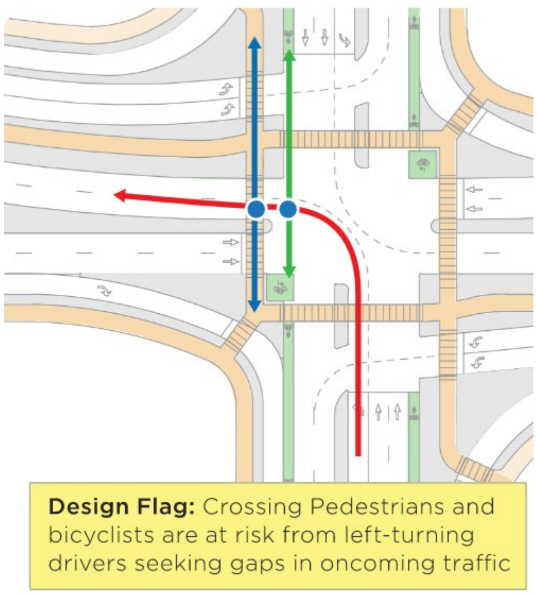


Measure of effectiveness	Yellow-Flag Threshold	Red-Flag Threshold
Vehicle turning speed & vehicle volume	<= 30 km/h **AND** <= 50 veh/h	> 30 km/h **OR** > 50 veh/h

** If the vehicle movement is stop-controlled or signalized (with no right-turns-on-red), or speeds are below 15 km/h (e.g., through a raised crosswalk) this flag is eliminated.*

- **Design Flag: Motor Vehicle Left-Turns (Pedestrian and Bicycle):** Both permissive and protected motor vehicle left turns can affect the safety and comfort of pedestrians and bicyclists. While pedestrians are crossing or bicyclists are making a through movement, permissive left-turning drivers are often focused on finding a gap in oncoming motor vehicle traffic and may not be watching out for nonmotorized road users

Figure 2: Design Flag - Motor Vehicle Left-Turns



Measure of effectiveness	Yellow-Flag Threshold	Red-Flag Threshold
Vehicle Turning Speed and Vehicle Volume	<= 30 km/h **AND** <=50 veh/h	>30kph **OR** >50 veh/h

- **Design Flag: Undefined Crossing at Intersection (Pedestrian and Bicycle):** For all intersection forms, unmarked or undesignated space at an intersection result in undefined space, and even if many states consider these unmarked locations "legal crossings", the level of comfort can be low when walking or biking. In addition, right-turning or left-turning vehicles are more likely to encroach on pedestrian and bicyclist crossings and may not expect pedestrians or bicycles at the downstream crossing point.

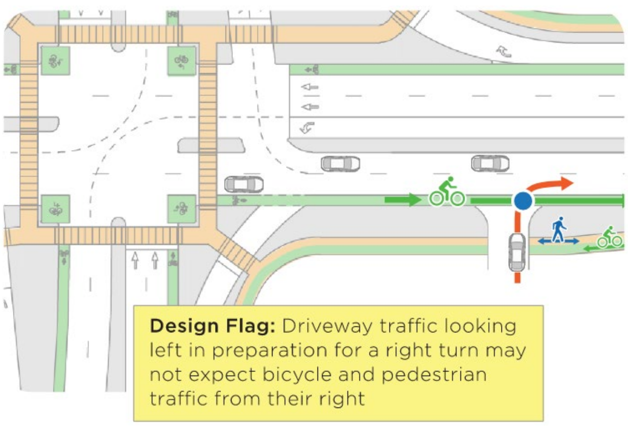
Measure of effectiveness	Yellow-Flag Threshold	Red-Flag Threshold
Path Markings	Unmarked Crossing	N/A

- **Design Flag: Uncomfortable/Tight Walking Environment (Pedestrian):**
This flag accounts for lower level of comfort for pedestrians using paths or sidewalks located in close proximity to traffic or buildings. In these situations, pedestrians tend to avoid conflicts which results in reduced usable width of the sidewalk.

Measure of effectiveness	Yellow-Flag Threshold	Red-Flag Threshold
Effective walkway width	< 1.5 m if traffic present on one side. < 3m if traffic present on two sides	N/A

- **Design Flag: Intersecting Driveways and Side Streets (Pedestrian and Bicycle):**
Driveways and side streets near intersections can result in an increased cognitive load and distractions for all users. Drivers attempting to turn out of a driveway or side street are focused on monitoring multiple streams of traffic to find gaps and merge, may not expect or look for pedestrians and bicycles. Driveways and side streets that intersect with two-way cycle tracks (either at street or sidewalk level) are of particular concern.

Figure 3: Design Flag - Intersecting Driveways and Side Streets



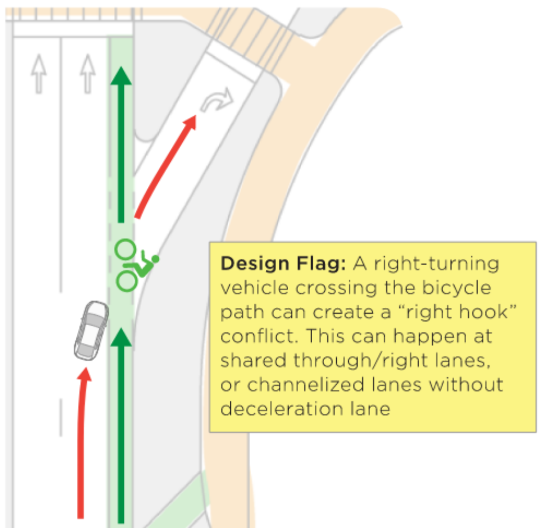
Measure of effectiveness	Yellow-Flag Threshold	Red-Flag Threshold
# Of Access points in Area of Influence	1-2 (for peds) 1-2 (for one-way bikes)	>2 (for peds) >2 (for one-way bikes) >0 (for two-way bikes)

- **Design Flag: Riding in Mixed Traffic (Bicycle):**
Riding in mixed traffic has been documented as both a safety issue and a comfort issue for bicyclists as it can be stressful and creates potential conflicts with vehicle traffic.

Measure of effectiveness	Yellow-Flag Threshold	Red-Flag Threshold
Vehicle Sped and Vehicle Volume	40-55 km/h **OR** 3,000 – 7000 vpd	>55 km/h **OR** >7000 vpd

- **Design Flag: Turning Motorists Crossing Bicycle Path (Bicycle):**
  For bicyclists proceeding straight through an intersection, the conflict zone where motor vehicle traffic can cross the bike path of travel creates a safety concern and source of user stress. This conflict is also called the "right hook" conflict. A right hook occurs when a vehicle passes a (slower) bicycle in the approach to an intersection. As the vehicle slows down to make right turns at the intersection, the bicyclist can catch up with the vehicle. As the vehicle turns, the driver may not be aware of the cyclist (in their blind spot), creating a conflict and potential crash.

Figure 4: Design Flag - Turning Motorists Crossing Bicycle Path



Measure of effectiveness	Yellow-Flag Threshold	Red-Flag Threshold
Motor Vehicle Lane Configuration	Turn to Exclusive Turn Lane	Turn from Shared Thru & Turn Lane

4.3 **Results**

The following figures present a risk flag comparison of the existing and proposed intersection configurations. Separate risk flag summaries have been prepared for pedestrian and bicycle modes.

Figure 5: Intersection Control Evaluation – Pedestrian risk flag summary (existing versus proposed)

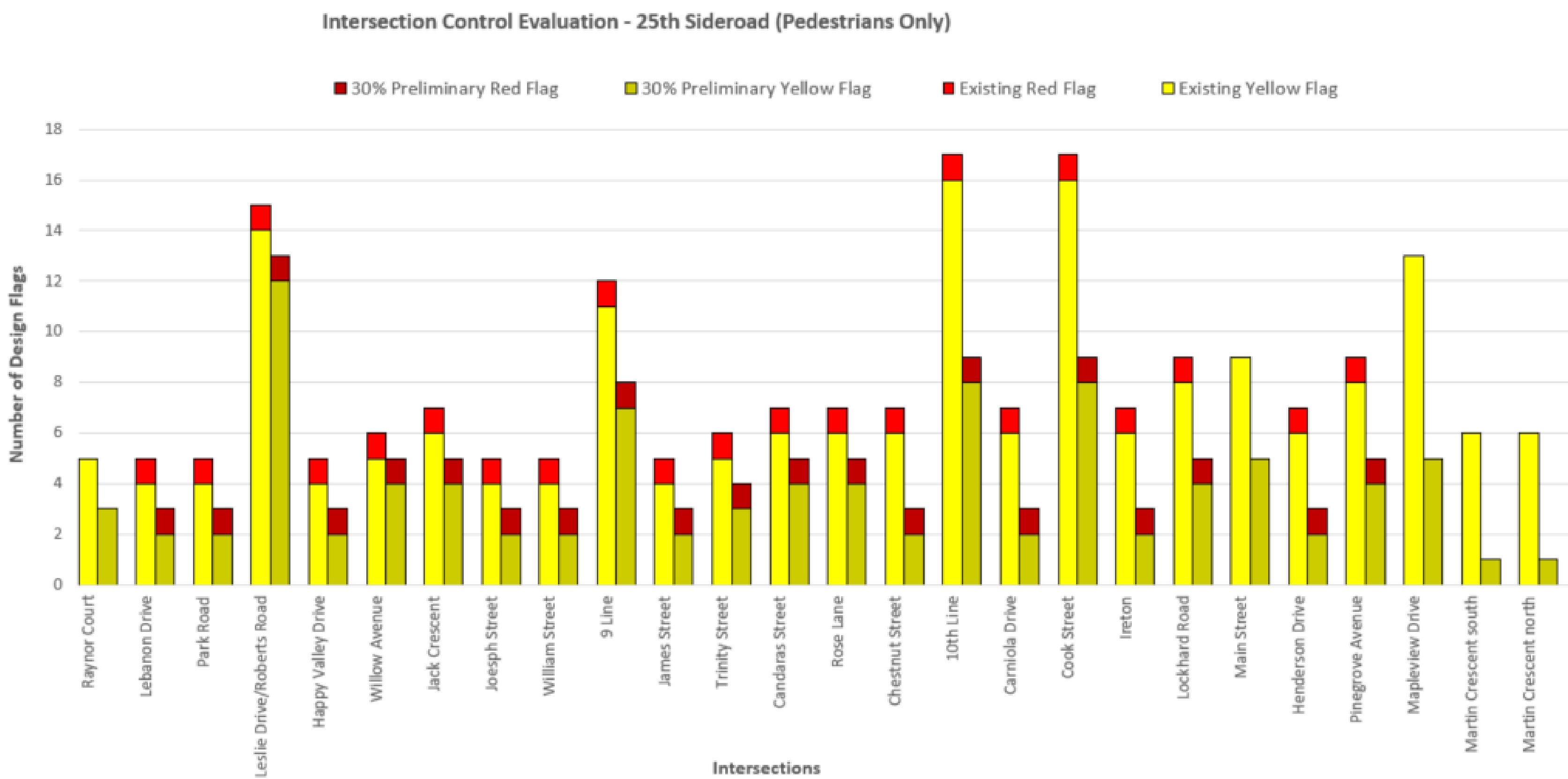


Table 1: Intersection Control Evaluation – Pedestrian risk flag details (existing versus proposed)

Scenario	**Existing**					**30% Preliminary**				
Number of Design Flags	Motor Vehicle Right-Turn	Motor Vehicle Left-Turn	Undefined Crossing at Intersection	Uncomfortable/Tight Walking Environment	Intersection Driveways and Side Streets	Motor Vehicle Right-Turn	Motor Vehicle Left-Turn	Undefined Crossing at Intersection	Uncomfortable/Tight Walking Environment	Intersection Driveways and Side Streets
Raynor Court										
Lebanon Drive										
Park Road										
Leslie Drive/Roberts Road										
Happy Valley Drive										
Willow Avenue										
Jack Crescent										
Joesph Street										
William Street										
9 Line										
James Street										
Trinity Street										
Candaras Street										
Rose Lane										
Chestnut Street										
10th Line										
Carniola Drive										
Cook Street										
Ireton										
Lockhard Road										
Main Street										
Henderson Drive										
Pinegrove Avenue										
Mapleview Drive										
Martin Crescent south										
Martin Crescent north										
Total Number of Flags Yellow (Y), Red (R)	46 Y 0 R	48 Y 0 R	36 Y 0 R	55 Y 0 R	3 Y 21 R	44 Y 0 R	49 Y 0 R	1 Y 0 R	0 Y 0 R	3 Y 21 R
	188 Y 21 R					97 Y 21 R				

Figure 6: Intersection Control Evaluation – Bicycle risk flag summary (existing versus proposed)

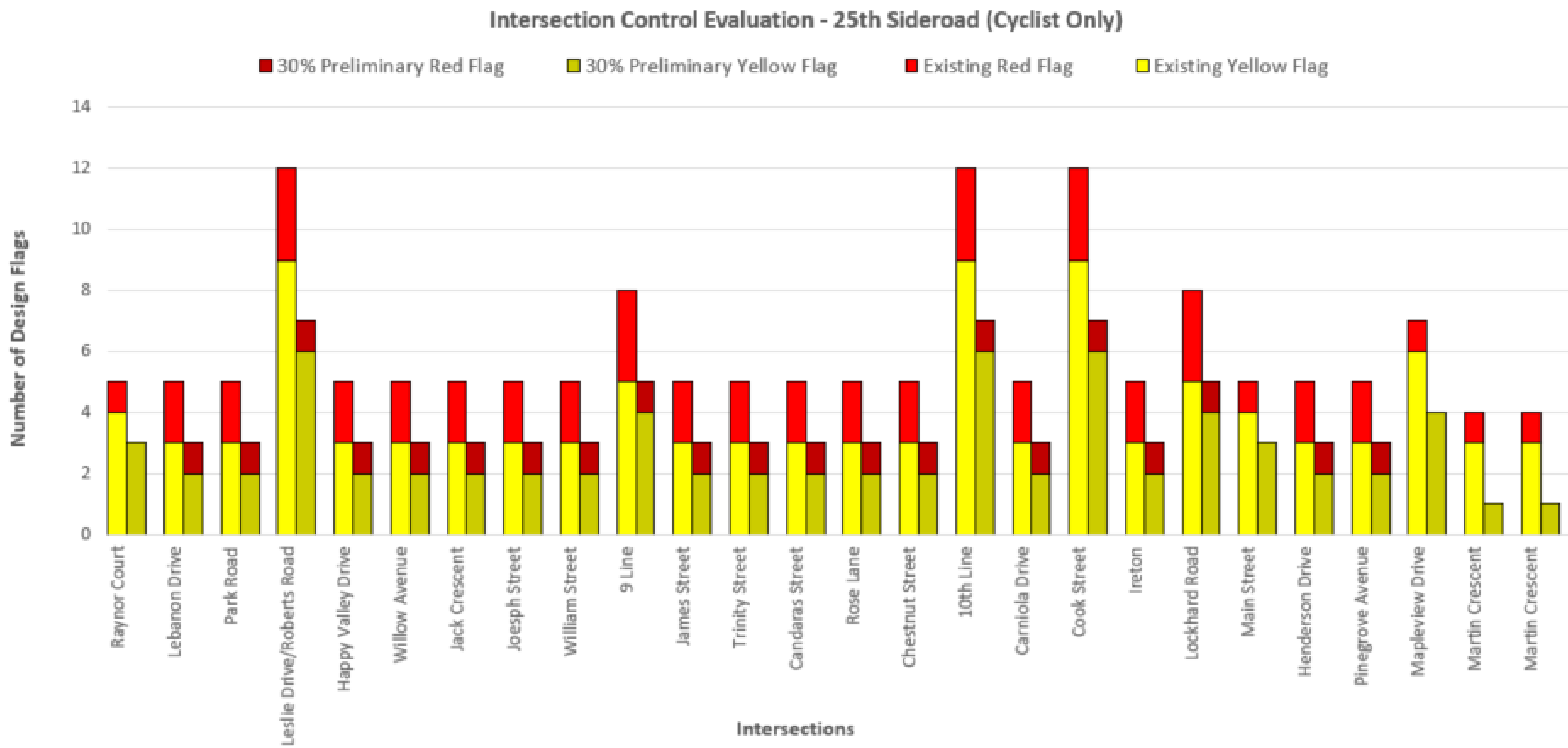


Table 2: Intersection Control Evaluation – Bicycle risk flag details (existing versus proposed)

Scenario	Existing						30% Preliminary					
Number of Design Flags	Riding in Mixed Traffic	Turning Motorists Crossing Bicycle Path - the "right hook"	Motor Vehicle Right-Turn	Motor Vehicle Left-Turn	Undefined Crossing at Intersection	Intersection Driveways and Side Streets	Riding in Mixed Traffic	Turning Motorists Crossing Bicycle Path - the "right hook"	Motor Vehicle Right-Turn	Motor Vehicle Left-Turn	Undefined Crossing at Intersection	Intersection Driveways and Side Streets
Raynor Court												
Lebanon Drive												
Park Road												
Leslie Drive/Roberts Road												
Happy Valley Drive												
Willow Avenue												
Jack Crescent												
Joesph Street												
William Street												
9 Line												
James Street												
Trinity Street												
Candaras Street												
Rose Lane												
Chestnut Street												
10th Line												
Carniola Drive												
Cook Street												
Ireton												
Lockhard Road												
Main Street												
Henderson Drive												
Pinegrove Avenue												
Mapleview Drive												
Martin Crescent south												
Martin Crescent north												
Total Number of Flags Yellow (Y), Red (R)	26 Y 0 R	0 Y 31 R	0 Y 0 R	38 Y 0 R	38 Y 0 R	3 Y 21 R	0 Y 0 R	0 Y 0 R	29 Y 0 R	38 Y 0 R	0 Y 0 R	3 Y 21 R
	105 Y 52 R						70 Y 21 R					

4.4 Key findings

The following points provide a summary of key findings from the Intersection Control Evaluation analysis:

- In general, the proposed design results in a significant improvement in pedestrian comfort and quality of the walking experience (yellow flags) throughout the study area corridor.

- Although an improvement over the existing condition, the proposed design for the signalized intersection with Leslie Drive/Roberts Road still exhibits numerous yellow risk flags that suggests a reduced level of pedestrian comfort is still present. This is the result of potential conflicts between pedestrians and right and left-turning vehicles. Options for improving pedestrian comfort at this intersection (reduce the number of yellow flags) may include the following:

  - Restrict right-turns on red.

  - Fully protected left-turn phases

  - Pedestrian lead phases

- At the other study area intersections, one option to further improve the comfort level offered to pedestrians (reduce the number of yellow flags) includes providing a raised pedestrian crossing to reduce the speed of right-turning vehicles.

- The proposed design results in no change in the design elements directly related to safety concerns for pedestrians (red flags). The design element of concern at these locations is the presence of driveways in the intersection influence area.

- The proposed design results in improved cyclist comfort and quality of riding experience throughout the study area corridor. Providing a raised crossing would further improve the comfort level for cyclists by reducing the speed of right-turning vehicle.

- The proposed design also results in a significant reduction in the number of design elements directly related to safety concerns (red flags) for cyclists. The reduced risk of right-hook type incidents results from placing cyclists on a dedicated cycle track is the key contributor to this improvement.

5 SYNTHESIS

5.1 Overview

This section of the report, findings from the historical collisions data review, plan-based road safety review, and quantitative risk assessment are used to finalize the identification of areas of higher collisions potential and develop appropriate diagnostic statements regarding contributing factors to these situations. This information will be used by the design team to nourish the design development and reduce road safety risks within the corridor.

5.2 Key findings

5.2.1 Intersections

- The examination of historical collision data suggests that 74% of collisions reported in the study area occurred at intersections. Of particular concern, is that 53% of the collisions reported at the intersection consisted of collision types typically associated with increased collision severity. These include right angle and turning related collisions. Based on these findings, road safety improvements focused on the study area intersections appear to offer the greatest potential for road safety improvement within the study area corridor.

- As 44% of the intersection related collisions were reported at the Innisfil Beach and 9th Line intersections, these intersections offer the greatest opportunity for improvement. We note that a future roundabout is proposed at the 9th Line intersection. This should significantly improve road safety and traffic operations at this location. Options to improve road safety at the existing Innisfil Beach signalized intersection may include the provision of fully protected left-turn signal phases.

- In general, results from the ICE analysis suggest that the proposed design changes at the study area intersections significantly improve pedestrian and cyclist comfort, and the quality of the walking and cycling experience at the study area intersections. The findings from this analysis also indicate that using raised pedestrian and cyclist crossings would further improve the level of comfort offered to pedestrians and cyclists.

- The proposed design for the signalized intersection with Leslie Drive/Roberts Road results in numerous yellow risk flags that suggests a reduced level of pedestrian comfort. A key contributor to this reduced level of comfort is potential conflicts between pedestrians, and right and left-turning vehicles. Potential options for improving pedestrian comfort at this intersection may include the following:

  - Restrict right-turns on red.
  - Fully protected left-turn phases
  - Pedestrian lead phases

5.2.2 Accommodation of active transportation modes

- During the analysis period, one pedestrian related collision was reported within the study area corridor. This collision occurred at the Jack Crescent intersection.

- As noted in the section above, findings from the ICE analysis suggest that the proposed design changes at the study area intersections greatly improve pedestrian and cyclist comfort, and the quality of the walking and cycling experience at the study area intersections. However, the plan-based review has identified several road safety concerns associate with the proposed sidewalks and cycle tracks on the mid-block sections. These include the following:

  - Throughout the facility, the proposed sidewalks and cycle tracks cross numerous commercial and residential driveways. At may of these locations, sightlines for drivers backing out of the driveways may be obstructed by decorative fences, and decorative hedges and trees. This is of particular concern due to the increased risk of collision between vehicles and vulnerable road users. Opportunities to removal these sightline restrictions should be examined.

  - The adequacy of current lighting levels on the corridor should be assessed to determine the need for any upgrade. Of particular concern will be lighting levels at the proposed mid-block crossings. The existing lighting levels will need to be assessed and adjusted as necessary.

  - The two-way cycle track crosses driveways at the Innisfil Water Treatment Plant. Drivers exiting the plant may not cyclist to be approaching from the right. Signage should be provided to warn drivers exiting the plant to look both ways for approaching cyclists. Signage should be provided to warn drivers exiting the plant to look both ways for approaching cyclists.

  - Several commercial sites feature driveways with nose-in/back-out parking. Sightlines for drivers backing out of these locations may be limited by other parked cars. This is of particular concern as they are located adjacent to the sidewalk and cycle track. Examples include the Fork and Plate Restaurant and Main Street Hair Salon. Opportunities to eliminate or reconfigure parking at these locations should be examined.

5.2.3 Mid-block crossings

Uncontrolled pedestrian crossings have been proposed or are under review at the following locations:

- Willow Avenue
- Jack Crescent
- 9th Line
- Candaras Street
- Rose Lane
- Main Street
- Pine Grove Avenue
- Lebanon Drive
- Joseph Street
- Station 13+960 (2960 25th Side Road)

In addition to the median refuge indicated at these locations, the provision of supplemental treatment measures should be considered. Recognized pedestrian collision countermeasures suggested for application at uncontrolled crossing locations is provided as part of the guidance offered by FHWA Safe Transportation for Every Pedestrian (STEP) program. These countermeasures are assigned based on specific roadway characteristics and are supported by road safety research and best practices. For the conditions proposed on the study area corridor, the following additional treatment measures have been identified for consideration:

- High-visibility crosswalk markings
- Parking restrictions on crosswalk approach
- Adequate nighttime lighting levels
- Crossing warning signs
- Raised crosswalk
- Rectangular Rapid-Flashing Beacon (RRFB)

In addition to the supplemental warning treatments outlined above, the following elements of the design should be examined to address other road safety risks identified at these mid-block crossings as part of the plan-based road safety review:

- Ensure the proposed landscaping (trees) do not obstruct sightlines to pedestrians and cyclists approaching the mid-block crossings.
- Provide any necessary signage for dismounting cyclists
- Ensure the size of the pedestrian storage/waiting area provided at these mid-block crossings is adequate and does not require pedestrians to stand in the cycle track.

5.2.4 **Access management**

A two-way-left-turn-lane (TWLTL) is proposed between Cook Street and Lockhart Road. Although details on the proposed development were not provided, opportunities to limit the number of driveways through effective access management should be considered to reduce the risk high driveway density can present to pedestrians and cyclists. Effective access management may also accommodate replacing the proposed TWLTL with more localized exclusive turning lanes.

If a TWLTL configuration is to be applied, the introduction of the TWLTL and its termination at exclusive left-turn lanes should be achieved with appropriate pavement markings or divisional islands.

Other access management opportunities may include the following:

- The Petro Canada features a wide driveway in close proximity to the proposed crosswalk at Joseph Street. This creates a potential for vehicles turning onto 25th Side Road to approach the proposed crosswalk at a skew. The close proximity of the driveway to the crosswalk may also reduce the effectiveness of any advanced waring measures. Opportunities to close this access or increase the separation between the access and crosswalk should be considered.

- The Petro Canada features a wide uncontrolled access at the William Street intersection. This configuration may contribute to increased entry speeds and unusual vehicle orientations at the intersection. Relocate the access away from the intersection and introduce positive control measures.

5.2.5 **Roadside design**

- A review of the historical collision data indicates that approximate 12% (5) of collisions reported within the study area involved roadside design elements. In addition, the plan-based road safety audit of the proposed design identified several roadside hazards located with in the required clear zone including trees, utility poles, exposed driveway culvert ends, and non-traversable ditch lines.

- From a road safety perspective, it is desirable to provide the minimum recommended clear zone requirement. However, it is also understood that establishing a clear zone in a constrained low-speed urban environment is not always practical and sometimes not desirable from the perspective of street character and context, and the accommodation of active transportation modes. As a result, the provision of a lateral hazard offset of 1.2 m to 1.8 m often replaces the clear zone requirement in low-speed urban areas. These lateral hazard offsets appear to be accommodated in the proposed design within the Context 1 and Context 3 zones.

- A quantitative analysis of the need to shield the roadside hazards discussed in the point above was conducted using the MTO Roadside.xls software tool. The results of this analysis have confirmed that shielding these hazards with barrier is not cost-effective.

- There appears to be an existing watercourse and structure in the vicinity of station 14+850 (3155 25th Side Road). Details on any necessary barrier/railing protection have not been provided. As a result, the audit team was not able to provide comment. As the design advances, details on the proposed barrier and bridge railing should be provided.

6 APPENDIX – DESIGN TEAM RESPONSE TO AUDIT

Comment ID	Observations	Suggested Action	Design Response
General Comments			
G1	The proposed cross section for Context 1 and Context 3 suggests a 3.2m lane width. However, this lane width appears to incorporate a portion of the concrete gutter. As noted in the TAC Geometric Design Guide, lane widths are exclusive of any concrete gutter. As a result, the gutter is not typically considered part of the travel lane. This suggests that the effective lane width proposed for Context 1 and Context 3 is approximately 3.0 m which is the Recommended Lower Limit for the proposed 50 km/h design speed.	Confirm the intended lane width and adjust as necessary.	25th Side Road is not considered a truck route or transit route, thus the lane width is appropriate. The vision is for an AT-first approach and using geometry to calm traffic speeds.
G2	Based on the point directly above, the narrow bioswale and buffer located between the travel lanes and the cycle track/sidewalk limits the available snow storage. As minimum lane widths are being proposed, careful consideration of snow clearing and removal practices will be required to avoid reducing the effective width of the travel lane during the winter months.	Review winter maintenance practices and requirements with Town Maintenance.	We have discussed with Town Maintenance early in the design process, and included mountable curb with splash strip is proposed as snow storage based on their input.
G3	The widening associated with the proposed cross section appears to impact the length of residential driveways. As several of these	Review driveways to confirm that adequate separation is provided	We are staying within the ROW where possible.

	existing driveways currently appears to be short, there is a potential for parked cars to encroach onto the sidewalk. One example includes the driveway at 2189 25th Side Road.	between parked cars and the adjacent sidewalk.	
G4	The cross section for Context 1 and Context 3 indicates several hazards located within the typical clear zone requirement for the proposed design speed and traffic volume present. These hazards include, but are not limited to, decorative trees, wooden utility poles, and the potential for exposed driveway culvert ends. Establishing a clear zone in a constrained low-speed urban environment is not always practical and sometimes not desirable from the perspective of street character and context, and the accommodation of active transportation modes. Shielding hazards with barrier is also not practical or desirable in this residential context and quantitative roadside analysis conducted by the road safety team using the MTO Roadside.xls tool has confirmed that shielding these hazards with barrier is not cost-effective. Research indicates that in low-speed urban environments, approximately 80% of roadside collisions involve objects with a lateral offset from the curb face equal to or	Examine opportunities to provide the required clear zone where practical. If this cannot be achieved and the hazard cannot be made breakaway or traversable, ensure an appropriate lateral offset is provided. Other potential options for consideration may include: • Relocate utility poles to back of right-of-way • Limit mature tree caliper size • Make driveway culvert ends traversable	Given this is a constrained, low-speed environment, and we are urbanizing contexts 1 and 3, it is not desirable to meet clear zone requirements.

	less than 1.2 m, and approximately 90% of urban roadside collisions have lateral offsets less than or equal to 1.8 m. As a result, the provision of a lateral hazard offset of 1.2 m to 1.8 m often replaces the clear zone requirement in low-speed urban areas.		
G5	Throughout the facility, the proposed sidewalks and cycle track crosses numerous commercial and residential driveways. At may of these locations, sightlines for drivers backing out of the driveways may be obstructed by decorative fences, and decorative hedges and trees. This is of particular concern due to the increased risk of collision between vehicles and vulnerable road users.	Opportunities to removal these sightline restrictions and the provide cyclist/pedestrians with advanced warning should be examined.	Project Team will review sightlines of the high volume commercial driveways. Obstructions such as fences could be relocated as part of detailed design.
G6	The adequacy of current lighting levels on the corridor should be assessed to determine the need for any upgrade. Of particular concern will be lighting levels at the proposed mid-block crossings.	Assess the existing lighting levels and adjust as necessary.	No photometric analysis is being done as part of preliminary design. We are shifting hydro poles with luminaires, but not removing any. We recommend the lighting be assessed at detailed design. Project team to add note in preliminary design report.

Context 1: Specific Comments			
1.1	Details on connecting the proposed cycle track to the existing on-street bike lanes on Innisfil Beach Road are not provided.	This information should be provided as the design process advances.	We will discuss in Preliminary Design report
1.2	A review of the design criteria indicates an MSU design vehicle for Context 1. The presence of the Innisfil Water Treatment Plant may introduce the need to accommodate a larger design vehicle.	Confirm the necessary design vehicle in the vicinity of the Innisfil Water Treatment Plant.	The Town has confirmed that the largest vehicle entering the water treatment plant is 53 foot tractor trailers. There is a ring road around the water plant to facilitate large shipments of equipment and chemicals and to avoid excessive backing up. The South entrance to the water plant has a very large entrance into the automatic gate. Most vehicles however enter the North gate as it is easier for them to back into the north loading dock. We will ensure these vehicles are accommodated.
1.3	The proposed cross section does not accommodate the current on-street resident only permitted parking north of Park Street. Appropriate signage will be required to restrict on-street parking (except in designated parking laybys) with the proposed cross section.	Restrict on-street parking as necessary.	The Town has reviewed and advises that on-street parking is no longer required, and thus it will be removed from the plans and restricted with appropriate by-laws.
1.4	Vehicles turning right onto the side roads may not see cyclists on the Cycle Track approaching from behind.	Consider the use of raised bike/ped crossings at side road intersections to slow vehicle turning speeds.	We have proposed raised and continuous sidewalk/cycle track.

1.5	The two-way cycle track crosses driveways at the Innisfil Water Treatment Plant. Drivers exiting the plant may not cyclist to be approaching from the right. Signage should be provided to warn drivers exiting the plant to look both ways for approaching cyclists.	Signage should be provided to warn drivers exiting the plant to look both ways for approaching cyclists.	We will note in report that signage will be part of detailed design.
1.6	Although detail have not been provided, it appears the Town is considering crosswalks at the following locations: • Lebanon Drive • Joseph Street Treatment measures focused on improving crosswalk conspicuity and the advanced warning offered to drivers will be required.	Treatment options for consideration may include the following: • Provide a median refuge island • High-visibility crosswalk markings • Parking restrictions on crosswalk approach • Adequate nighttime lighting levels • Crossing warning signs • Raised crosswalk • Rectangular Rapid-Flashing Beacon (RRFB) • Ensure the proposed landscaping (trees) do not obstruct sightlines to pedestrians and cyclists approaching the crosswalk.	We will replace the existing midblock ped signal at Joseph. The crossing at Lebanon Drive is proposed as a separate Town initiative, but we will add a note on the drawing at this location.
1.7	Crosswalk have been proposed at the following locations: • Willow Avenue	Additional treatment measures for consideration may include the following:	The OTM Book 15 process for crossing treatment will be used, to be confirmed during detailed design

	• Jack Crescent • 9th Line • Candaras Street • Rose Lane • Main Street • Pine Grove Avenue In addition to the median refuge indicated at these locations, the provision of supplemental treatment measures should be considered. As no Cross Ride is indicated, positive guidance and signage may be necessary to inform cyclists that they must dismount to cross at these locations.	• High-visibility crosswalk markings • Parking restrictions on crosswalk approach • Adequate nighttime lighting levels • Crossing warning signs • Raised crosswalk • Rectangular Rapid-Flashing Beacon (RRFB) • Ensure the proposed landscaping (trees) do not obstruct sightlines to pedestrians and cyclists approaching the crosswalk. • Provide any necessary signage for dismounting cyclists	
1.8	In addition to the comment directly above, the size of the pedestrian storage/waiting area provided at many of these mid-block crossings appears limited and may result in pedestrians standing in the cycle track.	Opportunities to increase the storage/waiting area at the mid-block crossings should be examined.	Project team to refine on case-by-case basis based on amount of storage.
1.9	Several commercial sites feature driveways with nose-in/back-out parking. Sightlines for drivers backing out of these locations may be limited by other parked cars. This is of particular concern as they are located adjacent to the sidewalk and cycle track.	Examine opportunities to eliminate or reconfigure parking at these locations.	We have limited control over this, but will recommend removing/relocating parking as appropriate.

	Examples include the Fork and Plate Restaurant and Main Street Hair Salon.		
1.10	The Petro Canada features a wide driveway in close proximity to the proposed crosswalk at Joseph Street. This creates a potential for vehicles turning onto 25th Side Road to approach the proposed crosswalk at skew. The close proximity of the driveway to the crosswalk may also reduce the effectiveness of any advanced waring measures.	Opportunities to close this access or increase the separation between the access and crosswalk should be considered.	This is an existing condition; driveway width may be longer than standard. WSP to review.
1.11	The Petro Canada features a wide uncontrolled access at the William Street intersection. This configuration may contribute to increased entry speeds and unusual vehicle orientations at the intersection.	Relocate the access away from the intersection and introduce positive control measures.	We have proposed narrowing width of William Street. WSP to show how we adjusted driveway to accommodate. We propose setting back entrance off of William.
1.12	A roundabout is proposed at the 9th Line intersection. As no details are available, the audit team has not provided comment on this portion of the facility.	N/A	Roundabout design will be provided once design has been further advanced.
1.13	Opportunities to improve user safety at the signalized intersections at Innisfil Beach Road and Leslie Drive / Roberts Road should be considered.	Options for consideration may include the provision of fully protected left-turn, and pedestrian lead phases.	This should be a consideration for next detailed design, including the use of Leading Pedestrian Interval signal phasing.
1.14	A short section of Two Way Left Turn Lane (TWLTL) is proposed between Lockhart Road and station 14+400. As details on the proposed development were not provided, the road safety team is not able to comment	Apply access management principles as necessary.	The Town has confirmed that TWLTL is not required all the way from Cook Street to Lockhart Road. It is only required from Lockhart Road to the South boundary of the

	on the appropriateness of the proposed TWLTL configuration. However, opportunities to limit the number of driveways through effective access management should be considered to reduce the risk high driveway density can present to pedestrians and cyclists. Effective access management may also accommodate replacing the proposed TWLTL with more localized exclusive turning lanes.		development. Drawings to be updated.
1.15	As detailed, the TWLTL transitions directly into the exclusive left-turn lanes at the intersections. This configuration may contribute to misuse and conflicts within the transition zones.	Appropriate pavement markings or divisional islands should be used to terminate the two-way left-turn lane in advance of the exclusive left-turn lane at intersections.	Agreed. This road design is being done by others. We will forward to the Town for their consideration.
1.16	There appears to be an existing watercourse and structure in the vicinity of station 14+850. Details on any necessary barrier/railing protection have not been provided. As a result, the audit team is not able to provide comment.	As the design advances, details on the proposed barrier and bridge railing should be provided.	WSP to adjust cross section to match bridge. May need short shared facility due to constraints. Railings to be added.

Context 2: Specific Comments			
2.1	Based on the proposed design speed and traffic volumes, TAC suggests a 1.5 m wide shoulder for a rural collector and 1.0m wide shoulder for a rural local road. Gravel shoulder widths of 1.0 m on the west side of the roadway and 0.5 m on the east side of the roadway have been proposed. This limits the accommodation of disabled/parked vehicles.	Parking restrictions will be required on the east side of the roadway.	It is proposed to prohibit parking on both sides, as there is no demand for parking.
2.2	The proposed ditch line cross section on the west side of the roadway appears to consist of a 3:1 foreslope and 3:1 backslope. This combination of slopes is not considered traversable and may result in the front end of errant vehicles planting into the backslope.	Consider providing a traversable ditch line cross section.	4:1 foreslope is traversable. We will see if it can fit, but may not due to right-of-way constraints. However, acceptable as is for a 50 km/h design speed.
2.3	The proposed clear zone to utility poles located in the backslope on the west side of the roadway appears to meet the requirements outlines in TAC (3.5m to 4.5m). However, a review of Streetview suggest the presence of anchor poles located on the east side of the roadway that appear to be located within the required clear zone.	Relocation of these anchor poles beyond the required clear zone should be examined.	We will add a drawing note to relocate beyond clear zone if they are being relocated.
2.4	A roundabout is proposed at the Big Bay Point intersection. As no details are available, the audit team has not provided comment on this portion of the facility.	N/A	This is being designed by others.

2.5	Details on the multi-use trail beyond the Big Bay Point Road intersection are not provided.	This information should be provided as the design process advances.	This is outside of the study limits.
Context 3: Specific Comments			
3.1	A two-way-left-turn-lane (TWLTL) is proposed between Cook Street and Lockhart Road. As details on the proposed development were not provided, the road safety team is not able to comment on the appropriateness of the proposed TWLTL configuration. However, opportunities to limit the number of driveways through effective access management should be considered to reduce the risk high driveway density can present to pedestrians and cyclists. Effective access management may also accommodate replacing the proposed TWLTL with more localized exclusive turning lanes.	Apply access management principles as necessary.	This is being designed by others and is development-driven. We will forward comment to the Town for their consideration.
3.2	Vehicles turning right onto the side roads may not see cyclists on the Cycle Track approaching from behind.	Consider the use of raised bike/ped crossings at side road intersections to slow vehicle turning speed.	We have proposed raised and continuous sidewalk/cycle track.
3.3	Although detail have not been provided, it appears the Town is considering crosswalks at the following location: • Station 13+960	Treatment options for consideration may include the following: • Terminate the TWLTL on the approaches to the crossing.	This area is development-driven and crossing locations are subject to adjacent land use. WSP to note next steps in preliminary design report.

	Treatment measures focused on improving crosswalk conspicuity and the advanced warning offered to drivers will be required. Termination of the proposed TWLTL on the approaches to the crosswalk is also recommended.	• Provide a median refuge island • High-visibility crosswalk markings • Parking restrictions on crosswalk approach • Adequate nighttime lighting levels • Crossing warning signs • Raised crosswalk • Rectangular Rapid-Flashing Beacon (RRFB) • Ensure the proposed landscaping (trees) do not obstruct sightlines to pedestrians and cyclists approaching the crosswalk. • Terminate the TWLTL on the approaches to the crosswalk.	
3.4	As detailed, the two-way left-turn lane transitions directly into the exclusive left-turn lanes at the intersections. This configuration may contribute to misuse and conflicts within the transition zones.	Appropriate pavement markings or divisional islands should be used to terminate the two-way left-turn lane in advance of the exclusive left-turn lane at intersections.	Agreed, pavement markings, signage, median islands would be shown once we have more details about design. This is being designed by others and is development-driven. We will forward comment to the Town for their consideration.