City of Ottawa

Planning, Development and Building Services Department

Multimodal Level of Service Guidelines Update

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The original 2015 Multi-Modal Level of Service Guidelines were prepared by the City of Ottawa with the assistance of IBI Group. This 2025 iteration of the Guidelines builds on that effort and aligns with new policy direction from the City of Ottawa 2022 Official Plan and 2023 Transportation Master Plan polices. It also is informed by new provincial MMLOS guidance, the Healthy Streets Approach, evolving industry best practices, and the experiences of City staff representing various branches. Parsons assisted the City in completing this comprehensive update.

1.0 Purpose of Guidelines & Introduction to Multimodal Level of Service

The primary mobility goal set out in the Ottawa Official Plan (November 2022) is to have more than half of all trips taken by sustainable modes by 2046, including walking, cycling, and transit. This goal aims to help the City meet its climate change targets, foster a healthy and equitable environment, and promote the evolution of walkable 15-minute neighbourhoods.

Evaluating the level of service (LOS) for all transportation modes and promoting inclusive multimodal street designs is a crucial step towards achieving the City's mobility goals. In the past, municipalities had often focused on the performance of vehicular traffic in evaluating the level of service provided by a street. No comparable LOS measures had been commonly institutionalized for other modes of travel. Because of this, the tradeoffs between reducing vehicle delay and the quality of travel for these other modes were often overlooked. That is, the typical outcomes of improving vehicle level of service were wider roads with more travel lanes, higher vehicle volumes, and faster vehicle speeds.

However, recognition of the need to provide more complete streets marked a shift towards establishing performance measures for all modes: cycling, pedestrian, transit and vehicular, in addition to consideration of the public realm environment. This all-in-one evaluation tool is referred to as Multimodal Level of Service (MMLOS) and allows consideration of all street users by assessing specific performance metrics for each mode.

For the purposes of these guidelines, multimodal level of service is defined as follows: A set of discrete quantitative measures used to describe the convenience and comfort experienced by all roadway users over a particular roadway segment or at a particular signalized intersection.

By evaluating the level of service for walking, cycling, transit and auto modes in addition to the space available for enjoying the public realm, the City can better view streets in the context of being "complete" and evaluate the tradeoffs and compromises between different modes.

1.1 Background

In 2015, the City of Ottawa adopted the first made-in-Canada MMLOS guidelines, which provided a step-by-step methodology for determining the level of service for different modes, in addition to target levels of service for different street contexts.

MMLOS analysis has since been applied in most City transportation planning and operational studies for both municipal and private developer projects. This document provides an update to the City's 2015 MMLOS Guidelines, and satisfies the following City TMP policy (approved by Council in May 2023):

> **Action 9-1B**: "Update the Multi-Modal Level of Service Guidelines and corresponding level of service targets, including the development of systematic approaches for documenting tradeoffs."

This Update builds upon the work completed in the previous MMLOS Guidelines, providing a detailed overview of how MMLOS indicators are to be used and interpreted as part of an approved City process to support multimodal travel in municipal projects and the transportation impact assessment process. This Update also includes a new Public Realm Level of Service Tool and Design Checklist that incorporates the values of the Healthy Streets Approach.

As the second iteration of the City of Ottawa's MMLOS framework, the methodology has been updated to reflect new design guidelines and standards, new City policies and best practices, experience gained through several years of practitioner experience, in addition to a review of new MMLOS guidelines across North America, including the Ontario Traffic Council's (OTC) Multimodal Level of Service Guidelines (2022).

Input from City stakeholders was gathered throughout the Update process using a mix of workshops, working group discussions and focused staff meetings. In addition, a workshop was held with key local industry experts and their feedback was collected.

1.2 Application of MMLOS Guidelines

In general, MMLOS supports the planning and design of complete streets by providing a quantitative tool for assessing different design alternatives and providing a mechanism for demonstrating improvements. MMLOS should be applied when there is a need to:

- Demonstrate the existing level of service for different travel modes and the public realm;
- Assess alternative design options and their impacts;
- Compare "before" and "after" conditions (e.g. after implementation of a complete street design); and
- As required to fulfill the City's Transportation Impact Assessment (TIA) process for developments.

The MMLOS calculation methodologies and targets presented in these guidelines are customized for the City of Ottawa context and apply to arterial, collector and select local roadway segments and signalized intersections within both urban and rural areas. Roadway segments are defined as the links between signalized intersections.

For the pedestrian, cycling, and transit travel modes, LOS measures are evaluated for both roadway segments and signalized intersections. For the automobile mode, LOS is evaluated for signalized intersections only, while for the public realm, LOS is evaluated for segments only.

Studies that require MMLOS evaluation may include transportation environmental assessments, corridor studies, functional design studies, neighbourhood traffic management studies, or development projects (through the TIA process). For the latter, the existing TIA Guidelines provide guidance on transportation reporting requirements for development applications. This document is intended to supplement, rather than supersede, the TIA Guidelines by providing detailed guidance on the MMLOS methods.

Overall, the MMLOS analysis system presented in these guidelines is based on an evaluation of facilities against City standards and policies. In general, facilities that meet City standards receive high scores, while those not in compliance receive poor scores. In addition, MMLOS targets are set to reflect the priority of modes within different contexts, as presented in City policies including the Official Plan and Transportation Master Plan, and identify opportunities for improvement.

Ultimately, the MMLOS scores and targets are intended to act as a tool for evaluating tradeoffs between modes where space is limited, and to inform decisions about complete street improvements in a more thorough way than was previously possible through conventional, vehicular-focused level of service evaluation. The Design Decision Framework presented in Section 9.0 provides a step-by-step process for evaluating such tradeoffs.

Examples of design outcomes that may result from MMLOS analysis could include repurposing travel lanes or narrowing lane widths to add or improve pedestrian and cycling facilities; reducing curb radii; adding continuous transit lanes; and adding queue jump lanes or transit priority measures at intersections.

It is important to highlight that this document is not intended to replace professional judgement about geometry, safety, or accessibility considerations. The document is intended to provide guidance rather than being prescriptive in articulating design elements.

Moreover, this document is far from all-encompassing, and practitioners are encouraged to interpret the guidelines as they may relate to non-standard treatments or configurations so long as the original intent of the methodology is maintained. Any such interpretations and assumptions shall be confirmed with the City.

It is also important to note that these guidelines, and the accompanying spreadsheet tool, are living documents and practitioners are advised to access the latest versions on the City website. The Document Control page at the beginning of this document and spreadsheet tool provide a history of updates.

As the guidelines are still evolving, practitioners are encouraged to provide feedback on the process laid out in this report, and to consider the application of other parallel processes where appropriate to address and analyze the impact of transportation projects. The City will continue to monitor the results of the framework and to adjust and calibrate the individual level of service tools based on experience and local conditions.

1.3 Exclusions

In terms of exclusions, these guidelines do not apply to the following:

Most 30 km/h Local Residential Streets

On December 11, 2019, City Council approved a Strategic Road Safety Action Plan (RSAP) Update which recommended that: "…all new local residential streets, constructed within new developments, or when reconstruction occurs on local residential streets, be designed for a 30 km/h operating speed".

The City's 2021 Local Residential Streets 30 km/h Design Toolbox provides a catalogue of speed reduction measures that can be applied to achieve 30 km/h operating speeds on local residential streets. Where streets are designed to a 30km/h standard using this Toolbox, the level of safety would be enhanced and MMLOS would be characteristically high overall. As a result, completing MMLOS analysis would be considered to provide limited benefit within these contexts and is thus not required.

However, local streets within "Mixed Industrial" areas, "Industrial and Logistics" areas, the Ottawa International Airport Economic District, and the Kanata North Economic District should be analyzed, as local streets in these areas are often exempt from the 30km/h Toolbox. In addition, unique local residential streets, including local residential streets close to transit stations, along cross-town bikeways, or with notably high traffic volumes, should be analyzed where considered beneficial.

Unsignalized Intersections and Roundabouts

As there are minimal situations in the Ottawa context where the assessment of tradeoffs between modes would be required at unsignalized intersections, they are not included within the scope of MMLOS analysis. In addition, as traffic count data is often not available for unsignalized intersections, analysis would significantly increase user level of effort. Roundabouts are also not included within the scope of these guidelines.

1.4 Methodological Considerations

1.4.1 Key Steps

Once the study scope is defined, the following key steps shall be followed for the completion of MMLOS analysis:

- ✓ **Step 1:** Identify performance targets for Pedestrian, Cycling, Transit and Automobile modes (Section 2).
- ✓ **Step 2**: Measure LOS for Pedestrian, Cycling, Transit and Automobile modes (Section 3 to Section 5).
- ✓ **Step 3:** Complete the Large Vehicle Design Checklist to ensure that design guidance for accommodating large vehicles is followed (Section 7).
- ✓ **Step 4:** Measure Public Realm LOS and complete the Design Checklist to assess Healthy Streets elements, where applicable (Section 8).
- ✓ **Step 5:** Where assessment of alternative design options is needed, follow the Design Decision Framework (Section 9).

1.4.2 Peak Hour versus Peak Period Analysis

For planning-level studies, the LOS for automobiles shall be based on **peak period** traffic volumes. The peak period refers to the two-and-a-half-hour period with the highest traffic volumes and are typically lower than peak hour volumes.

However, to gain a better understanding of intersection design requirements, analysis shall be completed based on **peak hour** traffic volumes (versus peak period volumes), and the automobile LOS score shall then be determined by applying a **peak period conversion factor**. This process is further described in Section 6.0.

1.4.3 Analysis Time Periods

With regards to the selection of the peak time of day for MMLOS analysis (e.g. morning peak hour versus afternoon peak hour), the peak hour representing the worst conditions for the mode being evaluated shall be selected. Where there is a significant difference in conditions between different peak hours, it may be necessary to complete separate MMLOS analysis for each.

It is important to highlight that MMLOS scores only apply to the time period(s) that were observed, recorded, and/or modelled. MMLOS scores should not be extrapolated to other time periods without supporting analysis. It is further noted that the same peak hour should be used for all intersection approaches (i.e. not the worst condition for each approach separately). The practitioner will need to determine which period, or periods represent the critical period(s) for the project, in accordance with the City’s input.

1.4.4 “Critical” and “Overall” Scores

In these guidelines, it is required to report both the "critical" score, which reflects the weakest performing point along the segment or weakest intersection approach (where applicable), and the "overall" score, which reflects the majority of the segment or average of all intersection approaches. The assessment of tradeoffs between modes shall be based on the “overall” score, while the “critical” score shall be used to identify locations for further improvement. The identification of critical and overall scores is described further below.

Road segments

- The “critical” score reflects the point along the segment with the narrowest width and lowest facility type, where applicable.

- The "overall" score reflects the facility width achieved along the majority (over 50%) of the segment. When calculating the "overall" segment score, it is important to carefully select the facility width that is most representative of the majority of the segment.

Signalized Intersections

- In many cases, each approach of the intersection will score differently for each mode, and results should be illustrated for each approach separately. The "critical" approach shall be highlighted.
- The "overall" score is to be calculated based on the average score of all intersection approaches. The average score of approaches shall be calculated by converting the letter score for each approach to a numerical score as follows:

Exhibit 1 – A-F Letter-to-Numerical Score Conversion

Letter Score	Numerical Score
A	5
B	4
C	3
D	2
E	1
F	0

When calculating average intersection LOS, the average number score shall be **rounded to the nearest whole number**. For example. an average score of 4.5 for all approaches would be rounded to 5.0 and result in an overall LOS A for the intersection, whereas an average score of 4.3 would be rounded down to 4.0 and result in an overall LOS B.

In addition, the MMLOS results shall not be amalgamated into one total intersection, segment or corridor score, since some of the modes require a more fine-grained analysis than traditional vehicular LOS. Instead, the results shall be presented for each mode separately.

1.4.5 Spreadsheet Tool

An accompanying spreadsheet tool is available on the City website for completing MMLOS analysis and submitting results. The spreadsheet tool greatly simplifies the MMLOS analysis process by prompting the practitioner to answer a series of questions and provides MMLOS results automatically. The completed sheet(s) shall be included with all MMLOS submissions to the City.

2.0 Level of Service Targets

The ultimate objective of developing a MMLOS program is to enable designers, City staff and the public to identify appropriate level of service targets within different land use contexts, assess tradeoffs between different modes, and ultimately implement a complete street design that best meets the needs of all users. Exhibit 2 presents targets for the **desirable** level of service by mode. These targets refer to the City of Ottawa Official Plan Schedules and include areas within Equity Priority Neighbourhoods as identified in the Transportation Master Plan – Part 1 (Appendix A). Equity Priority Neighbourhoods refer to areas within the City where there are high concentrations of residents who are socially and economically vulnerable and who may experience transportation-related barriers. The most up to date version of these documents can be referenced online through the City's website when considering the targets.

The targets represent a best effort at encapsulating City policies and plans over a wide range of conditions (i.e. varying built form and context) and aim to support complete street planning and design. At the same time, the targets aim to provide balanced goals that can be achievable in most cases within the context of MMLOS analysis, versus being aspirational targets only. These targets should be considered to provide **broad guidance** for the desired LOS rather than absolute cut-offs or minimum required LOS. Whenever possible, efforts should be made to exceed these targets without negatively impacting the ability to achieve the targets for other modes.

Exhibit 2 – MMLOS Targets

OP Transect / Designation / Policy Area	PLOS	BLOS		TLOS				Auto LOS
		Cross-Town Bikeway	Other	Rapid Transit Corridor	TP - Continuous Lanes	TP - Isolated Measures	Mixed Traffic	
Transect / Land-Use Designation								
Downtown Core, Inner Urban, Hub and/or Special District	A	A	B	A	B	C	E[1]/ D	E
Outer Urban or Suburban	C	B	C	A	B	C	E[1]/ D	E
Greenbelt or Rural	D	C	D	N/A	N/A	N/A	E[1]/ D	D
Mainstreet Corridor (outside a Hub)	B	B	C	A	B	C	E[1]/ D	E
Village Core	B	B	C	N/A	N/A	N/A	N/A[2]	E
Industrial and Logistics or Mixed Industrial	D	C	D	A	B	C	E[1]/ D	E
Policy Area								
Within 600m of a rapid transit station	A	A	B	A	B	C	E[1]/ D	E
Within 300m of school	B	B	C	A	B	C	E[1]/ D	E
Equity Priority Neighbourhood	B	B	C	A	B	C	E[1]/ D	E

1. Where the mixed traffic route runs along a "Frequent" transit route, as defined by OC Transpo's system map, the target shall be increased from E to D. At intersections, this higher target shall only apply to movements where transit operates or is expected to operate. It is noted that providing a higher transit LOS on mixed traffic routes is a key City priority. This will be achieved through the implementation of transit priority measures as part of the Transportation Master Plan process.
2. Where transit service is provided in Village Cores, the target TLOS shall be 'E'.

In following Exhibit 2, the following should be considered:

- In applying the targets, the higher targets always apply where there is overlap between designations and policy areas. For example, where a Mainstreet Corridor runs through an area that is also designated in the Suburban area, the Mainstreet targets will apply along that corridor. In general, the more granular level of target will govern.
- Where there are contexts that may be interpreted in different ways, the practitioner should use their best engineering judgment considering the intent of the MMLOS and confirm their interpretations with the City.
- In addition to considering targets, practitioners shall also confirm that all accessibility considerations in accordance with the City's universal design policy are met.

3.0 Pedestrian Level of Service (PLOS)

3.1 Intent

The primary intent of the Pedestrian Level of Service (PLOS) tool is to evaluate pedestrian safety and comfort, and guide pedestrian improvements by:

Segments
- Maximizing the quality of pedestrian facilities
- Minimizing the impact of adjacent traffic
- Maximizing the frequency of pedestrian crossing opportunities

Intersections
- Minimizing pedestrian exposure to traffic
- Minimizing pedestrian delay at intersections

It is noted that the Ottawa Accessibility Design Standards are a critical factor in road design and were incorporated into the PLOS tool.

3.2 Data Requirements

Data required to evaluate the pedestrian level of service are summarized in Exhibit 3 below.

Exhibit 3 – Data Requirements for Pedestrian Level of Service

Segments	Signalized Intersections
Pedestrian Facility Width » Sidewalk width » Offset from motor vehicle lanes » Motor vehicle volume » Posted speed » Presence of on-street parking **Distance between Controlled Crossings** » Maximum distance between controlled pedestrian crossings along the segment	**Exposure to Traffic** » Number of motor vehicle lanes that the crosswalk traverses and presence of a median refuge at each intersection leg » Peak hour volume of right- and left-turning vehicles conflicting with each crosswalk and the degree to which signal phasing protects these conflicts, i.e. protected, protective-permissive, permissive signal phases with or without leading pedestrian intervals (LPI) » Effective corner radius (simple curve) and vehicle speeds for right-turns into each crosswalk (e.g. east leg crosswalk: southeast intersection corner radius) » Presence of right-turn channels (conventional or smart channel, with or without a raised crosswalk)[1] » Number of opposing lanes crossed by left-turning vehicles » Presence of centreline hardening (i.e. physical barrier in the centreline of a roadway between the crossride and the intersection) » Crosswalk treatment (e.g. transverse marking, ladder markings, or raised crosswalks) **Pedestrian Delay** » Signal cycle length (s) » Pedestrian green time (walk time)

It is noted that there are many additional factors that contribute to pedestrian comfort, safety, and convenience beyond the factors listed above, including accessibility features, street lighting, amenities, pedestrian crowding,

[1] Although right-turn channels are deemed outside of the controlled crossing of a signalized intersection, they are included in the assessment of MMLOS for the purposes of these guidelines due to their impact on pedestrian and cycling modes of travel.

and streetscaping. While it is beyond the scope of the MMLOS tool to address all elements that may impact the pedestrian experience, the Public Realm LOS tool and Design Checklists provide a high-level review of several public realm features experienced at the pedestrian level, including space that may be allocated to trees, landscaping and amenities, in addition to accessible design features, presence of public art, presence of street and pedestrian lighting, and active street frontage characteristics (see Section 8.0).

3.3 Segments

3.3.1 Methodology Overview

Segment PLOS is calculated based on the weighted average of the following two metrics:

1. Pedestrian Facility Width (75%)
2. Distance between Controlled Crossings (25%)

The methodology applies to sidewalks, pedestrian pathways, and multi-use pathways. While paved shoulders are generally not preferred for pedestrian use due to factors such as accessibility challenges, lack of physical separation from motor vehicles and winter maintenance practices, they may be scored as pedestrian facilities in appropriate rural settings where pedestrian volumes are low.

Within a segment, facilities are evaluated on each side of the roadway unless a particular area does not require facilities on both sides (e.g. where the TMP Sidewalk Policy only requires sidewalks on one side, or a Road Modification Approval where the study area only includes one side of the street).

Prior to calculation of PLOS, the two pre-checks illustrated in Exhibit 4 below must first be applied to confirm compliance with the TMP Sidewalk and Multi-Use Pathway (MUP) policies presented in TMP Part 1 (May 2023), and replicated in Section 3.6 of these guidelines. Where the pre-checks are not met, the total PLOS score shall be E or F (as per Exhibit 4), with no further assessment (i.e. the Maximum Distance between Controlled Crossings metric shall not be applied).

Exhibit 4 – Segment Pedestrian Facility Width Pre-Check

Pre-check:		LOS
Does the MUP meet the TMP Multi-Use Pathway Policy? If not, does the location have a low volume of peak daily users AND are pedestrian volumes likely less than 20% of total users?[1, 2]	Yes	Score using Exhibit 5
	No	E
Does the segment meet the TMP Sidewalk Policy?	Yes	Score using Exhibit 5
	No	F

1. Refer to Exhibit 11 of the City of Ottawa Transportation Master Plan - Part 1: Policies (May 2023) for the Sidewalk and Multi-Use Pathway Policies. Policies are also located in Section 3.6 of this document.
2. If the MUP Policy Pre-Check is met, the Sidewalk Policy Pre-Check may consider a MUP.

Although the Ontario Traffic Manual (OTM) Book 18 defines a high-volume MUP as having more than 100 users per hour and a high ratio of pedestrians as 20%, MUP pedestrian/cycling volume data is often not available, and thus may be determined qualitatively.

For example, a high-volume MUP may be assumed where one is providing access to a rapid transit station, is in the Downtown Core Transect, or is in a significant cultural or recreational area (e.g. along the Rideau Canal), etc. Analysts can use their judgment to determine the magnitude of user volumes and the proportion of pedestrians and cyclists based on the context and any other available information.

3.3.2 Evaluation Tables

The Segment PLOS look-up tables are provided in Exhibit 5 and Exhibit 6. Further instructions are provided following each exhibit, as appropriate.

Exhibit 5 – Segment PLOS - Pedestrian Facility Width Look-up Table

Sidewalk Width (m)[1,2,3]	Offset from Motor Vehicle Travel Lanes (m)	Average Daily Curb Lane Traffic Volume	LOS			
			Posted Speed (km/h)			
			≤ 30	40 or 50	60	≥ 70
≥ 2.0	≥ 3.0, no parking	Any	A	A	A	B
	1.5-2.99, no parking or ≥ 3.0 including parking	≤ 3000	A	A	A	B
		> 3000	A	A	B	C
	0.5-1.49	≤ 3000	A	B	B	C
		> 3000	A	B	C	D
	< 0.5	≤ 3000	B	B	C	D
		> 3000	B	C	D	E
1.8-1.9	≥ 3.0, no parking	Any	A	A	B	B
	1.5-2.99, no parking or ≥ 3.0 including parking	≤ 3000	A	A	B	C
		> 3000	A	B	C	D
	0.5-1.49	≤ 3000	B	B	C	D
		> 3000	B	C	D	E
	< 0.5	≤ 3000	C	C	D	E
		> 3000	C	D	E	E
1.5-1.79	Any		E	E	E	E
<1.5	Any		F	F	F	F
No sidewalk	Any		F	F	F	F

1. Round the measured width to the nearest single decimal place.
2. Where a Multi-use Path (MUP) is provided in lieu of sidewalks, the MUP shall be evaluated using the above methodology, given that the segment passes the Segment PLOS Facility Width pre-check (see Exhibit 3). Where sidewalks are not required on both sides of the street under the TMP Sidewalk Policy, the side without a sidewalk shall not be scored.
3. A minimum sidewalk width of 3.0m is preferred for Downtown Core streets leading to LRT stations (within 600m), and along all streets that have existing or are zoned for continuous active frontages with high density and zero/minimal setback requirements. Where a sidewalk is between 1.5 and 2.9m wide in these contexts, select one facility width down in the score table. If sidewalks are ≥ 3.0m wide, score them using the ≥ 2.0m rows in this table.

Additional notes / data instructions are provided below.

- The above table is based primarily on the previous City of Ottawa MMLOS Guidelines, with adjustments to better reflect current City practices.
- This metric measures the quality of pedestrian facilities and the impact of adjacent vehicular traffic.
- Refer to Section 1.4.4 for the calculation of "overall" and "critical" segment scores.
- When identifying the "critical" segment PLOS score, it is important to distinguish between the "sidewalk clear width", which is the wider portion of the sidewalk to one side of a fixed feature, and the presence of a reduced "sidewalk width", which shall represent the "critical" segment PLOS.
- Where the sidewalk width is less than 1.5m, the total PLOS score shall be F, with no further assessment (i.e. the Maximum Distance between Controlled Crossings metric shall not be applied).
- **Offset from Motor Vehicle Lanes** refers to the separation between pedestrians and moving vehicles and includes any cross-section element(s) separating the pedestrian facility horizontally from the outer edge of

the closest vehicular travel lane. This may include boulevards, cycling facilities, parking lanes, traffic barriers, pinned curbs, etc.

- **On-street Parking** shall be included in the Offset from Motor Vehicle Lanes where parking is allowed at all times. If parking is not allowed during peak periods or permitted on weekends only, then parking should be considered to be absent and not included within the Offset from Motor Vehicle Lanes width.
- **Average Daily Curb Lane Traffic Volume** refers to the estimated annual average daily motor vehicle traffic volume (passenger car equivalent) in one direction in the closest non-parking lane to the curb / road edge (including bus lanes). One way of estimating this value is to apply a conversion factor to observed counts. Trucks should be accounted for using a Passenger Car Equivalent value of 1.7. For non-bus lanes, the curb lane volume can be estimated by dividing the directional Average Daily Traffic volume by the number of lanes in the direction of travel, excluding parking lanes. The practitioner may also propose alternative ways of estimating the traffic volume, which would be subject to approval by the City.

Exhibit 6 – Segment PLOS - Maximum Distance between Controlled Crossings Look-up Table

Maximum Distance between Controlled Crossings (m)	ADT ≤ 1,500 (Two-way) LOS	ADT > 1,500 (Two-way) LOS
≤ 200	A	A
201-230	A	B
231-260	A	C
261-290	A	D
291-400	A	E
> 400	A	F

Additional notes / data instructions are provided below.

- The above table is based primarily on the OTC's 2022 MMLOS Guidelines.
- This metric captures the pedestrian's ability to safely and comfortably cross the subject segment to reach destinations without significant out-of-way travel.
- This measurement shall be based on the centre-to-centre distance between crossings. Controlled crossings shall include signalized and unsignalized crosswalks at intersections, roundabouts and pedestrian crossovers (PXOs).
- For lower volume streets (≤ 1,500), uncontrolled crossings are acceptable assuming curb depressions are provided at regular intervals to enable accessible crossing opportunities.

3.4 Intersections

3.4.1 Methodology Overview

Intersection PLOS is calculated based on the weighted average of the following five metrics:

1. Number of traffic lanes that pedestrians must cross (60%)
2. Right-turn vehicle conflicts with the crosswalk (15%)
3. Left- turn vehicle conflicts with the crosswalk (5%)
4. Crosswalk treatment (5%)
5. Pedestrian Delay (15%)

The first four metrics and their respective weights are derived from the City of Charlotte's Pedestrian Level of Service (LOS) at Signalized Intersections, as well as local surveys conducted by the City of Ottawa during the development of the original 2015 Multi-Modal Level of Service (MMLOS) Guidelines. The Pedestrian Delay metric represents the average delay experienced by pedestrians crossing the street and is determined using methods outlined in the Highway Capacity Manual (HCM).

Refer to Section 1.4.4 for the calculation of "overall" and "critical" intersection scores.

3.4.2 Evaluation Tables

The look-up tables for the various intersection PLOS metrics and associated illustrations are provided in Exhibit 7 to Exhibit 13. Further instructions are provided following each exhibit, as appropriate.

Exhibit 7 – Intersection PLOS - Number of Lanes Crossed Look-up Table

Total Travel Lanes Crossed	LOS
1-3	A
4 with Median Refuge	A
4	B
5 with Median Refuge	B
5	C
6 with Median Refuge	C
6	D
7 with Median Refuge	D
7	E
8 with Median Refuge	E
≥ 8	F
Note: Right-turn channels are to be included in the number of total travel lanes crossed.[1]	

Additional notes / data instructions are provided below.

- The **Total Travel Lanes Crossed** shall be based on a count of the total number of travel lanes excluding bike lanes (and not the crossing distance divided by a 3.5m lane width).

[1] Although right-turn channels are deemed outside of the controlled crossing of a signalized intersection, they are included in the assessment of MMLOS for the purposes of these guidelines due to their impact on pedestrian and cycling travel.

- For crossings with a median narrower than 2.7m, or with a median that does not provide a pedestrian refuge by extending through the crosswalk (example shown in Exhibit 8 below), the crossing is not considered to have a median for the purpose of the PLOS score. It is noted that in these cases, the median shall not be counted as a travel lane.

Exhibit 8 – Example Median with No Pedestrian Refuge

Exhibit 9 – Intersection PLOS - Conflicts with Right-Turning Vehicles Look-up Table

Volume	Effective Corner Radius	Posted speed	Treatment[1]	LOS
Any	Any	Any	Protected only right-turn	A
			No right-turn	A
≤ 150 right-turns per hour	≤ 8m	Any	Protected-permissive with LPI	A
			Protected-permissive without LPI	A
			Permissive with LPI	A
			Permissive without LPI	B
	> 8m	≤ 50 km/h	Protected-permissive with LPI	A
			Protected-permissive without LPI	A
			Permissive with LPI	A
			Permissive without LPI	B
		> 50 km/h	Protected-permissive with LPI	A
			Protected-permissive without LPI	B
			Permissive with LPI	B
			Permissive without LPI	C
	-	Any	Smart channel with raised crossing	C
		Any	Smart channel without raised crossing	D
		Any	Conventional right-turn channel	E
	≤ 8m	Any	Protected-permissive with LPI	A

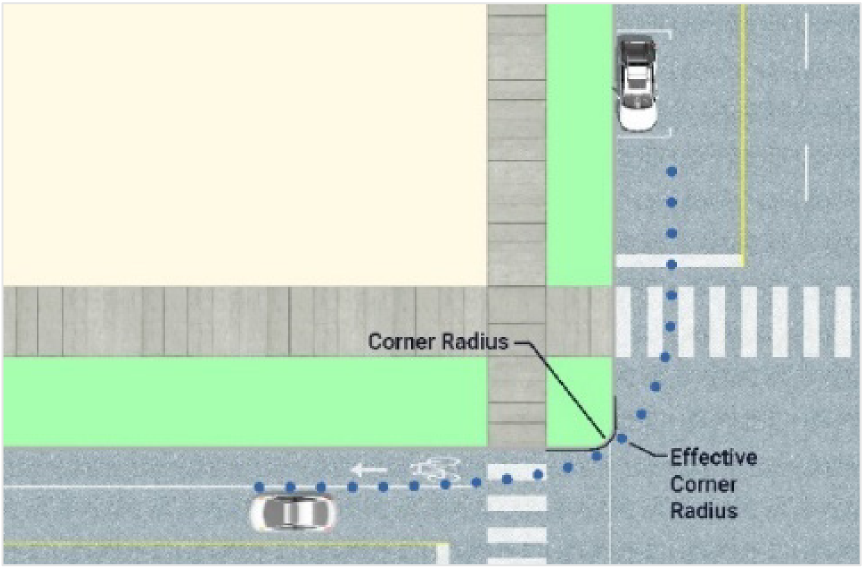
[1] Although right-turn channels are deemed outside of the controlled crossing of a signalized intersection, they are included in the assessment of MMLOS for the purposes of these guidelines due to their impact on pedestrian and cycling travel.

Volume	Effective Corner Radius	Posted speed	Treatment[1]	LOS
150-300 right-turns per hour			Protected-permissive without LPI	B
			Permissive with LPI	B
			Permissive without LPI	C
	> 8m	Any	Protected-permissive with LPI	C
			Protected-permissive without LPI	D
			Permissive with LPI	D
			Permissive without LPI	E
	-	Any	Smart channel with raised crossing	C
		Any	Smart channel without raised crossing	D
		Any	Conventional right-turn channel	E
> 300 right-turns per hour	≤ 8m	Any	Protected-permissive with LPI	D
			Protected-permissive without LPI	E
			Permissive with LPI	E
			Permissive without LPI	F
	> 8m	Any	Protected-permissive with LPI	E
			Protected-permissive without LPI	F
			Permissive with LPI	F
			Permissive without LPI	F
	-	Any	Smart channel with raised crossing	D
		Any	Smart channel without raised crossing	E
		Any	Conventional right-turn channel	F
Note: No right-turn on red (NRTOR) is required with protected right-turns and is strongly recommended where there is a right-turn overlap phase, or leading pedestrian/bicycle interval				

Additional notes / data instructions are provided below.

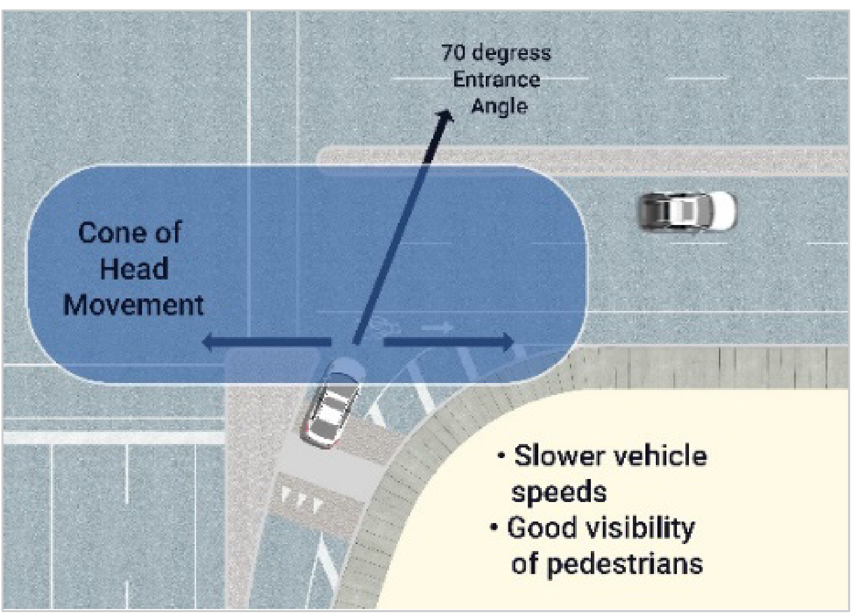
- The Right-Turn Conflict (and Left-Turn Conflict) measures are based primarily on the City of Ottawa's Protected Intersection Design Guide's (PIDG) recommendations for treatments.
- The **Volume**, **Effective Corner Radius** and **Posted Speed** inputs measure right-turn vehicle movements turning into the crosswalk by drivers not facing a red light, or in other words, vehicles travelling in the parallel traffic stream. For example, for the south crosswalk, inputs would be based on EBR vehicles.
- The **Effective Corner Radius** considers the additional space afforded to turning vehicles by non-vehicular travel lanes between the turn lane on the departing and receiving legs of an intersection. It is the same as the corner radius where vehicles must turn from the curbside lane into a departing curbside lane, however where parking lanes or bike lanes are provided adjacent to the travel / turn lanes, the effective radius can be determined by placing a simple or compound radius between the edge of the travel lane on the approach and departing legs (refer to the Exhibit 10). It is noted that the Effective Corner Radius shall be estimated based on a simple curve for the purposes of these guidelines.

Exhibit 10 – Effective Corner Radius



- For **Smart Channels**[1], the primary criterion is that the channel must intersect the street at an angle of 70° or greater; Exhibit 11 illustrates a typical urban "smart channel" with a 70° entry angle. The presence of a raised crossing at the smart channels improves pedestrian safety and comfort and thus provides a higher score. It is noted that smart channels are identified as a potential treatment where right-turns exceed 300 veh/hr and protected right-turns do not provide an appropriate vehicle level of service but are discouraged for lower right-turn volumes (see the Protected Intersection Design Guide).

Exhibit 11 – Typical Urban Smart Channel



[1] Although right-turn channels are deemed outside of the controlled crossing of a signalized intersection, they are included in the assessment of MMLOS for the purposes of these guidelines due to their impact on pedestrian and cycling modes of travel.

- For **Conventional Right-turn Channels**[1], the channel is counted as a lane crossed for both the parallel and perpendicular traffic streams (e.g. an EBR channel would be counted as a lane in both the south and west crosswalks).

Exhibit 12 – Intersection PLOS - Conflicts with Left-Turning Vehicles Look-up Table

Volume	Treatment	LOS
All turn volumes	Protected only left-turn	A
	No left-turns (e.g. T-intersections)	A
≤ 50 left-turns per hour OR < 100 left-turns per hour and one opposing traffic lane	Permissive or Protected-permissive left-turns	A
≥ 100 left-turns per hour OR > 50 left-turns per hour and ≥ two opposing traffic lanes	Permissive or Protected-permissive left-turns with LPI	D
	Permissive or Protected-permissive left-turns without LPI	E
Note: Opposing traffic lanes refer to lanes on the opposite approach where vehicles can make conflicting movements (i.e. through and right-turn lanes).		

Exhibit 13 – Intersection PLOS - Pedestrian Delay Look-up Table

Average Pedestrian Crossing Delay	
$\text{Delay} = 0.5 \times \frac{(\text{Cycle Length} - \text{Pedestrian Effective Walk Time})^2}{\text{Cycle Length}}$	
≤ 10s per intersection leg	A
> 10 to 20 sec	B
> 20 to 30 sec	C
> 30 to 40 sec	D
> 40 to 60 sec	E
> 60	F

- The Pedestrian Delay metric is intended to reflect the duration of the display of the solid white "walking pedestrian" symbol, which represents the "Effective Walk Time". One way to calculate this is:
  - **Effective Walk Time** = Split – Flashing Don't Walk – [Amber + All-red]
- It is noted that this method applies to fixed time control and may not provide correct values for non-fixed time control. In those cases, the following alternative method could be used:
  - Measure (or estimate) the average walk time and the average number of cycles within a time period and use those values for the calculation.

Exhibit 14 – Intersection PLOS - Crosswalk Treatment Look-up Table

Crosswalk Treatment	LOS
Raised Intersection Crosswalk	A
Ladder stripe hi-vis markings	B
Standard transverse markings	C

3.5 Interpretation of Results

The segment and intersection score qualitative descriptors provided in Exhibit 15 and Exhibit 16 can be used to interpret PLOS results, aiding in communication and decision making.

Exhibit 15 – Qualitative Segment PLOS Results by Letter Score – Segments

LOS	Result for Pedestrian Facility	Result for Distance between Controlled Crossings
A	Very comfortable	Very convenient
B	Comfortable	Convenient
C	Fairly comfortable	Fairly convenient
D	Less comfortable	Less convenient
E	Uncomfortable	Inconvenient
F	Very uncomfortable / does not meet minimum design guidelines	Very inconvenient

Exhibit 16 – Qualitative Intersection PLOS Results by Letter Score – Intersections

LOS	Result for Pedestrian Exposure	Result for Pedestrian Delay
A	Very comfortable	Minimal delay
B	Comfortable	Slight delay
C	Fairly comfortable	Moderate delay
D	Less comfortable	Notable delay
E	Uncomfortable	Significant delay
F	Very uncomfortable / Does not meet minimum design guidelines	High risk for unsafe crossing behaviour

An example illustrating the application of the PLOS methodology is provided in Appendix A, and Methodology Flowcharts are provided in Appendix B.

3.6 TMP Sidewalk and MUP Policies

The **TMP Sidewalk Policy** requires sidewalks in the following contexts:

Sidewalks are required on both sides of:

- New and reconstructed Arterials, Major Collectors and Collectors in the Urban Area and Villages (excluding the Greenbelt);
- New and reconstructed Arterials, Major Collectors and Collectors in the Greenbelt where required to provide connectivity or connect to adjacent facilities;
- New Locals in the Downtown Core and Inner Urban transects; and
- New Locals in the Outer Urban and Suburban transects and Villages where required to create continuous and direct connections to destinations such as public transit stops or stations, schools, public parks, pathways, recreation centres, public buildings and institutions, and commercial areas.

Sidewalks are required on one side of:

- New and reconstructed Arterials, Major Collectors and Collectors in the Greenbelt;
- New Locals in the Outer Urban and Suburban transects and in Villages; and
- Existing locals in the Urban Area and Villages, where possible given practical considerations such as the existing context, available space in the right-of-way, impacts to the stormwater system and trees, network connectivity, and financial affordability.

The **Multi-Use Pathway (MUP) Policy** identifies the following contexts where MUP placement is appropriate.

- Outside the Urban Area and Villages, and within the Greenbelt Transect.
- In specific situations within other Transects:
  - Within parks, greenspaces and along off-road corridors (except in locations with a high volume of peak daily users and a high ratio of pedestrians to cyclists, where separated facilities should be considered);
  - Along roads where there are a low number of active users expected, a high ratio of cyclists to pedestrians, and infrequent intersections;
  - To extend adjacent multi-use pathways by short distances; or,
  - To connect adjacent cycling facilities over short distances where there are significant constraints to providing separate pedestrian and cycling facilities.

4.0 Bicycle Level of Service (BLOS)

4.1 Intent

The primary intent of the Bicycle Level of Service (PLOS) tool is to evaluate cyclists' safety and comfort, and guide cycling improvements by:

Segments	• Maximizing the quality of cycling facilities • Minimizing the impact of adjacent vehicle traffic • Minimizing impact of crossing at uncontrolled locations
Intersections	• Minimizing cyclist exposure to traffic

It is important to highlight the following when implementing the BLOS methodology:

- Although the methodology for BLOS calculation is relatively more comprehensive than other modes, the excel spreadsheet tool accompanying these guidelines simplifies the implementation process prompting the practitioner to answer a series of questions and calculating the BLOS result automatically.
- As there are several common inputs between BLOS and PLOS, the excel tool requires that inputs for PLOS be entered before the calculation of BLOS.
- Judgement should be used when adapting the methodology to facility types not currently provided for in the methodology. For unusual conditions, the more conservative conditions should be considered.

In addition, while these guidelines do not make specific reference to the different forms of micromobility that may use cycling facilities (e.g. e-bikes and e-scooters), they are legal users of cycling facilities as per provincial regulations. Designers should consider e-bike and e-scooter user types when designing cycling facilities as they may have different operating characteristics.

4.2 Data Requirements

Data required to evaluate bicycle level of service are summarized in Exhibit 17 below.

Exhibit 17 – Data Requirements for Bicycle Level of Service

Segments	Signalized Intersections
Low-Volume/Speed Streets with Cycling Facilities (Excluding Shared Operating Space) » Motor vehicle volume (ADT) » Posted speed **Shared Operating Space** » Motor vehicle volume (ADT) » Posted speed **Bike Lanes** » Bike lane type (buffered or unbuffered, advisory, or contra-flow)	**Right-Turn Conflicts** » Peak right-turn motor vehicle volume (vph) » Right-turn signal phasing » Presence of Leading Bicycle Interval » Right-turn channel type (conventional or smart channel, presence of raised crossing), if applicable[1] » Presence of floating bike lane or other configurations where turning vehicles cross over cyclists' path of travel

[1] Although right-turn channels are deemed outside of the controlled crossing of a signalized intersection, they are included in the assessment of MMLOS for the purposes of these guidelines due to their impact on pedestrian and cycling modes of travel.

<table>
<tr><th>Segments</th><th>Signalized Intersections</th></tr>
<tr><td>

- Facility operation (uni-directional or bi-directional)
- Bike lane width
- Buffer width (if applicable)
- Presence of adjacent on-street parking and/or traffic barrier
- Number of adjacent vehicle lanes per direction

Paved Shoulders

- Paved shoulder width
- Buffer width (if applicable)

Cycle Tracks

- Facility operation (uni-directional or bi-directional)
- Cycle track width
- Boulevard width
- Presence of adjacent on-street parking and/or traffic barrier

Multi-Use Pathways

- MUP width
- Boulevard width
- Presence of adjacent on-street parking and/or traffic barrier
- Degree of pedestrian and cyclist demand (qualitative if volume data not available)

Uncontrolled Crossings (all facility types)

- Presence of median refuge suitable for pedestrian and bicycle storage (≥ 2.7 m wide)
- Number of lanes in both directions on street being crossed
- Posted speed on street being crossed

Cycling Path Blockages (bike lanes, shared operating space only, and paved shoulders)

- Presence of any bus stops or designated loading zones that block the cyclists' path of travel

</td><td>

- Crossride setback compliance with the City of Ottawa's PIDG or, if not applicable, effective corner radius (assuming simple curve)
- Posted speed

Left-Turn Conflicts

- Peak left-turn motor vehicle volume (vph)
- Number of opposing lanes
- Left-turn signal phasing

Left-Turn Treatment

- Accommodation of left-turning cyclists (presence of protected corner, two-stage queue box, or bike box; or number of lanes crossed)
- Posted speed

Traffic Adjustment where no Cycle Track

- Motor vehicle volume (ADT) on the approach
- Posted speed on the approach
- Whether cyclist in mixed traffic or bike lane present through intersection

</td></tr>
</table>

4.3 Segments

4.3.1 Methodology Overview

The Segment BLOS methodology assesses the following cycling facility types:

- Cycle tracks (uni- and bi-directional)
- Multi-use pathways
- Painted bike lanes (buffered and unbuffered) and physically separated bike lanes (uni- and bi-directional), advisory bike lanes and contraflow bike lanes
- Paved shoulders (buffered and unbuffered)
- Shared operating space (including mixed traffic and neighbourhood bikeways)

Refer to OTM Book 18 for definitions of each cycling facility type.

Similar to PLOS, evaluation of Segment BLOS is based on a look-up table approach. The Segment BLOS score is calculated based on the weighted average of the following four metrics:

1. Facility width (35%)
2. Buffer/boulevard width, if applicable (35%)
3. Uncontrolled crossing along the route, if applicable (15%)
4. Cycling path blockages, if applicable (15%)

Note: The weights of any non-applicable metrics are to be assigned proportionately to the remaining metrics.

4.3.2 Evaluation Tables

The look-up tables and associated illustrations for the Segment BLOS metrics are provided in Exhibit 18 to Exhibit 21. Further instructions are provided following each exhibit, where appropriate.

Exhibit 18 – Segment BLOS - Cycling Facility and Buffer/Boulevard Widths Look-up Table

Type of Bikeway			LOS
Low-Volume/Speed Streets with Cycling Facilities (Excluding Shared Operating Space)			
≤ 40 km/h posted speed and ≤ 3,500 ADT (Two-way)			A
> 40 km/h posted speed or > 3,500 ADT (Two-way)			Score based on facility type below
Cycle Track			
Cycle Track Width			**LOS**
Unidirectional	2.1-2.5m		A
	1.8-2.09m		B
	1.5-1.79m		C
	< 1.5m over more than 15m		D
Bidirectional	≥ 3.5m		A
	3.0-3.49m		B
	2.8-2.99m		C
	< 2.8m		D
Cycle Track Boulevard Width			
	Posted Speed	**Boulevard Width (Excluding curb)**	**LOS**
Unidirectional	≤ 40 km/h	≥ 0.6m	A
		<0.6m and no adjacent parking	B
		< 0.6m with adjacent parking	F
	50 km/h	≥ 1.0m	A
		0.6-0.99m	B
		0.3-0.59m	C
		< 0.3m	D
		< 0.6m with adjacent parking	F
	≥ 60 km/h	≥ 1.5m	A
		0.6-1.49m with adjacent parking	B
		1.0-1.49 m and no adjacent parking	C
		0.6-0.99 m and no adjacent parking	D
		<0.6m and no adjacent parking	E
		< 0.6m with adjacent parking	F
Bidirectional	≤ 60 km/h	≥ 1.5m or any boulevard width with continuous traffic barrier	A
		0.6-1.49m with adjacent parking	B
		1.0-1.49 m and no adjacent parking	C
		0.6-0.99 m and no adjacent parking	D
		< 0.6m with or without adjacent parking	F
Unidirectional and Bidirectional	≥ 70 km/h	Outside clear zone or continuous traffic barrier	A
		Inside clear zone	F

Multi-Use Pathway		
Does it meet the TMP Multi-Use Pathway Policy? If not, does the location have a low volume of peak daily users AND are pedestrian volumes likely less than 20% of total users?		
Yes		Score below
No (skip scoring for MUP Width and Boulevard)		E
MUP Width		
High-volume MUP (≥100 users/hour)	≥ 4.0m	A
	3.5-3.99m	B
	3.0-3.49m	D
	< 3.0m	E
Low- to moderate volume MUP (<100 users/hour)	≥ 3.5m	A
	3.0-3.49m	C
	< 3.0m	D
MUP Boulevard Width (Excluding curb)		
≥ 1.5m or any boulevard width with continuous traffic barrier		A
0.6-1.49m with adjacent parking		B
0.6-1.49m and no adjacent parking		C
< 0.6m		E

Painted or Physically Separated Bike Lanes (Including advisory bike lanes)		
Bike Lane Width		**LOS**
Unidirectional	2.0-2.5m	A
	1.8-1.99m	B
	1.5-1.79m, or 1.8m contraflow bike lane	C
	< 1.5m over more than 15m, or > 2.5m	E
Bidirectional	≥ 3.5m	A
	3.0-3.49m	B
	2.7-2.99m	D
	< 2.4m over more than 15m	F

Bike Lane Buffer Width

Posted Speed	ADT (two-way)	Buffer Width (Excluding curb)	LOS
≤ 40 km/h	≥ 6,500	≥ 1.0m with vertical measure	A
		≥ 1.0m and no vertical measure, or 0.3-0.99m with vertical measure, or ≥ 0.6m with adjacent parking	B
		0.3-0.99m and no vertical measure	D
		< 0.3m with one vehicle lane per direction	E
		< 0.3m with > one vehicle lane per direction	F
		< 0.6m with adjacent parking	F
		Advisory bike lane	F
	< 6,500	Any buffer, or no buffer with one vehicle lane per direction	B
		Advisory bike lane with ≥ 0.6m buffer from parking (if present) or no adjacent parking	B
		< 0.3m with > one vehicle lane per direction	F

		< 0.6m with adjacent parking	F
50 km/h	≥ 6,500	≥ 1.0m with vertical measure	A
		0.3-0.99m with vertical measure, or 0.6-0.99m with parking	C
		≥ 1.0m and no vertical measure	E
		< 1.0m and no vertical measure, or < 0.6m with adjacent parking	F
	< 6,500	≥ 1.0m with vertical measure	A
		≥ 1.0m and no vertical measure, or 0.3-0.99m with vertical measure, or ≥ 0.6m with adjacent parking	C
		0.3-0.99m and no vertical measure	D
		< 0.3m with one vehicle lane per direction	E
		< 0.3m with > one vehicle lane per direction	F
		< 0.6m with adjacent parking	F
	Any	Advisory bike lane	F
60 km/h	Any	≥ 1.5m with vertical measure	A
		0.3-1.49m with vertical measure, or ≥ 0.6m with adjacent parking	C
		≥ 1.0m and no vertical measure	E
		< 1.0m and no vertical measure, or < 0.6m with adjacent parking	F
		Advisory bike lane	F
≥ 70 km/h	Any	Any	F
Paved Shoulder without Buffer (Rural sections only)			
Is providing no buffer appropriate according to the OTM Book 18 Bicycle Facility Pre-Selection Nomograph - Rural Context? (see Appendix E)			
Yes			Score below
No	Shoulder Width ≥ 1.2m		E
	Shoulder Width < 1.2m		F
Shoulder Width	≥ 2.0m		B
	1.5-1.99m		C
	1.2-1.49m		D
	< 1.2m		F
Paved Shoulder with Buffer (Rural sections only)			
Shoulder Width	1.5-2.0m		A
	1.2-1.49m		C
	< 1.2m		F
Buffer Width	≥ 1.0m		A
	0.5-0.99m		B
	< 0.5m		E
Shared Operating Space (Including mixed traffic and neighbourhood bikeways)			
Posted Speed	**ADT (Two-way)**		**LOS**
≤ 30 km/h	≥ 6,500		D
	3,000-6,499		C
	1,500-2,999		B

	< 1,500	A
40 km/h	≥ 6,500	E
	3,000-6,499	D
	1,500-2,999	C
	500-1,499	B
	<500	A
50 km/h	> 6,500	F
	≤ 6,500	E
> 50 km/h	Any	F
Note: Where the cycling facility accommodates, or is expected to accommodate, high volumes of bicycle traffic (>1,500 cyclists/day) and it is narrower than 2.0m (unidirectional facility) or 3.5m (bi-directional facility), select one facility width down in the drop-down menu from the actual width.		

Additional notes / instructions are provided below.

- The above table is based on design guidance provided in the Ontario Traffic Manual Book 18: Cycling Facilities and standard City of Ottawa cross-sections.
- This metric measures the quality of cycling facilities and the impact of adjacent vehicular traffic.
- Refer to Section 1.4.4 for the calculation of “overall” and “critical” segment scores.
- The first facility type listed in Exhibit 18, Low-Volume/Speed Streets with Cycling Facilities (Excluding Shared Operating Space), is intended to ensure that cycling facilities along segments where mixed traffic operations is warranted (i.e. low-speed/volume streets) will automatically score Segment BLOS A for the Facility Width and Buffer Width metrics, even if the facility provided does not meet optimum lane or buffer widths. The Uncontrolled crossing along the route and Cycling path blockages metrics shall still be calculated for the segment.
- The Cycle Track Boulevard Width shall be measured as the distance between the back of the curb and the nearest edge of the cycle track.
- On streets with **bi-directional** cycling facilities, Segment BLOS will only be analyzed on the side with the cycling facility.
- On streets with a **MUP on one side and a cycling facility on the other side**, segment BLOS will be analyzed for each side of the segment separately.
- The cycling facility shall be considered to have **adjacent parking** where on-street parking is permitted during peak periods.
- As described for Segment PLOS (Section 3.3.1), **a high-volume MUP** is defined as one having more than 100 users per hour or one in a location expected to serve high user volumes. Analysts shall use their judgment to determine the magnitude of user volumes based on the context and any other available information.
- **Vertical measure** examples include pin curbs, flex posts, bollards and planters.

Exhibit 19 – Segment BLOS - Uncontrolled Crossings along the Route Look-up Table

Uncontrolled Crossing along Route		
Cross street with no median refuge		
No. of Travel Lanes	**Posted Speed**	**LOS**
≤ 3	≤ 30 km/h	A
	40 km/h	B
	50 km/h	C
	≥ 60 km/h	E
4-5	≤ 40 km/h	E
	≥ 50 km/h	F
≥ 6	Any	F
Cross street with median refuge (≥ 2.7m wide)		
No. of Travel Lanes	**Posted Speed**	**LOS**
≤ 3	≤ 30 km/h	A
	40 km/h	A
	50 km/h	B
	≥ 60 km/h	D
4-5	≤ 30 km/h	A
	40 km/h	C
	50 km/h	D
	≥ 60 km/h	E
≥ 6	≥ 40 km/h	D
	50 km/h	E
	≥ 60 km/h	F
Roundabout crossing (where uncontrolled for cyclists)		
No. of Lanes Crossed	**Posted Speed**	**LOS**
2	Any	D
≥3	Any	E

Note:
1. Where raised crossings are provided, subtract one of the travel lanes for the score.
2. Pedestrian crossovers (PXOs) are not evaluated as a controlled bicycle crossing.
3. For roundabouts, a one lane roundabout = 2 lanes crossed.

Additional notes / instructions are provided below.

- The **Uncontrolled Crossing along the Route** metric identifies the presence of uncontrolled crossings where cyclists do not have the right-of-way (i.e. two-way stop control, ramp or roundabout on the subject segment). At these approaches, cyclists must yield to traffic on the cross street (see Exhibit 20 below).
- The greater the number of lanes and the higher the speeds, the greater the safety risk and discomfort for cyclists. In addition, opportunities to cross may be infrequent due to the need to wait for a gap in traffic. The presence of a refuge median reduces the number of uncontrolled lanes that cyclists would need to

cross and thus improves the LOS. This metric is to be based on the uncontrolled crossing along the segment **with the highest number of lanes crossed.**

Exhibit 20 – Uncontrolled Crossing Example

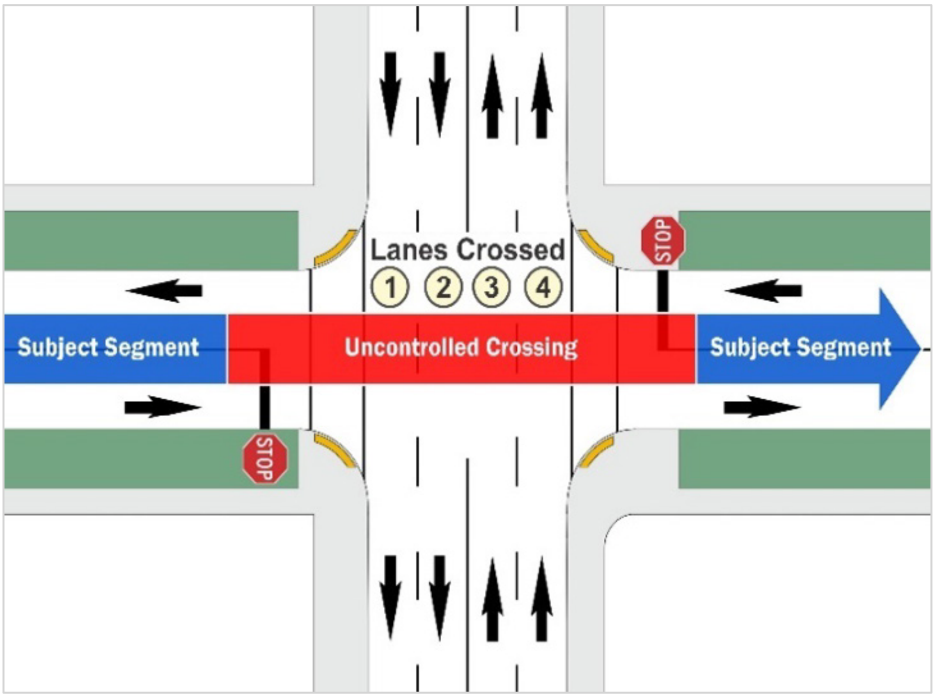


Exhibit 21 – Segment BLOS - Cycling Path Blockages Look-up Table

Cycling Path Blockages (bike lanes, paved shoulders and shared operating space only)	LOS
No frequent stops on cyclists' path of travel	A
Frequent bus stops that result in vehicles stopping on the cyclists' path of travel for short durations	C
Frequent designated loading zones that allow vehicles to stop in the cyclists' path of travel for longer duration	E

Additional notes / instructions are provided below.

- The Cycling Path Blockages metric only applies to bike lanes or paved shoulders without physical separation, or where cyclists operate in shared space (i.e. mixed traffic).
- The metric reflects the presence of bus stops or designated loading zones where stopped vehicles may block the cyclist's path of travel.

4.4 Intersections

4.4.1 Methodology Overview

City of Ottawa practice for designing cycling facilities at intersections has changed significantly since the MMLOS Guidelines were released in 2015. In particular, the City is increasingly designing and constructing protected intersections and released the Protected Intersection Design Guide (PIDG) in 2021. Protected intersections place great emphasis on separating cyclists from conflicts with motor vehicles, which can be applied to all cycling facility types regardless of whether a protected corner is provided. As such, a new intersection BLOS methodology was developed to better incorporate cyclists' protection from turning vehicles and recent City of Ottawa practice.

The Intersection BLOS score is calculated based on a total score of 150 based on the following four metrics:

1. Vehicle right-turn conflicts – 50 points
2. Vehicle left-turn conflicts – 50 points
3. Cyclist left-turn treatment – 50 points
4. "Adjustment for Mixed Traffic" – 50 points subtracted where approaches with mixed traffic do not meet the OTM Book 18 Bicycle Facility Pre-Selection Nomograph (see Appendix E)

Refer to Section 1.4.4 for the calculation of "overall" and "critical" intersection scores.

4.4.2 Evaluation Tables

The adjustment for unwarranted mixed traffic operations is provided in Exhibit 22, while the intersection BLOS look-up tables and associated illustrations for the Right-turn Conflict, Left-turn Conflict and Left-turn Treatment metrics are provided in Exhibit 23 to Exhibit 26. Further instructions are provided following each exhibit, as appropriate.

Exhibit 22 – Intersection BLOS - Traffic Adjustment where Cycle Track Not Present

Vehicle Speed and Volume	Bike Lane through Intersection	Mixed Traffic
≤ 40 km/h posted speed or ≤ 3,500 ADT (Two-way)	0	0
≤ 40 km/h posted speed or > 3,500 and ≤ 6,000 ADT (Two-way)	0	-25
> 40 km/h posted speed or > 6,000 ADT (Two-way)	-25	-50

Exhibit 23 – Intersection BLOS - Vehicle Right-Turn Conflicts Look-up Table

Cycling Facility Type	Vehicle Volume	Effective Corner Radius	Posted speed	Treatment[1]	Score
Floating bike lane or right-turn vehicle lane develops next to through bicycles in mixed traffic					0
Any	Any	Any	Any	Protected only right-turn	50
Any	Any	Any	Any	No right-turn	50
Bi-directional cross-ride	≤ 100 right-turns per hour	≤ 8m or target crossride setback met (PIDG Table 5.1)	Any	Protected-permissive with or without LBI	50
				Permissive with LBI	45
				Permissive	40
		> 8m and target crossride setback not met	≤ 50 km/h	Protected-permissive with or without LBI	50
				Permissive with LBI	45
				Permissive without LBI	40
			> 50 km/h	Protected-permissive with LBI	50
				Protected-permissive without LBI	40
				Permissive with LBI	40
				Permissive without LBI	30
	> 100 right-turns per hour	≤ 8m or target crossride setback met (PIDG Table 5.1)	Any	Protected-permissive with LBI	20
				Protected-permissive without LBI	10
				Permissive with LBI	10
				Permissive without LBI	0
		> 8m and target crossride setback not met	Any	Protected-permissive with LBI	10
				Protected-permissive without LBI	0
				Permissive with or without LBI	0
Uni-directional cross-ride or mixed traffic	≤ 150 right-turns per hour	≤ 8m or target crossride setback met (PIDG Table 5.1)	Any	Protected-permissive with or without LBI	50
				Permissive with LBI	45
				Permissive without LBI	40
		> 8m and target crossride setback not met	≤ 50 km/h	Protected-permissive with or without LBI	50
				Permissive with LBI	45
				Permissive without LBI	40
			> 50 km/h	Protected-permissive with LBI	50

[1] Although right-turn channels are deemed outside of the controlled crossing of a signalized intersection, they are included in the assessment of MMLOS for the purposes of these guidelines due to their impact on pedestrian and cycling modes of travel.

Cycling Facility Type	Vehicle Volume	Effective Corner Radius	Posted speed	Treatment[1]	Score
				Protected-permissive without LBI	40
				Permissive with LBI	40
				Permissive without LBI	30
		-	Any	Smart channel with raised crossing	30
		-	Any	Smart channel without raised crossing	20
		-	Any	Conventional right-turn channel	10
	150-300 right-turns per hour	≤ 8m or target crossride setback met (PIDG Table 5.1)	Any	Protected-permissive with LBI	50
				Protected-permissive without LBI	40
				Permissive with LBI	40
				Permissive without LBI	30
		> 8m and target crossride setback not met	Any	Protected-permissive with LBI	30
				Protected-permissive without LBI	20
				Permissive with LBI	20
				Permissive without LBI	10
		-	Any	Smart channel with raised crossing	30
		-	Any	Smart channel without raised crossing	20
		-	Any	Conventional right-turn channel	10
	> 300 right-turns per hour	≤ 8m or target crossride setback met (PIDG Table 5.1)	Any	Protected-permissive with LBI	20
				Protected-permissive without LBI	10
				Permissive with LBI	10
				Permissive without LBI	0
		> 8m and target crossride setback not met	Any	Protected-permissive with LBI	10
				Protected-permissive without LBI	0
				Permissive with LBI	0
				Permissive without LBI	0
		-	Any	Smart channel with raised crossing	20
		-	Any	Smart channel without raised crossing	10
		-	Any	Conventional right-turn channel	0

Cycling Facility Type	Vehicle Volume	Effective Corner Radius	Posted speed	Treatment[1]	Score
Note: No right-turn on red (NRTOR) is required with protected right-turns and is strongly recommended where there is a right-turn overlap phase, or leading pedestrian/bicycle interval					

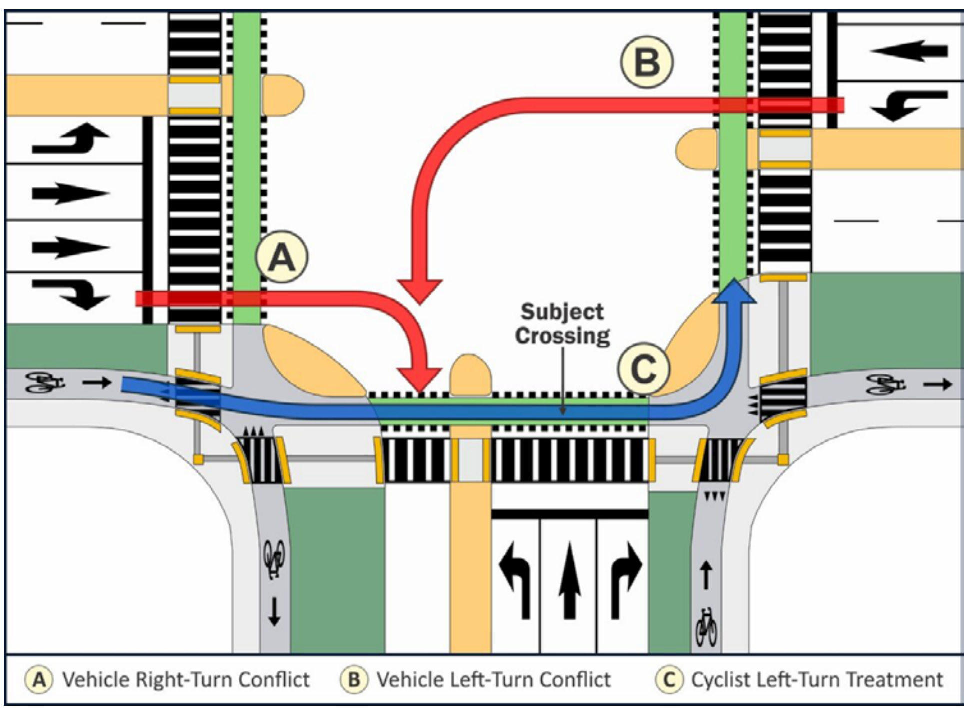
Exhibit 24 – Intersection BLOS - Vehicle Left-Turn Conflicts Look-up Table

Cycling Facility Type		Treatment	Score
All crossing types		Protected only left-turn	50
		No left-turns (e.g. T-intersections)	50
Bi-directional crossride		Permissive or Protected-permissive left-turns	0
Uni-directional crossride or mixed traffic	< 50 left-turns per hour OR < 100 left-turns per hour and one opposing lane	Permissive or Protected-permissive left-turns	50
	≥ 100 left-turns per hour OR ≥ 50 left-turns per hour with ≥ 2 opposing lanes	Permissive or Protected-permissive left-turns with centreline hardening and/or LBI	20
		Permissive or Protected-permissive left-turns without centreline hardening or LBI	0

Additional notes / instructions are provided below.

- The vehicle **Right-turn Conflict and Left-turn Conflict** metrics match the Intersection PLOS metrics of the same name, but with additional consideration for crossride setback where applicable. The Right- and Left-turn Conflict movements and left-turn treatments for a subject crossing are illustrated in Exhibit 25.

Exhibit 25 – Vehicle Left- and Right-Turn Movements and Cyclist Left-Turn Treatments



- Where **no crossride** is present (i.e. mixed traffic or bike lane through intersection), the right-turn and left-turn conflict shall be scored based on the uni-directional cross-ride facility scoring, and a penalty shall be applied to the score based on the adjacent traffic volume and speed, where appropriate (see Exhibit 22).

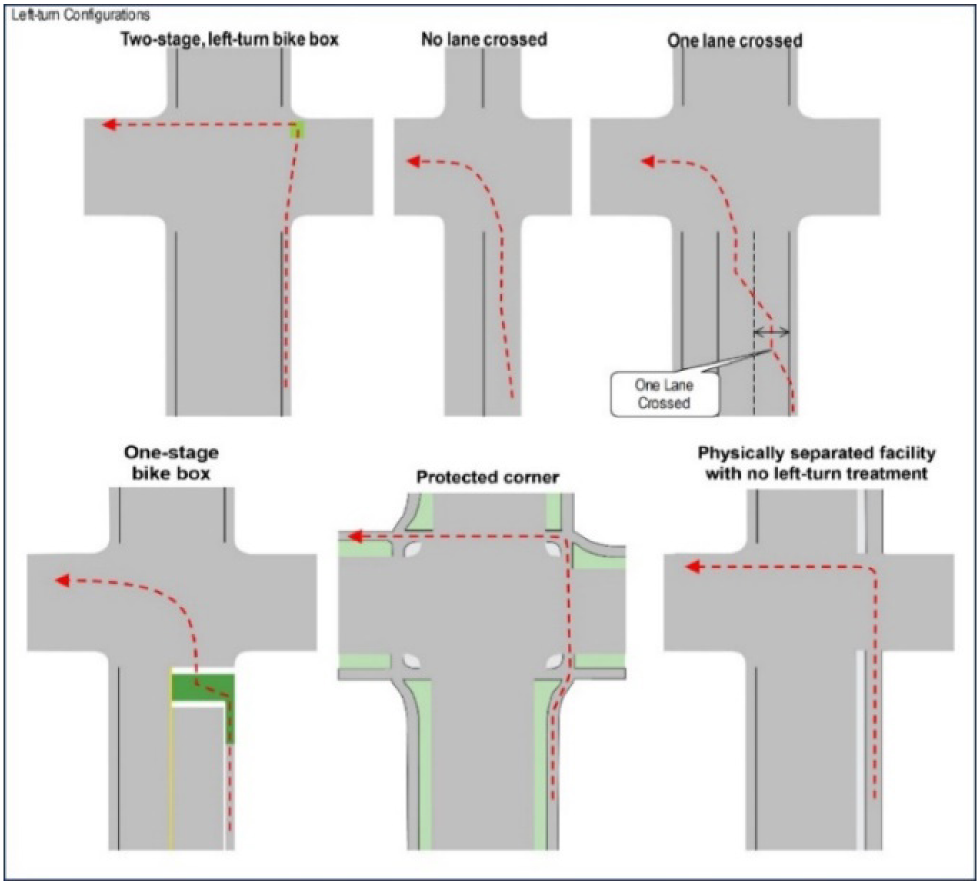
Exhibit 26 – Intersection BLOS - Cyclist Left-Turn Treatments Look-up Table

Left-turn Treatment	Posted Speed / ADT	Numerical Score
Protected corner	Any	50
No left-turns (e.g. T-intersections)	Any	50
Two-stage queue box	≤ 40 km/h	50
	> 40 km/h	30
Physically separated facility with no left-turn treatment	Any	30
One-stage + bike box	≤ 40 km/h and ≤ 6,000 ADT (Two-way)	50
	> 40 km/h or > 6,000 ADT (Two-way)	30
No lanes crossed by cyclists	≤ 40 km/h	40
	> 40 km/h	20
One lane crossed by cyclists	≤ 30 km/h	35
	40 km/h	25
	> 40 km/h	10
Two or more lanes crossed by cyclists	≤ 30 km/h	20
	> 30 km/h	0
Cyclists must use dual left-turn lanes	Any	0

Additional notes / instructions are provided below.

The **Left-Turn Treatment** metric applies to the crossing that cyclists would use on the first stage of a left-turn (if provided). The type of left-turn treatments provided for cyclists and the number of lanes crossed to make the left-turn are key considerations in assessing cyclist safety and comfort. The types of cyclist left-turn configurations at intersections are illustrated in Exhibit 27.

Exhibit 27 – Types of Cyclist Left-Turn Configuration



The total numerical score for intersection BLOS shall be **converted to a letter grade** based on Exhibit 28 below.

Exhibit 28 – Intersection BLOS Scoring System

Points	LOS
121-150	A
91-120	B
61-90	C
31-60	D
15-30	E
< 15	F

4.5 Interpretation of Results

The BLOS results can be interpreted using the segment and intersection score qualitative descriptors shown in Exhibit 29 and Exhibit 30, respectively.

Exhibit 29 – Qualitative Segment BLOS Results by Letter Score

LOS	Results for Cycling Facility
A	Very comfortable
B	Comfortable
C	Fairly comfortable
D	Less comfortable
E	Uncomfortable
F	Very uncomfortable / does not meet minimum design guidelines

Exhibit 30 – Qualitative Intersection BLOS Results by Letter Score

LOS	Results for Cycling Facility
A	Minimal exposure to traffic
B	Very little exposure to traffic
C	Some exposure to traffic
D	Notable exposure to traffic
E	Significant exposure to traffic
F	Does not meet minimum design guidelines

An example illustrating the application of the BLOS methodology is provided in Appendix A, and Methodology Flowcharts are provided in Appendix B.

5.0 Transit Level of Service (TLOS)

5.1 Intent

The primary intent of the Transit Level of Service (TLOS) metric is to evaluate the relative attractiveness of transit and ultimately support a mode shift to the transit mode. Specifically, the methodology outlined for segment and intersection TLOS analysis aims to maximize transit service by:

Segments	• Minimizing the degree to which transit vehicles are impeded by other traffic along segments
Intersections	• Minimizing the degree of transit delay at intersections

TLOS is intended to be calculated along corridors with existing or planned transit service. Interventions for increasing transit service and speed could include segregated transit facilities, transit signal priority measures, transit queue jump lanes and restrictions to movements for general traffic. It is noted that for buses operating in mixed traffic, delays along segments and at intersections will significantly influence the speed at which transit vehicles can travel.

5.2 Data Requirements

The data required to measure TLOS is summarized in Exhibit 31.

Exhibit 31 – Data Requirements for Transit Level of Service

Segments	Signalized Intersections
» Facility type (segregated or partially segregated ROW, curbside bus lanes, or mixed traffic) » Average transit travel speed (mixed traffic only) » Posted speed limit (mixed traffic only)	» Average signal delay for approaches with transit movements » Presence of transit priority treatments (grade separation, signal pre-emption, queue jump lanes, transit signal priority, restrictions to movements for general traffic)

It is noted that a segregated transit facility implies that some physical separation is provided between transit travel lanes and general-purpose travel lanes – whether it is through curb barriers or planting or separated by grade. Partially segregated transit facilities imply that transit vehicles operate on physically separated lanes for part of their journey but share the road with other modes in some areas (e.g. median rapid transit).

5.3 Segments

The Segment TLOS score is determined based on the **transit facility type** provided. For mixed traffic, performance is measured based on the ratio of transit vehicle operating speed to posted speed during the peak period. The Segment TLOS look-up table is provided in Exhibit 32.

Exhibit 32 – Segment TLOS - Transit Facility Type Look-up Table

Facility Type		Quantitative Measurement[1]	LOS
Segregated ROW		-	A
Partially Segregated ROW (e.g. median rapid transit)		-	A
Continuous Curbside Bus Lane		-	B
Mixed Traffic	Transit running time is observed or expected to be unimpeded[2]	$V_t/V_p \geq 0.95$	B
	Transit running time is observed or expected to be only slightly impeded	V_t/V_p = 0.8-0.94	C
	Transit running time is observed or expected to be moderately impeded	V_t/V_p = 0.6-0.79	D
	Transit running time is observed or expected to be significantly impeded	V_t/V_p = 0.4-0.59	E
	Transit running time is observed or expected to be drastically impeded	$V_t/V_p < 0.4$	F

[1] V_t/V_p is the ratio of average transit travel speed to posted speed limit

[2] Segments identified as "unimpeded" shall include in-lane bus stops, not requiring buses to change lanes or leave the flow of traffic. In some configurations, this may require curb extensions or bump-outs.

To maximize the efficiency of continuous bus lanes, driveways and on-street parking should be limited to the extent possible, as these elements can lead to a higher number of conflicts and increase transit delay.

For mixed traffic, the **average transit travel speed** for transit vehicles operating in mixed traffic may be acquired from OC Transpo or other datasets including the Google Distance Matrix API, and shall be estimated as follows:

- The average transit travel speed shall be estimated by dividing the length of the segment, defined as the distance between the far side of one intersection to the nearside of the next, by the average travel time to cross the segment.
- The average transit speed shall be determined for each side of the segment based on the peak hour speed along the subject side of the segment.
- The dwelling time at bus stops shall not be included in transit travel time estimates for the purposes of these guidelines (whether based on OC Transpo data or Google API).

It is noted that signal delays at either side of the segment (captured in Intersection TLOS) can also impact transit delay along segments, and improving intersection operations may also reduce transit delay along segments although not explicitly captured in Segment TLOS. It is also noted that "Segregated ROW" should only be input where there is a fully segregated transit facility running directly adjacent or along the corridor, and there are no buses operating on the segment itself.

For future conditions, transit travel time estimates should ideally be modelled through microsimulation (e.g. VISSIM). In the absence of modelling data, the degree to which transit running time is expected to be impeded can be projected by considering existing travel times (if applicable) and the degree to which future conditions / planned modifications may affect transit travel time. Considerations may include growth in traffic volumes, addition or removal of a lane, increased traffic delay, lower design speed, significant changes in ridership, bus platooning, and addition or removal of a layby, etc.

5.4 Intersections

The Intersection TLOS score is determined based on the **average signal delay** for movements on which transit routes operate during the peak period. The intersection TLOS look-up table is provided in Exhibit 33. Refer to Section 1.4.4 for the calculation of “overall” and “critical” intersection scores.

Exhibit 33 – Intersection TLOS - Transit Delay Look-up Table

Delay	Example Transit Priority Treatment (if delay is not available)	LOS
0	Grade separation / signal pre-emption	A
≤ 10 sec	Continuous bus lanes, or transit queue jump lane with TSP	A
11-20 sec		B
21-35 sec		C
36-55 sec	No transit priority measures and long cycle length	D
56-80 sec		E
> 80 sec		F

Note: The example transit priority treatment column is only applicable in the absence of a transit delay estimate.

The **average signal delay** shall be estimated based on approaches with transit movement(s) only (e.g. left-turn delay would not be included if no transit routes make left-turn movements at the intersection). If more than one transit movement exists on an approach, the highest delay shall be used.

Transit delay estimates based on traffic analysis software or field observations (for existing conditions) should be used wherever possible, however, in the absence of reliable delay estimates for transit signal priority measures, delay can be estimated based on the type of transit priority treatment provided, as shown in Exhibit 33. It is noted that other factors that may impact delay include cycle length and level of congestion.

5.5 Interpretation of Results

The segment and intersection score qualitative descriptors provided in Exhibit 34 can be used to interpret TLOS results.

Exhibit 34 – Qualitative Description of TLOS Scores

LOS	Results for Segments	Result for Intersections
A	Transit vehicles are not impeded by other traffic	Free flow
B	Transit vehicles are rarely impeded by other traffic	Stable flow / slight delays
C	Transit vehicles are occasionally impeded by other traffic	Stable flow / acceptable delays
D	Transit vehicles are often impeded by other traffic	Approaching unstable flow
E	Transit vehicles are very often impeded by other traffic	Unstable flow
F	Transit vehicles are almost always impeded by other traffic	Forced flow / jammed

An example illustrating the application of the TLOS methodology is provided in Appendix A, and Methodology Flowcharts are provided in Appendix B.

6.0 Traffic Operations and Automobile Level of Service (Auto LOS)

6.1 Traffic Operations Evaluation

An evaluation is required of any critical intersection within the study area during any or all of the relevant peak hours and scenarios. Summaries are to be provided in tabular format clearly identifying intersection performance under existing and future traffic conditions, including volume to capacity (V/C) ratios and queue lengths for each individual movement. In the case where a development is anticipated to proceed in phases or stages, projected performance for all intersections must be documented for the end of each phase.

Practitioners should also undertake one hour of peak observations (typically during either the AM or PM peak hours), where appropriate, to verify that the traffic volumes through the intersections reflect existing demands and to identify unusual operating conditions. The time of observations and conditions observed should be documented in writing in the report.

The V/C ratio for an intersection is defined as the sum of equivalent volumes for all critical movements divided by the sum of capacities for all critical movements assuming that the V/C ratios for critical movements can be equalized. In cases where minimum pedestrian phase times prevent equalizing the level of service for critical movements, then the V/C ratio for the most heavily saturated critical movement should be considered as the V/C ratio for the intersection. Adjustment for the impact of pedestrian activated control is permitted provided detailed supporting analysis including projected pedestrian volumes is provided and discussed in advance with traffic engineering staff.

Intersection evaluations should identify:

- Signalized Intersections
  - V/C ratios for the overall intersection, as defined above
  - V/C ratios and queue lengths for individual movements (provided in a separate table)
- Unsignalized Intersections - Level of service (LOS) where the LOS is between A and E; V/C where capacity is based on gap analysis if intersection LOS is F.

Existing signal timing information such as phasing, pedestrian minimums and clearance intervals must be used as a base to analyze the existing capacity of signalized intersections. This signal timing data should be obtained from the City of Ottawa Traffic Operations Branch. Operational design of the signals analyzed should be in accordance with City of Ottawa signal operation practices. V/C and queue length calculations relating to future conditions should be determined using signal timing optimized for the volume conditions being studied.

Detailed output from analysis software is to be provided in an appendix to the report and copies of the electronic files should be provided to the City. The guidance provided in the Ottawa Transportation Impact Assessment (TIA) Guidelines shall be consulted in completing intersection capacity analysis. Acceptable parameters for operational analysis of signalized intersections, as per the TIA Guidelines, are provided in Appendix D.

6.2 Auto LOS Evaluation

The 2023 Transportation Master Plan - Part 1 prescribes that “For network planning purposes, a target volume-to capacity (v/c) ratio of 1.0 will be adopted citywide. This target will apply to travel over the entire peak period to optimize the City's investment in road infrastructure and ensure space is used as efficiently as possible. Peak hour v/c targets will continue to be used for operational planning”.

Although both operational and planning studies shall report V/C ratio and queue length results based on **peak hour** volumes to allow the optimization of signal timing and queue storage (see previous section), when undertaking planning level studies (e.g. environmental assessments, functional design studies, ROW requirements, etc.), the V/C ratio shall be multiplied by the **peak hour to peak period conversion factor** for the purposes of MMLOS reporting, tradeoffs evaluation and decision-making. The city-wide average conversion factors for the morning and afternoon peak hours are 0.84 and 0.92, respectively. These factors can be refined if more specific data on the peaking characteristics of demand is available for specific areas.

The Auto LOS score shall then be determined based on Exhibit 35.

Exhibit 35 – Auto LOS Evaluation Table

LOS	Volume-to-Capacity Ratio
A	0 to 0.60
B	0.61 to 0.70
C	0.71 to 0.80
D	0.81 to 0.90
E	0.91 to 1.00
F	> 1.00

It is noted that although queue lengths are not a part of the Auto LOS score, evaluating their impact on intersection operations is a crucial component of Auto LOS analysis, and should be considered when evaluating design alternatives.

In cases where roadways have closely spaced signals and especially when there are heavy turning movements, the design and associated traffic analysis should consider impacts of storage limitations on the operation of the subject intersection and adjacent signalized intersections.

For example, a recommendation to lengthen a left-turn lane's queue storage does not typically impact the LOS of other modes and would not typically trigger a need to revisit MMLOS analysis. On the other hand, a recommendation to provide a smart channel rather than a protected right-turn due to peak hour queuing concerns would impact PLOS and BLOS and should be primarily a MMLOS tradeoff decision using peak period factored results.

In addition, any consideration of reduction in cross section widths should comply with road use, operations and minimum lane widths. Where the proposed design includes lane removal or vehicle movement restrictions, the impact on the corridor and adjacent network is to be considered as part of the design and associated traffic analysis.

7.0 Large Vehicle Design Checklist

The goal of the Large Vehicle Design Checklist is to ensure that design guidance for accommodating large vehicles is followed. The checklist includes a series of “yes”/ “no” questions that analysts should answer when carrying out MMLOS analysis.

The process of completing the Large Vehicle Design Checklist involves conducting turning template analysis for “design” and “control” large vehicles (including trucks, buses, emergency vehicles, farm vehicles, etc.) and shall be used to determine the necessary curb radii and lane widths. In general, minimum curb radii and lane widths should be used to limit impacts to pedestrians and cyclists.

The Large Vehicle Design Checklist is shown below:

- Have the design and control vehicle(s) been identified for each applicable intersection leg and movement? (yes/no)
- Has a turning template analysis been carried out? (yes/no)
- Have minimum lane widths been identified and considered? (yes/no)
- Have constraints and tradeoffs been assessed and documented? (yes/no)
- Have constraints and tradeoffs been addressed in the design? (yes/no)

The following additional instructions should be considered.

- Where the answer for any checklist item is “no”, the item shall be identified for further discussion and action as part of the larger project process.
- While completing the checklist, consideration should be given to current/existing intersection accommodation of large vehicle turning movements.
- For TIAs, this checklist is required for on-site design and approaches with road modifications only. It is not intended for each approach of all TIA study area intersections.

8.0 Public Realm Level of Service (PRLOS) and Design Checklists

8.1 Intent

The Healthy Streets Approach is a system of policies and strategies that encourage a healthier, more inclusive city with higher use of non-auto modes by putting human health and quality of life at the centre of decision-making. The approach was developed by Lucy Saunders, Director at Healthy Streets, and was first applied in London before being expanded across the UK and adapted in Australia and Hungary.

The system is guided by the following ten Healthy Streets Indicators describing the human experience: Everyone feels welcome; Easy to cross; Presence of shade and shelter; Places to stop and rest; Not too noisy; People choose to walk and cycle; People feel safe; Things to see and do; People feel relaxed; and Clean air.

A key feature of the Healthy Streets Approach is that it does not rigidly define streets as "healthy" or "unhealthy" but rather aims to provide incremental improvements based on the surrounding context and available resources.

Policy 9-1 (Continue to Advance Complete Streets) of the City of Ottawa TMP states that the MMLOS Update shall include *"the Healthy Streets Approach which emphasizes the importance of creating a safe, welcoming and relaxing environment by considering elements such as noise, air quality, lighting, rest areas, and shade."*

The **Public Realm LOS tool** and **Design Checklists** presented in this document aim to satisfy the above policy and were developed specifically for the Ottawa context with the goal of ensuring that consideration of improvements to enhance the user experience within municipal streets were made.

8.2 Public Realm LOS Tool

The Public Realm LOS Tool assesses how the street impacts the overall user experience by evaluating:

- Space allocated to sidewalks
- Potential for trees/amenities in the boulevard
- Ease of crossing opportunities
- Presence of cycling facilities
- The quality of bus stop elements
- The impacts of adjacent vehicle speeds and number of traffic lanes

The Public Realm LOS tool shall apply to municipal design projects within the Urban Transect, Suburban Transect and Villages, and segments bordering proposed developments (within the TIA process). In addition, the tool shall apply to segments only as most opportunities for user enjoyment generally occur along street segments, and as public realm elements at intersections are generally already considered within the intersection MMLOS analysis.

As a target, **the ratio of Proposed Design PR LOS / Existing PR LOS should be greater than 1.0** for all projects with geometric changes that impact the public realm.

8.2.1 Evaluation Tables

The Public Realm LOS tool is calculated based on a weighted average of seven metrics, as shown in Exhibit 36.

Exhibit 36 – Public Realm LOS Look-up Table

Metric Description (Weight%)	Scoring	
Boulevard Width available for landscaping, benches, etc. (15%)	See Boulevard Width look-up table (Exhibit 37)	
Sidewalk Width (25%)	≥ 3.0m	A
	2.0-2.99m	B
	1.8-1.99m	C
	1.5-1.79m	D
	< 1.5m	F
Maximum distance between controlled pedestrian crossings (15%)	From Segment PLOS analysis	
Presence of cycling facility, whether it is warranted or not (10%)	Yes	A
	No	F
Bus stop elements (landing space/presence of shelter) * (10%)	Curbside platform with shelter (island style)	A
	Curbside landing zone with shelter behind sidewalk	B
	Curbside platform with no shelter	C
	Curbside landing zone with no shelter	D
	No platform, landing zone or shelter	E
Number of midblock traffic lanes (both directions) (10%)	≤ 2	A
	3	B
	4	D
	5	E
	≥ 6	F
Posted Speed (15%)	≤ 40 km/h	A
	41-50 km/h	B
	51-60 km/h	D
	> 60 km/h	F
* If the street is not a transit route, score LOS A.		

Exhibit 37 –Public Realm LOS - Boulevard Width Look-up Table

Boulevard Width	LOS	Notes
Inner Boulevard		
≥ 4.0m	A	Can accommodate curbside trees in typical soft surface arterial cross section. Accommodates curbside bus stop with shelters and wide range of furniture and fixtures.
2.0-3.99m	B	Can accommodate landing zone style bus stops without shelters and turf at the low end. A wide range of furniture and fixtures and possible soil volume for trees can be accommodated with mitigation design in the appropriate context.
1.5-1.99m	C	Can accommodate turf, most furniture and fixtures, and possibly soil volume for trees with mitigation design in appropriate context.
1.2-1.49m	D	Can only accommodate light poles, traffic signs, regulatory signs, and snow storage. Must be hard surfaced. Cannot accommodate trees, turf, or most furniture.
0.6-1.19m	E	Limited ability to accommodate light poles, traffic signs, regulatory signs, and snow storage. Must be hard surfaced. Cannot accommodate trees, turf, or most furniture.
≤ 0.6m	F	Cannot accommodate any vertical features. Must be hard surfaced.
Middle Boulevard		
≥ 3.0m	A	Can be functional for trees and all amenities (at low end may require mitigations such as soils cells in order to achieve target soil volumes).
2.0-2.99m	B	Can accommodate turf at the low end. A wide range of furniture and fixtures and possible soil volume for trees can be accommodated with mitigation design in the appropriate context.
1.5-1.99m	C	Can accommodate turf, most furniture and fixtures, and possibly soil volume for trees with mitigation design in appropriate context.
0.5-1.49m	D	Can only accommodate light poles, traffic signs, regulatory signs, and snow storage (at the higher end). Must be hard surfaced. Cannot accommodate trees, turf, or most furniture.
Half-height curb serving as the boulevard	E	Half-height curbs are generally not preferred if they separate pedestrians from furnishings in the inner boulevard.
≤ 0.5m	F	Could include a half-height curb between a cycle track and sidewalk (as per City practices) but cannot accommodate any further public realm features.
Outer Boulevard		
≥ 3.0m	A	Can accommodate trees and all amenities (i.e. bus stops, cafes, all furniture). Except in contexts with zero setback zoning, in which case ROW trees are not recommended in outer boulevards.
2.0-2.99m	B	Can accommodate a wide range of furniture and fixtures (including seating and limited café areas) and turf at the lower end. Can accommodate soil volume for trees if the adjacent zoning sets back development by 3m or more (see minimum front yard setback in Zoning Bylaw). If this is the case, score LOS A.
1.5-1.99m	C	Can accommodate turf, most furniture and fixtures (including display tables, seating, news boxes, etc.), and possibly soil volume for trees with mitigation design in appropriate context.
0.5-1.49m	D	Cannot accommodate trees, turf, or most furniture. However, limited amenities such as sandwich boards and display tables may be accommodated, provided that they do not impact the pedestrian clear zone or straight path of travel.
≤ 0.5m	F	Minimum ROW offset - cannot accommodate trees, turf, or furniture.

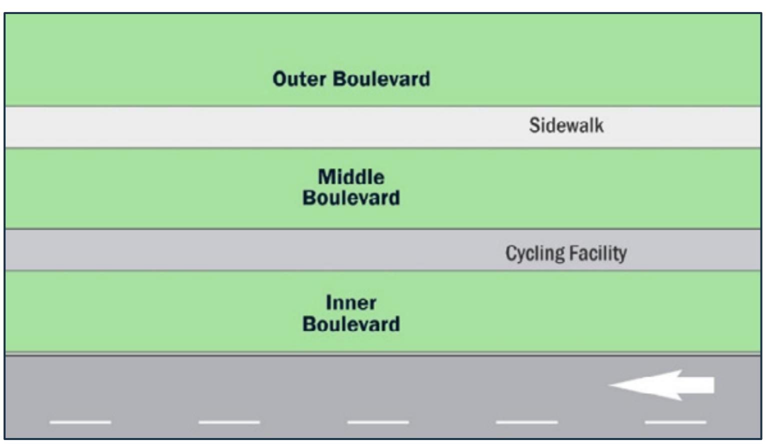
In completing the Public Realm LOS evaluation, the following shall be considered:

- Each side of the segment shall be scored separately.
- The Boulevard Width and Sidewalk Width metrics shall be based on the width provided along the majority (>50%) of the segment.
- The Boulevard Width shall be measured as the distance between the back of the curb and the nearest edge of the sidewalk or cycle track, if present.
- For the evaluation of the Boulevard Width metric (see Exhibit 37). the inner, middle and outer boulevard widths shall be identified for each side of the segment, and the **greatest** boulevard width on each side shall be selected for scoring based on the street context as follows:
    - For Mainstreet or Active Frontage streets within a Hub, Special District, or Village Core:
        - The score shall be based on the greatest of the inner and middle boulevard scores only, as trees are not recommended to be planted in the outer boulevard within these contexts as trees will eventually deteriorate due to development disturbances.
    - For all other street types:
        - The score shall be based on the greatest of the inner, middle, and outer boulevard scores, except where minimum setbacks are less than 3.0m, in which case the score shall be based on the greatest of the inner and middle boulevard scores only.
- Regarding bus stop types, curbside platforms generally refer to bus stops with sufficient space between the curb and sidewalk for people to wait comfortably, while landing zones generally refer to bus stops with a narrower strip between the curb and sidewalk.
- For streets with more than one bus stop on the subject side of the segment, the score shall be based on the stop that scores worse for this metric.

The definitions for inner, middle and outer boulevard widths are provided below and illustrated below:

- The **Inner Boulevard** is defined as the space between the curb and the cycle track (or sidewalk if no cycle track is present).
- The **Middle Boulevard** is defined as the space between the cycle track and sidewalk.
- The **Outer Boulevard** is defined as the space behind the sidewalk or MUP. The width shall consider space outside of the ROW if zoning sets back adjacent future development for planting (see Exhibit 37).

Exhibit 38 – Inner, Middle, and Outer Boulevard Locations



8.2.2 Calculation of Overall Score

The overall Public Realm LOS score is calculated automatically in the companion excel tool, and the calculation process is described below.

- For each side of the segment, the A-F letter scores for the seven PRLOS are converted to numerical scores based on the A-F Letter-to-Numerical Score Conversion presented in Exhibit 1 and copied below (rounded to the nearest whole number).

Exhibit 1 – A-F Letter-to-Numerical Score Conversion

Letter Score	Numerical Score
A	5
B	4
C	3
D	2
E	1
F	0

- The weighted average of the seven Public Realm LOS metrics is calculated.
- The average numerical scores for both sides of the segment are calculated and the average overall segment Public Realm LOS letter score is determined.

8.2.3 Interpretation of Results

The Public Realm LOS results can be interpreted using the qualitative descriptors shown in Exhibit 39 below.

Exhibit 39 – Public Realm LOS Scoring System and Qualitative Descriptions

Total Public Realm Score	LOS	Result
25 - 30	A	Excellent performance
20 – 24	B	Very Good performance
15 – 19	C	Good performance
10 – 14	D	Average performance
5 – 9	E	Below average performance
0 – 4	F	Poor performance

An example illustrating the application of the Public Realm LOS methodology is provided in Appendix A.

8.3 Public Realm Design Checklists

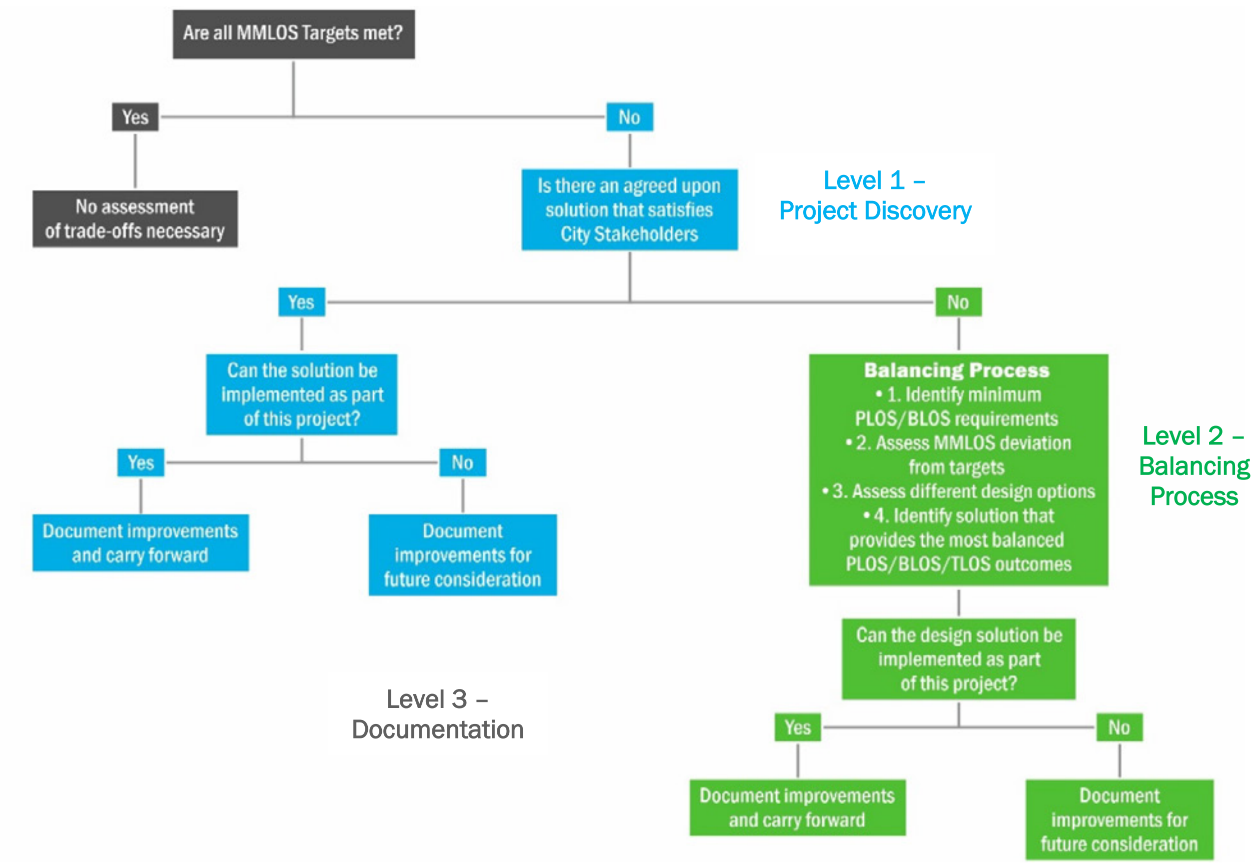
Public Realm Design Checklists were developed for functional; preliminary and detailed; and construction stages to further encourage the consideration of Healthy Streets elements, including greenery, amenities, public art, lighting, active building frontages and speed reduction measures at the different stages of project development. These checklists are a supplement to the MMLOS analysis and are generally intended for municipal projects or as part of the TIA Road Modification Approvals process in projects where the public realm is of particular importance. The Public Realm Design Checklists are provided in Appendix C.

9.0 MMLOS Design Decision Framework

The MMLOS analysis tool aims to identify opportunities to improve street designs in a way that balances the needs of all modes and ultimately facilitates a shift to active travel and transit. However, MMLOS targets cannot always be met for all modes due to limited right-of-way and cost considerations. It is often necessary to assess tradeoffs between the needs of multiple modes and prioritize different cross-section elements. Although it is difficult to provide a single formula for assessing tradeoffs in all cases, as each project and context is unique, a MMLOS Design Decision Framework has been developed to provide guidance for assessing tradeoffs within restricted rights-of-way.

The Design Decision Framework, illustrated in Exhibit 40 below, generally applies to the functional design stage of municipal design projects and requires that City stakeholders be identified and consulted. Regarding the TIA process for developments, the decision-making process would generally only apply during the Road Modification Approval process for streets directly adjacent to the development, as the City's guidelines only require that TIA studies identify potential improvements to pedestrian, cycling and transit modes.

Exhibit 40 – MMLOS Design Decision Framework for Municipal Projects



Potential City Stakeholders				
Accessibility	Asset Management (Road Renewal)	Community Planning	Environmental Assessments (Transportation)	Fire Services
OC Transpo	Network Modification	Public Health	ROW Management	Strategic Asset Management
Paramedic	Forestry	Urban Design	Traffic Services (Traffic Operations, Street Lighting, Road Safety)	Transportation Planning (TDM, AT, ATM, TMP, RMA Review)

9.1 Level 1 – Project Discovery

After identifying City stakeholders, the first step in the process is to gather City stakeholders to:

1. Discuss project context, challenges, opportunities and goals.
2. Determine whether: (a) there is a previously agreed upon cross-section recommendations from the City's Road Safety Action Plan in-service road safety reviews or previous studies such as environmental assessments, or (b) there is an obvious design solution that would satisfy City stakeholders and for which sufficient right-of-way is available.

In either of the above cases, a MMLOS analysis of the preferred design would be completed only to confirm that the design meets City requirements. If no previously agreed upon design recommendations exist, previous recommendations are dated, or there is insufficient right-of-way to satisfy all City stakeholders, the Decision-Making process would proceed to Level 2.

9.2 Level 2 – Balancing Process

The balancing process includes four steps and aims to identify a design that best balances improvements between modes while taking site context into account. A description of the balancing process is provided below.

9.2.1 Step 1: Ensure Minimum Pedestrian and Cycling Requirements Met

As the OP fundamentally prioritizes safety for vulnerable road users over enhanced vehicle capacity, all effort shall be made for the following minimum pedestrian and cyclist requirements, listed in order of priority, to be included in the design to the extent possible before any further options/tradeoffs are explored. The design should also consider whether large vehicle minimum turning requirements are met.

Pedestrian Requirements:

- TMP Sidewalk Policy met (i.e. sidewalk provided on one or both sides of the street based on context)
- Sidewalk width ≥ 1.8m (narrower widths permitted in constrained areas)
- Appropriate protection for pedestrians provided at intersections according to the PIDG (if applicable)

Cycling Requirements:

- Cycling facilities are provided on collectors, major collectors, and arterials in accordance with the TMP
- OTM Book 18 Bicycle Facility Pre-Selection Nomographs met (i.e. appropriate protection from traffic based on traffic volumes and speeds is provided)
- Appropriate protection for cyclists provided at intersections according to the PIDG (if applicable)

Where right-of-way is limited (e.g. retrofit projects), potential design solutions for meeting minimum pedestrian and cycling requirements may include:

- Implementing shared or condensed facilities (e.g. MUPs, bi-directional cycling facilities)
- Reducing the widths of other cross-section elements, where appropriate
- Removing on-street parking
- Repurposing general travel lanes for active travel uses
- Prohibiting certain vehicle movements/ shifting vehicles to parallel corridors

While property impacts should be mitigated wherever possible, City staff should also be engaged to identify locations where some property impact may be acceptable to meet minimum guidelines and standards. Where it is determined that minimum pedestrian and cycling requirements cannot be met within the project context, the practitioner shall identify measures to improve safety conditions to the extent possible and document the improvements made.

9.2.2 Step 2: Assess MMLOS Deviation from Targets

- This step involves clearly defining how well each of the modes meets its target in order to identify which modes shall be prioritized for improvement, while balancing impacts to other modes. The general table format for documenting the difference between MMLOS scores and targets is provided below.

Exhibit 41 – Example Deviation of MMLOS Scores from Targets

Intersection of xxx/yyy				
	PLOS	BLOS	TLOS	AutoLOS
Target	B	B	B	E
Current MMLOS	C	C	E	E
Deviation	-1	-1	-3	0

- In the above example, Transit has the highest deviation from its target. As such, mitigation measures that improve TLOS would be prioritized.
- Where two or more modes have the same deviation from their target, mode priority shall be identified based on the land use context as shown in Exhibit 42 below. These mode priorities are recommended as the general case, however where specific local contexts have obvious and significantly different mode priority targets, these should be identified and used.

Exhibit 42 – Priority of Modes (Only use when Prioritization Not Clear from Target Deviations)

OP Transect / Designation / Policy Area	Mode Priority
Downtown Core, Inner Urban, Hub and/or Special District, Mainstreet Corridor (outside a Hub), Village Core	Pedestrian, Bicycle, Transit, Car
Outer Urban or Suburban	Pedestrian, Transit, Bicycle, Car
Outer Urban or Suburban and Transit Priority Corridor/Within 600m of Rapid Transit Station	Transit, Pedestrian, Bicycle, Car
Greenbelt or Rural	Transit, Car, Bicycle, Pedestrian
Industrial and Logistics or Mixed Industrial	Transit, Car, Pedestrian, Bicycle

9.2.3 Step 3: Identify and Assess Different Design Options (*Iterative Process*)

The deviation of modes from their target should guide the identification of mitigation measures and alternative design options. When assessing design options, the following should be considered:

- Balance improvements between pedestrian, cycling, transit and automobile LOS where possible. For example, where PLOS and BLOS targets are both A, a design option that results in PLOS C and BLOS C would be preferable to a design option that results in PLOS A and BLOS E.
- Where sustainable modes are **cumulatively 3 or more** letter grades below their LOS targets and right-of-way restrictions exist, diversion of automobile traffic to parallel corridors and alternative modes may be considered. It is noted that this would generally not be within the scope of TIA projects.
- Where a particular metric within the Public Realm LOS is identified as a high priority within a street context (e.g. bus stop features), the impact of design changes on this score shall be considered and documented in the assessment of design alternatives.

This process shall be continued iteratively until a recommended design is identified.

9.2.4 Step 4: Confirm Preferred Design

Following the iterative assessment of different design options and identification of a recommended option, the City PM team is to liaise with key City stakeholders to discuss the impacts of the alternative design options assessed and identify/confirm the preferred alternative that best balances the needs of pedestrian, bicycle, transit and automobile modes within the context.

It is important to highlight that although mode targets represent the vision for different facilities, the decision-making process moves away from the goal of meeting targets and **towards the goal of achieving balanced improvements** between pedestrian, cycling, transit and automobile modes, in addition to considering improvements to the public realm. Even where a design falls short of its mode targets, the process of identifying and implementing balanced design improvements for different modes would be considered a successful application of the MMLOS process.

9.3 Level 3 – Document Results

A primary objective of the Decision-Making process is to ensure that design decisions and their impacts are thoroughly recorded. As such, documentation shall present each step of the process as applicable, and include the following checklist:

- Are there any previously approved designs (e.g. from environmental assessments), or any previous recommendations from an In-Service Road Safety Review? (yes/no)
- Are there any agreed upon solutions that can be accommodated within the right-of-way? (yes/no)
- Does the facility meet minimum pedestrian requirements? (yes/no)
- Does the facility meet minimum cycling requirements? (yes/no)
- Has the deviation of modes from targets been recorded? (yes/no)
- Have the impacts of alternative design options been recorded in an appropriate table format? (yes/no)
- Has a preferred solution that yields the best balance between modes been identified? (y/n)

Appendix A:

Examples

Segment MMLOS Example – St. Joseph Boulevard

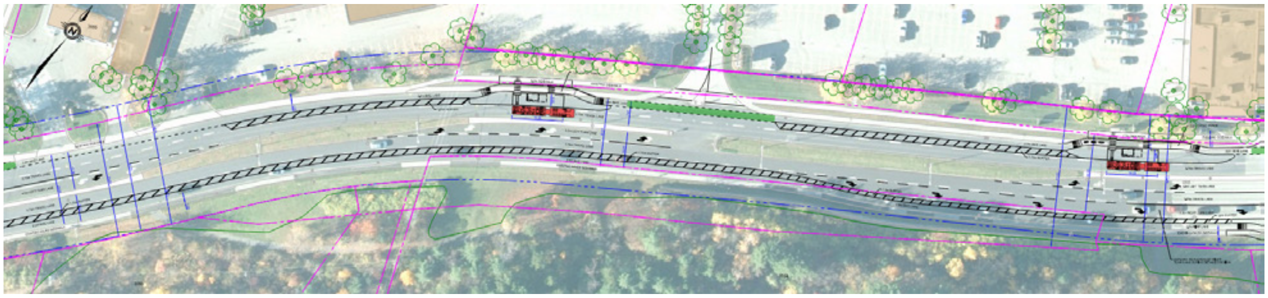
Segment Summary

Segment	St. Joseph Boulevard – Place d'Orléans Drive / Duford Drive to Prestone Drive
Road Classification	Arterial
Transect	Suburban (East)
Policy Designations	Hub, Mainstreet Corridor
TMP Designations	Cross-Town Bikeway
Policy Areas	Within 600m of a rapid transit station (Place d'Orléans LRT Station)

Existing

This segment of St. Joseph Boulevard currently has a divided cross-section with two vehicle travel lanes per direction and auxiliary turn lanes. There are sidewalks on both sides, and a portion of the north side sidewalk is separated from motor vehicles with an asphalt and grass boulevard; a boulevard is not provided along the rest of the segment on both sides. There are no cycling facilities and buses currently operate in mixed traffic. St. Joseph Boulevard is a truck route.

Proposed



A conceptual design was developed for short-term, low-cost improvements to St. Joseph Boulevard. A lane of traffic is removed in each direction to provide buffered bike lanes without impacting existing curbs where possible. Existing sidewalks remain in place and boulevards are unimpacted. Existing auxiliary turn lanes are maintained. Some reconstruction is proposed at bus stops, where the bike lanes transition to a cycle track which bends out behind new bus platforms with shelters.

MMLOS Results

The inputs for targets and for each mode along with a screen capture of the filled-out spreadsheet are provided below. The results are then summarized, and the decision-making process described with recommended modifications to the design if applicable.

Targets

- Four overlapping land-use designations and policy areas: Hub, Suburban Transect, Mainstreet Corridor and Within 600m of a rapid transit station.
- The highest target of those identified for each of these designations / areas governs for each mode. The selection of these targets is summarized as follows:

PLOS

- Hub: **A**
- Suburban Transect: **C**
- Mainstreet Corridor: **B**
- Within 600m of a rapid transit station: **A**

BLOS (Cross-Town Bikeway)

- Hub: **A**
- Suburban Transect: **B**
- Mainstreet Corridor: **B**
- Within 600m of a rapid transit station: **A**

TLOS (Mixed Traffic, none classified as "frequent routes")

- Hub: **E**
- Suburban Transect: **E**
- Mainstreet Corridor: **E**
- Within 600m of a rapid transit station: **E**

PLOS Analysis

- Sidewalks on both sides of this arterial street.
- Posted speed limit of 50 km/h.
- Traffic volumes exceed 6,500 veh/day (both directions).
- Varying sidewalk widths, generally 1.8 to 2.0m on north side and 1.6m wide for south side.
  - Sidewalks narrow to 1.5m at critical points on the north and south sides.
- No on-street parking.
- Approximately 400m between signalized intersections (i.e. the length of the segment, as there are PXOs or other controlled crossings within the segment).

Create Summary	Segment Name	St. Joseph - Duford to Prestone			
Check Analysis	Add New Segment	Copy Segment		Remove Segment	
	OP Transect / Policy Area	Within 600m of a rapid transit station			
	Segment Component	Majority (>50%)		Critical	
	Side of Street	W or N	E or S	W or N	E or S
Pedestrian	PLOS Inputs	Reset Side	Reset Side	Reset Side	Reset Side
	Posted Speed (km/h)	50 km/h		50 km/h	
	Two-Way ADT	10,000		10,000	
	Pedestrian Facility	Sidewalk	Sidewalk	Sidewalk	Sidewalk
	Does the facility meet the TMP Sidewalk or MUP Policy? If not, for MUPs, does the location have a low volume of peak daily users AND are pedestrian volumes likely less than 20% of total users?	Yes	Yes	Yes	Yes
	Facility Width (m)	1.80m	1.60m	1.50m	1.50m
	Offset from Motor Vehicle Travel Lanes (m)	≥ 3.0m	-	-	-
	Presence of Adjacent Parking?	No	-	-	-
	General Purpose Curb Lane ADT	-	-	-	-
	Max. Distance between Controlled Crossings (m)	291-400m	291-400m	291-400m	291-400m
	Score	4.00	1.00	1.00	1.00
	PLOS	B	E	E	E
	Target PLOS	A			

BLOS Analysis

- 2.0m wide buffered bike lanes on both sides, with ~30m sections of cycle tracks at bus stops.
- 1.75m painted buffer (no vertical measures) along the majority of both sides.
  - At a critical point on the north side, there is no buffer and on the south side the buffer narrows to 1.2m.
- Traffic volumes exceed 6,500 veh/day (both directions).
- Posted speed limit of 50 km/h.
- No unsignalized crossing along the route on either side which would require the cyclist to yield at a crossing.
- Cycling path blockages may occur (painted bike lane) but not regularly, as there are no designated loading zones along the segment and cycle tracks bend out behind bus stops.

	BLOS Inputs	Reset Side	Reset Side	Reset Side	Reset Side
Bicycle	Cycling Route Classification	Cross-Town Bikeway			
	Cycling Facility	Painted or Physically Separated Bike Lanes	Painted or Physically Separated Bike Lanes	Painted or Physically Separated Bike Lanes	Painted or Physically Separated Bike Lanes
	Is the minimum level of separation provided according to OTM Book 18 Pre-Selection Nomograph - Rural Context (Figure 5.6)? (for paved shoulders)	-	-	-	-
	Facility Operation	Unidirectional	Unidirectional	Unidirectional	Unidirectional
	Pedestrian/Cyclist Volume	-	-	-	-
	Facility Width	2.0-2.5m	2.0-2.5m	2.0-2.5m	2.0-2.5m
	Boulevard/Buffer Width (excluding curb)	≥ 1.0m and no vertical measure	≥ 1.0m and no vertical measure	< 1.0m and no vertical measure or < 0.6m with adjacent parking	≥ 1.0m and no vertical measure
	Unsignalized Roadway Crossing Type (where cyclists are required to yield)	None	None	None	None
	Number of Travel Lanes at Crossing	-	-	-	-
	Crossing includes Median Refuge (≥ 2.7m)	-	-	-	-
	Cross-street Posted Speed (km/h)	-	-	-	-
	Cycling Path Blockages (e.g. bus stops and/or loading zones)	Rare	Rare	Rare	Rare
	Score	3.30	3.30	2.88	3.30
	BLOS	C	C	C	C
	Target BLOS	A			

TLOS Analysis

- Buses operating in mixed traffic, none being classified as “frequent route”.
- Posted speed limit of 50 km/h.
- Operating speeds are currently 33 km/h EB and 31 km/h WB during the critical (PM) peak. With the removal of a traffic lane in each direction, it is anticipated that speeds will decrease due to congestion. It is assumed that speeds will decrease enough to reduce TLOS by one letter grade (from D to E), or approximately to 25-29 km/h.

Transit	TLOS Inputs	Reset Side	Reset Side
	Transit Facility	Mixed Traffic	
	Facility Type	Mixed Traffic	Mixed Traffic
	Expected Transit Running Time	Moderately Impeded	Moderately Impeded
	Transit Travel Speed (if available)	30 km/h	25 km/h
	TLOS	D	E
	Target TLOS	-	

Public Realm LOS Analysis

- No inner boulevard (curb only, measured from start of curb).
- No middle boulevard along the majority of the segment on the north side, or any of the segment on the south side.
- The outer boulevard is considered in the score despite St. Joseph Boulevard being a Mainstreet Corridor within a Hub. There is currently no active frontage, so the outer boulevard benefits user experience. If adjacent property is redeveloped with active frontage in the future, this metric may be recalculated when assessing the development site plan.
  - The outer boulevard exceeds 3.0m along both sides of the segment.
- Pedestrian clear zone (sidewalk) width of approximately 1.8m and 1.6m along the majority of the segment on the north side and south side, respectively.
- Approximately 400m between controlled pedestrian crossings.
- Island style bus stops with shelters and seating in in the WB direction, and no bus stops in the EB direction.
- Three traffic lanes (including turn lanes) along the majority of the segment.

Public Realm	PRLOS Inputs	Reset Side	Reset Side
	Context	Other Streets	Other Streets
	Inner Boulevard Width	≤ 0.6m	≤ 0.6m
	Middle Boulevard Width	≤ 0.5m	≤ 0.5m
	Outer Boulevard (Frontage) Width	≥ 3.0m	≥ 3.0m
	Transit Route on Segment?	Yes	Yes
	Bus Stop Elements	Curbside platform with shelter (island style)	No platform, landing zone or shelter
	Number of Midblock Traffic Lanes (both travel directions)	3	
	Score	**21.90**	**18.00**
	PRLOS	**B**	**C**
		C	

Large Vehicle Design Check

The large vehicle design check for the segment is provided below. This check confirms that the design process has properly considered the accommodation of the large vehicles along the segment.

Have the design and control vehicle(s) been identified for each leg of the intersection and for each movement?	N/A
Has a turning template analysis been carried out?	N/A
Have constraints and tradeoffs been addressed and documented?	N/A
Are minimum lane widths provided?	Yes
Is there more design work needed to address constraints and tradeoffs?	No

Results Summary

The MMLOS results for the St. Joseph Boulevard segment are summarized in Table 1.

Table 1: MMLOS Results Summary – St. Joseph Boulevard between Place d'Orléans / Duford Drive and Prestone Drive

Mode	LOS Target	Overall MMLOS Score		Critical MMLOS Score	
		North Side	South Side	North Side	South Side
Pedestrian	A	B	E	E	E
Bicycle	A	C	C	C	C
Transit	E	D	E	-	-
Public Realm	-	B	C	-	-

The MMLOS targets are not met for pedestrians nor bicycles but are met for transit. The Public Realm scores perform moderately well due to the wide outer boulevard. Note that a target of PRLOS (Proposed)/PRLOS Existing > 1.0 should be achieved for projects with geometric changes that impact the public realm.

Design Decision Process

The balancing process (Level 2) must be carried out to guide the decision-making process, though it is noted that opportunities for improving LOS scores are limited as mitigating impacts to existing curbs is a key direction in this project. The deviations from targets for the initially proposed design are presented in Table 2.

Table 2: Deviations from Targets for the St. Joseph Boulevard Segment – Initial Design

Segment of St. Joseph Boulevard between Place d'Orleans / Duford Drive and Prestone Drive			
	PLOS	BLOS	TLOS
Target	A	A	E
Current MMLOS	E	C	E
Deviation	-4	-2	0

Based on the deviation from targets, the order of priority for improvements is pedestrian and bicycle. Note that the transit target is already achieved. While PLOS has the largest deviation from its target and is the highest priority, there is no opportunity to widen the sidewalk or boulevard without reconstruction. However, the BLOS score may be improved by adding a pinned curb or other physical separation within the painted buffer. The resulting deviations for this design option are identified in Table 3.

Table 3: Deviations from Targets for the St. Joseph Boulevard Segment – Bike Lanes with Pinned Curbs

Segment of St. Joseph Boulevard between Place d'Orleans / Duford Drive and Prestone Drive			
	PLOS	BLOS	TLOS
Target	A	A	E
Initial MMLOS	E	C	E
Initial Deviation	-4	-2	0
Option 1 MMLOS	E	A	E
Option 1 Deviation	-4	0	0

However, as PLOS continues to be significantly lower than its target (more than 3 scores below target) the potential of diverting traffic to alternative routes or modes should be investigated.

Intersection MMLOS Example - Richmond Road / Grenon Avenue

Intersection Summary

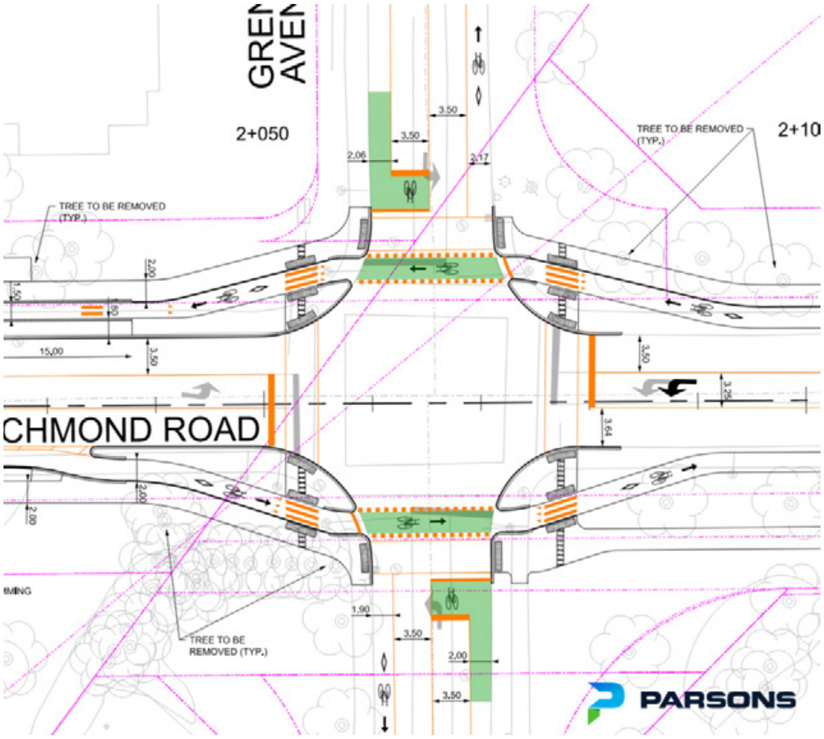
Information	Richmond	Grenon
Road Classification	Arterial	Local
Transect	Outer Urban	
Policy Designations	Mainstreet Corridor	-
TMP Designations	Cross-Town Bikeway (2023 Draft)	-
	Transit Priority Corridor (Isolated Measures) (2013)	-
Policy Areas	-	

Existing

This compact intersection in a residential area accommodates a single through and a single left-turn traffic lane in each direction and crosswalks on all approaches. There are no cycling facilities provided through the intersection. “Frequent” transit route buses operate in mixed traffic on Richmond Road only.

Proposed

A functional design for the resurfacing and sidewalk renewal on Richmond Road between Bayshore Drive and Pinecrest Road. At the intersection with Grenon Avenue, cycle tracks and crossrides are proposed on the Richmond Road approaches and bike lanes with bike boxes (no crossrides) are proposed on the Grenon Avenue approaches. Crosswalks with standard transverse markings will be provided on all approaches. The existing lane configuration will remain on the Richmond Road approaches, but the design proposes that the left-turn lanes on Grenon Avenue are removed. Buses will continue to operate in mixed traffic on Richmond Road.



MMLOS Results

The inputs for each mode along with a screen capture of the filled-out spreadsheet are provided below. The results are then summarized, and the decision-making process described with recommended modifications to the design if applicable.

Targets

The segment targets are identified based on two overlapping land-use designations. The highest target of those identified for each of these designations governs each mode. The selection of these targets is summarized as follows:

PLOS
- Outer Urban Transect: **C**
- Mainstreet Corridor: **B**

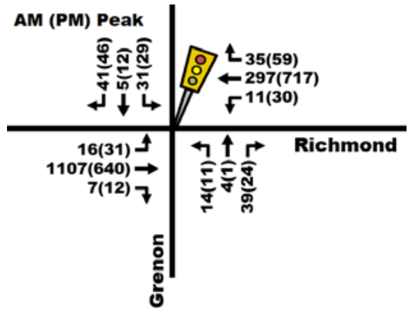
BLOS (Cross-Town Bikeway)
- Outer Urban Transect: **B**
- Mainstreet Corridor: **B**

TLOS (TP – Isolated Measures)
- Outer Urban Transect: **C**
- Mainstreet Corridor: **C**

Auto LOS
- Outer Urban Transect: **E**
- Mainstreet Corridor: **E**

PLOS Analysis

- Three traffic lanes or fewer on all intersection legs.
- No pedestrian refuge space on any of the crossings.
- Projected traffic volumes and signal phasing as shown to the right and below.
- Corner radii > 8.0m at all corners.
- No right-turn channels.
- Posted speed limit of 60 km/h on Richmond Road and 50 km/h on Grenon Avenue.
- Crosswalks with standard transverse pavement markings on all approaches.
- Both the AM and PM peak produce the same score.



Create Summary / Check Analysis / Add New Intersection	Intersection Name	Richmond / Grenon - AM & PM (Same)			
		Copy Intersection		Remove Intersection	
	OP Transect / Policy Area	Mainstreet Corridor (outside a Hub)			
Pedestrian	PLOS Inputs	Reset Leg	Reset Leg	Reset Leg	Reset Leg
	Pedestrians Crossing the	North Leg	South Leg	East Leg	West Leg
	Number of Travel Lanes Crossed	1-3	1-3	1-3	1-3
	Median Refuge (≥2.7m)	No	No	No	No
	Crosswalk Treatment	Std Transverse Markings	Std Transverse Markings	Std Transverse Markings	Std Transverse Markings
	Signal Cycle Length (sec)	65.0			
	Effective Walk Time (sec)	24.1	24.1	7.0	7.0
	Conflict with Right-Turn Vehicles (For PLOS & BLOS)	WBR	EBR	NBR	SBR
	Right-Turn Geometry	Right-Turn With No Channel	Right-Turn With No Channel	Right-Turn With No Channel	Right-Turn With No Channel
	Right-Turn Signal Phasing	Permissive (with LPI/LBI)	Permissive (with LPI/LBI)	Permissive	Permissive
	Right-Turn Volume	≤ 150 veh/h	≤ 150 veh/h	≤ 150 veh/h	≤ 150 veh/h
	Right-Turn Effective Corner Radius	> 8m	> 8m	> 8m	> 8m
	Cross-street Posted Speed (km/h)	60 km/h		50 km/h	
	Conflict with Left-Turn Vehicles (For PLOS & BLOS)	EBL	WBL	SBL	NBL
	Left-Turn Signal Phasing	Perm or Prot+Perm (with LPI)	Perm or Prot+Perm (with LPI)	Perm or Prot+Perm	Perm or Prot+Perm
	Left-Turn Volume	≤ 50 veh/h	≤ 50 veh/h	≤ 50 veh/h	≤ 50 veh/h
	Left-Turn Opposing Lanes	-	-	-	-
	Score	4.60	4.60	4.45	4.45
	PLOS	A	A	B	B
		A			
	Target PLOS	B			

BLOS Analysis

- Cycle tracks provided on Richmond Road and bike lanes on Grenon Avenue.
  - Crossrides (unidirectional) are only provided crossing the north and south legs.
  - Bike lanes provided on departure and receiving end for north-south cyclists, but no crossrides provided north-south.
- Bike boxes are provided for left-turn movements departing from the Grenon Avenue intersection legs (i.e. east and west crossings). No left-turn treatments are provided for cyclists departing from the physically separated cycling facilities on Richmond Road.
- See the PLOS analysis for right- and left-turn conflicts input.
  - In addition, the target crossride setback is met on the north and south legs.
- Both the AM and PM peak produce the same score.

Bicycle	BLOS Inputs	Reset Leg	Reset Leg	Reset Leg	Reset Leg
	Cycling Route Classification	Cross-Town Bikeway			
	Cyclists Crossing the	North Leg	South Leg	East Leg	West Leg
	Type of Cycling Facility Across Leg	Crossride	Crossride	Bike Lane Through Intersection	Bike Lane Through Intersection
	Two-Way ADT (in Cyclist Travel Direction)	14,000		1,500	
	Floating Bike Lane or Right-Turn Lane Crossover Approaching the Crossing?	No	No	No	No
	Crossride Operation	Unidirectional	Unidirectional	-	-
	Target Crossride Setback Met?	Yes	Yes	-	-
	Right-Turn Vehicle Volume from Adjacent Roadway > 100 veh/h?	-	-	-	-
	Cyclist Left-Turn Operation	WBL	EBL	NBL	SBL
	Cyclist Left-Turn Treatment Type	General Purpose Through-Left or Single Left-Turn Lane	General Purpose Through-Left or Single Left-Turn Lane	One-Stage Bike Box	One-Stage Bike Box
	Vehicle Lanes Crossed by Cyclists	One Lane Crossed	One Lane Crossed	-	-
	Score	105	105	95	95
	BLOS	B	B	B	B
		B			
	Target BLOS	B			

TLOS Analysis

- "Frequent" transit buses operate in mixed traffic on Richmond Road (EBT and WBT) only.
  - EBT delay is approximately 26 sec/veh during the AM peak and 10 sec/veh during the PM peak.
  - WBT delay is approximately 6 sec/veh during the AM peak and 14 sec/veh during the PM peak.
- AM peak governs the score.
- The west approach represents the critical score (i.e. highest transit delay).

Transit	TLOS Inputs	Reset Direction	Reset Direction	Reset Direction	Reset Direction	Reset Direction	Reset Direction	Reset Direction	Reset Direction
	Transit Facility	TP - Isolated Measures				TP - Isolated Measures			
	Vehicles Travelling	Southbound	Northbound	Westbound	Eastbound	Southbound	Northbound	Westbound	Eastbound
	Average Transit Delay (if available)			≤ 10 sec	21-35 sec			11-20 sec	≤ 10 sec
	Example Transit Priority Treatment			-	-			-	-
	TLOS	-	-	A	C	-	-	B	A
		B				A			
	Target TLOS	C				C			

Auto LOS Analysis

- Overall intersection v/c ratios are 0.85 during the AM peak and 0.65 during the PM peak.

Create Summary	Intersection Name	Richmond / Grenon - AM	Richmond / Grenon - PM
Check Analysis	Add New Intersection	Copy Intersection / Remove Intersection	Copy Intersection / Remove Intersection
	OP Transect / Policy Area	Mainstreet Corridor (outside a Hub)	Mainstreet Corridor (outside a Hub)
Auto	AutoLOS Inputs	Reset AutoLOS	Reset AutoLOS
	Overall Intersection Volume to Capacity Ratio	0.81 to 0.90	0.61 to 0.70
	Individual Movements V/C Ratios and Queue Lengths	See Separate Traffic Operations Table	See Separate Traffic Operations Table
	AutoLOS	D	B
	Target AutoLOS	E	E

The Traffic Operaions summary table for the assessment of individual movement v/c ratios and queue lengths is provided below.

Intersections	Movements	Delay (s)	v/c Ratio	v/c LOS	Storage Lane (m)	95th Queue (m)
Grenon & Richmond (AM)	EBL	5.4	0.02	A	45	3
	EBTR	26.0	0.92	E	-	#249
	WBL	8.5	0.10	A	50	4
	WBTR	5.8	0.28	A	-	36
	NBLTR	14.1	0.24	A	-	10
	SBLTR	17.5	0.33	A	-	14
	Overall	20.7	0.85	D	-	-
Intersections	Movements	Delay (s)	v/c Ratio	v/c LOS	Storage Lane (m)	95th Queue (m)
Grenon & Richmond (PM)	EBL	7.1	0.12	A	45	6
	EBTR	10.0	0.59	A	-	93
	WBL	6.3	0.09	A	50	6
	WBTR	13.6	0.71	C	-	#148
	NBLTR	14.1	0.16	A	-	8
	SBLTR	13.9	0.56	A	-	20
	Overall	12.0	0.65	B	-	-

Large Vehicle Design Check

The large vehicle design check for the intersection is provided below. This check confirms that the design process has properly considered the accommodation of the large vehicles in the intersection.

Have the design and control vehicle(s) been identified for each leg of the intersection and for each movement?	Yes
Has a turning template analysis been carried out?	Yes
Have constraints and tradeoffs been addressed and documented?	Yes
Are minimum lane widths provided	Yes
Is there more design work needed to address constraints and tradeoffs?	No

Results Summary and Design Decision Process

The MMLOS results for the Richmond Road / Grenon Avenue intersection are summarized in Table 4.

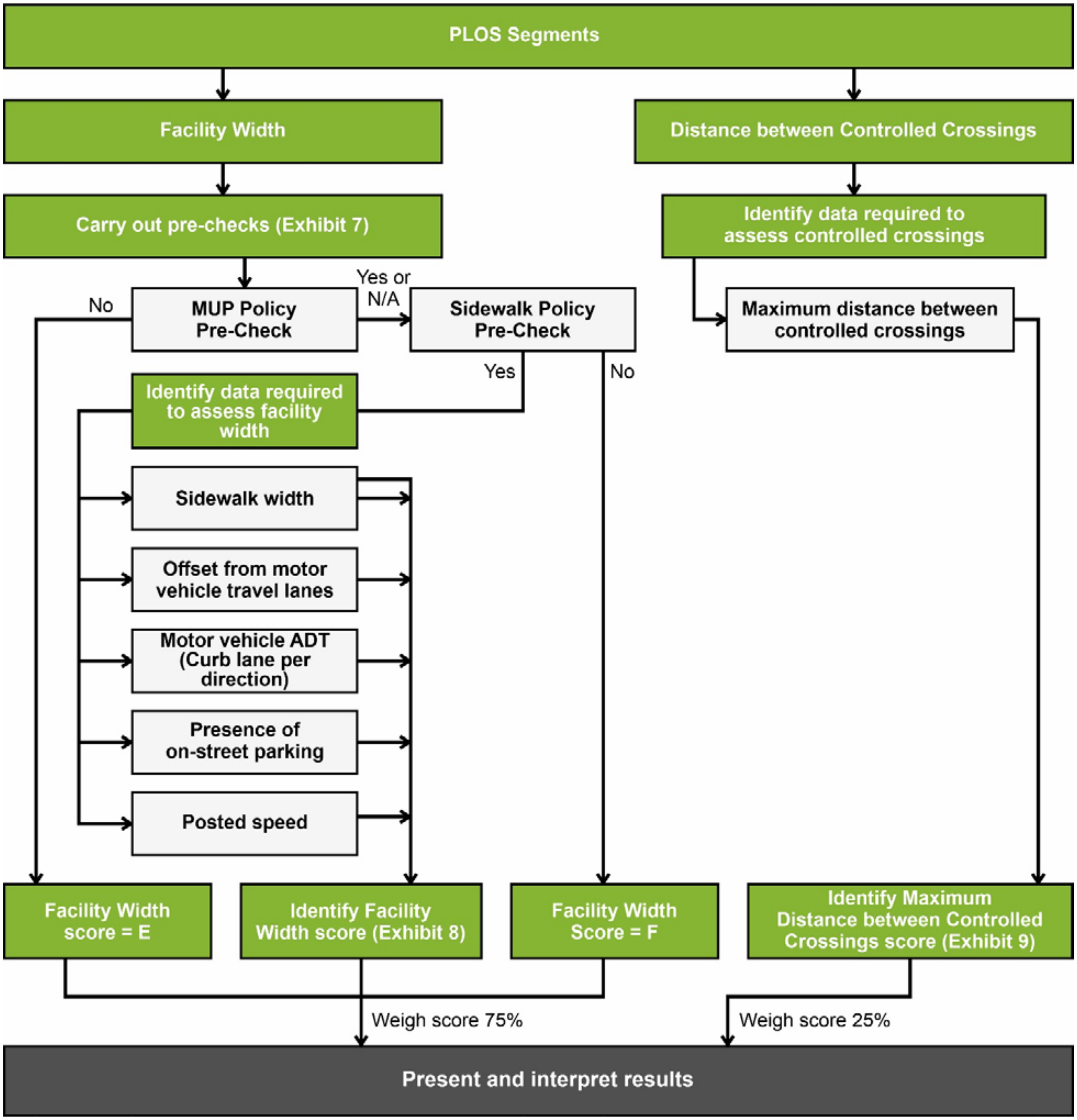
Table 4: MMLOS Results Summary – Richmond Road / Grenon Avenue

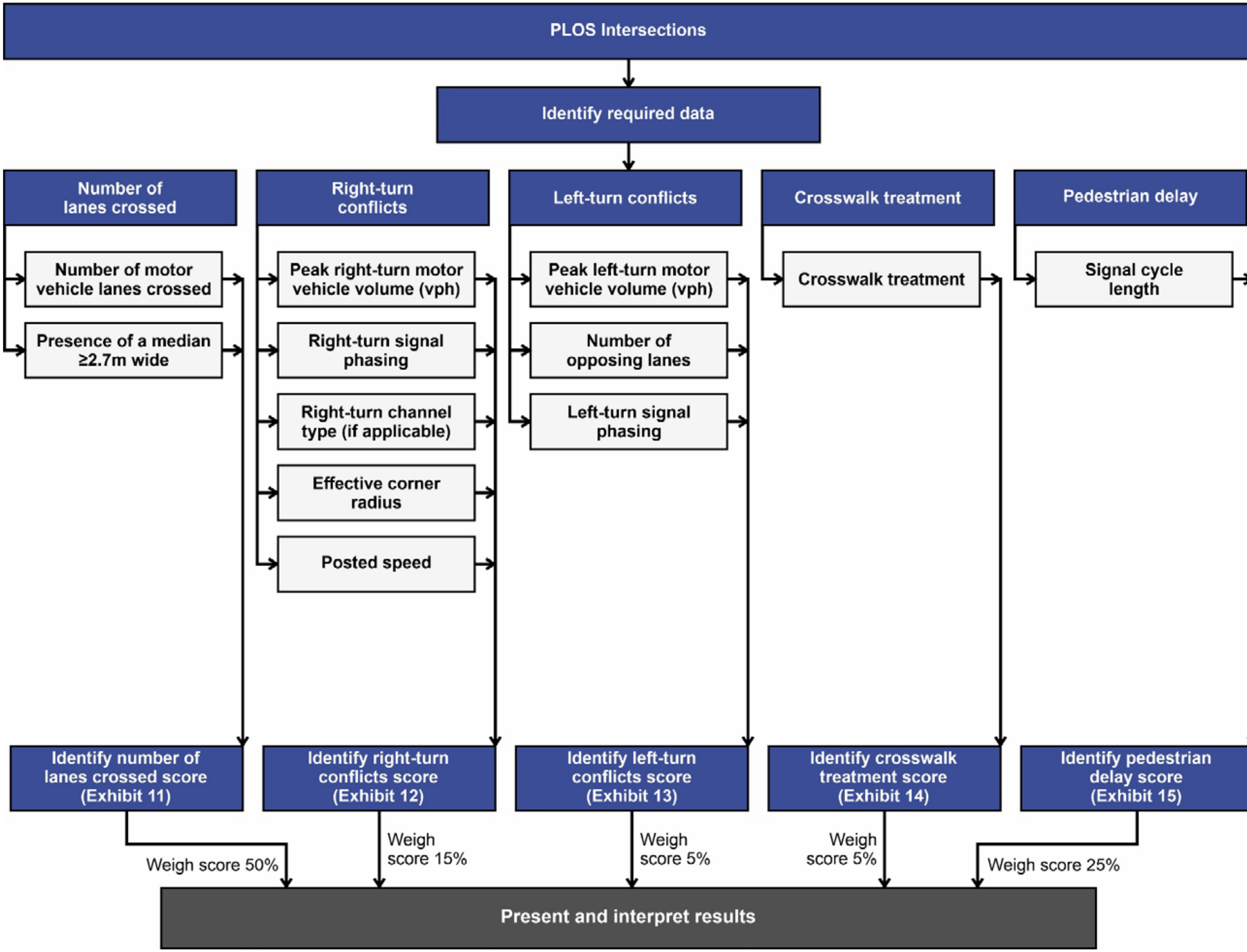
Mode	LOS Target	Overall MMLOS Score – AM Peak	Overall MMLOS Score – PM Peak	Critical Approach (AM & PM)
Pedestrian	B	A	A	B
Bicycle	B	B	B	B
Transit	C	B	A	C
Auto	E	D	B	D

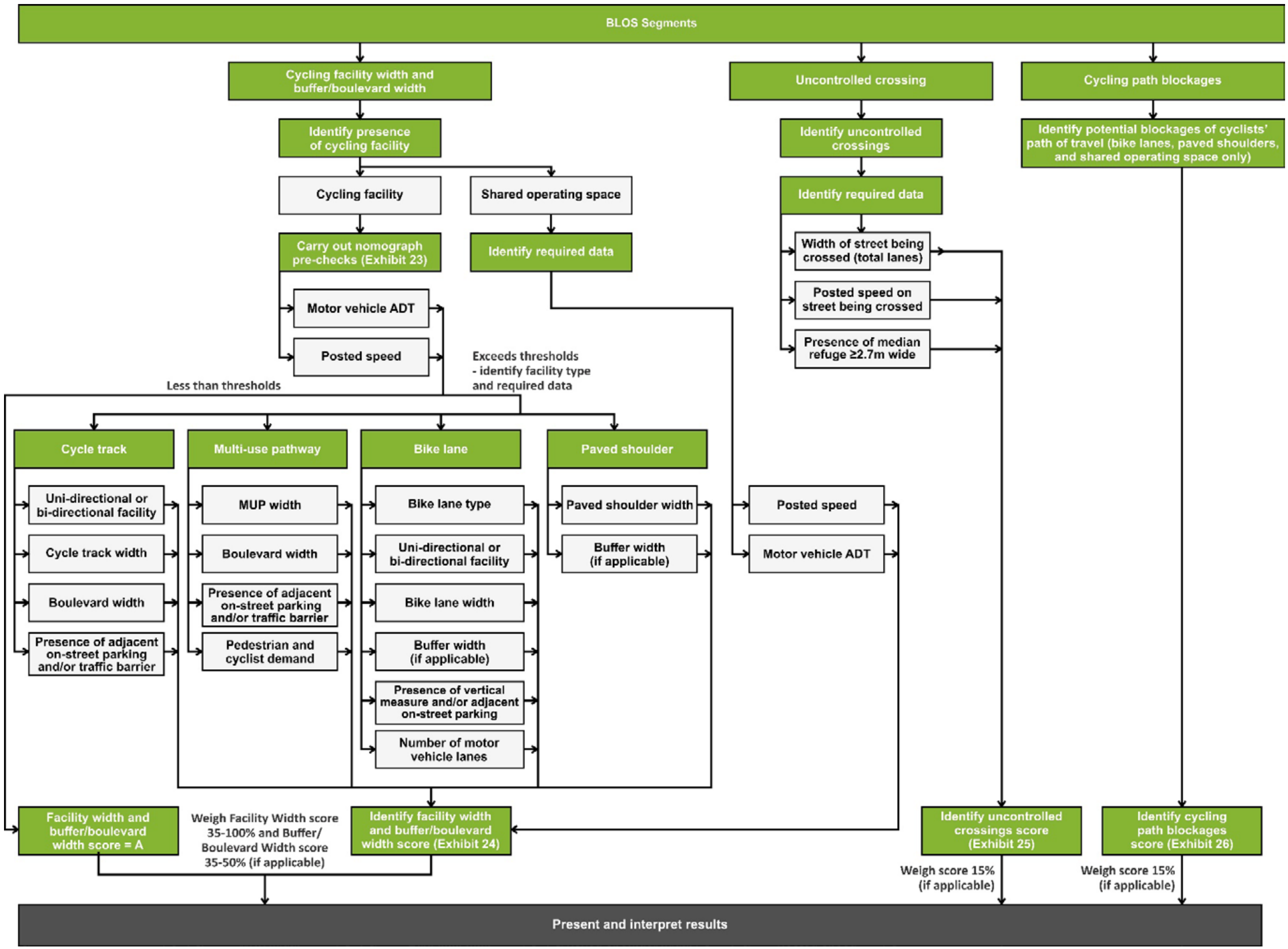
The MMLOS targets are met for all modes, including critical approaches. As such, the design decision process need not continue to Stage 2, and the design may be recommended as is.

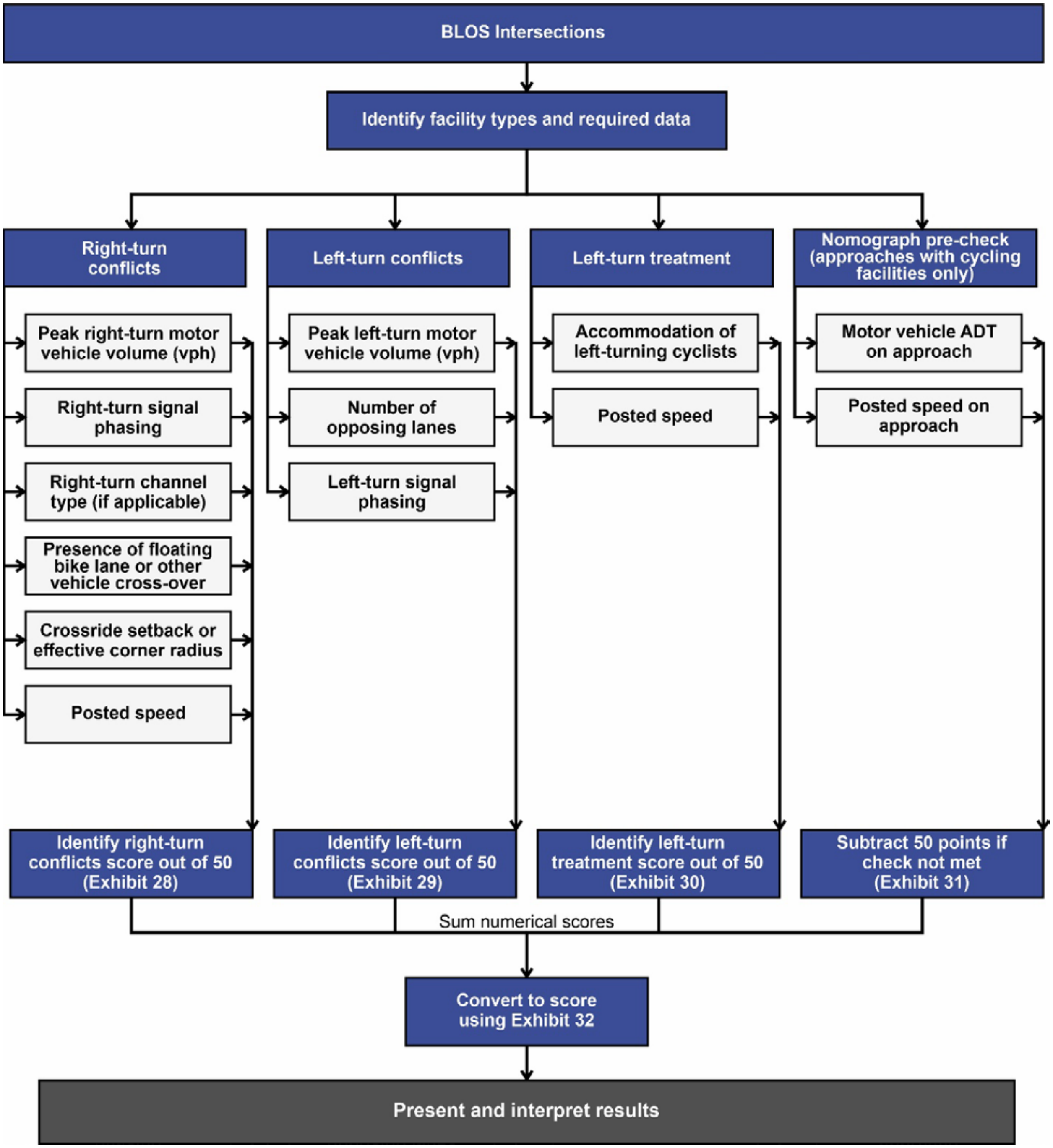
Appendix B:

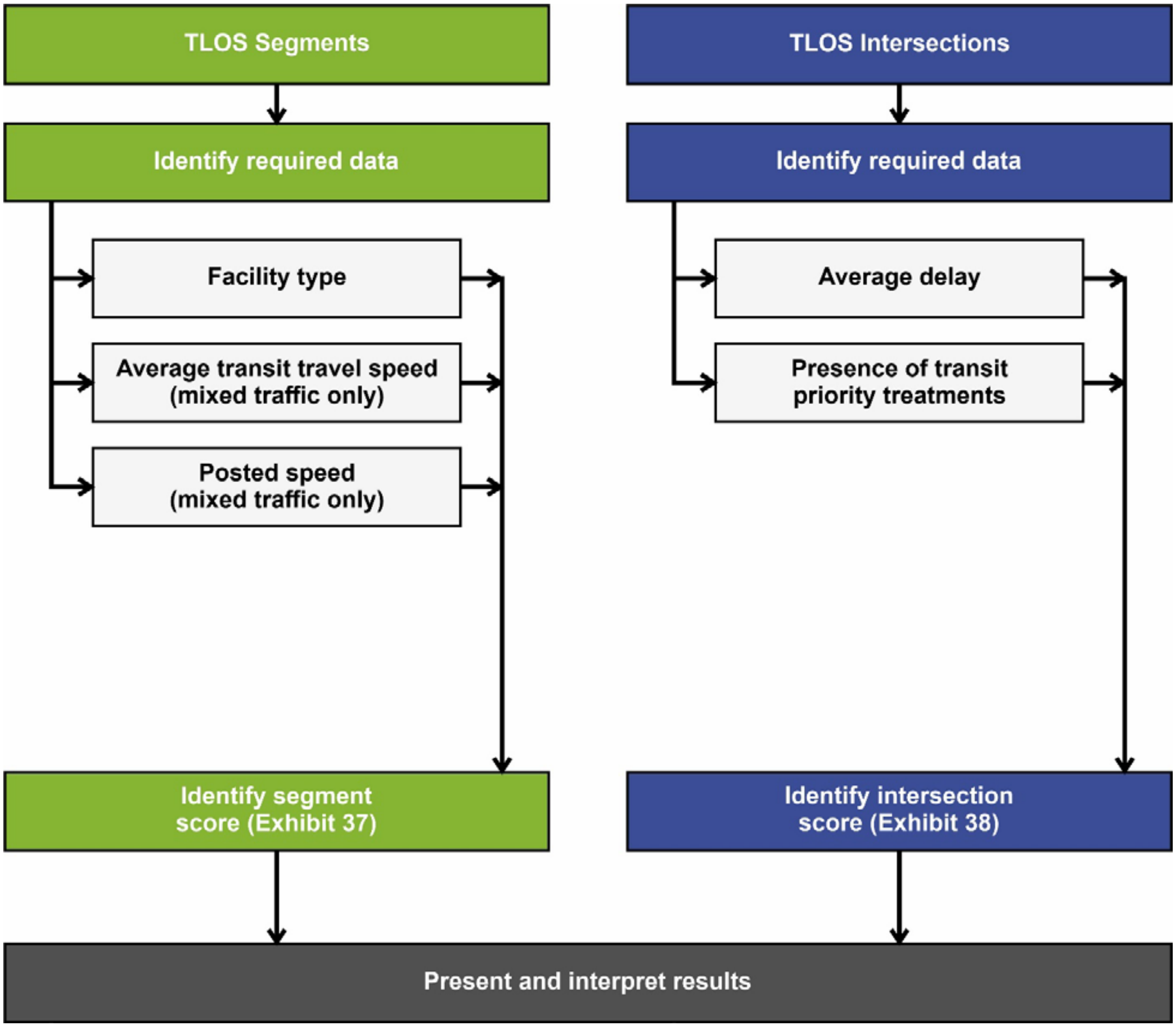
MMLOS Methodology Flowcharts


PLOS Segments
Facility Width
Distance between Controlled Crossings
Carry out pre-checks (Exhibit 7)
Identify data required to assess controlled crossings
No
MUP Policy Pre-Check
Yes or N/A
Sidewalk Policy Pre-Check
Maximum distance between controlled crossings
Yes
No
Identify data required to assess facility width
Sidewalk width
Offset from motor vehicle travel lanes
Motor vehicle ADT (Curb lane per direction)
Presence of on-street parking
Posted speed
Facility Width score = E
Identify Facility Width score (Exhibit 8)
Facility Width Score = F
Identify Maximum Distance between Controlled Crossings score (Exhibit 9)
Weigh score 75%
Weigh score 25%
Present and interpret results


PLOS Intersections
Identify required data
Number of lanes crossed
Right-turn conflicts
Left-turn conflicts
Crosswalk treatment
Pedestrian delay
Number of motor vehicle lanes crossed
Presence of a median ≥2.7m wide
Peak right-turn motor vehicle volume (vph)
Right-turn signal phasing
Right-turn channel type (if applicable)
Effective corner radius
Posted speed
Peak left-turn motor vehicle volume (vph)
Number of opposing lanes
Left-turn signal phasing
Crosswalk treatment
Signal cycle length
Identify number of lanes crossed score (Exhibit 11)
Identify right-turn conflicts score (Exhibit 12)
Identify left-turn conflicts score (Exhibit 13)
Identify crosswalk treatment score (Exhibit 14)
Identify pedestrian delay score (Exhibit 15)
Weigh score 50%
Weigh score 15%
Weigh score 5%
Weigh score 5%
Weigh score 25%
Present and interpret results


BLOS Segments
Cycling facility width and buffer/boulevard width
Uncontrolled crossing
Cycling path blockages
Identify presence of cycling facility
Identify uncontrolled crossings
Identify potential blockages of cyclists' path of travel (bike lanes, paved shoulders, and shared operating space only)
Cycling facility
Shared operating space
Identify required data
Carry out nomograph pre-checks (Exhibit 23)
Identify required data
Width of street being crossed (total lanes)
Posted speed on street being crossed
Presence of median refuge ≥2.7m wide
Motor vehicle ADT
Posted speed
Less than thresholds
Exceeds thresholds - identify facility type and required data
Cycle track
Multi-use pathway
Bike lane
Paved shoulder
Uni-directional or bi-directional facility
Cycle track width
Boulevard width
Presence of adjacent on-street parking and/or traffic barrier
MUP width
Boulevard width
Presence of adjacent on-street parking and/or traffic barrier
Pedestrian and cyclist demand
Bike lane type
Uni-directional or bi-directional facility
Bike lane width
Buffer width (if applicable)
Presence of vertical measure and/or adjacent on-street parking
Number of motor vehicle lanes
Paved shoulder width
Buffer width (if applicable)
Posted speed
Motor vehicle ADT
Facility width and buffer/boulevard width score = A
Weigh Facility Width score 35-100% and Buffer/ Boulevard Width score 35-50% (if applicable)
Identify facility width and buffer/boulevard width score (Exhibit 24)
Identify uncontrolled crossings score (Exhibit 25)
Identify cycling path blockages score (Exhibit 26)
Weigh score 15% (if applicable)
Weigh score 15% (if applicable)
Present and interpret results


BLOS Intersections
Identify facility types and required data
Right-turn conflicts
Left-turn conflicts
Left-turn treatment
Nomograph pre-check (approaches with cycling facilities only)
Peak right-turn motor vehicle volume (vph)
Right-turn signal phasing
Right-turn channel type (if applicable)
Presence of floating bike lane or other vehicle cross-over
Crossride setback or effective corner radius
Posted speed
Peak left-turn motor vehicle volume (vph)
Number of opposing lanes
Left-turn signal phasing
Accommodation of left-turning cyclists
Posted speed
Motor vehicle ADT on approach
Posted speed on approach
Identify right-turn conflicts score out of 50 (Exhibit 28)
Identify left-turn conflicts score out of 50 (Exhibit 29)
Identify left-turn treatment score out of 50 (Exhibit 30)
Subtract 50 points if check not met (Exhibit 31)
Sum numerical scores
Convert to score using Exhibit 32
Present and interpret results


TLOS Segments
Identify required data
Facility type
Average transit travel speed (mixed traffic only)
Posted speed (mixed traffic only)
Identify segment score (Exhibit 37)
TLOS Intersections
Identify required data
Average delay
Presence of transit priority treatments
Identify intersection score (Exhibit 38)
Present and interpret results

Appendix C:

Public Realm Design Checklists

Functional Design Checklist

Check	Information/References	Existing Layout (if applicable)	Proposed Layout	Explanation
Is the segment made accessible to all to the greatest extent possible?	See the City of Ottawa Accessibility Design Standards.			
Is a straight path of pedestrian travel provided wherever possible?	See the City of Ottawa Accessibility Design Standards and Protected Intersection Design Guide.			
Is there space provided for people with disabilities to park or be dropped off/picked up (i.e. parking/loading or pullover space) near building entrances, particularly those serving a higher proportion of people with disabilities (e.g. medical facilities, long-term care facilities)?	See the City of Ottawa Accessibility Design Standards.			
Are accessible loading areas, landing areas, and cycle track crossing zones provided at bus stops, where applicable?	See the OC Transpo Bus Stops and 'Off-Road' Cycling Facilities Interaction Zone Guidelines.			
Have traffic calming/speed reduction measures been integrated into the segment (if lower speeds are desired)?	See the City of Ottawa Traffic Calming Design Guidelines, Local Residential Streets 30 km/h Design Toolbox (where applicable) and Designing Neighbourhood Collector Streets Guideline (where applicable).			
Have landscape opportunities been considered and implemented within traffic calming/speed reduction measures where possible (e.g. curb extensions, centre island narrowings)?	See the City of Ottawa Traffic Calming Design Guidelines and Local Residential Streets 30 km/h Design Toolbox (where applicable).			
Has a boulevard location that is unconstrained by overhead and underground utilities been identified and prioritized as part of the functional design?	Identify the percentage of linear boulevards that is unconstrained as an indicator of the feasibility of planting greenery.			
Is the street of Primary Maintenance Class 3, 4, or 5? If so, is sufficient boulevard space provided for snow storage?	See the Recommended Maintenance Quality Standards for Roads and Sidewalks/Pathways Table 101.01.01. Roadways with snow removal time exceeding two days require snow storage space in the boulevard. A 1.2m inner boulevard is the desired minimum for snow storage.			
Has the proportion of heavy vehicle traffic been considered in the design?	See City of Ottawa Urban and Rural Truck Route maps and OC Transpo Network map.			
Is the street a key emergency response street identified by Fire or Paramedic Service? See Appendix D of the City of Ottawa Traffic Calming Design Guidelines. If the street segment is within a designated Design Priority Area, has the designer confirmed whether the design is to be presented to the City's Urban Design Review Panel?	Contact the City of Ottawa Planning, Real Estate, and Economic Development department.			

Preliminary and Detailed Design Checklist

Check	Information/References	Existing Layout (if applicable)	Proposed Layout	Explanation
Are accessibility requirements met?	See the City of Ottawa Accessibility Design Standards.			
Are amenities such as benches, bicycle parking, and waste receptacles provided in the boulevard(s) (as appropriate to the context/street type)?	See the Regional Road Corridor Design Guidelines, Designing Neighbourhood Collector Streets, Downtown Moves and other City of Ottawa design guidelines and standard cross-sections.			
If amenities (e.g. patios, A-frame signs) are provided, do they allow a straight path of pedestrian travel?	See the City of Ottawa Accessibility Design Standards.			
Are benches provided at a frequency that is appropriate to the land use context?	The City of Ottawa Accessibility Design Standards recommend 30m bench spacing, however this spacing may be increased depending on the context. Increased frequency of bench placement is desired on Mainstreet Corridors, Minor Corridors and in Hubs, Villages, and Special Districts.			
Are trees and other greenery provided wherever space allows and constraints (e.g. utility conflicts) are mitigated?	Greening is almost always preferred over hardscaping. Contact the City of Ottawa Forestry Department to review space requirements for planting.			
If trees, other greenery, and/or amenities are provided, do they allow sufficient sightlines for pedestrians, cyclists, and vehicles?	See the City of Ottawa Accessibility Design Standards.			
Are trees provided in locations that provide shade to active transportation and transit users, including those using benches?	See Regional Road Corridor Design Guidelines, Designing Neighbourhood Collector Streets, Downtown Moves and other City of Ottawa design guidelines and street cross-sections.			
Is supplemental pedestrian level lighting provided along the segment, as appropriate to the context/street type?	See the City of Ottawa Right-of-Way Lighting Policy.			
Are there features on abutting private land that supplement and complement the features in the right-of-way, as appropriate to the context/street type?	See the Ottawa Official Plan, which emphasizes the importance of integrating new development into the public realm.			
Are there buildings abutting the segment with features including entrances, awnings, overhangs, and windows, which help to activate the street frontage, as appropriate to the context/street type?	See the Ottawa Official Plan, which emphasizes the importance of active frontages in Design Priority Areas (including Hubs, Special Districts and Corridors); and the Zoning By-law, which sets maximum front yard setbacks based on context.			
Is bike parking provided at locations and a frequency that meets the demand of adjacent land uses?	See City of Ottawa Public Bike Parking Strategy.			
Where the City's Public Art Policy applies, is public art being planned in conjunction with the street design?	See the City of Ottawa Public Art Policy.			
Are shelters, seating, trees, and associated street furniture provided at bus stops, where warranted by OC Transpo?	Contact OC Transpo to confirm whether bus shelters and other amenities at bus stops are required.			
If there are medians, are they landscaped wherever sufficient width is available?	See Regional Road Corridor Design Guidelines, Designing Neighbourhood Collector Streets, Downtown Moves, and other City of Ottawa design guidelines and standard cross-sections. See City of Ottawa Standard Detail Drawings for boulevard and median widths to support landscaping.			
Have low-impact development (LID) features (e.g. rain gardens) been considered and implemented where appropriate?	See the City of Ottawa's LID Guidelines (when available).			

Check	Information/References	Existing Layout (if applicable)	Proposed Layout	Explanation
Is there a BIA, community organization, or City department/s willing to take responsibility for enhanced streetscape elements? If no, this item can be checked if basic streetscaping that follows the City's standard details for streetscape elements is provided (including no flowers or other vegetation requiring regular water/replanting/maintenance, non-standard furniture or non-standard surface treatments). If yes, complete the following sub-checks:	See the City of Ottawa's standard details for street furniture.			
Have all non-standard elements been properly detailed in the drawings and contract documents?				
Has the BIA or other community organization, or City department/s agreed to take responsibility for all non-standard elements and signed an M&L agreement?				
Has the “owner/s” been documented in writing in the project close out files?				

Additional Checks During Construction

Check	Information/References	Existing Layout (if applicable)	Proposed Layout	Explanation
Have supplier information, manufacture information, model, and reference numbers for all non-standard elements been added to the as-built landscape drawings and filled with the City's drawing information centre??	See the Standard Tender Documents for Unit Price Contracts and project drawings and specifications			
Has all product documentation, including warranty and maintenance information where applicable, been filed with project documentation and provided to the “owner/s” BIA, community organization or City department/s?	See submittals, shop drawings, project drawings and specifications			
Has additional inventory for future repairs been ordered, documented and delivered to City storage yards for any non-standard elements “owned” by City department/s?				
If the project is within a designated DPA, has an Operations and Maintenance Manual been develop and provided both the ROW agreements team and to all “owners” of unique elements within the streetscape?				

Appendix D:

Acceptable Parameters for Operational Analysis of Signalized Intersections

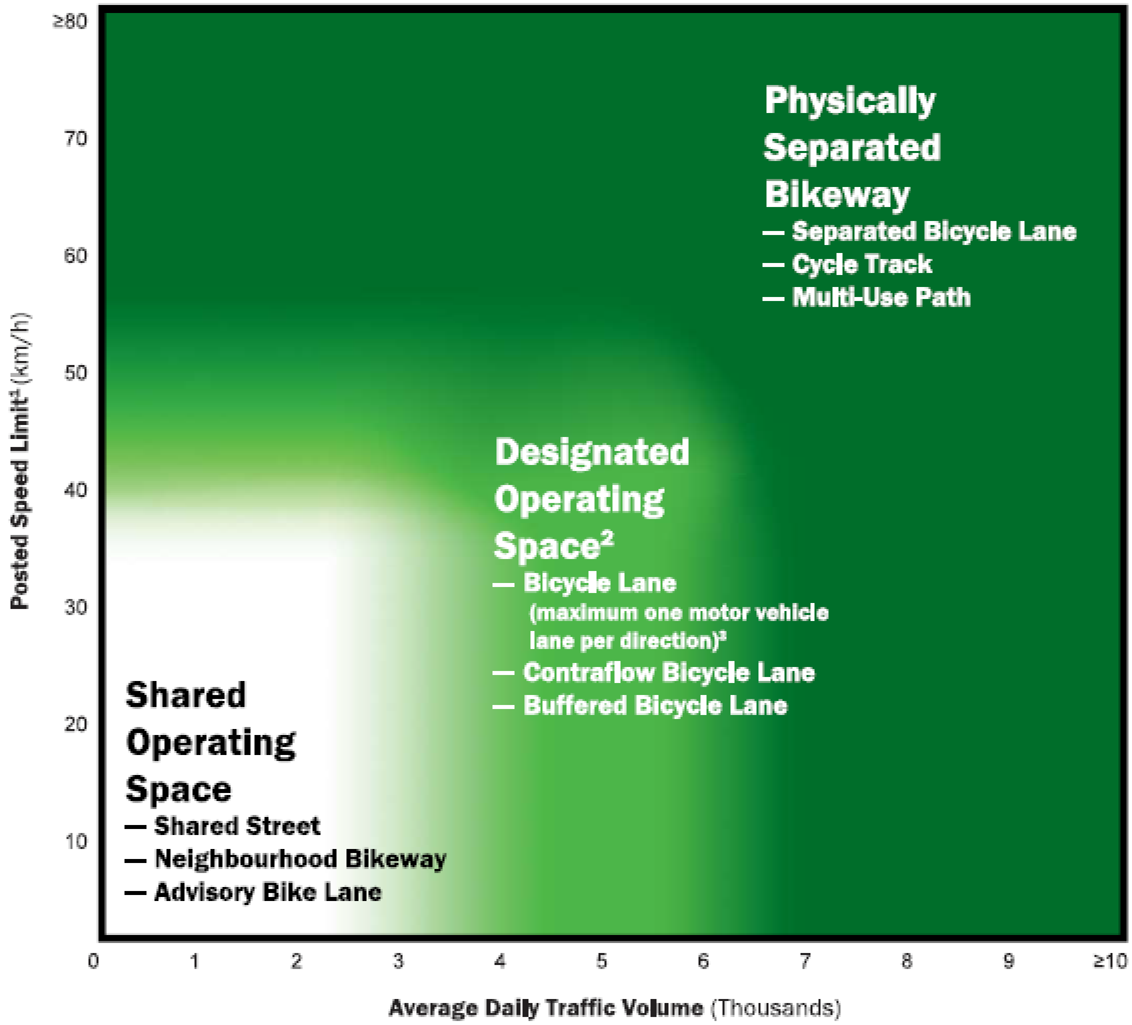
Operational and Timing Standards for Signalized Intersections

GENERAL TIMING STANDARDS	
Maximum cycle length for analysis	• 120 sec
Minimum green time	• 10 sec for side street through movements • 5 sec for left-turn phases
Vehicle clearance	• Must consist of amber and all red display. Duration in accordance with Ontario Traffic Manual Book 12.
PEDESTRIAN PHASES	
Minimum walk time	• 7 sec
Walking speed	• 1.2 m/sec; 1.1 m/sec if near old age home, school or shopping centre
Pedestrian clearance	• Must be sufficient to allow crossing from curb to curb (including central medians). Includes vehicle clearance time in accordance with Ontario Traffic Manual Book 12.
Median storage	• If centre median storage for pedestrians is provided, then the minimum walk time must be of sufficient duration to allow a crossing from the curb to the far side of the median plus one lane. The pedestrian clearance interval must be of sufficient duration to permit the longest crossing from the median to the curb. Use of the median for pedestrian refuge shall only be considered in consultation with TPO staff.
AUXILIARY TURN LANE PHASING	
Overlap left-turn	• In cases where left-turn phasing is required for opposing left-turn movements and one of the movements is much heavier than the opposing movement, consideration should be given to early termination of the arrow indication for the lighter left-turn movement in order to permit an earlier commencement of the conflicting through movement. Appropriate vehicle clearance displays must be provided for all left-turn phases. Proper account must be made for lost time resulting from these clearances.
Protected only left-turn phasing	• Protected only left-turn phasing must be used when conditions are such that an undue hazard might result if permissive phasing were used. This is normally considered to be the case with a double left turn.
Shared lane operation	• All movements permitted from a shared use lane must operate on the same signal phase.
Dual right/left-turn movements	• Conflicting pedestrian movements should not be permitted simultaneously with dual right/left-turn movements. Normally, dual right turns will also require signalization.
Right/Left-turn arrows	• A right/left-turn arrow shall not be displayed at the same time that a conflicting pedestrian movement is permitted.
INTERSECTION SPACING AND MINIMUM STORAGE LENGTHS	
Visibility	• As per the requirements of the Ontario Traffic Manual, Book 12, signalized intersections should be a minimum of 120 metres apart, centreline to centreline, to ensure adequate visibility of the signal heads.
Through vehicle storage between intersections	• Signalized intersections must be sufficiently spaced to ensure that storage is available to accommodate 1.5 times the average number of vehicles arriving on each red indication during the heaviest hour (assuming an average vehicle length of 7 metres).
Storage lane lengths	• Left-turn storage lanes must be long enough to accommodate 1.5 times the average number of arrivals per cycle in the heaviest hour. Where double left turn lanes are in use, calculations should assume a 45%/ 55% distribution of traffic between the lanes. • Right-turn storage lanes must be long enough to permit right-turning traffic to clear the maximum queue of through vehicles that is anticipated to accumulate during the red indication. All calculations must assume an average vehicle length of 7 metres.
PARAMETERS FOR INTERSECTION ANALYSIS	
Heavy vehicle equivalent	• Heavy vehicles or buses 1.7
Saturation flow rate	• The maximum assumed ideal unadjusted saturation flow rate shall not exceed 1800 passenger cars per hour of green per lane, unless a higher or lower rate can be justified by the Consultant through data.

Appendix E:

OTM Book 18 Bicycle Facility Pre-selection Nomograph

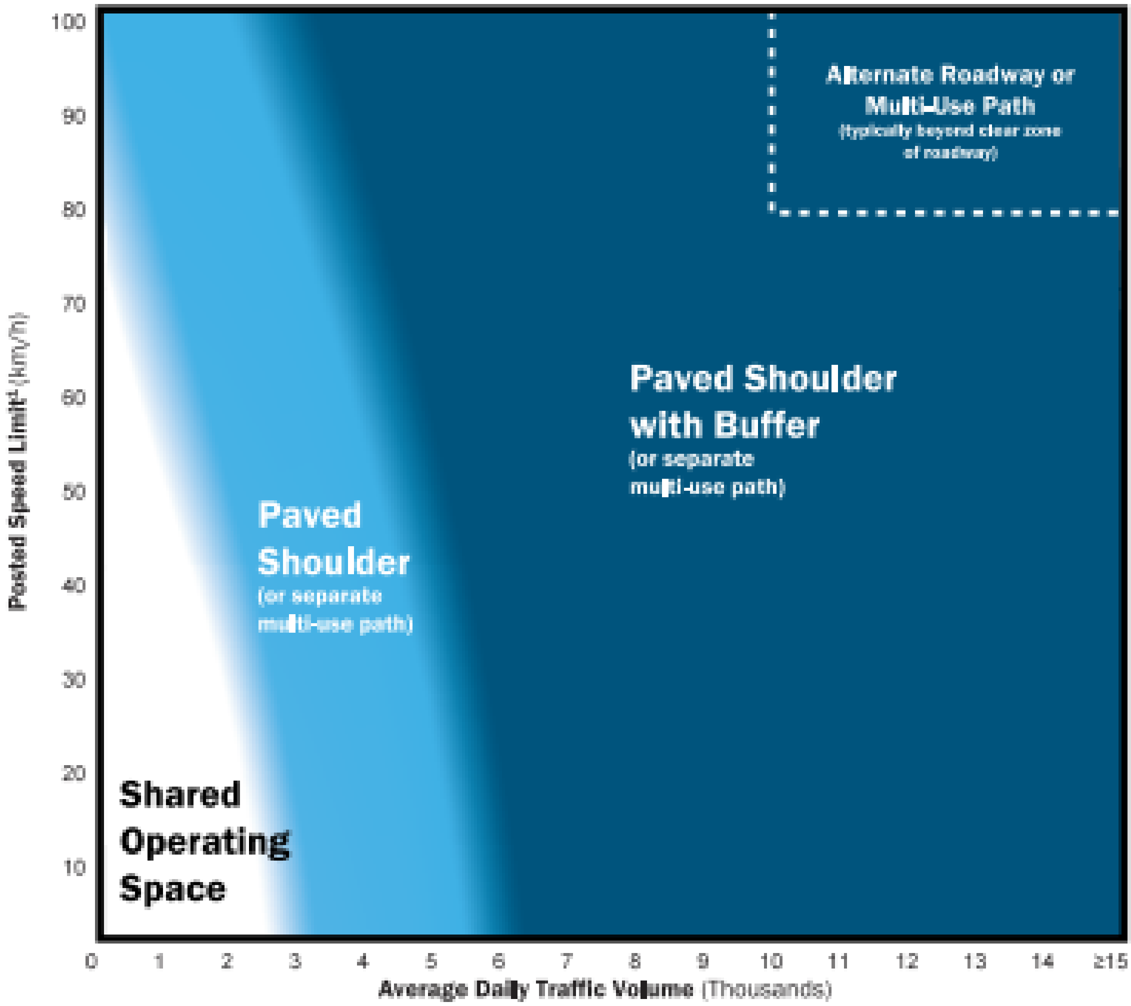
Desirable Cycling Facility Pre-Selection Nomograph Urban/Suburban Context (Step 1)



1. Operating speeds are assumed to be similar to posted speeds. If evidence suggests this is not the case, practitioners may consider using 85th percentile speeds or implementing measures to reduce operating speeds.
2. Physically separated bikeways may always be considered in the designated operating space area of the nomograph.
3. On roadways with two or more lanes per direction (including multi-lane one-way roadways), a buffered bicycle lane should be considered the minimum with a typical facility being a physically separated bikeway.

Figure 5.5 – Desirable Cycling Facility Pre-selection Nomograph — Urban/Suburban Context

Desirable Cycling Facility Pre-Selection Nomograph Rural Context[1] (Step 1)



1 In rural town/hamlet/village contexts, the urban/suburban nomograph may be used.
2 Operating speeds are assumed to be similar to posted speeds. If evidence suggests this is not the case, practitioners may consider using 85th percentile speeds or implementing measures to reduce operating speeds.
3 Paved shoulders should ideally be implemented where feasible along all designated bike routes, regardless of whether recommended by the nomograph
4 If the paved shoulder is recommended, consider incorporating a buffer as well if space allows
5 For roads with a posted speed limit of 80km/hr or higher a paved shoulder of 1.2 to 1.5 m, an additional 0.5 m to 1.0 m buffer should be considered, particularly if the roadway is a common truck route, due to the wind velocity impact of passing trucks

Figure 5.6 – Desirable Cycling Facility Pre-selection Nomograph — Rural Context