City of Markham

Vision Zero Road Safety Plan

FINAL REPORT







CIMA+ project number: B001780
January 2026

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Vision Zero Road Safety Plan

FINAL REPORT

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Executive Summary

Introduction

The City of Markham (the City) is one of the largest municipalities within York Region, with a population of approximately 338,000 in the 2021 census and a projected growth to approximately 619,000 by 2051[1]. While this growth offers opportunities for economic development and improved quality of life for residents in Markham, it also presents an increased risk for conflicts throughout the City's transportation network, as well as increased infrastructure and transportation demands.

In 2023, the City experienced nearly 1,000 reported motor vehicle collisions within the municipal road network, including more than 200 collisions that resulted in an injury, of which nearly 40 collisions involved a pedestrian and 40 collisions involved a cyclist. These collisions in 2023 resulted in approximately $19.8 million[2] in direct and indirect costs and exacted a profound emotional and societal toll on those involved.

To mitigate the risks associated with the City's collision history, a comprehensive Vision Zero Road Safety Plan will need to be developed and implemented to support the City's planned growth. CIMA Canada Inc. (CIMA+) was retained by the City to develop the Vision Zero Road Safety Plan. The success of the Plan is mainly based on a data-driven approach to road safety, which includes a thorough review and update of the collision data analysis to evaluate safety patterns and trends. This report summarizes the development process of the City's Vision Zero Road Safety Plan and presents the final countermeasures plan to achieve the identified Vision, Mission, and Goal of the Plan.

Vision Zero Road Safety Plan Development Process

The Vision Zero Road Safety Plan (RSP) will help to facilitate the implementation of many road safety countermeasures through a proactive strategy to address serious injury and fatal collisions. The aim of this plan is to establish a safe transportation system for all road users by employing a data-driven approach that follows the Safe System paradigm. This is achieved by:

- Identifying and prioritizing the key safety needs that can be addressed through engineering, enforcement, education, and engagement.
- Taking advantage of the resources available from the City, its partners, and the York Region Traveller Safety Plan and aligning them to meet the identified safety needs, accomplishing the shared goal of the RSP.

[1] Proposed 2051 Forecast and Land Needs Assessment, York Region, March 2021
[2] Based on the societal costs listed in "Collision Costs for Use in Ontario with Implementation of Safety Analyst" (J. White, MTO Traffic Office, July 2012) and forecasted to 2024 dollar – property damage only collisions: $13,559 per collision; injury collision: $44,383 per collision; fatal collisions: $1,837,343 per collision.

- Guiding safety investment decisions in a coordinated and consistent approach to maximize the effectiveness of resources within the City.

In recent years, Vision Zero, a strategy supported by policies and data to eliminate traffic fatalities and serious injuries, became popular among elected officials and within the road safety community. Vision Zero began in Sweden in 1997, with the premise that any loss of life is unacceptable and, as such, this concept aims to achieve zero fatalities and injuries throughout the transportation network. Therefore, system designers, operators, maintenance staff, and policymakers have a shared responsibility to provide a Safe System for all travellers, regardless of their chosen mode of travel, income level, race, gender, or physical abilities. A Safe System approach includes the following principles: humans make mistakes; humans are vulnerable; road injuries and deaths are preventable; improvements in road safety should be proactively implemented; multiple layers of protection should be implemented in the road system; and all parties involved have a shared responsibility towards road safety. The pillars of the Safe System approach are shown in **Figure E- 1**.



Figure E- 1: Safe System Pillars

The City has previously participated in the development of York Region's Traveller Safety Plan (TSP), including attending several workshops and providing their input on the overall vision and goal, the proposed emphasis areas, and the final list of countermeasures to be implemented as part of the TSP. This Vision Zero Road Safety Plan aims to improve safety along the City's road network through a data-driven effort in tandem with the Region's existing TSP. The RSP builds on the City's existing road safety programs by determining key areas (known as emphasis areas) for which safety can be enhanced and by developing a set of individual safety initiatives (known as countermeasures) that would be most effective in reducing fatal and injury collisions for each emphasis area. **Figure E- 2** shows the key steps in developing the RSP.

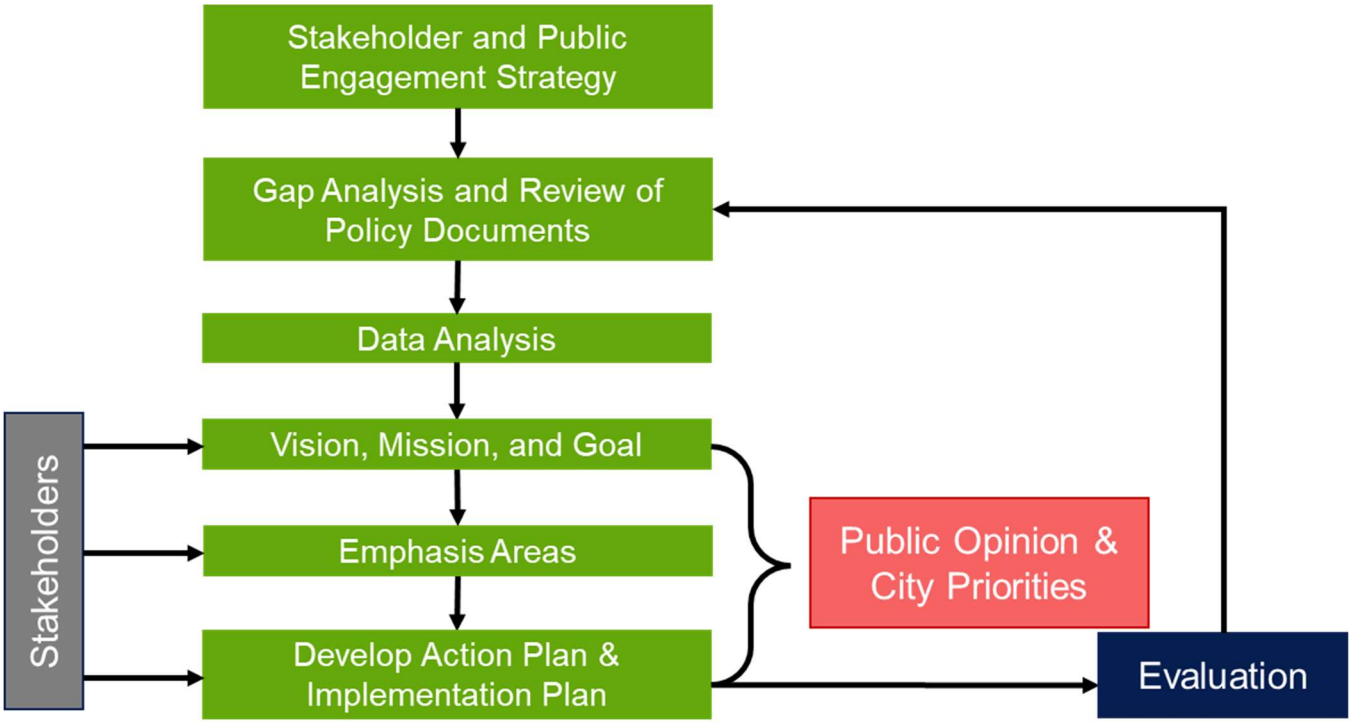


Figure E- 2: Vision Zero Road Safety Plan Development Process

Existing road safety programs were reviewed to obtain a detailed understanding of the road safety programs currently managed by the City, and key findings, identified gaps, and preliminary recommendations were developed and used to inform the RSP countermeasures plan. Key stakeholders were also consulted throughout the process, including advocacy groups, law enforcement, the Ministry of Transportation, York Region, first responders, and school boards, as shown in **Figure E- 3**.



Figure E- 3: Vision Zero Road Safety Plan Stakeholders

Vision, Mission, and Goal

Developing the framework to guide decision-making was one of the initial steps in creating the RSP. This framework is typically anchored by a vision for the program, a mission, and a specific short-term goal. The vision represents a high-level, long-term ideal that shapes the overall direction of the RSP and its detailed objectives. The mission statement guides the direction of the RSP by providing more clarity on how the vision can be accomplished. Finally, the goal statement outlines what the RSP intends to achieve within a defined timeframe, serving as a step toward realizing the broader vision. Based on stakeholder input, the **vision** of the Markham Vision Zero Road Safety Plan is:

A safer transportation system that enables all road users, regardless of age or ability, to travel safely without experiencing serious injury or death.

The **mission** statement is:

A leading community partnership committed to fostering a safe, inclusive, and sustainable transportation system to eliminate death and injuries for all road users through collaboration, innovation, culture change, and proactive policy and engineering measures.

Finally, the realistic short-term **goal** of the RSP has been set to:

Reduce fatal and serious injury collisions by at least 10% within five years, with a parallel commitment to achieving a 10% reduction in collisions involving vulnerable road users.

Emphasis Areas

An emphasis area is a type of collision that is a priority safety concern. Resources, including both human and financial resources as well as strategic initiatives, will be allocated to actions to reduce these collisions. The selection of emphasis areas is the foundation to achieving the City's overall vision to develop a transportation system that enables all road users to travel safely without experiencing serious injury or death. In order to achieve this commitment, it is imperative to apply resources where these collisions are most often occurring. The emphasis areas for the RSP were developed based on findings from the collision data analysis (2017-2019 and 2022-2023) and input from the public and stakeholders. The six emphasis areas are shown in **Figure E- 4**.



Figure E- 4: Vision Zero Road Safety Plan Emphasis Areas

Countermeasures

The Plan to eliminate injuries and fatalities on City roads through the RSP will consist of many individual initiatives called "countermeasures". A countermeasure is an action taken to reduce the frequency or severity of one or more specific types of collisions. The countermeasures chosen for the RSP have a high likelihood of contributing to the reduction of collision frequency or severity of one or more of the chosen emphasis areas. For existing countermeasures, the consultant team engaged with the City during the development of the Region's TSP, which included both an interview and a questionnaire. For future countermeasures, stakeholders were engaged in group discussions to determine the proposed list of countermeasures. Countermeasures are generally categorized into the following four "E's" of road safety:



Engineering countermeasures are changes to the physical format of the roadway including traffic calming measures; changes to traffic control devices such as traffic signal timing; warning devices or pavement markings; policy and practice changes; changes to regulations such as traffic flow or parking rules; or use of technology such as variable message signs or blank out no-right turn on red signs. Most engineering actions are site-specific or limited to a group of similar sites.



Enforcement countermeasures include both police staffed and automated enforcement. They emphasize attempting to gain better compliance with existing rules of the road, with the secondary aim of educating drivers about the consequences of their actions. Enforcement can be continuous or limited to specific campaigns and locations or be widespread in nature.



Education countermeasures aim to change road user behaviour so that road users are more aware of establishing a positive road safety culture. It is essential to proactively inform and prepare the public by providing comprehensive information about Vision Zero, including its significance, guiding principles, and implementation timeline. This will enable community members to better understand and engage with the forthcoming changes to roads and neighborhoods.



Engagement countermeasures are similar to education measures in that they both involve changing public behaviour. The difference is the messaging approach in how the public is involved in the education and process of the RSP. For instance, a driver turning at an intersection may not appreciate how difficult it is for an elderly pedestrian to cross through the stream of turning traffic. Engagement is a part of the Education portion of the countermeasure program, but the RSP has highlighted it, as engagement should be emphasized throughout the process.

In addition to the four "E's", countermeasures are categorized into four types: policy, systemic, location-specific, and demographic-specific.

Policy countermeasures indicate new standards, policies, or guidelines customized for the City. Policy countermeasures also consist of studies to further understand the behaviour of a group of users or contributing factors to collisions. An example of a policy countermeasure is a Community Safety Zone Policy.

Systemic countermeasures have proven effective (usually engineering countermeasures) and will be implemented widely across the City. An example of a systemic countermeasure is Accessible Pedestrian Signals, which could be applied to all signalized intersections.

Location-specific countermeasures improve safety at individual sites. Detailed analysis is required to identify locations and determine the countermeasure type required. An example of a location-specific countermeasure is implementing traffic calming countermeasures (such as curb extensions) along a specific corridor.

Demographic-specific countermeasures focus on a particular behaviour of road users or a sub-group of road users, such as drivers, pedestrians, or a particular age range. A detailed analysis is required. An example of a demographic-specific countermeasure is an educational campaign for young drivers (i.e., 16-25 years old).

Public, Stakeholder, and Council Consultation

In addition to the collision analysis and existing road safety program review, the project team sought input to understand the public's perspective on road safety within Markham throughout the development of the RSP. Residents of the City provided feedback through various platforms:

- An in-person Public Information Centre (PIC #1) was held on Wednesday, September 18, 2024 at Milliken Mills Community Centre to introduce the study to the public and receive further input on road safety-related concerns within the City's transportation network;
- From July 27th to September 27th 2024, public opinion was also collected through an online survey with more than 300 responses collected; and,
- An in-person Public Information Centre (PIC #2) was held on Tuesday, March 25, 2025 at the Markham Civic Centre to present the draft countermeasures plan and gather feedback from the public.

Stakeholders were also engaged throughout the countermeasures plan development process through two in-person meetings:

- Stakeholder Meeting #1 was held on Wednesday, October 2, 2024 at the Markham Civic Centre to gather feedback regarding the vision, mission, and goal statements and emphasis areas; and,

- Stakeholder Meeting #2 was held on Tuesday, February 25, 2025 at the Markham Civic Centre to finalize the proposed list of countermeasures.

In addition to public and stakeholder engagement, a workshop was held with City Council on Monday, November 25, 2024 at the Flato Markham Theatre. The purpose of this workshop was to introduce the project to Council, present the work completed to date, and gather feedback relating to traffic calming and speed management approaches and treatments.

Road Safety Countermeasures Plan

The countermeasures identified across the six emphasis areas are designated for a potential five-year implementation through the RSP. The countermeasures were prioritized based on the implementation importance, expected safety benefits, implementation costs, resource requirements, and potential for coordinating implementation with other programs. Timing and quantities of countermeasure deliverables may be subject to change, given the dependencies on project prioritization and budget.

In total, the Countermeasures Plan includes 92 unique countermeasures based on a data-driven approach, including 68 engineering countermeasures, 3 enforcement countermeasures, and 21 education and engagement countermeasures.

The status of each supporting activity and countermeasure has been defined using the four categories below:

- **Existing (EX)** – These countermeasures have already been implemented within the City and are to be retained at the current level of effort;
- **Expanded (EXP)** – Existing programs to be expanded;
- **Future (FUTR)** – Future new countermeasures selected by the City and partner agencies; and,
- **Recommended (REC)** – Additional new countermeasures recommended by the consultant team.

Countermeasures are divided between emphasis area-specific countermeasures and administrative countermeasures. Administrative countermeasures refer to a broad range of tasks and functions that contribute to the effective functioning and success of the RSP. These countermeasures encompass various administrative, logistical, and operational tasks that are essential for the smooth execution of the Countermeasures Plan. **Table E- 1** summarizes the proposed number of countermeasures per emphasis area.

Table E- 1: Number of Countermeasures per Emphasis Area

Emphasis Area	Countermeasure Type			Total
	Engineering	Enforcement	Education / Engagement	
Administrative	20	-	9	29
Intersections	12	-	-	12
Vulnerable Road Users	18	-	4	22
School Zones	5	1	4	10
Aggressive Driving	11	2	1	14
Distracted Road Users	2	-	1	3
Young Drivers	-	-	2	2
Total	68	3	21	92

Site Selection and Policy Papers

The project team developed a site selection methodology to prioritize implementation of the proposed location-specific countermeasures at locations that have the highest potential for safety improvements. Overall, the proposed methodology ranks sites based on the presence or magnitude of specific target issues and/or target conflicts associated with each countermeasure, while also considering elements such as cost-effectiveness, warrants, rankings from network screening and systemic safety reviews, and site applicability and feasibility of implementation.

In addition to the site selection methodology, the project team also developed the following policy papers to guide the implementation of the RSP:

- Community safety zones;
- Fatal and serious injury collision investigation;
- Intersection sight distances;
- Left-turn phasing;
- Traffic calming and speed management; and,
- Traffic inquiry process.

A review of the City's existing community engagement strategies and design guidelines was also undertaken by the project team to develop recommendations for enhancements.

Implementation Activities

Before executing the RSP Countermeasures Plan, it is crucial to establish a foundation for the RSP. This foundation consists of six steps that are shown in **Figure E- 5**.



Figure E- 5: Vision Zero Road Safety Plan Implementation Process

Additional staff and/or staff time (in the form of new hires or reallocation of existing staff) is required, as a significant effort needs to be allocated to analyze safety data, develop specific programs, implement countermeasures, and monitor results. Full-time equivalent (FTE) staff (i.e., Program Manager, Data Analysts, Safety Technologists, etc.) can be phased in for future years, through the annual budget cycles, to facilitate specific functions and roles necessary to successfully deliver the Plan.

An organizational structure defines the roles and responsibilities of the professionals and their agencies while securing the coordination essential for managing and implementing the RSP. The organizational structure proposed for the City of Markham to manage and implement the Vision Zero Road Safety Plan is shown in **Figure E- 6** and is as follows:

- **Road Safety Plan Leadership (RSPL) Committee** is formed by internal and external stakeholders, including professionals at the safety management and decision-making level at each partner agency;
- **Program Manager (PM)** is a full-time dedicated professional appointed to be the City coordinator and the main point of contact among all partner agencies;
- **Data Analysis and Evaluation (DAE)** is formed by one or more data analysts who will be responsible for all data-related management supporting the RSP and Road Safety Management System; and,
- **Emphasis Area (EA) Working Groups** are formed by City professionals who execute the RSP Countermeasures Plan. There are two primary EA Working Groups (Infrastructure and Behavioural) which encompass the six Emphasis Areas of the RSP.

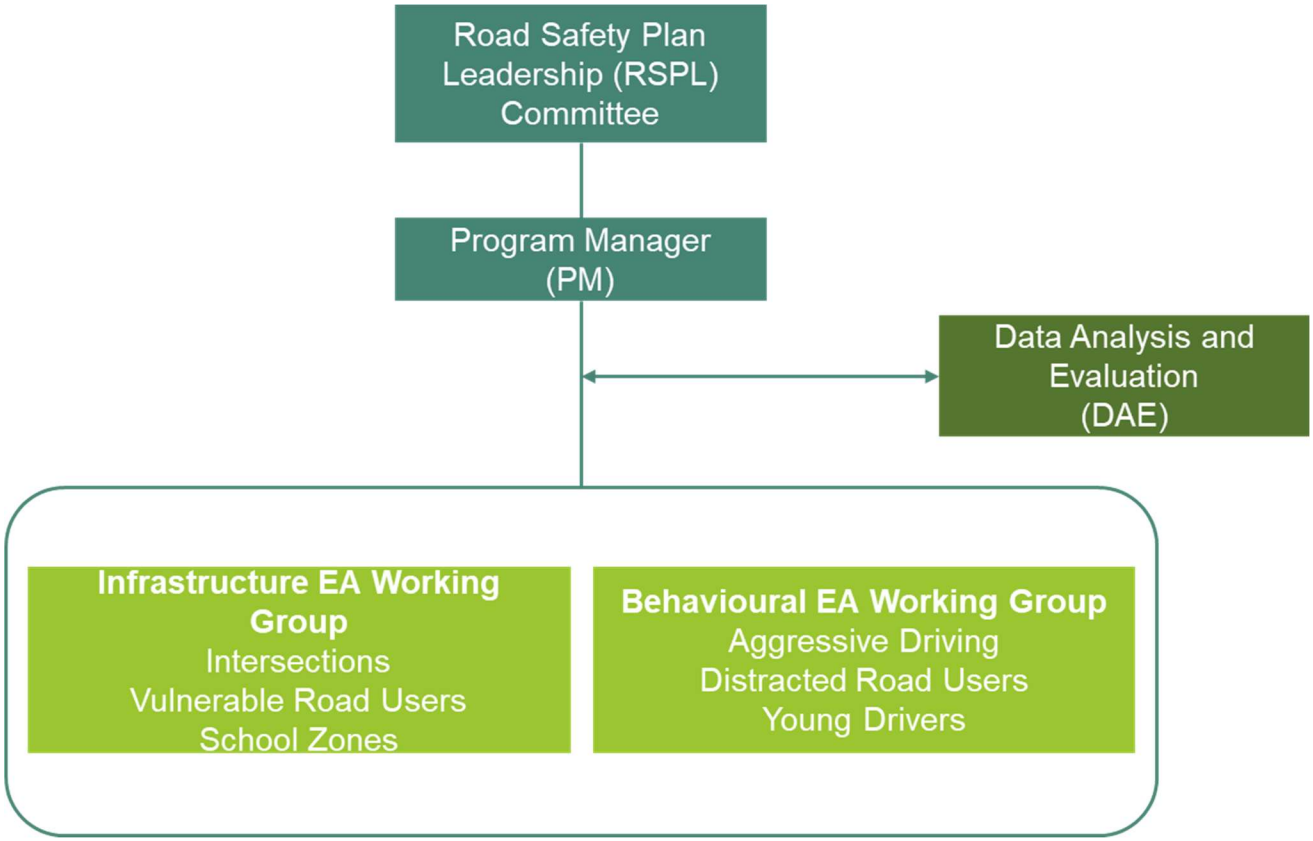


Figure E- 6: Vision Zero Road Safety Plan Organizational Structure

In addition, a communications strategy was developed to ensure enhanced coordination of all road safety-related education and engagement initiatives. **Table E- 2** illustrates the communication strategy action items as part of the implementation of the RSP.

Table E- 2: Communications Strategy Summary

Title	Description
Vision Zero Branding	▪ Vision Zero branding in collaborative public education campaigns.
Driver Education Campaigns	▪ Outreach campaigns on how to interpret and use new traffic devices (e.g. roundabouts) for the road users within the City. ▪ Outreach campaigns to support the educational and enforcement programs outlined in the Countermeasures Plan.
Road User Education	▪ Increased awareness for driver, pedestrian, and cyclist safety on the roads and the expected injury levels at different impact speeds.

A key component of any road safety program is monitoring and evaluation. Evaluations allow us to understand the effectiveness of a program, project, or countermeasure through the analysis of data for a specific performance measure such as collisions, speed, or conflicts. Evaluation provides critical information to identify if the countermeasure is working, if any adjustments are required, or if additional countermeasures are needed. Further, evaluation allows the opportunity to improve existing processes and inform future decision making. The efficacy of the countermeasures included in the RSP should be evaluated and findings should be included in an annual report to record the advancements of the Vision Zero Road Safety Plan. The effectiveness of education, engagement, and enforcement countermeasures may be difficult to measure as they aim to change road user behaviour, which may take a significant amount of time.

It should be noted that short-term or initial results cannot be considered truly indicative of the effect of the program, as it takes a few years of data collection to accurately determine, statistically, if a change has occurred. Therefore, it will be several years (likely four or five) before a valid evaluation of the program's effectiveness can be made. However, the program's progress (i.e. implementation of countermeasures) should be monitored and evaluated annually to ensure that the planned actions are becoming reality as envisioned. In addition, there are some early signs of success that can be observed because of implementing the RSP. These could include public and stakeholder engagement in the road safety programs, positive media and public feedback, receiving budget and resources for implementing programs, and short-term, preliminary evaluation results of some engineering countermeasures.

Financial resources required to implement the countermeasures are based on implementation cost, life cycle and associated/recurring operating and maintenance costs.

To support annual delivery of the Plan, an average annual budget of approximately $4 million is anticipated. This is to cover new programs, safety audits/studies, additional staffing resources, implementation, and operations & maintenance costs. However, the average budget may vary between $2 million – $6 million per year depending on priorities, the type/scope of each countermeasure to be implemented, and initiation of new programs that may not be identified within the Plan.

To assess if the selected countermeasures and their allocated quantities are adequate for reducing fatal and injury collisions as well as vulnerable road user collisions, crash modification factors (CMFs) were used (if available). Although crash modification factors may not be available for certain road safety countermeasures, their value remains significant. These countermeasures often offer unique benefits in mitigating specific risks or addressing emerging safety concerns, contributing positively to overall road safety despite the absence of traditional quantifiable metrics. The CMFs were employed to estimate the expected collision reduction benefits of each countermeasure. The same CMFs that were used in the development of the Region's TSP were used to evaluate the benefits of the City's RSP, where applicable.

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1. Introduction

The City of Markham (the City) is one of the largest municipalities within York Region, with a population of approximately 338,000 in the 2021 census and a projected growth to approximately 619,000 by 2051[3]. While this growth offers opportunities for economic development and improved quality of life for residents in Markham, it also presents an increased risk for conflicts throughout the City's transportation network, as well as increased infrastructure and transportation demands.

In 2023, the City experienced nearly 1,000 reported motor vehicle collisions within the municipal road network, including more than 200 collisions that resulted in an injury, of which nearly 40 collisions involved a pedestrian and 40 collisions involved a cyclist. These collisions in 2023 resulted in approximately $19.8 million[4] in direct and indirect costs and exacted a profound emotional and societal toll on those involved.

To mitigate the risks associated with the City's collision history, a comprehensive Vision Zero Road Safety Plan needed to be developed and implemented to support the City's planned growth. CIMA Canada Inc. (CIMA+) was retained by the City to develop the Vision Zero Road Safety Plan. The success of the Plan is mainly based on a data-driven approach to road safety, which includes a thorough review and update of the collision data analysis to evaluate safety patterns and trends.

A review of collision data spanning from 2017 to 2023 is shown in **Figure 1**. It should be noted that collisions from 2020 and 2021 were excluded from the analysis due to the impact of the COVID-19 pandemic. A fluctuation in the number of Property Damage Only (PDO) collisions between 2017 and 2022 is observed, with an increase in 2023. It appears that the number of collisions in 2022 was slightly impacted by the lingering effect of travel behaviour changes due to COVID-19 restrictions, however, the number of collisions in 2023 increased beyond the pre-COVID levels. This is consistent with observations in other Ontario jurisdictions. In addition, the number of major injury collisions fluctuated between 2017 and 2019, as well as in 2022 and 2023. On average, there were 203 injury collisions per year, including 8 major injury collisions annually and one fatal collision recorded in 2022. Overall, the number of injury collisions has been fairly consistent.

[3] Proposed 2051 Forecast and Land Needs Assessment, York Region, March 2021
[4] Based on the societal costs listed in "Collision Costs for Use in Ontario with Implementation of Safety Analyst" (J. White, MTO Traffic Office, July 2012) and forecasted to 2024 dollar – property damage only collisions: $13,559 per collision; injury collision: $44,383 per collision; fatal collisions: $1,837,343 per collision.

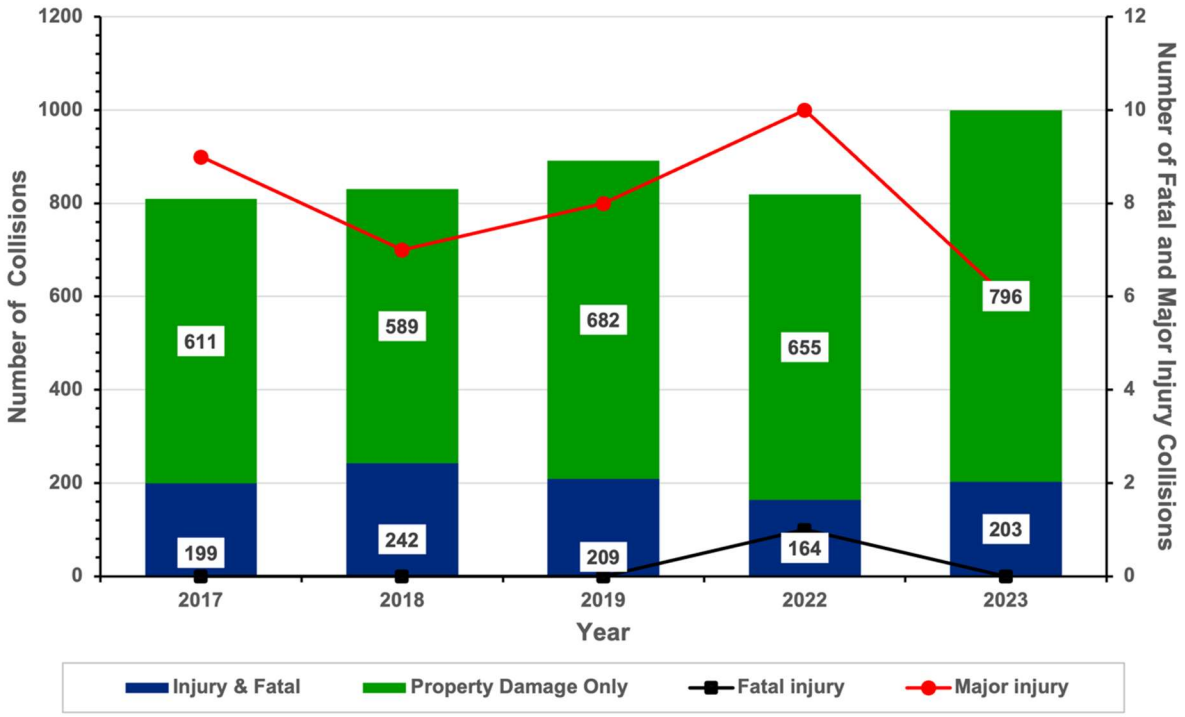


Figure 1: Collisions on Markham Roads by Severity (2017 – 2019, 2022 – 2023)

In recent years, Vision Zero, a strategy supported by policies and data to eliminate traffic fatalities and serious injuries, became popular among elected officials and within the road safety community. Vision Zero began in Sweden in 1997, with the premise that any loss of life is unacceptable and, as such, this concept aims to achieve zero fatalities and injuries throughout the transportation network. Therefore, system designers, operators, maintenance staff, and policymakers have a shared responsibility to provide a Safe System for all travellers, regardless of their chosen mode of travel, income level, race, gender, or physical abilities. The Vision Zero approach requires significant cultural and legislative changes regarding the approach taken toward traffic and road safety, roadway design, enforcement, and education of road users.

The City has previously participated in the development of York Region's Traveller Safety Plan (TSP), including attending several workshops and providing their input on the overall vision and goal, the proposed emphasis areas, and the final list of countermeasures to be implemented as part of the TSP. This Vision Zero Road Safety Plan aims to improve safety along the City's road network through a data-driven effort in tandem with the Region's existing TSP. Both plans adhere to the Safe System approach, which depicts a singular overall system that demands that everyone look at road safety from a public health perspective. This Vision Zero Road Safety Plan will complement the City's role in the Region's TSP and allow them to meet the road safety needs identified in both plans through a coordinated approach that maximizes the effectiveness of expenditures.

This report summarizes the development process of the City's Vision Zero Road Safety Plan and presents the final countermeasures plan to achieve the identified Vision, Mission, and Goal of the Plan.

2. Vision Zero Road Safety Plan Development Process

The Vision Zero Road Safety Plan (RSP) will help to facilitate the implementation of many road safety countermeasures through a proactive strategy to address serious injury and fatal collisions. The aim of this plan is to establish a safe transportation system for all road users by employing a data-driven approach that follows the Safe System paradigm. This is achieved by:

- Identifying and prioritizing the key safety needs that can be addressed through engineering, enforcement, education, and engagement.
- Taking advantage of the resources available from the City, its partners, and the York Region TSP and aligning them to meet the identified safety needs, accomplishing the shared goal of the RSP.
- Guiding safety investment decisions in a coordinated and consistent approach to maximize the effectiveness of resources within the City.

A Safe System approach includes the following principles:

- Humans make mistakes;
- Humans are vulnerable;
- Road injuries and deaths are preventable;
- Improvements in road safety should be proactively implemented;
- Multiple layers of protection should be implemented in the road system; and,
- All parties involved have a shared responsibility towards road safety.

In fact, a wide range of organizations can influence road safety, including those in planning (e.g. incorporating safety at early stages of a project's life cycle), engineering (e.g. improving sightlines at unsignalized intersections), law enforcement (e.g. enforcing safe speeds around schools), public health (e.g. awareness campaigns on the consequences of impaired driving), education (e.g. educational campaigns against distracted driving), and/or advocacy (e.g. garner support for safer cycling facilities). The pillars of the Safe System approach are shown in **Figure 2**.



Figure 2: Safe System Pillars

The RSP builds on the City's existing road safety programs by determining key areas (known as emphasis areas) for which safety can be enhanced and by developing a set of individual safety initiatives (known as countermeasures) that would be most effective in reducing fatal and injury collisions for each emphasis area. **Figure 3** shows the key steps in developing the RSP.

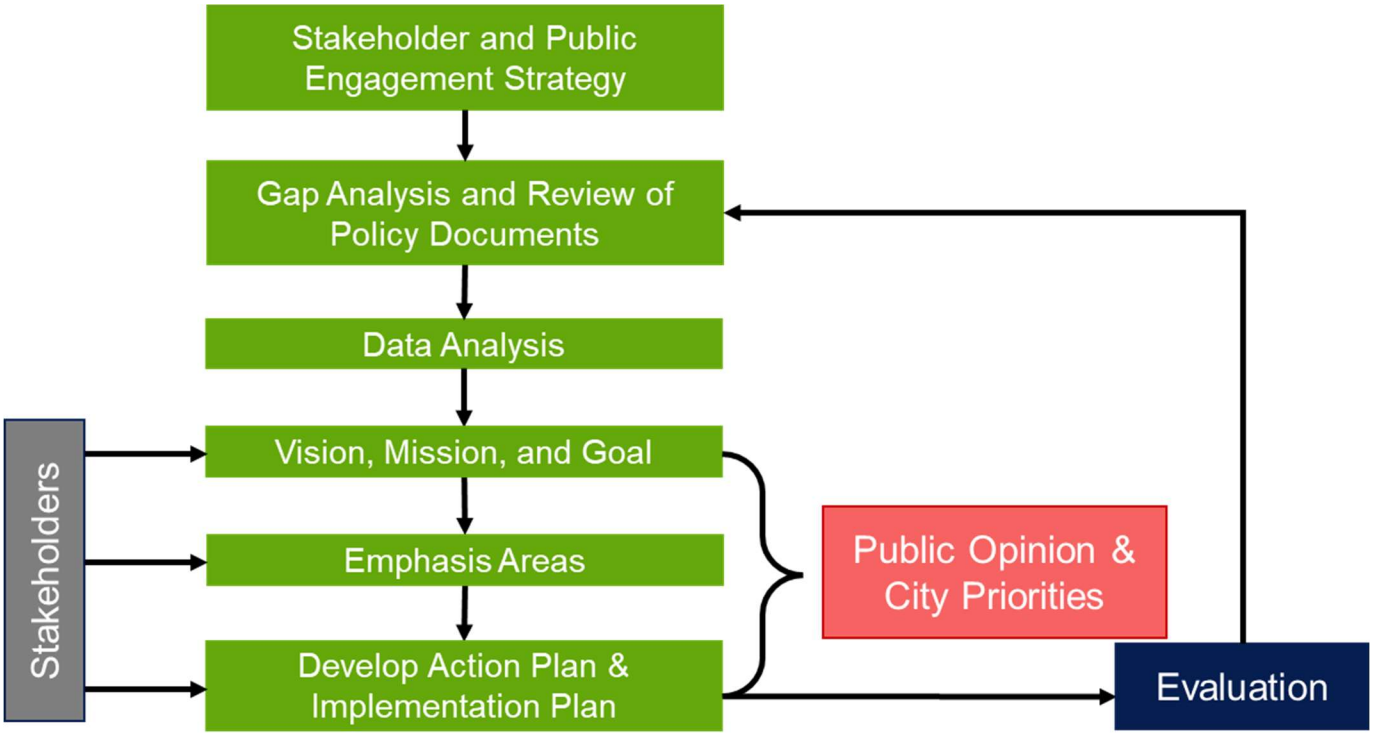


Figure 3: Vision Zero Road Safety Plan Development Process

3. Existing Road Safety Program Review

Existing road safety programs were reviewed to obtain a detailed understanding of the road safety programs currently managed by the City of Markham. A preliminary interview was conducted at the onset of the project to gather general information about the existing road safety programs. Some of the successful safety programs and initiatives that the City is currently delivering include:

- Radar speed feedback signs;
- In-road flexible signs;
- Community safety zones;
- School zones;
- Road Watch;
- Pedestrian crossovers (PXOs);
- Crossing guard program;
- Sidewalk network completion;
- Active school travel program;
- Active transportation capital projects;
- Cycling pedestrian advisory committee meetings;

- Network-wide safety review; and,
- Education programs.

Key findings, identified gaps, and preliminary recommendations were documented in a report (**Appendix A**) and used to inform the development of the RSP countermeasures plan.

4. Project Stakeholders

The development of the RSP was a collaborative process where feedback and input from internal and external stakeholders were critical to the project's success. At the outset of the study, key stakeholders that would be able to contribute to road safety within the City were identified, including advocacy groups, law enforcement, the Ministry of Transportation, York Region, first responders, and school boards, as shown in **Figure 4**.



Figure 4: Vision Zero Road Safety Plan Stakeholders

Two stakeholder meetings were held with the identified partner agencies, wherein the project team gathered valuable feedback to inform the development of the RSP, including:

- Stakeholder Meeting #1: Vision, Mission, and Goal Statements and Emphasis Areas; and,
- Stakeholder Meeting #2: Countermeasure Development.

5. Vision, Mission, and Goal

Developing the framework to guide decision-making was one of the initial steps in creating the RSP. This framework is typically anchored by a vision for the program, a mission, and a specific short-term goal. The vision represents a high-level, long-term ideal that shapes the overall direction of the RSP and its detailed objectives. The mission statement guides the direction of the RSP by providing more clarity on how the vision can be accomplished. Finally, the goal statement outlines what the RSP intends to achieve within a defined timeframe, serving as a step toward realizing the broader vision.

An in-person Stakeholder Meeting #1 was held on October 2, 2024. During this meeting, the partner agencies developed a vision, mission, and goal for the RSP that is in line with the Vision Zero approach.

The **vision** of the Markham Vision Zero Road Safety Plan is:

A safer transportation system that enables all road users, regardless of age or ability, to travel safely without experiencing serious injury or death.

The **mission** statement is:

A leading community partnership committed to fostering a safe, inclusive, and sustainable transportation system to eliminate death and injuries for all road users through collaboration, innovation, culture change, and proactive policy and engineering measures.

Finally, the realistic short-term **goal** of the RSP has been set to:

Reduce fatal and serious injury collisions by at least 10% within five years, with a parallel commitment to achieving a 10% reduction in collisions involving vulnerable road users.

The City is expected to report on the plan's progress and revisit its goal every five years if necessary. Further details of Stakeholder Meeting #1 and the development of the vision, mission, and goal can be found in the *Vision, Mission, Goal, and Emphasis Areas Memorandum* (**Appendix B**).

6. Emphasis Areas

An emphasis area is a type of collision that is a priority safety concern. Resources, including both human and financial resources as well as strategic initiatives, will be allocated to actions to reduce these collisions. The selection of emphasis areas is the foundation to achieving the City's overall vision to develop a transportation system that enables all road users to travel safely without experiencing serious injury or death. In order to achieve this commitment, it is imperative to apply resources where these collisions are most often occurring.

Typically, road safety strategies include several emphasis areas. The number of emphasis areas needs to be limited to ensure enough resources are allocated to the most critical areas. However, best practice suggests including 4 to 6 emphasis areas that constitute most of the City's fatal and injury collisions with various contributing factors, such as road deficiencies, risky behaviours, and sensitive demographics. A combination of emphasis areas will provide flexibility, effectiveness, and redundancy in the City's RSP through the development of an all-inclusive countermeasures plan.

The emphasis areas for the RSP were developed based on findings from the collision data analysis (2017-2019 and 2022-2023) and input from the public and stakeholders. In Stakeholder Meeting #1, a summary of public input from the online survey and the collision data analysis results were presented to the partner agencies. During the meeting, additional feedback from the partner agencies was gathered to help select the RSP emphasis areas.

6.1 Collision Data

The RSP is a data-driven study, with collision analysis using data from 2017-2019 and 2022-2023, including collisions that occurred on roadways and at intersections within the City's jurisdiction only. On March 17, 2020, the Government of Ontario declared a state of emergency due to the COVID-19 pandemic and ordered the gradual closure of businesses and facilities. As a result of the state of emergency and subsequent stay-at-home orders from the Province, Markham, similar to other jurisdictions in Ontario, experienced a reduction in vehicular traffic volumes, resulting in a corresponding reduction in the number of collisions. The COVID-19 pandemic restrictions were in place until July 2021. As a result, there is likely an underrepresentation of collision frequency in 2020 and 2021. Therefore, the collision data from January 1, 2020 to December 31, 2021 was excluded from the collision analysis.

As shown in **Table 1**, a total of 4,350 collisions were reported on City roads from 2017 to 2019 and 2022 to 2023. Of those collisions, approximately 76.6% (3,333 collisions) resulted in property damage only (PDO), 23.4% (1,016 collisions) resulted in injuries, and 0.02% (1 collision) resulted in a fatality. Overall, 23.4% of the collisions reported within the study period resulted in an injury or a fatality. Further details of the collision analysis can be found in **Appendix C**.

Table 1: Collision Statistics (2017-2019, 2022-2023)

Property Damage Only	Injury	Fatal	Total	Fatal & Injury Collisions
3,333	1,016	1	4,350	1,017

The RSP combined fatal and injury collisions for the analysis, as it supports the City's mission to eliminate death and injuries for all road users. The collision analysis provided a better understanding of how collisions are happening within the City and who is involved (e.g. mode of transportation, age groups, collision impact types, driver action, etc.). Once the project team completed the collision analysis, a preliminary list of target areas (referred to as "emphasis areas") with the largest group of collisions was identified.

Figure 5 summarizes the ranking of collision emphasis areas for the City of Markham. It is important to note that the categories in this figure are not mutually exclusive. As such, a single collision might be included in several collision types, resulting in overlaps between the collision emphasis areas. For example, if a pedestrian was involved in a collision with a distracted driver at an intersection, this collision is represented in three collision types: intersection collisions, pedestrian collisions, and distracted driving collisions.

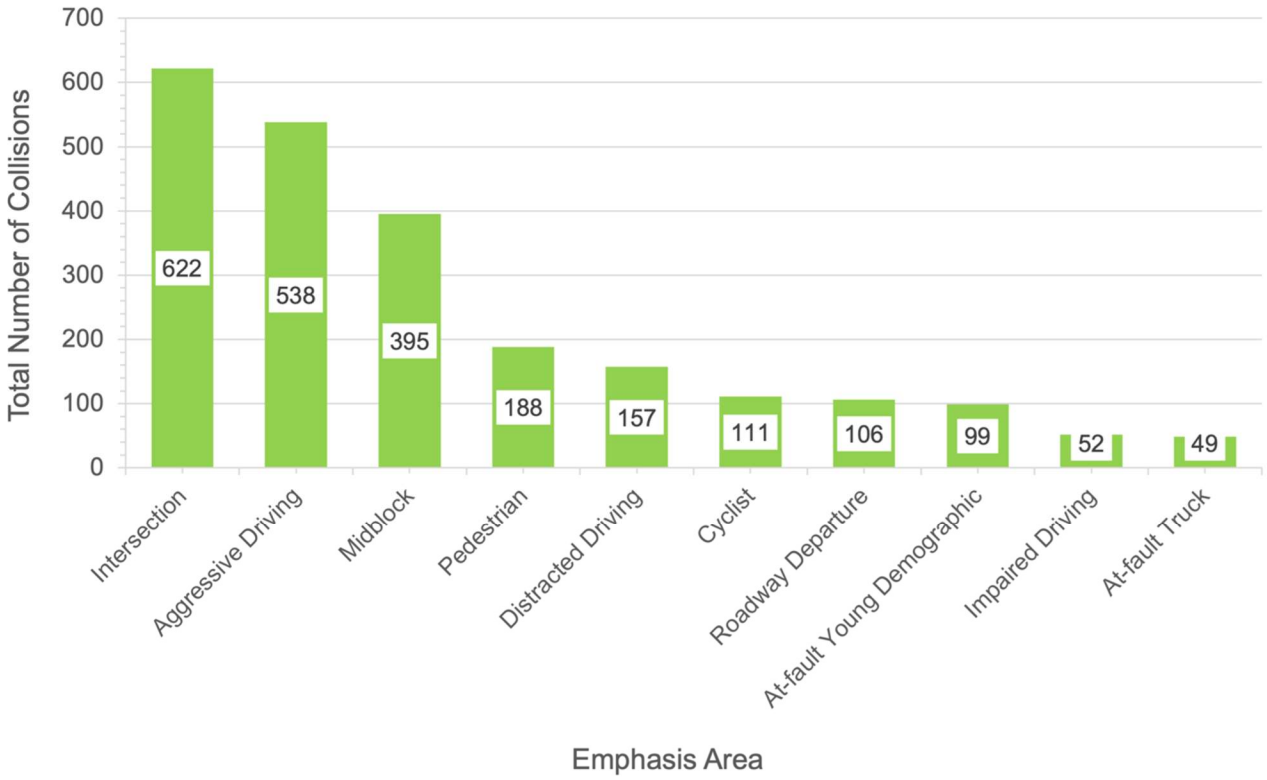


Figure 5: Fatal and Injury Collisions by Emphasis Area (2017-2019, 2022-2023)

Intersection collisions account for approximately 61.2% of all fatal and injury collisions on City roads. Other significant emphasis areas for collisions include aggressive driving (52.9%), pedestrians (18.5%), distracted driving (15.4%), and cyclists (10.9%).

As per this indicator, the candidate collision emphasis areas for the RSP include *Intersections*, *Aggressive Driving*, *Midblocks*, *Pedestrians*, *Distracted Driving*, *Cyclists*, *Roadway Departure*, *At-fault Young Demographic*, *Impaired Driving*, and *At-fault Trucks*. The long list of emphasis areas examined are those suggested by the literature, such as FHWA publications and the Highway Safety Manual (HSM).

6.2 Public Input

An online survey and an in-person Public Information Centre (PIC) were conducted to gather public input on the proposed emphasis areas. Based on feedback from residents, key priority areas included aggressive driving, intersection collisions, school zone road safety, and pedestrian and cyclist safety. Further details from the survey and PIC can be found in **Section 8**.

6.3 Stakeholder Meeting #1

During Stakeholder Meeting #1, the collision data analysis and public results were presented to the partner agencies, and the emphasis areas were finalized. General details of this stakeholder meeting are provided under **Section 8** and details of the discussion can be found in **Appendix B**. The six emphasis areas of the Vision Zero Road Safety Plan are shown in **Figure 6**. As previously mentioned, a single collision might involve multiple emphasis areas, resulting in overlaps. It should be noted that intersections, vulnerable road users, aggressive driving, and distracted road users are also emphasis areas in York Region's TSP.



Figure 6: Vision Zero Road Safety Plan Emphasis Areas

As the RSP progresses and countermeasures are implemented, priorities will be revisited, which may result in adjustments to the emphasis areas. The emphasis areas should be revisited with each update of the RSP, as collisions will be reduced, and new road safety concerns may arise.

7. Countermeasures

The Plan to eliminate injuries and fatalities on City roads through the RSP will consist of many individual initiatives called "countermeasures". A countermeasure is an action taken to reduce the frequency or severity of one or more specific types of collisions. The countermeasures chosen for the RSP have a high likelihood of contributing to the reduction of collision frequency or severity of one or more of the chosen emphasis areas.

Through a two-step process, as discussed in the subsections below, the City and partner agencies identified and selected the countermeasures based on their knowledge of the emphasis areas and their understanding of their ability to undertake new or enhanced safety initiatives.

7.1 Countermeasure Development

7.1.1 Existing Countermeasures Review

The consultant team engaged with the City during the development of the Region's TSP to comprehensively understand their existing road safety countermeasures and programs. This interview, in addition to the questionnaire, formed the foundation for assessing the current state of safety measures. The insights and findings collected from the municipality interviews were then documented in the *Road Safety Programs Review* report (**Appendix A**). This report serves as a crucial reference point to identify preliminary strengths, gaps, and areas for improvement within the existing safety programs.

7.1.2 Future Countermeasure Selection

As discussed in **Section 6.3**, Stakeholder Meeting #1 provided a platform for engaging in group discussions to determine the emphasis areas for future road safety countermeasures. Once emphasis areas were identified, stakeholders were provided with reference materials to aid in selecting future countermeasures. Stakeholders identified the existing and expanding road safety countermeasures currently being implemented and determined the future countermeasures they would like to introduce. During Stakeholder Meeting #2, the information collected from stakeholders was integrated and used to review existing and future countermeasures.

7.2 Countermeasure Categories

7.2.1 The Four "E's" of Road Safety

Road safety is a diverse and complex field requiring the involvement of partners from various disciplines with various expertise. The four "E's" of road safety provide a broad range of different approaches which may be taken to address road safety issues. These diverse approaches will provide short-term and long-term actions and address most of the major roadway safety issues, road user perceptions, and road user behaviours.

The definitions of the four "E's" of road safety are below.



Engineering countermeasures are changes to the physical format of the roadway including traffic calming measures; changes to traffic control devices such as traffic signal timing; warning devices or pavement markings; policy and practice changes; changes to regulations such as traffic flow or parking rules; or use of technology such as variable message signs or blank out no-right turn on red signs. Most engineering actions are site-specific or limited to a group of similar sites.



Enforcement countermeasures include both police staffed and automated enforcement. They emphasize attempting to gain better compliance with existing rules of the road, with the secondary aim of educating drivers about the consequences of their actions. Enforcement can be continuous or limited to specific campaigns and locations or be widespread in nature.



Education countermeasures aim to change road user behaviour so that road users are more aware of establishing a positive road safety culture. It is essential to proactively inform and prepare the public by providing comprehensive information about Vision Zero, including its significance, guiding principles, and implementation timeline. This will enable community members to better understand and engage with the forthcoming changes to roads and neighborhoods.



Engagement countermeasures are similar to education measures in that they both involve changing public behaviour. The difference is the messaging approach in how the public is involved in the education and process of the RSP. For instance, a driver turning at an intersection may not appreciate how difficult it is for an elderly pedestrian to cross through the stream of turning traffic. Engagement is a part of the Education portion of the countermeasure program, but the RSP has highlighted it, as engagement should be emphasized throughout the process.

Engineering countermeasures tend to prompt immediate (or almost immediate) improvement on the specific safety problem being addressed. Education and engagement countermeasures may take a significant amount of time to influence road user behaviour and result in permanent behavioural change. However, the overall effects may be much greater than individual engineering countermeasures. Enforcement countermeasures fall somewhat in between and require persistent efforts to result in even temporary behavioural change.

7.2.2 Types of Countermeasures

In addition to the four "E's", countermeasures are also categorized into four types: policy, systemic, location-specific, and demographic-specific.

Policy countermeasures indicate new standards, policies, or guidelines customized for the City. Policy countermeasures also consist of studies to further understand the behaviour of a group of users or contributing factors to collisions. An example of a policy countermeasure is a Community Safety Zone Policy.

Systemic countermeasures have proven effective (usually engineering countermeasures) and will be implemented widely across the City. An example of a systemic countermeasure is Accessible Pedestrian Signals, which could be applied to all signalized intersections.

Location-specific countermeasures improve safety at individual sites. Detailed analysis is required to identify locations and determine the countermeasure type required. An example of a location-specific countermeasure is implementing traffic calming countermeasures (such as curb extensions) along a specific corridor.

Demographic-specific countermeasures focus on a particular behaviour of road users or a sub-group of road users, such as drivers, pedestrians, or a particular age range. A detailed analysis is required. An example of a demographic-specific countermeasure is an educational campaign for young drivers (i.e., 16-25 years old).

7.3 Collision Modification Factors (CMFs) and Unit Rates

A Collision Modification Factor (CMF) is an estimate of the potential changes (mostly potential reductions) in collision frequency which might be expected as a result of implementing a specific countermeasure. Where available, CMFs have been supplied for the proposed countermeasures to better inform the City and partner agencies of the possible degree of success of the action items (See the RSP Countermeasures Plan with associated CMFs for countermeasures in **Appendix D**). Generally, the CMFs are available for engineering countermeasures (typically those applied at a specific site). There are fewer specific data and studies on the effectiveness of education, engagement, and enforcement programs, as the effectiveness of these programs is much more difficult to measure.

The CMF Clearinghouse is a database developed and maintained by the US Federal Highway Administration[5] and is recognized as the most comprehensive source of information for engineering countermeasures in North America. Each source of research in the Clearinghouse is rated according to the quality of the research methodology and is categorized according to the specific effect expected. It uses scholarly research from across the world to determine the effectiveness of countermeasures (i.e., their CMF values). For this project, Clearinghouse information was consulted as the main source of CMFs, but additional CMFs were also obtained from other credible sources such as the National Highway Traffic Safety Administration (NHTSA) Countermeasures That Work[6] and Federal Highway Administration (FHWA) Proven Safety Countermeasures[7]. Note that the CMFs used to develop the RSP are the same as the CMFs from the Region's TSP, where applicable.

8. Public and Stakeholder Consultation

The public was engaged to gather input and understand residents' perspectives on road safety in Markham. Feedback was collected through various platforms and at different stages of the project.:

- An in-person Public Information Centre (PIC #1) was held on Wednesday, September 18, 2024 at Milliken Mills Community Centre to introduce the study to the public and receive further input on road safety-related concerns within the City's transportation network;
- From July 27th to September 27th 2024, public opinion on road safety priorities was also collected through an online survey with more than 300 responses collected; and,
- An in-person Public Information Centre (PIC #2) was held on Tuesday, March 25, 2025 at the Markham Civic Centre to present the draft countermeasures plan and gather feedback from the public.

8.1 PIC #1

During PIC #1, Markham residents provided their input through various interactive activities (shown in **Figure 7**), including:

- **Brainstorm Wall:** A brainstorming activity allowed attendees to provide detailed written feedback on key road safety concerns and potential improvements. Residents shared suggestions on enhancing pedestrian and cyclist safety, improving public transit, and addressing gaps in infrastructure. Common topics included combining local and regional road safety plans, enhancing data sharing with York Region, and adopting international safety standards like Vision Zero.

[5] www.cmfclearinghouse.org
[6] www.nhtsa.gov/book/countermeasures/countermeasures-work
[7] highways.dot.gov/safety/proven-safety-countermeasures

- **Interactive Map:** Participants were encouraged to mark specific locations on an interactive map to highlight areas with safety concerns. The map was colour-coded to represent different safety concerns:
  - Red: Speeding concerns;
  - Yellow: Unsafe intersections;
  - Green: Pedestrian and cyclist safety concerns;
  - Blue: Safety for seniors and children; and,
  - Black: Excessive truck traffic.

The primary issues raised during the meeting focused on aggressive driving and disobeying of traffic laws, the safety of pedestrians and cyclists, and the impact of poor land use and infrastructure on car dependency. Attendees also emphasized the importance of incorporating international practices, particularly from European countries like the Netherlands, into local road safety plans. Another major theme was the need for more proactive planning and improvements in public transit to reduce reliance on cars and reduce congestion. The main areas of concern include:

- Safety concerns for pedestrians and cyclists;
- Aggressive driving behaviour and poor enforcement of traffic laws, particularly around speeding and illegal parking;
- Car dependency due to inadequate land use, cycling infrastructure, and public transit; and,
- Reactive transit planning by York Region Transit (YRT), rather than a proactive approach.

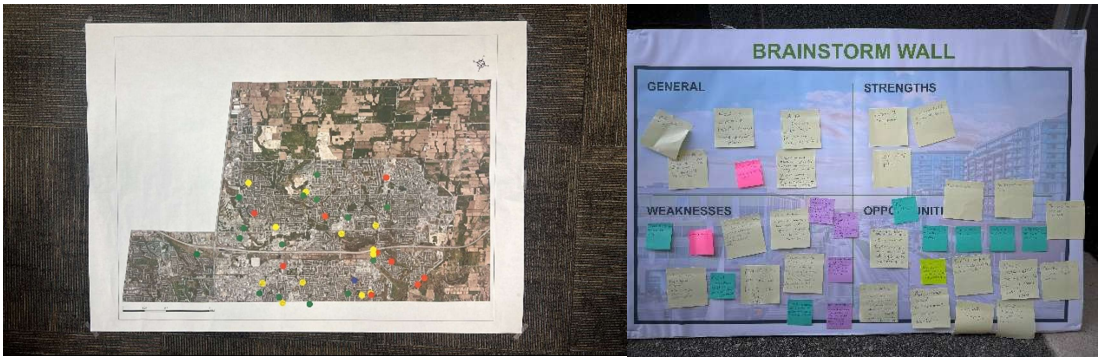


Figure 7: Interactive Activities at Public Information Centre (PIC #1)

8.2 Online Public Survey

The online survey was active from July 27th to September 27th 2024 and a total of 332 responses were collected. Respondents provided valuable information on preferred modes of travel (i.e. driving, walking, cycling), road safety concerns in Markham, and road safety priorities.

The top ten priorities noted in the survey in order of importance were *Aggressive Driving*, *Impaired Driving*, *Intersections*, *School Zones*, *Pedestrians*, *Cyclists*, *Parks and Playground Areas*, *Distracted Driving and Walking*, *Young Drivers*, and *Weather-Related Collisions*, which were similar to the top priorities determined by the collision data analysis, although the order of the priorities differed. A summary of the public opinion survey analysis is shown in **Figure 8**, and more details can be found in **Appendix E**.

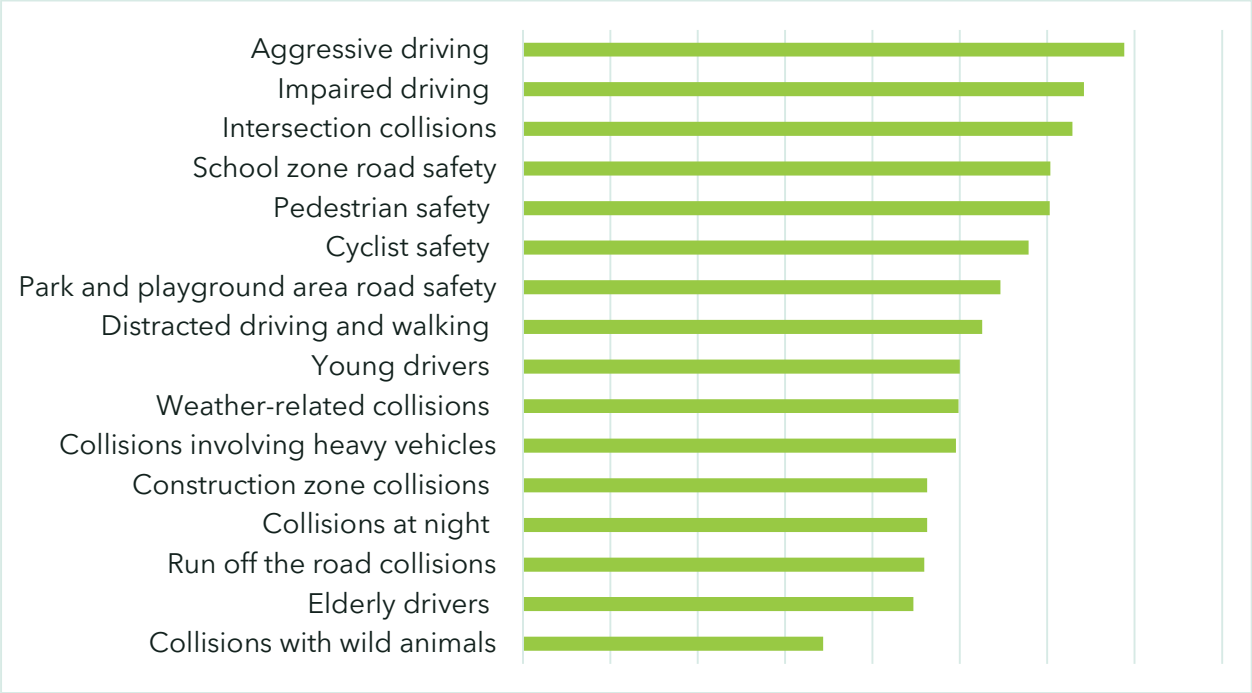


Figure 8: Emphasis Area Priority Ranking by Online Survey Participants

8.3 PIC #2

During PIC #2, Markham residents were encouraged to provide their input on the draft countermeasures plan, including the vision, mission, and goal statements, the emphasis areas, and the preliminary list of countermeasures. Comment sheets were provided for attendees to provide their feedback, which generally focused on pedestrian and cyclist safety, distracted road user behaviour, and speed management. Residents also indicated their support for physical engineering countermeasures and suggested less reliance on enforcement countermeasures. The following specific countermeasures were proposed:

- Rumble strips along bike lanes to address distracted road user behaviour;
- "Slow Down" pavement markings within school zones and near senior homes;
- Left-turn phases at signals;
- Cycling and pedestrian infrastructure; and,
- A blanket ban of right-turn-on-red movements.

8.4 Stakeholder Meeting #1

As mentioned previously, stakeholders were engaged throughout the countermeasures plan development process by providing local knowledge an guidance through two in-person meetings:

- Stakeholder Meeting #1 was held on Wednesday, October 2, 2024 at the Markham Civic Centre to gather feedback regarding the vision, mission, and goal statements and emphasis areas; and,
- Stakeholder Meeting #2 was held on Tuesday, February 25, 2025 at the Markham Civic Centre to finalize the proposed list of countermeasures.

The purpose of Stakeholder Meeting #1 was to introduce the project to the identified partner agencies and communicate their role in ensuring the RSP's success. The overall Vision Zero and Safe System frameworks were presented to provide an appropriate context for the RSP development process. Two breakout sessions were conducted, with attendees allocated to five breakout groups:

- Activity #1: Develop potential vision, mission, and goal statements.
- Activity #2: Establish appropriate emphasis areas with opportunities to improve road safety in Markham.

To guide the breakout group discussions, sample vision, mission, and goal statements from other road safety plans were provided, as well as example emphasis areas, an overview of the collision history on Markham roadways, and results from the online public survey and PIC #1. Details from the discussions at Stakeholder Meeting #1 can be found in **Appendix B**.

8.5 Stakeholder Meeting #2

Once the emphasis areas were finalized during Stakeholder Meeting #1, a preliminary list of administrative countermeasures as well as countermeasures for each emphasis area was developed. This list was presented at Stakeholder Meeting #2 in order to build consensus on the proposed list of countermeasures and identify the involved teams. Minor adjustments were made to the list of countermeasures as a result of the discussion. The final list of countermeasures is discussed in **Section 10**.

9. Council Workshop

In addition to public and stakeholder engagement, a workshop was held with City Council on Monday, November 25, 2024 at the Flato Markham Theatre. The purpose of this workshop was to introduce the project to Council and to present the work completed to date, including the collision data analysis, the public and stakeholder engagement, and the draft vision, mission, and goal statements and emphasis areas. Recommended speed management and traffic calming approaches and principles were highlighted, and a proactive process for implementing traffic calming measures throughout the City was presented. Examples of common traffic calming treatments were shown, including pavement marking treatments, roadway narrowing treatments, and horizontal and vertical deflection treatments. Two breakout sessions were conducted to gather feedback from Councillors relating to the following:

- Which locations should be prioritized for traffic calming treatments;
- Whether resources should be increased to shift to a more proactive approach for traffic calming;
- The role of residents and the community in approving and implementing traffic calming;
- Which types of traffic calming treatments should require Council approval;
- Which engineering traffic calming treatments should be prioritized; and,
- Which education and enforcement traffic calming treatments should be prioritized.

A detailed summary of the discussions can be found in the memorandum in **Appendix F**.

10. Road Safety Countermeasures Plan

The countermeasures identified across the six emphasis areas are designated for a potential five-year implementation through the RSP. The countermeasures were prioritized based on the implementation importance, expected safety benefits, implementation costs, resource requirements, and potential for coordinating implementation with other programs. Timing and quantities of countermeasure deliverables may be subject to change, given the dependencies on project prioritization and budget.

In total, the Countermeasures Plan includes 92 unique countermeasures based on a data-driven approach, including 68 engineering countermeasures, 3 enforcement countermeasures, and 21 education and engagement countermeasures.

The status of each supporting activity and countermeasure has been defined using the four categories below:

- **Existing (EX)** – These countermeasures have already been implemented within the City and are to be retained at the current level of effort;

- **Expanded (EXP)** – Existing programs to be expanded;
- **Future (FUTR)** – Future new countermeasures selected by the City and partner agencies; and,
- **Recommended (REC)** – Additional new countermeasures recommended by the consultant team.

Further details on each countermeasure (i.e. unit cost range, CMFs, leading agencies, supporting agencies, and implementation considerations) are summarized in **Appendix D**. The following sub-sections include a breakdown of the administrative and emphasis area-specific countermeasures included in the Countermeasures Plan.

10.1 Road Safety Management Countermeasures

Road safety management countermeasures refer to a broad range of tasks and functions that contribute to the effective functioning and success of the RSP. These countermeasures encompass various administrative, logistical, and operational tasks that are essential for the smooth execution of the Countermeasures Plan. Examples of road safety management countermeasures include a road safety database update, data analysis including network and systemic screening reviews, road safety audits, and more.

The road safety management countermeasures included in the RSP are required to implement the recommended countermeasures. The importance of these road safety management countermeasures lies in their ability to create a solid foundation for the RSP, ensuring that resources are managed efficiently, communication is clear, and stakeholders are engaged and informed. Without effective road safety management countermeasures, the core objectives of the RSP may face challenges such as unclear communication channels and a lack of overall coordination. Therefore, these road safety management countermeasures play a crucial role in enhancing the overall effectiveness and success of the RSP.

The Countermeasures Plan includes 29 road safety management countermeasures, including 20 engineering countermeasures and 9 education and engagement countermeasures.

10.2 Emphasis Area-Specific Countermeasures

Countermeasures are selected with an initial emphasis area in mind but often impact multiple emphasis areas. For example, a countermeasure designed to prevent vehicle-to-vehicle collisions at an intersection may also prevent collisions involving pedestrians or cyclists at the intersection. In the Countermeasures Plan (**Appendix D**), countermeasures are listed only once, and each is connected to the emphasis area for which the countermeasure is expected to have the highest impact.

The estimated impact of countermeasures, as outlined in the Countermeasures Plan, often requires detailed analysis to determine the necessary scale of implementation, which may vary significantly in the future. For engineering countermeasures, the scope of implementation considers the number of potential candidate sites; however, not all of these sites are guaranteed to be improved. For enforcement countermeasures, the duration, number of officers, and frequency of enforcement requires an in-depth review to assess effectiveness. Similarly, the scale and cost of educational programs will depend on the approach used to reach the target audience, including the medium and duration of the messaging. Ultimately, the degree of success of the RSP at reducing collisions is influenced by the degree of effort and investment. If safety improvement is not achieved, more resources will need to be allocated.

The following sections present the countermeasures. While some can be implemented immediately, others require funding or formal approvals, and some depend on larger projects' timelines, such as road construction or provincial outreach campaigns. The countermeasures plan below is intended for the five-year time frame but also shows long-term measures that will likely have to be implemented outside the first five years of the RSP. Long-term countermeasures still require planning and approvals to be obtained in the near future to ensure these programs are implementable in the future.

The location-based countermeasures are required to be implemented at priority sites identified through a data-driven exercise. The project team developed a site selection methodology to prioritize locations for implementing key countermeasures and, based on this approach, identified a list of potential sites, as described in **Section 11**. In addition, it is recommended that the City conduct a separate screening process to identify collision-prone locations with the highest potential for safety improvements. Specifically, the Empirical Bayes network screening (as per the Highway Safety Manual) and a systemic safety review (as per the Federal Highway Administration approach) are recommended.

The primary goal of network screening is to assess the safety performance of sites based on their unique collision history to identify those sites with the greatest potential for safety improvements. The network screening process is reactive in nature, as it relies on the occurrence of collisions to identify sites requiring safety intervention. While the network screening approach is valuable in identifying high-priority sites, it could ignore or downplay the importance of sites that experience a lower collision frequency but present risk factors that increase the potential for collisions.

To address this limitation of the network screening process, a network-wide systemic safety review of the City's road network must also be conducted. Systemic safety analysis is a proactive, data-driven approach to identifying roadway facilities with multiple collision risk factors. The systemic safety analysis is focused on roadway and environmental collision characteristics rather than prior collision history. This review entails prioritizing facilities (i.e. intersections and road segments) based on environmental collision risk factors (i.e. roadway features strongly associated with specific collision types). According to the FHWA, this approach supplements traditional site analysis and also helps agencies broaden their traffic safety efforts by considering collision risk factors along with collision history when identifying where to make low-cost safety improvements.

It is recommended that countermeasures are deployed at sites identified as high priority based on the comprehensive safety assessments mentioned above, as well as the results of the site selection process described in **Section 11**. However, it is imperative to conduct thorough engineering evaluations at each of these sites to identify the location-specific collision trends, risk factors, and appropriate countermeasures to mitigate the identified concerns.

10.2.1 Intersections

Within the five-year collision study period, **collisions at intersections contributed to 61% of fatal and injury collisions** on City roads. The most common intersection-related collision impact types were angle collisions, single motor vehicle (SMV) collisions, turning movement collisions, rear end collisions, and collisions involving pedestrians and cyclists. Turning movement collisions, angle collisions, and collisions involving pedestrians and cyclists are best addressed through engineering countermeasures, which can directly target the contributing factors to those types of collisions. Rear end and single motor vehicle collisions likely overlap with aggressive and distracted road user collisions.

In total, the intersections emphasis area has 12 countermeasures which are all engineering countermeasures. Intersection countermeasures tend to be more location-specific, as intersections can be unique in design and vary in volume and capacity. Some countermeasures are better suited to be incorporated into future capital projects. Some low-cost countermeasures such as turn restrictions, left-turn traffic calming, or signal timing improvements may be good candidates for systemic implementation that can effectively increase safety.

Table 2 lists a sample of the countermeasures that are effective at reducing the frequency and/or severity of collisions occurring at intersections. More details on the countermeasures (i.e. unit cost range, CMFs, leading agencies, supporting agencies, and implementation considerations) for intersections are found in **Appendix D**.

Table 2: Sample of Intersection Countermeasures

Countermeasure	Description	Effectiveness	Status *
Traffic Signals	Install traffic signals where warranted.	Reduction in the frequency and/or severity of turning movement collisions and angle collisions.	EXP
Roundabouts	Implement roundabouts where appropriate.	Reduction in the frequency and/or severity of all collisions at intersections.	FUTR
Left-Turn Lane Offset	Define key locations for the implementation of left-turn lane offsets. Left-turn lane offsets create better visibility for both the turning vehicle and oncoming traffic.	Reduction in the frequency and/or severity of left-turning movement collisions.	FUTR
Left-Turn Signal Phases (Protected / Protected + Permissive)	Implement protected turning movements to provide turning vehicles exclusive right-of-way in sequence, reducing collisions with oncoming vehicles, cyclists and pedestrians.	Reduction in the frequency and/or severity of left-turning movement collisions and pedestrian collisions.	EX
Left-Turn Lanes	Implement left-turn lanes at intersections when applicable, especially in free-flow conditions, to reduce rear end collisions.	Reduction in the frequency and/or severity of left-turning movement collisions and rear end collisions at intersections.	EXP

*The abbreviations used in this field are defined in **Section 10**.

10.2.2 Vulnerable Road Users

Collisions involving vulnerable road users almost always result in injury, often serious. Within the five-year study period, **collisions involving pedestrians contributed to 18% of fatal and injury collisions** on City roads, while **collisions involving cyclists contributed to 11% of fatal and injury collisions** on City roads. The majority of injury collisions involving pedestrians and cyclists occurred at intersections (71% for pedestrians, 75% for cyclists). One fatal collision involving a pedestrian was recorded in 2022.

In total, there are 22 countermeasures for vulnerable road users, including 18 engineering countermeasures and 4 education and engagement countermeasures. Many countermeasures for vulnerable road user safety are also effective for other emphasis areas, such as intersections, distracted road users, and/or aggressive driving.

For collisions involving vulnerable road users, the selected countermeasures include infrastructure improvements and changing road users' behaviours. Engineering countermeasures that can be implemented in the short-term include bicycle signals, crosswalks and crossrides, illumination improvements, and leading pedestrian intervals (LPIs).

Table 3 lists a sample of the countermeasures that are effective at reducing the frequency and/or severity of collisions involving vulnerable road users. More details on the countermeasures (i.e. unit cost range, CMFs, leading agencies, supporting agencies, and implementation considerations) for vulnerable road users are found in **Appendix D**.

Table 3: Sample of Vulnerable Road Users Countermeasures

Countermeasure	Description	Effectiveness	Status *
Setback Pedestrian Crosswalks	Install setback pedestrian crosswalks where applicable. Setback pedestrian crosswalks are crosswalks positioned a short distance away from the intersection, creating a buffer zone to improve pedestrian visibility and safety by reducing conflicts with turning vehicles.	Reduction in the frequency and/or severity of pedestrian collisions at intersections.	FUTR
Pedestrian Signals	Install pedestrian signals where warranted.	Reduction in the frequency and/or severity of pedestrian collisions at midblock segments.	EXP
Illumination at Active Transportation Facilities	Install or upgrade street lighting specifically designed to highlight pedestrian and cyclist crossings and enhance safety. Improved illumination for active transportation facilities provides increased visibility and safety, especially in low-light or nighttime conditions.	Reduction in the frequency and/or severity of collisions involving active transportation users (pedestrians, cyclists, micromobility).	EXP
Bicycle Signals	Install dedicated signals for cyclists at signalized intersections. Bicycle signals are often implemented in conjunction with special signal timings or phasing for cyclists.	Reduction in the frequency and/or severity of cyclist collisions at signalized intersections.	FUTR
Expand Existing Sidewalk Network Completion	Expand the current capital program to install new sidewalks, completing the City's network.	Reduction in the frequency and/or severity of pedestrian collisions at midblock segments.	EXP

*The abbreviations used in this field are defined in **Section 10**.

10.2.3 School Zones

School zone safety was identified in the top five priority areas in the online survey and was discussed during Stakeholder Meeting #1. Children are among the most vulnerable road users, making school zone safety crucial. Countermeasures like crossing guard programs, systemic intersection improvements near schools, school zones, and school streets programs all promote safer driving near schools. Prioritizing child safety in these areas advances the City's vision to create a safer transportation system that enables all road users to travel safely without experiencing serious injury or death. The City has already implemented some of the recommended countermeasures. In addition, the City is developing a **School Zone Safety Guide** in parallel to the RSP, which aims to identify engineering policies and treatments to promote safer environments at or near schools and provide a direction for the expansion of the City's school safety and active travel programs.

In total, the school zones emphasis area has 10 countermeasures which include 5 engineering countermeasures, 1 enforcement countermeasure, and 4 education and engagement countermeasures.

Table 4 lists a sample of the countermeasures that are effective at reducing the frequency and/or severity of collisions occurring near schools. More details on the countermeasures (i.e. unit cost range, CMFs, leading agencies, supporting agencies, and implementation considerations) for school zones are found in **Appendix D**. Note that the City's **School Zone Safety Guide** study also resulted in recommendations to improve road safety within school zones, some of which overlap with the countermeasures identified in the RSP. Further coordination will be required to ensure that countermeasures are implemented and monitored accordingly.

Table 4: Sample of School Zone Countermeasures

Countermeasure	Description	Effectiveness	Status *
40 km/h Backpack Program	Implement a 40 km/h Backpack Program. The program visually remind drivers to slow down in school zones through backpacks worn by students.	Reduction in the frequency and/or severity of collisions near school zones.	FUTR
Systemic Intersection Improvements Near Schools	Implement improvements to all intersections near existing schools and include safety reviews at intersections for all new schools.	Reduction in the frequency and/or severity of all collisions at intersections near school zones.	FUTR
Traffic Management Plan and School Area Review	Develop customized Traffic Management Plans (TMPs) for school sites to improve traffic flow. Work with schools to implement engineering solutions for any identified concerns.	Reduction in the frequency and/or severity of collisions near school zones.	FUTR
School Zone Enforcement	Introduce targeted police enforcement in school zones to address concerns such as parking violations, stop sign compliance, speeding, and other traffic issues.	Reduction in the frequency and/or severity of collisions near school zones.	FUTR
Intersection Safety School Program	Add an intersection safety module to the fire safety teaching plans for Markham Fire Suppression crews, who currently teach fire safety to all students in grades 1-4 within the City.	Reduction in the frequency and/or severity of all collisions at intersections.	FUTR

*The abbreviations used in this field are defined in **Section 10**.

10.2.4 Aggressive Driving

Aggressive driving consists of driver actions that include following too closely, exceeding the speed limit, speed too fast for conditions, disobeying traffic control, and failing to yield right-of-way. Within the five-year collision study period, **collisions involving aggressive driving contributed to 53% of fatal and injury collisions** on City roads.

In total, the aggressive driving emphasis area has 14 countermeasures which include 11 engineering countermeasures, 2 enforcement countermeasures, and 1 education and engagement countermeasure. Aggressive driving countermeasures aim to change the behaviour of drivers and behavioural change is not immediate. To achieve measurable and timely results, engineering measures like speed feedback signs, red light cameras, or community safety zones can effectively deter aggressive driving.

Table 5 lists a sample of the countermeasures that are effective at reducing the frequency and/or severity of collisions involving aggressive drivers. More details on the countermeasures (i.e. unit cost range, CMFs, leading agencies, supporting agencies, and implementation considerations) for aggressive driving are found in **Appendix D**.

It should be noted that City Council previously adopted a policy prohibiting the installation of vertical deflection traffic calming treatments on City roadways due to concerns from the Fire Department, York Region Transit (YRT), and the Toronto Transit Commission (TTC). It is recommended that this moratorium be lifted to implement vertical deflection countermeasure , as these treatments such as speed cushions are shown to be effective in specific cases and their design variations accommodate heavy vehicles, including fire trucks and buses.

Table 5: Sample of Aggressive Driving Countermeasures

Countermeasure	Description	Effectiveness	Status *
Red Light Camera Program	Implement automated enforcement for red light violations at signalized intersections to reduce intentional red light running and minimize right-angle collisions.	Reduction in the frequency and/or severity of angle collisions. However, the frequency of rear end collisions might increase.	FUTR
Community Safety Zones	Implement additional Community Safety Zones (CSZ) where appropriate. A CSZ is a designated area on a roadway where traffic violations (e.g., speeding) are subject to higher fines and penalties.	Reduction in speed and the frequency and/or severity of all collisions in CSZs.	EXP
Automated Speed Enforcement	Implement Automated Speed Enforcement in Community Safety Zones and school zones.	Reduction in speed and the frequency and/or severity of all collisions.	REC
Pavement Markings	Install traffic calming pavement markings, such as stencils, flush medians, edge lines, centrelines, and peripheral transverse bars, at appropriate locations.	Reduction in speed and the frequency and/or severity of all collisions.	EXP
Vertical Deflection	Install vertical deflection traffic calming treatments such as speed cushions and raised crosswalks at appropriate locations.	Reduction in speed and the frequency and/or severity of all collisions.	REC

*The abbreviations used in this field are defined in **Section 10**.

10.2.5 Distracted Road Users

Distracted driving has become one of the leading causes of injury and death on Ontario roads. Police code collisions involving distracted driving as the driver being "inattentive", but police officials note that it is likely that this type of collision is underreported, as it is difficult to establish this condition in many cases. Within the five-year collision study period, **collisions involving distracted driving contributed to 15% of fatal and injury collisions** on City roads. Based on discussions during Stakeholder Meeting #1, this emphasis area was expanded to include all distracted road users.

In total, there are 3 countermeasures for distracted road users, including 2 engineering countermeasures and 1 education and engagement countermeasure. Like aggressive driving, changing road user behaviour will reduce the number of distracted road user collisions. For measurable and effective changes in a timely manner, engineering countermeasures such as guide rail upgrades and enhanced pavement markings can be implemented.

Table 6 lists the countermeasures that are effective at reducing the frequency and/or severity of collisions involving distracted road users. More details on the countermeasures (i.e. unit cost range, CMFs, leading agencies, supporting agencies, and implementation considerations) for distracted road users are found in **Appendix D**.

Table 6: Distracted Road Users Countermeasures

Countermeasure	Description	Effectiveness	Status *
Guide Rail Upgrades	Upgrade guide rail and end treatments to the latest MASH standards.	Reduction in the frequency and/or severity of collisions near water, ditches.	FUTR
Enhanced Pavement Markings	Introduce enhanced pavement markings where appropriate. Enhanced pavement markings use durable and highly visible materials, such as reflective paint or thermoplastics, to enhance visibility and guide drivers.	Reduction in the frequency and/or severity of single motor vehicle collisions.	EX
"Distracted-Free Driving" Awareness Days	Encourage no-phone driving through workplace policies and promote the use of technology solutions, such as smartphone apps and features (e.g., "Do Not Disturb" mode or apps that block notifications while driving or in motion).	Reduction in the frequency and/or severity of distracted driving collisions.	FUTR

*The abbreviations used in this field are defined in **Section 10**.

10.2.6 Young Drivers

Young drivers aged 15 to 29 represent the largest demographic for at-fault collisions, with **young drivers being at fault in 29% of fatal and injury collisions** on City roads. In total, there are 2 countermeasures for young driver collisions, both of which are education and engagement countermeasures, which will take a period of time to have a measurable effect on road safety.

Table 7 lists the countermeasures that are effective at reducing the frequency and/or severity of collisions involving young drivers. More details on the countermeasures (i.e. unit cost range, CMFs, leading agencies, supporting agencies, and implementation considerations) for young drivers are found in **Appendix D**.

Table 7: Young Drivers Countermeasures

Countermeasure	Description	Effectiveness	Status *
Alcohol and Drugs Youth Programs	Continue to provide the Alcohol and Drugs Youth Program offered by the York Region Public Health. This program is free of cost and conducted throughout the school year.	Reduction in the frequency and/or severity of impaired driving collisions involving young drivers.	EX
Young Drivers Education Campaign	Increase young driver road safety awareness through programs related to distracted driving and impaired driving (i.e., alcohol and drug use) in secondary schools. Publicize and enforce seat belt laws.	Reduction in the frequency and/or severity of young driver collisions.	REC

*The abbreviations used in this field are defined in **Section 10**.

10.3 Road Safety Countermeasures Plan Summary

Table 8 summarizes the Vision Zero Road Safety Plan's countermeasures. Further details can be found in the Countermeasures Plan (**Appendix D**).

Table 8: Number of Countermeasures per Emphasis Area

Emphasis Area	Countermeasure Type			Total
	Engineering	Enforcement	Education / Engagement	
Administrative	20	-	9	29
Intersections	12	-	-	12
Vulnerable Road Users	18	-	4	22
School Zones	5	1	4	10
Aggressive Driving	11	2	1	14
Distracted Road Users	2	-	1	3
Young Drivers	-	-	2	2
Total	68	3	21	92

11. Site Selection

In addition to the countermeasures presented in **Section 10**, the project team developed a site selection methodology to prioritize implementation of the proposed location-specific countermeasures at locations that have the highest potential for safety improvements. Overall, the proposed methodology ranks sites based on the presence or magnitude of specific target issues and/or target conflicts associated with each countermeasure, while also considering elements such as cost-effectiveness, warrants, rankings from network screening and systemic safety reviews, and site applicability and feasibility of implementation. The proposed site selection methodology is summarized in **Figure 9**. The full site selection methodology memorandum including the potential sites identified for key countermeasures are presented in **Appendix G**.

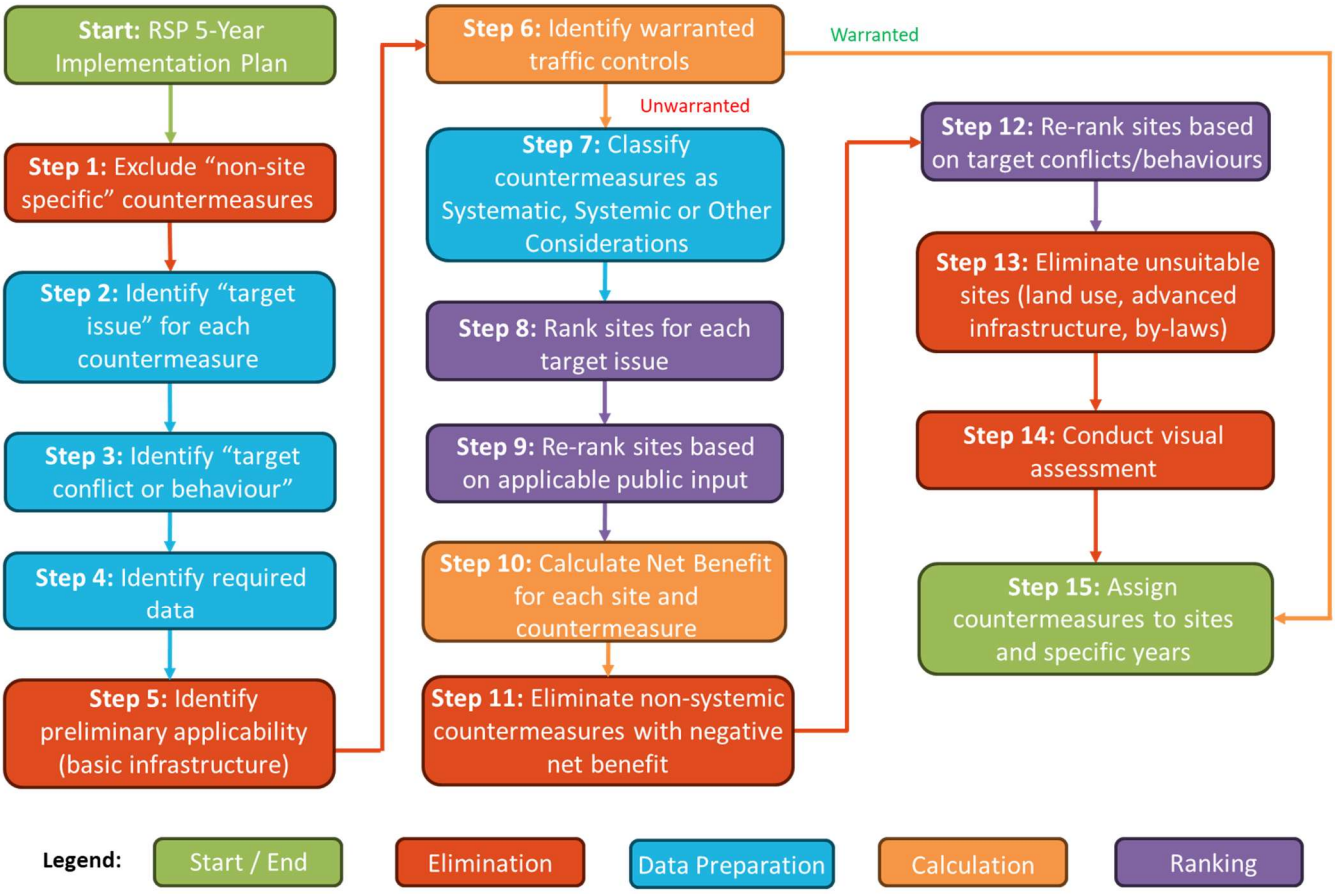


Figure 9: Proposed Site Selection Process

12. Policy Papers

The project team also developed several policy papers to guide the implementation of the RSP. The following policy papers are summarized in this section:

- Community safety zones;
- Fatal and serious injury collision investigation;
- Intersection sight distances;
- Left-turn phasing;
- Traffic calming and speed management; and,
- Traffic inquiry process.

The full policy papers are presented in **Appendix H**.

12.1 Community Safety Zones

One of the countermeasures identified for aggressive driving collisions is Community Safety Zones (CSZs), which are specific areas where additional safety measures are enforced to protect the public, particularly vulnerable groups such as pedestrians, cyclists, and children. Traffic violations that occur within CSZs are subject to higher fines and penalties, allowing for strict enforcement of traffic laws. The project team undertook an environmental scan of CSZ policies for other municipalities in Ontario, which was used to develop a proposed policy for the City of Markham. It was recommended that the City implement CSZs at all existing and future school zones, as well as other road segments based on a two-step warrant methodology. The first step of the warrant involves identifying special areas of concern such as parks, recreational facilities, healthcare centres, daycare centres, and senior living communities. Once appropriate areas are identified, a detailed assessment of specific risk factors should be undertaken, including a review of traffic volumes, collision history, operating speeds, pedestrian volumes, and other factors. Further details can be found in the full policy paper in **Appendix H**.

12.2 Fatal and Serious Injury Collision Investigation

The City has also requested an update to their policies and procedures for conducting fatal and serious injury collision investigations based on best practices in Ontario. The purpose of these investigations is to conduct a multi-faceted review to understand the circumstances of the collision, causal factors that contributed to it, and any potential mitigation measures to lessen the likelihood of a collision occurring in the future. The proposed enhanced policy is summarized in **Figure 10**.

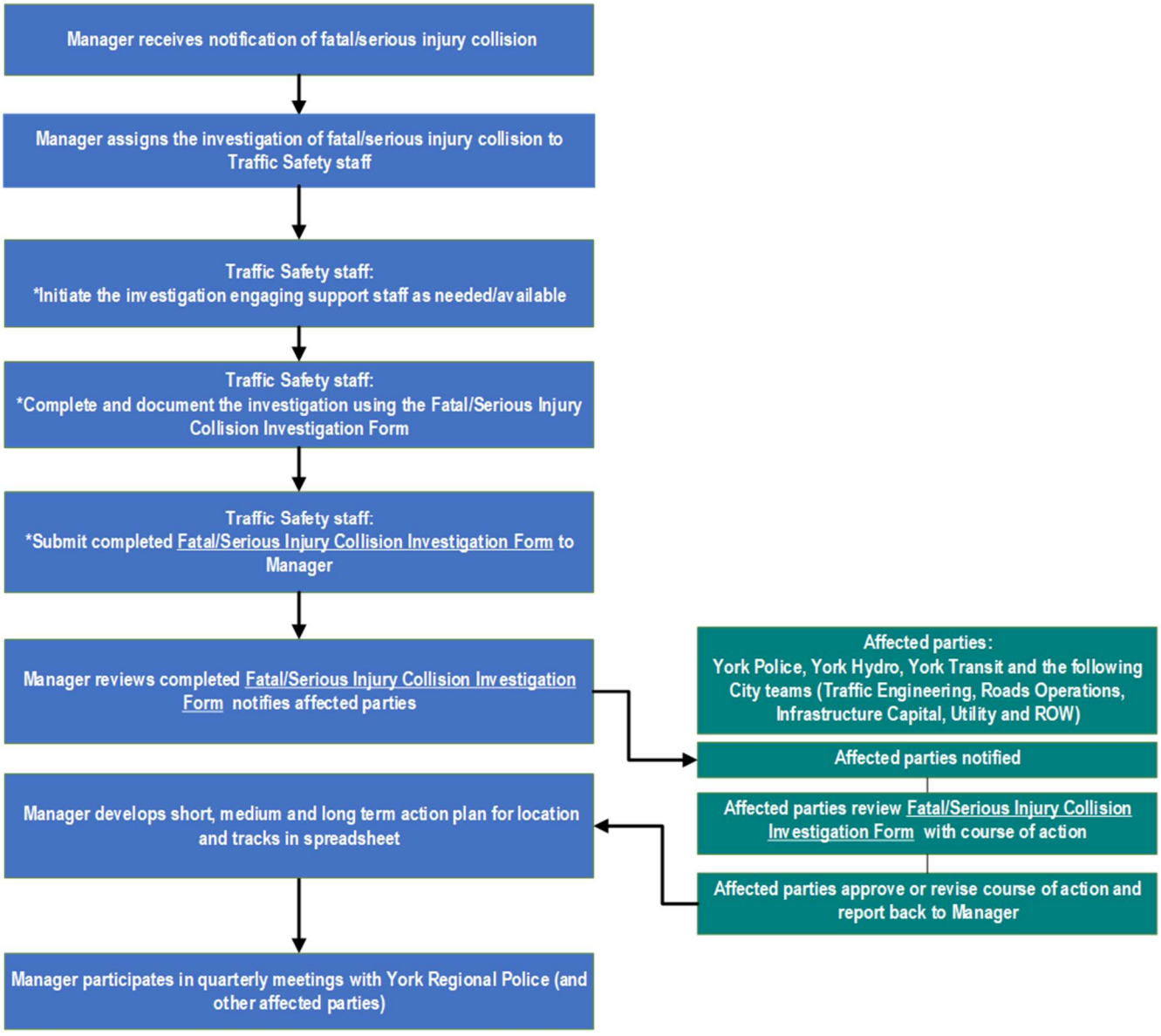


Figure 10: Flow Chart for Fatal and Serious Injury Collision Investigation Policy

12.3 Intersection Sight Distances

The project team also developed a policy paper that summarizes different types of intersection sight triangles and provides recommendations detailing minimum distances and dimensions required for sightlines and daylight triangles. Guidelines were also developed for sightlines for transit shelters and vulnerable road users, as well as signage for driveways and accesses. The policy paper also outlines procedures for measuring sight distances and potential mitigation measures for locations with insufficient sightlines. Further details can be found in the full policy paper in **Appendix H**.

12.4 Left-Turn Phasing

A review of the City's current policies and practices for left-turn signal phasing was conducted to develop a process to implement protected-permissive and fully protected left-turn phasing. Based on an environmental scan and the City's existing left-turn phase implementation methodology, recommendations were made to assist with determining the need for a left-turn phase, the type of left-turn phase, and time-of-day operations. Further details can be found in the full policy paper in **Appendix H**.

12.5 Traffic Calming and Speed Management

A policy for the implementation of traffic calming and speed management measures was also developed based on existing procedures in the City of Markham as well as an environmental scan. The proposed process for setting base speed limits and conducting a network review of posted speeds is shown in **Figure 11**, while **Figure 12** shows the proposed process for conducting a traffic calming program. As mentioned earlier, vertical deflection traffic calming measures should be reintroduced in the City. Historical concerns from emergency services and transit agencies should be considered, with speed cushions serving as a potential approach to mitigate impacts to emergency response times and transit service reliability.

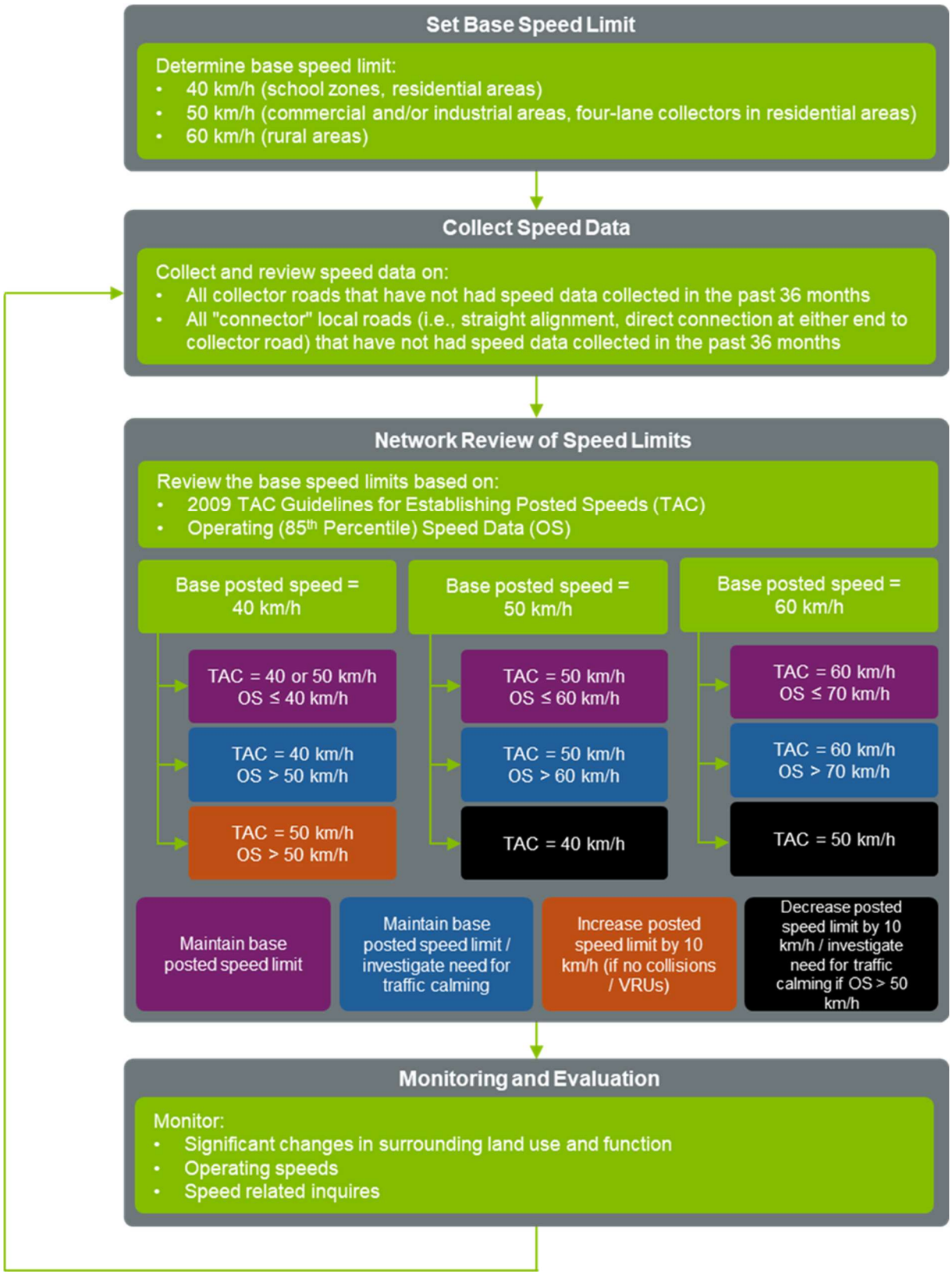


Figure 11: Speed Limit Selection Process

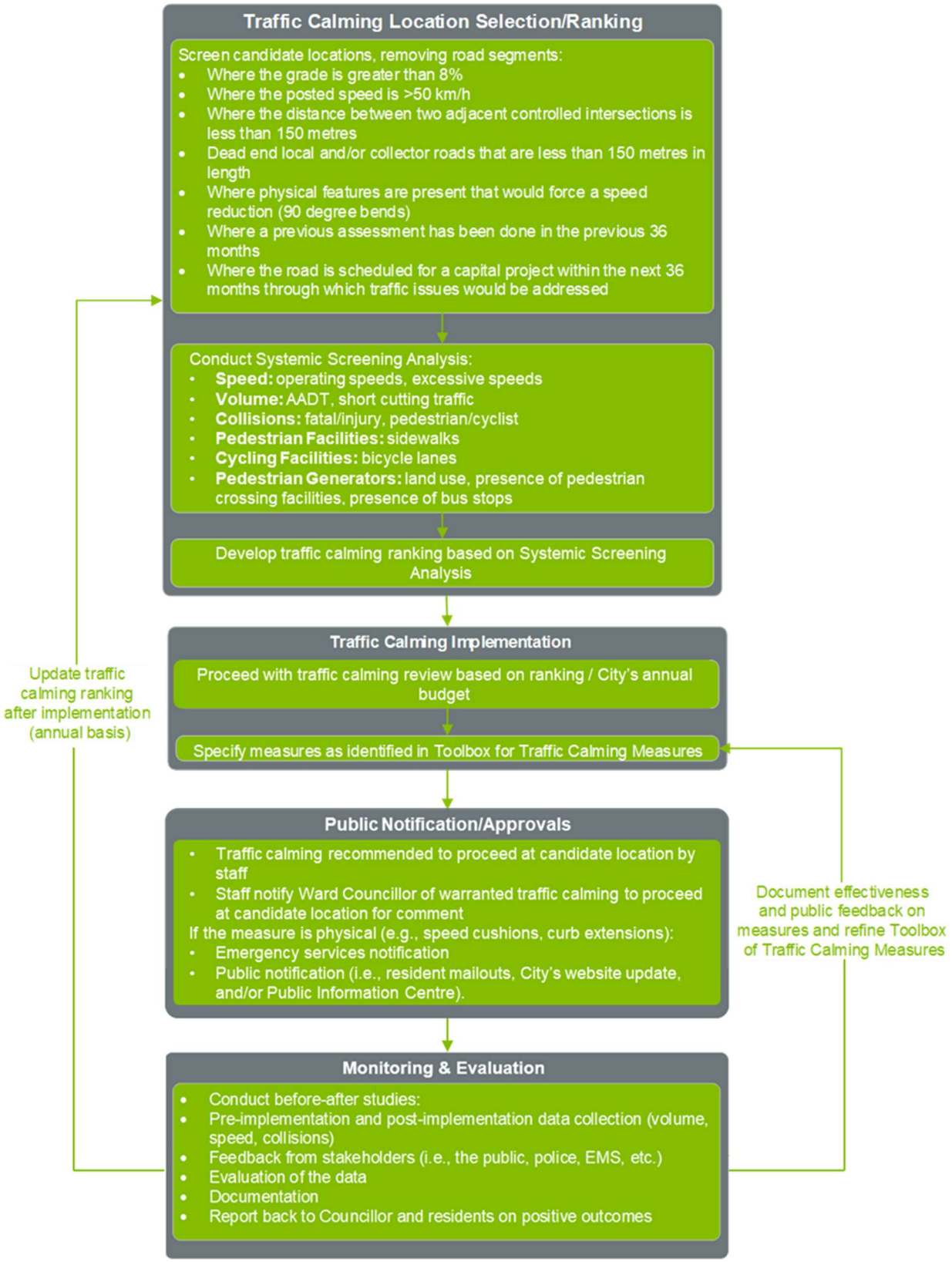


Figure 12: Traffic Calming Program Process

12.6 Traffic Inquiry Process

The project team conducted a review of the City's existing procedures for responding to traffic inquiries from residents and developed recommendations to enhance the process based on an environmental scan of other jurisdictions. A summary of the proposed procedure is summarized in **Figure 13** and includes recommendations on record keeping, prioritizing inquiries, and setting timelines for providing responses.

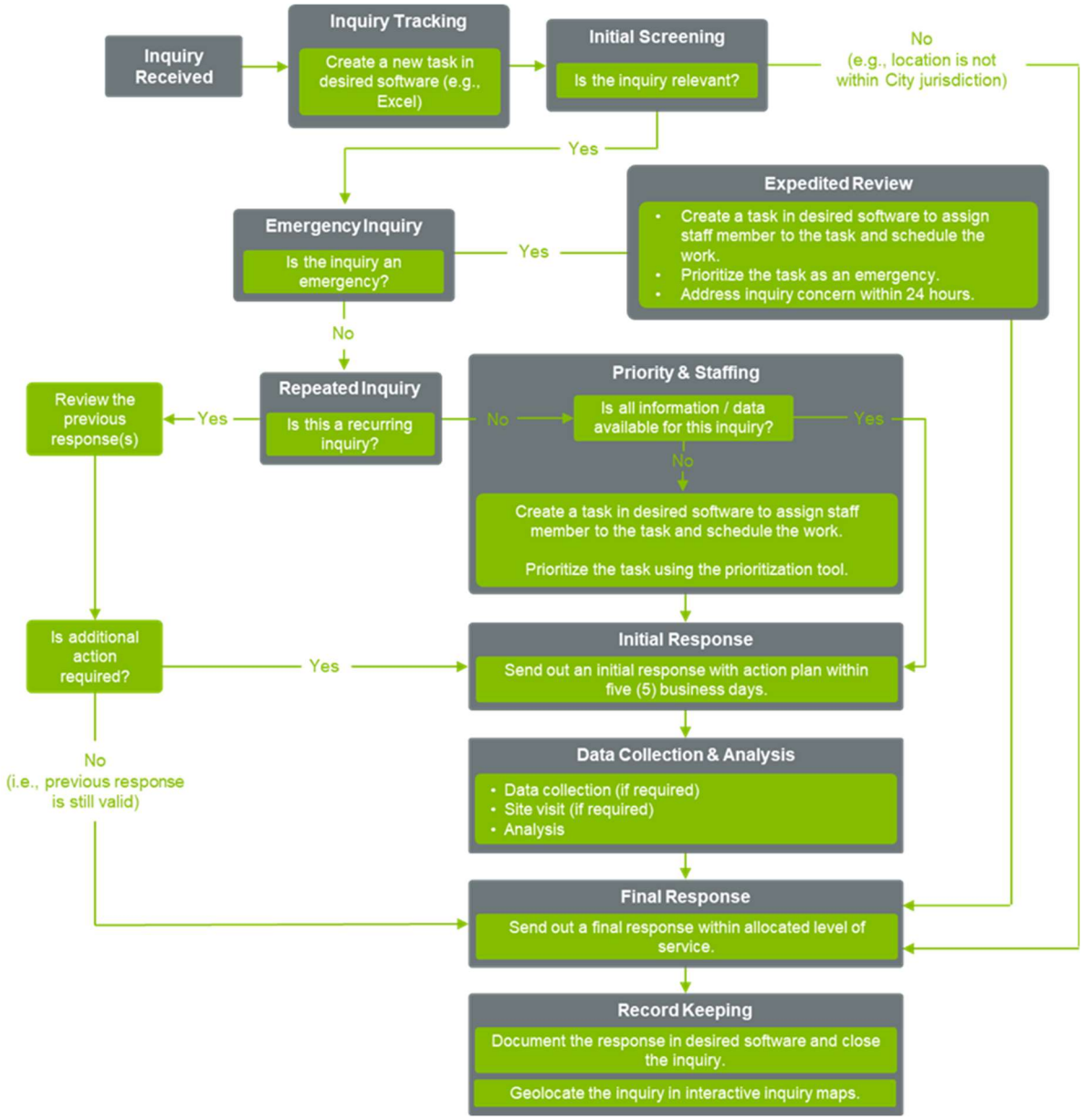


Figure 13: Traffic Inquiry Process Flowchart

13. Enhancement of City's Strategies and Guidelines

A review of the City's existing community engagement strategies and design guidelines was undertaken by the project team to develop recommendations for enhancements.

13.1 Community Engagement Strategies

Potential improvements to the City's communications and engagement strategies were recommended by the project team following an interview with the City to gather information on existing practices. Recommendations include developing a formalized communications strategy, clearly identifying objectives and goals of community engagement efforts, selecting appropriate communications tools for a target audience, developing messaging based on data-driven insights, conducting continuous monitoring and evaluation of the effectiveness of community engagement efforts, providing dedicated communications staff and training for road safety, and exploring collaboration opportunities with internal and external stakeholders. Further details can be found in the full memorandum in **Appendix I**.

13.2 Design Guidelines Update

The project team also reviewed the City's existing Design Engineering Standards and Practices and conducted an environmental scan of other jurisdictions to develop recommendations for enhancements that integrate road safety through all stages of the planning and design process of transportation and infrastructure projects. These recommendations include changes to the general approach to the planning and design process, incorporating Road Safety Audits or In-Service Road Safety Reviews into capital infrastructure projects, developing an Intersection Control Study process, revisions to the existing engineering design guidelines, and proposed road safety practices for the City. Further details can be found in the full memorandum in **Appendix J**.

14. Implementation Activities

The RSP forms the framework for developing a fully implemented road safety program in the City. The RSP requires the commitment of the City and partner agencies and the approval of additional human and financial resources to implement the Countermeasures Plan.

Before executing the RSP Countermeasures Plan, it is crucial to establish a foundation for the RSP. This foundation consists of six steps that are shown in **Figure 14**.



Figure 14: Vision Zero Road Safety Plan Implementation Process

14.1 Organizational Structure for Road Safety Delivery

The path to creating a successful and sustainable Vision Zero Road Safety Plan in Markham requires strong leadership and the City's continuous commitment to champion and establish a strong positive traffic safety culture (PTSC) among all stakeholders. Establishing an organizational structure supported by close collaboration among the various departments and divisions is essential for successfully implementing the RSP Countermeasures Plan.

The *National Cooperative Highway Research Program (NCHRP) Report 501* provides guidance on the ideal organizational structure for a successful road safety plan, also known as an Integrated Safety Management System (ISMSystem).

Additional staff and/or staff time (in the form of new hires or reallocation of existing staff) is required, as a significant effort needs to be allocated to analyze safety data, develop specific programs, implement countermeasures, and monitor results. Full-time equivalent (FTE) staff (i.e., Program Manager, Data Analysts, Safety Technologists etc) can be phased in for future years, through the annual budget cycles, to facilitate specific functions and roles necessary to successfully deliver the Plan.

An organizational structure defines the roles and responsibilities of the professionals and their agencies while securing the coordination essential for managing and implementing the RSP. The organizational structure proposed for the City of Markham to manage and implement the Vision Zero Road Safety Plan is shown in **Figure 15** and is as follows:

- **Road Safety Plan Leadership (RSPL) Committee** is formed by internal and external stakeholders, including professionals at the safety management and decision-making level at each partner agency;
- **Program Manager (PM)** is a full-time dedicated professional appointed to be the City coordinator and the main point of contact among all partner agencies;

- **Data Analysis and Evaluation (DAE)** is formed by one or more data analysts who will be responsible for all data-related management supporting the RSP and Road Safety Management System; and,
- **Emphasis Area (EA) Working Groups** are formed by City professionals who execute the RSP Countermeasures Plan. There are two primary EA Working Groups (Infrastructure and Behavioural) which encompass the six Emphasis Areas of the RSP.

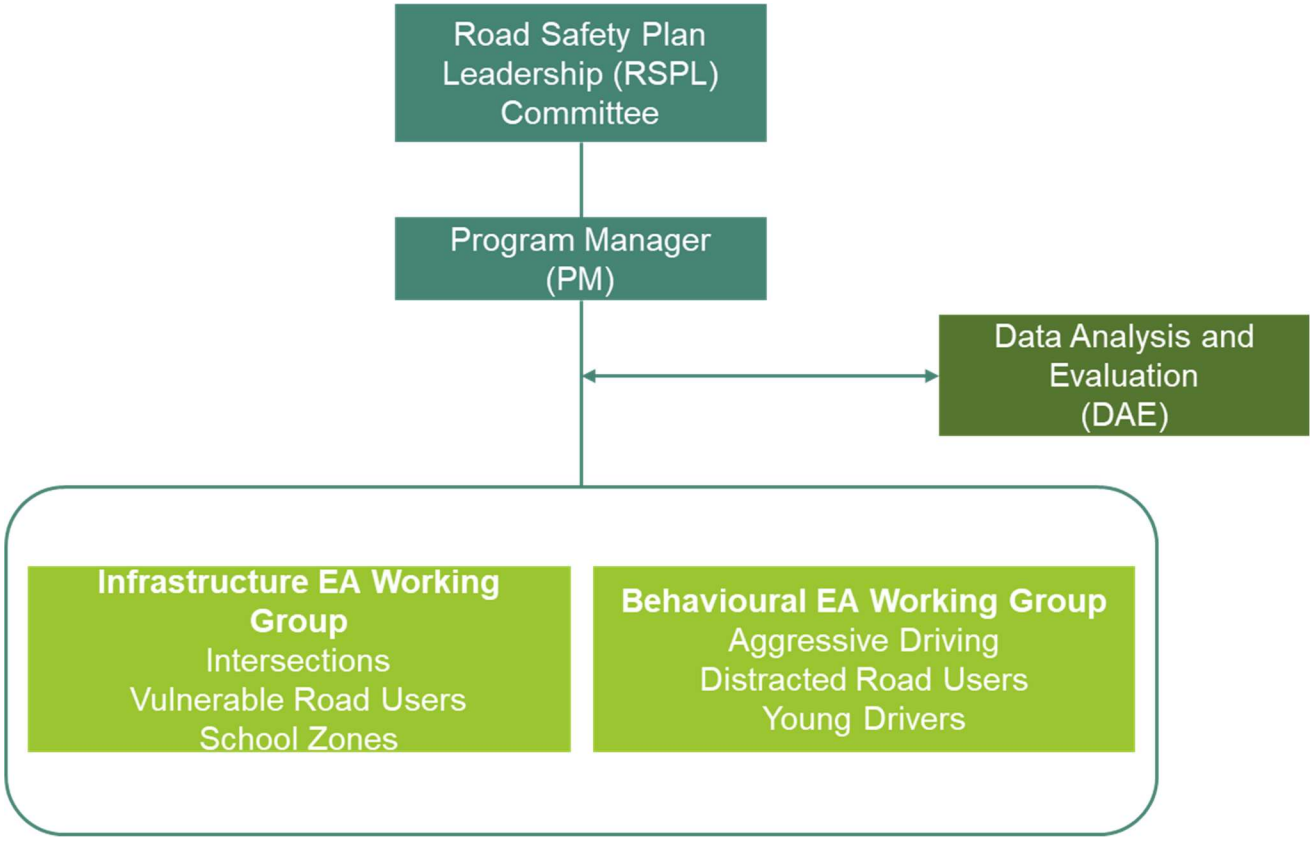


Figure 15: Vision Zero Road Safety Plan Organizational Structure

14.1.1 Road Safety Plan Leadership (RSPL) Committee

The RSPL Committee is the point of leadership, decision-making, and accountability at the highest level in the organizational structure of the RSP. Members of the RSPL Committee may include internal and external stakeholders. Committee members will be safety champions in their departments and divisions (i.e. traffic engineering, roads operations, etc.) as well as champions in their own agency (i.e. York Regional Police, school boards, etc.). Based on the RSPL Committee's meeting agenda, there will be core/permanent members and ad-hoc members.

The RSPL Committee is responsible for managing the RSP by ensuring reliable data collection programs, evaluating the impact performance (i.e. safety effectiveness of strategies), and process performance (i.e. implementation schedule of strategies). The RSPL Committee is also responsible for ensuring that resources are in place to implement the actions and safety programs endorsed by internal and external stakeholders and realize the countermeasures found in the RSP Countermeasures Plan or new ones recommended by the Working Groups.

There must be clear, open, and uninhibited lines of communication, coordination, and cooperation among all internal and external stakeholders and complete up-to-date documentation. The City is recommended to assign a main point of contact (i.e. the professional responsible for actively participating in the RSPL Committee meetings, making decisions, and transferring safety knowledge into implementation) for their road safety program.

Typically, the "final" decision makers at municipalities are not staff and are not directly involved when developing safety programs and selecting priorities. Generally, the "final" decision makers at municipalities are senior management and the City Council. It is recommended that the final decision makers be invited to relevant meetings of the RSPL Committee. It is envisioned that their exposure to the safety processes and meetings will increase their support and approvals. Additional ad-hoc participants to the RSPL Committee's meetings may include representatives from City municipal departments, enforcement personnel, boards of education, health services, university researchers, consultants, the Ministry of Transportation, and more.

The RSPL Committee will, jointly with the City's Data Analysis and Evaluation (DAE) Unit, adopt the key performance indicators (KPIs) and devise the data collection before, during, and after the implementation of countermeasures and programs to allow for evaluations at all stages of the RSP. The KPIs include measurements of the impact performance (i.e. safety effectiveness of strategies) and process performance (i.e. implementation schedule of strategies). The impact and process performances indicate how the implementation of the RSP is progressing and how best to revisit the Countermeasures Plan annually to meet the annual objectives. The core/permanent members of the RSPL Committee will be:

- Program Manager of the RSP;
- Relevant Directors of the City;
- Data Analysis and Evaluation Unit representative; and,
- City Corporate Communications.

Additional ad-hoc members of the RSPL Committee, to be invited to meetings as required, include:

- York Regional Police;
- York Region Transit (YRT);

- York Region Traffic Safety;
- Markham Fire and Emergency Services;
- York Region Paramedic Services;
- Markham Cycling and Pedestrian Advisory Committee (CPAC) representatives;
- Markham Advisory Committee on Accessibility representatives;
- York Region Public Health;
- School Board representatives;
- Ministry of Transportation (MTO); and,
- Others as needed.

14.1.2 Program Manager

A full-time dedicated Program Manager should be appointed as the coordinator and main point of contact for all internal and external stakeholders. The Program Manager (PM) is directly responsible for the success of the RSP. The PM leads the day-to-day management of the road safety team, delivers update reports at the RSPL Committee meetings, liaises with the DAE Unit, liaises closely with the Working Group leads, works with internal and external stakeholders, coordinates and documents the implementation of the RSP actions (i.e. programs and countermeasures), and coordinates road safety into the regular capital reconstruction program. The Program Manager must have the authority to oversee and direct the City's road safety programs, projects, and initiatives.

14.1.3 Data Analysis and Evaluation (DAE) Unit

One or more data analysts should form the Data Analysis and Evaluation (DAE) Unit. External support, such as on-retainer consultants, may assist with the more complicated data analyses, such as statistical safety modelling, network-wide safety screenings, or before-after evaluations.

The DAE Unit leads the exploration of potential data sharing and mutual support among the internal and external stakeholders. Each stakeholder will identify its resources to fulfill the need for data collection, processing, and analysis to ensure reliable data-driven decision-making. The close coordination and cooperation among the internal and external stakeholders will enhance data reliability in the City.

Data reliability is assessed by timeliness, completeness, uniformity, integration, accessibility, and accuracy. The results of the analyses are only as sound as the data collected and processed for the analyses. The City should strive to collect data and assist in the development of:

- Critical safety databases of collision history, including severity of collisions (i.e. fatal, serious injury, minor injury, property damage only);

- Traffic volumes in terms of annual updates for the estimates of AADTs for every critical road segment and intersection in the City's road network (including motor vehicles by size, pedestrians, cyclists, and other modes of transportation);
- Up-to-date road infrastructure inventory; and,
- Travel speeds along road segments.

The DAE Unit reports the collision analytical findings and manages the road safety management process for the City, including annual network screening for the list of sites with the most potential for safety improvements and groups of sites for systemic projects supporting the strategies adopted by the RSPL Committee.

Transparency of the actions taken and measuring their safety effectiveness are vital for the specific and overall evaluations of the RSP. The evaluation findings lead to adjustments to the RSP for better outcomes. Thus, as stated earlier, adopting quantifiable KPIs and setting a continuous data collection program that enables trustworthy data-driven decisions are essential.

14.1.4 Emphasis Area Working Groups

The Emphasis Area (EA) Working Groups should consist of internal and external representatives that plan new or expanded actions for the selected emphasis area. The multi-disciplinary nature of each emphasis area will indicate the desired participants (e.g. engineering, planning, police, emergency services, education, communications, etc.). Guest agencies may attend the Working Group's meetings to learn from the initiatives and programs. In total, the City has six Emphasis Areas. Each Emphasis Area will be categorized into two EA Working Groups:

- **Infrastructure EA Working Group:** Including Intersections, Vulnerable Road Users, and School Zones Emphasis Areas. This Working Group focuses on improving the physical environment of the roads to enhance safety and reduce risk. Members of this working group are expected to have expertise in the design and/or delivery of engineering treatments.
- **Behavioural EA Working Group:** Including Aggressive Driving, Distracted Road Users, and Young Drivers Emphasis Areas. This Working Group focuses on addressing human factors contributing to traffic safety issues, such as road user behaviour, attitudes, and habits. Members of this working group are expected to have expertise in the development and/or delivery of enforcement and/or educational treatments.

Condensing the Emphasis Area (EA) Working Groups into two main teams improves efficiency by streamlining focus, optimizing resource allocation, and reducing time commitments. With fewer teams, participants can focus on broader, related strategies, enhancing collaboration and knowledge-sharing. This structure simplifies decision-making, reduces meeting demands, and ensures that resources and expertise are concentrated on the most critical safety issues. Ultimately, this approach fosters a more coordinated and effective execution of the RSP Countermeasures Plan.

The EA Working Groups are responsible for investigating and implementing strategies to address key safety concerns, with a focus on reducing collisions, injuries, and fatalities in alignment with the Vision Zero philosophy. The teams will work collaboratively across disciplines and agencies to ensure the success of the RSP's initiatives.

The EA Working Groups will report to the Program Manager as well as the RSPL Committee, summarizing the progress of initiatives, findings, and recommendations for future actions. Considering budget limitations, it is recommended that existing City staff members, as well as staff members from external organizations, are utilized to form Working Groups.

14.1.5 Staffing

The RSP requires more resources – not only financial, but also human resources. Additional staff and/or staff time (in the form of new hires or reallocation of existing staff) is required, as a significant effort needs to be allocated to analyze safety data, develop specific programs, implement countermeasures, and monitor results. It should be noted that the positions are intended to support the additional efforts required for the implementation of the Vision Zero Road Safety Plan. They are not intended to reduce the current workloads of staff to maintain the status quo. Additionally, these positions are meant to be dedicated entirely to safety-related work, rather than traffic-related tasks.

To ensure that efforts aimed at enhancing road safety are focused and effective, it is imperative to augment the team with a singular contact source for road safety. The new role of Program Manager (as described in **Section 14.1.2**) will be the main point of contact among all stakeholders and will coordinate the implementation of the RSP.

At its core, Vision Zero is a data-driven road safety philosophy with the objective of eliminating fatalities and serious injuries within the transportation system. A full-time data analyst will be required to review and assess collision data, road inventory data, and traffic count data. Easily accessible, up-to-date, and complete data is required to make informed road safety decisions and to prioritize road safety efforts at locations with potential for safety improvements. In addition, one full-time safety engineer will be needed to support the Program Manager in implementing activities and countermeasures in the RSP as well as aid in the facilitation of the EA Working Groups. Additional technologists will be needed to assist with the implementation of the City's road safety programs, including but not limited to the Automated Speed Enforcement Program, the Traffic Calming Program, the Fatal Collision Investigation Program, and the Traffic Safety Inquiry Program.

Effective communication is instrumental in creating awareness and garnering public support for road safety measures. A Communications Specialist focused on this area can tailor messages, campaigns, and outreach strategies specifically to the unique challenges and goals of road safety initiatives. Furthermore, having a Communications Specialist will ensure consistent messaging, coherent branding, and the ability to swiftly address and mitigate any misinformation or public concerns. By concentrating expertise in this critical aspect of road safety, the Communications Specialist will contribute significantly to fostering a safer road environment and cultivating a positive public perception of these vital initiatives.

In addition, collaboration among all partner agencies will help save resources and time. Through this project, teamwork with stakeholders has paved the road for knowledge exchange and future collaboration. The next step is to strengthen these relationship sand formalize the knowledge resource-sharing process to enable the RSP partner agencies to continuously collaborate and share resources for road safety delivery within the City. This also includes collaboration with other municipalities within York Region through the Region's TSP framework.

14.2 Institutionalizing Road Safety in Markham

While road safety is recognized as a top priority for the City and the involved RSP stakeholders, this is not enough. Road safety must be integrated into the decision-making process throughout the City and agencies that are involved within the road and transportation system. Developing a positive traffic safety culture (PTSC) means creating a climate where traffic safety is highly valued and rigorously pursued. The RSP can help institutionalize changes in the traffic safety culture through the following actions:

- Interaction, collaboration, and liaison between safety partners and other staff and agency members, including invitation as non-participating members of certain RSP activities;
- Encouraging the use of collision data and emphasizing emphasis areas' objectives and strategies in all road network decision-making;

- Incorporating safety explicitly into existing plans and programs through formal and informal reviews; and,
- Directing funding from the RSP to specific programs run by departments other than traffic operations and road safety.

Dr. Nicholas Ward, a senior research scientist at the Western Transportation Institute at Montana State University, says[8]:

"The goal of the traffic safety culture paradigm is to develop a process for changing values and attitudes so that safety is part of every transportation decision, whether individual or organizational."

Part of this cultural shift will be to invite members of departments or agencies not directly involved in the RSP to participate and to apply the philosophy of Safe Systems and the RSP in their agency, department, or division.

14.3 Communications Strategy

Many aspects of the program depend on effective and pointed communications and outreach. Enhanced coordination of all road safety-related education and engagement initiatives will make them collectively more effective. Using a common brand (e.g. Vision Zero brand) and emphasizing they are all being delivered to help improve road safety City-wide will add to the effectiveness.

An ideal communications structure would involve coordinating, and possible centralizing, all education and engagement efforts into one comprehensive communications program. This would allow for optimization of the use of resources (in terms of which emphasis areas and which demographics are targeted), as well as tight coordination with partner agencies (including the Region and its municipalities) on timing and messaging to get the maximum effectiveness. This would also allow for better measurement and evaluation and is in line with the recommendations made by the project team to enhance the City's existing community engagement strategies, as outlined in **Section 13.1**.

Table 9 illustrates the communication strategy action items as part of the implementation of the RSP.

[8] A Primer for Traffic Safety Culture by Nicholas Ward, Ph.D., Jay Otto, and Jeff Linkenbach, Ph.D., May 2014

Table 9: Communications Strategy Summary

Title	Description
Vision Zero Branding	▪ Vision Zero branding in collaborative public education campaigns.
Driver Education Campaigns	▪ Outreach campaigns on how to interpret and use new traffic devices (e.g. roundabouts) for the road users within the City. ▪ Outreach campaigns to support the educational and enforcement programs outlined in the Countermeasures Plan.
Road User Education	▪ Increased awareness for driver, pedestrian, and cyclist safety on the roads and the expected injury levels at different impact speeds.

14.4 Evaluation and Monitoring

As previously mentioned, the goal of the five-year RSP is to reduce the number of fatal and serious injury collisions by at least 10%, as well as to reduce the number of collisions involving vulnerable road users by at least 10%. A key component of any road safety program is monitoring and evaluation. Evaluations allow us to understand the effectiveness of a program, project, or countermeasure through the analysis of data for a specific performance measure such as collisions, speed, or conflicts. Evaluation provides critical information to identify if the countermeasure is working, if any adjustments are required, or if additional countermeasures are needed. Further, evaluation allows the opportunity to improve existing processes and inform future decision making.

14.4.1 Countermeasure and Program Evaluation

Countermeasure evaluation is the assessment of a specific countermeasure (e.g. leading pedestrian intervals) at multiple comparable sites (e.g. signalized intersections). When implementing a countermeasure at several sites, the estimated effectiveness of the countermeasure is more accurately represented through the evaluation of the combined sites. The following subsections provide further details on countermeasure evaluation including measures of effectiveness, potential sources of bias, evaluation methods, data requirements, and more.

Program evaluation focuses on the assessment of the City's Vision Zero Road Safety Plan effectiveness as a whole. Program evaluation may include analysis of the total Vision Zero Road Safety Plan's efforts and the individual emphasis area efforts (i.e. Intersections, Vulnerable Road Users, School Zones, Aggressive Driving, Distracted Road Users, and Young Drivers). A program's success can be measured by the change in collisions and/or the activities implemented to achieve the program's overall goal (further detailed in the subsections below). Moreover, program evaluation provides vital information on the gaps and limitations of the RSP's existing processes and procedures.

14.4.2 Measures of Effectiveness

Measures of effectiveness (MOEs) are the metrics chosen to assess the effectiveness of a specific countermeasure and may include:

- **Collisions:** The effectiveness of a countermeasure may be evaluated based on the change of collision frequency. In addition to evaluating the change in total collisions, it is common to differentiate collisions by severity (i.e. fatal, serious injury, minor injury, or property damage only). It is recommended that the chosen collisions for evaluation be aligned with the City's future decision-making processes and goals. In alignment with the RSP goal, the City may wish to evaluate the safety effectiveness of countermeasures based on the change in total, fatal, and serious injury collisions, as well as collisions involving vulnerable road users. In addition, the change in *correctable* collisions for the countermeasure should be evaluated. For example, if the City is evaluating the effectiveness of leading pedestrian intervals (LPIs), the change in total, fatal, serious injury, and vulnerable road user collisions may be evaluated, as well as collisions involving a turning motor vehicle and a pedestrian.
- **Speed:** The effectiveness of a countermeasure may be evaluated based on the change in speed – specifically, the operating speed (i.e. the 85th percentile speed). The 85th percentile speed is the speed at which or below 85% of the vehicles are travelling. As it is representative of overall traffic behaviour on a roadway, it is the value most commonly used in the assessment of traffic data. It is common to differentiate speed data into AM peak period, Mid-day peak period, PM peak period, Off-peak period, and a 24-hour total, based on the direction of travel.
- **Violations:** The frequency of traffic violations (both automated and police enforcement) may be evaluated to assess a countermeasure's safety effectiveness. Traffic violations may include but are not limited to disobeying traffic controls (e.g. disobeying a red light, disobeying a stop sign), failing to yield the right-of-way, improper turns, improper lane changes, or following too closely. Evaluating the frequency of traffic violations provides important insight into driver behaviour and the human factors that are often associated with collisions.

- **Conflicts:** Through the use of video-based analysis, conflicts (i.e. near misses) may be evaluated to assess the safety effectiveness of a countermeasure. Collisions are relatively rare and random in nature. Therefore, conflicts provide a deeper understanding of the site's safety performance. Video-based artificial intelligence (AI) technology enables road safety agencies to collect conflict data by road user type, movement, and more. Conflict analysis allows them to assess the impacts of a safety countermeasure before any additional collisions occur. Data including vehicle, pedestrian, and cyclist volumes, speeds, and direction of travel, as well as vehicle turning path trajectories, points in turning movements (start, mid-point, end), road user classification, vehicle classification, date and time of observation, pedestrians and cyclists in the crosswalk, and vehicle/pedestrian/cyclist conflicts or near misses may be collected.
- **Perceived Safety/Comfortability:** The perceived safety or comfort level of a site can be evaluated to assess the effectiveness of a countermeasure. Generally, this information is collected through a public survey (either online or at the treatment site). While users' perceived safety and comfort are important, this measure of effectiveness is not generally recommended for road safety. Perception is very individualized and based on human experiences, choices, and options. Thus, the perceived level of safety and/or comfort can be vastly different from one person to the next. Further, Vision Zero is a data-driven road safety philosophy with the objective to eliminate fatalities and serious injuries within the transportation system. Therefore, proven safety concerns (i.e. collision history or risk) are often the measures of effectiveness.

14.4.3 Evaluation Methods

The Highway Safety Manual includes three (3) basic study designs, including Experimental Before-After Studies, Observational Before-After Studies, and Observational Cross-Sectional Studies[9]. Experimental Before-After Studies involve the random selection of sites for countermeasure implementation. These sites are known as "treatment sites". Next, "control sites" are selected at random – countermeasures are not implemented at control sites. Control sites are used as a baseline to account for other temporal factors, such as driver behaviour.

Observational Studies involve the selection of treatment sites based on prior safety concerns (i.e. historical collision frequency or risk). There are two types of Observational Studies:

- **Observational Before-After Studies** compare the change before and after implementing a countermeasure. These studies may or may not include the analysis of control sites to account for temporal changes over time.

[9] American Association of State Highway and Transportation Officials (AASHTO), Highway Safety Manual, 2010

- **Observational Cross-Sectional Studies** compare sites with (treatment sites) and without (control sites) a specific feature to estimate the effectiveness of that feature. For example, sites with and without ladder crosswalk markings may be evaluated and compared to estimate the performance of the treatment sites without the feature (ladder crosswalk markings).

Observational Studies are more regularly used in road safety. This is because sites identified for implementing safety countermeasures are largely chosen based on prior safety concerns and not at random. When implementing safety countermeasures, the intention is often to reduce collision frequency and/or severity. Thus, implementing countermeasures at locations with high historical collision frequency or risk will likely have the greatest impact. Additionally, Before-After Studies are generally used in road safety due to the defined before and after periods and the specific countermeasures.

14.4.4 Vision Zero Road Safety Plan Evaluation

The efficacy of the countermeasures included in the RSP should be evaluated and findings should be included in an annual report to record the advancements of the Vision Zero Road Safety Plan. The effectiveness of education, engagement, and enforcement countermeasures may be difficult to measure as they aim to change road user behaviour, which may take a significant amount of time.

It should be noted that short-term or initial results cannot be considered truly indicative of the effect of the program, as it takes a few years of data collection to accurately determine, statistically, if a change has occurred. Therefore, it will be several years (likely four or five) before a valid evaluation of the program's effectiveness can be made. However, the program's progress (i.e. implementation of countermeasures) should be monitored and evaluated annually to ensure that the planned actions are becoming reality as envisioned. In addition, there are some early signs of success that can be observed because of implementing the RSP. These could include public and stakeholder engagement in the road safety programs, positive media and public feedback, receiving budget and resources for implementing programs, and short-term, preliminary evaluation results of some engineering countermeasures.

Before-after studies involving performance metrics such as speed, violations, and/or conflicts require a minimum of three months for before and after periods. Thus, evaluations to assess the impacts of these metrics can commence shortly after countermeasure implementation begins. The Highway Safety Manual recommends three to five years for collision before and after analyses periods. Therefore, evaluating countermeasures for the impacts of collisions (i.e. frequency and severity) will not initiate until later years.

14.5 Financial Consideration

14.5.1 Costs

The financial resources needed to implement the RSP were estimated based on implementation, operating, and maintenance costs. A unit cost for each countermeasure was calculated based on information provided by the City and the consultant's experience working with similar Ontario municipalities and is in line with the unit costs used in the development of the Region's TSP. A number of assumptions were made when estimating countermeasure costs, including:

- **Local Context/Conditions and Implementation Scope:** Unit costs are indicative of the expenses associated with typical implementations of a countermeasure. Actual costs may differ based on the size of the implementation, specific characteristics of the project site, design specifications, and unforeseen challenges encountered during implementation;
- **Additional Expenses and Factors:** While the unit costs encompass the direct expenses tied to implementation, it is important to account for ancillary costs such as engineering, planning, permits, maintenance, and ongoing operational considerations. These factors can significantly impact the overall financial implications of the countermeasure deployment; and,
- **Allocation within Existing Budget:** Certain countermeasures, particularly those associated with traffic operations and civil work, could coincide with current budget allocations or be accommodated within the scope of future capital programs' budgets.

14.5.2 Benefits

To assess if the selected countermeasures and their allocated quantities are adequate for reducing fatal and injury collisions as well as vulnerable road user collisions, crash modification factors (CMFs) were used (if available). Although crash modification factors may not be available for certain road safety countermeasures, their value remains significant. These countermeasures often offer unique benefits in mitigating specific risks or addressing emerging safety concerns, contributing positively to overall road safety despite the absence of traditional quantifiable metrics. The CMFs were employed to estimate the expected collision reduction benefits of each countermeasure. As mentioned earlier, the same CMFs that were used in the development of the Region's TSP were used to evaluate the benefits of the City's RSP, where applicable. The following limitations should be considered when using CMFs:

- **Site-Specific Variability:** The adopted CMFs were originally calculated and presented in various sources based on average or specific outcomes from various locations, conditions, and contexts. For example, if the effectiveness was measured at sites with particularly poor initial safety performance, then a CMF will rate highly. The actual effectiveness of a given countermeasure, as indicated by CMFs, may be different for the City due to the characteristics of the specific site or location where it is implemented. Factors such as initial collision magnitude and severity, traffic patterns, geometric design, local behaviour, and infrastructure influence how a countermeasure interacts with the road environment.
- **Interaction with Multiple Countermeasures:** A CMF is typically calculated by assessing the effectiveness of implementing a single countermeasure. Often, multiple countermeasures are implemented simultaneously at the same location. The combined effects of such interactions will deviate from the expected effects of individual implementations specifically when two or more countermeasures influence the same type of collision.
- **Delayed Effects:** The safety effects of certain countermeasures, particularly those aimed at influencing driver behaviour and cultivating a safety-conscious culture, might not manifest immediately after their initial implementation. The tangible safety outcomes might extend beyond the scope of the Vision Zero Road Safety Plan's five-year duration.
- **Difficulty in Predicting Outcomes of Enforcement, Education, and Engagement Countermeasures:** As noted earlier, engineering countermeasures lend themselves to straightforward measurement and analysis, which is not the case for enforcement, education, and engagement countermeasures. The longer time frames in achieving change, variability in the way behavioural change occurs, options for types of communications, size of the program, and overlap with other measures applied simultaneously make predicting the effects of these types of countermeasures more difficult and less accurate.
- **Assumptions for Assessing Treatable Collisions:** The use of observed collision frequencies at priority locations for each countermeasure can result in a slight overestimation of collision reductions due to the randomness of observed collisions. As another example, the implementation of specific countermeasures may not be feasible at their identified priority locations (e.g. there might not be a sufficient right-of-way for traffic calming measures at a priority segment with multiple collisions involving speeding and aggressive driving). These details cannot be identified at this stage of the RSP development and need to be explored through an in-depth engineering review of the road network.

14.5.3 Budget

Financial resources required to implement the countermeasures are based on implementation cost, life cycle and associated/recurring operating and maintenance costs.

To support annual delivery of the Plan, an average annual budget of approximately $4 million is anticipated. This is to cover new programs, safety audits/studies, additional staffing resources, implementation, and operations & maintenance costs. However, the average budget may vary between $2 million – $6 million per year depending on priorities, the type/scope of each countermeasure to be implemented, and initiation of new programs that may not be identified within the Plan.

15. Conclusion

As outlined in the Vision Zero approach to road safety, any loss of life on the transportation network is unacceptable. Through shared responsibility and collaboration, effective cultural and legislative change can be affected to achieve zero fatalities and injuries in the future. The Vision Zero Road Safety Plan will enable the City of Markham to effectively implement a wide range of road safety initiatives that are aligned with the Safe System framework, providing clear and actionable guidance for their execution. A proactive, data-driven approach to preventing collisions is required to achieve the City's ultimate vision of a safer transportation system for all road users. This includes bold leadership that prioritizes capital and operating investments to reinvent how the City addresses road safety, with the aim of realizing long-term benefits. Cooperation with key road safety partners to achieve a shared goal will be critical to realizing success. This plan delivers the necessary recommendations and analysis to build a successful program in alignment with York Region's Traveller Safety Plan, of which the City is a key stakeholder.

As part of this effort, a Countermeasures Plan has been developed featuring 92 targeted road safety countermeasures for a total of six emphasis areas. These measures are designed to reduce fatal and injury collisions as well as collisions involving vulnerable road users over the next five years, with a focus on specific collision types that are more likely to result in serious harm and that align with the City's multi-modal priorities. It is anticipated that the proposed suite of countermeasures will allow the City to effectively manage the projected growth in the future and mitigate the risk for conflicts, reducing the direct and indirect societal costs of collisions. In addition, the Vision Zero Road Safety Plan includes a proposed organizational realignment and robust evaluation and monitoring components to ensure the effectiveness and ongoing success of these initiatives.

CIMA+ project number: B001780
January 2026

A

Appendix A
Road Safety Programs Review Report

MEMO

TO : City of Markham

FROM : CIMA+

DATE : August 11, 2025

SUBJECT : Road Safety Program Review: Benchmarking & Recommendations

1. Background & Introduction

CIMA+ was retained by the City of Markham (City) to assist in developing an effective Road Safety Plan (RSP). Phase 1 of the project focuses on refining the work plan and reviewing background information. As part of the RSP development, a comprehensive review of the City's existing road safety program was captured in the *Background Information Review* memorandum.

1.1. Purpose

This memorandum builds upon the *Background Information Review* memorandum to provide a complete summary of the findings from the best practices and benchmarking exercise, along with a detailed overview of the gap analysis conducted to evaluate the City's existing road safety program. It highlights both the program's strengths and areas for improvement.

2. Best Practices & Benchmarking

The City of Markham leads several safety programs that are at the forefront of those found in similar municipalities across Ontario. However, road safety practices are constantly evolving, and public agencies are working toward targeted programs that can further reduce the frequency and severity of collisions on their road network. It is therefore highly valuable for the City to explore new initiatives and learn from the experiences of others to strengthen its safety programs and enhance outcomes.

Five municipalities were reviewed in comparison to Markham's existing road safety program. The findings are summarized in **Table 1**.

Table 1: Summary of Road Safety Program Benchmarking

Program	City of Markham	Region of York	City of Mississauga	City of Hamilton	City of London	Town of Oakville
Radar Speed Feedback Signs	✓	✓	✓	✓	✓	✓
In-Road Flexible Signs	✓	✓	✓	✓	✓	✓
Community Safety Zones & School Zones	✓	✓	✓	✓	✓	✓
Speed Limit Reduction Program	No	✓	✓	✓	✓	✓
Automated Speed Enforcement	Currently being developed	✓	✓	✓	✓	✓
Red Light Camera Program	No	✓	Currently being developed	✓	✓	No
Road Watch Program	✓	✓	✓	No	No	✓
Traffic Calming Program	✓	Mainly non-physical measures	✓	✓	✓	✓
Pedestrian Crossovers	✓	✓	✓	✓	✓	✓
Leading Pedestrian Intervals (LPIs)	No	✓	✓	No	No	✓
Crossing Guard Program	✓	No	✓	✓	✓	✓
Sidewalk Network Completion	✓	✓	✓	✓	✓	✓
Active School Travel Program	✓	✓	✓	✓	✓	No
Active Transportation Capital Projects	✓	✓	✓	✓	✓	✓

Program	City of Markham	Region of York	City of Mississauga	City of Hamilton	City of London	Town of Oakville
Network Screening	Completed in 2020	✓	✓	✓	✓	✓
In-Service Road Safety Reviews	✓	✓	✓	✓	✓	✓
Road Safety Audits	No	No	No	✓	No	No
Educational Programs	✓	✓	✓	✓	✓	✓
Annual Road Safety Report	No	✓	No	✓	No	No
Fatal and/or Serious Injury Collision Investigation	No	✓	No	✓	No	No

Based on the findings from the benchmarking exercise, the City of Markham stands out for its advanced approach to road safety programs when compared to other municipalities of similar size in Ontario. The City has demonstrated a strong commitment to road safety through a range of proactive measures that exceed the current practices of many comparable communities. These efforts reflect a forward-thinking approach to addressing traffic safety and the needs of local residents.

However, there are still opportunities to further enhance the City's road safety program by aligning it more closely with emerging best practices and innovative strategies. These areas for improvement can be effectively addressed through targeted actions in the Vision Zero Road Safety Plan action plan.

3. Gap Analysis

Markham is evaluating its current road safety programs to improve and optimize its efforts. To do this, existing constraints and barriers must be acknowledged. Based on industry best practices and jurisdictional benchmarking, CIMA+ has identified the following strengths and opportunities for improvement for the City's existing road safety programs in **Table 2**.

Table 2: Summary of Gap Analysis

Program	Strengths	Opportunities
General	> There appears to be general support for road safety initiatives from elected officials and senior management. > The City has established a Cycling & Pedestrian Advisory Committee that provides valuable input on pedestrian and cycling safety to inform the decision-making of future projects. > Traffic Inquiry Process, Fatal and Serious Injury Collision Investigation, Intersection Sight Distances, Left Turn Phasing, Community Safety Zone, and Traffic Calming and Speed Management policy papers are being developed as part of this project. > The City is working in partnership with the Region of York and other neighbouring local area municipalities to enhance road safety initiatives, coordinate infrastructure improvements, and implement regional strategies that promote safe and accessible transportation networks.	> A formalized road safety training program for City staff involved in road safety has not yet been developed or implemented. There is also an opportunity to create a centralized library of road safety resources to support consistent understanding and application across all departments involved in the Road Safety Strategy. > The City could strengthen public awareness of its road safety efforts by publishing an annual road safety report and developing a Vision Zero dashboard featuring real-time statistics to track progress. > The City has not developed a formal Inclusion, Diversity, Equity, Accessibility Initiative. > The City's design guidelines (e.g., cross-section standards, traffic control guidelines, school zone design guidelines) require an update to ensure vision zero principles are included. > In addition to the policy papers being developed as part of this project, there is an opportunity to identify and prioritize additional policy papers and guidelines (such as complete streets). > A dedicated road safety champion has not yet been identified to lead, coordinate, and promote the Road Safety Strategy.
Safety Data Program	> The City has developed an annual data collection plan. However, guidelines are vague and not well defined. > The City collects traffic volume data including turning movements counts (TMCs) and automatic traffic recorder (ATR) data, traffic speed data, and road characteristics data.	> There is an opportunity to establish a formal plan that includes the regular collection of traffic volume, speed, pedestrian and cyclist volume, and collision data. Additionally, routine audits of the road safety database should be conducted to maintain data quality and support evidence-based decision-making.

Program	Strengths	Opportunities
Radar Speed Feedback Signs	> The City has 24 radar speed feedback signs which are installed on roadways with an 85th percentile speed exceeding 10 km/h over the posted speed limit. Radar feedback signs are rotated every three months to maximize coverage and effectiveness. > City staff periodically conduct pre and post speed evaluations to monitor the effectiveness of the program. > The City has a dedicated annual budget ($30,000) to operate the program.	> The City has not developed and implemented a formal policy for the program. > Radar speed feedback signs are installed on a request basis. The City does not have a formal network-wide process to proactively install signs based on risk (e.g., collision history, operating speed, etc.). > Although periodic evaluations are conducted, a formal safety evaluation process has not been developed and implemented to assess the effectiveness of the program.
In-Road Flexible Signs	> The City launched the program as a pilot in 2017, and it has since been expanded. > The City has a dedicated annual budget ($10,000) to operate the program. > In-road flexible signs were installed on the approach to school zones to decrease vehicular speeds. > A Traffic Calming and Speed Management policy paper is being developed as part of this project.	> Introducing in-road flexible speed signs at additional high-risk locations can strengthen the overall traffic calming program and reinforce speed compliance in critical areas.
Community Safety Zones & School Zones	> The City has implemented two Community Safety Zones as part of a pilot project which was well received. > A Community Safety Zone policy paper is being developed as part of this project.	> Implementing additional community safety zones at high-risk locations can help enhance protection for vulnerable road users and reduce collision severity.
Speed Limit Reduction Program	> N/A	> Opportunities to decrease speed limits in residential areas have not yet been reviewed and evaluated.
Automated Speed Enforcement	> On May 27, 2025, Markham Council approved the development and implementation of an ASE program.	> The City has not yet implemented automated speed enforcement to enhance compliance with speed limits

Program	Strengths	Opportunities
	16 cameras will be deployed to qualifying community safety zones, targeting a Spring 2026 implementation.	and improve safety in high-risk areas such as school zones and community safety zones.
Road Watch Program	> The City supports the York Regional Police's program by completing signage installations.	> There is an established committee for the program. However, meetings have been paused since the beginning of the COVID-19 pandemic.
Pedestrian Crossovers	> The City has an annual budget for the design and construction of new PXOs. However, the funding is subject to an annual review process and dependent on the number of recommend/warranted locations.	> The City does not have a formal network-wide process to introduce protected pedestrian crossings proactively based on collision history, safety risk, speed, and more.
Crossing Guard Program	> There are 92 existing school crossing guard stations across Markham. > The City's crossing guard program is aligned with the recommendations included in the Ontario Traffic Council School Crossing Guard Guide. > The City recently completed a School Zone Safety Guide project to review and enhance their existing program.	> The School Zone Safety Guide outlines several opportunities to enhance the City's crossing guard program.
Sidewalk Network Completion	> The City has sidewalk completion programs to address gaps within the road network. > The program is included in the City's capital budget, with $7.7 million allocated in 2023. > The City plans to increase the annual budget to expedite program delivery.	> The City may wish to prioritize sidewalk implementation based on identified risk factors such as pedestrian volumes, proximity to schools and transit, and collision history to maximize safety benefits.
Active School Travel Program	> The City recently completed a School Zone Safety Guide project to review and enhance their existing program. > In 2024, the City developed a School Zone Safety Handbook featuring a toolbox of school safety countermeasures for implementation.	> The School Zone Safety Guide outlines several opportunities to enhance the City's active school travel program.
Active Transportation Capital Projects	> The City developed an Active Transportation Master Plan in 2021.	> The City's development application review process currently lacks provisions for active transportation facilities.

Program	Strengths	Opportunities
	> There is consistent funding for active transportation capital projects (e.g., the 2023 budget was approximately $3.2 million).	
Network Screening	> Network screening was completed in 2020. > The results from the networkwide safety review were used to inform safety projects.	> Network screening was conducted as a one-time project rather than a continuous program.
Systemic Safety Analysis	> Markham was among the first Ontario municipalities to undertake systemic safety analysis. > Systemic safety analysis was conducted in 2020.	> Systemic safety analysis was conducted as a one-time project rather than a continuous program.
In-Service Road Safety Reviews	> The City conducts in-service road safety reviews for select locations on an as-needed basis.	> The City currently conducts in-service road safety reviews at select locations on an as-needed basis, rather than through a proactive or systematic approach. > The City does not currently conduct road safety audits as part of a continuous program.
Educational Programs	> The City's Traffic Engineering and Communications team develop and publicize road safety messaging through social media, the City website, and local newspapers.	> The City has not developed a formal corporate communications strategy with clear objectives, targeted tools, messaging, and KPIs, incorporating demographic data to tailor outreach effectively. > Conducting a road user safety culture analysis would help assess public perceptions of risk and levels of compliance among all road users, informing more targeted and effective road safety initiatives.

4. Recommendations & Conclusion

The Vision Zero Road Safety Plan will include specific recommendations to enhance the City's existing road safety program, aligning it with best practices. These recommendations will outline targeted actions, strategies, and initiatives designed to address identified safety gaps, mitigate high-risk areas, and promote safer conditions for all road users.

Prepared by:

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Soroush Salek, Ph.D., P.Eng., RSP$_1$

CIMA+ project number: B001780
January 2026

B

Appendix B
Vision, Mission, Goal, and Emphasis Areas Memorandum

MEMORANDUM

TO	:	City of Markham
FROM	:	CIMA+
DATE	:	October 24, 2024
SUBJECT	:	City of Markham Road Safety Plan Vision, Mission, Goal, and Emphasis Areas

As part of the City of Markham Road Safety Plan project, Stakeholder Workshop #1 was held at the Markham Civic Centre on Wednesday, October 2, from 9:00 am to 12:00 pm. The in-person workshop included an introduction to Vision Zero and the Safe Systems Approach and an overview of the current state of road safety in Markham. The workshop attendees included representatives from the City of Markham, York Regional Police, the Regional Municipality of York, various school boards, various advocacy groups, the Canadian Automobile Association, and Markham Fire and Emergency Services. All attendees were allocated to five breakout groups for two 45-minute brainstorming activities. The objective of Activity #1 was to develop potential vision, mission, and goal statements. Activity #2 aimed to establish emphasis areas with opportunities to improve safety in Markham through a multi-disciplinary approach. A draft vision statement, mission statement, goal statement, and emphasis areas for the City of Markham are developed based on the recurring topics and themes from the brainstorming activities noted above, findings from the City's collision data analysis, and input from the online public survey and the comprehensive collision analysis results. Summaries of each breakout room activity can be found in **Appendix A**.

Vision

A vision statement is a high-level, long-term viewpoint that dictates ultimate success. Breakout groups indicated that the vision statement should encompass the entire transportation system, including roads, sidewalks, trails, and all road users. Groups also discussed the importance of aligning the City's vision with the York Region's. All the breakout groups opted to include language relating to eliminating death or injury for all transportation system users, with one group specifying that all ages and abilities should be accommodated. The ultimate goal of any Road Safety Plan following the Vision Zero and Safe Systems Approach objectives is zero fatal and serious injuries. Although this Road Safety Plan will be Markham's first Vision Zero plan and achieving zero fatal and serious injuries will take significant time, effort, and funding, the vision statement determines high-level and long-term success. The vision statements from each breakout group are summarized in **Table 1**.

Table 1: Vision Statements

Breakout Group	Vision Statement
Group 1	A transportation system that allows people of all ages and abilities to safely move around without experiencing death or injury.

Breakout Group	Vision Statement
Group 2	Eliminate all injuries and fatalities by providing a safer environment for all road users.
Group 3	A safer transportation system that allows all users to safely move without suffering injury or fatality.
Group 4	A transportation system that allows people of all ages and abilities to safely move around without experiencing death or injury.
Group 5	Markham is developing a comprehensive road safety action plan that works towards ending traffic-related fatalities and injuries for all transportation system users.

Considering the discussed vision statements by different breakout groups, the proposed vision statement for the City of Markham's Road Safety Plan is: **A safer transportation system that enables all road users, regardless of age or ability, to travel safely without experiencing serious injury or fatality**.

Mission

The mission statement reflects the City's culture and defines the purpose of the Road Safety Plan by providing more details on how the vision can be achieved. All the breakout groups opted to develop a mission statement, with one group combining it with their vision statement. Several groups discussed the necessity of a multi-disciplinary, collaborative approach to reduce injuries and fatalities, while other groups mentioned that changes must be made to policies, infrastructure, education, and culture to achieve this vision. The importance of shared responsibility, accountability, inclusivity, sustainability, accessibility, and innovation were also discussed. The mission statements from each breakout group are noted in **Table 2**.

Table 2: Mission Statements

Breakout Group	Mission Statement
Group 1	Changing Markham's transportation policies, culture, and infrastructure to achieve our vision.
Group 2	Improve the safety and security of all residents by increasing road users' confidence to live, play, and learn in a complete community.
Group 3	A safer transportation system that allows all users to safely move without suffering injury or fatality.
Group 4	This group discussed the importance of shared responsibility and including policymakers to keep them accountable.
Group 5	Prioritize the reduction of fatalities and injuries, enhance infrastructure for all transportation system users, and foster a safe, inclusive, and sustainable transportation environment in Markham through collaboration, innovation, education, and proactive policy and engineering measures.

Considering the breakout group discussions, the proposed mission statement for the City of Markham's Road Safety Plan is: **A leading community partnership committed to fostering a safe,**

inclusive, and sustainable transportation system to eliminate fatalities and injuries for all users through collaboration, innovation, culture change, and proactive policy and engineering measures.

Goal

A goal statement defines what the Road Safety Plan aims to achieve in a specified period. Based on the breakout group discussions, a clear and measurable goal statement is preferred. Many breakout groups identified the need for a SMART (Specific, Measurable, Action-Oriented, Relevant, and Time-Bound) goal statement. It is important to have a SMART goal to provide clarity and focus to the Road Safety Plan. SMART goals also provide an opportunity to evaluate success and adjust programs, projects, and procedures to enhance road safety in Markham. All breakout groups focused their goal statements on reducing collisions that result in injury or death, which aligns with the Vision Zero and Safe Systems Approach objectives. Four of the five breakout groups opted to include a specific percentage reduction value and time period. One group indicated that separate goals should be developed to reduce overall fatalities and injuries and reduce collisions involving vulnerable road users. Another group indicated the importance of aligning with the Region's goals. **Table 3** summarizes the goal statements of each breakout group.

Table 3: Goal Statements

Breakout Group	Goal Statement
Group 1	Reduce transportation-related injuries and deaths by 10% over five years.
Group 2	Reduce severe collisions (those involving injury or death) by 10% over five years.
Group 3	A 10% reduction in fatal and injury collisions for all road users by 2029.
Group 4	This group indicated that a percentage reduction and a timeline should be developed separately for fatal and injury collisions and for collisions involving vulnerable road users.
Group 5	Achieve a minimum 15% reduction over five years in fatal and injury collisions involving vulnerable transportation system users, including cyclists, pedestrians, and micromobility users.

As noted above, most breakout groups converged on a 10% reduction in fatal and injury collisions over five years. One group opted to use a minimum benchmark in their goal statement, which allows the City to exceed the initial expectations of stakeholders and the public. Nearly all of the breakout groups used a five-year timeline, which aligns with timelines used by other jurisdictions, including York Region. A five-year timeline will allow the City of Markham to implement the Plan's initiatives and evaluate success.

The proposed goal statement is: **Reduce fatal and serious injury collisions by at least 15% within five years, with a parallel commitment to achieving a 15% reduction in collisions involving vulnerable road users during this time.**

Emphasis Areas

Emphasis Areas are areas of the highest priority with opportunities to improve safety in Markham through a multi-disciplinary approach. They are typically selected from a type or group of collisions that is a priority safety concern from a technical (i.e., collision analysis findings), political (i.e., input from City Council), and social (i.e., input from the public) perspective. These groups of collisions will be areas where resources will be allocated to develop and implement action plans. The emphasis areas were established based on the findings of the collision analysis, the public engagement survey, and the Public Information Centre (PIC) #1. Several breakout groups noted the importance of a data-driven approach rather than relying on public perception. The emphasis areas from each breakout group are depicted in **Table 4**.

Table 4: Emphasis Areas

Breakout Group	Emphasis Areas
Group 1	> Intersections > Vulnerable Road Users (including pedestrians, cyclists, and school zone safety) > Distracted and Aggressive Driving
Group 2	> Safety Education for Youth > Intersections > Distracted Road Users > Pedestrians > Cyclists
Group 3	> Pedestrians > Cyclists > Young Drivers > Intersections > Aggressive Driving > Distracted Driving
Group 4	> Micromobility Users
Group 5	> Intersections > Vulnerable Road Users (including pedestrians and cyclists) > School Zone Safety > Aggressive Driving and Driver Behaviour > Safety Technology (including red light cameras) > Reducing Auto Dependency

Considering the proposed emphasis areas by different breakout groups, the six proposed emphasis areas for the Markham Road Safety Plan are:

- **Intersections**
- **Aggressive Driving**
- **Vulnerable Road Users**
- **Distracted Road Users**

- **School Zones**
- **Young Drivers**

1.1. Intersections

Intersections were a topic chosen by four out of the five breakout groups. Additionally, this emphasis area was identified through the collision analysis (ranked 1) and by the public (ranked 3). Based on the collision analysis, most fatal and injury collisions (60%) reported in Markham (2017-2019, 2022-2023) appear to occur at intersections. Of the fatal and injury collisions occurring at intersections, 50% occurred at signalized intersections, and 50% occurred at unsignalized intersections. To capture the even split in fatal and injury collisions at both types of locations, "intersections" is proposed as the first all-encompassing emphasis area. Countermeasures for this emphasis area may include signal phasing improvements (e.g., dedicated left turn phasing), a Red Light Camera (RLC) Program, protected intersection design, decreased curb radii, enhancement pavement markings, roundabouts, right-turn on red prohibitions, improvement sightlines, and more.

1.2. Aggressive Driving

Three of the five breakout groups chose Aggressive Driving as an emphasis area for the City, with two breakout groups opting to combine it with Distracted Driving. This emphasis area was also identified through the collision analysis (ranked 2) and by the public (ranked 1). Based on the collision analysis, 53% of fatal and injury collisions reported in Markham (2017-2019, 2022-2023) were defined as Aggressive Driving. Aggressive Driving is recommended as the third emphasis area to address these concerns. This emphasis area will allow the opportunity to implement various programs, projects, and initiatives. Countermeasures for this emphasis area may include reduced lane widths, traffic calming, Automated Speed Enforcement (ASE), road diets, educational campaigns, reduced speed limits, school zones, and more.

1.3. Vulnerable Road Users

Vulnerable road user safety was discussed by all five breakout groups. Collisions involving vulnerable road users such as pedestrians, cyclists, and micromobility users generally have a higher injury severity. Thus, this emphasis area is extremely important for eliminating serious injuries and fatalities within Markham's transportation network. This emphasis area was identified through the collision analysis, with pedestrian collisions ranked 5th and cyclist collisions ranked 7th. The five-year collision analysis (2017-2019, 2022-2023) shows 187 and 111 fatal and injury collisions involving pedestrians and cyclists, respectively, accounting for a combined total of 29% of all fatal and injury collisions in Markham. Pedestrian and cyclist safety ranked 5 and 6, respectively, in the public survey. Focusing efforts on improving safety for vulnerable road users allows a greater opportunity to ensure that the Plan's vision to eliminate fatal and serious injury collisions among all road users can be achieved. Countermeasures for this emphasis area may include protected pedestrian crossings, Leading Pedestrian Intervals (LPIs), audible pedestrian signals, enhanced winter maintenance, improved street lighting, dedicated and protected cycling infrastructure, crossrides, bicycle signals, coloured conflict pavement markings, educational campaigns, and more.

1.4. Distracted Road Users

Distracted Road Users was discussed by four out of the five breakout groups. Distracted Driving, in particular, was identified through the collision analysis (ranked 6), while the public identified Distracted

Driving and Walking (ranked 8). The five-year collision analysis (2017-2019, 2022-2023) shows that 15% of fatal and injury collisions in Markham were defined as Distracted Driving collisions. Based on feedback from one of the breakout groups, this emphasis area was adjusted to include all distracted road users. Countermeasures for this emphasis area may include safety edges, educational campaigns, increased enforcement, and more.

1.5. School Zones

School zone safety was chosen by two out of the five breakout groups. A school zone refers to an area on a street near a school or a designated crossing leading to a school with the likely presence of younger pedestrians or cyclists. Based on the online survey results, this emphasis area was ranked 4th by the public. Although school zones were not exclusively analyzed during the collision analysis as this information was unavailable, school children are also known as vulnerable road users, and collisions involving school children generally have a higher severity of injury. Improving school zone safety may also improve active school travel (i.e., using human-powered travel to get to and from school, including cycling, rollerblading, skateboarding, and scootering). Countermeasures for this emphasis area may be implemented within a school zone or on nearby or neighbouring streets of a school that are not necessarily directly in front of a school. Countermeasures may include community safety zones, traffic calming (e.g., speed humps, narrowing lane width, curb extensions), school crossings, a crossing guard program, educational campaigns, enforcement, and more.

1.6. Young Drivers

Young Drivers was selected as an emphasis area by two out of the five breakout groups. This emphasis area was also identified by the collision analysis (ranked 4) and by the public (ranked 9). Based on the five-year collision analysis (2017-2019, 2022-2023), 29% of fatal and injury collisions involved a young driver between the ages of 16 and 29. Countermeasures for this emphasis area may include educational campaigns, increased enforcement, collaboration with driving schools, and more.

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A

Appendix A: Breakout Room Summary

1.7. Breakout Group 1

1.7.1. Vision

A transportation system that allows people of all ages and abilities to safely move around without experiencing death or injury.

1.7.2. Mission

Changing Markham's transportation policies, culture, and infrastructure to achieve our vision.

1.7.3. Goal

Reduce transportation-related injuries and deaths by 10% over five years.

1.7.4. Emphasis Areas

Preferred Emphasis Areas

- Intersections
- Aggressive Driving
- Pedestrians
- Cyclists
- School Zones

Disliked Emphasis Areas

- Young Drivers

Chosen Emphasis Areas

- Intersections
- Vulnerable Road Users
- Distracted and Aggressive Driving

1.8. Breakout Group 2

1.8.1. Vision

Eliminate all injuries and fatalities by providing a safer environment for all road users.

1.8.2. Mission

Improve the safety and security of all residents by increasing road users' confidence to live, play, and learn in a complete community.

1.8.3. Goal

Reduce severe collisions (those involving injury or death) by 10% over five years.

1.8.4. Emphasis Areas

Preferred Emphasis Areas

- Safety Education for Youth
- Pedestrian Safety at Intersections
- Distracted Road Users

Disliked Emphasis Areas

- Distracted Driving

Chosen Emphasis Areas

- Safety Education for Youth
- Intersections
- Distracted Road Users
- Pedestrians
- Cyclists

1.9. Breakout Group 3

1.9.1. Vision and Mission

A safer transportation system that allows all users to safely move without suffering injury or fatality.

1.9.2. Goal

A 10% reduction in fatal and injury collisions for all road users by 2029.

1.9.3. Emphasis Areas

Preferred Emphasis Areas

- Pedestrians
- Cyclists
- Young Drivers

Chosen Emphasis Areas

- Pedestrians
- Cyclists
- Young Drivers
- Intersections
- Aggressive Driving
- Distracted Driving

1.10. Breakout Group 4

1.10.1. Vision

A transportation system that allows people of all ages and abilities to safely move around without experiencing death or injury.

1.10.2. Emphasis Areas

Preferred Emphasis Areas

- Micromobility Users

Disliked Emphasis Areas

- Cyclists

Chosen Emphasis Areas

- Micromobility Users

1.11. Breakout Group 5

1.11.1. Vision

Markham is developing a comprehensive road safety action plan that works towards ending traffic-related fatalities and injuries for all transportation system users.

1.11.2. Mission

Prioritize the reduction of fatalities and injuries, enhance the infrastructure for all transportation system users, and foster a safe, inclusive, and sustainable transportation environment in Markham through collaboration, innovation, education, and proactive policy and engineering measures.

1.11.3. Goal

Achieve a minimum 15% reduction over five years in fatal and injury collisions involving vulnerable transportation system users, including cyclists, pedestrians, and micromobility users.

1.11.4. Emphasis Areas

Chosen Emphasis Areas

- Intersections
- Vulnerable Road Users
- School Zone Safety
- Aggressive Driving and Driver Behaviour
- Safety Technology
- Reducing Auto Dependency

CIMA+ project number: B001780
January 2026

C

Appendix C
Collision Data Review Report

City of Markham

Road Safety Plan

Technical Memorandum – Collision Data Review

August 2024

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1. Introduction

Despite extensive road safety initiatives, guidelines, and policies, around 870 collisions occur on Markham municipal roadways each year, out of which around 203 collisions (23%) result in injuries – approximately 8 of which (1%) are major injuries.[1] Therefore, Markham has recognized that a new and broader-based approach is required and has proposed the development of a City-wide Road Safety Plan. This study will set out the targets, policies, and action plans to guide the City and its road safety partners toward creating safer travel and reducing the number of injury collisions for all travellers.

The Safe System Approach suggests that the Road Safety Plan should be evidence-based, factual, and heavily dependent on Data-Driven Safety Analysis. This analysis aims to determine the nature of safety problems and identify a path to improvements that will save lives and reduce severe injuries. The first step is to review recent historical collisions to explore trends, patterns, and characteristics of collision data and further identify preliminary collision emphasis areas. Emphasis areas are a type or group of collisions that are a priority safety concern for which resources will be allocated to develop and implement action plans. The selection of emphasis areas is critical to achieving our goals.

The main purpose of this Technical Memorandum is to provide a detailed overview of injury collisions on the municipal road networks under the jurisdiction of the City of Markham. The regional arterial road network is being addressed through York Region's Vision Zero Traveller Safety Plan.

On March 17, 2020, the Government of Ontario declared a state of emergency due to the COVID-19 pandemic and ordered the gradual closure of businesses and facilities. As a result of the state of emergency and subsequent stay-at-home orders from the Province, City of Markham, similar to other jurisdictions in Ontario, experienced a reduction in vehicular traffic volumes, resulting in a reduction in the number of collisions. The COVID-19 pandemic restrictions were in place until July 2021. As a result, the 2020 and 2021 collisions are not included in the analysis as they do not represent normal operations of the transportation network (i.e., less traffic and more aggressive driving behaviours).[2]

This memorandum covers a detailed collision analysis of Markham's road network, excluding regional roads. The analysis starts with an overview of the collision frequency between the

[1] Major injuries are those which result in the person being admitted to the hospital, including admission for observation. If the person is treated in the emergency room, but not admitted, this is considered a minor injury.
[2] W.G.M. Vanlaar, H. Woods-Fry, H. Barrett, C. Lyon, S. Brown, C. Wicklund, R.D. Robertson. The impact of COVID-19 on road safety in Canada and the United States. Accident Analysis & Prevention, Volume 160, 2021. https://www.sciencedirect.com/science/article/pii/S0001457521003559.

years 2017 to 2019 and 2022 and 2023 for all collision severity types. Then it focuses on the analysis of the injury collisions for the same time period. The analysis highlights the collision patterns and trends as well as the most predominant collision types within the municipal roads.

The findings of the collision data analyses will provide valuable insights into the process of selection of emphasis areas that will be finalized in collaboration with the project stakeholders, for consideration in the development of action plans.

2. Data Analysis

2.1. Overall Trends in Collisions

The following sections present the collision data broken down into various categories to better understand the nature and frequency of collisions occurring on the City of Markham road network. The areas of interest with a large number of collisions are discussed in more detail in Section 2.2 Collision Attributes.

The overall collision frequencies between the years 2017 to 2019, 2022, and 2023 are presented in Figure 1 by severity type. The figure shows that the number of Property Damage Only (PDO) collisions fluctuated between 2017 and 2022, and then increased significantly in 2023. It appears that the number of collisions in 2022 was slightly impacted by the lingering effect of travel behaviour changes due to COVID-19 travel restrictions but the number of collisions in 2023 increased beyond the pre-COVID levels. This is consistent with observations in other Ontario jurisdictions.

There was a total of 1,016 injury collisions and 1 fatal collision between 2017 to 2019, 2022 and 2023. The number of injury collisions has been fairly consistent. The number of major injury collisions has fluctuated between 2017 to 2019, 2022 and 2023, with an average of 8 collisions per year resulting in major injuries. There was one fatal collision in 2022.

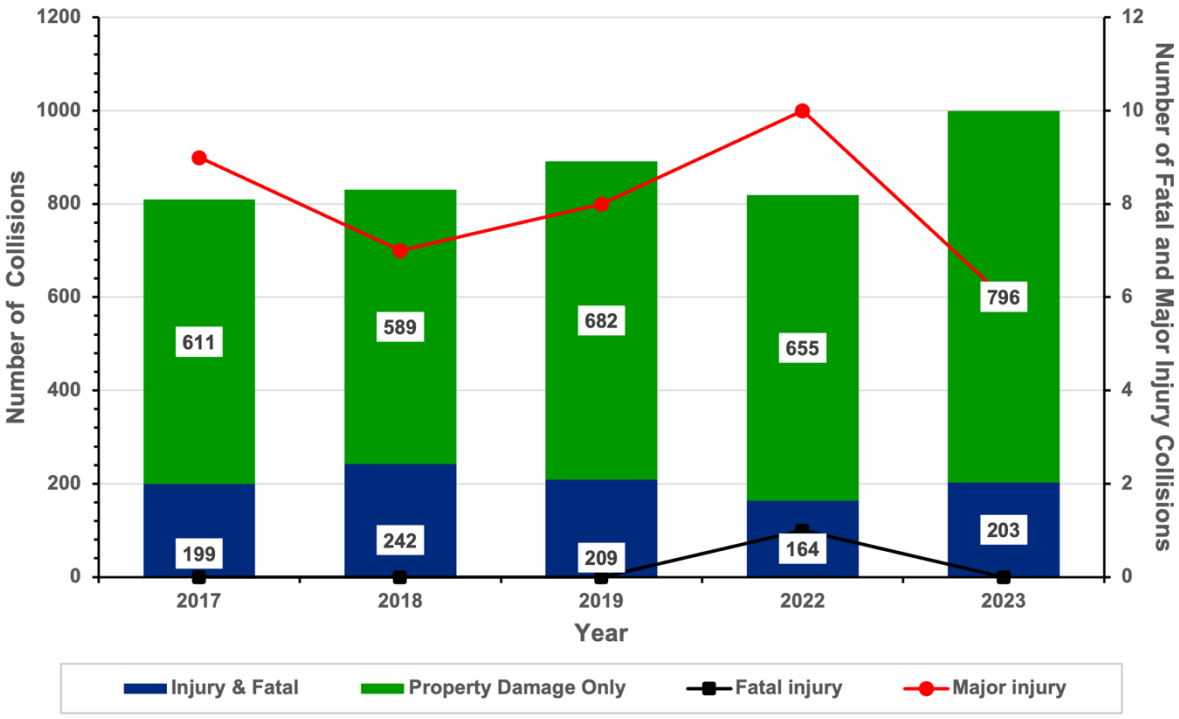


Figure 1: Total Number of Collisions by Year (2017-2019, 2022, and 2023)

The following sub-sections present the statistics for injury collisions between 2017 and 2019 as well as 2022 and 2023 (a total of 1,016 collisions) regarding impact type, month, and time of day. In the remainder of this technical memorandum, we did not report on the severity levels of injury collisions due to low frequency of major injury collisions.

2.1.1. Disclaimer on COVID-19 Pandemic and Traffic Patterns

On March 17, 2020, the Government of Ontario declared a state of emergency due to the COVID-19 pandemic and ordered gradual closure of businesses and facilities. As a result of the state of emergency and subsequent stay at home orders from the Province, the City of Markham, similar to other jurisdictions in Ontario, experienced reduction in vehicular traffic volumes, resulting in a reduction in the number of collisions. With the gradual removal of travel restrictions, traffic volumes have increased since July 2021.

Due to the pandemic related travel restrictions, the number of collisions in 2020 and 2021 were significantly lower than the pre-pandemic levels: total collisions during these two years were, on average, 43% lower than the average of the years 2017 to 2019, 2022, and 2023; injury collisions were 47% lower. There were two fatal collisions during the pandemic period, including a rear end collision involving a cyclist on Carlton Road, between Main Street Unionville and Old Ivy Lane, and a pedestrian collision at the intersection of Denison Street and Birchmount Road.

2.1.2. Impact Type

Figure 2 shows the average number of injury collisions by initial impact types for 2017 to 2019, 2022 and 2023 on municipal roads. The most common impact type for injury collisions was angle collisions, followed by Single Motor Vehicle (SMV)-other.[3] The fatal collision was a pedestrian related collision that occurred in 2022 at the intersection of Dudley Avenue and Morgan Avenue. It should be noted that the SMV-other collision type includes pedestrian related collisions.

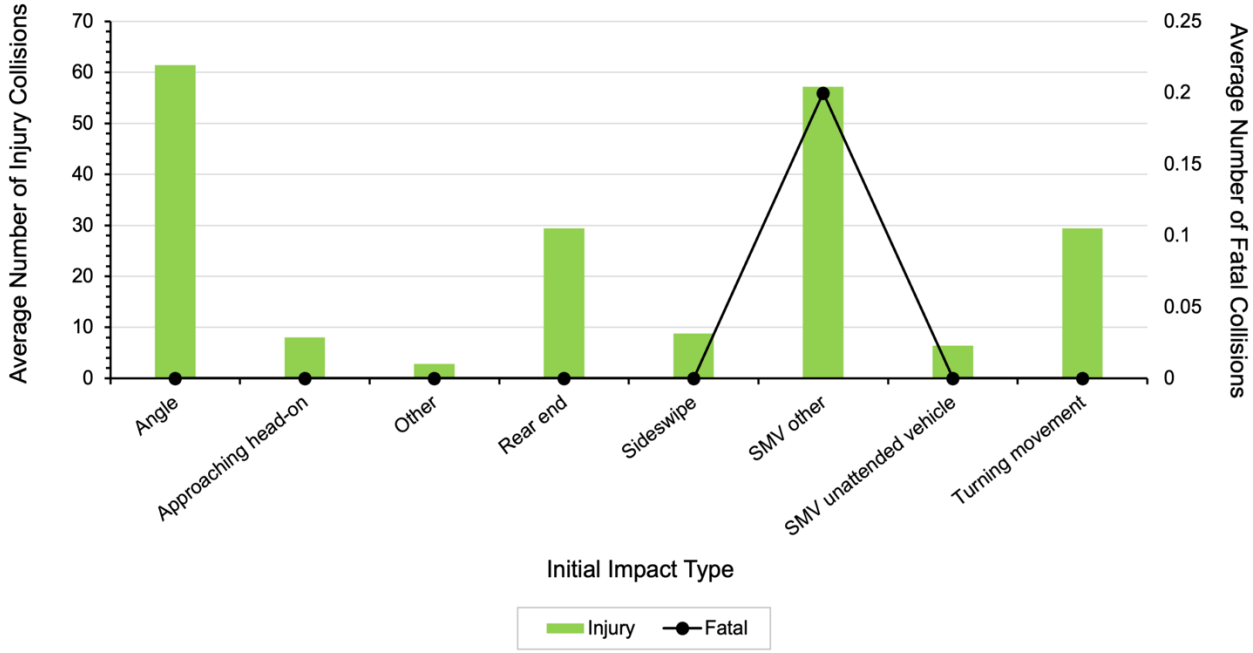


Figure 2: Annual Average Number of Injury / Fatal Collisions by Initial Impact Type (2017-2019, 2022 and 2023)

2.1.3. Month

Figure 3 shows the average number of injury collisions each month. This figure shows that more collisions occurred in summer and fall compared to winter and spring. The fatal collision occurred in August. The seasons are defined as follows:

[3] There are two types of SMV collisions: SMV-unattended vehicle, where a vehicle strikes a vehicle unattended by its driver. Include parked, stopped, disabled, abandoned and runaway vehicles, provided it was not under the care and control of a driver. Does not include vehicles stopped for traffic or standing while loading or unloading passengers or Cargo; and SMV-other, where a single motor vehicle initially collides with a fixed object, pedestrian or animal.

- Spring: March 22 – June 21;
- Summer: June 22 – September 21;
- Fall: September 22 – December 21; and
- Winter: December 22 – March 21.

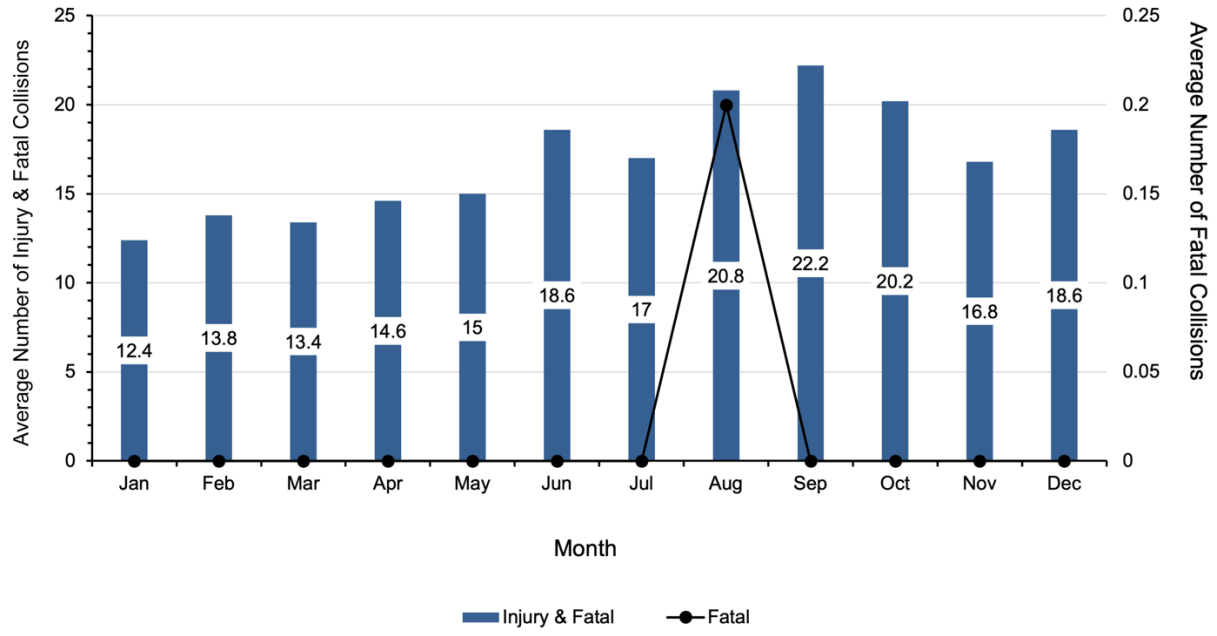


Figure 3: Annual Average Number of Injury / Fatal Collisions by Month (2017-2019, 2022 and 2023)

2.1.4. Time of Day

The average number of injury collisions by weekday and weekend time of the day are respectively shown in Figure 4 and Figure 5. Most injury collisions on weekdays occurred during the PM rush hours, followed by the AM rush hours. On weekends, most injury collisions occurred between 12:00 PM and 7:00 PM.

The time of day for different categories is defined as follows:

- Early Morning: 12:00 AM – 6:00 AM;
- AM Rush Hours: 6:00 AM – 10:00 AM;
- Midday: 10:00 AM – 2:00 PM;
- PM Rush Hours: 2:00 PM – 6:00 PM; and
- Evening: 6:00 PM – 12:00 AM.

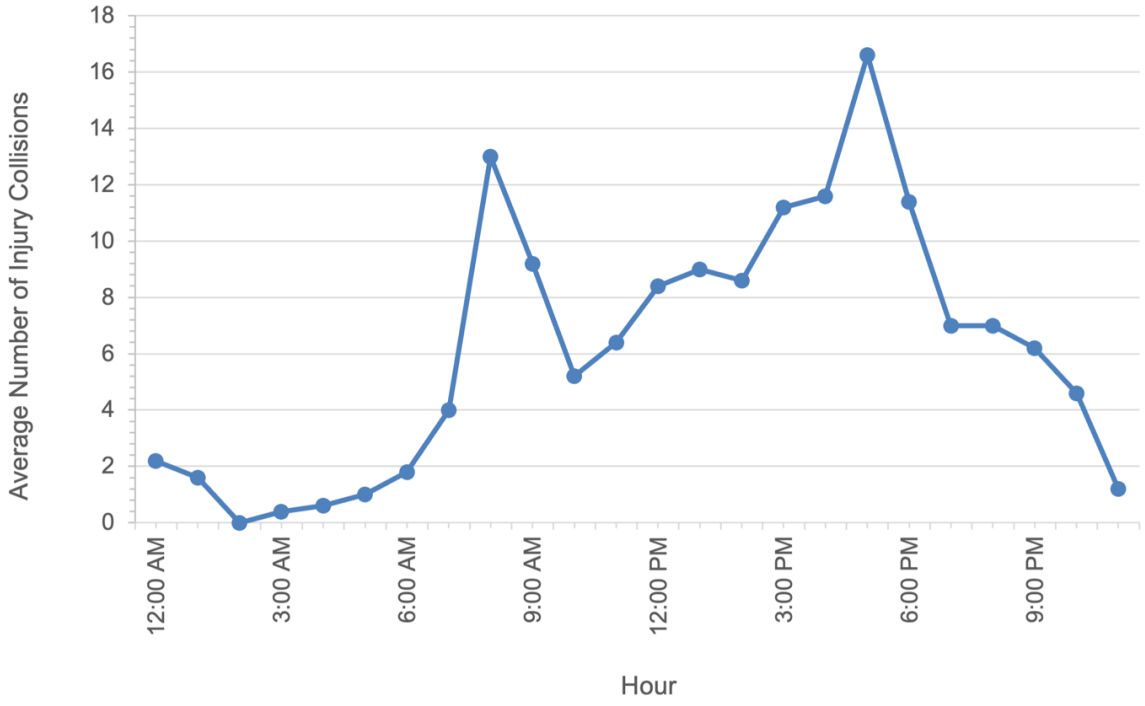


Figure 4: Annual Average Number of Injury Collisions by Weekday Time of Day (2017-2019, 2022 and 2023)

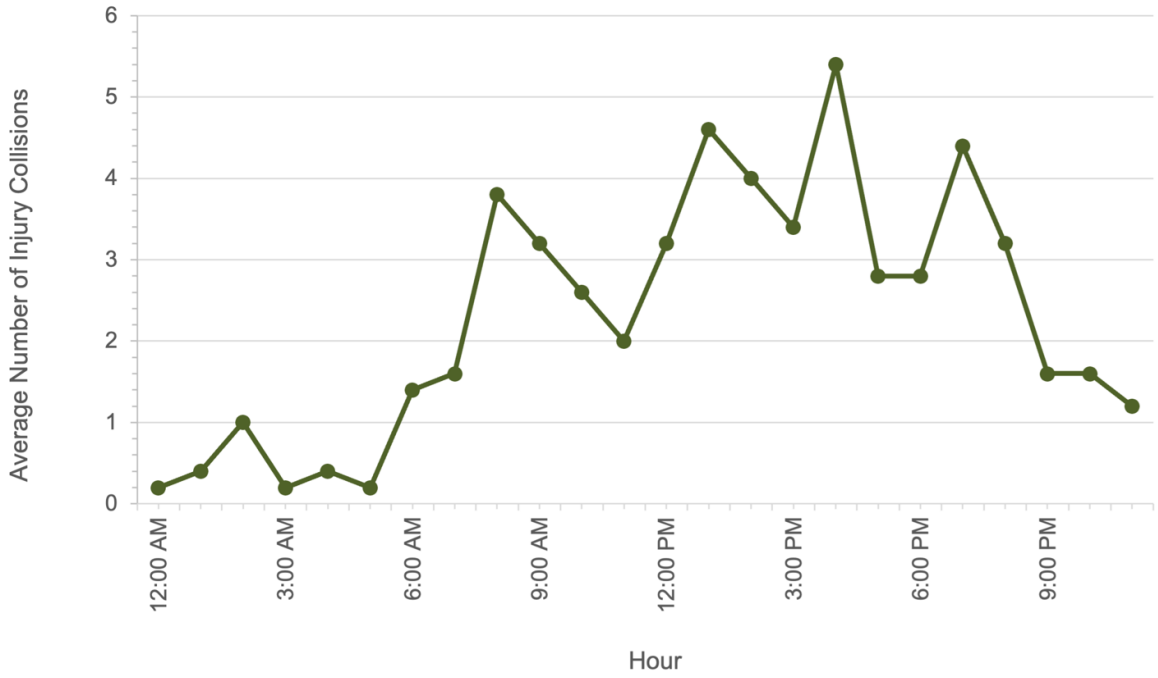


Figure 5: Annual Average Number of Injury Collisions by Weekend Time of Day (2017-2019, 2022 and 2023)

2.1.5. Age and Gender

A review of the ages of all at-fault drivers involved in injury collisions revealed that the highest number of collisions for male drivers is between the ages of 15 and 29. The results show younger drivers (age 15-29), were at-fault in 29% of injury collisions. The next highest age group was 40 to 54, which were at fault in 26.9% of injury collisions. The number of male drivers involved in collisions was higher than female drivers, especially in the younger age groups.

Figure 6 shows the average number of injury collisions based on the age and gender of the driver-at-fault.

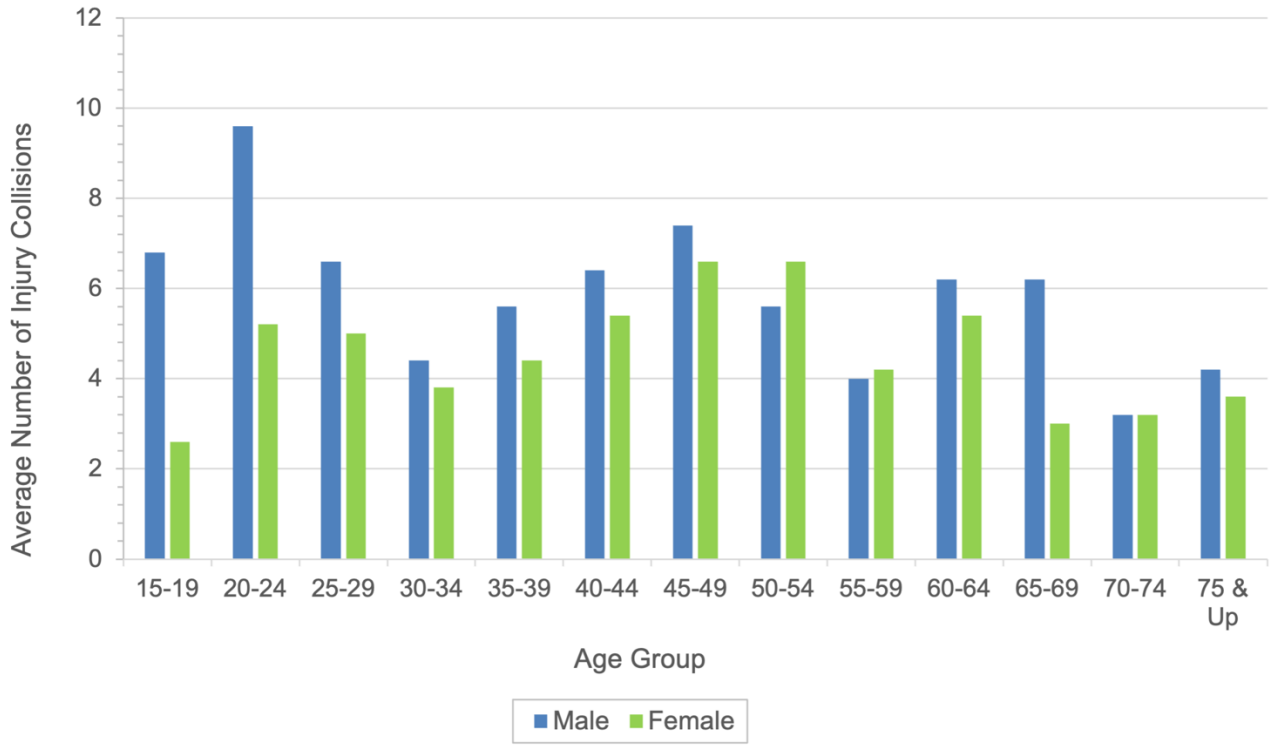


Figure 6: Annual Average Number of Injury Collisions by Drivers-At-Fault Age (2017-2019, 2022 and 2023)

2.2. Collision Attributes

The following sections present the collision data based on specific criteria, including location, driver actions, driver condition, road conditions, and collisions involving pedestrians and cyclists.

2.2.1. Intersection Collisions

Most injury collisions (61.2%) occurred at intersections. There were 622 injury collisions at City intersections in 2017-2019 and 2022-2023. The intersections with the highest number of collisions are listed in Table 1.

Table 1: Intersections with Highest Frequency of Injury Collisions

Intersection	Number of Fatal + Injury Collisions (2017-2019, 2022-2023)*	Number of Fatal Collisions (2017-2019, 2022-2023)*	Number of Injury Collisions (2017-2019, 2022-2023)*
Markham Road at **Castlemore Avenue**	12	-	12
Denison Street at **Brimley Road**	12	-	12
Denison Street at **Esna Park Drive**	11	-	11
Denison Street at **Hood Road**	11	-	11
Denison Street at **Birchmount Road**	9	-	9
Middlefield Road at **Highglen Avenue**	9	-	9
Markham Road at **Bur Oak Avenue**	9	-	9
Denison Street at **Teddington Avenue**	8	-	8
John Street at **Aileen Road**	8	-	8
Reesor Road at **Elgin Mills Road East**	8	-	8
Main Street Markham at **Bullock Drive / Parkway Avenue**	8	-	8
Denison Street at **Middlefield Road**	8	-	8
Denison Street at **Featherstone Avenue**	8	-	8
Dudley Avenue at **Morgan Avenue**	1	1	0

* Note: This ranking is not adjusted for the regression to the mean bias

Figure 7 classifies injury collisions at intersections by traffic control type. Out of 622 intersection injury collisions, 50% of them occurred at signalized intersections.

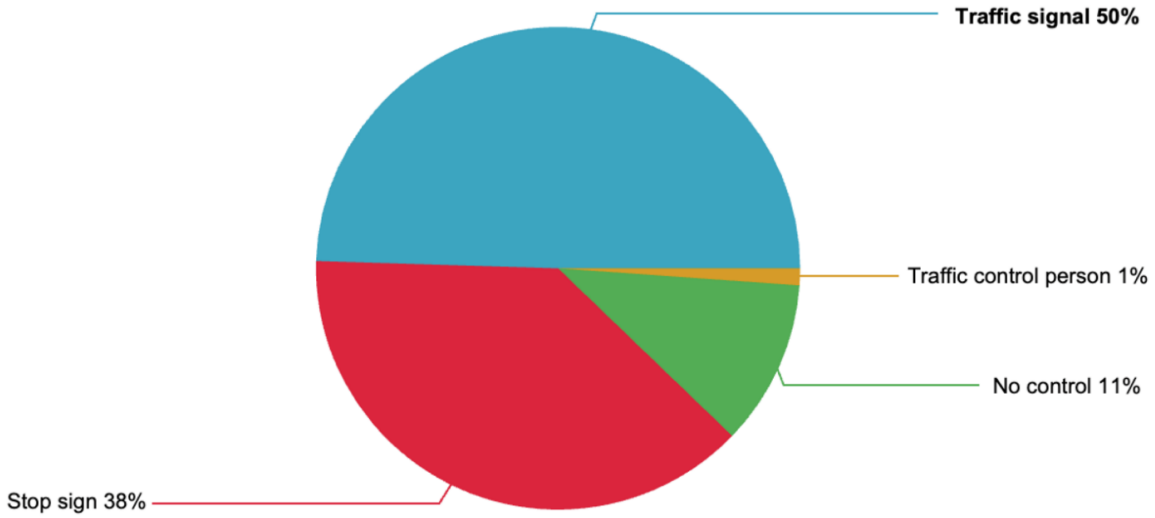


Figure 7: Classification of Intersection-Related Injury Collisions by Traffic Control Type (2017-2019, 2022 and 2023)

Figure 8 shows the classification of collisions by initial impact type for injury collisions which occurred at signalized intersections. At signalized intersections, the most prevalent collision initial impact type is angle (35%) followed by turning movement (26%); SMV-other collisions (19%), and rear end (14%) are next in order.

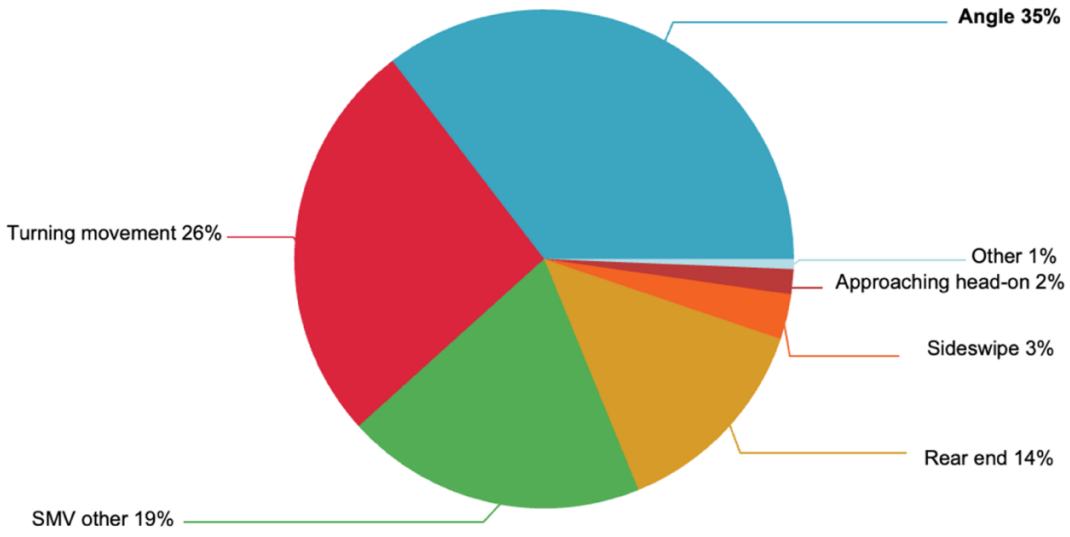


Figure 8: Classification of Signalized Intersection Related Injury Collisions by Initial Impact Type (2017-2019, 2022 and 2023)

Figure 9 shows the percentage of initial impact types of injury collisions at unsignalized intersections. This figure shows that angle collisions constituted 43% of all collisions, followed by SMV other (30%) and rear end (9%) collisions.

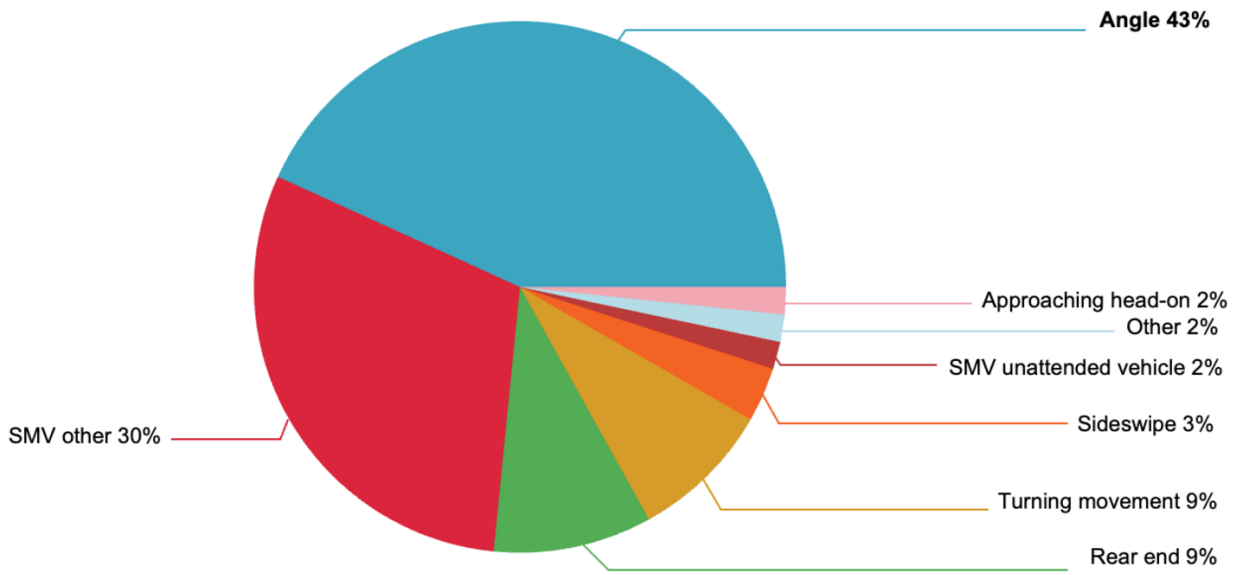


Figure 9: Classification of Unsignalized Intersection Related Injury Collisions by Initial Impact Type (2017-2019, 2022 and 2023)

2.2.2. Mid-block Collisions

There were 395 injury collisions on the City's mid-block locations in 2017 -2019 and 2022-2023. Mid-block collisions with the highest number of collisions are listed in Table 2.

Table 2: Sections with Highest Frequency Injury Collisions

Road Section	Number of Injury Collisions (2017-2019, 2022-2023)*	Number of Fatal Collisions (2017-2019, 2022-2023)*	Number of Injury Collisions (2017-2019, 2022-2023)*
Markham Road between **16th Avenue/Main Markham Street North** and **Edward Jeffreys Avenue**	11	-	11
Esna Park Drive between **John Street/Woodbine Avenue** and **Alden Road/Rodick Road**	8	-	8
Reesor Road between **14th Avenue** and **Steeles Avenue East**	7	-	7
Denison Street between **Hood Road** and **Esna Park Drive**	7	-	7

Road Section	Number of Injury Collisions (2017-2019, 2022-2023)*	Number of Fatal Collisions (2017-2019, 2022-2023)*	Number of Injury Collisions (2017-2019, 2022-2023)*
Commerce Valley Drive West between **South Park Road & Highway 7**	4	-	4
John Street between **Nolan Court** and **Esna Park Drive/Woodbine Avenue**	4	-	4

* Note: This ranking is not adjusted for the regression to the mean bias

Figure 10 shows the classification of mid-block injury collisions by initial impact type. At mid-blocks, SMV-other collisions accounted for approximately 34% of the 1,017 injury collisions, followed by rear end (18%) and angle collisions (16%).

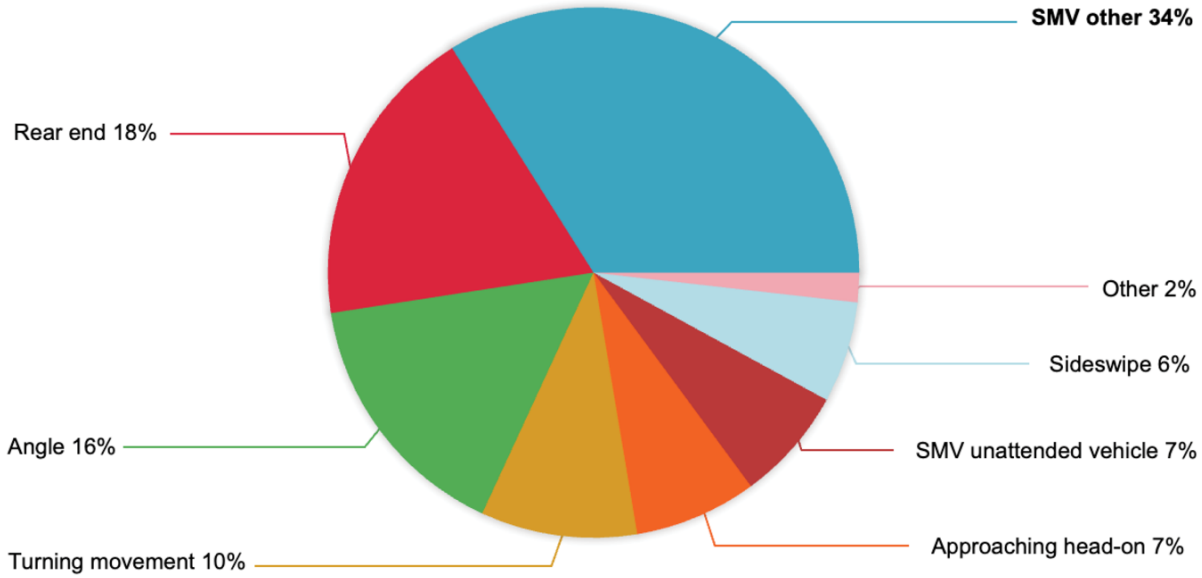


Figure 10: Classification of Mid-Block Injury Collisions by Initial Impact Type (2017-2019, 2022 and 2023)

2.2.3. Aggressive Driving

Figure 11 shows the annual number of injury collisions on municipal roads caused by aggressive driving. Aggressive driving is defined as collisions with *Driver Actions* coded as:

- Following too close;
- Exceeding speed limit;
- Speed too fast for condition;
- Disobeyed traffic control; and

- Failed to yield right-of-way.

A total of 538 out of 1,017 (53%) injury collisions were defined as aggressive driving. As shown in this figure, the number of aggressive driving-related injury collisions on municipal roads has fluctuated over 2017-2019, 2022 and 2023.

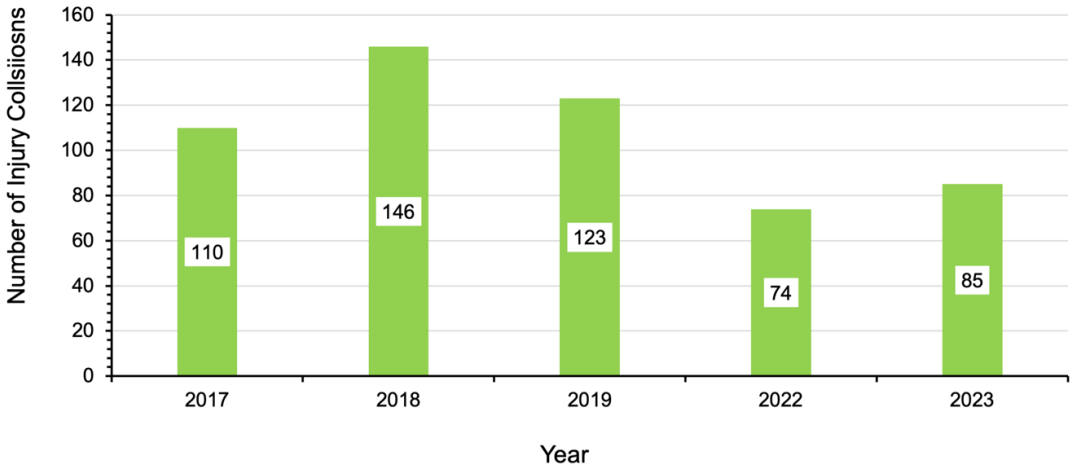


Figure 11: Number of Aggressive Driving Related Injury Collisions by Year (2017-2019, 2022 and 2023)

Figure 12 shows the classification of aggressive driving-related injury collisions by driver action. Most aggressive driving-related injury collisions were caused by failure to yield right-of-way (47%), disobeying traffic control devices (27%), and following too close (16%).

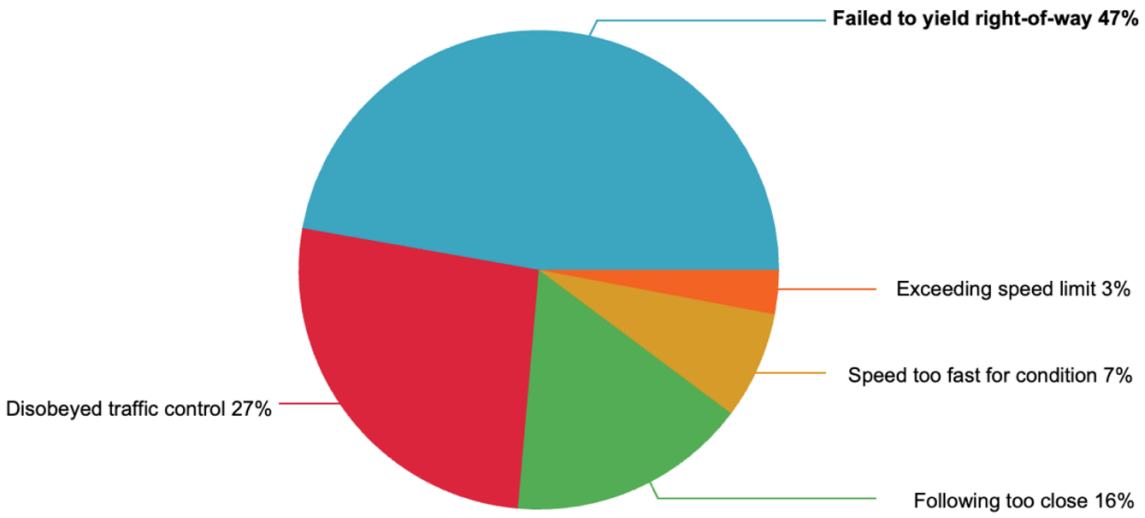


Figure 12: Classification of Aggressive Driving Related Injury Collision by Driver Action (2017-2019, 2022 and 2023)

2.2.4. Distracted Driving

Figure 13 shows the annual number of injury collisions on Markham roads caused by distracted driving. Distracted driving is defined as collisions with *Driver Condition* coded as 'Inattentive' and *Driver Actions* coded as:

- Following too close;
- Exceeding speed limit;
- Speed too fast for condition;
- Speed too slow for condition;
- Improper turn;
- Disobeyed traffic control;
- Failed to yield right-of-way;
- Improper passing;
- Lost control; and
- Improper lane change.

There were 157 out of 1,017 (15.4%) injury collisions defined as distracted driving. Similar to aggressive driving, the number of injury collisions caused by distracted driving has fluctuated in recent years with no discernible trend. The determination of distracted driving by police officers attending the scene of a collision is very difficult. It is quite conceivable that the actual number of collisions resulting from distracted driving is higher. Also, as of January 2023, the Ontario Motor Vehicle Accident Report form was updated to accommodate several important newer concepts in traffic engineering such as micromobility, carpool lanes, and driver condition. The “inattentive” code under driver condition expanded to the following fields:

- Hand-held device (code 80)
- In-car device (code 81)
- Two-way radio (code 82)
- Other inattention (code 98)

However, it appears that MTO Authorized Requester Information Services (ARIS) which provides collision reports in Extensible Markup Language (xml) format to road authorities has not yet been updated to accommodate the new codes. As a result, the number of inattentive collisions is smaller than expected in 2023. Our investigation shows that this is the case across Ontario and not exclusive to Markham or York Region.

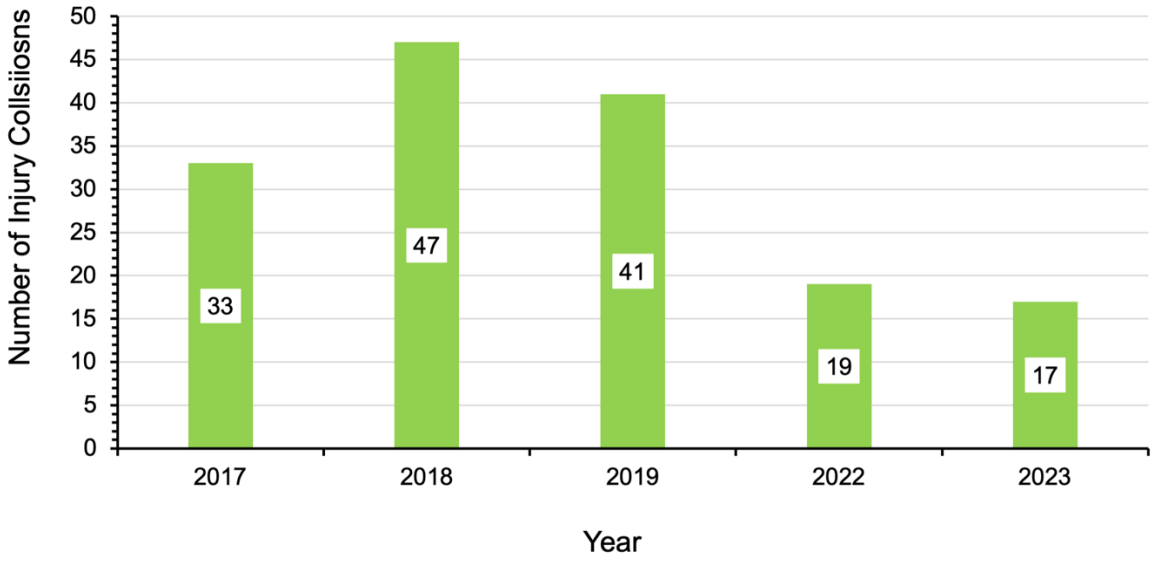


Figure 13: Number of Distracted Driving-Related Injury Collisions by Year (2017-2019, 2022 and 2023)

Figure 14 shows the classification of distracted driving-related injury collisions by driver action. Most distracted driving-related injury collisions involved failure to yield right-of-way (32%), disobeying traffic control devices (22%), improper turn and following too close (13% each).

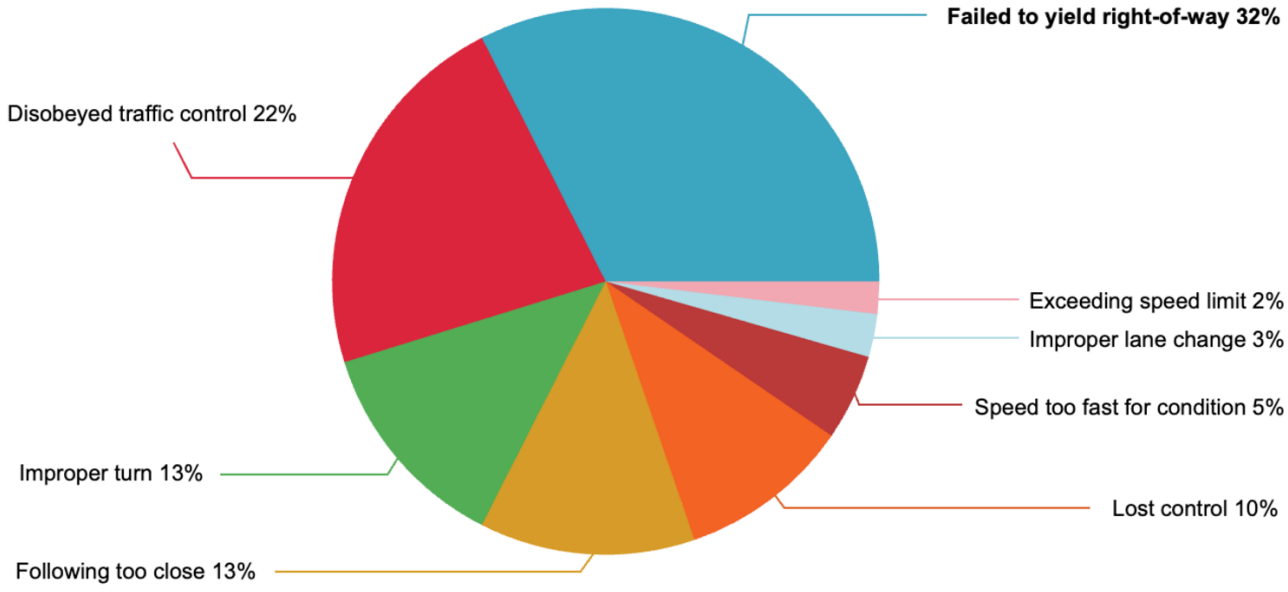


Figure 14: Classification of Distracted Driving Related Injury Collisions by Driver Action (2017-2019, 2022 and 2023)

2.2.5. Impaired Driving

There was a total of 52 out of 1,017 (5%) injury collisions from 2017-2019, 2022 and 2023 due to impaired driver condition on municipal roads. Impaired driving is defined as collisions coded with the following attributes:

- Driver had been drinking;
- Driver's ability impaired due to alcohol usage;
- Driver's ability impaired due to drugs usage;
- Driver's medical or physical disability; and
- Driver's fatigue.

Figure 15 shows the annual number of injury collisions on municipal roads caused by impaired driving, with the highest numbers related to 2023 and 2017, respectively.

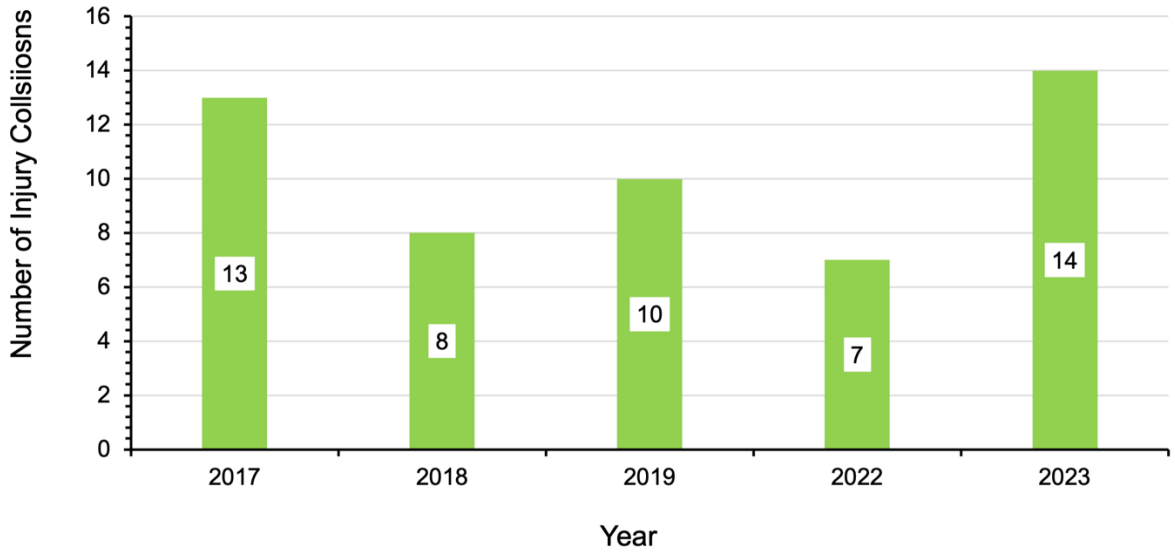


Figure 15: Number of Impaired Driving-Related Injury Collisions by Year (2017-2019, 2022 and 2023)

Figure 16 shows the classification of impaired driving-related injury collisions by driver condition. Most impaired driving injury collisions were caused by drivers who were under the influence of alcohol (31%).

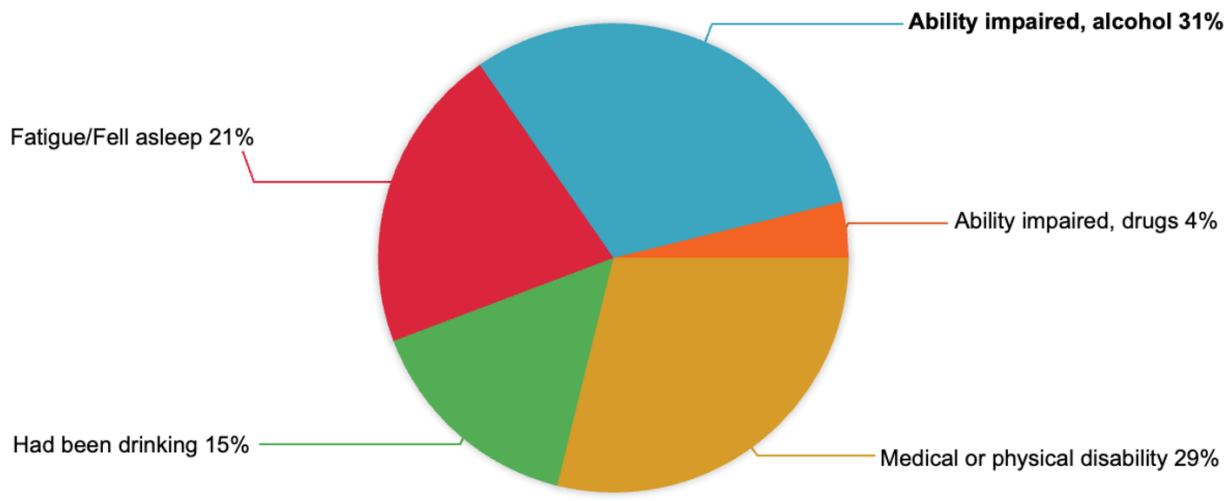


Figure 16: Classification of Impaired Driving Related Injury Collisions by Driver Condition (2017-2019, 2022 and 2023)

2.2.6. Road Condition

Figure 17 shows the classification of collisions by road surface type. Most injury collisions occurred on dry surface condition (77%), followed by wet surface (16%) and snow/ice (7%).

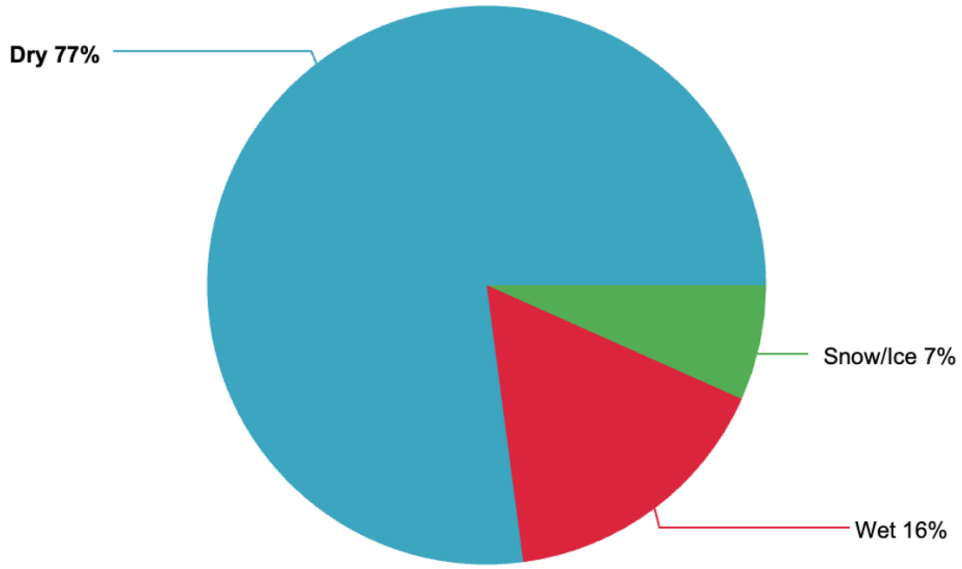


Figure 17: Classification of Injury Collisions by Road Surface Condition (2017-2019, 2022 and 2023)

2.2.7. Pedestrian Collisions

From 2017-2019, 2022 and 2023, a total of 188 pedestrian-involved injury collisions occurred on municipal roads (Figure 18), with the average being 38 each year. There was one fatal pedestrian-involved collision in 2022.[4]

On weekdays, most pedestrian collisions occurred during PM peak hours, followed by AM peak hours. On weekends, most pedestrian collisions occurred between 7:00 AM and 10:00 AM with another peak between 4:00 PM and 8:00 PM (Figure 19). Over 65% of pedestrian collisions occurred from September to January in the fall and winter months (Figure 20).

Drivers involved in injury collisions failed to yield right-of-way for 43% of collisions with pedestrians (Figure 21).

Approximately 71% out of 188 pedestrian-involved injury collisions were intersection-related (Figure 22), and among those, 36% occurred at intersections with no traffic control and 31% occurred at signalized intersections (Figure 23).

The municipal intersections with the highest number of collisions involving pedestrians are listed in Table 3. It is noted that for over 56% of injury collisions at intersections, pedestrians were crossing with the right-of-way (Figure 24).

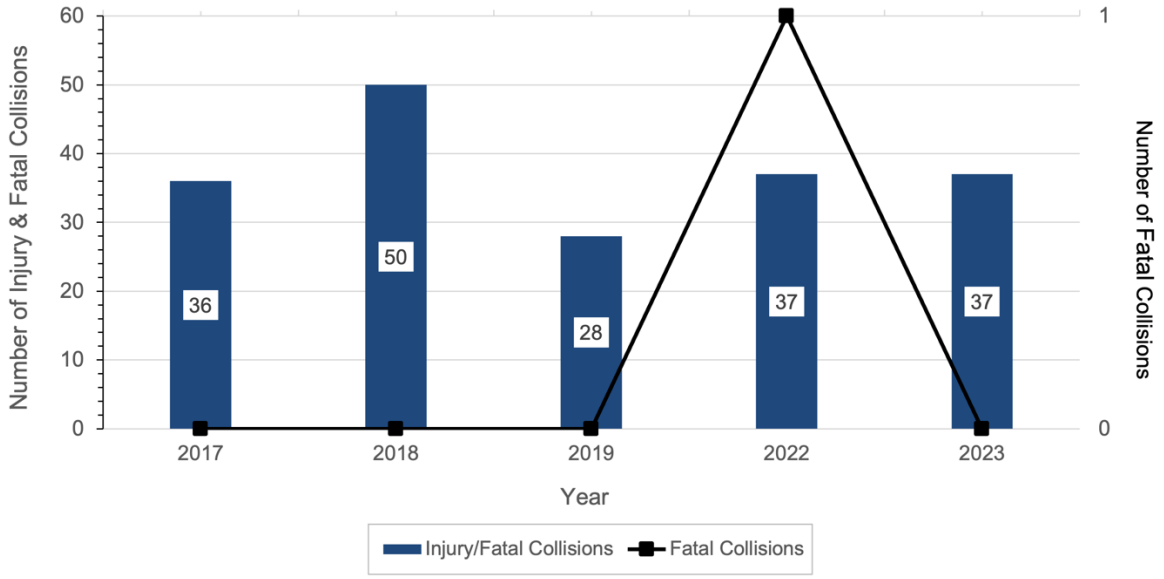


Figure 18: Number of Pedestrian Injury / Fatal Collisions by Year (2017-2019, 2022 and 2023)

[4] There was another fatal pedestrian collision in 2021, during the period affected by the COVID-19 pandemic. Refer to Section 2.1.1.

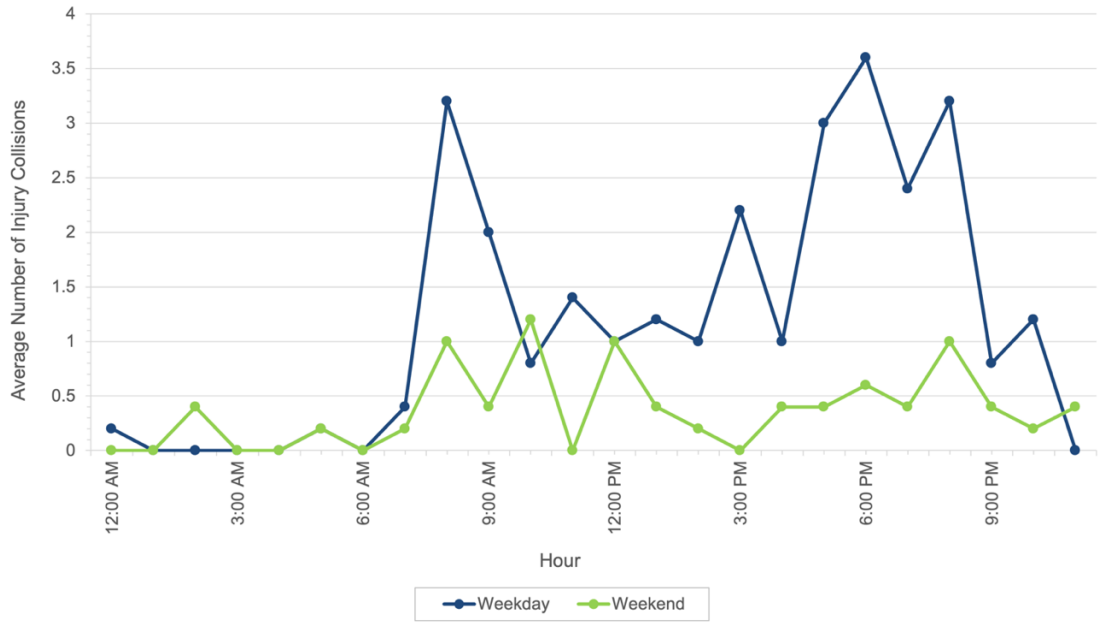


Figure 19: Annual Average Number of Pedestrian Injury Collisions by Hour of the Day (2017-2019, 2022 and 2023)

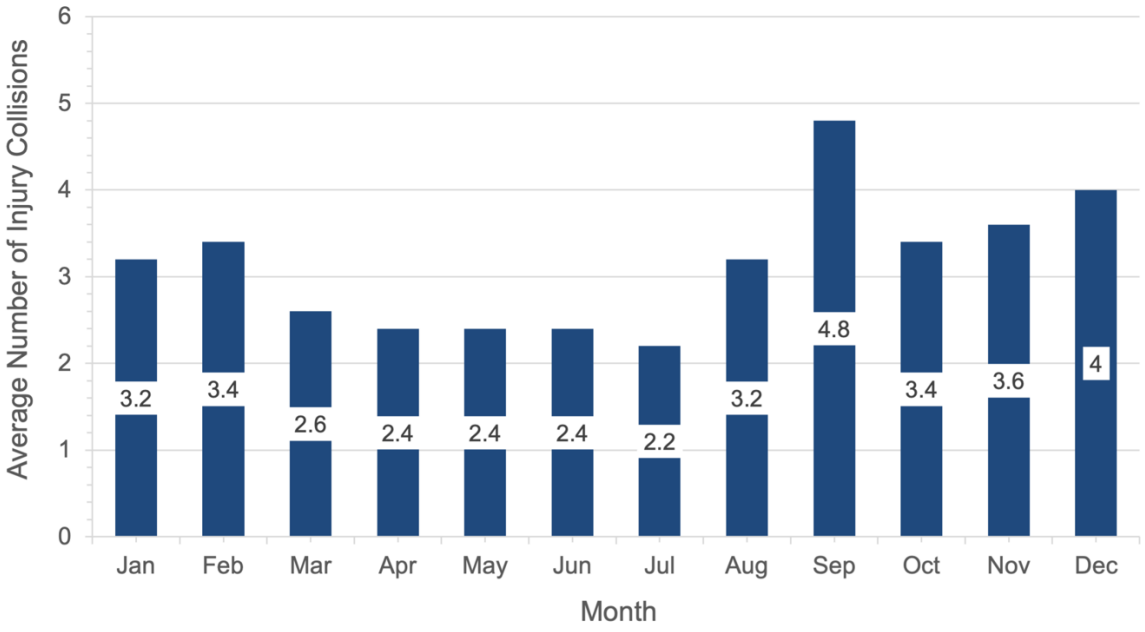


Figure 20: Annual Average Number of Pedestrian Injury Collisions by Month (2017-2019, 2022 and 2023)

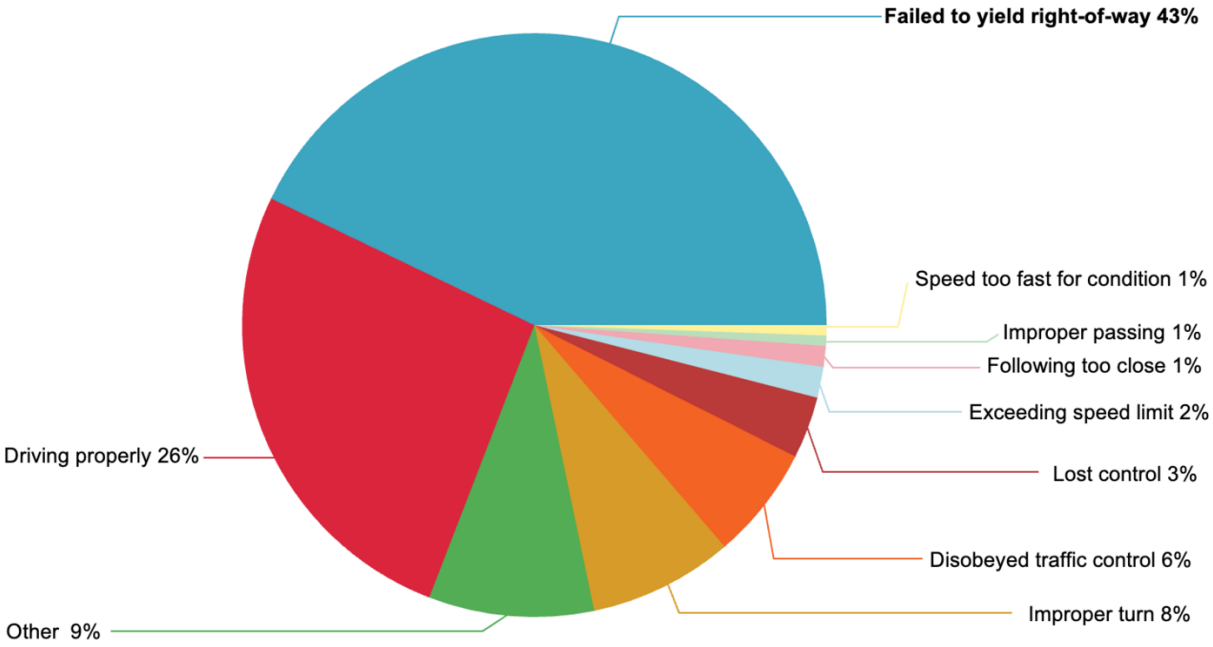


Figure 21: Classification of Pedestrian Injury Collisions by Driver Action (2017-2019, 2022 and 2023)

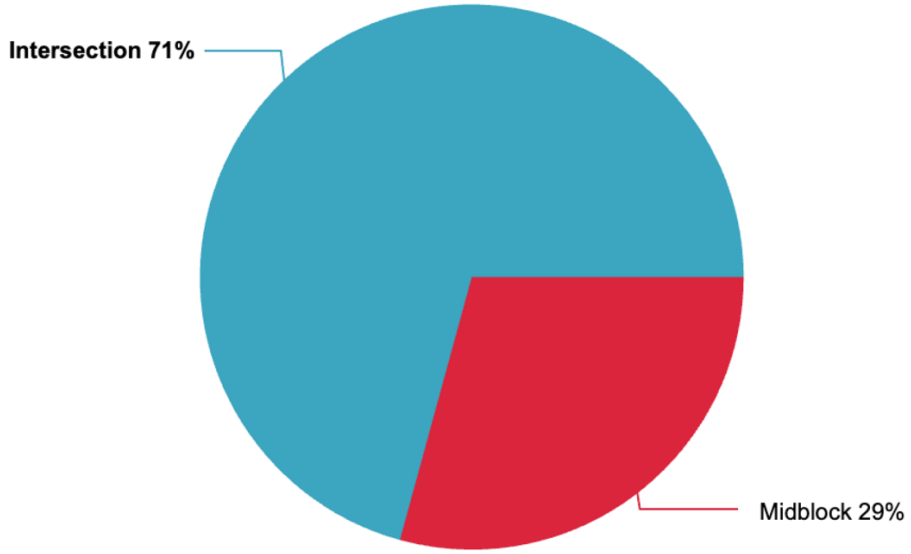


Figure 22: Classification of Pedestrian Injury Collisions by Collision Location (2017-2019, 2022 and 2023)

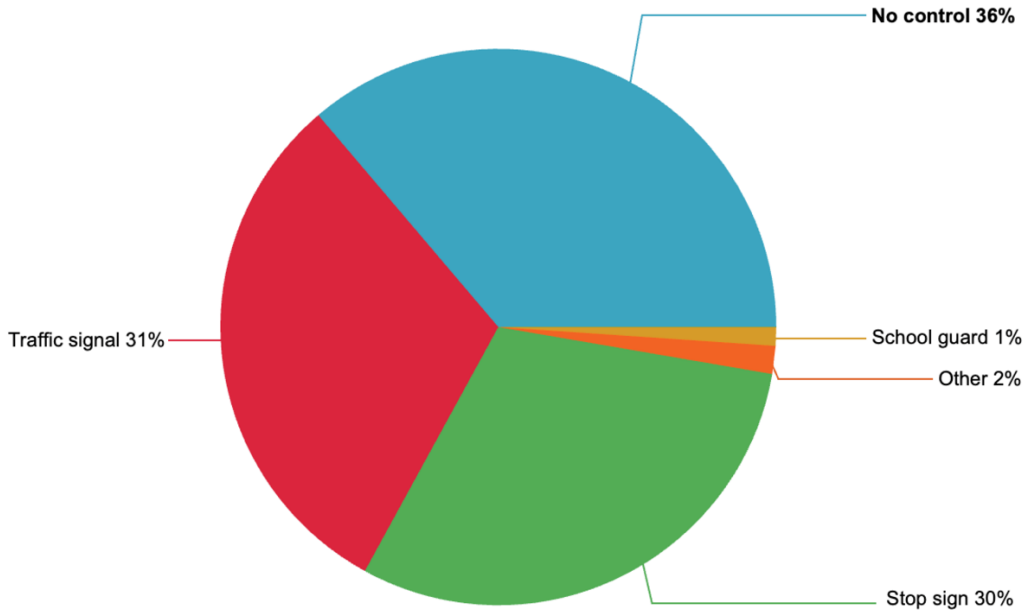


Figure 23: Classification of Intersection-Related Pedestrian Injury Collisions by Traffic Control Type (2017-2019, 2022 and 2023)

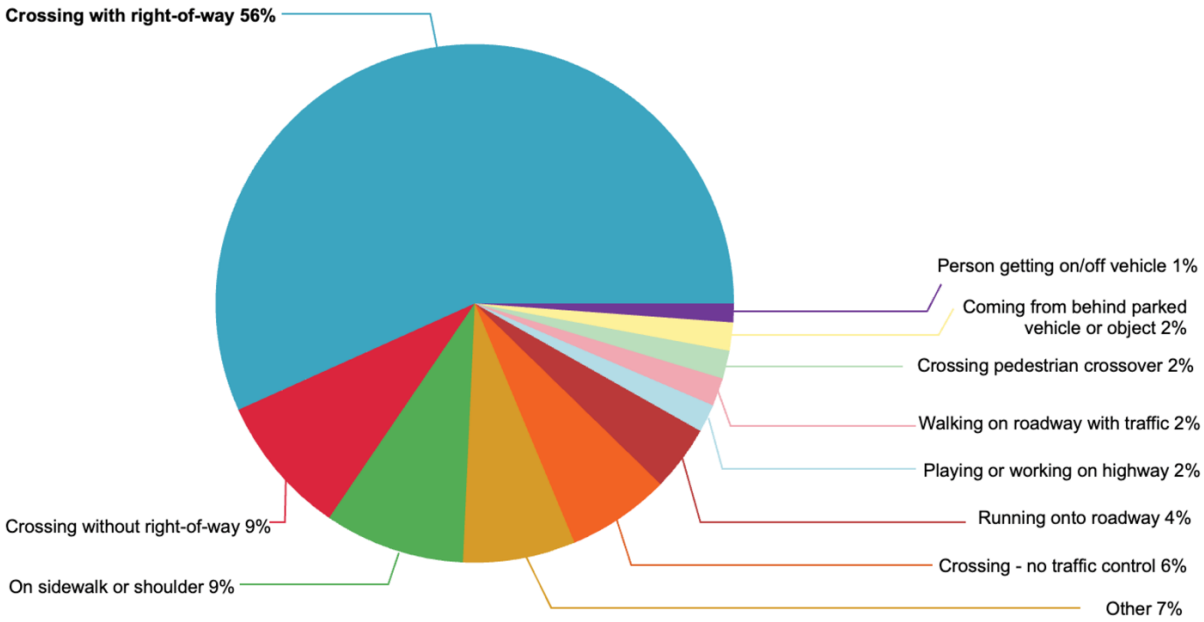


Figure 24: Classification of Pedestrian Injury Intersection-Related Collisions by Pedestrian Action (2017-2019, 2022 and 2023)

Table 3: Intersections with the Highest Frequency of Pedestrian Injury Collisions

Intersection	Number of Pedestrian Fatal + Injury Collisions (2017-2019, 2022-2023)*	Number of Pedestrian Fatal Collisions (2017-2019, 2022-2023)*	Number of Pedestrian Injury Collisions (2017-2019, 2022-2023)*
Denison Street at **Milliken Meadows Drive**	4	-	4
Main Street Markham at **Bullock Drive / Parkway Avenue**	4	-	4
Markham Road at **Edward Jeffreys Avenue**	3	-	3
Apple Creek Boulevard at **Town Centre Boulevard**	3	-	3
Rodick Road at **Calvert Road**	3	-	3
Carlton Road at **Village Parkway**	3	-	3
Aldergrove Drive at **Fenton Road**	2	-	2
Denison Street at **Aldergrove Drive / Eden Avenue**	2	-	2
Hillcroft Drive at **Worthing Avenue**	2	-	2
Eastvale Drive at **Elson Street**	2	-	2
Masseyfield Gate at **Risebrough Circuit**	2	-	2
Middlefield Road at **Elson Street**	2	-	2
Denison Street at **Esna Park Drive**	2	-	2
Old Kennedy Road at **Aldergrove Drive**	2	-	2
Denison Street at **Hood Road**	2	-	2
Denison Street at **Coppard Avenue**	2	-	2
Denison Street at **Teddington Avenue**	2	-	2
Dudley Avenue at **Morgan Avenue**	1	1	0

* Note: This ranking is not adjusted for the regression to the mean bias

2.2.8. Cyclist Collisions

From 2017-2019, 2022 and 2023, a total of 111 cyclist-involved injury collisions occurred on municipal roads (Figure 25). Cyclist-involved collisions were significantly higher in 2023 than the previous years. There were no cyclist fatal collisions during the study period (There was a fatal cyclist collision in 2020, during the period affected by the COVID-19 pandemic. Refer to Section 2.1.1.).

Most cyclist collisions occurred between September and December (Figure 26). While there is a gradual decrease in cyclist collisions from September to January, the relatively high numbers of

collisions in winter months, particularly December and January, indicate that cycling trips are being made during these months, which may indicate a need for enhancing winter maintenance on the City's road and cycling network.

The highest number of cyclist collisions by age group was between 10 and 19 years old (Figure 27).

Drivers involved in injury collisions failed to yield right-of-way in 45% of cyclists-involved collisions which occurred on municipal roads (Figure 28). In addition, cyclists were riding properly in 62% of injury collisions and failed to yield the right-of-way in 11% of injury collisions (Figure 29).

Approximately 75% of the 111 cyclist-involved injury collisions on municipal roads were intersection-related (Figure 30), and among those, 43% occurred at signalized intersections (Figure 31). The intersections with the highest number of collisions involving cyclists are listed in Table 4.

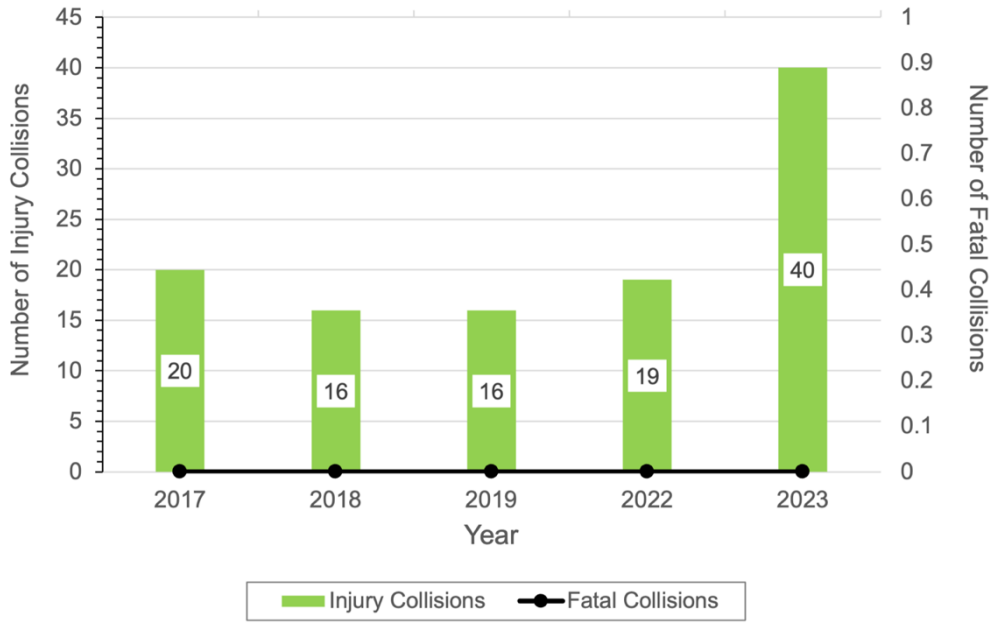


Figure 25: Number of Cyclists Injury Collisions by Year (2017-2019, 2022 and 2023)

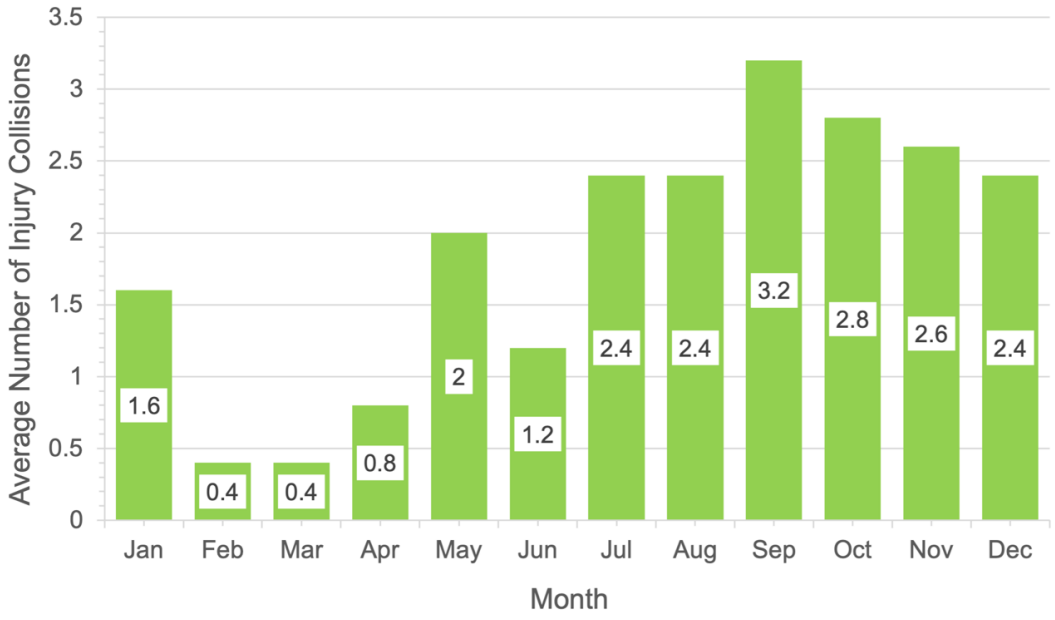


Figure 26: Annual Average Number of Cyclist Injury Collisions by Month (2017-2019, 2022 and 2023)

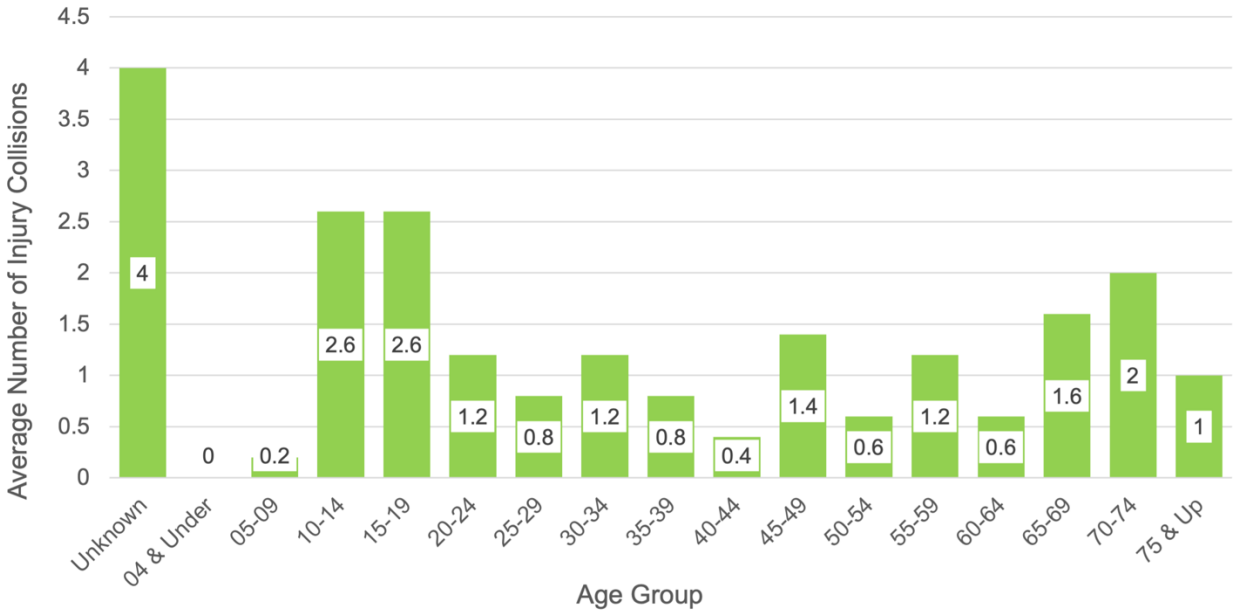


Figure 27: Annual Average Number of Cyclists Injury Collisions by Age Group (2017-2019, 2022 and 2023)

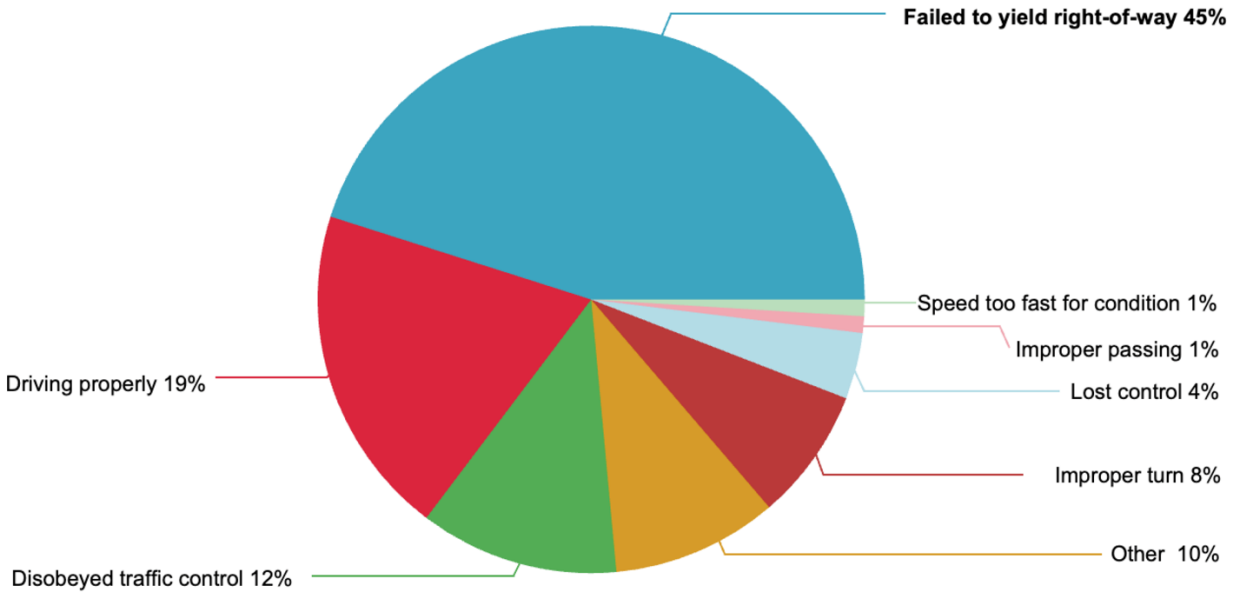


Figure 28: Classification of Cyclist Injury Collisions by Driver Action (2017-2019, 2022 and 2023)

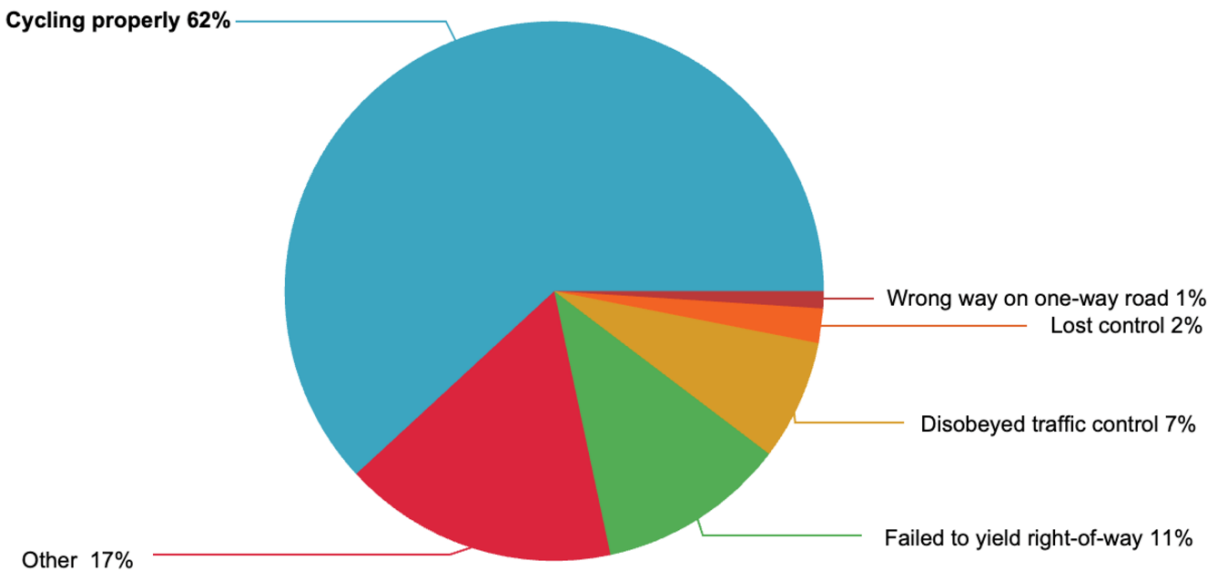


Figure 29: Classification of Cyclist Injury Collisions by Cyclist Action (2017-2019, 2022 and 2023)

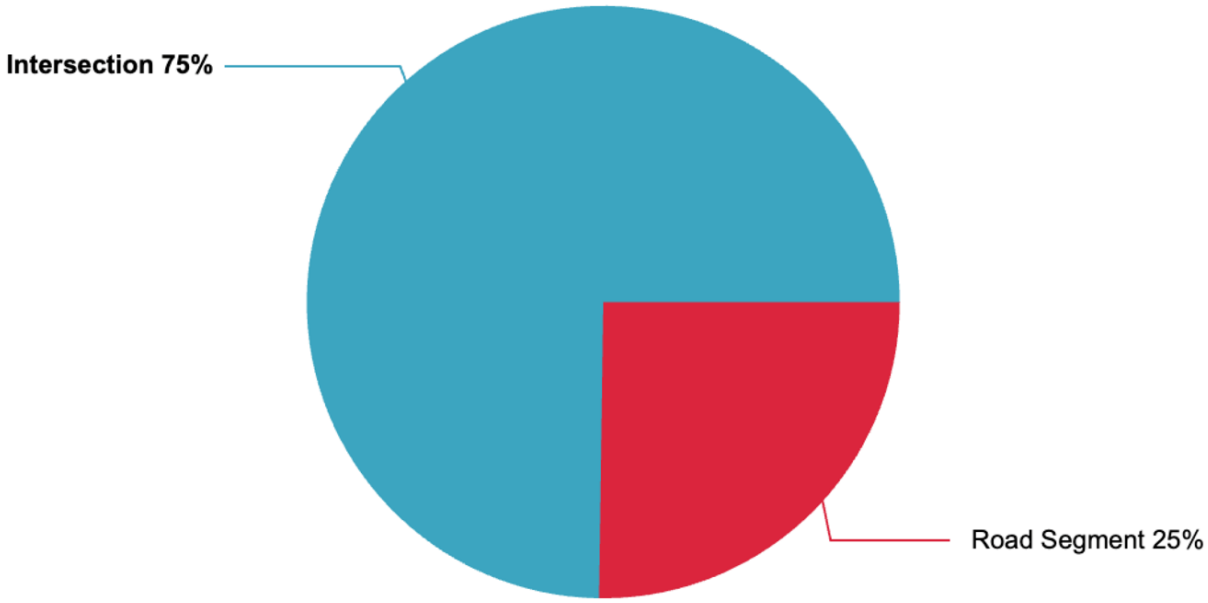


Figure 30: Classification of Cyclist Injury Collisions by Collision Location (2017-2019, 2022 and 2023)

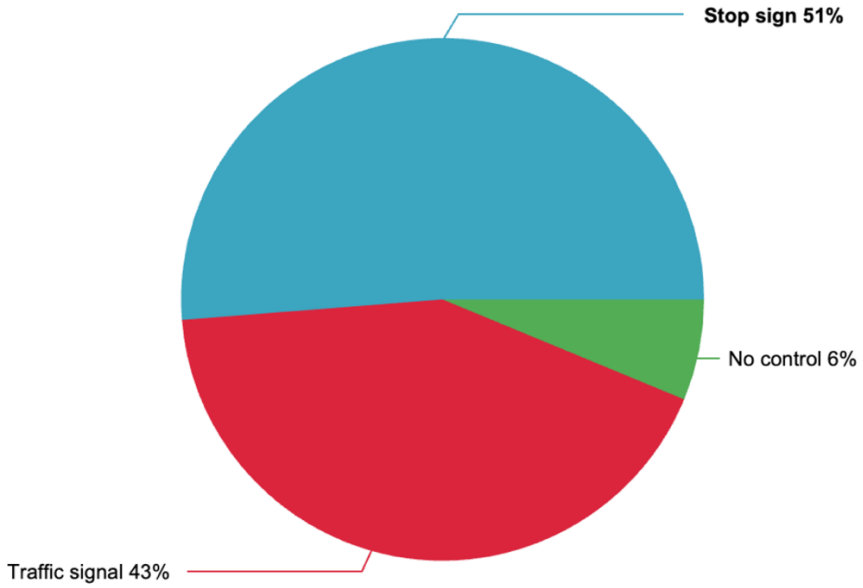


Figure 31: Classification of Intersection-Related Cyclist Injury Collisions by Traffic Control Type (2017-2019, 2022 and 2023)

Table 4: Intersections with Highest Frequency of Cyclist Injury Collisions

Intersection	Number of Cyclist Fatal + Injury Collisions (2017-2019, 2022-2023)*	Number of Cyclist Fatal Collisions (2017-2019, 2022-2023)*	Number of Cyclist Injury Collisions (2017-2019, 2022-2023)*
Denison Street at **Old Kennedy Road**	5	-	5
Markham Road at **Castlemore Avenue**	3	-	3
Markham Road at **Bur Oak Avenue**	2	-	2
Village Parkway at **Buchanan Drive**	2	-	2
Birchmount Road at **Risebrough Circuit**	2	-	2
Middlefield Road at **Golden Avenue**	2	-	2
Brimley Road at **Randall Avenue**	2	-	2
Brimley Road at **Winston Road**	2	-	2
Old Kennedy Road at **Aldergrove Drive**	2	-	2
Rachel Crescent at **Dalt Hicks Way**	2	-	2

* Note: This ranking is not adjusted for the regression to the mean bias

2.2.9. At-fault Truck Collisions

Truck collisions are defined as collisions with *Vehicle Type* coded as the following:

- Truck – open;
- Truck – dump;
- Truck – closed;
- Truck – tractor;
- Truck – tank;
- Truck – other;
- Pick-up truck; and
- Snow Plow.

There was a total of 82 out of 1,017 (8%) injury collisions defined as truck-related collisions; among those, 49 (60%) recorded as at-fault truck-related collisions. The analysis in this section focuses on the at-fault truck injury collisions.

From 2017-2019, 2022 and 2023, there has been an increase in the number of at-fault truck collisions (Figure 32).

The month with the highest number of truck collisions was July, followed by January (Figure 33). The most prevalent driver action is 'failed to yield right-of-way' (35%) followed by disobeyed traffic control (10%) and lost control (10%) in injury at-fault truck collisions that occurred on municipal roads (Figure 34).

Approximately 55% of the 50 at-fault truck injury collisions on City roads were intersection-related (Figure 35), and among those, 59% occurred at stop signs and 33% occurred at signalized intersections (Figure 36). There was only one intersection with more than one injury collision involving at-fault trucks, as identified in Table 5.

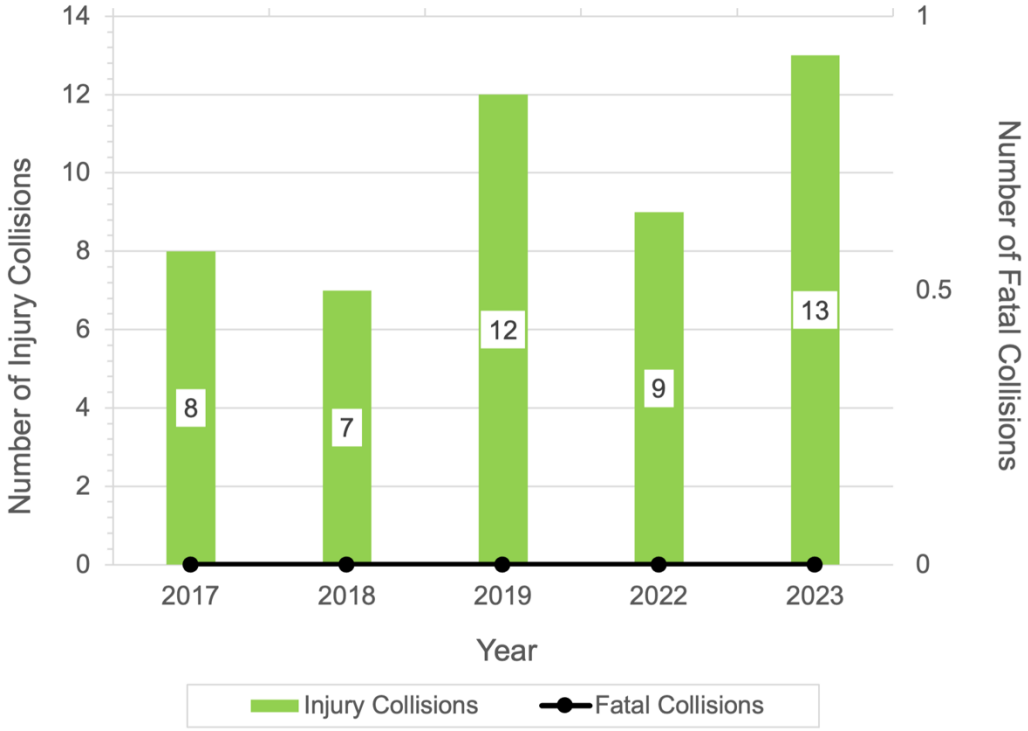


Figure 32: Number of At-fault Truck Injury Collisions by Year (2017-2019, 2022 and 2023)

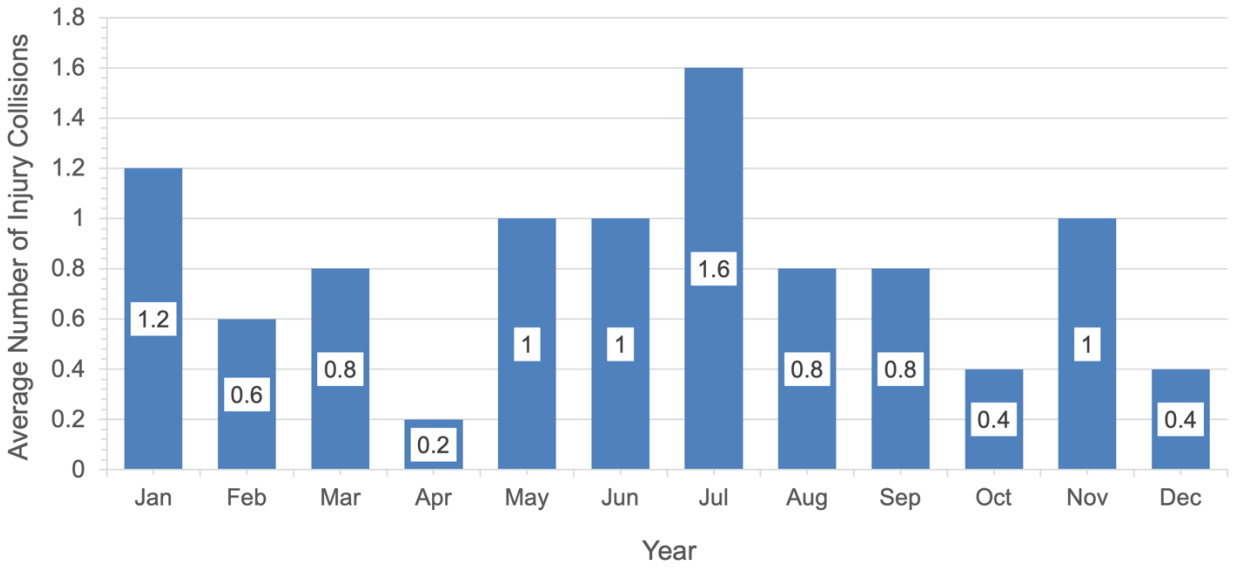


Figure 33: Annual Average Number of At-fault Truck Injury Collisions by Month (2017-2019, 2022 and 2023)

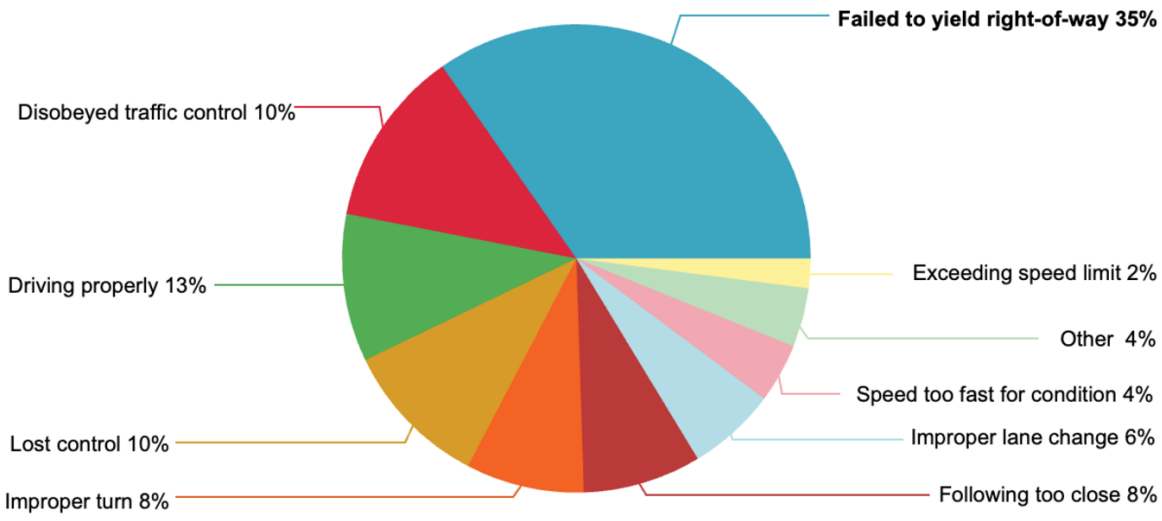


Figure 34: Classification of At-fault Truck Injury Collisions by Driver Action (2017-2019, 2022 and 2023)

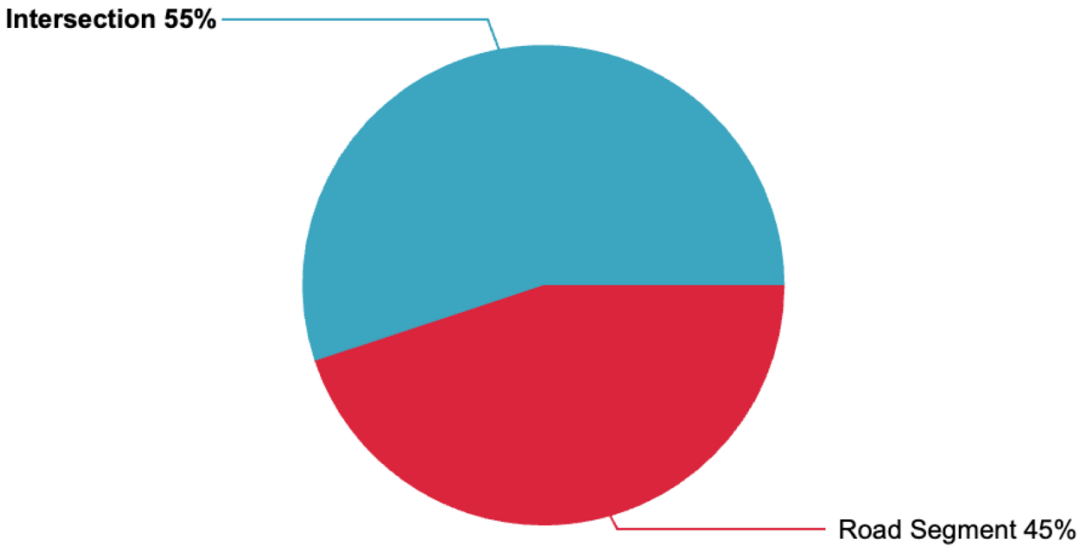


Figure 35: Classification of At-fault Truck Injury Collisions by Collision Location (2017-2019, 2022 and 2023)

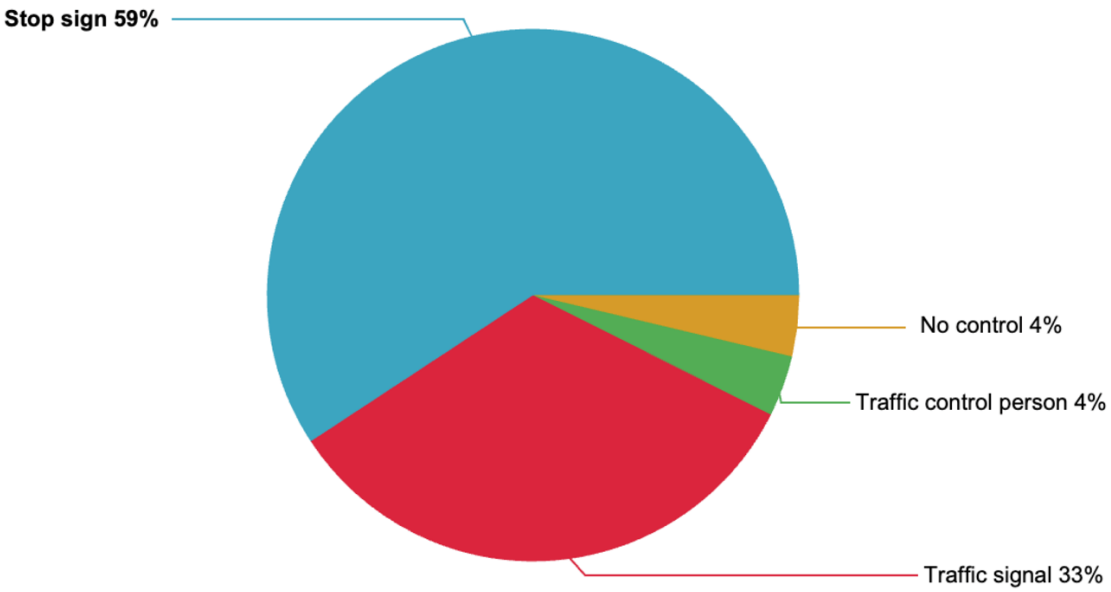


Figure 36: Classification of Intersection-Related At-fault Truck Injury Collisions by Traffic Control Type (2017-2019, 2022 and 2023)

Table 5: Intersections with Highest Frequency of At-fault Truck Injury Collisions

Intersection	Number of At-fault Truck Injury Collisions (2017-2019, 2022-2023)*	Number of At-fault Truck Fatal Collisions (2017-2019, 2022-2023)*	Number of At-fault Truck Injury Collisions (2017-2019, 2022-2023)*
Reesor Road at **19th Avenue**	2	-	2

* Note: This ranking is not adjusted for the regression to the mean bias

2.2.10. Roadway Departure

Roadway departure collisions are defined as collisions with *Initial Impact Type* coded as SMV and *Driver Event* coded as the following:

- Rollover;
- Ran off road;
- Skidding/sliding;
- Pole (utility, power);
- Building or wall;
- Curb;
- Pole (sign, parking meter);
- Tree, shrub, stump;
- Fence/noise barrier;
- Ditch; and
- Concrete or steel guide rail.

There was a total of 106 out of 1,017 (10%) injury collisions defined as roadway departure collisions. The locations with the highest numbers of collisions involving roadway departure are listed in Table 6.

Table 6: Intersections with Highest Frequency of Roadway Departure Injury Collisions

Intersection	Number of Roadway Departure Injury Collisions (2017-2019, 2022-2023)*	Number of Roadway Departure Fatal Collisions (2017-2019, 2022-2023)*	Number of Roadway Departure Injury Collisions (2017-2019, 2022-2023)*
Reesor Road at **19th Avenue**	3	-	3
Reesor Road between **14th Avenue** and **Steeles Avenue East**	3	-	3
Laureleaf Road between **Hammok Crescent** and **Babcombe Drive / Limcombe Drive**	2	-	2

2.3. Collision Analysis Summary

The main purpose of the collision analysis summarized in this part of the technical memorandum was to identify the largest types or groups of collisions that occurred on municipal roads of Markham. This information will be used as input for identifying emphasis areas, which are groupings of collisions with the greatest potential for safety improvement. Figure 37 shows the largest groups of collisions within municipal roads of Markham. The information presented on this figure in conjunction with the review of the existing safety programs and City priorities will assist stakeholders in choosing the emphasis areas.

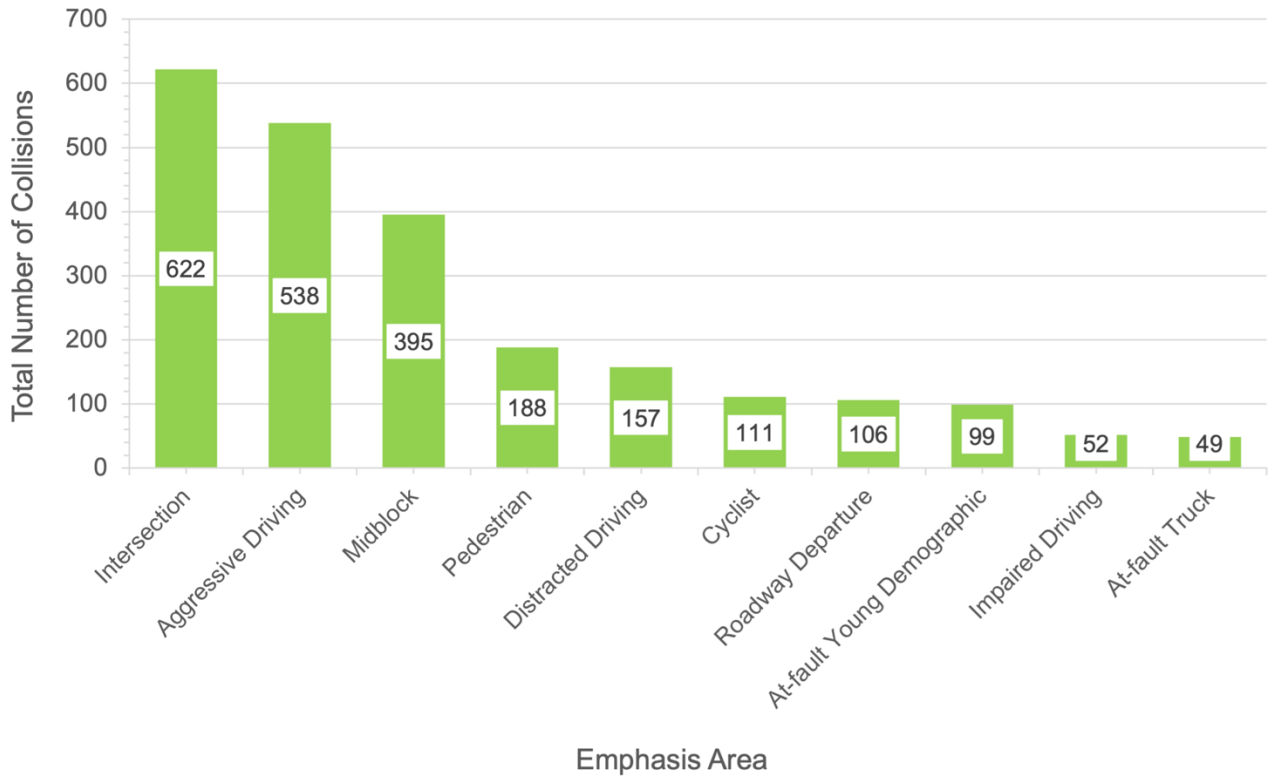


Figure 37: Potential Emphasis Area Overview (2017-2019, 2022 and 2023)

SUBMITTED BY CIMA CANADA INC.
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Burlington, ON, L7N 3G7
T: 289 288-0287 F: 289 288-0285
cima.ca

CIMA+ project number: B001780
January 2026

D

Appendix D
Countermeasures Plan

Emphasis Area: Aggressive Driving	Aggressive driving is defined as collisions with Driver Condition not coded as 'Inattentive' and Driver Actions coded as: - Following too close; - Exceeding speed limit; - Speed too fast for condition; - Disobeyed traffic control; and - Failed to yield right-of-way.		Percent of Fatal and Injury Involvement
Performance Measure - Number of aggressive driving collisions - Number of aggressive driving infractions - Number of enforcement waves - Number of red-light camera sites - Number of automated speed enforcement sites - Operating speed reduction	**When** - Time of Day: AM and PM peak hours - Month of Year: Throughout the year	**Priority Location** - Congested road segments - Road segments with wide cross-section	**Direct Target Population** - Drivers	**52.9%**

No.	Countermeasure	4 E's	Status	Description	Lead Agency	Support Team	5-Year Implementation Plan						CMF	Unit Cost	Effectiveness	Implementation Consideration
							Total	Year 1	Year 2	Year 3	Year 4	Year 5				
AG-01	Red Light Camera Program	Engineering	FUTR	Implement automated enforcement for red light violations at signalized intersections to reduce intentional red light running and minimize right-angle collisions.	City Bylaw Enforcement	City Finance Department	6	0	0	0	6	0	0.789	$50,000 per approach	Reduction in the frequency and/or severity of angle collisions. However, the frequency of rear-end collisions might increase.	-
AG-02	Community Safety Zones	Engineering	EXP	Implement additional Community Safety Zones (CSZ) where appropriate. A CSZ is a designated area on a roadway where traffic violations (e.g., speeding) are subject to higher fines and penalties.	City Engineering Department	York Regional Police	5	1	1	1	1	1	0.93	$25,000 per location	Reduction in speed and the frequency and/or severity of all collisions in CSZs.	-
AG-03	Vehicle Restrictions	Engineering	REC	Implement the restriction of certain travel movements that create unsafe conditions for pedestrians, cyclists, or other road users, ensuring the solution addresses the issue without shifting the problem to another area.	City Engineering Department	City Operations Department; York Regional Police; City Fire and Emergency Services	5	1	1	1	1	1		$5,000 per location	Reduction in cut-through traffic and the frequency and/or severity of all collisions.	-
AG-04	Continuous Centre Medians	Engineering	REC	Install physical center medians in urban areas where appropriate to prevent cross-median collisions and/or restrict access.	City Engineering Department	City Operations Department; City Urban Design Department; City Fire and Emergency Services	1	0	0	1	0	0	0.29	$165 per m	Reduction in speed and the frequency and/or severity of all collisions, especially collisions with opposing traffic.	-
AG-05	Automated Speed Enforcement	Engineering	REC	Implement Automated Speed Enforcement in Community Safety Zones and school zones.	City Engineering Department	City Legislative Services; City Finance Department	6	0	0	6	0	0	0.52	$250,000 per camera	Reduction in speed and the frequency and/or severity of all collisions.	-
AG-06	Senior Safety Zones	Engineering	FUTR	Introduce Senior Safety Zones where appropriate. Senior Safety Zones are designated road segments that include signage and other measures (i.e., "SLOW DOWN" pavement markings) to improve senior safety.	City Engineering Department	City Operations Department; York Region Public Health	5	1	1	1	1	1		$25,000 per location	Reduction in speed and the frequency and/or severity of all collisions in senior safety zones.	-
AG-07	Radar Speed Feedback Signs	Engineering	EX	Install radar speed feedback signs at locations with a history of speeding issues to encourage drivers to reduce their speed.	City Engineering Department	External Contractor	10	2	2	2	2	2	0.95	$5,500 per sign	Reduction in speed and the frequency and/or severity of all collisions.	-
AG-08	Pavement Markings	Engineering	EXP	Install traffic calming pavement markings, such as stencils, flush medians, edge lines, centrelines, and peripheral transverse bars, at appropriate locations.	City Engineering Department	City Operations Department	5	1	1	1	1	1	0.93	$11,000 per site (dragon's teeth)	Reduction in speed and the frequency and/or severity of all collisions.	-
AG-09	Roadway Narrowing	Engineering	EXP	Install roadway narrowing traffic calming treatments such as flexible bollards and road diets where appropriate.	City Engineering Department	City Operations Department; City Fire and Emergency Services	5	1	1	1	1	1	0.63	$687,500 per km (road diets)	Reduction in speed and the frequency and/or severity of all collisions.	-
AG-10	Horizontal Deflection	Engineering	REC	Install horizontal deflection traffic calming treatments such as curb extensions, reduced corner radii, chicanes, and traffic circles or roundabouts, where appropriate.	City Engineering Department	City Operations Department; City Fire and Emergency Services	10	2	2	2	2	2	0.981	$275,000 per intersection (corner radius reductions)	Reduction in speed and the frequency and/or severity of all collisions.	-
AG-11	Vertical Deflection	Engineering	REC	Install vertical deflection traffic calming treatments such as speed cushions and raised crosswalks at appropriate locations.	City Engineering Department	City Operations Department; City Fire and Emergency Services	5	1	1	1	1	1	0.6	$3,300 per speed hump/cushion	Reduction in speed and the frequency and/or severity of all collisions.	-
AG-12	Project S_PACE	Education & Engagement	REC	Launch Project S_PACE, an annual road safety social media campaign and enforcement project (previously known as "Slow Down, Move Over").	York Regional Police		1	1	0	0	0	0	0.91	$35,000 initial cost, $20,000 per year to maintain program	Reduction in speed and the frequency and/or severity of aggressive driving collisions.	-
AG-13	Priority Location / Time Enforcement Targeting Aggressive Driving	Enforcement	REC	Introduce targeted enforcement based on demonstrated patterns of aggressive driving observed through infractions and collision history.	York Regional Police	City Bylaw Enforcement	1	1	0	0	0	0		$35,000 initial cost, $20,000 per year to maintain program	Reduction in speed and the frequency and/or severity of aggressive driving collisions.	-

AG-14	Road Watch Program	Enforcement	EX	Continue to provice the Road Watch Program, a community-based reporting program run by the York Regional Police to address aggressive driving.	York Regional Police	City Engineering Department	1	1	0	0	0	0		$35,000 initial cost, $20,000 per year to maintain program	Reduction in speed and the frequency and/or severity of aggressive driving collisions.	-

Emphasis Area: Distracted Road Users	Distracted driving is defined as collisions with Driver Condition coded as 'Inattentive' and Driver Actions coded as: - Following too close; - Exceeding speed limit; - Speed too fast for condition; - Speed too slow for condition; - Improper turn; - Disobeyed traffic control; - Failed to yield right-of-way; - Improper passing; - Lost control; and - Improper lane change.		Percent of Fatal and Injury Involvement
Performance Measure - Number of distracted driving collisions - Number of distracted driving infractions - Number of improved road segments (e.g., guide rails, pavement markings) - Number of education campaigns - Number of enforcement waves	**When** - Time of Day: AM and PM peak hours - Month of Year: Throughout the year	**Priority Location** - Signalized intersections - Congested road segments - Construction zones	**Direct Target Population** - All road users	**15.4%**

No.	Countermeasure	4 E's	Status	Description	Lead Agency	Support Team	5-Year Implementation Plan						CMF	Unit Cost	Effectiveness	Implementation Consideration
							Total	Year 1	Year 2	Year 3	Year 4	Year 5				
DRU-01	Guide Rail Upgrades	Engineering	FUTR	Upgrade guide rail and end treatments to the latest MASH standards.	City Engineering Department	City Operations Department	5	1	1	1	1	1		$412,500 per km	Reduction in the frequency and/or severity of collisions near water, ditches.	-
DRU-02	Enhanced Pavement Markings	Engineering	EX	Introduce enhanced pavement markings where appropriate. Enhanced pavement markings use durable and highly visible materials, such as reflective paint or thermoplastics, to enhance visibility and guide drivers.	City Engineering Department	City Operations Department	10	2	2	2	2	2	0.893	$2.2 per m per side	Reduction in the frequency and/or severity of single motor vehicle collisions.	-
DRU-03	"Distracted-Free Driving" Awareness Days	Education & Engagement	FUTR	Encourage no-phone driving through workplace policies and promote the use of technology solutions, such as smartphone apps and features (e.g., "Do Not Disturb" mode or apps that block notifications while driving or in motion).	York Regional Police	York Region Traffic Safety; York Region Public Health	1	1	0	0	0	0	0.91	$35,000 initial cost, $20,000 per year to maintain program	Reduction in the frequency and/or severity of distracted driving collisions.	-

Emphasis Area: Intersections	Intersection collisions represent collisions occurring within an intersection area or involving vehicles waiting at or proceeding towards the intersection regardless of the distance from the intersection. A majority of fatal and injury collisions on Markham's roads are intersection collisions.	Percent of Fatal and Injury Involvement
Performance Measure - Number of intersection and intersection-related collisions - Number of intersections converted to roundabouts - Number of improved intersections	**When** - Time of Day: AM and PM peak hours - Month of Year: Through out the year	**Priority Location** - Signalized intersections **Direct Target Population** - All road users	**61.2%**

4 2 36 5 57 58 38 39 40 41 42 43 7

No.	Countermeasure	4 E's	Status	Description	Lead Agency	Support Team	5-Year Implementation Plan						CMF	Unit Cost	Effectiveness	Implementation Consideration
							Total	Year 1	Year 2	Year 3	Year 4	Year 5				
INT-01	Traffic Signals	Engineering	EXP	Install traffic signals where warranted.	City Engineering Department	York Region Traffic Safety	15	3	3	3	3	3	0.86	$385,000 per intersection	Reduction in the frequency and/or severity of turning movement collisions and angle collisions.	-
INT-02	Intersection/Railway Illumination	Engineering	FUTR	Implement appropriate illumination at intersections and railway crossings where warranted.	City Engineering Department		10	2	2	2	2	2	0.67	$55,000 per intersection	Reduction in the frequency and/or severity of collisions occurred under low-light conditions at intersections.	-
INT-03	Roundabouts	Engineering	FUTR	Implement roundabouts where appropriate.	City Engineering Department		1	0	0	0	0	1	0.32	$1,925,000 per roundabout	Reduction in the frequency and/or severity of all collisions at intersections.	-
INT-04	Sightline Improvements	Engineering	FUTR	Remove obstructions within pedestrian waiting areas and daylighting triangles to improve drivers' ability to enter an intersection safely. This is particularly crucial at two-way stop controlled intersections, especially in high-speed areas.	City Engineering Department	City Operations Department; City Bylaw Enforcement	5	1	1	1	1	1	0.53	$32,500 per approach	Reduction in the frequency and/or severity of turning movement collisions and angle collisions at intersections.	-
INT-05	Left-Turn Lane Offset	Engineering	FUTR	Define key locations for the implementation of left-turn lane offsets. Left-turn lane offsets create better visibility for both the turning vehicle and oncoming traffic.	City Engineering Department		1	0	0	0	1	0	0.64	$1,100,000 per intersection	Reduction in the frequency and/or severity of left-turning movement collisions.	-
INT-06	Protected Intersections	Engineering	REC	Implement protected intersections where appropriate. Protected intersections include various treatments to improve safety for vulnerable road users, including pedestrian refuge areas, protected signal phases, and setback crossings.	City Engineering Department	York Region Traffic Safety	1	0	0	0	1	0		$1,100,000 per intersection	Reduction in the frequency and/or severity of collisions involving vulnerable road users at intersections.	-
INT-07	Left-Turn Signal Phases (Protected / Protected + Permissive)	Engineering	EX	Implement protected turning movements to provide turning vehicles exclusive right-of-way in sequence, reducing collisions with oncoming vehicles, cyclists and pedestrians.	City Engineering Department		4	0	1	1	1	1	0.718	$55,000 per phase	Reduction in the frequency and/or severity of left-turning movement collisions and pedestrian collisions.	-
INT-08	Left-Turn Lanes	Engineering	EXP	Implement left-turn lanes at intersections when applicable, especially in free-flow conditions, to reduce rear end collisions.	City Engineering Department	City Operations Department	2	0	0	1	0	1	0.72	$302,500 per two-way approach	Reduction in the frequency and/or severity of left-turning movement collisions and rear end collisions at intersections.	-
INT-09	Driveway Access Management	Engineering	REC	Avoid and/or remove driveway movements close to intersections, especially traffic signals, to reduce potential conflict points.	City Engineering Department	City Operations Department	1	0	0	1	0	0	Far-side: 0.75 (1/1.33) Near-side: 1.22 (1/0.82)	$11,000 per approach	Reduction in the frequency and/or severity of access-related collisions near intersections.	Potential conflict with property owners' existing approved site plans
INT-10	Left-Turn Traffic Calming	Engineering	REC	Implement left-turn traffic calming to reduce collisions involving left-turning vehicles. Left-turn traffic calming involves altering the median island, usually at signalized intersections, to reduce the turning radius and slow down turning speeds.	City Engineering Department		6	2	0	2	0	2	0.82	$10,000 per approach	Reduction in the frequency and/or severity of left-turning movement collisions and pedestrian collisions.	-
INT-11	Reduced Speeds at Intersection Approaches	Engineering	REC	Reduce posted speed limits on the approach to major intersections to reduce frequency and severity of all collision types.	City Engineering Department		6	0	3	0	3	0	0.93	$2,000 per approach	Reduction in the frequency and/or severity of all collisions at intersections.	-
INT-12	Turn Prohibitions (Full or Part-Time)	Engineering	REC	Introduce full-time or part-time turn prohibitions where congestion is causing collisions. Care should be taken not to simply relocate the problem elsewhere.	City Engineering Department	City Operations Department	4	0	1	1	1	1	0.36	$2,000 per approach	Reduction in the frequency and/or severity of turning movement collisions and pedestrian collisions.	-

Emphasis Area: School Zones	Although collision data in school zones is not available, children are among the most vulnerable road users, making school zone safety crucial.		Percent of Fatal and Injury Involvement
Performance Measure - Number of collisions in school zones - Operating speed reduction in school zones - Number of education campaigns	**When** - Time of Day: arrival and dismissal periods - Month of Year: September to June	**Priority Location** - Schools	**Direct Target Population** - Students - Staff - Parents	-

No.	Countermeasure	4 E's	Status	Description	Lead Agency	Support Team	5-Year Implementation Plan						CMF	Unit Cost	Effectiveness	Implementation Consideration
							Total	Year 1	Year 2	Year 3	Year 4	Year 5				
SZ-01	School Safety Education Program	Education & Engagement	EX	Increase awareness of road safety at and around schools through programs such as "Bike to School Week", "Getting to School Safely Gameboards", Healthy Schools Participating in AST/Walking Initiatives, and safety information distribution. Also includes education on school bus safety for motorists.	York Region Public Health	MTO; York Region School Boards	1	1	0	0	0	0	0.91	$35,000 initial cost, $20,000 per year to maintain program	Reduction in the frequency and/or severity of collisions near school zones.	-
SZ-02	Intersection Safety School Program	Education & Engagement	FUTR	Add an intersection safety module to the fire safety teaching plans for Markham Fire Suppression crews, who currently teach fire safety to all students in grades 1-4 within the City.	City Fire and Emergency Services	York Region Public Health; York Region School Boards; York Regional Police	1	1	0	0	0	0	0.91	$35,000 initial cost, $20,000 per year to maintain program	Reduction in the frequency and/or severity of all collisions at intersections.	-
SZ-03	Active School Travel (AST) Program	Education & Engagement	EXP	Expand the existing Active School Travel Program. Active School Travel promotes active school travel through education and infrastructure improvements such as signage, pavement markings, and bicycle parking. The Markham School Zone Safety Guide study recommends expanding the program.	City Engineering Department	City Operations Department; York Region School Boards; York Region Public Health	1	1	0	0	0	0	0.84 to 0.86 (FI)	$30,000 initial cost, $10,000 per year to maintain program	Reduction in the frequency and/or severity of school-age children collisions near school zones.	-
SZ-04	40km/h Backpack Program	Education & Engagement	FUTR	Implement a 40 km/h Backpack Program. The program visually remind drivers to slow down in school zones through backpacks worn by students.	York Regional Police	CAA; City Engineering Department; York Region Traffic Safety	5	1	1	1	1	1		$10,000 per school	Reduction in the frequency and/or severity of collisions near school zones.	-
SZ-05	School Zone Enforcement	Enforcement	FUTR	Introduce targeted police enforcement in school zones to address concerns such as parking violations, stop sign compliance, speeding, and other traffic issues.	York Regional Police	City Bylaw Enforcement	1	1	0	0	0	0		$35,000 initial cost, $20,000 per year to maintain program	Reduction in the frequency and/or severity of collisions near school zones.	-
SZ-06	Systemic Intersection Improvements Near Schools	Engineering	FUTR	Implement improvements to all intersections near existing schools and include safety reviews at intersections for all new schools.	City Engineering Department	City Operations Department	20	4	4	4	4	4	0.9 (FI)	$55,000 per school	Reduction in the frequency and/or severity of all collisions at intersections near school zones.	-
SZ-07	Traffic Management Plan and School Area Review	Engineering	FUTR	Develop customized Traffic Management Plans (TMPs) for school sites to improve traffic flow. Work with schools to implement engineering solutions for any identified concerns.	City Engineering Department	York Region School Boards	5	1	1	1	1	1		$11,000 per school	Reduction in the frequency and/or severity of collisions near school zones.	-
SZ-08	School Streets Program	Engineering	EXP	Expand the School Streets Pilot Program. The School Streets Program temporarily closes or restricts vehicle access to streets near schools during peak drop-off and pick-up times to improve safety, reduce congestion, and encourage active transportation.	City Engineering Department	City Operations Department; York Region School Boards; York Regional Police; City Fire and Emergency Services; York Region Public Health	5	1	1	1	1	1		$31,000 per location	Reduction in the frequency and/or severity of collisions near school zones.	-
SZ-09	School Zones	Engineering	EX	Implement additional school zones where appropriate. School zones are areas near schools where there are special speed limits and other traffic regulations designed to protect students as they travel to and from school.	City Engineering Department	City Operations Department	5	1	1	1	1	1	0.93	$25,000 per location	Reduction in speed and the frequency and/or severity of all collisions near school zones.	-
SZ-10	School Crossing Guard Program	Engineering	EX	Continue to provide the School Crossing Guard Program. School crossing guards help ensure the safety of children crossing streets near schools by directing traffic and assisting with pedestrian crossings during peak arrival and dismissal times.	City Engineering Department	Staffing Services Inc. (Third Party Vendor)	0	0	0	0	0	0		$18,000 per crossing guard	Reduction in the frequency and/or severity of school-age children collisions near school zones.	-

Emphasis Area: Vulnerable Road Users	Vulnerable road users includes all travellers who are vulnerable in an event of collisions, such as pedestrians, cyclists, motorcyclists, and micromobility users. However, when analyzing collision data, the analysis focus on collisions involving pedestrians and cyclists. Collisions involving pedestrians contributed to 19% of fatal and injury collisions on City of Markham roads, while collisions involving cyclists contributed to 11% of fatal and injury collisions.			Percent of Fatal and Injury Involvement
Performance Measure - Number of pedestrian collisions - Number of bicyclist collisions - Number of motorcyclist collisions - Number of improved intersections - Operating speed reduction - Number of grade separations accomplished - Percentage of bicyclist riders who wear helmets - Number of education campaigns	**When** - Time of Day: AM and PM peak hours - Month of Year: Throughout the year for pedestrians and cyclists	**Priority Location** - Intersections (71% of pedestrian collisions and 75% of cyclist collisions)	**Direct Target Population** - Pedestrians (including students, children, and seniors) - Cyclists - Motorcyclists - Micromobility users **Indirect Target Population** - Drivers	**29.5%**

No.	Countermeasure	4 E's	Status	Description	Lead Agency	Support Team	5-Year Implementation Plan						CMF	Unit Cost	Effectiveness	Implementation Consideration
							Total	Year 1	Year 2	Year 3	Year 4	Year 5				
VRU-01	AODA Upgrades	Engineering	EXP	Upgrade existing locations to meet AODA requirements, including the installation of audible pedestrian signals, tactile plates, curb cuts, etc.	City Engineering Department	City Operations Department; CPAC	6	0	0	0	3	3		$151,250 per intersection	Reduction in the frequency and/or severity of vulnerable road user collisions at intersections.	-
VRU-02	Setback Pedestrian Crosswalks	Engineering	FUTR	Install setback pedestrian crosswalks where applicable. Setback pedestrian crosswalks are crosswalks positioned a short distance away from the intersection, creating a buffer zone to improve pedestrian visibility and safety by reducing conflicts with turning vehicles.	City Engineering Department	CPAC	6	0	0	0	3	3		$770 per crosswalk	Reduction in the frequency and/or severity of pedestrian collisions at intersections.	-
VRU-03	Pedestrian Signals	Engineering	EXP	Install pedestrian signals where warranted.	City Engineering Department	CPAC	1	1	0	0	0	0	0.554	$110,000 per location	Reduction in the frequency and/or severity of pedestrian collisions at midblock segments.	-
VRU-04	Addition of Active Transportation Facilities (On-Road Painted Bicycle Lanes)	Engineering	EXP	Implement on-road, painted bicycle lanes where appropriate.	City Engineering Department	City Operations Department; CPAC	5	1	1	1	1	1	0.86	$3,850 per km per side	Reduction in the frequency and/or severity of collisions involving active transportation users (pedestrians, cyclists, micromobility).	-
VRU-05	Addition of Active Transportation Facilities (Protected On-Road)	Engineering	EXP	Implement on-road protected cycling facilities separated by physical barriers (e.g., bollards, planters, curbs, etc.) where appropriate.	City Engineering Department	City Operations Department; CPAC	2	1	1	0	0	0	0.37	$44,000 per km per side	Reduction in the frequency and/or severity of collisions involving active transportation users (pedestrians, cyclists, micromobility).	-
VRU-06	Addition of Active Transportation Facilities (Protected Off-Road)	Engineering	EXP	Implement protected off-road bicycle facilities including raised cycle tracks or multi-use pathways where appropriate.	City Engineering Department	City Operations Department; CPAC	2	0	0	0	1	1	0.37	$1,375,000 per km per side	Reduction in the frequency and/or severity of collisions involving active transportation users (pedestrians, cyclists, micromobility).	-
VRU-07	Bicycle Conflict Zone Pavement Markings	Engineering	FUTR	Install green conflict zone pavement markings at transition zones or locations of potential conflict between motor vehicles and cyclists.	City Engineering Department	City Operations Department; CPAC	5	1	1	1	1	1		$3,850 per intersection	Reduction in the frequency and/or severity of cyclist collisions.	-
VRU-08	Illumination at Active Transportation Facilities	Engineering	EXP	Install or upgrade street lighting specifically designed to highlight pedestrian and cyclist crossings and enhance safety. Improved illumination for active transportation facilities provides increased visibility and safety, especially in low-light or nighttime conditions.	City Engineering Department	CPAC	5	1	1	1	1	1	0.58	$38,500 per location	Reduction in the frequency and/or severity of collisions involving active transportation users (pedestrians, cyclists, micromobility).	-
VRU-09	Bicycle Signals	Engineering	FUTR	Install dedicated signals for cyclists at signalized intersections. Bicycle signals are often implemented in conjunction with special signal timings or phasing for cyclists.	City Engineering Department	CPAC	1	0	0	1	0	0		$27,500 per approach	Reduction in the frequency and/or severity of cyclist collisions at signalized intersections.	-
VRU-10	Crossride Markings	Engineering	EXP	Install crossride (i.e., bicycle crossing) pavement markings at intersections and driveways to highlight the presence of cyclists crossing and organize their movements.	City Engineering Department	CPAC	5	1	1	1	1	1	0.6	$22,000 per crossride	Reduction in the frequency and/or severity of cyclist collisions at intersections.	-
VRU-11	Leading Pedestrian Intervals (LPIs)	Engineering	FUTR	Install Leading Pedestrian Intervals (LPIs) where applicable. LPIs are a traffic signal strategy that activates the pedestrian walk signal before the vehicle green, allowing pedestrians to enter the intersection safely and reducing pedestrian-vehicle collisions.	City Engineering Department	CPAC	8	0	2	2	2	2	0.81	$5,500 per intersection	Reduction in the frequency and/or severity of pedestrian collisions at signalized intersections.	Potential conflict with permissive left-turn phases; Potential increase in traffic delay

VRU-12	Signal Optimization for Pedestrians	Engineering	FUTR	Reduce traffic signal cycle length to allow pedestrians to cross the street more frequently. This countermeasure could result in higher vehicle delays and congestion and therefore should be implemented with caution.	City Engineering Department	CPAC	5	1	1	1	1	1		$5,500 per intersection	Reduction in the frequency and/or severity of pedestrian collisions at intersections.	Potential increase to traffic delay
VRU-13	Right Turn on Red Restrictions	Engineering	FUTR	Implement right turn on red (RTOR) prohibitions to reduce conflicts with pedestrians who are crossing perpendicular to the vehicle direction.	City Engineering Department	CPAC	6	0	3	0	3	0	0.97	$11,000 per intersection	Reduction in the frequency and/or severity of pedestrian collisions at signalized intersections.	Potential increase in traffic delay
VRU-14	Active Transportation Project Ranking and Multi-Modal LOS Analysis	Engineering	REC	Leverage the existing tool for prioritizing active transportation projects developed by NCHRP, including developing a ranked list of projects. Conduct multi-modal LOS analysis to provide more equal use of the roadway system for all types of travel, including transit, cycling, and walking.	City Engineering Department	CPAC	1	0	1	0	0	0		-	Reduction in the frequency and/or severity of collisions involving active transportation users (pedestrians, cyclists, micromobility).	-
VRU-15	Advanced Warning Signs for Motorcyclists	Engineering	REC	Provide advance warning signs to alert motorcyclists of reduced traction, irregular roadway surfaces, and work zones.	City Engineering Department	City Operations Department	1	0	0	0	1	0		-	Reduction in the frequency and/or severity of collisions involving motorcyclists.	-
VRU-16	Fully Paved Shoulders	Engineering	REC	Install fully paved shoulders to provide motorcyclists space for roadside recovery and breakdowns.	City Engineering Department	City Operations Department	1	0	0	0	1	0		-	Reduction in the frequency and/or severity of collisions involving motorcyclists.	-
VRU-17	Pedestrian Crossovers (PXOs)	Engineering	EX	Install pedestrian crossovers (PXOs) where warranted. Consider upgrading existing PXO crossing controls (i.e., signs, pavement markings, and/or flashers) to partial or full signalization where appropriate.	City Engineering Department	City Operations Department; CPAC	15	3	3	3	3	3	0.82	$137,500 per PXO	Reduction in the frequency and/or severity of pedestrian collisions at midblock segments.	-
VRU-18	Expand Existing Sidewalk Network Completion	Engineering	EXP	Expand the current capital program to install new sidewalks, completing the City's network.	City Engineering Department	City Operations Department; CPAC	5	1	1	1	1	1	0.35	$275,000 per km per side	Reduction in the frequency and/or severity of pedestrian collisions at midblock segments.	-
VRU-19	Cyclist Safety Education Program	Education & Engagement	EXP	Increase cyclist road safety awareness through programs like "Driving Around Cyclists" for driver education, "Helmet Education," "Be Safe, Be Seen" to improve visibility in low-light conditions, and "Stay Alert, Stay Safe." Continue the Trails Etiquette Campaign, and partner with York Region to offer "Cycling Safety" workshops (in-person or virtual).	City Engineering Department	CPAC; York Region School Boards; York Region Public Health; York Regional Police; CAA; MTO	1	1	0	0	0	0	0.91	$35,000 initial cost, $20,000 per year to maintain program	Reduction in the frequency and/or severity of cyclist collisions.	-
VRU-20	Pedestrian Safety Education Program	Education & Engagement	REC	Increase pedestrian road safety awareness through programs like "Be Safe, Be Seen" to improve visibility in low-light conditions and "Stay Alert, Stay Safe." Attend public events to distribute pedestrian safety materials, continue the Trails Etiquette Campaign, and partner with York Region to offer "Walking Safety" workshops (in-person or virtual).	City Engineering Department	CPAC; York Region School Boards; York Region Public Health; York Regional Police; CAA; MTO	1	1	0	0	0	0	0.91	$35,000 initial cost, $20,000 per year to maintain program	Reduction in the frequency and/or severity of pedestrian collisions.	-
VRU-21	Enforcement of Motorcyclists	Education & Engagement	EX	Implement targeted enforcement against dangerous motorcycling behaviour, unlicensed riding, and impaired driving.	York Regional Police		5	1	1	1	1	1		-	Reduction in the frequency and/or severity of motorcyclist collisions.	-
VRU-22	Micromobility Safety Education Program	Education & Engagement	REC	Increase road safety awareness for micromobility users through targeted education and outreach programs.	City Engineering Department	CPAC; York Region School Boards; York Region Public Health; York Regional Police; CAA; MTO	1	1	0	0	0	0	0.91	$35,000 initial cost, $20,000 per year to maintain program	Reduction in the frequency and/or severity of micromobility collisions.	-

Emphasis Area: Young Drivers	Collisions involving young drivers aged 16 to 29 contributed to 29% of fatal and injury collisions on City of Markham roads.		Percent of Fatal and Injury Involvement
Performance Measure - Number of collisions involving young drivers - Number of education campaigns	**When** - Time of Day: AM and PM peak hours - Month of Year: Throughout the year	**Priority Location** - Signalized intersections	**Direct Target Population** - Young Drivers	**29.0%**

No.	Countermeasure	4 E's	Status	Description	Lead Agency	Support Team	5-Year Implementation Plan						CMF	Unit Cost	Effectiveness	Implementation Consideration
							Total	Year 1	Year 2	Year 3	Year 4	Year 5				
YD-01	Alcohol and Drugs Youth Programs	Education & Engagement	EX	Continue to provide the Alcohol and Drugs Youth Program offered by the York Region Public Health. This program is free of cost and conducted throughout the school year.	York Region Public Health		0	0	0	0	0	0	0.91	$35,000 initial cost, $20,000 per year to maintain program	Reduction in the frequency and/or severity of impaired driving collisions involving young drivers.	-
YD-02	Young Drivers Education Campaign	Education & Engagement	REC	Increase young driver road safety awareness through programs related to distracted driving and impaired driving (i.e., alcohol and drug use) in secondary schools. Publicize and enforce seat belt laws.	York Region District School Board	York Region Public Health; MTO; York Region Traffic Safety; York Regional Police; City Corporate Communications Department; York Catholic District School Board	1	1	0	0	0	0	0.91	$35,000 initial cost, $20,000 per year to maintain program	Reduction in the frequency and/or severity of young driver collisions.	-

CIMA+ project number: B001780
January 2026

E

Appendix E
Summary of Online Survey Responses

Markham Public Survey Summary
Total Respondents: 332

Please let us know which one category you represent most in your response today.	Number of Responses
Markham Resident	307
Working in Markham	10
Student	7
Living outside of Markham	6
Business Owner	1
Visitor	1

What are your preferred methods of travel inside the City? (Please rank these options in order where 1 is most preferred and 6 is least preferred)	Number of Responses
Driving	1770
Walking	1411
Public Transit	1167
Cycling	1108
Rideshare or Taxi	685
Scootering, Skateboarding, Rollerblading	537

Scoring System:

Rank	Number of Points
1	6
2	5
3	4
4	3
5	2
6	1

The City of Markham wants to know your major concerns regarding different types of collisions and their contributing factors. Please rate the following collision emphasis areas.	Number of Responses
Aggressive driving	1376
Distracted driving and walking	1295
Impaired driving	1284
Intersection collisions	1258
School zone road safety	1207
Pedestrian safety	1206
Cyclist safety	1157
Park and playground area road safety	1093
Young drivers	1000
Weather-related collisions	997
Collisions involving heavy vehicles	991
Collisions at night	925
Construction zone collisions	925
Run off the road collisions	919
Elderly drivers	894
Collisions with wild animals	687

Scoring System:

Rank	Number of Points
Highest Priority	5
High Priority	4
Medium Priority	3
Low Priority	2
Not a priority	1
No opinion	0

Reflecting on the list of collision types in the previous question, how do you currently rate road safety in the City of Markham?	Number of Responses
Very Good	11
Good	36
Acceptable	127
Poor	85
Very Poor	43

As a follow-up to the previous question, if you are a Markham resident, how do you rate road safety in your neighbourhood within the City of Markham (close to your residence or workplace)?	Number of Responses
Very Good	30
Good	43
Acceptable	101
Poor	80
Very Poor	46
I don't live or work in Markham	2

How frequently do you experience or witness near-miss incidents while travelling within the City of Markham?	Number of Responses
Monthly	64
Weekly	111
Daily	63
Rarely	58
Never	6

What measures do you believe would most effectively improve road safety in the City of Markham? (Select up to three)	Number of Responses
Increased police presence and traffic enforcement	142
Installation of more traffic signals and stop signs	41
Improved street lighting	39
Enhanced pedestrian crossings and sidewalks	118
Dedicated bike lanes and cyclist infrastructure	98
Public awareness campaigns on road safety	58
Traffic calming measures (e.g., speed bumps, roundabouts)	83
Improved public transportation options	45
Other	83

What is your age?	Number of Responses
15 years old or younger	0
16-19 years old	2
20-24 years old	7
25-34 years old	28
35-44 years old	37
45-54 years old	41
55-64 years old	55
65-74 years old	59
75 years old or older	28
Prefer not to answer	26

What is your gender?	Number of Responses
Male	151
Female	103
Non-binary	2
Prefer not to answer	27

Are there specific intersections or roadways in the City of Markham that you consider particularly dangerous?
Markham Rd. & 16th Ave. Wootten Way & Hwy. 7 Hwy. 7 from Kennedy Rd. to Yonge St.
Not sure
The whole of Main Street Markham from Major Mackenzie Dr to Hwy 407 needs serious attention. It's deeply unfriendly for drivers and especially for other road users. The provided cycling and walking infrastructure is compromised by bending to the convenience of drivers over the safety of people not in cars. Intersections and exits from plazas are dangerous, particularly because drivers routinely roll through stops and red lights. Drivers travel too fast on 16th Avenue; reduced speed limits have no effect because the road hasn't been redesigned
Robinson and Highway 7 - amazing amount of vehicular, especially heavy trucks and ironically school buses
McCowan Rd, Southdale Drive Conservation Dr. Traffic turns off McCowan to Southdale. Since the NO TURN ON RED went up at McCowan & Hwy7. Speeding to beat 3 lights. Cars are speeding and not stopping at stop
Main St North & 16th Ave high speed and racing on Main st North every day and night. Racing starts at 11pm
None
16th and McCowan, Hwy 7 and McCowan, Major Mac and McCowan…speeding, running lights, aggressive
Southdale and Mc Cowan . Cars turning right from north bound Mc Cowan on to Southdale.
McCowan & Hwy 7
Small intersections with lights without left turn lanes. Hwy 7 and Conservation/Laidlaw has a very high rate of inconsiderate drivers who fail to alert other drivers that they wish to make a left turn without signalling! Extremely annoying because it makes the opposite side driver waiting who also wants to turn left as they assume they want to drive through the intersection as there is no left turn signal on. I say this happens about 80 % of time. Also, if I want to go straight through intersection, I have to honk because someone is turning left and crossing my path! These drivers assume that everyone wants to turn left to get onto Hwy 7 and think no one is
BulocK and McCowan Traffic during rush hour and blocking pedestrian walkway
Robinson Street, Hwy &
Most intersections have concerns given drivers are trying to rush through the intersection in order to not have
Markham Main and hwy 7
Yonge and John St. Clark and Yonge St.
Speeding corner of Major Buttons and Richwood with only a two way stop. Children walking across the
Church/George Streets…vehicles going wrong way on Church and Joseph Streets….speeding on George
9th line and hwy7; hwy7 and Wooten way, bullock and Markham road; entire area around the Markham road
Markham Rd and 16th Avenue. Markham Rd and Hwy 7. 9th Line and Hwy 7. Main street Markham (hwy 7 -
Markland and woodbine
Main St & Ramona Blvd - Speed and reckless turns Main St & Beech St - Speed and reckless turns
Green Lane and Leslie
Most roads are not safe for cyclists in Markham. If we want to reduce congestion, address climate change and promote active travelling for residents, the roads need to be safer for people to consider other modes of
denison st between gorvette and old kennedy, mccowan between southdale dr to bullock dr 14th av and
Markham and Elson
14th Ave. And markham rd. Left turns.
Kennedy and Highway 7 McCowan and Highway 7
no specific intersections
16th and Woodbine. Drivers get too close to pedestrians, speed through the intersection on amber/all-red, or
All of these streets/roads and all the intersecting streets/roads have speed limit that's too high, cars driving too fast, no bicycle safety lanes, no pedestrian safety crossings. Highway 7 has a small portion that has semi-protected bicycle lanes, but it starts way too far for me, and have to ride with drivers who are racing each other at 80 km/h on 50 km/h zone with no consequences. Also the protected bicycle lane ends abruptly, then
Warden Ave & Rodick , during school days

Not sure if this counts as Markham - Reesor Road / Steeles Avenue East. If a northbound car on Reesor Road (travelling towards Steeles) is trying to turn left onto Steeles, it's difficult to see both ways clearly due to the trees / grass blocking the view and I've seen some close calls. Woodbine Avenue / Steeles Avenue East (westbound on Steeles). There are a lot of cars that try to "cut the line" and go on 404 North last minute
- Anything on the major roads and commercial presence (Hwy 7 & Kennedy, Hwy 7 & McCowan, Hwy 7 & Warden, Kennedy & South Unionville, the shops close to Hwy 7 & Main Street Unionville-- it's impossible to take a left turn, also cyclists just don't have many left turn options and crossing on the sidewalk again is difficult because you then move on and off the road/bike lane which confuses drivers) - Any major roads in neighbourhoods with stop signs because drivers tend to roll stop - My concern is predominately as a cyclist and pedestrian as the infrequency of bike lanes force cyclists onto the road (though most people opt for the
Carlton and mainstreet
When walking, I've seen near misses for pedestrians at lots of intersections around the down town Markham
Notice drivers don't stop at STOP signs esp. when entering main streets. All of Bur Oak.
Warden & Hwy 7. Drivers turn through intersection long after the lights have changed.
Bullock and Hwy 7. Cars speed southbound on Bullock and cut in the right turn lane to go west on Hwy 7
Highway 7 and Woodbine. Left turning vehicles continuing to enter intersection after red light.
Don Mills/Steeles & just about every other intersection. Drivers are speeding/reckless; pedestrians simply do not look up from phones; bicyclers swerve to avoid potholes & rough patches near road edges. Highway 404
All neighbourhoods where there are stop signs!
Hwy 7 / McCowan Hwy 7 / Markham Rd. 16th / Woodbine 16th / Markham Rd. Major Mac / Woodbine Major Mac / Bayview Steeles / Markham Rd. 14th / Markham Rd. .....
No
It is really no difference where. Issue is lack of knowing the rules/no training/failure to follow the rules. This is for everyone-drivers, bikers, walkers etc -we all have to know and follow the same rules.
Didn't pay attention
Honestly, any intersection that does not allow for left-turn advance green light is dangerous. There are many
Anything with a light along hwy7
Fonthill and Fred Varley, Main St. Unionville and Fred Varley, Main St. Unionville and Carlton, Pomander Rd and
Kennedy and Hiway 7
N/A
Speeding near Thonlea Secondary school on Bayview
Highway 7 and McCowan McCowan and Carlton Lots of people, impatient drivers.
Major intersections along 16th Avenue - especially those near 404. Turning left after the left turn arrow have
Markham Rd and 14th McCowan and 7 Kennedy and 7
Kennedy and Carlton has become dangerous with the can't turn on a red and designated left turn times. It has resulted in car conflict with pedestrians, erratic driving by people that won't wait (right turn & upturn instead of
All Markham intersections are dangerous . Running red lights , illegal right turns on a green to not stop for a walking person , running stop sighs … don't get me started . Driving in Markham is sooooo dangerous . Speed !!!
On Old Kennedy Road between Steeles Avenue and Aldergrove Road. Many small roads and cars parking on the street make it hard to drive out from the small roads due to visibility and vehicles.
Anywhere along highway 7 east of 9th line. There are no sidewalks and no way to safely cross north/south east of 9th line. Also highway 7 between Kennedy and Mccowan. Somewhat paved area is right next to where cars
Woodbine and 16th Ave., when drivers turn left or right without slowing down to look at the other directions
16th Avenue at Brother Andre. Construction has been ongoing here since before the pandemic and continues to hinder traffic and shut down one lane of traffic forcing agressive driving near the high school.
NB Markham Rd. towards Hwy 7 has an awkward merge that becomes one-lane and is really frustrating to navigate because of backlog/traffic jam. It's such a bottleneck and drivers do not merge safely.

McCowan and Steeles
Bur Oak and Markham Road: the pedestrian signals need to be checked regularly as at times they aren't working.
As a wheelchair (not an option in how do I get around) the intersection of Yonge Street and the 407 and highway 7. It is extremely dangerous to try and go from the south of the 407 to the north side. Cars race onto the entrance ramps with no regard for wheelchair users,. baby strollers etc. There is not even the white pedestrian crossing lines to indicate a pedestrain crossing. No signs nothing. For an area which is being built up
-McCowan & Bur Oak (aggressive & inattentive drivers) -McCowan & 16th Ave (speeding, aggressive & inattentive drivers) -McCowan & Bullock Ave (drivers who block intersection - Go Train signals need to be
Highway 48, between Castlemore and Major Mackenzie Drive
Lack of bike lanes on Highway 7 east of Sciberras. Lack of dedicated bike lane on Carlton between Kennedy and
stop signs & crossings ignored everywhere, as well as stops before right turns on red.
John st and woodbine Very busy interesection with a lot of turning in all directions
Warden at UHS left turn into plaza is dangerous because of immediate crosswalk backup. Cars back up and turning cars don’t notice. Hwy 7 at Warden is bad because of urgency to move to the lane that feeds the
The small streets within the neighborhood and close to school areas are the most dangerous ones, as many drivers are new and don't obey the laws /regulations. They drive crazily fast because they are afraid of being late for work, etc. Most of them are very inconsiderate. For instance, at stop sign, cars usually don't full stop and count for 3 seconds before passing, especially when there are no cars on the other sides. They don't wait for pedestrians to finish crossing the streets before making turns. Some drivers that I have noticed are on their cell phones either texting or chatting with friends. While they may be hand-free from their cell phones, they also get
McGowan & Hwy7, Markham Rd & Hwy 7, Markham Rd and Major Mackenzie. Crowding into interactions,
All of the intersections in Markham are dangerous. Too many cars, too many people driving them and no new
Bayview and Romfield Bayview and Willowbrook Hwy 7 Transfer on the 407 at Bayview and Leslie Bayview
Markham Rd & James Scott, no left turn lanes and merging lanes. Highway 7 and Markham Rd. entrance to
McCowan and Hwy 7
Any traffic intersections where lanes merge just beyond the traffic light.
Yonge and Steeles; lots of pedestrians and motorists turning
Sir Galahad speeding by cars taking short cuts to bypass Speed bump on Parkway. Lack of Snow removal, we are used as cut thru traffic between Church st and Parkway but classified as a crescent
16th Avenue and 48. Very busy and aggressive driving
Hwy7/Kennedy Rd & Hwy7/McCown Rd
Highway 7 and any other street. It should have been widened instead of putting a bus in the middle thats not
Bur Oak and Rainbow Valley Cres./Chancery Confusing and obstructive intersection. People treat it is a 4 way stop when it's actually a 2 way. Several accidents over the years and regular near misses. Near school and park. Residents jay walk across Bur Oak to go to school or to the park. Too long of a gap between stop signs.
Some of the streets that intersect with Albert St.
14th Avenue and 9th Line by-pass. Cars speed especially driving south on 9th Line by-pass.
Round about at Village parkway. People fly through going north and southbound disregarding people entering or already in the roundabout. Village Parkway and Buchanan, village Patkway and Kriegoff people don’t notice the signs and don’t stop. I’m not talking about rolling stop I’m talking about 40km drive throughs. Also the no
Markham Rd. and 14th Ave. - eastbound cars turning north on to Markham cannot see cars going straight (westbound) on 14th Markham Rd. And James Scott - aggressive drivers going north on Markham cutting off drivers in the lane that continues. I have often seen drivers go straight (north) through the isolated turn lane and
9th Line &Hwy 7 intersection for pedestrians, cyclists as well as drivers. Aggressive drivers are my concern. To
Don mills Road between John street and Hwy 7.
Woodbine & Hwy 7 - very wide intersection due to bus lanes, people get impatient to turn left and crowd pedestrians and/or cut off other vehicles. I wonder if some drivers aren’t able to focus on how many things are

Grandview Ave & Young
Bay Thorn Drive speed no stopping distracted drive all in a residential area with a school and many small children with little or no policing for years. total disrespect for Highway traffic act. Children at risk every day at
Major Mackenzie and Markham. The one lane south of Maj Mac needs to be widened See lots of close calls there. Why are huge trucks on Donald cousins from Major Mac to castlemore. They should take Major Mac to 9th line. Mingay and castlemore intersection needs a light. Kids whipping around in scooters make all matters
Along 19th between woodbine and warden - impatient drivers overtaking cyclists too close. This occurs every other time that I ride my bike on 19th. The hill is particularly bad. Almost got hit head-on by a dump truck
Rodick and 16th ave not aligned completely
Warden and Highway 7
Kennedy and 16th, mccowan and 16th, mccowan and hwy 7, Kennedy and hwy 7. Warden and hwy7. Woodbine
Practically everywhere in Unionville.
Major MacKenzie Dr. Cars speeding and weaving in and out of traffic. They seem to treat it as a highway.
N/A
Verclaire gate and rougeside prom. Failure to stop at stop signs. Also, rougeside prom. and Birchmount - speeding is a huge issue as well as going through a red light. I've witness this on multiple occasions
Hwy 7 & McCowan Hwy 7 & Warden (High School kids running across to the mall) Warden and the street just below the Hilton Hotel. Our family and friends think it's ridiculous the city turned it into a one left hand turn lane onto Warden. I imagine there were accidents there with people turning incorrectly but I don't feel it's fair
John Street between Bayview and Leslie, where there is nothing between the pedestrian and oncoming cars (guardrails have been added along the pedestrian walkways for some distances but there are long stretches
Kennedy and Carlton, McCowan ad Carlton. All major intersections on Hiway 7
Bayview and Steeles - lights too short in almost all directions Bayview and John - volume of traffic
Warden and 16th Ave
All roadways at night. There aren't enough lights illuminating the intersections.
Bike lanes, bikers still use the sidewalks instead, and are still biking
Village Parkway & Carlton. Drivers not stopping at Stop signs.
Woodbine ave and 16 ave, often see cars turning left from 16 ave to woodbine ave north immediately on the right side lane, so if i turn right from 16 ave to woodbine north, i get cut off or honked even though i have the
Hwy 7 & McCowan , drivers often ignore no right turn on red .
Elgin mills and woodbine
Bullock and Austin Drives
Unionville Main Street and Carlton Poor visibility and no good lighting
Warden with 16th Avenue Speed to cross on yellow light
Bayview and steeles and willowbrook and bayview….people run through the lights just after they have turned red….and cars are in the intersection waiting to turn…you have to predict if they are going to stop or go right
Intersection Hwy 48 & 16th Running red light Aggressive driving U turns (do not allow these ever) very
n/a
McGowan and Hwy 7, and Kennedy and Hwy 7
Westbound of 14th Ave at Markham Rd. We should consider setting up an individual LEFT turn signal that runs during peak hours only for controlling traffic from 14th Ave Eastbound to Markham Rd Northbound.
Woodbine/16
McCowan rd and highway 7
Markham Road and 16 th High volume, many different turns and driveways.
16th and Woodbine-heavy traffic Hwy 7 and McCowan-heavy traffic 9th Line-bypassing
Trying to walk across any of the hwy 7 main intersections in Unionville
16th and 48 48 and bullock. People trying to cut lanes from right only to bypass the single lane traffic

bayview ave north of Highway 407. Speeding. Drivers speeding in the right hand lane , then cutting in to the
9th and 7
Every street with a stop sign...motorists slow and go. Some feel a.stop sign is "stoptional" never see police ticketing people who run stop signs also,the no right on red signs are causing terrible gridlock.
Any major road - Hwy 7, Markham Road, McCowan, Warden, Woodbine, 16th, Major Mack, etc.
Warden and 16th.
People running red lights ar all major intersections eg kennedy and 7, Mccowan and 7 etc
Village parkway and Buchannon, Village parkway and krieghoff. These stop signs are continually ran, not even rolling stop, just completely run at 50 km/hr. Dog and I have nearly been run over many times and this is also a
Village parkway and Buchanan. Speeding and running the stop signs without stopping
16th avenue and rodick road Warden avenue and Carlton road Fred varley and Main Street unionville Carlton
Hwy 7 and village parkway; cars u-turning at the same time as car Turing right in hwy 7: car turning from hwy7
I'm front of buttonville elementary and ste.Marguerite. drivers didn't respect stop signs, fly past them all the time, they don't respect pedestrian crossings. I've almost been hit so many times I now carry rocks in my pockets when walking my dog as drivers just don't care about anyone outside their car. Sadly, they're all in a
Galsworthy Dr and Highway7… speeding and aggressive driving
Elson Steeles Middlefield need crossing or traffic lights, it’s too long to walk esp. for seniors, children, disabled,
Southdale Drive and Conservation. No turn on Red from McCowan to Hwy 7 increased the traffic flow down this street 1,000%. No one stops at the stop sign. The cars speed up to miss two red lights on Hwy 7. The children walk to school on this road. School buses cannot navigate the corner of Conservation and Southdale when cars are ripping through the street. School Bus has to drop off children at the corner and it is deadly. The scream of
the stretch of road between south intersection of don mills and simsonston blvd and north intersection of don
Between north and south intersection of Simonston blvd and Don mills where two big accidents of one which a
Birchmount and north of enterprise
Markham road and 14th ave Markham road and Denision
The Hwy 7 corridor has multiple locations that are a risk, specific to red light activity (cars proceeding through
Everywhere in Markham, Along Steeles, Dension and Markham Road.
All along hwy 7. Pedestrians have a tough time ceossing multi lane stroads, especially if they want to catxh the
Yonge & Centre St. Thornhill. Driving south to turn onto Colborne St., northbound traffic "fly" up the centre lane to get into left turn onto Centre creating near head on collisions. There should be yellow markings for the LEFT TURN lane turning onto Centre St. In fact, I think there should be a green arrow for left turns at intersections
The all-way stop at Fairburn Dr and the shopping plaza driveways (First Markham Place and SmartCentres Markham Woodside). The intersection is highly congested on weekends, drivers block the entire intersection so
Woodbine and Major Mackenzie
Kennedy and Highway 7. McCowan/hwy 7. McCowan/16th Ave. Carlton/Main St. Unionville. Bulloch/McCowan. Austen Drive/Bulloch. High speed of approaching cars and then making the right hand turn even if it's a red light. On Kennedy going south or north, many cars step on it even though the light is yellow and end up going
Kennedy and Highway 7. The right turn arrow from Northbound Kennedy to Eastbound Highway 7 does not have a yellow arrow, jumps from green to disappearing leaving no time for drivers to prepare to stop. Same thing for Enterprise and Warden. I have also seen many near misses where a car is making a u-turn at Kennedy
Hwy 7 from Markham Road West to Yonge Street at every intersection. Markham Road at Bullock and at 16th
Depending on the time of day.....any intersection can be considered particularly dangerous
1. Anywhere on Hwy 7 (York Region road) 2. Anywhere there is a school on an arterial road (either Markham or
Pretty well all major intersections of two arterial roads - Kennedy/H7, Kennedy/16th, McCowan/H7, Markham
Southdale Drive and Conservation - Speed and Stop Sign which no one stops at.
16th and Village Parkway. High speed transition to VP from 16th. Red light runners on 16th.
Yonge and Highway 7, Connector Road

Markham road and Highway 7
Not specific places but specific drivers who are in a rush and not respectful of other drivers. Stop signs / lights etc won't do anything. These people are in a rush, adrenaline pumped, distracted and disregard others. Putting more controls in will do nothing to these people. They will just annoy the good drivers. I would say more enforcement. More ticketing. Higher fines. License suspension. If there are consequences, people will behave better. Without consequences, they will continue to be bully drivers. These measures would also be helpful for
Frankly any intersection is a gamble.
McCowan and Bullock. Vehicles blocking the intersection due to the train coming. Also illegal kick electric scooters, and illegal e-bikes with throttles please enforce the byelaws and the traffic act that relate to them.
McCowan/16th Ave - Cars turning left in this intersection make dangerous left turns frequently as there is a large incentive/pressure to do so due to relatively short left turn lights relative to traffic volume, especially at rush hour. There is also two TTC stops near the intersection where students regularly cross the road and the amount of near miss car-pedestrian accidents I witness during the school year is absurd due to low pedestrian visibility or lack of significant LPI. Williamson Rd/16th Ave - Many drivers making left turns from 16th Ave onto
None, no need to change anything, leave as is.
Major Mackenzie and Woodbine
None
Kennedy / Steeles Ave McCowan Rd / Hwy 7 High pedestrians areas
Steeles & Reesor
On side streets turning onto the main streets, there are always people with either electric bike, electric scooters, etc. going on full speed on the sidewalk. They did not even intend to slow down. One time I saw an electric scooter going into the second lane of traffic (same as a car). Also, some electric bikes going very slow
Woodbine Ave from Major Mac to Elgin Mills, the speed limit near Nokiidaa Public School is currently at 50 during school hours, which should be 40 to be safe. Since this portion of the Woodbine Ave is usually not packed
highway 7 between Warden and McCowan. Too congested causing people to infiltrate onto community streets,
Intersections along the side-running VIVA Rapidway in Downtown Markham
Aggressive driving in Boxgrove
All main roads like Steeles, Hwy 7, McCowan, Middlefield, Markham, etc. number countdown after 1 the traffic lights don't turn orange; you should always have all left turn on all major traffic lights also longer not just for 3
Kennedy Road and Steeles Avenue East, 16th Avenue and Warden Avenue.
Happens nearly everywhere - particularly main roads and side roads just off the main roads
McCowan and Highway 7
McCowen and Hwy 7
Major Mackenzie and Kennedy Ninth Line train tracks just south of reesor road are dangerous for cyclists because of the angle. More protections and options need to be available for cyclists. Many friends have fallen
Major Mackenzie / Kennedy Major Mackenzie / hwy 48 Hwy 48/16
McCowan/Hwy 7
Zero cycling infrastructure on some major routes, Warden, Kennedy, McCowan, 16th Ave. These roads are
Poorly maintained roads > North of Rodick and 14th
Buroak and McCowan
Dennison/ Kennedy. All 407 intersections
Warden and hwy 7: Extremely busy and very frequently unsafe left turns where drivers do not check for crossing pedestrians or oncoming cyclists or even cars. Hwy 7 and Birchmount/Village Parkway: Cars are typically using and blocking bikelane to make a right turn despite signage to yield to cyclists. Hwy 7 and Birchmount south: Bike lane besides street parking, causing very frequent dooring incidents close calls. Hwy 7 bike lane: drivers do not stop at stop sign at all, lots of near misses for cyclists, pedestrians and even cars. Bur Oak: Cars going over speed limit, running stop signs. Delivery drivers using opposite lane to pass traffic driving into oncoming

Unionville Mainstreet and Carleton - it is a game of chicken 24 hours per day magnified by tourists with high
South bound on Kennedy and 16th ave. Many aggressive drivers
Hwy. 7 @ Main St. Markham. I was crossing as a pedestrian along Hwy. 7 north side when a motorist turning left to go north cut in front of me, violating my right of way and nearly hitting me. I was involved in a similar near
Hwy7 & McCowan, John St & Leslie. Left turn drivers running the red signal by the time the pedestrian light
Mccowan and bullock drive (too many cars trying to left turn , sometimes blocking opposite coming traffic , making hard for all cars to move , sometimes pedestrians can't even across the road due to these cars blocking
woodbine & 16th
7/mccowan 16th/mccowan 7/hwy 48 Leslie/commerce valley drive
16th ave & warden: frequent car accidents 16th ave & Kennedy: traffic jams on peak hours; ongoing
14 th and Reesor Rd Excessive speeding, a lot of bicycle riders in the area.
STOP sign violations.....most if not all such intersections in The City
Esna Park/Alden Road and Rodick Road
Rodick Rd/Alden Rd/Esna Park Dr
Hwy 7 @ Warden. Red-light running.

As a follow-up to the previous question, if you are a Markham resident, are there specific intersections or roadways in your neighbourhood that you consider particularly dangerous (close to your residence or
1. Main St Markham & Ramona Blvd (Markham GO Station); Main St. Markham & Bullock Dr --this section of Main St is a disaster for drivers and other users alike. "Blocking the box" is common. Drivers constantly block the crosswalks. The crosswalks aren't painted. The crosswalk buttons make you wait an entire light cycle for a WALK signal even if the light is green for drivers, resulting in pedestrians crossing against their signal. The WALK signals are too short (I watched a senior using a walker struggle to get across just yesterday). 2. Parkway Ave & George St --this intersection takes all the traffic from the adjacent Main St & Bullock Dr intersection and funnels it to a 4-way stop, which drivers still apparently don't know how to use. The intersection is very wide and the crosswalks faded/at odd angles. This is directly adjacent to a school and a pool and a park and a church. It's not
The above intersection is difficult to cross. Si is Galsworthy and Robinson.
Southdale Dr. & Conservation. There is a STOP sign at this intersection which 1 in 1,000 obey. There are school busses that cannot round the corner until the cars move. The school bus stops at Southdale/and or Conservation to allow children on or off. EVEN WHEN THE POLLS ARE OUT CARS ARE GOING AROUND AND NOT STOPPING. THERE ARE MANY CHILDREN WALKING TO SCHOOL ALONG THIS ROAD - CARS SPPED AND DO NOT STOP - The residents here have reported/complained - STILL NOTHING IS DONE....The scream of brakes is daily - what is it going to take before we even see maybe a POLICE CAR in this area, a child getting hit or worse??? In years gone bye (yes I know) we had a traffic office here sometimes. Being the wife of a retired senior office - any
Main St North between Bullock and 16th Ave.
No
Roy Rainey and Edward Jeffreys…excessive speed along Edward Jeffreys to Mingay, Speed limit is 40km…drivers
Exiting/entering stores on south side of Hwy 7 from both directions between Wooten Way & 9th line, especially
Kennedy & 16th - when eastbound 16th traffic stopped at lights, some drivers use the right turn lane to speed
16th and McCowan And 16th and Kemedy
Markham Road and Wilson Street - people going south turn onto Wilson, speed around the corner on Water Street to Robinson Street, then speed along Robinson to cut through other side streets to get to Hwy 7. I've had
People drive too fast in our neighborhood which has lots of kids out playing
Henderson and John St.
As above. Children not always obeying the two way stop if on bicycles and some drivers not using defensive
Heavy traffic Wootten Way Senator Reesor's mornings. Cars race along senator reesor's from 9th line to avoid left turn light at hwy 7. Traffic guard is very diligent but as an early morning walker, it is noted that cars attempt

See above; they are all near me and all very bad. The area around the Go station often requires several turns
Ramona Blvd and Markham Rd., at the Go Station, too much high speed traffic for a spot used by a lot of pedestrians. Also, hwy 7 and Wootten Way. A lot of predestrian traffic and a lot of illegal or ill-advised turns from Wootten way onto Hwy 7 (right turns). I have witnessed a lot of right turns on red at 16th ave and Markham rd., recently changed to no right turns on red Monday - Friday during the day, it should just be all the
Yes, there is no bicycle lanes on Woodbine or on Rodick. Bicycle lane on Markland ends at Woodbine
All around the Main St and GO Station Area. Especially in Winter, early mornings and evenings. Transit traffic is
Green Lane and Leslie
At Leslie and John St. (my neighbourhood), there aren't enough bike lanes for people commuting to the local schools (Bayview Fairways PS or St. Rob's, etc.). Most of the schools in this neighbourhood are not walking distance and while YRDSB promotes active travelling for my kids (ie. walking, biking, scootering, etc.) to school, the roadways are not conducive and safe for cyclists despite there being a bike lane for some parts of the roads. Some people are driving way too fast along Leslie as well as along John St. For an adult cyclist, it's a bit scary riding on the ride, let alone kids of elementary/high school age. A second area of safety is the intersection of Leslie and 14th Lane. If I were to commute by bus along Leslie and get on the bus stop (Stop ID: 1929) or stop at
denison st between gorvette and old kennedy - long vehicle queues and interaction between cyclists on sidewalks; pedestrians to plaza and highrises. birchmount - steeles to highway 7 - vehicles are parked on bike
Between Steels Avenue to 407 on Markham, night time race is happening. It is too dangerous.
Pathway on Liebeck Cres. (opposite 67 Liebeck Cres.) that leads into Carlton Park playground area. This is a highly used pathway for kids playing in the playground area all day and especially after dinner and on the weekends. It's also used a lot for young children walking and biking to Crosby grade school. Surprisingly, for a crescent of only 80 to 85 houses, the traffic on this street is very busy all day and evening, with cars frequently passing by this entrance to the park. People with kids and people playing tennis at UTC tennis club OFTEN park directly in front of the pathway, blocking the entire pathway. They also park on the west side in front of 67 Liebeck Cres. as well as parking just in front of the pathway on the east side (70 Liebeck Cres.) blocking the sight and the way for the kids entering and exiting the playground area, as well as dealing with cars frequently passing this park entrance between cars parked on the east side of Liebeck so close to the park and cars parked illegally on the west side of Liebeck opposite the pathway. This is very dangerous because the kids are running, or on
Stop signs (including in communities)between Town Centre Blvd and Rodick Rd. on the Cox Blvd, always seen
Markland Street. Drivers speed, don't watch for pedestrians, or are aggressive with pedestrians
Every intersection on 14th Avenue. First of all the speed limit as is on this street is too high 50-60 km/h. Yet, at any given time majority drivers are flying through it, if I were to guess, would be at least 80 km/h. When I'm ok foot trying to cross with the walk sign, cars at intersection always encroach into it and stopping just before hitting me. When I'm riding bicycle/scooter on 14th Avenue, cars are constantly passing me too close, honking at me, making illegal turns (speeding past me to make a turn in front me forcing me to stop or crash). My commute is from Markham Rd & 14th Ave to Denison and Clayton. Safest option for me include the path 14th Ave to Middlefield, then turn on Highglen to Kennedy, then from Kennedy to Denison until I reach Clayton. Majority of the ride is on Highglen, which has a supposed bike lane. Even the speed limit there is 40 km/h. Yet I find riding ok Highglen is no less dangerous than riding on 14th Ave. Despite the presence of school and school
Warden Ave & Steeles Ave
While not dangerous per se, Steeles Avenue East / Kennedy Road (eastbound on Steeles) - a lot of people ignore the fact that the right lane is for turning right on Kennedy only. These drivers go straight and ignore that rule.
Ray Street & Castan -- people don't know how to use a stop sign South Unionvillle roundabout next to T&T --
I would say any intersection, you have to pay close attention as you just don’t know.
Emery Hill and Wychwood. Many drivers don’t stop at the stop sign.
Kennedy Road & Carlton Road - High vehicle speeds on Carlton Road turning south onto Kennedy Road. Vehicles will see the light is about to change from Carlton Road & Waterbridge Lane and accelerate hard in an attempt to

9th line and Cornell park ave. Too many cars go into the median. Drivers drive so fast down Cornell Park Ave. Near misses at CornellnZpark and Zmilner lane with kids crossing to go to school. Drivers race west bound to
Leslie and Green Lane/Summerdale. Left turning vehicle going into the right lane; speeding; aggressive driving.
Every intersection, as far as we can see. Why are there not more patrol officers? Have they all just retired and not been replaced over the years? We drive, bicycle & walk every day in Markham & are on high alert all the
All neighbourhoods where there are stop signs!
16th Ave. / Markham Rd., All roads that allow license-less elecric bicycles, All roads allow drowsy drivers,
No
by legacy PS and the community centre/golf course. Apparently, we no longer have to stop at stop signs or
Didn't pay attention
As above
Fonthill and Fred Varley because of Parkview School and the condos street parking at 20 Fred Varley. The cars
Carlton and Main
N/A
As stated above
See above.
No
Ppl running reds, ppl blocking intersections (esp at Markville Mall), ppl stepping out in to traffic (jay walking)....while looking at their phone. And.....2 school buses that almost hit me this week, one ran a red
Again all intersection in Markham are dangerous . Nobody obeys the traffic laws and nobody cares about other
Celadine Drive is hard out due to all the traffic driving by.
Highway 7 east of 9th line, no sidewalks or wide enough stretch of pavement or grass to walk on and no way to safely cross north/south when walking Golden Ave just west of Markham rd, driver speed up that street often and there is a part of the road that curves which is very dangerous if they lose control. Speed bump would be
Along 16th Ave., some drivers don't stop, nor slow down, when entering 16th Ave. from side streets.
9th line between 16th Avenue and Bur Oak. Once it gets dark, people use this stretch of 9th line for excessive speeding and racing. Surprised the police haven't made it an issue as they would nab a lot of people after 9PM.
Cornell Park Ave. and Bur Oak Ave. - drivers not following stop signs and do not obey four-way stop rules. Same with Cornell Park Ave. and Country Glen Rd. At Riverlands Ave. and Cornell Rouge Blvd. which is near an elementary school, the pedestrian walkway is awkwardly placed and not very visible (next to Rouge Park P.S.),
Same as above.
-McCowan & Bur Oak (cyclists & pedestrians are frequently at risk by aggressive/ inattentive drivers) -McCowan & 16th Ave (cyclists & pedestrians are frequently at risk by speeding vehicles & aggressive truck drivers)
All-way stop at Main St. Unionville and Carlton is hard to cross for pedestrians.
Village pkwy stop signs & crosswalks constantly ignored. Birchmount & hwy 7 u turning.
John st and Leslie lot of right and left turns
Fail to stop at stop sign at Carlton/ Hemingway Cres. Fail to stop at stop signs Carlton/ Village Parkway.
Pierra Garden and South Unionville and intersections along the South Unionville ave., especially at night time where cars are speeding; McCowan and South Unionville, and 14th Ave., Markham Rd and Dennison Ave.,
The intersection of Fred Varley and Fonthill. Cars are parked on Fred Varley making it unsafe to turn from
Hwy 7 and Ninth Line. Speed from all directions, rolling through reds to make right turn in front of those with
Because there are too many cars, people, and congestion because of lack of roads in Markham all intersections
Bayview and Romfield top and bottom and especially by the Plaza where 3 lanes become 2 and not enough
James Scott and Schouten cres.requires a 4way stop intersection.
No
Exit to 16th ave from the shopping mall at the North East corner of 16th ave and woodbine Ave

Birchmount Road and Verdale Crossing. People driving on Birchmount treat that intersection as two way stop instead of 4 way stop. Frequent near miss hitting for cars driving along Verdale Crossing enter that intersection. Birchmount Road and Simcoe Promenade. New road, no crosswalk. People driving on Birchmount at night don't
Bayview and John; lots of people turning left with left turn lights not allowing enough vehicles to turn at rush hour. At rush hour it's gridlocked on John St heading west backed up past Porterfield up onto the railroad
Wilfred Murison Ave between McCown Rd to Bridle Walk school zone some drivers speed to 80 km where
Again Bur Oak and Rainbow Valley Cres./Chancery
Yes, see above. There is a limited (almost no) view of cars turning and pedestrians walking or cycling. Also, the stop sign at Markham Public library is misplaced - it needs to be closer to the street for better viewing.
I do not consider it safe to walk on the sidewalk on Donald Cousins Parkway between 9th Line by-pass and Fieldside. Cars drive at excessively high speeds particularly in the evening. During the night it can sound like a
Village Parkway roundabout Village parkway and Buchanan Village Patkway and Kreigoff Kids walk these
A lot of teens and adults ride bikes on the sidewalk in the Markham Village area side streets even though there
Because this road is very winding, it becomes difficult to see clearly when it rains, as the headlights from oncoming cars can be blinding. I suggest adding streetlights on both sides of the road for better visibility.
Markham Rd and 16th. The lane restrictions going south often result in people trying to cross through the intersection and cut others off because they're not in the correct lane to continue south. This also happens at
TURN LEFT FROM GRANDVIEW AVE TO YOUNG
Bay Thorn Drive Yonge to Royal Orchard
Mingay and castlemore Fredmclaren and castliemore Castlemore is way too busy. People use it to avoid lights in major Mac. Too many people parking around wismer park cause there is not enough parking
Crossing the road as a pedestrian - hollingham and rodick (crossing rodick) Crossing as a pedestrian- Apple
Hwy 7 and 404 South on ramp
Warden and Highway7
Bur oak and mingay
Making left-hand turns at Fincham and Ninth Line where the City has neglected to put a traffic light. There are always cars there making left turns out into the heavy north and south traffic.
McCowan & Bullock. Cars turning north from Bullock to McCowan and sitting in intersection because of GO
N/A
See above
Village Parkway & Hwy 7 (Can you turn right onto Hwy 7 in that narrow road with the diamond? No one knows what to do there? It is not clear.) 16th Avenue going south from Warden. (People don't realize it's slippery on that slight hill approaching Village Parkway during the winter months. How do we educate people on how to
DonMills where a young woman was killed by a truck driver, always feels unsafe, because of close oncoming trafic.. etc many similarly dangerous roads… how can we escape a vehicle coming at us? As a driver! If trafic flow
Main and Carlton
Willowbrook Road - cars travelling too fast even with the speed bumps
All roadways at night. There aren't enough lights illuminating the intersections.
Same as above
Hillmount rd and willow heights blvd, often see drivers don't stop or rolling stop at the stop sign
Pingel Road is a narrow street with one way parking only. About once a week, there is a tow truck with a trailer parking on the no parking side of the road overnight. This insulted in a unsafe situation for cars passing through.
Elgin mills and woodbine
as above
The above
Warden Ave with Glencove because many car make the U turn coming on Warden from south to get into the light and get faster in Apple Creek maybe to their offices or to the high school.

Woodbine and steeles….a high traffic area
Markham,Bur Oak
n/a
9th Line & 14th Ave (obstructed view when driving southbound & turning right onto 14th)
Prohibit left turn at 14th Ave from Father Michael McGivney Catholic Academy. They block all East and West bound traffic along 14th Ave! Plus set up a center land at McCowan Rd so that traffic can make a safe left turn
Woodbine/16, NE corner when car driving east bound turning into T&T plaza. West bound cars sometimes go
Main street unionville excessive cars speeders since the high school and senior residents area connected to
Hey 7 and Wooten Way. Many students crossing at lunch time , no turning lanes, bus stop.
7th and McCowan 9th line
Carlton near millstone - many drivers drive too fast, some pass other cars, many roll through the stop sign and are impatient if they are driving behind a car that is within speed limit (I.e. not speeding like they want to). This
Buroak and Goldenwood cres intersections especially near Greensboro public school. No one follows rules and
Bayview Avenue and Romfield Circuit. Speeding. Drivers on Bayview running red lights
People don't stop at Green Lane and Kings College, Durie lane amd king college and even Thorn Lane and Kings
Village parkway and Carlton - busy intersection and rules are often not followed at 4 way stop and drivers are
Village Parkway and Fred Varley. Fred Varley and Kreighoff. Why were traffic limiting tactics never implemented on VP at both hwy 7 and 16th???? The road is used as alternative to warden and kennedy!! No
All ignored stop signs along Carlton Road between main st and warden And not stopping at Fred Varley and
Village parkway in general needs speed bumps, there are long stretches of road where people are going 60
Wentworth court and village parkway. Cars speeding along village parkway
Fred varley and Main Street unionville Carlton and Main Street unionville
Amberwood and village parkway; drivers not yielding or stopping for pedestrian at designated crossing.
All along John button especially between Roddick and Apple Creek.
Galsworthy Dr…speeding
Same as above
as stated above.
Captain Rolph Boulevard. People speeding and dropping off kids at the walkway to the high school. Making u-
two car accidents within a month. one car accident killed one person. car collision with tree or light post. need
Yes, between north and south bound Don mills & simonston blvd. Driving and walking scares me bec of
Bur oak is used as a speedway most days and so is Markham Rd/Hwy 48
All of the three and four way stops. No one stops anymore at stop signs. Speeding on Royal Orchard Blvd and
Hwy 7 and McCowan, Hwy 7 and Warden, McCowan and 16th and McCowan and Bullock. Although practically all intersections in Markham have a red light problem, these ones are the worst as there is a higher amount of pedestrian traffic in most of them. Specific to the Hwy 7 and Warden one, there tends to be cars traveling at a
Tara Cres, Dension Road, Markham and Steeles Intersection, Markham and Elson Intersection
Main street Unionville and Carlton. Constsnt battles between pedestrians and cars crossinf the intersection.
Should be an advance green arrow at John and Bayview to turn left onto John St. when you're travelling north on Bayview. It's very difficult when turning left to see oncoming southbound traffic.
Glenbourne Park Drive has people speeding and the street has no sidewalks
See above.
Kennedy and Highway 7, reasoning listed above
Hwy 7 and Markham Road.
Any STOP intersection is dangerous.....drivers ignore signage 90% of the time
Carlton Rd between Kennedy and McCowan: paved carriageway is too wide (14 metres), the open space makes it too easy to speed (>40 km/h) -- turn radii too wide --> pedestrian crossings too wide -- inadequate cycling infrastructure to support 3 schools and 4 parks -- too much non-neighbourhood traffic during rush hour -->

Kennedy/16th, as per above
Since the no turn on red sign went up at McCowan and Hwy 7 the traffic has increased 1000%. We have no sidewalks - a school zone - and a stop sign at Southdale and Conservation which NO ONE obeys. In the past we had a police presents once in a while and they could not keep up with issuing tickets due to the line up of cars.
As above. Also at Briarwood and Village parkway close to 16th Ave. Driveway parking of large vehicles obscures traffic turning south on VP such that it can't see traffic from Briarwood Road turning onto VP and that traffic off
Markham road and Highway 7
Briarwood Road eastbound. Residents and visitors alike drive too fast down the hill. It is only a matter of time before someone is hurt. A bike rider resident was hit recently by some who lives on the street She was going
The 4-way STOP sign at Hollingham/Halstead/Nadine is a nightmare. Cars heading north on Hollingham often
The east side of Austin should prohibit driving West out of the mall during mall hours. When the mall closes, it's a constant stream of cars exiting them all parking lot creating dangerous situation a local feeder Street. Also
Castle more Rd/Markham Rd - some drivers fail to recognize left turn signal being present and assume green, so they run through the intersection while cars are given ROW left turns. I have almost been t-boned twiced
None, no need to change anything. If you lower speed limits we might as well start walking as it will be faster.
Same as above
I feel we have gone far enough with intersections and in some cases too far. Over regulation leads to people, ignoring rules in frustration. Reckless and careless drivers don't obey the rules anyways! I also think this survey is very one-sided, not indicating that some of the problem are cyclist, pedestrians and scooter riders who don't pay any attention to the rules of the road and cause of the accidents. Considering pedestrian cyclist and scooter
None in particular
Adding a bike lane to 14th avenue from Ninth to Markham Road would make it a lot safer to commute. It is not safe to commute on the road because of all the single lane traffic. There are not a lot of ways to go east/west
McCowan and 14th and Featherstone and Highglen. Students are looking at their phones and wearing headphones when crossing the street and not even intend to stop and look. Just stepped out on the road,
Woodbine Ave from Major Mac to Elgin Mills, pass the Nokiidaa Public School, the speed limit is 60, however, people tends to speed a lot, especially during the night. There were a lot of wild animals during the night. And
highway 7 between Warden and McCowan. Too congested causing people to infiltrate onto community
Unionville College traffic at 16th Ave/Kennedy Road during School Hours, especially with left-turn vehicles trying
Pedestrian crossing into Boxgrove park at Boxgrove bypass. I've written my councillors many times about this.
Steeles and all major intersections; Hwy 7 and McCowan…
WOODBINE AVE between Honda blvd and 19th…it seens drivers think it is Mosport ….most going above the
Kennedy Road and 16th Avenue.
Bullock and Hwy 7
Castlemore and highway 48 area is very dangerous for cyclists who are travelling east and west on castlemore because drivers exiting plaza are distracted/not paying attention to cyclists using designated laneway
No
Hey 7 McCowan Rd Kennedy Rd
Yes, there is lots of people and cyclists that cross it and can be harmed as well.
Warden and hwy 7: Extremely busy and very frequently unsafe left turns where drivers do not check for crossing pedestrians or oncoming cyclists or even cars. Hwy 7 and Birchmount/Village Parkway: Cars are typically using and blocking bikelane to make a right turn despite signage to yield to cyclists. Hwy 7 and Birchmount south:
Aitken Circle - cut in short cut from 16th avenue - regular repetative behaviour of speeding though east section
Along Carlton road between Kennedy and Main Street Unionville during peak commute period, and during evening when aggressive drivers trying to race past the light at Kennedy interaction
Leslie St. @ Tanglewood Trl. When biking on the shared pathway at night (wearing bright clothes and using flashing lights), a driver turning right onto Leslie St. nearly hit me because they apparently did not see me until I

Brimley & Randall, drivers occasionally slow roll the stop sign and gets confused about who goes first as it's
Central Park drive (Carlton road) during school time , some cars do not stop for kids crossing street even when
woodbine & 16th
Mingay ave (too many fast drivers) Mingay / Edward Jeffreys (lots of rolling stop) Mingay / Buroak
Cars entering Unionville College from Kennedy, traveling south to north, create a dangerous situation with a
See above
No
John Street from Bayview Ave to Woodbine Ave Rodick Road from 16th Ave to Esna Park Dr Denison Street,
Apple Creek @ Town Centre. Vehicles not yielding to pedestrians.

Are there any other concerns regarding road safety in the City of Markham you think are missing?
Crowded new buildings being constructed ear markham Traffic too heavy now
Markham needs to not re-invent the wheel in terms of crafting its Vision Zero. New York City has been working on a Vision Zero since 2014. Toronto since 2016. There are lessons to be learned not just here in North America but across the globe. On the one hand, we are behind in our work; on the other it gives us access to a wealth of information. I strongly encourage the project team to incorporate information from other jurisdictions. Given project timelines there will be no solutions implemented before 2026 - this means by the project's own data at least another 250 collisions resulting in injury & death. The project needs to move as quickly as possible. Toronto has installed 1,371 Pedestrian Head Start Signals in that time, one of the most effective and low-cost solutions available. Markham should follow suit. This is low-hanging fruit; just start implementing them. (https://www.toronto.ca/services-payments/streets-parking-transportation/road-safety/vision-zero/vision-zero-dashboard/) Improved public transit will reduce the number of personal vehicles on the road and therefore the number of collisions. Markham badly needs a plan to incorporate the higher-speed micromobility vehicles into the transportation mix. They are too fast for sidewalks and too slow for most mixed traffic, leading to
I see a lot of drivers unable to keep to their lane. I don't know if the driver is drunk, sloppy, on their phone or
First and foremost why does the "City" never listen or to the residents. The infrastructure of this part of Markham was never designed for this kind of traffic. Now there is work afoot to put up more condos etc. HOW IN THE HECK ARE POPLE GOING TO MOVE? THE DREAM IS THEY WILL US PUBLIC TRANSPORT.... Road safety is a big issue in this part of the City - going back to the residents advising "DO NOT put a McDonald opening on McCowan.....Now look at the mess this intersection is. Accidents and sirens daily! Road safe is a laugh - it is
Police presence urgently needed to ticket speeders on Main St North until you will decide how to solve this
Drop speed on side streets to 30 like some of Toronto has.
Police should clamp down on late night car/motor cycle street racing. Increase fines and licence suspension for
Running red lights is becoming common. Entering the oncoming side of the road at a curve is the norm for many drivers. Serious violations occur every day. Items such as implementing bike lanes and limiting right turns on red
I am an experienced driver with 45 years with an excellent driving record and knows how to use common sense when driving. What I can’t stand is the placement of money grabbing speed cameras more recently placed in Markham! In the past 2 years I have received 3 of these type of tickets North York, Markham, Pickering. In all of these situations my common sense driving means nothing. I know I am a safe driver and didn’t deserve those ridiculous speed camera tickets! Going over about 10 kilometres on a 50 zone on a main road, daytime, excellent weather conditions and no pedestrians in sight and 2 of those tickets were on a weekend. The Markham ticket I received in my area was midday during week where all students were inside…again no pedestrians at all and never has there been a pedestrian or student hit in that zone in the 34 years of living in that area, yet city felt it needed a speed camera there. Not in any of those situations did I think I was a dangerous driver at those speeds towards other driver’s or pedestrians that were non existent…yet I’m slammed with expensive tickets that my money could have been used towards groceries or fuel! City of Markham owes the tax payer statistics of revenue being generated since installing these cameras along with

I live in the area west of Markham Rd., south of 16th Ave. I am surprised and worried about the number of CLEARLY senior citizens who exercise by riding a bicycle WITHOUT A HELMET. And many of these individuals are not steady, confident cyclists. I'd like to see action taken to raise awareness of cycling safety among seniors. It also might help to implement a "helmet donation" program (somehow, I know it's not easy) where people with
Illegal U turn and no signal turning at intersections cause traffic chaos amd accident
People speeding excessively at night. They're not necessarily racing against others, they're out joy riding. They have excessive exhaust noise that disrupts sleep. The excessive exhaust noise is also a scourge during the day.
The impact of all the new and future construction of residences will only increase cars on the road. What are the infrastructure plans to widen the roads (if possible). Having more vehicles on the road, will only increase
Inconsistent bicycle lanes i.e. start, end forcing cyclist in vehicle lane
There is a no right turn sign at Bayview and Proctor for morning traffic. This forces all traffic west along John St. There are streets in this neighbourhood with no sidewalks in addition to 2 public schools. Totally ridiculous!!
No turn on red on certain intersections and they’re different at different intersections…has created frustration
drivers are speeding on our local roads and run stop signs. some cyclist do not adhere to stop signs. pedestrians
I think the main issues are in the contested main streets of the city, or along the outskirts - it is extremely common to see accidents happen due to red lights being run, or especially right turns not paying attention to
Intersections like Hwy 7 and Markham, 16th and Markham, Hwy 7 and Wootten Way, should be no right turns on Red. This is a huge pedestrian safety issue. Don't make it no right turns from this time to this time, why
Speeding in local roads and around schools
No, in short, I would like to see more bike lanes and pedestrian safety measures to encourage active travelling. I like the idea of a shared pathway where the pedestrian and cyclist share the sidewalk. Where I live, we have a section of Leslie that has this shared pathway and it's great. Please consider widening the sidewalks to allow for
Parking enforcement is poor, that may cause accidents.
Drivers excessive use of horns
not at this time
Lack of cycling and pedestrian infrastructure is a major issue. Pedestrians and cyclists often use the road, even
Cars drive too aggressively and they honk at bicycles on the road while also passing them very close. They're extremely angry while driving a 1 ton hunk of metal. I think some fines associated with honking also needs to be
Reduce speed in sub-divisions; dedicated cycling lanes on all major roads
Yielding on right turns. Whether at a stop sign or traffic light. I see and experience at least weekly, near misses
I am happy that the City recognizes that police presence and traffic calming measures are some key items to consider. There are a couple of items that I want to add for the City to consider. Regarding enforcement, generally there needs to be much more enforcement, and I think that the City should have more automated enforcement to catch bad drivers on things on things that are currently approved, such as running red lights. In other words, expand the use of Administrative Penalties (APs). This will reduce some of the workload of Police while enforcing the rules. I am of the opinion that a steep financial penalty (such as the $325? for running red lights) to the owner of the vehicle is significant deterrent, even without any penalties to the driver. The City should also explore and lobby the York Region / Province of Ontario for the expanded use of camera systems within the AP framework, where applicable (I'm not familiar enough with what is allowed and what isn't). For example, the City can install cameras on buses to catch drivers that make illegal turns in front of the bus when the bus is at a bus stop at an intersection or cameras that catch drivers turning right when they're not allowed to do so. Specifically with speed cameras, I am of the opinion that the current implementation is inherently flawed because the speed limit imposed on some roads do not align with the design of the road (e.g. the road is designed for 60 km/h but the speed limit is 50 km/h). Due to the misalignment, the City (with good intentions

I have lived in cycle-based cities in both European and East Asian countries where cycling was my primary mode of transportation. In all these countries I have lived in, only Markham is the place where drivers have actively tried to hit me, taunt me, and complain that I was not giving "right of way" even though they were turning left while I was going straight. The cycle lanes are not good, and they are not enough. The introduction of micro-mobility options (e-scooters & shared bikes) is a fantastic idea, but there needs to be infrastructure supporting it. Why are cyclists/scooterists forced onto the sidewalks? Many people in Markham feel unsafe on the roads,
Consider more roundabouts and better intersection design. Allow pedestrians to cross earlier than the green changes so people are visable to turning drivers. Narrow roads more to create traffic calming in neighbourhoods
My concern is the city is blindly focusing on pedestrian and non car user safety, at the expense of traffic jam and efficient traffic flow. Car users are as important as bike riders and pedestrians. Everyone has equal share of the road and road safety. The onus seem to be so biased against car users on all the new measures that I have seen.
Teaching people to use lanes properly. The roads are so straight and unfortunately boring to drive that people are prone to distracted driving or aggressive driving. Prioritize pedestrians, cycling and public transit and consider the whole trip. Lots of times their is infrastructure for part but it disappears for other parts of the trip.
16th Ave and Major Mackenzie should have speed cameras.
Road markings need to be clear or reflected. e.g. need right turn arrow on right lane of Applecreek to go south
I live in Cornell and we have little front yards. Our windows are practically on the street. I am always terrified that a speeding car will end up in my living room. Cars have crashed into homes here. Bad planning. Cornell
Over the last few years I observed a noticeable degradation in the quality of drivers obtaining a license. Scrutinizing the drivers test system and identifying corruption sensitive points in the process is a necessity. No
Where can I start? Well, we used to see patrols a lot, as well as radar stops. No one has patrolled our street in well over a decade. I know, because I garden in front. We are seniors who tend to follow the law, but many
No
EDUCATION. Please stop always blaming the drivers. I cannot tell you how many times I have almost hit people walking in the dark without reflective gear/lights etc. and they are on the road. Same for the bikes. Common sense tells you that this is not safe. We all have to follow the same rules but the media/City always blames the drivers so everyone else thinks it is ok to do whatever they want. Stop it. We all have to work together and respect each other and know we are all doing what we should be doing. Put the blame on everyone that is not
Drivers Education
There is a need to revamp traffic violations law. Pedestrians believe in myths that they are always the priority in terms of crossing & traffic signals. Need further education & reminders to always watch traffic at all time. Also I think the recent lowering of driving speed is unnecessary & increase traffic jam. Most of drivers don’t observe.
The road signs' font size is too small. I wear glasses while driving and even with my newest glasses that are
Donald cousins pkw from steels to hwy 7 regularly sees speeds of 150 mph or more at night. Especially
We need more crosswalks at non intersections such Village Pwky and the pathway leading to Toogood Pond.
Ontario is losing too many young men from motor cycle accidents; the is no obvious outreach to curtail speed and safety. Auto drivers do not care much for cyclists; cyclists do not care about pedestrians; pedestrians can do
Speed limit in some school zones is too low eg 40km/hour. Drivers tend to speed up after passing the zones to catch up. School zones are normally busy only between 8 am and 9 am, and 3 pm and 4 pm. The rest of time is pretty normal. Suggest shorter time zone. Also, some school zone is too long in terms of distance, eg the
Markham has its share of drivers who make left turns on red llights.cameras are really needed to change habits.
Excessive speed
Need more police presence, hardly ever see police on 14th and I drive across it 10-15 times a week, for 15 years. Street racing on hwy 7 over night, motorcycles and cars racing at 3 Am....I can hear it from my condo.
Cyclists need to know and follow the road rules.
There seems to be urgency to change things with little thought about the outcome or monitoring of what the changes did. Seems to be concerted effort to make car travel less convenient.

Yes, cars parking in bike lanes, bussing going in and out of bike lanes, where there aren't any bike lanes, cars cutting close and honking at me when I'm riding my bicycle on the street, when I'm riding my bike on the sidewalk, I keep on having to dodge rogue branches from poking me in the eyes. Drivers who hit pedestrians/cyclists should lose their license for multiple months unless they are 100% clear of fault. An easier
Yes !! How come electric bikes , electric scooters, small motor cycles are allowed on the side walks . The drivers of all the above mentioned are wearing helmets . As a walker we are not and they come up behind you and they
The no right turn on red signs at several intersections might need to be bigger. Drivers like to honk at you from
Non-intersection problems like (1) young drivers speeding at night on residential roadways, (2) drivers pulling out into traffic from plazas without regard for other drivers already using the road.
Drivers need to be reeducated on how to use a four-way stop and stop signs. There needs to be more police presence in neighbourhoods and especially around schools. Stop signs need to be enlarged especially around schools, playgrounds, and community centers. Street lines need to be more visible and regularly repainted or maintained. As a lower priority, there should also be reeducation on parking rules, i.e. parking in the same
No
A REQUIREMENT for cyclists to use the very expensive but totally underused lake-to-lake cycle path on Leslie
While having Police presence is good, the timing is important, and the police officers need to be strict on the violators. In addition, police officers need to check the legitimate of the drivers' driving skillset and obeying the
The amount of traffic is too high for the current road infrastructure. Public transit is too infrequent as it takes twice as long or more to get anywhere otherwise I would use public transit much more.
Much of problem is general anger of drivers. Police have too much to cope with this and it is lower priority. Use more tech, such as photo radar, camera and increase the fines significantly and perhaps add licence
This survey is your solution regarding road safety? It's hard to get to the speed limit with all the congestion on
Speeding, incorrect lane changing illegal u turns. No perceived inforcement of the rules of the road and no
Stop using traffic lights to solve problems. City needs to look at ways to improve traffic flow, synchronizing traffic lights, roundabouts, median barriers, no parking in markham road main street, removing bump outs and redesigning enterances to shopping areas. Road safety will come at a cost but I think the major part of the
Keep up the good work
Our traffic lights need to be synchronized and upgraded to AI control
Nil
Stop building condos along highway 7. The traffic is ridiculous! Fines for texting should be greatly increased.
Where are traffic and road safety incidents reported and measured?
Yes. We have bad drivers in Markham. I heard many to to rural area to take drivers test and then don’t know how to drive in the traffic congestion or know all the rules. I have personally confronted a number of drivers and they always say ..”sorry no English” I’m an immigrant too so I still tell them what they did wrong almost
We definitely need rules about motorized scooters. Headgear at least. And if they’re driven after dark, they need plenty of lights. I get their appeal and don’t suggest making them illegal; but definitely safer.
As residents of Markham, we would like to understand why these accidents are happening. Where are the accident-prone locations? We don’t want to pay extra for insurance, as our car insurance premiums are increasing every year. In addition to addressing traffic concerns, please also consider installing cameras in some
Very often when driving in the evening I encounter people driving without their lights on, sometimes not even running lights. With the reduced street lights on Major Mackenzie this makes these vehicles almost invisible. It’s
N/A
Fire Trucks, Ambulance, Police have blocked roads every day at drop off and p/u at Bay Thorn Public school and has been this way for years the Parents do as they wish with posted signs no stopping easy money for Markham as some don't care and will accept the ticket or fight it, how about some towing once a month and tickets for all weekly. Not sto, distracted driving on the phone or texting while many children going or coming to school $ 400
Drivers should be educated that the left lane is a passing lane. Otherwise, drivers should drive in the right lane….

The timing of lights is awful in marlham. People speed to get through at least one light on every main rd. Fix
Paved shoulders for bikes (whether identified as a bike lane or not)
road markings
Lots of residential streets are used by tuner cars with loud exhaust noises like mingay.
It is time to address the growing problem of people who are having their car engines modified to operate louder and faster during the summer months. Not only do I see most of the drivers of these cars driving aggressively, the deafening noise pollution created by roaring engines and backfiring is stressful for residents who have to
Work with the province to get a mandated driver re-testing every 5 or more years. Many people forget the rules of the road (they don't exist just for the "other" guy), what it means to be a courteous driver, how to handle a minor fender bender. All the stuff one hears talked about on the radio or TV, but that people aren't
Better timing of stop lights to allow better flowing of traffic.
The lack of proper sidewalks in some areas are a concern. Particularly when entering Markham Town Square from the Highway 7 or Verclaire Gate entrance. Extremely dangerous for the hundreds of people that walk from
Being able to securize major long light intersections . Ie enterprise east of warden so more cars make it though.
YES!!!! The cyclists are not following the rules? They are riding through red lights, they are not waiting at four way stops, they are driving diagonally through intersections. You can never be sure they are going to stop at a red light when you are making a right hand turn on a red light. I am constantly paranoid that I will be making
Cyclist safety is non existent! No matter what you do unless the bike lanes are facing oncoming traffic ! Are
Battery operated vehicles (bikes, scooters, etc.) running on sidewalks.
Better enforcement of bylaws and regulations; no need for more enforcers. Speedy noisy low body cars and motor cycles. Too many car trips for unimportant travel. Cyclists are uncaring and too fast in pedestrian areas,
As a result of condo construction there is and will be too much volume of traffic for the present roadways.
Trees need to be pruned within residential streets for better lighting at night and safety.
Motorists On their cellphones during slowdowns and traffic stops....Motorists driving at 30km/h on the passing
Pedestrians do not follow traffic light signals. They totally ignore do not walk signals.
I see drivers not obeying traffic laws quite often
My neighborhood has practically no side walk past the subdivision? No side walk east of woodbine on Elgin Mills or side walk on Victoria square Blvd. It is very discouraging to walk or cycle which I prefer to commute with for
no
Drivers are very inconsiderate
Check how some trees need to be trim in order to see at good distance the road signs
I like the intersections where you cannot make a right turn on a red light….that helps a lot
Drivers & walkers using cell phone and being distracted U-turns causing sudden reaction by other driver BAN
People tossing garbage including bottles out of their vehicles while driving… it’s a safety issue for pedestrians &
Remove those "Do Not Right Turn" signs during peak hours at selected intersections. This action caused more
Installed cameras in the neighborhood of school zones, lots of cars running stop signs before school (rush, maybe late for school) and after school . E.g. Vinecliff Blvd and Hazelton at 8:30-9:00am;2:30-3pm. Rodick and
Dedicated bicycle lanes near high schools
Speeding- if I go the speed limit I am passed all the time.
Need for forced driver education retesting on a regular basis
Pedestrians using devices or earplugs while crossing. Running red lights especially in front of Brother Andre
Need to establish rules for what can be on sidewalk - example; ban adult cyclists, scooters, electric bicycles from
Adults riding bikes on sidewalks and popping out in front of drivers who are unaware they are there until the last minute. Bicycle safety does not seem to be a priority. I don’t mind young children riding on sidewalks, the
Racing vehicles during the late evening and night.
Aggressive and reckless driving

Cyclists need to know a helmet is mandatory as is a working bell. On Leslie the sidewalk is wide to be shared but cyclists without bells shout" move" . My grandmother was run down by a bicycle and sustained terrible injuries.
Drivers are poorly educated. Drivers ed should be mandatory. Drivers be accountable and fines reflective of the severity of infractions. Need more policing and enforcement on our roads in our communities
Drivers are rude and inconsiderate of pedestrians ie not giving pedestrians right of way and impatient ie speeding. I think increased police presence/harsh penalties is the only way and maybe more enhanced
This is getting worse and worse and will continue to get worse as more condos go up. More road connections need to be created in the unionville area, having only a few entry points into the area, particularly in the north
Na
Speed bumps on Fred varley and Main Street unionville. Speed bumps around Fonthill Blvd.
The disrespect for children in school/daycare areas during school hours is baffling. Speed bumps are useless, get some chips to give out tickets on a regular basis. We never see cops doing this anymore.
More safety and police information for residents of Markham
Common sense - these roads where not designed to take the flow of traffic we now have in Markham. The lack of enforcement on drivers who do not give a damn should be way higher in consequences. Listening to the people who live in the neighbourhood before making drastic changes that give great concern as to the safety of
There is a bike line on Parkway Avenue. Every day the bike line is filled with parked cars opposite Markhaven Home for seniors. These drivers open their car doors without looking and make it very dangerous for cyclists.
better lighting at intersections where people use frequently to cross at night
More permanent solar speed signs needed in area that have speeding accidents. More signs of no drinking and
Asking for options without sharing the data seems like a waste.
There is a push to add more cycling lanes in the city but I don't feel this is necessary. I ride a bike as well but most cycling happens during a 6 month period so half the year, those bike lanes are not serving a purpose. Most cyclists don't follow the rules of the road either so they need to own their safety more instead of blaming drivers. Overall time to get from one end of the city to the other is increasing and I feel like this is driving the increase in people running lights as their commute is already becoming too long. Bike lanes are fine but they
You need bigger parks with basketball courts and soccer fields and let cars and parking.
Enforce reduced speeds on all roads. Crossing signals do not allow enough time, especially for elderly and
I wish I could use a bike more for transportation in Markham but I don't feel safe cycling on major roads. The bike lanes printed on roads do nothing to separate cyclists and drivers, and so cyclists have to hope that they are visible enough to passing cars. I do think more people would use bikes, e-bikes, and scooters if there was
Driver speed and a complete disregard and respect for other drivers and pedestrians. Parking lots are very dangerous where pedestrians and drivers are lax in watching out for each other and speed of cars in parking lots
When a crosswalk countdown gets to 0, the light should change
People in Markham are just bad drivers.
On a day like today, the trails are all flooded so people who like to ride on them can't so they drive. The city does a poor job of keeping up the trails like the Village and Valleys trail where the section until highway 7 near Bulloch is just mushy gravel. Other sections are muddy and poorly maintained making them only good when it's hot and dry. The city should maintain trails in the winter time as these are just as important as roads. The
Yes- driving schools that cater to international students and non-nationals are putting more inexperienced drivers behind the steering wheel. THIS is the sole reason for the collisions in Markham
Too many unprotected left turns. The intersection at Warden and Highway 7 is so wide that three cars are in the intersection at the same time waiting to turn left. When the light turns yellow, it takes so much time for three
Policing is virtually non existent across Markham and the Mayor does not care about cyclists or pedestrians, he should ride a bike along Hwy 7 so he could personally relate. Markham needs to spend substantial funds on

The City through MSSTF (Markham Safe Streets Task Force) in 2006/2007 developed a great report (recognized by the Region). A comparison of findings of that report to today's environment will reflect little change/improvement. Were you to look at that report ask yourselves: -"What did we get wrong; What did we not enact? That initiative years ago was NOT a waste of time however the City did not carry through with
Simply put, Markham is not walkable and barely cyclable. The main reason people drive is because there are no other options, causing designs to revolve around cars, leading to more drivers, etc etc. To give an example, the upcoming plans for densification of McCowan/Hwy 7 give minimal thought to how people get around -- with no cycling paths, disjointed public transport services (YRT/Viva, TTC, GO train), and wide suburban tracts with no
Allegedly, there are lots of concerns, especially among seniors, about cyclists being too aggressive on trails - not
In the area I live in the safest idea would be to close off Southdale Drive from McCowan. We do not need a very
It seems like yellow light duration is shrinking (assuming drivers are watching the walk count down I expect) this makes it dangerous for slow moving vehicles like bicycles to get through the light. The light can be green as the bike enters the intersection and red before it exits it at the other side. Also get all those electric scooters and e-
Enforcement of traffic rules - everyone must follow them - drivers, cyclists, pedestirans.
Pedestrians & cyclists' safety awareness as they have very wrong concept of their responsibility
adding sidewalks in some areas to increase pedestrian safety
People who don't know the rules of the road. For example making a right turn from the left lane. Or making a left turn from the right lane. U turn in an intersection. Driving over a curb. Parking so close to a car that the other driver's door cannot be opened. Taking up two spots to park a vehicle. Drag racing at night. Driving the
I know a lot of people complain about them, but I'm a fan of the no right turn on a red. Cars often don't stop on the red and pedestrian's don't pay attention and focus on their phone. Highway 7 is already a nightmare and
Left turns. For example, turning left from Bullock onto Markham Road, heading north. There should be marker lines. Most people cut the corner going through southbound lanes to make the left.
I think roundabouts are a great idea instead of stop signs or traffic signals in some cases. Successful implementations at Village Pkwy/Fitzgerald Ave has improved pedestrian visibility/safety and driver safety.
None, leave everything as it is.
Pedestrians & cyclists have to understand they need to follow traffic rules, and to be more careful even if they have the right of way. They are ultimately the ones who will have more severe injuries.
No
The lack of education a lot of drivers have when driving. This is I think a licensing issue however.
I placed the long answer on another question. More measures in place to impede drivers is not the answer. We are already over regulated, it is ridiculous. We need everyone to follow the rules which includes drivers,
Prohibit Right-On-Red at all times to prioritize pedestrian/cyclist safety over hypothetical time savings of motorists. More dedicated protected left turns at busy intersections, to protect both pedestrains/cyclists and motorists. Preference for roundabouts over the regular intersections, both in major arterial roads and neighbourhood streets. Pedestrian walk signals should be the default, pedestrians should not have to press a button. Build wider sidewalks so that it can become a shared pathway for both bikes and pedestrians. I'm disappointed in the bike lanes design on Hwy 7 and Yonge Street, the Viva routes. There's more protections for trees/shrubs with knee-height concrete curbs/barriers than the tax-paying cycling public which gets no
We don't need to slow traffic down even more. Its part of what creates angry and aggressive driving. We need
Moving in the right direction (pun not intended) but needs more infrastructure (double lanes on Steeles and 14th) to support the growing population and reduce traffic. Adding bike lanes so more people commute by bike as an alternative method of transport which is a win win to have less cars on the road, but also ensuring cyclists
Reckless driving. I once saw a young person driving very fast on Coppard and Highglen going east while the crossing-guard in the middle of the road stopping traffic. This person drove to the left turn lane and then went around the crossing-guard and kept going in a very fast speed. Fortunately there were no students on the side
more signs will NOT work you need to fix the root causes

Pedestrian safety measures such as advanced pedestrian signal that claims to increase pedestrian safety may have unintended consequences of longer signal cycles and red lights, leading to more pedestrians running across
Have councillors who are engaged with their community and are supportive.
Crosswalk and/or bus stop for example between Steeles and Elson St at Middlefield.
New immigrants are driving too slow (not even at speed limit) and not moving to right lane. There is a lot of new rules we can't turn right during rush hours on major intersection along 16 ave and the signs are too small
Educating retailers who sell and riders with e-bikes, e-scooters, e-unicycles (a.k.a. hoverboards), and bicycles that it is hazardous to be riding on the pedestrian walk. Then enforcing the Ontario Highway Traffic Act on these
Drivers actively ignoring the presence of pedestrians, stop signs, and other general base-line driving knowledge
There are way to many speed limits...very confusing..it depends on what day of the week, what time of the day, what month, etc. Speed limits should be consistent and simple..70k/h for major roads, 60k/h for residential
More protected and designated cycling infrastructure with physical protections from traffic will yield better
Need more dedicated bike infrastructure, like Vancouver downtown
Lower speed limits around school and Senior homes (30 km/hr)
Very novice drivers getting their license and elderly that should not be driving any longer
Although there is a lot of bike lanes a lot of them are not connected. We need better bike lane infrastructure for
Safe bike lanes to cross hwy 407 north / south
Driver's behaviour has drastically changed over the years, much more aggressive or extremely distracted driving. Warden is a drag strip for exotic cars. Neighborhoods are race tracks. Delivery drivers are extremely
Desperately need more safe roads for cyclists (i.e. dedicated bike lanes) and education for drivers to share the
Motorized Scooters , EBikes and Unicycles are totally out of control - driving recklessly on Markham pathways and sidewalks at high speed with disregard for pedestrians. When using the road they are high risk to be hit be cars due to poor roadway designs. Need regulation and enforcement on Markham pathways - have never ever
Lack of dedicated bike lane forcing cyclists to use side walk. Main artillery roads are too dangerous for cylcists
This survey bundled distracted driving with distracted walking on question 4. I would've rated these on very different levels of importance, because the consequences of distracted driving are far more severe than distracted walking. As a YRT rider I have seen drivers on their phones every time I take the bus. YRP once had a program where they put officers on buses to look for distracted drivers and I think that could still be effective today. Improper headlight use is also something YRP should look out for — I have seen many cars on the road at night driving around with only daytime running lights and no taillights. I have been in a near-miss incident because a driver did not use their headlights at night. The City of Markham should also consider the Idaho
At major street pedestrian buttons should automatically show the walk signal.
Too many cars speeding against yellow light which easily cause collisions with cars making left turn
More police patrol, bikes do not stop on 4 way stops, e-scooters need to be regulated as they are a hazard
Speeders. Little to no police presence or enforcement.
A disregard exists for rules of the road which is an "attitude" that exists. Higher fines in all categories and a
Would be nice to see police charging all the teenagers with the muffler deletes and modded exhaust off the road
No
Lack of resources and funding to implement road safety measures.
No.

CIMA+ project number: B001780
January 2026

F

Appendix F
Council Workshop Memorandum

MEMO

TO : City of Markham

FROM : CIMA+

DATE : August 8, 2025

SUBJECT : Road Safety Plan – Council Workshop Memorandum

1. Background

The City of Markham, in collaboration with its road safety partners, recently initiated a comprehensive study to improve road safety. This data-driven effort prioritizes key safety needs across the transportation system based on the pillars of the Safe System approach and Vision Zero philosophy. The City's Road Safety Plan (RSP) aims to develop an implementation plan to address traffic fatalities and serious injuries, ensuring safer travel for all residents, regardless of their mode of transportation.

In this phase of the project, the development of the Road Safety Plan (RSP), insights gathered from public and stakeholder engagement, and an overview of speed management and traffic calming measures were presented to the Council Members for feedback, helping to shape the future traffic strategy. Two breakout sessions related to speed management and traffic calming strategies were held with senior management, the mayor, and Council, with each session focusing on three (3) individual roundtable discussion questions. This memo summarized the discussions and key takeaways from the Council Workshop.

2. Breakout Session #1

This breakout session primarily evolved around the general process of proactively implementing speed management/traffic calming treatments.

2.1. Discussion Topic 1

What locations (apart from school zones) do you believe should be prioritized for traffic calming?

Locations and roads with specific characteristics are generally considered desirable locations. There was an agreement among the participants that locations with high pedestrian activities, especially involving children and seniors, should be prioritized, such as roads adjacent to hospitals, parks, community centres, and transit stations. It was also mentioned that local roads serving large subdivisions often experience speeding issues. These roads typically have a two-lane cross-section, wide shoulder, and a 40 km/hr posted speed limit. This is mainly because these roads were mostly designed before the subdivisions were planned or occupied, potentially with higher design speeds and wider road widths, which can encourage higher travel speeds.

Some additional takeaways on traffic calming priority locations are summarized as follows:

- Some local roads parallel to major roads are used as cut-through routes, resulting in higher travel speeds.
- Locations with speed limit drops (transitioning from rural to urban) tend to experience speeding issues.
- Traffic calming measures may be prioritized as pilot programs in new communities, where implementation is expected to be more straightforward compared to existing communities.
- Priority locations may be selected based on key trip routes rather than focusing solely on intersections or points of interest.
- Once traffic calming measures are implemented, they should be monitored over time to evaluate their effectiveness and determine if the same measures are still applicable, given infrastructure changes may alter traffic patterns.
- The financial aspects, such as return on investment and maintenance cost, should be taken into consideration.

2.2. Discussion Topic 2

How do you feel about increasing the necessary resources to move to a more proactive approach to addressing traffic calming concerns through an annual program?

All groups generally agreed on increasing resources and adopting a more proactive approach targeting deficient roads. A frequently raised idea was to require traffic calming measures in new subdivisions. Some participants suggested that a hybrid approach—proportionally allocating resources between proactive and reactive strategies—might be more effective.

Some additional considerations mentioned are as follows:

- The program should first focus on low-cost treatments.
- Understanding the effectiveness of different measures is crucial.
- The City currently collects speed data, which can be used to inform the implementation of traffic calming measures through a data-driven approach.
- Residents' feedback could be considered, as it may lead to the same conclusions as priority locations identified through the proactive approach.

2.3. Discussion Topic 3

What role should residents and the community have in approving and implementing traffic calming measures? How could they be informed and consulted?

There were mixed opinions on the required level and frequency of public involvement. Some participants believe it may be more valuable to consider what has been successfully done in comparable cities through peer review instead of basing the decision on public perceptions. On the other hand, some participants believe public involvement should be required from the early investigation stage when identifying the problem. Although public consultation can be time-consuming, City Councillors should demonstrate the effectiveness of selected measures to the public and allow them to voice their opinions.

Some additional messages heard in the discussions are as follows:

- The importance of public education was emphasized in most discussions. The purpose of education is not only to make the public aware of potential treatments but also to change how they view traffic calming measures. Effective educational campaigns can lead to smoother implementations with less resistance from the public.
- It is crucial to present the information to the public in a way that makes it easy to understand the effectiveness of measures. It is also important to strike a balance between evidence and experience-driven demonstrations.
- Implementing treatments as a pilot program and gathering public feedback afterward is believed to be more effective than asking for public support before implementation.
- It is important to ensure that feedback from public consultations reflects overall public opinion while balancing the differing perspectives of residents living on the affected road and those using it as a cut-through, as their priorities may conflict.
- Traffic calming policies may evolve over time and should be updated based on altered traffic patterns. Public input on policies can be collected once every few years to inform required updates and reprioritization.
- Some participants suggested joining neighbourhood or community chat groups to share information and collect feedback effectively.

3. Breakout Session #2

The second round of breakout sessions focused on gathering feedback from councillors regarding their preferred approach and process of implementing speed management/traffic calming treatments.

3.1. Discussion Topic 1

Which types of treatments do you think require specific Council approval to implement? What treatments could staff implement without specific Council approval?

The key takeaways from each group were generally aligned. Most agree that proposed treatments should be based on data-driven analysis and engineering judgment. Council approval should only be required for treatments expected to result in major infrastructure changes or significant impacts on traffic patterns, such as lane reductions, conversions to roundabouts, or road diets. Treatments with a smaller footprint and/or lower implementation costs, such as pavement markings or flexible bollards, should not require council approval.

The following list summarizes a few additional items discussed:

- A detailed decision matrix emphasizing basic safety standards and requirements should be incorporated into the policy development process. Once the Council approves the policy, no further approval should be necessary. However, public consultation could still be conducted to gather feedback and inform the public in advance.
- Any implementation plan for a traffic calming measure should include collecting before and after data as part of a pilot program to demonstrate effectiveness.

- Local councillors should always be notified of planned changes, although approval may not be necessary. This is to ensure the treatments align with the approved policy. If there is objections from the public, they can file complaints and bring the recommendation back to Council for reconsideration.
- Major stakeholders, including emergency services, should always be notified of treatments to be implemented.

3.2. Discussion Topic 2

Identify which Engineering treatments should be prioritized in the City's list of possible treatment types and why?

Some participants believe that treatments should be considered on a case-by-case basis according to the specific characteristics of each location. The following list summarizes some key messages from the discussions regarding treatments for prioritization, along with a few concerns raised:

- Flexible bollards are believed to be effective and practical. It is recommended that they be implemented as part of a pilot program, considering potential winter maintenance challenges.
- One individual was in favour of replacing all-way stop controls with mini roundabouts (on a case-by-case basis).
- Roadway narrowing treatments through pavement markings are supported due to their low cost and effectiveness. However, concerns were raised regarding markings fading over time and user compliance.
- Some groups prefer concrete speed cushions over rubber ones for their durability.

3.3. Discussion Topic 3

Identify which Education & Enforcement treatments should be prioritized to improve safety and why?

The discussions on Education & Enforcement treatments highlighted the importance of education over enforcement. In addition, implementation of enforcement devices, such as Speed Display Boards and Automated Speed Enforcement, were generally preferred.

The following additional key messages were also brought up during the discussion:

- Education is considered a high priority and must be repetitive and widespread to create lasting change.
- Speed Display Boards and Automated Speed Enforcement devices, preferably remote ones, are good measures to implement. However, the associated capital and operating costs versus revenue need to be factored in. It can be considered for partnerships with other municipalities to benefit from cost sharing. Revenue can be re-invested into other road safety programs and address public perception.
- Partnering with insurance companies, driver training companies, and school boards may be considered to improve driver education.
- It can be considered to collaborate with other municipalities in identifying effective treatments and education messaging through a data-driven approach.

- Road safety can be added as an additional component to the City's fire safety program in schools run by the fire department. It is a low-cost initiative and can be prioritized immediately.

4. Q&A

A round of Q&A was held during the workshop regarding the City's RSP development process. The discussions are summarized as follows.

Q1. For which year was the collision data presented? Police have responded to over 1,000 motor vehicle collisions with significant impacts over the past two years.

- The numbers shown on the collision slides are based on 2017-2019 and 2022-2023 data and are specific to collisions on the City's roads. The numbers from police might have included collisions that occurred on regional roads.

Q2. Regarding feedback from public engagement events, was there any request for grade separation?

- The program aimed to develop a series of countermeasures to be included in the stakeholder consultation process, which can include grade separations, roundabouts, or other treatments targeting safety issues at intersections. The list of measures shown in the presentation comes from the public and does not represent the final list of measures for consideration.

Q3. The collision data shown only represents the patterns on local roads. What are the collision statistics on regional roads?

- The collision data on regional roads within the City of Markham has been reviewed as part of York Region's study. The Region's action plans were developed to address issues pertaining to collisions on regional roads.

Q4. Will the measures developed for the City of Markham's roads be applied to regional roads?

- CIMA+ has developed the York Region's Traveller Safety Plan and is aware of its action plan. The City's and the Region's programs are expected to be consistent. The City worked closely with the Region on developing the Region's Traveller Safety Plan and will continue collaborating to ensure the two plans align.

Q5. What are the sources of the collision numbers? Are they from the police or insurance companies?

- The collision data used in the study are based on collisions recorded in the police database, regardless of police presence or self-reporting. However, if a collision was not reported, it was not included in the database. Although collision data is reliable, it is an underestimation of the level of safety considering unreported collisions and near-misses that did not result in collisions; therefore, in addition to collision data, stakeholder and public inputs are also obtained for better understanding of safety issues and guiding the development of the safety plan.

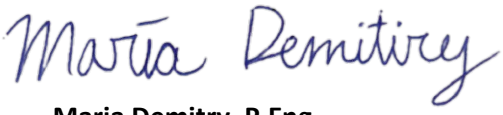
Q6. Ensure that the collision data and the emphasis areas are for local roads only to avoid confusion.

- CIMA+ will continue to clarify this in all project documents. The City's emphasis areas align with those of the Region's Traveller Safety Plan, which are determined using a similar scientific and data-driven approach.

Prepared by:

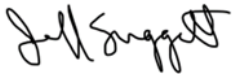


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Verified by:



Jeffery Suggett, M.Sc. Senior Project Manager

CIMA+ project number: B001780
January 2026

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Appendix G
Site Selection Methodology Memorandum

City of Markham

Vision Zero Road Safety Plan

SITE SELECTION REPORT



CIMA+ project number: B001780
28-August-2025

City of Markham

Vision Zero Road Safety Plan

SITE SELECTION REPORT

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1. Introduction

The City of Markham ('the City') is in the process of developing a five-year Road Safety Plan (RSP) based on the core pillars and principles of the Safe System approach, with the aim of eliminating traffic fatalities and serious injuries for all travellers.

As part of the development of RSP, CIMA and City staff identified a number of engineering countermeasures to be implemented across the City over a 5-year period. Quantities of locations for each countermeasure were also established, including XX "unit" countermeasures (e.g., traffic signal, pedestrian crossover, etc.) and YY km of "linear" countermeasures (e.g., bicycle lanes).

Before the City begins implementing these countermeasures, it is necessary to determine which sites are best suited for each countermeasure. This report describes the methodology (process) used for the countermeasure site selection and presents the results of this process.

In general terms, the methodology consisted of ranking sites based on the presence or magnitude of specific target issues and/or target conflicts associated with each countermeasure, while also taking into consideration elements such as warrants, rankings from network screening and systemic risk assessment, and site applicability / feasibility.

The following sections present the resulting recommended sites for countermeasures after applying the site selection process.

The 44 countermeasures in **Table 1** were reviewed as part of the site selection process. The minimum target quantities are also displayed. The number of sites recommended for each countermeasure were equal to or greater than the minimum target quantity to allow the municipality to choose alternative locations if needed.

Table 1: Countermeasures in Site Selection Process

ID	Countermeasure	Intersection or Midblock	Target Quantity
INT-01	Traffic Signals	Intersection	15
INT-02	Intersection/Railway Illumination	Intersection	10
INT-03	Roundabouts	Intersection	1
INT-04	Sightline Improvements	Intersection	5
INT-05	Left-Turn Lane Offset	Intersection	1
INT-06	Protected Intersections	Intersection	1
INT-07	Left-Turn Signal Phases (Protected / Protected + Permissive)	Intersection	4
INT-08	Left-Turn Lanes	Intersection	2
INT-09	Driveway Access Management	Intersection	1
INT-10	Left-Turn Traffic Calming	Intersection	6
INT-11	Reduced Speeds at Intersection Approaches	Intersection	6
INT-12	Turn Prohibitions (Full or Part-Time)	Intersection	4
G-23	Roundabout Screening and Feasibility Analysis	Intersection	1
VRU-01	AODA Upgrades	Intersection	6
VRU-02	Setback Pedestrian Crosswalks	Intersection	6
VRU-03	Pedestrian Signals	Midblock	1
VRU-04	Addition of Active Transportation Facilities	Midblock	10 km
VRU-05	Addition of Active Transportation Facilities (Protected On-Road)	Midblock	1 km
VRU-06	Addition of Active Transportation Facilities (Protected Off-Road)	Midblock	1 km
VRU-07	Bicycle Conflict Zone Pavement Markings	Intersection	5
VRU-08	Illumination at Active Transportation Facilities	Intersection	5
VRU-09	Bicycle Signals	Intersection	1
VRU-10	Crossride Markings	Intersection	5
VRU-11	Leading Pedestrian Intervals (LPIs)	Intersection	8
VRU-12	Signal Optimization for Pedestrians	Intersection	5
VRU-13	Right Turn on Red Restrictions	Intersection	6
VRU-15	Advanced Warning Signs for Motorcyclists	Intersection and Midblock	1
VRU-16	Fully Paved Shoulders	Midblock	1
VRU-17	Pedestrian Crossovers (PXOs)	Midblock	15
VRU-18	Expand Existing Sidewalk Network Completion	Midblock	2.5 km

ID	Countermeasure	Intersection or Midblock	Target Quantity
SZ-06	Systemic Intersection Improvements Near Schools	Intersection	20 schools
SZ-07	Traffic Management Plan and School Area Review	Intersection and Midblock	5 schools
SZ-08	School Streets Program	Midblock	5 locations
AG-01	Red Light Camera Program	Intersection	6
AG-03	Vehicle Restrictions	Intersection	5
AG-04	Continuous Centre Medians	Midblock	1 km
AG-06	Senior Safety Zones	Midblock	5
AG-07	Radar Speed Feedback Signs	Midblock	10
AG-08	Pavement Markings	Midblock	5
AG-09	Roadway Narrowing	Midblock	10 km
AG-10	Horizontal Deflection	Intersection and Midblock	10
AG-11	Vertical Deflection	Midblock	5
DRU-01	Guide Rail Upgrades	Midblock	5 km
DRU-02	Enhanced Pavement Markings	Midblock	10 km

2. Site Selection Process

The site selection process involved 10 steps, summarized in **Figure 1**. This process has been applied to the countermeasures identified as part of the City of Markham Road Safety Plan for this study to help identify the most suitable locations for implementing each countermeasure.

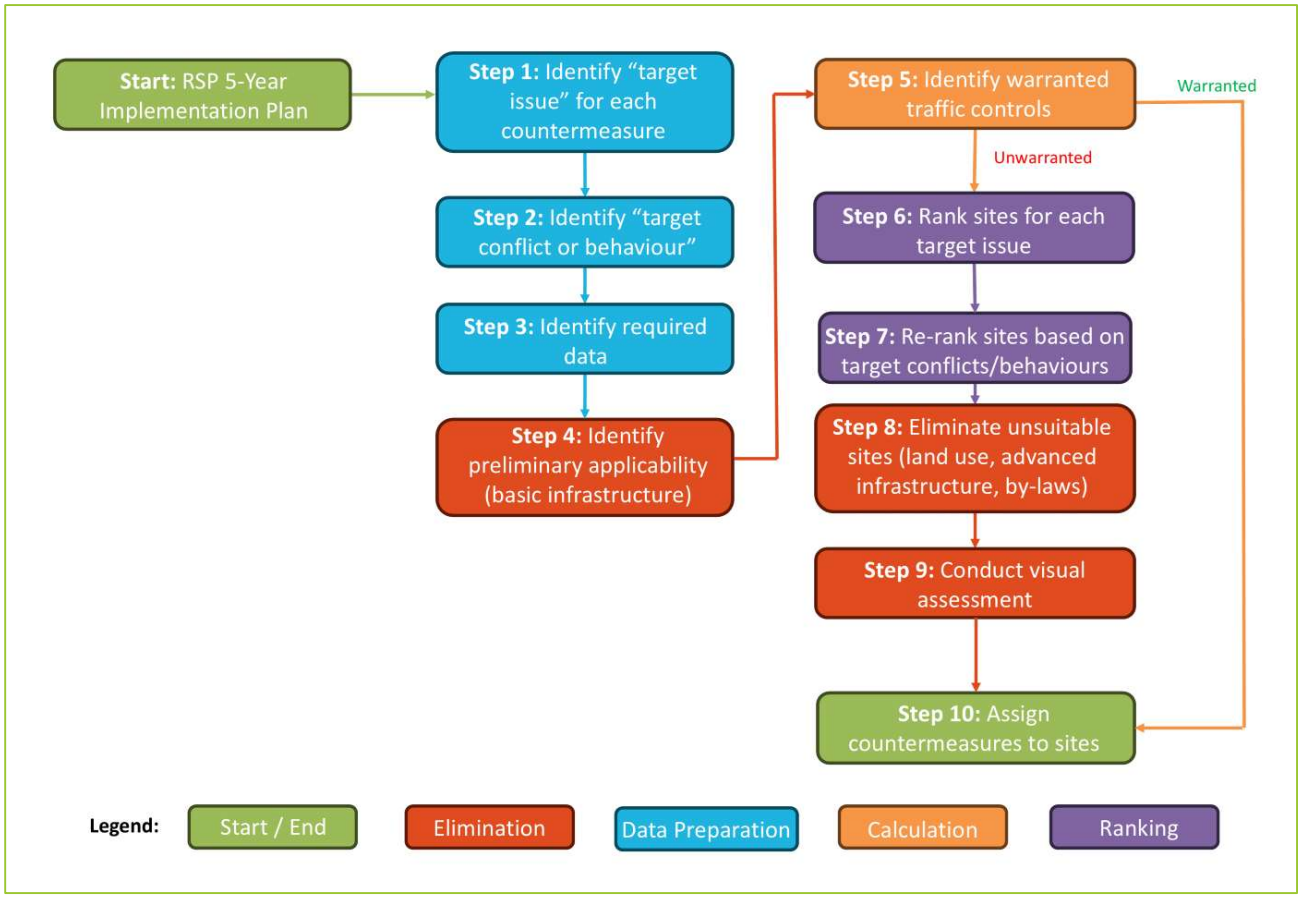


Figure 1: Site Selection Process.

The following is an overview of the site selection process. Further details are provided in **Appendix A**.

The first four steps were data preparation steps to allow for elimination and ranking steps to be performed later.

- **Step 1:** Target Issues were identified for the list of countermeasures outlined in the City of Markham RSP.
- **Step 2:** Target Conflicts were identified for each countermeasure.

- **Step 3:** The required data for each countermeasure was identified. This data included infrastructure data, collision data, traffic volumes, turning movement counts (TMC), speed data, land use, and regulations.
- **Step 4:** Basic infrastructure data was used to identify the preliminary applicability of the countermeasures. The countermeasures that were not applicable at the sites were removed as options for those sites.
- **Step 5:** The warranted traffic control locations were identified.
- **Step 6:** The data in Step 3 was used to calculate scores for the Target Issues which allow for the sites to be ranked. The calculations generally represent a percentage value associated with each variable, and weights range between 0.1 and 1.0; the higher the weight of a variable, the more closely associated with the target issue that variable is.
  - The most common calculation for the partial scores was to use the highest value of the attribute in the list of sites available as the denominator so that the magnitudes of all other sites were proportional to the site with the highest value.
  - For example, if the highest number of total collisions was 10, the denominator for the highest total collisions partial score would be 10. The partial scores of all other sites would be proportional to the 10 collisions.
- **Step 7:** The sites were re-ranked based on the target conflicts relevant to countermeasures. The highest number of target conflicts for that particular conflict was used as the denominator similar to the calculation performed in Step 6. Additionally, the network screening rankings were used to re-rank the locations.
- **Step 8:** GIS data and advanced infrastructure data was used to eliminate unsuitable sites. For example, if the GIS data shows that the countermeasure already exists at the site then that site would be eliminated.
- **Step 9:** Visual assessments were conducted (using aerial imagery and Google Street View) at the top ranked sites until enough sites were deemed suitable to meet the quantities required for each countermeasure. The countermeasures were then assigned to sites in Step 10.
- **Step 10:** The countermeasures are assigned to the top ranking sites until the minimum target quantities have been met.

3. Data Acquisition and Preparation

The data used to perform the site selection included infrastructure data, collision data, traffic volumes, TMC, speed data, and land use. The required data for this assignment was extracted from the City of Markham's Traffic Engineering Software (TES) database, GIS files and complementary datasets provided by the Municipality, and Google Earth / Google Maps Street View / satellite imagery. The data utilized in the site selection are provided in the following sections.

3.1 Infrastructure Data

The infrastructure data was extracted from TES. The attributes were Geo ID (a unique intersection or road segment ID in TES), description of intersection or road segment (i.e. street name), number of lanes, length of segment, traffic control (i.e. traffic signal vs. stop sign), area type, speed limit, and road classification.

3.2 Collision Data

Collision data for the years 2017-2019 and 2022-2023 and latest network screening results were obtained from TES. Information on each collision within the study area was coded into TES based on the Motor Vehicle Accident (MVA) reports. Each collision location was geographically referenced to the appropriate site using the existing Geo ID. The collision data included details about collision severity and collision impact type, and network screening results included details such as predicted and expected collision frequencies for different collision severity types (i.e., property damage only (PDO) and fatal and non-fatal injury (FI)).

3.3 Traffic Volume, Turning Movement Counts and Speed Data

Available AADT data was provided, through the TES database, for all road segments located within the study area. Operating speed data was also extracted from TES based on automatic traffic recorder (ATR) data collected by the City. Similarly, intersection volume data from turning movement counts (TMC) in the TES data base were also extracted.

Being cognisant of the COVID-19 pandemic impact on traffic volume and speed patterns across the Municipality, CIMA+ reviewed the speed data and identified some levels of volatility in the 2020 and 2021 data compared to data collected in other years. As per this preliminary finding, we adopted the years 2017-2019 and 2022-2023 as the analysis years and extracted the associated volume and TMC data accordingly. Similarly, we adopted the years 2017-2019 and 2022-2024 for the speed data.

3.4 Land Use Data

The land use data was obtained using GIS files and complementary datasets provided by the Municipality. Google Earth / Google Maps Street View / satellite imagery was reviewed in combination with the data provided by the Municipality at the top ranked locations for each countermeasure.

3.5 Data Preparation

The obtained data were further integrated into a single dataset and further utilized to complete the countermeasure site selection. The involved data processing steps are summarized below:

- The Municipality's road segment and intersection datasets were adopted as the reference, and its core data fields (AADT, # of lanes, speed limit) were processed for completeness and accuracy.
- The most recent speed study data (lower limit of speed pace and speed limit compliance) were added to the road segment dataset.
- The collision data was summarized based on collision attributes and target conflicts (i.e. pedestrian involved, cyclist involved, during school hours, turning movement, and etc.) and added to the road segment and intersection datasets.
- The TMC data was used to obtain the 8-hour volumes of different users (i.e. heavy vehicles, pedestrians, and cyclists) of the intersections and associated road segments.
- The provided GIS data files were reviewed, and their relevant data fields (i.e., location of community housing, long-term facilities, schools and other relevant land uses) were identified. For points of interest, a "selection by location" was performed for road segments and intersection using 150 m buffers from the centrelines and centres of the road segments and intersections, respectively. For infrastructure data (i.e. guide rails, signals, bike lanes, etc.), a selection by location was performed for road segments and intersections using 50 m buffers from the centrelines and centres of the road segments and intersections respectively.
- A visual review of satellite imagery was then conducted to manually remove, from the selection, road segments that were selected due to being adjacent to, but not having relevant land uses.

4. Resulting Site Rankings by Countermeasure

Table 2 through **Table 49** summarize the top-ranking sites for each countermeasure. It should be noted that the selected locations presented herein are still subject to further feasibility assessments, and, therefore, are not considered final; for this reason, some tables contain more locations than the quantities specified in the City of Markham RSP to provide staff with the option to choose alternative locations.

Table 2: INT-01 Traffic Signals

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Angle and Turning Movement Collisions	Injury Angle and Turning Movement Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M2955	Elgin Mills Rd E @ REESOR RD (2)	13	3	11	3	9078	1.025	14	-	1
M0292	Fairburn Dr @ Rodick Rd	10	2	11	1	22236	0.744	35	-	2
M1544	Elson St @ Marydale Ave	7	5	6	3	-	0.729	47	-	3
M0664	Kirkham Dr @ New Delhi Dr	7	3	8	3	14658	0.694	340	-	4
M3936	Wootten Way N @ Church St	6	3	6	2	10305	0.690	58	-	5
M2611	Reesor Rd @ 19th Ave (S)	11	4	11	2	10264	0.638	340	-	6
M3830	Bur Oak Avenue @ Church Street	4	2	3	2	13507	0.600	152	-	7
M2644	Bur Oak Ave @ Williamson Rd	3	1	3	0	10740	0.494	41	-	8
M0932	Bur Oak Ave @ EMERY HILL BLVD/HILLWOOD ST	6	1	9	1	9288	0.484	88	-	9
M2029	Doncaster Ave @ Henderson Ave	7	2	2	0	13983	0.477	66	-	10
M0725	John St @ Henderson Ave	5	0	4	0	17981	0.474	80	-	11
M2694	Bur Oak Ave @ COUNTRY RIDGE DR/FRED MCLAREN BLVD	2	1	3	1	12236	0.455	340	-	12

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Angle and Turning Movement Collisions	Injury Angle and Turning Movement Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1048	Village Pky @ Carlton Rd	9	3	4	0	12761	0.415	340	31	13
M0915	Manhattan Dr @ Carlton Rd	1	1	1	1	9653	0.398	340	-	14
M0228	Carlton Rd @ Main St Unionville	3	0	1	0	11212	0.365	86	-	15
M2623	Bur Oak Ave @ Swan Park Rd	6	0	4	0	10222	0.323	127	-	16
M0335	Bur Oak Ave @ DONALD SIM AVE/LANE	1	0	0	0	6585	0.136	309	-	17

Summary of Signal Warrant Justification:

- (M2955) Elgin Mills Rd E @ REESOR RD (2): Justification 1: 92%, Justification 2: 84%, Justification 3: 100%, Justification 4: 100%, Justification 5: 26%, Justification 6: 0%, Justification 5A met
- (M0292) Fairburn Dr @ Rodick Rd: Justification 1: 72%, Justification 2: 56%, Justification 3: 0%, Justification 4: 100%, Justification 5: 40%, Justification 6: 0%
- (M1544) Elson St @ Marydale Ave: Signal warrant justification data not available
- (M0664) Kirkham Dr @ New Delhi Dr: Justification 1: 84%, Justification 2: 67%, Justification 3: 0%, Justification 4: 100%, Justification 5: 26%, Justification 6: 0%
- (M3936) Wootten Way N @ Church St: Justification 1: 78%, Justification 2: 44%, Justification 3: 0%, Justification 4: 0%, Justification 5: 6%, Justification 6: 0%
- (M2611) Reesor Rd @ 19th Ave (S): Justification 1: 92%, Justification 2: 85%, Justification 3: 100%, Justification 4: 100%, Justification 5: 40%, Justification 6: 0%
- (M3830) Bur Oak Avenue @ Church Street: Justification 1: 100%, Justification 2: 100%, Justification 3: 100%, Justification 4: 0%, Justification 5: 13%, Justification 6: 0%
- (M2644) Bur Oak Ave @ Williamson Rd: Justification 1: 86%, Justification 2: 68%, Justification 3: 0%, Justification 4: 25%, Justification 5: 13%, Justification 6: 0%

- (M0932) Bur Oak Ave @ EMERY HILL BLVD/HILLWOOD ST: Justification 1: 41%, Justification 2: 50%, Justification 3: 0%, Justification 4: 0%, Justification 5: 26%, Justification 6: 0%
- (M2029) Doncaster Ave @ Henderson Ave: Justification 1: 83%, Justification 2: 82%, Justification 3: 100%, Justification 4: 100%, Justification 5: 0%, Justification 6: 0%
- (M0725) John St @ Henderson Ave: Justification 1: 100%, Justification 2: 88%, Justification 3: 100%, Justification 4: 100%, Justification 5: 13%, Justification 6: 0%
- (M2694) Bur Oak Ave @ COUNTRY RIDGE DR/FRED MCLAREN BLVD: Justification 1: 56%, Justification 2: 48%, Justification 3: 0%, Justification 4: 0%, Justification 5: 20%, Justification 6: 0%
- (M1048) Village Pky @ Carlton Rd: Justification 1: 86%, Justification 2: 60%, Justification 3: 0%, Justification 4: 100%, Justification 5: 13%, Justification 6: 0%
- (M0915) Manhattan Dr @ Carlton Rd: Justification 1: 88%, Justification 2: 83%, Justification 3: 100%, Justification 4: 100%, Justification 5: 6%, Justification 6: 0%
- (M0228) Carlton Rd @ Main St Unionville: Justification 1: 81%, Justification 2: 54%, Justification 3: 0%, Justification 4: 0%, Justification 5: 0%, Justification 6: 100%
- (M2623) Bur Oak Ave @ Swan Park Rd: Justification 1: 100%, Justification 2: 100%, Justification 3: 100%, Justification 4: 0%, Justification 5: 0%, Justification 6: 0%
- (M0335) Bur Oak Ave @ DONALD SIM AVE/LANE: Justification 1: 52%, Justification 2: 35%, Justification 3: 0%, Justification 4: 0%, Justification 5: 0%, Justification 6: 0%

Table 3: INT-02 Intersection/Railway Illumination

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Non-Daylight Collisions	Pedestrian and Cyclist Non-Daylight Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M2708	Rodick Rd @ 14th Ave	2	1	1	0	45230	0.134	-	-	1
M3275	STRATHMORE DR (1) @ Crandall Dr	3	0	1	0	-	0.088	-	-	2
5557	Busch Ave @ Brock Ave	0	0	0	0	52265	0.082	-	-	3
New18	Main St Markham South @ Old Wellington St	0	0	0	0	33342	0.052	-	-	4
M2561	Village Pky @ Buchanan Dr	1	0	1	0	-	0.039	-	-	5
New23	Hollingham Rd @ Glamorgan Crt	0	0	0	0	16040	0.025	-	-	6
M5115	Morning Dove Dr @ Black Creek Dr	1	1	0	0	-	0.024	-	-	7
M3276	Cobblestone Dr @ WOOLSTHORPE CRES (2)	1	0	0	0	-	0.024	-	-	7
M5456	Reesor Road @ Reesor Road	1	1	0	0	-	0.024	-	-	7

Note:
City may want to consider reviewing lighting levels for potential enhancements at these sites

Table 4: INT-03 Roundabouts

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Angle and Turning Movement Collisions	Injury Angle and Turning Movement Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M2955	Elgin Mills Rd E @ REESOR RD (2)	13	3	11	3	9078	1.025	14	-	1
M0292	Fairburn Dr @ Rodick Rd	10	2	11	1	22236	0.744	35	-	2

Table 5: INT-04 Sightline Improvements

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Angle and Turning Movement Collisions	Failed to Yield	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M2623	Bur Oak Ave @ Swan Park Rd	6	0	4	4	10222	0.621	127	-	1
M2082	Esna Park Dr @ Steelcase Rd E	6	0	9	2	-	0.551	39	-	2
M1558	White's Hill Ave @ Black Creek Dr	2	2	2	2	-	0.433	-	-	3
M0293	Harbord St @ Bur Oak Ave	4	2	6	1	-	0.379	89	-	4
M1318	Corby Rd @ Apple Creek Blvd	2	1	3	2	12015	0.378	142	-	5
M1307	Rodick Rd @ FORESTER CRES/RACHEL CRES	1	1	2	0	-	0.369	340	-	6

Table 6: INT-05 Left-Turn Lane Offset

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Left Turn Collisions	Injury Left Turn Collisions	Failed to Yield	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M4204	Rodick Rd / Esna Park Dr @ Alden Rd / Esna Park Dr	32	7	11	4	7	63754	2.146	2	-	1
M3066	Markham Rd @ Bur Oak Ave	29	9	8	1	3	31592	1.189	30	7	2

Table 7: INT-06 Protected Intersections

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Pedestrian Collisions	AADT	8 Hour Ped Volume	8 Hour Heavy Vehicle Volume	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M2332	Rodick Rd @ Riviera Dr	14	4	1	30464	27	467	1.466	177	33	1
M1850	Denison St @ Hood Rd	28	11	2	25002	136	407	1.269	6	4	2
M4288	Birchmount Rd @ Frontage Rd	5	2	0	15484	180	158	1.149	-	-	3

Table 8: INT-07 Left-Turn Signal Phases (Protected / Protected + Permissive)

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Angle and Turning Movement Collisions	Injury Angle and Turning Movement Collisions	Failed to Yield	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1708	Denison St @ Brimley Rd	36	12	35	11	7	26009	2.927	1	4	1
M2903	Hwy 48 @ Castlemore Ave	32	12	22	10	6	31668	2.509	5	1	2
M1846	Denison St @ Middlefield Rd	30	8	27	7	7	24747	2.410	4	20	3
M1850	Denison St @ Hood Rd	28	11	26	8	1	25002	1.785	6	4	4
M1090	Main St Markham North @ Bullock Dr/Parkway Ave	21	8	14	3	5	25593	1.634	20	6	5

Table 9: INT-08 Left Turn Lanes

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Left Turn Collisions	Injury Left Turn Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M3098	Denison St @ Featherstone Ave	19	8	10	5	16258	1.831	3	22	1
M1316	Apple Creek Blvd @ Town Centre Blvd/Hollingham Rd	15	7	8	4	20540	1.582	10	27	2

Table 10: INT-09 Driveway Access Management

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Driveway Related Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1850	Denison St @ Hood Rd	28	11	0	25002	1.222	6	4	1
M4204	Rodick Rd / Esna Park Dr @ Alden Rd / Esna Park Dr	32	7	0	63754	1.130	2	-	2

Table 11: INT-10 Left Turn Calming

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Left Turn Collisions	Injury Left Turn Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M2903	Hwy 48 @ Castlemore Ave	32	12	17	9	31668	2.964	5	1	1
M1708	Denison St @ Brimley Rd	36	12	16	7	26009	2.740	1	4	2
M2317	Denison St @ Birchmount Rd	36	12	11	4	31992	2.301	11	8	3
M4204	Rodick Rd / Esna Park Dr @ Alden Rd / Esna Park Dr	32	7	11	4	63754	2.148	2	-	4
M1850	Denison St @ Hood Rd	28	11	8	4	25002	1.950	6	4	5
M1846	Denison St @ Middlefield Rd	30	8	8	2	24747	1.782	4	20	6
M3066	Markham Rd @ Bur Oak Ave	29	9	8	1	31592	1.563	30	7	7

Table 12: INT-11 Reduced Speeds at Intersection Approaches

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Aggressive Driving Collisions	Speed Limit of Approach with Higher Speed Limit	Speed Limit of Approach with Lower Speed Limit	Speed Compliance of Approach with Lower Compliance	85th Percentile Speed of Approach with Higher 85th Percentile Speed	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1846	Denison St @ Middlefield Rd	30	8	18	50	50	0.03	70.26	24747	3.367	4	20	1
M1708	Denison St @ Brimley Rd	36	12	19	50	40	0.07	75.51	26009	3.331	1	4	2
M2317	Denison St @ Birchmount Rd	36	12	23	50	50	0.34	67.02	31992	3.318	11	8	3
M1850	Denison St @ Hood Rd	28	11	20	50	50	0.18	67.69	25002	3.187	6	4	4
M2903	Hwy 48 @ Castlemore Ave	32	12	19	60	40	0.12	73.38	31668	3.160	5	1	5
M2299	Denison St @ Esna Park Dr	26	11	17	50	50	0.18	67.69	38558	2.692	52	12	6
M2318	Rodick Road @ 14th Ave	21	4	15	60	50	0.04	75.3	45230	2.653	340	11	7

Table 13: INT-12 Turn Prohibitions (Full or Part-Time)

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Angle and Turning Movement Collisions	Injury Angle and Turning Movement Collisions	Left Turn Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M0275	Apple Creek Blvd @ McIntosh Dr	14	5	16	4	6	13066	1.323	18	-	1
M2295	Denison St @ Cartmel Dr	9	3	8	3	6	17646	0.868	84	-	2
M1899	Brimley Rd @ CARDIFF RD/WORTHING AVE	8	2	8	1	2	12148	0.695	22	-	3
M2176	CITIZEN CRT/ROYAL CREST CRT @ Birchmount Rd	4	1	6	1	3	19200	0.638	74	-	4

Table 14: G-23 Roundabout Screening and Feasibility Analysis

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Angle and Turning Movement Collisions	Injury Angle and Turning Movement Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M2317	Denison St @ Birchmount Rd	36	12	28	9	31992	2.786	11	8	1
M4204	Rodick Rd / Esna Park Dr @ Alden Rd / Esna Park Dr	32	7	16	6	63754	2.155	2	-	2

Table 15: VRU-01 AODA Upgrades

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Pedestrian Collisions	AADT	8 Hour Heavy Vehicle Volume	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1090	Main St Markham North @ Bullock Dr/Parkway Ave	21	8	4	25593	272	2.746	20	6	1
MNew110	Yonge Street @ Meadowview Avenue	41	11	4	-	-	2.100	-	-	2
M3151	Markham Rd @ Edward Jeffreys Ave	16	4	3	26242	311	2.021	25	47	3
M2167	Rodick Rd @ Calvert Rd	8	4	3	10688	111	1.902	340	19	4
M2002	Denison St @ Aldergrove Dr	13	5	2	20282	244	1.681	15	22	5
M2158	Middlefield Rd @ Elson St	13	7	2	17025	176	1.539	12	52	6

Table 16: VRU-02 Setback Pedestrian Crosswalks

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Pedestrian Collisions	Vehicle - Pedestrian Collisions (Failed to Yield or Disobeyed Traffic Control)	AADT	8 Hour Heavy Vehicle Volume	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M2358	Carlton Rd @ Webber Cres	2	1	1	1	-	-	0.505	340	-	1
M0303	ROYAL ORCHARD BLVD (2) @ Blue Spruce Lane	1	1	1	1	-	-	0.502	340	-	2
M0275	Apple Creek Blvd @ McIntosh Dr	14	5	0	0	13066	160	0.378	18	-	3
M0888	Bullock Dr @ Jug Lane	1	1	1	0	11949	126	0.317	-	-	4
M2307	John St @ PORTERFIELD CRES (1)	8	3	0	0	-	-	0.270	13	-	5
M4346	Markham Rd @ Battista Perri Dr	2	1	0	0	26047	315	0.266	-	-	6

Table 17: VRU-03 Pedestrian Signals

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Pedestrian Collisions	Heavy Vehicle 8 Hour Volume	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M2029Y1514	Doncaster Ave btwn Henderson Avenue & Yonge Street[a]	19	3	1	52	209	1.076	4	192	1
M2299M4204	Esna Park Drive btwn Denison Street & Alden Road/Rodick Road[a]	8	2	0	559	1286	0.982	11	1	2
M1846M2158	Middlefield Rd btwn Denison Street & Elson Street	2	1	0	116	2455	0.903	525	1	3

Notes:
a: Install near bus stops

Table 18: VRU-04 Addition of Active Transportation Facilities

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Cyclist Collisions	Heavy Vehicle 8 Hour Volume	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1846M2158	Middlefield Rd btwn Denison Street & Elson Street	2	1	0	116	2455	1.077	525	1	1
M2051M3604	Birchmount Rd btwn Harvest Moon Drive/Risebrough Circuit & Steeles Avenue East	2	0	0	63	7535	0.757	525	36	2
M2389M3716	Brimley Rd btwn Wilclay Avenue/Winston Road & Steeles Avenue East	5	2	0	36	6434	0.750	45	1	3
M0768M0917	Carlton Rd btwn Paddock Lane & Canterfield Close	0	0	0	0	1741	0.617	525	251	4
M1478M2733	Denison St btwn Townley Avenue & Hillcroft Drive	1	1	0	140	7633	0.562	525	1	5

Table 18 were extended to meet the target distance established in the Markham RSP and to provide continuous facilities over distances that would encourage users to use them. The following are the resulting **recommended "corridors"**:

- (M1846M2158) Middlefield Rd btwn Denison Street & Elson Street: Extend from Middlefield Road between 14th Avenue to Steeles Avenue for 2.3 km total
- (M2051M3604) Birchmount Rd btwn Harvest Moon Drive/Risebrough Circuit & Steeles Avenue East: Extend from Birchmount between 14th Avenue to Steeles Avenue for 2 km total
- (M2389M3716) Brimley Rd btwn Wilclay Avenue/Winston Road & Steeles Avenue East: Extend from 14th Avenue to Steeles Avenue for 2 km total and consider for road diet
- (M0768M0917) Carlton Rd btwn Paddock Lane & Canterfield Close: Replace sharrow with dedicated bike lane from Carlton Road between Kennedy Road to McCowan Road for 1.7 km total
- (M1478M2733) Denison St btwn Townley Avenue & Hillcroft Drive: Extend from Brimley Road to McCowan Road for 1.1km

Table 19: VRU-05 Addition of Active Transportation Facilities (Protected On-Road)

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Cyclist Collisions	Heavy Vehicle 8 Hour Volume	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1936M2002	Denison St btwn Mallory Avenue/Teddington Avenue & Aldergrove Drive/Eden Avenue[a]	7	1	0	182	7633	0.869	525	1	1

Note:
a: Extend from Kennedy Road to Brimley Road for 1.2 km and consider for road diet

Table 20: VRU-06 Addition of Active Transportation Facilities (Protected Off-Road)

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Cyclist Collisions	Heavy Vehicle 8 Hour Volume	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
Y1472M3151	Markham Rd btwn 16th Avenue/Main Markham Street North & Edward Jeffreys Avenue[a]	29	11	1	153	30151	1.291	1	36	1

Note:
a: Extend from 16th Avenue to Castlemore Avenue for 1.3km

Table 21: VRU-07 Bicycle Conflict Zone Pavement Markings

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Cyclist Collisions	AADT	8 Hour Heavy Vehicle Volume	8 Hour Bike Volume	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M2903	Hwy 48 @ Castlemore Ave	32	12	4	31668	394	8	2.105	5	1	1
M4433	Enterprise Blvd @ Birchmount Rd	24	2	2	-	291	4	1.322	8	28	2
M4204	Rodick Rd / Esna Park Dr @ Alden Rd / Esna Park Dr	32	7	1	63754	836	0	0.982	2	-	3
M1850	Denison St @ Hood Rd	28	11	0	25002	407	32	0.873	6	4	4
M5010	South Town Centre Blvd @ Clegg Rd	6	2	1	10446	191	8	0.704	62	29	5

Table 22: VRU-08 Illumination at Active Transportation Facilities

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Pedestrian Collisions	Cyclist Collisions	Pedestrian and Cyclist Collisions	AADT	8 Hour Ped Volume	8 Hour Heavy Vehicle Volume	8 Hour Bike Volume	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M2903	Hwy 48 @ Castlemore Ave	32	12	1	4	5	31668	363	394	8	2.665	5	1	1
M1850	Denison St @ Hood Rd	28	11	2	0	2	25002	136	407	32	1.760	6	4	2
M4433	Enterprise Blvd @ Birchmount Rd	24	2	0	2	2	-	375	291	4	1.470	8	28	3
M4204	Rodick Rd / Esna Park Dr @ Alden Rd / Esna Park Dr	32	7	0	1	1	63754	105	836	0	1.023	2	-	4
M5010	South Town Centre Blvd @ Clegg Rd	6	2	0	1	1	10446	514	191	8	0.908	62	29	5

Note:
City may want to consider reviewing lighting levels for potential enhancements at these sites

Table 23: VRU-09 Bicycle Signals

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Cyclist Collisions	Through Vehicle - Bicycle Collisions	AADT	8 Hour Heavy Vehicle Volume	8 Hour Bike Volume	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M4433	Enterprise Blvd @ Birchmount Rd	24	2	2	1	-	291	4	1.155	8	28	1
M4204	Rodick Rd / Esna Park Dr @ Alden Rd / Esna Park Dr	32	7	1	1	63754	836	0	0.982	2	-	2
M5010	South Town Centre Blvd @ Clegg Rd	6	2	1	1	10446	191	8	0.704	62	29	3

Table 24: VRU-10 Crossride Markings

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Cyclist Collisions	Left Turning and Right Turning Vehicle - Bicycle Collisions	AADT	8 Hour Heavy Vehicle Volume	8 Hour Bike Volume	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M4433	Enterprise Blvd @ Birchmount Rd	24	2	2	1	-	291	4	1.238	8	28	1
M1850	Denison St @ Hood Rd	28	11	0	0	25002	407	32	0.873	6	4	2
M4204	Rodick Rd / Esna Park Dr @ Alden Rd / Esna Park Dr	32	7	1	0	63754	836	0	0.815	2	-	3
M0963	Ridgecrest Rd @ Castlemore Ave	1	1	1	1	4884	70	61	0.747	218	-	4
M2176	CITIZEN CRT/ROYAL CREST CRT @ Birchmount Rd	4	1	1	1	19200	212	42	0.720	74	-	5
M5010	South Town Centre Blvd @ Clegg Rd	6	2	1	0	10446	191	8	0.538	62	29	6

Table 25: VRU-11 Leading Pedestrian Intervals (LPIs)

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Pedestrian Collisions	Left Turning Vehicle - Pedestrian Collisions	AADT	8 Hour Ped Volume	8 Hour Heavy Vehicle Volume	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1937	Denison St @ Gorvette Dr/Milliken Meadows Dr	8	5	4	4	21072	112	255	2.414	340	13	1
M1090	Main St Markham North @ Bullock Dr/Parkway Ave	21	8	4	2	25593	210	272	2.246	20	6	2
M1316	Apple Creek Blvd @ Town Centre Blvd/Hollingham Rd	15	7	3	2	20540	514	230	2.083	10	27	3
M1850	Denison St @ Hood Rd	28	11	2	2	25002	136	407	1.769	6	4	4
M2158	Middlefield Rd @ Elson St	13	7	2	2	17025	212	176	1.539	12	52	5
M3151	Markham Rd @ Edward Jeffreys Ave	16	4	3	1	26242	653	311	1.521	25	47	6
M1458	Denison St @ Coppard Ave	10	5	2	2	16900	141	182	1.505	26	13	7
M2167	Rodick Rd @ Calvert Rd	8	4	3	1	10688	218	111	1.402	340	19	8
M2903	Hwy 48 @ Castlemore Ave	32	12	1	1	31668	363	394	1.375	5	1	9
M1936	Denison St @ Mallory Ave/Teddington Ave	16	8	2	1	20502	288	247	1.250	277	13	10
M2002	Denison St @ Aldergrove Dr	13	5	2	0	20282	135	244	1.181	15	22	11

Table 26: VRU-12 Signal Optimization for Pedestrians

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Pedestrian Collisions	AADT	8 Hour Ped Volume	8 Hour Heavy Vehicle Volume	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1090	Main St Markham North @ Bullock Dr/Parkway Ave	21	8	4	25593	210	272	2.746	20	6	1
M1937	Denison St @ Gorvette Dr/Milliken Meadows Dr	8	5	4	21072	112	255	2.414	340	13	2
M1316	Apple Creek Blvd @ Town Centre Blvd/Hollingham Rd	15	7	3	20540	514	230	2.333	10	27	3
MNew110	Yonge Street @ Meadowview Avenue	41	11	4	-	-	-	2.100	-	-	4
M3151	Markham Rd @ Edward Jeffreys Ave	16	4	3	26242	653	311	2.021	25	47	5

Table 27: VRU-13 Right Turn on Red Restrictions

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Pedestrian Collisions	Right Turning Vehicle - Pedestrian (Failed to Yield) Collisions	AADT	8 Hour Ped Volume	8 Hour Heavy Vehicle Volume	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1090	Main St Markham North @ Bullock Dr/Parkway Ave	21	8	4	1	25593	210	272	2.746	20	6	1
M2002	Denison St @ Aldergrove Dr	13	5	2	1	20282	135	244	2.181	15	22	2
M2167	Rodick Rd @ Calvert Rd	8	4	3	1	10688	218	111	2.152	340	19	3
M1316	Apple Creek Blvd @ Town Centre Blvd/Hollingham Rd	15	7	3	0	20540	514	230	1.583	10	27	4
M1937	Denison St @ Gorvette Dr/Milliken Meadows Dr	8	5	4	0	21072	112	255	1.414	340	13	5
M1262	Bur Oak Ave @ William Berczy Blvd	2	2	1	1	8642	-	-	1.368	54	35	6
M3151	Markham Rd @ Edward Jeffreys Ave	16	4	3	0	26242	653	311	1.271	25	47	7
M1850	Denison St @ Hood Rd	28	11	2	0	25002	136	407	1.269	6	4	8
M2903	Hwy 48 @ Castlemore Ave	32	12	1	0	31668	363	394	1.125	5	1	9
M2158	Middlefield Rd @ Elson St	13	7	2	0	17025	212	176	1.039	12	52	10

Table 28: VRU-15 Advanced Warning Signs for Motorcyclists (Intersections)

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Motorcycle Collisions	Wet Surface Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M2332	Rodick Rd @ Riviera Dr	14	4	1	3	30464	2.332	177	33	1

Table 29: VRU-15 Advanced Warning Signs for Motorcyclists (Midblocks)

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Motorcycle Collisions	Wet Surface Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M2299M4204	Esna Park Drive btwn Denison Street & Alden Road/Rodick Road	8	2	1	1	1286	2.837	11	1	1
M1850M2299	Denison St btwn Hood Road & Esna Park Drive	14	7	1	2	15175	2.751	525	36	2
M0767M1013	Laidlaw Blvd btwn Bullock Drive & Heritage Road	3	1	1	1	465	2.363	48	488	3

Table 30: VRU-16 Fully Paved Shoulders

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Motorcycle Collision	Wet Surface Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
Y0033M1747	Reesor Rd btwn 14th Avenue & Steeles Avenue East	16	7	0	2	5849	0.898	12	441	1
M2611M2955	Reesor Rd btwn 19th Avenue & Elgin Mills Road East	11	3	0	2	4244	0.770	34	818	2
M0131Y1031	19th Ave btwn Mill Race Court & Ninth Line	5	1	0	0	2209	0.655	93	320	3
M0942M4409	Dickson Hill Rd btwn 19th Avenue & Highway 48	0	0	0	0	384	0.624	-	-	4
Y0506M3610	19th Ave btwn Woodbine Avenue & Highway 404	4	1	0	2	96	0.610	195	739	5

Table 31: VRU-17 Pedestrian Crossovers (PXOs) (Intersections)

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Pedestrian Collisions	AADT	8 Hour Ped Volume	8 Hour Heavy Vehicle Volume	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M0292	Fairburn Dr @ Rodick Rd	10	2	1	22236	9	305	0.743	35	-	1
M0751	Elgin Mills Rd E @ REESOR RD (1)	7	5	1	7662	2	88	0.553	340	-	2
M2228	Elson St @ James Edward Dr[a]	3	1	1	-	-	-	0.507	273	-	3
M2362	Trail Ridge Lane @ Stonebridge Dr	2	1	1	-	-	-	0.505	160	-	4
M3239	Lady Fern Dr @ Rouge Bank Dr	1	1	1	-	-	-	0.502	-	-	5
M0275	Apple Creek Blvd @ McIntosh Dr	14	5	0	13066	79	160	0.378	18	-	6
M2955	Elgin Mills Rd E @ REESOR RD (2)	13	3	0	9078	0	151	0.336	14	-	7
M2307	John St @ PORTERFIELD CRES (1)	8	3	0	-	-	-	0.270	13	-	8
M1899	Brimley Rd @ CARDIFF RD/WORTHING AVE[b]	8	2	0	12148	59	125	0.195	22	-	9
M3448	Chestnut Gate @ John St[c]	1	1	0	24631	40	287	0.133	340	-	10
M2176	CITIZEN CRT/ROYAL CREST CRT @ Birchmount Rd	4	1	0	19200	64	212	0.121	74	-	11
M0574	The Bridle Walk @ Cynthia Jean St	0	0	0	2459	280	23	0.121	-	-	12
M3350	Castlemore Ave @ Greenspire Ave	0	0	0	4678	248	50	0.119	340	-	13

Notes:
a: Consider implementing a crosswalk at Elson @ Featherstone instead
b: Potential route to St. Benedict Catholic Elementary School
c: Consider IPS for consistency with nearby crossings

Table 32: VRU-17 Pedestrian Crossovers (PXOs) (Midblocks)

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Pedestrian Collisions	Heavy Vehicle 8 Hour Volume	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M0767M0888	Bullock Dr btwn Laidlaw Boulevard & Jug Lane	6	1	1	122	4800	1.235	9	369	1
M2029Y1514	Doncaster Ave btwn Henderson Avenue & Yonge Street	19	3	1	52	209	1.076	4	192	2
M2299M4204	Esna Park Drive btwn Denison Street & Alden Road/Rodick Road	8	2	0	559	1286	0.982	11	1	3
M1846M2158	Middlefield Rd btwn Denison Street & Elson Street	2	1	0	116	2455	0.903	525	1	4
M0007M2048	Denison St btwn Victoria Park Avenue & Don Park Road	10	3	0	184	3231	0.864	10	36	5
M0802M1810	Fincham Ave btwn Larkin Avenue & Emeline Crescent	2	1	1	0	740	0.846	525	-	6
M0591M1892	Raymerville Dr btwn Hickory Drive & Norwich Drive	1	0	1	0	1989	0.811	525	608	7
M2295M2733	Denison St btwn Cartmel Drive & Hillcroft Drive	1	1	0	78	12662	0.772	525	1	8
M0198M0228	Main St Unionville btwn Fred Varley Drive & Carlton Road	6	3	1	19	1011	0.771	31	442	9
M0212M0276	Hollingham Rd btwn Glamorgan Court & Coledale Road/Lockridge Avenue	1	1	1	0	1862	0.761	525	536	10
M1850M2299	Denison St btwn Hood Road & Esna Park Drive	14	7	0	378	15175	0.754	525	36	11
M0004Y1493	John St btwn Nolan Court & Esna Park Drive/Woodbine Avenue	27	4	0	0	12285	0.745	5	95	12
M1935M2317	Denison St btwn Clayton Drive & Birchmount Road	7	2	0	309	1779	0.738	525	1	13
Y1493M4204	Esna Park Drive btwn John Street/Woodbine Avenue & Alden Road/Rodick Road	25	8	0	172	28819	0.728	2	1	14
M4382M4383	Victoria Square Blvd btwn Donald Buttress Boulevard East/Vine Cliff Boulevard & Betty Roman Boulevard/Stony Hill Boulevard	0	0	0	25	6340	0.726	-	-	15
M1936M2002	Denison St btwn Mallory Avenue/Teddington Avenue & Aldergrove Drive/Eden Avenue	7	1	0	182	7633	0.664	525	1	16
Y0947M2317	Denison St btwn Warden Avenue & Birchmount Road	7	3	0	138	8382	0.659	525	1	17
M0730M2285	John St btwn Johnson Street & Baywood Gate/Candice Gate	3	0	0	0	11283	0.652	525	283	18
Y1285M3251	9th Line btwn 14th Avenue & Winterberry Drive	5	2	1	21	5967	0.646	28	740	19
M3215M4470	Denison St btwn Fonda Road & Coleluke Lane	0	0	0	51	111	0.645	525	1	20

The following are the **recommended PXO locations** along the segments in **Table 32**:

- (M2029Y1514) Doncaster Ave btwn Henderson Avenue & Yonge Street: Consider installing near bus stops
- (M2299M4204) Esna Park Drive btwn Denison Street & Alden Road/Rodick Road: Consider installing near bus stops
- (M1846M2158) Middlefield Rd btwn Denison Street & Elson Street: Consider installing at trail 170m south of Denison and provide enhanced advance warning due to the horizontal
- (M0802M1810) Fincham Ave btwn Larkin Avenue & Emeline Crescent: Consider installing near bus stops
- (M2295M2733) Denison St btwn Cartmel Drive & Hillcroft Drive: Consider installing near bus stops
- (M0212M0276) Hollingham Rd btwn Glamorgan Court & Coledale Road/Lockridge Avenue: Consider installing further west, near bus stops and Leighland Park path access
- (M1850M2299) Denison St btwn Hood Road & Esna Park Drive: Consider installing near bus stops
- (M0004Y1493) John St btwn Nolan Court & Esna Park Drive/Woodbine Avenue: Consider installing near bus stops
- (M1935M2317) Denison St btwn Clayton Drive & Birchmount Road: Consider installing near bus stops
- (Y1493M4204) Esna Park Drive btwn John Street/Woodbine Avenue & Alden Road/Rodick Road: Consider installing near bus stops
- (M4382M4383) Victoria Square Blvd btwn Donald Buttress Boulevard East/Vine Cliff Boulevard & Betty Roman Boulevard/Stony Hill Boulevard: Install at intersection of Vine Cliff Blvd
- (M1936M2002) Denison St btwn Mallory Avenue/Teddington Avenue & Aldergrove Drive/Eden Avenue: Consider installing near bus stops
- (Y0947M2317) Denison St btwn Warden Avenue & Birchmount Road: Consider installing near bus stops
- (M0730M2285) John St btwn Johnson Street & Baywood Gate/Candice Gate: Install at entrance to Pomona Valley Tennis Club / Playground
- (M3215M4470) Denison St btwn Fonda Road & Coleluke Lane: Install at intersection with Fonda Rd and build a refuge on the east side

Table 33: VRU-18 Expand Existing Sidewalk Network Completion

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Pedestrian Collisions	Heavy Vehicle 8 Hour Volume	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
Y0197M2974	Lee Ave btwn Kennedy Road & Noble Street	1	1	1	0	314	0.610	525	-	1
M0308M2703	Bodrington Court btwn Yorktech Drive & Disk Drive	2	1	1	0	-	0.333	-	-	2
M2213M2217	Doncrest Dr btwn Brendan Court & Poinsetta Drive	0	0	0	0	202	0.333	-	-	3
M1712M2138	Daffodil Ave btwn Spirea Court & Rosea Court	0	0	0	0	155	0.333	-	-	4
M1987M2266	Old English Lane btwn Hampshire Court & Carriage Hill Court	0	0	0	0	557	0.291	-	-	5

The segments in **Table 33** were extended to meet the target distance established in the Markham RSP and to provide continuous sidewalks over distances that would encourage users to use them. The following are the resulting **recommended sidewalk segments:**

- (Y0197M2974) Lee Ave btwn Kennedy Road & Noble Street: 850 m from Kennedy Rd to Brimley Rd
- (M0308M2703) Bodrington Court btwn Yorktech Drive & Disk Drive: 320 m
- (M2213M2217) Doncrest Dr btwn Brendan Court & Poinsetta Drive: 270 m from Bayview Ave to Poinsetta Dr
- (M1712M2138) Daffodil Ave btwn Spirea Court & Rosea Court: 490 m from Laureleaf Rd to Poinsetta Dr, plus Poinsetta Dr from Daffodil Ave to Doncrest Dr
- (M1987M2266) Old English Lane btwn Hampshire Court & Carriage Hill Court: 620 m from Steeles Ave to pedestrian connection to Bayview Glen Public School

Table 34: SZ-06 Systemic Intersection Improvements Near Schools

GeoID	Location name	Total Collisions	Fatal Injury Collisions	School Hour Collisions	Injury School Hour Collisions	AADT	School Hours Pedestrian + Bicycle Volumes	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1846	Denison St @ Middlefield Rd	30	8	1	0	24747	96	1.400	4	20	1
M3782	Bur Oak Ave @ Mingay Ave	6	0	1	0	13086	806	0.767	81	32	2
M3778	Bur Oak Avenue @ Dogwood Street	3	1	2	1	-	436	0.742	-	-	3
M3781	Bur Oak Ave @ Roy Rainey Ave	6	0	1	0	10223	477	0.660	51	26	4
M1937	Denison St @ Gorvette Dr/Milliken Meadows Dr	8	5	0	0	21072	47	0.493	340	13	5
M0330	Williamson Rd @ Jenmat Dr	1	1	1	1	-	-	0.458	-	-	6
M1072	Carlton Rd @ Chant Cres	1	1	1	1	-	-	0.458	340	-	6
M1182	Hillmount Rd @ Willow Heights Blvd	1	1	1	1	-	-	0.458	340	-	6
M0630	Birchmount Rd @ Highgate Dr/Riseborough Circt	5	4	0	0	14720	55	0.412	340	22	9
M2644	Bur Oak Ave @ Williamson Rd	3	1	0	0	10740	365	0.403	41	-	10
M0659	Green Lane @ Aileen Rd/Willowbrook Rd	13	1	0	0	14410	156	0.388	340	41	11
M4430	Bur Oak Ave @ Alfred Paterson Dr	4	0	0	0	6620	515	0.268	56	-	12
M2029	Doncaster Ave @ Henderson Ave	7	2	0	0	13983	232	0.265	66	-	13
M1728	Cornell Cres @ HIGHGLEN AVE (2)	2	0	2	0	-	-	0.249	340	-	14
M2623	Bur Oak Ave @ Swan Park Rd	6	0	0	0	10222	260	0.243	127	-	15
M0335	Bur Oak Ave @ DONALD SIM AVE/LANE	1	0	1	0	6585	203	0.198	309	-	16
M3255	Rouge Bank Dr @ COTTONTAIL AVE/RUSSELL JARVIS DR	1	0	1	0	6294	168	0.186	269	-	17
M0963	Ridgecrest Rd @ Castlemore Ave	1	1	0	0	4884	465	0.176	218	-	18
M2558	Bur Oak Ave @ Greensborough Village Cir (2)	3	1	1	0	-	-	0.173	-	-	19
M3028	FAIRTY DR/TAPLANE DR @ Coxworth Ave	2	2	0	0	3358	345	0.161	-	-	20

GeoID	Location name	Total Collisions	Fatal Injury Collisions	School Hour Collisions	Injury School Hour Collisions	AADT	School Hours Pedestrian + Bicycle Volumes	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M4383	BETTY ROMAN BLVD/STONY HILL BLVD @ Victoria Square Blvd	6	1	0	0	6635	-	0.157	227	-	21
M1413	The Bridle Walk @ Castlemore Ave	0	0	0	0	4784	445	0.146	340	-	22

The following are the **nearby schools** for the intersections in **Table 34**:

- (M1846) Denison St @ Middlefield Rd: Parkland Public School, Markham Gateway Public School, and Middlefield Collegiate Institute
- (M3782) Bur Oak Ave @ Mingay Ave: Wismer Public School
- (M3778) Bur Oak Avenue @ Dogwood Street: Bur Oak Secondary School
- (M3781) Bur Oak Ave @ Roy Rainey Ave: San Lorenzo Ruiz Catholic Elementary School
- (M1937) Denison St @ Gorvette Dr/Milliken Meadows Dr: Milliken Mills High School
- (M0330) Williamson Rd @ Jenmat Dr: Mount Joy Public School
- (M1072) Carlton Rd @ Chant Cres: William Berczy Public School
- (M1182) Hillmount Rd @ Willow Heights Blvd: Lincoln Alexander Public School
- (M0630) Birchmount Rd @ Highgate Dr/Riseborough Circt: Milliken Mills Public School
- (M2644) Bur Oak Ave @ Williamson Rd: Mount Joy Public School
- (M0659) Green Lane @ Aileen Rd/Willowbrook Rd: St. Rene Goupil - St. Luke Elementary School
- (M4430) Bur Oak Ave @ Alfred Paterson Dr: Greensborough Public School
- (M2029) Doncaster Ave @ Henderson Ave: Henderson Avenue Public School
- (M1728) Cornell Cres @ HIGHGLEN AVE (2): St. Francis Xavier Catholic Elementary School
- (M2623) Bur Oak Ave @ Swan Park Rd: St. Julia Billiart Catholic School
- (M0335) Bur Oak Ave @ DONALD SIM AVE/LANE: Bill Hogarth Secondary School
- (M3255) Rouge Bank Dr @ COTTONTAIL AVE/RUSSELL JARVIS DR: Legacy Public School

- (M0963) Ridgecrest Rd @ Castlemore Ave: Castlemore Public School
- (M2558) Bur Oak Ave @ Greensborough Village Cir (2): Greensborough Public School
- (M3028) FAIRTY DR/TAPLANE DR @ Coxworth Ave: Parkland Public School
- (M4383) BETTY ROMAN BLVD/STONY HILL BLVD @ Victoria Square Blvd: Sir Wilfrid Laurier Public School
- (M1413) The Bridle Walk @ Castlemore Ave: All Saints Catholic Elementary School

Table 35: SZ-07 Traffic Management Plan and School Area Review (Intersections)

GeoID	Location name	Total Collisions	Fatal Injury Collisions	School Hour Collisions	Injury School Hour Collisions	Vehicle - Pedestrian and Bicycle (General) Collisions	AADT	School Hours Pedestrian + Bicycle Volumes	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1937	Denison St @ Gorvette Dr/Milliken Meadows Dr	8	5	0	0	4	21072	47	0.964	340	13	1
M1846	Denison St @ Middlefield Rd	30	8	1	0	1	24747	96	0.835	4	20	2
M0630	Birchmount Rd @ Highgate Dr/Riseborough Circt	5	4	0	0	3	14720	55	0.790	340	22	3
M3782	Bur Oak Ave @ Mingay Ave	6	0	1	0	0	13086	806	0.621	81	32	4
M3781	Bur Oak Ave @ Roy Rainey Ave	6	0	1	0	0	10223	477	0.514	51	26	5
M4430	Bur Oak Ave @ Alfred Paterson Dr	4	0	0	0	0	6620	515	0.170	56	-	6

The following are the **nearby schools** for the intersections in **Table 35**:

- (M1937) Denison St @ Gorvette Dr/Milliken Meadows Dr: Milliken Mills High School
- (M1846) Denison St @ Middlefield Rd: Parkland Public School, Markham Gateway Public School, and Middlefield Collegiate Institute
- (M0630) Birchmount Rd @ Highgate Dr/Riseborough Circt: Milliken Mills Public School
- (M3782) Bur Oak Ave @ Mingay Ave: Wismer Public School
- (M3781) Bur Oak Ave @ Roy Rainey Ave: San Lorenzo Ruiz Catholic Elementary School

- (M4430) Bur Oak Ave @ Alfred Paterson Dr: Greensborough Public School

Table 36: SZ-07 Traffic Management Plan and School Area Review (Midblocks)

GeoID	Location name	Total Collisions	Fatal Injury Collisions	School Hour Collisions	Injury School Hour Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1316Y1612	Apple Creek Blvd btwn Hollingham Road/Town Centre Boulevard & Glencove Drive/Warden Avenue	3	1	1	1	12828	1.927	94	1	1
M1603M3813	Enterprise Boulevard btwn Main Unionville Street/Unionville Gate & University Boulevard	4	2	1	1	8732	1.905	192	1	2
M0662M0890	Royal Orchard Blvd btwn Kirk Drive & Bay Thorn Drive	1	1	1	1	2645	1.694	525	380	3
M0212M0276	Hollingham Rd btwn Glamorgan Court & Coledale Road/Lockridge Avenue	1	1	1	1	1862	1.591	525	536	4
M2009M2230	Coppard Ave btwn Elson Street & Rowe Court	1	1	1	1	-	1.167	525		5

The following are the **nearby schools** for the segments in **Table 36**:

- (M1316Y1612) Apple Creek Blvd btwn Hollingham Road/Town Centre Boulevard & Glencove Drive/Warden Avenue: Unionville High School
- (M1603M3813) Enterprise Boulevard btwn Main Unionville Street/Unionville Gate & University Boulevard: Bill Crothers Secondary School
- (M0662M0890) Royal Orchard Blvd btwn Kirk Drive & Bay Thorn Drive: Woodland Public School
- (M0212M0276) Hollingham Rd btwn Glamorgan Court & Coledale Road/Lockridge Avenue: St Justin Martyr Catholic Elementary School
- (M2009M2230) Coppard Ave btwn Elson Street & Rowe Court: Armadale Public School

Table 37: SZ-08 School Streets Program

GeoID	Location name	Total Collisions	Fatal Injury Collisions	School Hour Collisions	Injury School Hour Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1477M2030	Coxworth Ave btwn Herrick Place & Elson Street	1	1	1	1	593	1.647	-	-	1
M0820M0822	Bay Thorn Dr btwn Normark Drive & Donalbain Crescent	1	1	0	0	741	0.334	-	-	2
M0770Y1573	Simonston Blvd btwn Waggoners Wells Lane & Don Mills Road	3	2	1	0	346	0.323	124	839	3
M0551M1085	Galsworthy Dr btwn Robinson Street & Abercorn Road	0	0	0	0	503	0.314	-	-	4
M0811M1157	Central Park Dr btwn Havagal Crescent & Atlantic Avenue	0	0	0	0	1568	0.304	-	-	5

The following are the **nearby schools** for the segments in **Table 37**:

- (M1477M2030) Coxworth Ave btwn Herrick Place & Elson Street: Parkland Public School
- (M0820M0822) Bay Thorn Dr btwn Normark Drive & Donalbain Crescent: Baython Public School
- (M0770Y1573) Simonston Blvd btwn Waggoners Wells Lane & Don Mills Road: St Michael Academy
- (M0551M1085) Galsworthy Dr btwn Robinson Street & Abercorn Road: James Robinson Public School
- (M0811M1157) Central Park Dr btwn Havagal Crescent & Atlantic Avenue: Central Park Public School

Table 38: AG-01 Red Light Camera

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Angle and Turning Movement Collisions	Injury Angle and Turning Movement Collisions	Disobeyed Traffic Control Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1708	Denison St @ Brimley Rd	36	12	35	11	0	26009	2.149	1	4	1
M2317	Denison St @ Birchmount Rd	36	12	28	9	0	31992	1.908	11	8	2
M2903	Hwy 48 @ Castlemore Ave	32	12	22	10	0	31668	1.842	5	1	3
M1850	Denison St @ Hood Rd	28	11	26	8	0	25002	1.674	6	4	4
M1846	Denison St @ Middlefield Rd	30	8	27	7	0	24747	1.632	4	20	5
M2299	Denison St @ Esna Park Dr	26	11	20	8	0	38558	1.479	52	12	6

Table 39: AG-03 Vehicle Restrictions

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Pedestrian Collisions	Cyclist Collisions	AADT	8 Hour Ped Volume	8 Hour Heavy Vehicle Volume	8 Hour Bike Volume	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1936	Denison St @ Mallory Ave/Teddington Ave	16	8	2	1	20502	288	247	55	1.830	277	13	1
M1846	Denison St @ Middlefield Rd	30	8	0	1	24747	265	248	27	1.814	4	20	2
M2158	Middlefield Rd @ Elson St	13	7	2	1	17025	212	176	45	1.745	12	52	3
M1708	Denison St @ Brimley Rd	36	12	0	0	26009	142	269	0	1.634	1	4	4
M2002	Denison St @ Aldergrove Dr	13	5	2	0	20282	135	244	9	1.543	15	22	5
M1458	Denison St @ Coppard Ave	10	5	2	0	16900	141	182	0	1.249	26	13	6

Table 40: AG-04 Continuous Centre Medians

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Driveway Related Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
Y1493M4204	Esna Park Drive btwn John Street/Woodbine Avenue & Alden Road/Rodick Road	25	8	11	28819	2.438	2	1	1
Y1472M3151	Markham Rd btwn 16th Avenue/Main Markham Street North & Edward Jeffreys Avenue	29	11	7	30151	2.065	1	36	2
M2029Y1514	Doncaster Ave btwn Henderson Avenue & Yonge Street	19	3	8	209	1.633	4	192	3
M0004Y1493	John St btwn Nolan Court & Esna Park Drive/Woodbine Avenue	27	4	3	12285	1.486	5	95	4

Table 41: AG-06 Senior Safety Zones

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Pedestrian Collisions	Heavy Vehicle 8 Hour Volume	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1786M3830	Church St btwn Country Glen Road & Bur Oak Avenue	7	1	0	99	3866	0.621	53	536	1
M2865M3830	Bur Oak Ave btwn Rustle Woods Avenue & Church Street	3	1	0	36	1269	0.611	16	226	2
M1513M1529	Bur Oak Ave btwn White's Hill Avenue & Almira Avenue	0	0	0	83	1819	0.442	371	134	3
M0320M0386	Swansea Rd btwn Janna Court & Prince William Drive	0	0	0	0	1032	0.253	525	839	4

Note:
Senior safety zones should be extended to reasonable limits around the identified locations

Table 42: AG-07 Radar Speed Feedback Signs

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Posted Speed Limit	Speed Compliance	Aggressive Driving Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M0942M4409	Dickson Hill Rd btwn 19th Avenue & Highway 48	0	0	40	0.03	0	384	1.246	-	-	1
M0526M3591	Simonston Blvd btwn Chumleigh Crescent & Chelsea Road	2	0	40	0.24	1	254	0.899	525		2
M0498M0521	Laureleaf Rd btwn Poinsetta Drive & Poinsetta Drive[a]	1	0	40	0.19	0	1100	0.876	384	839	3
M2510M3920	Golden Meadow Dr btwn Monkhouse Road & Mossgrove Street	1	0	40	0.2	0	237	0.864	118	608	4
M0875M1564	Elgin St btwn Orsi Court & Albion Close	1	0	40	0.21	0	1167	0.856	266	818	5
M2159M3075	Grandview Ave btwn Highland Park Boulevard & Jewell Street[b]	2	0	40	0.36	1	127	0.804	-	-	6
M1982M2122	Huntington Park Dr btwn Livingstone Road & Prince Edward Boulevard	1	0	40	0.26	0	22	0.803	-	-	7
M0249M3905	Country Ridge Dr btwn Sage Gate & Hollyhock Street/Roy Rainey Avenue[c]	0	0	40	0.24	0	0	0.785	-	-	8
M0820M0822	Bay Thorn Dr btwn Normark Drive & Donalbain Crescent	1	1	40	0.36	1	741	0.767	-	-	9
M1503M1506	Walkerville Rd btwn Walkerville Road & Almira Avenue	0	0	40	0.29	0	2012	0.740	-	-	10

Notes:
a: Consider between Poinsetta and Multiflora to increase distance from Stop sign
b: On approaches to pedestrian crossing
c: Near Parkette

Table 43: AG-08 Pavement Markings

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Posted Speed Limit	Speed Compliance	Aggressive Driving Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M0004Y1493	John St btwn Nolan Court & Esna Park Drive/Woodbine Avenue[a]	27	4	50	0.26	9	12285	2.609	5	95	1
Y0033M1747	Reesor Rd btwn 14th Avenue & Steeles Avenue East	16	7	60	0.13	2	5849	1.867	12	441	2
M1450M3270	Enterprise Blvd btwn East Valley Drive & Andre De Grasse Street	10	1	50	0.18	4	4385	1.831	3	33	3
M2029Y1514	Doncaster Ave btwn Henderson Avenue & Yonge Street[b]	19	3	50	0.52	4	209	1.701	4	192	4
M0767M0888	Bullock Dr btwn Laidlaw Boulevard & Jug Lane[c]	6	1	50	0.21	3	4800	1.488	9	369	5

Notes:
a: Lane narrowing through pavement markings (3.3 m lanes + 0.8 m painted median) from Bayview to Woodbine
b: Lane narrowing through pavement markings (3.3 m lanes + 1.6 m painted median)
c: Existing bike lanes, not compatible with horizontal deflection

Table 44: AG-09 Roadway Narrowing

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Posted Speed Limit	Speed Compliance	Aggressive Driving Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M2158M3714	Middlefield Rd btwn Elson Street & Steeles Avenue East	10	3	50	0.32	6	8215	1.956	17	1	1
M0007M2048	Denison St btwn Victoria Park Avenue & Don Park Road	10	3	50	0.22	6	3231	1.913	10	36	2
M1850M2299	Denison St btwn Hood Road & Esna Park Drive	14	7	50	0.18	2	15175	1.636	525	36	3
M0076M1938	14th Ave btwn Alden Road/Hood Road & Riviera Drive	4	2	60	0.1	2	758	1.545	13	35	4
M1846M2158	Middlefield Rd btwn Denison Street & Elson Street	2	1	50	0.03	0	2455	1.522	525	1	5
M2299M4204	Esna Park Drive btwn Denison Street & Alden Road/Rodick Road	8	2	0	0.53	3	1286	1.464	11	1	6
M1935M2317	Denison St btwn Clayton Drive & Birchmount Road	7	2	50	0.34	4	1779	1.450	525	1	7
M1316Y1612	Apple Creek Blvd btwn Hollingham Road/Town Centre Boulevard & Glencove Drive/Warden Avenue	3	1	50	0.4	2	12828	1.142	94	1	8

Note:
Road diets are recommended to be used in combination with the roadway narrowing

The segments in **Table 44** were extended to meet the target distance established in the Markham RSP. The following are the resulting **recommended segment lengths:**

- (M2158M3714) Middlefield Rd btwn Elson Street & Steeles Avenue East: 0.4 km
- (M0007M2048) Denison St btwn Victoria Park Avenue & Don Park Road: 1.1 km from Woodbine to Esna Park
- (M1850M2299) Denison St btwn Hood Road & Esna Park Drive: 0.9 km from Esna Park to Warden
- (M0076M1938) 14th Ave btwn Alden Road/Hood Road & Riviera Drive: 1.8 km from Woodbine to Alden
- (M1846M2158) Middlefield Rd btwn Denison Street & Elson Street: 0.6 km
- (M2299M4204) Esna Park Drive btwn Denison Street & Alden Road/Rodick Road: 1.4 km Steeles to 14th

- (M1935M2317) Denison St btwn Clayton Drive & Birchmount Road: 2.1 km from Warden to Kennedy
- (M1316Y1612) Apple Creek Blvd btwn Hollingham Road/Town Centre Boulevard & Glencove Drive/Warden Avenue: 2.0 km from Woodbine to Alden

Table 45: AG-10 Horizontal Deflection (Intersections)

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Pedestrian Collisions	Right Turning Vehicle - Pedestrian Collisions	AADT	8 Hour Ped Volume	8 Hour Heavy Vehicle Volume	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M1090	Main St Markham North @ Bullock Dr/Parkway Ave	21	8	4	2	25593	210	272	2.746	20	6	1
M2167	Rodick Rd @ Calvert Rd	8	4	3	2	10688	218	111	2.152	340	19	2
MNew110	Yonge Street @ Meadowview Avenue	41	11	4	2	-	-	-	2.100	-	-	3
M1316	Apple Creek Blvd @ Town Centre Blvd/Hollingham Rd	15	7	3	1	20540	514	230	2.083	10	27	4
M2002	Denison St @ Aldergrove Dr	13	5	2	1	20282	135	244	1.681	15	22	5
M1937	Denison St @ Gorvette Dr/Milliken Meadows Dr	8	5	4	0	21072	112	255	1.414	340	13	6
M0868	Old Kennedy Rd @ Aldergrove Dr	8	5	2	1	10811	271	204	1.398	23	45	7
M2733	Denison St @ Hillcroft Dr	6	5	1	1	15453	148	155	1.388	7	22	8
M3151	Markham Rd @ Edward Jeffreys Ave	16	4	3	0	26242	653	311	1.271	25	47	9
M1850	Denison St @ Hood Rd	28	11	2	0	25002	136	407	1.269	6	4	10

Table 46: AG-10 Horizontal Deflection (Midblocks)

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Pedestrian Collisions	Right Turning Vehicle - Pedestrian Collisions	AADT	Ped 8 Hour Volume	Heavy Vehicle 8 Hour Volume	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
Y1285M3251	9th Line btwn 14th Avenue & Winterberry Drive	5	2	1	1	5967	14.5	21	0.896	28	740	1
M0228M0285	Carlton Rd btwn Main Unionville Street & Pomander Road	1	1	1	1	9345	186.5	32	0.790	380	226	2
M0730M2285	John St btwn Johnson Street & Baywood Gate/Candice Gate	3	0	0	0	11283	0	0	0.652	525	283	3

Table 47: AG-11 Vertical Deflection

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Posted Speed Limit	Speed Compliance	Aggressive Driving Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M0714M2043	Waggoners Wells Lane btwn Steeles Avenue East & Aberfeldy Crescent	1	0	40	0.02	1	2338	1.737	-	-	1
M1099Y1909	Cachet Pkwy btwn Blencathra Hill & Major Mackenzie Drive East	1	0	40	0.15	0	58	1.163	525	-	2
M1232M1877	Cachet Pkwy btwn Willow Creek Drive & Blencathra Hill	0	0	40	0.12	0	85	1.155	525	-	3
M2100M2216	Laureleaf Rd btwn Hammok Crescent & Babcombe Drive/Limcombe Drive[a]	3	2	40	0.17	0	844	0.971	72	608	4
M2027Y1515	Glen Cameron Rd btwn Dudley Avenue & Yonge Street	4	1	40	0.37	3	314	0.970	63	839	5

Note:
a: Consider also between Steeles and Hammok

Table 48: DRU-01 Guide Rail Upgrades

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Posted Speed Limit	Speed Compliance	Roadway Departure Collisions	Fixed Object (Guide Rail)	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
Y0033M1747	Reesor Rd btwn 14th Avenue & Steeles Avenue East	16	7	60	0.13	5	1	5849	1.922	12	441	1
M1899M2389	Brimley Rd btwn Cardiff Road/Worthing Avenue & Wilclay Avenue/Winston Road	5	2	50	-	4	3	13465	1.719	525	82	2
M2611M2955	Reesor Rd btwn 19th Avenue & Elgin Mills Road East	11	3	60	0.11	6	0	4244	1.627	34	818	3
M0685M0888	Bullock Dr btwn Jonquil Crescent & Jug Lane	9	1	50	0.26	3	2	4921	1.591	101	488	4
M2158M3714	Middlefield Rd btwn Elson Street & Steeles Avenue East	10	3	50	0.32	1	1	8215	1.396	17	1	5
M1846M2158	Middlefield Rd btwn Denison Street & Elson Street	2	1	50	0.03	1	1	2455	1.358	525	1	6
M0131Y1031	19th Ave btwn Mill Race Court & Ninth Line	5	1	60	0.02	4	0	2209	1.321	93	320	7
M2955Y2153	Elgin Mills Rd E btwn Reesor Road & Ninth Line	4	1	60	0.03	4	0	553	1.259	525	-	8
M1864M2744	Main St Markham South btwn Old Wellington Street & Fisher Court	7	1	50	0.14	1	1	7409	1.084	525	369	9
Y1031M2119	19th Ave btwn Ninth Line & Reesor Road	3	1	60	0.02	2	0	6006	0.941	54	438	10
M0767Y0748	Bullock Dr btwn Laidlaw Boulevard & McCowan Road	9	1	50	0.58	1	0	5226	0.921	6	1	11
M0730M2285	John St btwn Johnson Street & Baywood Gate/Candice Gate	3	0	40	0.05	1	0	11283	0.819	525	283	12
Y0506M3610	19th Ave btwn Woodbine Avenue & Highway 404	4	1	60	0.16	2	0	96	0.801	195	739	13

The following are the **guide rail lengths** for the segments in **Table 48** based on Municipality-provided GIS data:

- (Y0033M1747) Reesor Rd btwn 14th Avenue & Steeles Avenue East: 401.2 m of guide rail
- (M1899M2389) Brimley Rd btwn Cardiff Road/Worthing Avenue & Wilclay Avenue/Winston Road: 225 m of guide rail
- (M2611M2955) Reesor Rd btwn 19th Avenue & Elgin Mills Road East: 572.8 m of guide rail

- (M0685M0888) Bullock Dr btwn Jonquil Crescent & Jug Lane: 100 m of guide rail
- (M2158M3714) Middlefield Rd btwn Elson Street & Steeles Avenue East: 155 m of guide rail
- (M1846M2158) Middlefield Rd btwn Denison Street & Elson Street: 175 m of guide rail
- (M0131Y1031) 19th Ave btwn Mill Race Court & Ninth Line: 161.8 m of guide rail
- (M2955Y2153) Elgin Mills Rd E btwn Reesor Road & Ninth Line: 1771.3 m of guide rail
- (M1864M2744) Main St Markham South btwn Old Wellington Street & Fisher Court: 330 m of guide rail
- (Y1031M2119) 19th Ave btwn Ninth Line & Reesor Road: 151.8 m of guide rail
- (M0767Y0748) Bullock Dr btwn Laidlaw Boulevard & McCowan Road: 17 m of guide rail
- (M0730M2285) John St btwn Johnson Street & Baywood Gate/Candice Gate: 360 m of guide rail
- (Y0506M3610) 19th Ave btwn Woodbine Avenue & Highway 404: 847.4 m of guide rail

Table 49: DRU-02 Enhanced Pavement Markings

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Posted Speed Limit	Speed Compliance	Roadway Departure Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
Y0033M1747	Reesor Rd btwn 14th Avenue & Steeles Avenue East	16	7	60	0.13	5	5849	2.141	12	441	1
Y1493M4204	Esna Park Drive btwn John Street/Woodbine Avenue & Alden Road/Rodick Road	25	8	0	-	3	28819	2.024	2	1	2
M2611M2955	Reesor Rd btwn 19th Avenue & Elgin Mills Road East	11	3	60	0.11	6	4244	2.007	34	818	3
Y1472M3151	Markham Rd btwn 16th Avenue/Main Markham Street North & Edward Jeffreys Avenue	29	11	50	0.28	0	30151	1.899	1	36	4
M0004Y1493	John St btwn Nolan Court & Esna Park Drive/Woodbine Avenue	27	4	50	0.26	0	12285	1.676	5	95	5
M1450M3270	Enterprise Blvd btwn East Valley Drive & Andre De Grasse Street	10	1	50	0.18	3	4385	1.661	3	33	6

GeoID	Location name	Total Collisions	Fatal Injury Collisions	Posted Speed Limit	Speed Compliance	Roadway Departure Collisions	AADT	Score	Network Screening Ranking	Systemic Risk Ranking	Final Ranking
M2029Y1514	Doncaster Ave btwn Henderson Avenue & Yonge Street	19	3	50	0.52	2	209	1.545	4	192	7
M0131Y1031	19th Ave btwn Mill Race Court & Ninth Line	5	1	60	0.02	4	2209	1.494	93	320	8
M2158M3714	Middlefield Rd btwn Elson Street & Steeles Avenue East	10	3	50	0.32	1	8215	1.407	17	1	9
M2955Y2153	Elgin Mills Rd E btwn Reesor Road & Ninth Line	4	1	60	0.03	4	553	1.397	525	-	10
M0685M0888	Bullock Dr btwn Jonquil Crescent & Jug Lane	9	1	50	0.26	3	4921	1.234	101	488	11
M0767Y0748	Bullock Dr btwn Laidlaw Boulevard & McCowan Road	9	1	50	0.58	1	5226	1.232	6	1	12
Y0560M2611	19th Ave btwn York/Durham Line & Reesor Road	4	1	60	0.2	4	485	1.228	525	-	13
M1846M2158	Middlefield Rd btwn Denison Street & Elson Street	2	1	50	0.03	1	2455	1.094	525	1	14
Y1031M2119	19th Ave btwn Ninth Line & Reesor Road	3	1	60	0.02	2	6006	1.045	54	438	15
M2100M2216	Laureleaf Rd btwn Hammok Crescent & Babcombe Drive/Limcombe Drive	3	2	40	0.17	3	844	1.044	72	608	16
M2299M4204	Esna Park Drive btwn Denison Street & Alden Road/Rodick Road	8	2	0	0.53	0	1286	1.042	11	1	17

A

Appendix A

Road Site Selection Process

Appendix A: Detailed Site Selection Process

The site selection process that was used includes the 10 steps in **Figure A-1**. The details for each step are presented in the remainder of this Appendix.

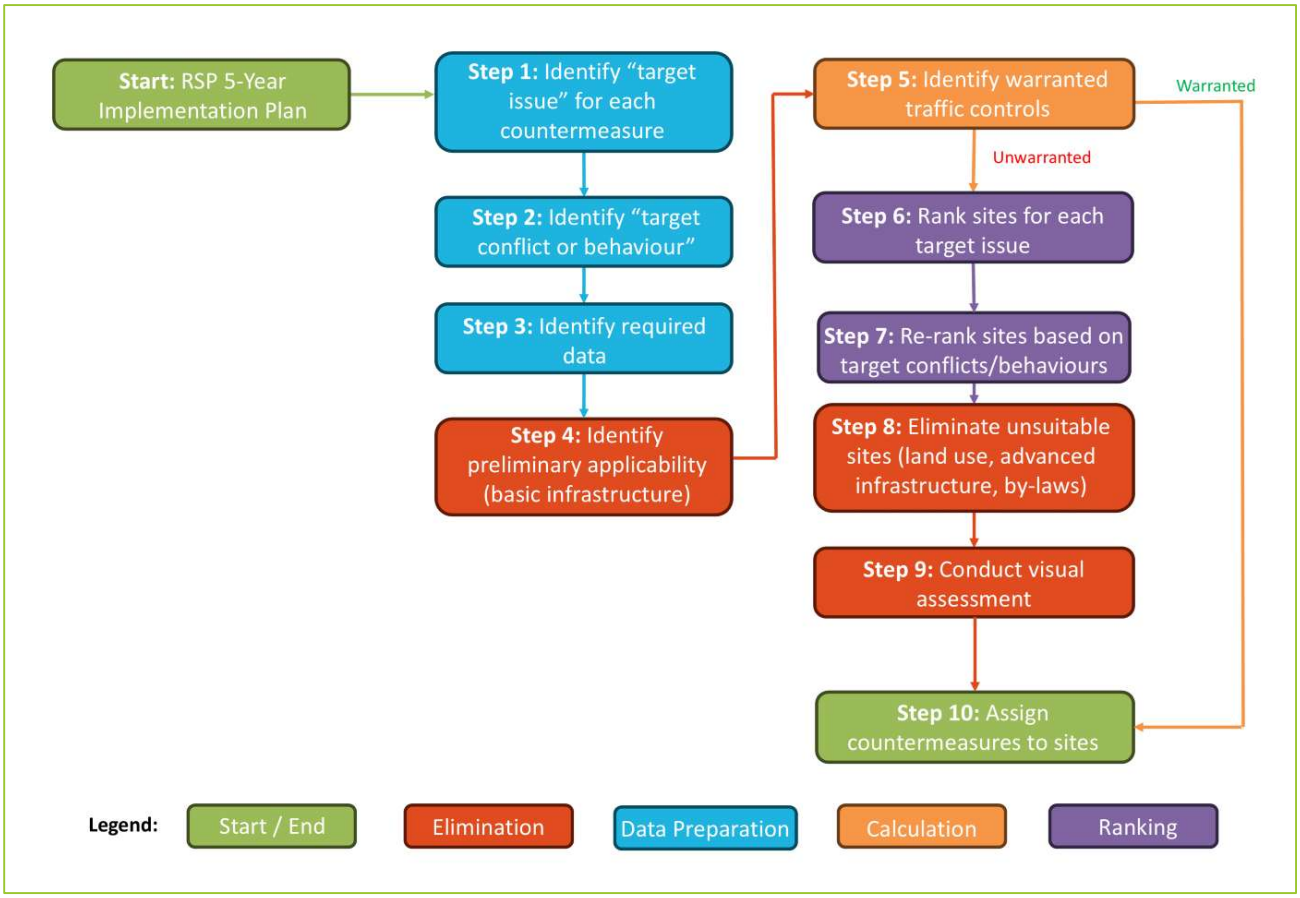


Figure A-1: Site Selection Process.

4.1 Step 1: Identify the Target Issue for Each Countermeasure

While, ideally, each countermeasure would have its own list of ranked sites, this would eventually result in various sites ranking high for multiple countermeasures that target the same issue. For example, there are 5 countermeasures that target speeding; if one ranking is developed for each of these countermeasures, it is likely that the same sites would appear at the top of most (if not all) rankings because the same type of input data (collisions, speeds, etc.) would be used. At the end of the process, this would require complex cross-referencing of all 5 rankings to assign the countermeasures to individual sites to ensure that no site would be assigned a disproportionate number of countermeasures, while other sites would not be assigned any countermeasures.
Therefore, countermeasures should be grouped based on the target issues that they address, which will result in one single ranking for each target issue. The single ranking will

facilitate the distribution of countermeasures amongst sites by, for example, assigning countermeasures with the highest effectiveness over the target issue to the highest ranked sites (i.e., those where the target issue is more pronounced), while the countermeasures with lower effectiveness would be assigned to lower ranked sites. As an example, for the target issue of speeding, the highest ranked sites would be assigned AG-11: Vertical Deflection while the lower ranked sites would be assigned AG-07: Radar Speed Feedback Signs.[1]

The 44 remaining countermeasures were classified into the following 11 different target issues:

- Pedestrian Safety (11)
- Angle and Turning Movement Collisions (7)
- Cyclist Safety (6)
- Speeding (5)
- Left-turn Collisions (3)
- School Safety (3)
- Driveway related collisions (2)
- Motorcyclist Safety (2)
- Roadway Departure (2)
- Active Transportation Safety (2)
- Nighttime Collisions (1)

4.2 Step 2: Identify the Target Conflict or Behaviour for Each Countermeasure

Some countermeasures have specific target conflicts or behaviours that are a subset of their associated target issues. For example, while INT-01: Traffic Signals can help address angle and turning movement conflicts between all road users and movements at an intersection, INT-04: Sightline Improvements only helps address the "failed to yield" behaviour, and INT-08: Left-Turn Lanes only helps address collisions involving left-turning vehicles; similarly, while DRU-02: Enhanced Pavement Markings can help mitigate all roadway departure collisions, DRU-01: Guide Rail Upgrades only mitigates roadway departure collisions involving an existing guide rail (fixed object). Assigning target conflicts or behaviours will help identify countermeasure suitability for each site under the different target issue rankings.
The 44 remaining countermeasures were classified into the following 16 different target conflicts or behaviours:

[1] Subject to applicability. For example, speed bumps/cushions are not suitable for arterial roads or major transit routes. Applicability is determined in Steps 4, 8 and 9.

- All (15)
- Vehicle - Pedestrian (General) (6)
- Vehicle - Bicycle (General) (4)
- Failed to Yield (3)
- Vehicle - Pedestrian and Bicycle (General) (3)
- Left Turn (2)
- Vehicle - Motorcycle (General) (2)
- Aggressive Driving (1)
- Disobeyed Traffic Control (1)
- Fixed Object (Guide Rail) (1)
- LT and RT Vehicle - Bicycle (1)
- LT Vehicle - Pedestrian (1)
- RT Vehicle - Pedestrian (1)
- RT Vehicle - Pedestrian (Failed to Yield) (1)
- Vehicle - Pedestrian (Failed to Yield or Disobeyed Traffic Control) (1)
- Vehicle - TH Bicycle (1)

Table A-1 summarizes target issues and target conflicts or behaviours applicable to each countermeasure.

Table A-1: Countermeasures by Target Issue and Target Conflict or Behaviours

ID	Countermeasure	Target Issue	Target Conflict
AG-01	Red Light Camera Program	Angle and Turning Movement Collisions	Disobeyed Traffic Control
AG-03	Vehicle Restrictions	Active Transportation Safety	All
AG-04	Continuous Centre Medians	Driveway related collisions	All
AG-06	Senior Safety Zones	Pedestrian Safety	All
AG-07	Radar Speed Feedback Signs	Speeding	All
AG-08	Pavement Markings	Speeding	All
AG-09	Roadway Narrowing	Speeding	All
AG-10	Horizontal Deflection	Pedestrian Safety	RT Vehicle - Pedestrian

ID	Countermeasure	Target Issue	Target Conflict
AG-11	Vertical Deflection	Speeding	All
DRU-01	Guide Rail Upgrades	Roadway Departure	Fixed Object (Guide Rail)
DRU-02	Enhanced Pavement Markings	Roadway Departure	All
G-23	Roundabout Screening and Feasibility Analysis	Angle and Turning Movement Collisions	All
INT-01	Traffic Signals	Angle and Turning Movement Collisions	All
INT-02	Intersection/Railway Illumination	Nighttime Collisions	All
INT-03	Roundabouts	Angle and Turning Movement Collisions	All
INT-04	Sightline Improvements	Angle and Turning Movement Collisions	Failed to Yield
INT-05	Left-Turn Lane Offset	Left-turn Collisions	Failed to Yield
INT-06	Protected Intersections	Pedestrian Safety	Vehicle - Pedestrian (General)
INT-07	Left-Turn Signal Phases (Protected / Protected + Permissive)	Angle and Turning Movement Collisions	Failed to Yield
INT-08	Left-Turn Lanes	Left-turn Collisions	Left Turn
INT-09	Driveway Access Management	Driveway related collisions	All
INT-10	Left-Turn Traffic Calming	Left-turn Collisions	All
INT-11	Reduced Speeds at Intersection Approaches	Speeding	Aggressive Driving
INT-12	Turn Prohibitions (Full or Part-Time)	Angle and Turning	Left Turn

ID	Countermeasure	Target Issue	Target Conflict
		Movement Collisions	
SZ-06	Systemic Intersection Improvements Near Schools	School Safety	All
SZ-07	Traffic Management Plan and School Area Review	School Safety	Vehicle - Pedestrian and Bicycle (General)
SZ-08	School Streets Program	School Safety	Vehicle - Pedestrian and Bicycle (General)
VRU-01	AODA Upgrades	Pedestrian Safety	Vehicle - Pedestrian (General)
VRU-02	Setback Pedestrian Crosswalks	Pedestrian Safety	Vehicle - Pedestrian (Failed to Yield or Disobeyed Traffic Control)
VRU-03	Pedestrian Signals	Pedestrian Safety	Vehicle - Pedestrian (General)
VRU-04	"Addition of Active Transportation Facilities		
(On-Road Painted Bicycle Lanes)"	Cyclist Safety	Vehicle - Bicycle (General)	
VRU-05	Addition of Active Transportation Facilities (Protected On-Road)	Cyclist Safety	Vehicle - Bicycle (General)
VRU-06	Addition of Active Transportation Facilities (Protected Off-Road)	Cyclist Safety	Vehicle - Bicycle (General)
VRU-07	Bicycle Conflict Zone Pavement Markings	Cyclist Safety	Vehicle - Bicycle (General)
VRU-08	Illumination at Active Transportation Facilities	Active Transportation Safety	Vehicle - Pedestrian and Bicycle (General)
VRU-09	Bicycle Signals	Cyclist Safety	Vehicle - TH Bicycle
VRU-10	Crossride Markings	Cyclist Safety	LT and RT Vehicle - Bicycle
VRU-11	Leading Pedestrian Intervals (LPIs)	Pedestrian Safety	LT Vehicle - Pedestrian
VRU-12	Signal Optimization for Pedestrians	Pedestrian Safety	Vehicle - Pedestrian (General)
VRU-13	Right Turn on Red Restrictions	Pedestrian Safety	RT Vehicle - Pedestrian (Failed to Yield)

ID	Countermeasure	Target Issue	Target Conflict
VRU-15	Advanced Warning Signs for Motorcyclists	Motorcyclist Safety	Vehicle - Motorcycle (General)
VRU-16	Fully Paved Shoulders	Motorcyclist Safety	Vehicle - Motorcycle (General)
VRU-17	Pedestrian Crossovers (PXOs)	Pedestrian Safety	Vehicle - Pedestrian (General)

4.3 Step 3: Identify Required Data for Each Countermeasure

Based on the target issues and conflicts, specific types of data will be necessary to determine applicability and develop site rankings. In general terms, the required data include:

- Applicable infrastructure road classification / control type / active transportation facilities and elements.
- Collision types, including specific road users, impact types, movements, etc.
- Volumes, including vehicle/road user type, movements, etc.
- Other data, including speeds, warrant results, public concerns, by-laws, transit routes, etc.

The full list of data requirements, by countermeasure, is provided in a Microsoft Excel spreadsheet that accompanies this technical memorandum. Some of the required information can be quickly retrieved from the City's TES database; however, some additional data will be necessary, as summarized in **Table A-2**.

Some of the additional data are likely to be readily available in the form of GIS shapefiles (sidewalks, bicycle lanes, illumination, transit routes, etc.); other information may be in the form of by-law schedules (parking regulations, community safety zones, etc.); and some information is likely to be in other records maintained by staff (public concerns, traffic signal details, exclusive turning lanes, etc.). It is recognized that not all additional data may be available in the City's databases or may be in formats that are not suitable for analysis of a large set of sites. In the absence of certain data, particularly infrastructure data, information previously gathered as part of the Systemic Risk Assessment will be used to supplement the missing information whenever possible. Eventually, any missing data type will simply result in additional top ranked sites being reviewed in Step 9 (Visual Assessment).

Table A-2: Data Requirements

Data Type	Specific Data	Source	Application
Basic Infrastructure	▪ Intersection vs. Midblock ▪ Intersection Control Type ▪ Area Type	TES	General applicability of countermeasures

Data Type	Specific Data	Source	Application
	▪ Road Class ▪ Number of Lanes		
Collision Data	▪ Total Collisions ▪ Injury Collisions ▪ VRU Involvement ▪ Collision Impact Type ▪ Specific Movements Involved ▪ Specific Events or Behaviours Involved ▪ Light and Road Surface Conditions ▪ Time of Day (peak hours or school pick-up/drop-off)	TES	Identification of target issues and/or target conflicts or behaviours. Scoring for site rankings.
Traffic Volumes	▪ Motor Vehicles ▪ Specific Movements ▪ Bicycle and Pedestrians ▪ Time of Day	TES	Identification of target issues and/or target conflicts or behaviours. Scoring for site rankings.
Speed Data	▪ Speed Limit ▪ Speed Pace ▪ Compliance	TES	Identification of target issues and/or target conflicts or behaviours. Scoring for site rankings.
Active Transportation Infrastructure	▪ Sidewalks ▪ Crosswalks ▪ Bicycle Lanes ▪ Bicycle Tracks ▪ Multi-use Paths	City to Provide, as available	Determination of presence / absence of specific countermeasures, pedestrian desire lines, crosswalk types, cycling facility types.
Transit Infrastructure	▪ Bus Routes	City to Provide, as available	Identification of interference with potential countermeasure.
Additional Infrastructure	▪ Exclusive Left- and Right-turning Lanes ▪ Right-turning Channels ▪ Boulevards ▪ Illumination ▪ Guide Rails	City to Provide, as available	Determination of presence / absence for specific countermeasures.
Traffic Signals and PXOs	▪ Exclusive Left- and Right-turning Phases ▪ Pedestrian Countdown Timers ▪ Bicycle Signals	City to Provide, as available	Determination of presence / absence for specific countermeasures.

Data Type	Specific Data	Source	Application
	▪ Pushbuttons ▪ Accessible Push Buttons ▪ Pedestrian Crossover Types		
Accessibility	▪ Tactile Walking Surface Indicators	City to Provide, as available	Identification of existing locations.
Regulations	▪ On-street Parking Regulations ▪ School Zones ▪ Community Safety Zones	City to Provide, as available	Identification of interference with potential countermeasure; identification of candidate sites for specific countermeasures.
Land Use	▪ Schools ▪ Hospitals ▪ Seniors Residences ▪ Other Major Pedestrian Generators (libraries, community centres, etc.)	City to Provide, as available	Identification of preferred locations for specific countermeasures; identification of target areas for education / engagement measures.
Public Concerns	▪ Intersection Visibility Concerns ▪ Pedestrian Crossing Requests ▪ School Pick-up and Drop-off Concerns (congestion, safety, etc.) ▪ General Aggressive Driving Concerns	City to Provide, as available	Identification of candidate sites for specific countermeasures.

4.4 Step 4: Identify Preliminary Applicability

For each target issue, a matrix will be created with locations vs. countermeasures using basic infrastructure data (e.g., intersection vs. midblock, road class, traffic control type, etc.). Non-applicable countermeasures will eventually be removed from consideration at specific locations.

4.5 Step 5: Identify Warranted Traffic Controls

Using data from TES, traffic control warrants (signal, all-way stop control and PXO) will be calculated for all locations. Intersections warranted for traffic control upgrades will be set aside for implementation and removed from consideration for other countermeasures. The rationale for their removal is that (a) road user behaviours, conflicts and collision patterns are likely to change with the new traffic control, and (b) several additional countermeasures, such as accessibility elements, are installed in conjunction with the upgraded traffic control. Prior to finalizing the list of warranted traffic control upgrades, GIS tools will be used to identify nearby adjacent traffic controls that may prevent potential upgrades based on

guidance from the Ontario Traffic Manual (for example, PXOs are not recommended if there is another form of traffic control within 200 m of the candidate site).

4.6 Step 6: Rank Sites for Each Target Issue

In this step, one site ranking is developed for each Target Issue using relevant, easily retrievable data to calculate a "Target Issue Score". The score is calculated by adding up "weighted partial scores", relative to each data element, which range between 0 and 1. The example below provides the calculation for one site,[2] for the Target Issue "Speeding".

Example Site Data

Speed Limit:	60 km/h	Total Collisions:	50
Speed Pace:	66 – 70 km/h	Highest Total Collisions:	70
Compliance:	52%	Aggressive Driving Collisions:	31
Site AADT:	74,496	Highest Aggr. Driving Collisions:	36
Highest AADT:	93,782		

In the data set above, "Highest AADT" refers to the site within the jurisdiction that presents the highest AADT value; the same applies to "Highest Total Collisions" and "Highest Aggressive Driving Collisions". The relative magnitude of each of these attributes at the site under review compared with the site with the highest value of that attribute. In other words, the site with the highest AADT value represents 100%, and other sites are assigned AADT scores proportional to this maximum value. The same principle applies to the collision attributes.

Table A-3 illustrates the proposed calculations used to obtain the site's score for the "Speeding" target issue. The calculations generally represent a percentage value associated with each variable, and weights range between 0.1 and 1.0; the higher the weight of a variable, the more closely associated with the target issue that variable is. In the example provided, the two speed related metrics and aggressive driving collisions are more closely related to the "Speeding" target issue and are assigned the highest weights, while total collisions and AADT are more generally related to speeding and are assigned the lowest weights.

Table A-3: Scoring Example for Target Issue "Speeding"

Metric	Calculations	Weights	Weighted Partial Score
Speed Pace over Speed Limit	(66 – 60) / 60 = 0.10	1.0	0.10
Incompliance	1 – 0.52 = 0.48	1.0	0.48
Total Collisions	50 / 70 = 0.71	0.1	0.071
Aggressive Driving Collisions	31 / 36 = 0.86	1.0	0.86
AADT	74,496 / 93,782 = 0.79	0.1	0.079
Total Score			**1.590**

[2] A York Regional Road site was used for this example.

After calculating the scores, sites are then ranked in descending order of their total score for each target issue. **Table A-4** summarizes the proposed data required, partial score calculation and weights for each target issue (separately for intersections and midblock locations), as well as the maximum scores achievable.

The proposed data correspond to risk elements associated with each target issue. For example, collisions with heavy vehicles can substantially increase the severity of collisions with pedestrians and cyclists; therefore, heavy vehicle AADT was included for the "Pedestrian Safety" and "Cyclist Safety" target issues with a higher weight than general AADT. For the "Nighttime Collisions" target issue, collisions with pedestrians and cyclists were also assigned a higher weight because these users are typically more difficult to see at night compared to motor vehicles.

To incorporate the results of the network screening rankings, an additional 0.25 is added to the score of each site that ranks 1st to 20th; 0.10 is added to the to the score of each site that ranks 21st to 50th.

Similarly, to incorporate the results of the systemic risk assessment rankings, an additional 0.25 is added to the score of each site that ranks 1st to 20th; 0.10 is added to the to the score of each site that ranks 21st to 50th.

Table A-4: Proposed Score Calculations for Target Issue Rankings

Data Required	Partial Score Calculation	Weight	Max. Score[3]
Target Issue: Speeding (Midblock)			
Speed Limit Speed Pace Compliance Total Collisions Aggressive Driving Collisions AADT	(Lower limit of speed pace – speed limit) / speed limit	1	3.2
	1 – % compliance	1	
	% of site's total collisions relative to site with highest total collisions	0.1	
	% of site's aggr. driving collisions relative to site with highest aggr. driving collisions	1	
	% of site's AADT relative to site with highest AADT	0.1	
Target Issue: Speeding (Intersection)			
	(Lower limit of speed pace – speed limit) / speed limit	1	3.2
	1 – % compliance	1	
	% of site's total collisions relative to site with highest total collisions	0.1	

[3] Sites in the Top 50 of the network screening and systemic risk assessment rankings have an additional score between 0.10 and 0.25.

Data Required	Partial Score Calculation	Weight	Max. Score[3]
Speed Limit Speed Pace Compliance Total Collisions Aggressive Driving Collisions AADT	% of site's aggr. driving collisions relative to site with highest aggr. driving collisions	1	
	% of site's AADT relative to site with highest AADT	0.1	
Target Issue: Pedestrian Safety (Intersection)			
Total Collisions Pedestrian Collisions AADT 8-hour Ped. Volume 8-hour Heavy Vehicle Volume	% of site's total collisions relative to site with highest total collisions	0.1	1.95
	% of site's pedestrian collisions relative to site with highest pedestrian collisions	1	
	% of site's AADT relative to site with highest AADT	0.1	
	% of site's 8-hour Ped. Volume relative to site with highest 8-hour Ped. Volume	0.5	
	% of site's 8-hour Heavy Vehicle Volume relative to site with highest 8-hour Heavy Vehicle Volume	0.25	
Target Issue: Pedestrian Safety (Midblock)			
Speed Limit Speed Pace Compliance Total Collisions Pedestrian Collisions AADT Heavy Vehicle AADT	(Lower limit of speed pace – speed limit) / speed limit	0.5	2.45
	1 – % compliance	0.5	
	% of site's total collisions relative to site with highest total collisions	0.1	
	% of site's pedestrian collisions relative to site with highest pedestrian collisions	1	
	% of site's AADT relative to site with highest AADT	0.1	
	% of site's Heavy Vehicle AADT relative to site with highest Heavy Vehicle AADT	0.25	

Data Required	Partial Score Calculation	Weight	Max. Score[3]
Target Issue: Cyclist Safety (Intersection)			
Total Collisions Cyclist Collisions AADT 8-hour Bike Volume 8-hour Heavy Vehicle Volume	% of site's total collisions relative to site with highest total collisions	0.1	1.95
	% of site's cyclist collisions relative to site with highest cyclist collisions	1	
	% of site's AADT relative to site with highest AADT	0.1	
	% of site's 8-hour Bike Volume relative to site with highest 8-hour Bike Volume	0.5	
	% of site's 8-hour Heavy Vehicle Volume relative to site with highest 8-hour Heavy Vehicle Volume	0.25	
Target Issue: Cyclist Safety (Midblock)			
Speed Limit Speed Pace Compliance Total Collisions Cyclist Collisions AADT Bike AADT Heavy Vehicle AADT	(Lower limit of speed pace – speed limit) / speed limit	0.5	2.95
	1 – % compliance	0.5	
	% of site's total collisions relative to site with highest total collisions	0.1	
	% of site's cyclist collisions relative to site with highest cyclist collisions	1	
	% of site's AADT relative to site with highest AADT	0.1	
	% of site's Bike AADT relative to site with highest Bike AADT	0.5	
	% of site's Heavy Vehicle AADT relative to site with highest Heavy Vehicle AADT	0.25	
Target Issue: Angle and Turning Movement Collisions (Intersection)			
Total Angle and Turning Movement Collisions Injury Angle and Turning Movement Collisions AADT 8-hour volumes for relevant conflicting movements	% of site's angle and turning movement collisions relative to site with highest angle and turning movement collisions	0.5	1.85
	% of site's angle and turning movement injury collisions relative to site with highest angle and turning movement injury collisions	1	
	% of site's AADT relative to site with highest AADT	0.1	
	% of site's 8-hour cross product of relevant conflicting volumes relative to	0.25	

Data Required	Partial Score Calculation	Weight	Max. Score[3]
	site with highest cross product of relevant conflicting volumes [4]		
Target Issue: School Safety (Intersection)			
Total Collisions During School Hours	% of site's total collisions during school hours relative to site with highest total collisions during school hours[5]	0.5	1.85
Injury Collisions During School Hours	% of site's injury collisions during school hours relative to site with highest injury collisions during school hours	1	
AADT	% of site's AADT relative to site with highest AADT	0.1	
Pedestrian + bicycle volumes during school hours	% of site's pedestrian + bicycle volumes during school hours relative to site with highest pedestrian + bicycle volumes during school hours[6]	0.25	
Target Issue: School Safety (Intersection)			
Speed Limit Speed Pace Compliance	(Lower limit of speed pace – speed limit) / speed limit	0.5	2.6
	1 – % compliance	0.5	
Total Collisions During School Hours	% of site's total collisions during school hours relative to site with highest total collisions during school hours[5]	0.5	
Injury Collisions During School Hours	% of site's injury collisions during school hours relative to site with highest injury collisions during school hours	1	
AADT	% of site's AADT relative to site with highest AADT	0.1	
Pedestrian + bicycle volumes during school hours			

[4] Cross product of relevant conflicting volumes calculated as follows: NBT*EBT + NBT*WBT + SBT*EBT + SBT*WBT + NBL*SBT + SBL*NBT + EBL*WBT + WBL*EBT.
[5] School hours include Mon-Fri, 7:30 - 9:30 and 14:00 - 16:00, excluding July / August, January 1-7, March 11 – 20, and December 20 – 31.
[6] Only Spring and Fall turning movement counts are considered.

Data Required	Partial Score Calculation	Weight	Max. Score[3]
Target Issue: Roadway Departure (Midblock)			
Speed Limit Speed Pace Compliance Total Collisions Roadway Departure Collisions AADT	(Lower limit of speed pace – speed limit) / speed limit	0.5	2.2
	1 – % compliance	0.5	
	% of site's total collisions relative to site with highest total collisions	0.1	
	% of site's roadway departure collisions relative to site with highest roadway departure collisions	1	
	% of site's AADT relative to site with highest AADT	0.1	
Target Issue: Nighttime Collisions (Intersection)			
Total Non-daylight Collisions Injury Non-daylight Collisions Ped+BikeNon-daylight Collisions AADT	% of site's total non-daylight collisions relative to site with highest total non-daylight collisions	0.25	1.85
	% of site's injury non-daylight collisions relative to site with highest injury non-daylight collisions	0.5	
	% of site's ped+bike non-daylight collisions relative to site with highest ped+bike non-daylight collisions	1	
	% of site's AADT relative to site with highest AADT	0.1	
Target Issue: Nighttime Collisions (Midblock)			
Total Non-daylight Collisions Injury Non-daylight Collisions Ped+BikeNon-daylight Collisions AADT	% of site's total non-daylight collisions relative to site with highest total non-daylight collisions	0.25	1.85
	% of site's injury non-daylight collisions relative to site with highest injury non-daylight collisions	0.5	
	% of site's ped+bike non-daylight collisions relative to site with highest ped+bike non-daylight collisions	1	
	% of site's AADT relative to site with highest AADT	0.1	

Data Required	Partial Score Calculation	Weight	Max. Score[3]
Target Issue: Left-turn Collisions (Intersection)			
Total Left-turn Collisions Injury Left-turn Collisions AADT 8-hour volumes for relevant conflicting movements	% of site's left-turn collisions relative to site with highest left-turn collisions	0.5	1.85
	% of site's left-turn injury collisions relative to site with highest left-turn injury collisions	1	
	% of site's AADT relative to site with highest AADT	0.1	
	% of site's 8-hour cross product of relevant conflicting volumes relative to site with highest cross product of relevant conflicting volumes[7]	0.25	
Target Issue: Driveway Related Collisions (Intersection)			
Driveway Related Collisions AADT	% of site's driveway related collisions relative to site with highest driveway related collisions	1	1.1
	% of site's AADT relative to site with highest AADT	0.1	
Target Issue: Driveway Related Collisions (Midblock)			
Driveway Related Collisions AADT	% of site's driveway related collisions relative to site with highest driveway related collisions	1	1.1
	% of site's AADT relative to site with highest AADT	0.1	
Target Issue: Driveway Related Collisions (Midblock)			
Driveway Related Collisions AADT	% of site's driveway related collisions relative to site with highest driveway related collisions	1	1.1
	% of site's AADT relative to site with highest AADT	0.1	
Target Issue: Wet Surface Collisions (Intersection)			
Total Collisions Wet Surface Collisions AADT	% of site's total collisions relative to site with highest total collisions	0.1	1.2
	% of site's wet surface collisions relative to site with highest wet surface collisions	1	
	% of site's AADT relative to site with highest AADT	0.1	

[7] Cross product of relevant conflicting volumes calculated as follows: NBL*SBT + SBL*NBT + EBL*WBT + WBL*EBT.

Data Required	Partial Score Calculation	Weight	Max. Score[3]
Target Issue: Wet Surface Collisions (Midblock)			
Speed Limit Speed Pace Compliance Total Collisions Wet Surface Collisions AADT	(Lower limit of speed pace – speed limit) / speed limit	0.25	1.7
	1 – % compliance	0.25	
	% of site's total collisions relative to site with highest total collisions	0.1	
	% of site's wet surface collisions relative to site with highest wet surface collisions	1	
	% of site's AADT relative to site with highest AADT	0.1	
Target Issue: Motorcyclist Safety (Intersection)			
Total Collisions Motorcycle Collisions Wet Surface Collisions AADT	% of site's total collisions relative to site with highest total collisions	0.1	1.7
	% of site's motorcycle collisions relative to site with highest motorcycle collisions	1	
	% of site's wet surface collisions relative to site with highest wet surface collisions	0.5	
	% of site's AADT relative to site with highest AADT	0.1	
Target Issue: Motorcyclist Safety (Midblock)			
Speed Limit Speed Pace Compliance Total Collisions Motorcycle Collisions Wet Surface Collisions AADT	(Lower limit of speed pace – speed limit) / speed limit	0.5	2.7
	1 – % compliance	0.5	
	% of site's total collisions relative to site with highest total collisions	0.1	
	% of site's motorcycle collisions relative to site with highest motorcycle collisions	1	
	% of site's wet surface collisions relative to site with highest wet surface collisions	0.5	
	% of site's AADT relative to site with highest AADT	0.1	
Target Issue: Active Transportation Safety (Intersections)			
Total Collisions Pedestrian Collisions Cyclist Collisions AADT 8-hour Ped. Volume 8-hour Bike Volume	% of site's total collisions relative to site with highest total collisions	0.1	3.45
	% of site's pedestrian collisions relative to site with highest pedestrian collisions	1	
	% of site's cyclist collisions relative to site with highest cyclist collisions	1	
	% of site's AADT relative to site with highest AADT	0.1	
	% of site's 8-hour Ped. Volume relative to site with highest 8-hour Ped. Volume	0.5	

Data Required	Partial Score Calculation	Weight	Max. Score[3]
8-hour Heavy Vehicle Volume	% of site's 8-hour Bike Volume relative to site with highest 8-hour Bike Volume	0.5	
	% of site's 8-hour Heavy Vehicle Volume relative to site with highest 8-Hour Heavy Vehicle Volume	0.25	

4.7 Step 7: Re-rank Sites for Countermeasures with a Specific Target Conflict or Behaviour

For each countermeasure that has a specific target conflict or behaviour (e.g., right-turn collisions with pedestrians – refer to Step 2), the relevant data will be retrieved and added to the scores from Step 6. Sites will then be re-ranked sites based on the new scores. The target conflict or behaviour scores will be calculated in a manner similar to AADTs and collisions in Step 6, with sites that have the highest number of target conflicts or behaviours representing 100%, and other sites' scores being proportional to this maximum value; the suggested weight for the target conflict is 1.00. **Table A-5** provides an example of incorporating target conflicts or behaviours into the countermeasure scores.

Table A-5: Example of Target Conflict or Behaviour Scoring

Site	Step 8 Score	Step 8 Rank	No. of Target Conflicts or Behaviours	Target Conflict or Behaviour Score	Revised Countermeasure Score	New Rank
Site A	1.820	1	3	0.429	1.82 + 1.00 x 0.429 = 2.249	3
Site B	1.780	2	4	0.571	1.78 + 1.00 x 0.571 = 2.351	2
Site C	1.720	3	3	0.429	1.72 + 1.00 x 0.429 = 2.149	4
Site D	1.650	4	7	1.000	1.65 + 1.00 x 1.000 = 2.650	1
Site E	1.630	5	1	0.143	1.63 + 1.00 x 0.143 = 1.773	5

4.8 Step 8: Eliminate Unsuitable Sites for Countermeasures Based on Land Use, Advanced Infrastructure Data, or By-laws

For each countermeasure that is associated with a specific land use, advanced infrastructure data (e.g., bicycle facilities, illumination, guide rail) or by-law (school zone, CSZ, on-street parking.), GIS tools will be used to identify suitable locations and eliminate further unsuitable locations still remaining.

For example, VRU-09: Bicycle Signals will be considered suitable only at signalized intersections where bicycle lanes, cycle tracks, or multi-use paths are present; INT-05: Left-Turn Lane Offset will only be considered at intersections with existing, traditional left-turn lanes; SZ-06: Systemic Intersection Improvements Near Schools will be considered at intersections near schools; AG-06: Senior Safety Zones will be targeted at areas near seniors residences.

4.9 Step 9: Visual Assessment

For each target issue ranking, visually assess top ranked locations (using aerial imagery and Google Street View) to confirm suitability of countermeasures still under consideration and eliminate further unsuitable locations still remaining.

For example, sites that are still under consideration for the countermeasure INT-04: Sightline improvements will be reviewed to identify the presence of potential obstructions to stopping and departure sight distances at intersections, as well as visibility towards pedestrian waiting areas; AG-07: Radar Speed Feedback Signs will be reviewed to ensure that candidate sites have suitable locations to install the boards (i.e., available utility poles with line of sight not obstructed by trees); INT-09: Driveway Access Management and AG-04: Continuous Centre Medians will be reviewed to ensure that affected sites have an available alternative access.

4.10 Step 10: Assign Countermeasures to Specific Sites

In the last step, each countermeasure will be assigned to specific sites still under consideration based on the required target quantities.

CIMA+ project number: B001780
January 2026

H

Appendix H
Policy Papers

City of Markham

Community Safety Zone Policy Paper

Vision Zero Road Safety Plan

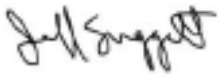
CIMA+ file number: B001780

City of Markham

Community Safety Zone Policy Paper

Vision Zero Road Safety Plan

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Introduction

The City of Markham (the City) has engaged CIMA Canada Inc. (CIMA+) to support the development of a comprehensive Vision Zero Road Safety Plan (RSP), aimed at enhancing road safety and reducing traffic-related risks across the City. As part of this larger initiative, the project will include the creation of five detailed policy papers that will guide the City's efforts in improving road safety. These papers will address a range of key issues, including fatal and serious injury collision investigations, a traffic inquiry process, Community Safety Zones, and traffic calming and speed management.

This memorandum outlines the policy paper on Community Safety Zones, developed as part of *Task 4-6: Develop Policy Papers and Guidelines*.

1.1 Purpose and Overview

The purpose of this memo is to present a recommended policy for the City of Markham that outlines the criteria and process to establish a Community Safety Zone (CSZ).

This initiative involves a structured and systematic approach to identify, prioritize, and implement Community Safety Zones using a defensible risk-based approach. The development of the policy is documented in detail in the following sections:

- **Section 2:** Current Procedures in the City of Markham
- **Section 3:** Environmental Scan
- **Section 4:** Proposed Policy

1.2 Need

In Ontario, a CSZ refers to a specific area where additional safety measures are enforced to protect the public, particularly vulnerable groups like pedestrians, cyclists, and children. These zones are usually established in locations where there is a higher risk of collisions or where increased attention to safety is necessary. Overall, CSZs in Ontario are designed to improve public safety by creating an environment where traffic laws are strictly enforced to reduce collisions resulting in injuries or fatalities.

1.3 Legislative Context

In Ontario, the primary legislation related to CSZs is found under the Highway Traffic Act (HTA), specifically Section 214.1. This section grants municipalities the authority to establish CSZs through by-laws if they determine that public safety is of special concern in those areas:

"The council of a municipality may by by-law designate a part of a highway under its jurisdiction as a community safety zone if, in the council's opinion, public safety is of special concern on that part of the highway."[1]

Offences such as speeding, careless driving, and failing to stop for a school bus that are committed within a CSZ are subject to increased penalties, typically involving fines that are double the standard amount for these infractions.

Municipalities in Ontario are responsible for enacting by-laws to designate CSZs within their jurisdictions. These by-laws typically include detailed descriptions of the specific highway segments designated as CSZs, specifying the precise locations where enhanced enforcement measures will be applied. They also outline the effective periods during which the CSZ designation is active, including the specific days and times when the designation is in force. Additionally, by-laws must include specifications for the placement and maintenance of official signage marking the CSZ boundaries to ensure that motorists are adequately informed of the zone's limits. Provisions for the enforcement of traffic laws within CSZs are also detailed in the by-laws, often incorporating measures such as automated speed enforcement systems to monitor and address infractions effectively.

Municipalities may also designate School Zones or implement other safety programs targeting specific road safety issues, which can complement or operate alongside CSZs. For example, the City of Toronto has designated all elementary and secondary school frontages as CSZs to enhance the safety of school children.

2. Current Procedures in the City of Markham

The City of Markham implemented CSZs on three collector roads (Green Lane, Willowbrook Road, and Aileen Road) in 2000, as part of a neighbourhood traffic calming initiative (**Figure 1**). The CSZs were found to be ineffective at reducing speeds. The City chose to not pursue the establishment of any additional CSZs at that time.

As part of the School Zone Safety Guide (SZSG) project, the City has recommended CSZs be implemented at all public and Catholic elementary and secondary schools on City roads in the City of Markham. City staff indicated the following:

- The City is open to expanding CSZs beyond School Zones with a phased approach for future installation.
- The City has requested that a detailed policy paper with clearly defined criteria be developed to ensure CSZs are applied objectively, using an evidence-based and data-driven approach.

[1] Highway Traffic Act, 1990

> The City noted that previous recommendations from the SZSG project do not require adjustments.



Figure 1: Current Community Safety Zones in the City of Markham

3. Environmental Scan

An environmental scan of Community Safety Zone policies among municipalities within Ontario was undertaken. The following municipalities were scanned for their practices:

- Region of Halton
- Region of York
- Region of Durham
- Region of Niagara
- City of Richmond Hill

- City of Vaughan

Elements reviewed as part of the environmental scan included:

- Identification of candidate locations
- Development of warrant score sheets
- Development of risk factors
- General implementation guidelines

The findings of the environmental scan are outlined in the sub-sections below.

3.1 Region of Halton

CIMA+ recently completed an update on the Region's CSZ policy. In the Region of Halton, candidate locations for CSZ implementation were road segments in proximity to sensitive land uses such as schools, community housing, long-term care facilities, parks, and outdoor playgrounds. These land uses generally generate trips involving vulnerable road users, such as pedestrians and cyclists, who are required to be protected against vehicular traffic subject to the presence of certain risk factors. For this project, a shortlist of road segments adjacent to such land uses was created using GIS coding. The shortlisted road segments were further reviewed through a systemic safety analysis, identifying risk factors that experienced a higher likelihood of fatal or injury collisions. The risk factors identified were:

- Annual Average Daily Traffic (AADT) ≥ 20,000
- Total number of lanes (both directions) ≥ 5
- Presence of bus stops
- Daily truck volume ≥ 250
- 85th percentile speed compliance ≥ 5 km/h

The road segments were first evaluated using the previously mentioned risk factors and ranked accordingly. A separate ranking was then conducted for the shortlisted road segments based on their projected number of fatal and non-fatal collisions. The expected collision count for each segment was determined by adding the expected collisions for the segment itself and its boundary intersections. These two rankings were then combined to create a priority list of locations where Community Safety Zones are recommended for implementation in Halton.

3.2 Region of York

Similar to the Region of Halton, the Region of York has a two-tiered approach to selecting candidate locations for CSZs. First, candidate locations are pre-screened based on the presence of elementary or secondary schools, community centres, high pedestrian volumes (defined as more than 100 pedestrians over an 8-hour period), and seniors' centres and residences. They also note that the proposed CSZ length must be a minimum of 1 km to a maximum of 2.5 km.

Amongst the pre-screened locations, the Region of York applies a second collision warrant or a risk warrant. The collision warrant consists of a collision ratio of less than 1:900 (collisions per year/AADT) averaged over 36 consecutive months. The risk warrant considers the following:

- Posted speed limit
- Average daily traffic volume
- Number of lanes
- Length of sidewalks
- Truck volume
- Pedestrians crossing in any 8-hour period
- Intersections and entrances per kilometre

3.3 Region of Durham

Similar to the previous two Regional municipalities, the Region of Durham also has a two-tiered approach to selecting candidate locations for CSZs. The Region of Durham follows a similar approach and criteria to the Region of York, with very minor variations. For example, Region of Durham does not take into consideration the posted speed limit as a risk factor, but rather the operating speed.

3.4 Region of Niagara

CIMA+ recently completed a project for the Region of Niagara to update their policy for CSZs. Suitable candidates for CSZs are locations based on land use which are anticipated to generate a high amount of pedestrian and cyclist traffic. These would be characterized as locations in urban areas with lower posted speed limits (i.e., 70 km/h or lower).

Candidate locations were pre-screened by CIMA+ using available open-source GIS data layers such as schools, senior homes, and places of worship. GIS queries were run to examine the distance between the nearest Regional road and the centroid of the property to determine the number and proximity of land uses as an initial indication as to potential candidates for CSZs.

The Region of Niagara has a list of risk factors from which candidate CSZs can be compared to prioritize those that meet a certain score from the risk factors. Some of these risk factors include:

- **Difference between operating speeds (85th percentile) and posted speed limit**: As opposed to the posted speed limit, operating speed was considered a more reliable indicator of a speeding concern on the road in question. The difference between the 85th percentile operating speed and the posted speed limit was taken to reduce bias against roadways with higher posted speeds. Where the posted speed limit changes within the section of road, the lowest posted speed was used as a basis for the evaluation.

- **AADT**: Used as an indicator of a more urbanized area likely having a greater need for a CSZ.
- **Number of lanes**: Roads with additional lanes tend to have a greater risk of collisions than two-lane roads and pose more difficulty for pedestrians wishing to cross at a midblock location.
- **Sidewalk coverage**: Roads with continuous sidewalk coverage are safer for pedestrians walking alongside the road than roads with discontinuous or absent sidewalk coverage.
- **Truck volumes**: Used as an indicator of a more undesirable environment for pedestrians and cyclists.
- **Pedestrian movements (crossing or walking parallel to the roadway in any 8-hour period)**: Used as an indicator of pedestrian movements.
- **Intersections and driveways per kilometre**: Used as an indicator of an urban area with significant development (residential or commercial) directly fronting onto the roadway, generating access related conflicts.
- **Land use**: Used as an indicator of pedestrian volumes with higher weighting given to schools over other types of land use. Engineering judgement was used to determine whether to include or exclude different types of land use.

Candidate road segments are selected based on the collision history along the segment and the aforementioned risk factors. Candidate road segments will be considered for CSZ implementation if they score 25 points or higher in the warrant analysis. An overview of the warrant scoresheet is provided in **Table 1.**

Table 1: Warrant Scoring for CSZ in the Region of Niagara

Risk Factor	Score
Fatal and injury collisions per year along road segment (including intersections)	Score **5 points** per fatal or injury collision involving a pedestrian or cyclist per year (rounded up)
Operating Speed (85th percentile) vs. Posted Speed Limit	**3 points:** >15 km/hr **2 points:** 5 – 15 km/hr **1 point:** <5 km/hr
Average Annual Daily Traffic volume	**3 points:** >20,000 AADT **2 points**: 10,000 – 20,000 AADT **1 point:** <10,000 AADT
Number of Lanes	**3 points:** >4 lanes **2 points:** 3 or 4 lanes **1 point:** 2 lanes
Length of Sidewalks	**3 points:** <25% sidewalk coverage **2 points:** 25 – 75% sidewalk coverage **1 point:** >75% sidewalk coverage
Truck Volume	**3 points:** >5% truck volumes **2 points:** 3 – 5% truck volumes **1 point:** <3% truck volumes

Risk Factor	Score
Pedestrians crossing or walking parallel to road section in any 8-hour period (1)	**3 points:** >100 pedestrians **2 points:** 50 – 100 pedestrians **1 point:** <50 pedestrians
Intersection and Driveways per Kilometre	**3 points:** >30 intersections/driveways per km **2 points:** 10 – 30 intersections/driveways per km **1 point:** <10 intersections/driveways per km
Land Use	**3 points:** for every school **2 points:** for every senior residence **1 point:** for every other location with high anticipated pedestrian /cyclist traffic

(1) *If counts available at multiple locations, use the highest recorded pedestrian volume. A score of 0 should be assigned to locations without available pedestrian count*
In the Region of Niagara, candidate road segments for a CSZ must have a minimum length between 1.0 and 2.5 km and have a posted speed of 60 km/h or less.

3.5 City of Richmond Hill

CIMA+ recently completed a project for the City of Richmond Hill, with a few recommendations to enhance CSZ selection criteria. Major safety and risk factors are taken into consideration to justify the need of a CSZ. The City's CSZ evaluation process is comprised of two main warrants:

- **Warrant 1: Designated Areas of Special Concern**
  - Determines if the proposed CSZ is within an area that has a special concern to public safety.
- **Warrant 2: Safety Warrant**
  - Determines if a CSZ is warranted based on eight risk factors.

Locations included in the Warrant 1 review are:

- Elementary or Secondary Schools
- Community Centres
- Senior's Centres and Residences
- Hospitals
- Playgrounds and parks
- Residential neighbourhoods with cut-through traffic and
- Roadways with bike facilities (e.g., on-road bike lanes, multi-use pathways)

The City of Richmond Hill's safety warrant (Warrant 2) is comprised of a list of seven risk factors that help evaluate if the section of interest is a suitable candidate. Each risk factor has a threshold to determine impact, and the risk factors range from a value of one (low) to three (high). A minimum of 13 points must be accumulated to satisfy the safety warrant. The seven risk factors are as follows:

- Average Daily Traffic
- Truck Volume
- Pedestrian Crossing Volume in any 8-Hour Period

- Intersection and Entrances per kilometre
- 85th Percentile Speed
- Collisions per Year for 3 Years
- Number of bus stops (in both directions) per kilometre

The recommended list of risk factors and the warrant scoring sheet is presented in **Table 2**.

Table 2: Warrant 2 Scoring for CSZ in the City of Richmond Hill

Risk Factor	Risk Factor Scoring			Score
	High (3)	Moderate (2)	Low (1)	
Average Daily Traffic	> 6,000	3,000 to 6,000	< 3,000	
Truck Volume (% of traffic)	>5%	3% to 5%	<3%	
Pedestrians (equivalent adults[2] crossing in any 8-hour period)	>75	40 to 75	<40	
Intersection and Entrances per Kilometre	>10	4 to 10	<4	
85th Percentile Speed (km/h)	>50	40 to 50	<40	
Collisions per Year (3 Years)	>3	2 to 3	<2	
Number of Bus Stops per Kilometre	>4	2 to 4	>4	
			Total Score	**/ 21**

In the City of Richmond Hill, all designated CSZ must:

- Have a length between 0.5 and 2.5 km.
- Have high pedestrian traffic, identified as an average pedestrian volume of at least 75 pedestrians per hour, over any eight hour period.

In the City of Richmond Hill, all CSZ locations require the full support and endorsement of the York Regional Police. Each by-law that establishes a CSZ must specify that its designation is in effect for 24 hours a day and seven days a week to assist with police enforcement.

CSZs must be implemented in conjunction with other traffic safety measures, police enforcement, and appropriate signage.

[2] **Equivalent adult volume** = unassisted pedestrian volume + 2 x Assisted pedestrian volume, where: **Unassisted** = Adults and adolescents at or above the age of 12 are considered “unassisted” pedestrians; **Assisted** = Children under the age of 12, senior citizens, disabled pedestrians and other pedestrians requiring special consideration or assistance are considered “assisted” pedestrians. In cases where an adult is accompanying a pedestrian included in the “assisted” category, both individuals should be counted as “assisted” pedestrians to reflect their higher vulnerability. It should be recognized that the exact age of the pedestrian is not critical, but the observers will need to use their judgment to place each pedestrian into one of the two categories

3.6 City of Vaughan

The policy in the City of Vaughan is a two-step warrant system consisting of a set of criteria to justify a Community Safety Zones designation:

- Warrant 1: Designated Area of Special Concern
- Warrant 2: Safety Warrant

A candidate location must satisfy both warrants in order to qualify for the implementation of a CSZ.

Warrant 1 identifies specific locations where CSZs can be considered because of the propensity of these land uses to attract vulnerable road users near vehicular traffic resulting in potential safety concerns. Land uses that satisfy Warrant 1 include:

- School Zones
- Trail Access Points
- Retirement Housing
- Community Centres
- Parks
- Places of Worship
- Neighbourhoods with cut-through traffic
- Roadways with bike facilities (e.g., on-road bike lanes, multi-use pathways)

Where schools and parks are adjacent to each other, they are to be considered a single candidate site. Each candidate location will be reviewed to determine if other boundary roads (in addition to the road across the location's frontage) are also candidates for Community Safety Zone implementation.

Once an area is confirmed as a designated area of special concern (i.e., satisfies Warrant 1), Warrant 2 assesses the potential of implementing a Community Safety Zone to address safety issues by considering the presence of risk factors as noted below. The process includes a risk scoring matrix to assess each candidate location.

School Zones are automatically considered warranted for Community Safety Zones and are not required to satisfy Warrant 2. The following risk factors are included in Warrant 2:

- **Volume:** Higher volumes of vehicles result in a higher potential for conflicts with vulnerable road users.
- **Number of Lanes:** Longer crossing distances associated with multi-lane roadways raise the exposure of vulnerable road users to conflicts with vehicles.
- **Length of Sidewalk:** Sidewalks physically separate vulnerable road users from traffic and therefore offer safety advantages.
- **Truck Volume:** Trucks require more room to manoeuvre, generally have larger blind spots, and the severity of collisions between trucks and vulnerable road users tends to be higher.

- **Bus Stops:** Bus stops are a surrogate for the presence of pedestrians and the number of crossings made by pedestrians.
- **Intersections and Entrances:** Intersections and entrances increase the number of vehicle-vulnerable road user conflict points.
- **Operating Speeds:** Higher operating speeds tend to result in greater severities when collisions do occur with vulnerable road users.
- **Vulnerable Road User (VRU) Collision History:** The collision history is a means of assessing the potential for collisions to occur.

Each risk factor is scored as 'high' (3), 'moderate' (2), or 'low' (1). **Table 3** lists the risk factors and the corresponding thresholds used to determine the scores. Note this scoring process is used to determine the location's priority.

Table 3: Warrant Scoring for CSZ in the City of Vaughan

Risk Factor	Risk Factor Scoring			Score
	High (3)	Moderate (2)	Low (1)	
Average Daily Traffic	> 6000	3000 to 6000	< 3000	
Number of Lanes	> 4	3 to 4	2	
Presence of Sidewalks	None	One side	Both sides	
Truck Volume (% of traffic)	> 5%	3% to 5%	< 3%	
Number of Bus Stops per Kilometre	> 4	2 to 4	< 2	
Intersection and Entrances per Kilometre	> 10	4 to 10	< 4	
85th percentile speed – posted speed (km/h)	> 10	0 to 10	< 0	
VRU Collisions per Year (5 years)	> 2	1 to 2	0	
			Total Score	**/ 24**

The minimum score for a location to be compliant with Warrant 2 is 14.

The City of Vaughan has laid out specific characteristics for CSZs, including their relation to school areas, signage, and their designation near adjacent CSZs.

For school areas, CSZ begins signs should be installed 100 m upstream of the School Area signs (Wc-1), placed at the area limits. These distances are consistent with the placement criteria for warning signs provided in the *Ontario Traffic Manual Book 6 – Warning Signs*.

For CSZ locations outside of school areas, the CSZ Begins signs should be installed 140 m in advance of the sensitive land use (i.e., the locations listed for Warrant 1) and the CSZ Ends signs shall be installed the same distance beyond (i.e., 140 m).

For zones greater than 1 km in length, additional CSZs signs shall be spaced not more than 300 m apart (or as specified in *OTM Book 5 – Regulatory Signs*).

In cases where the end and start points for two adjacent CSZs are within 250 m of each other, they should be treated as a single, continuous CSZ to reduce driver confusion and facilitate on-street enforcement. Furthermore, CSZ boundaries shall be determined as road sections meeting the conditions of Warrant 2 and shall be extended to encompass any immediately adjacent road sections that satisfy Warrant 1.
In the City of Vaughan, all warranted locations will be presented to Community Safety Zone stakeholders (e.g., York Regional Police, School Boards and York Region) for their review and consideration. Once a section of road has been designated as a Community Safety Zone, it shall retain the designation until the land use changes.

3.7 Town of Innisfil

As part of Innisfil's Community Safety Zones Policy, a CSZ should be established on sections of a road abutting and providing access to the following land uses:

- Elementary Schools
- Secondary Schools
- Hospitals
- Seniors Residences

These land uses attract a higher number of pedestrians. Therefore, drivers should operate their vehicles with additional care. A CSZ may be established on sections of road abutting and providing access to the following land uses, provided there is a specific traffic safety concern:

- Parks
- Playgrounds
- Community Centres
- Day Care Centres
- Seniors Centres

For the purpose of the Town's guidelines, a CSZ associated with one of the above land uses should include the road along the frontage (or side lot line or rear lot line, provided there is an access to the municipal right-of-way) of the lands plus an additional 150 m along the road in both directions measured from the intersection of the property line and the right-of-way, at minimum. Engineering judgement may require a CSZ which is greater in length.

A CSZ may be considered as a tool in an overall traffic calming strategy, in keeping with the Town's Traffic Calming Policy and Traffic Calming Design Guide, provided doing so would be in keeping with the general guidance provided in the Ontario Traffic Manual regarding CSZs. As per the Traffic Calming Policy, traffic calming measures are only to be considered on municipal roads with an 85th percentile speed equal to or greater 10 km/h above the posted speed limit. CSZs may be particularly effective as a traffic calming measure if paired with automated speed enforcement (ASE) technology.

A CSZ may also be considered on sections of road with a higher-than-expected collision history, provided doing so would be in keeping with the general guidance provided in the Ontario Traffic Manual regarding CSZs. For the purpose of the Town's guidelines, a higher-than-expected collision history is considered to be a collision to Annual Average Daily Traffic (AADT) volume ratio of higher than 1:900 (collisions per year to AADT). The annual average number of collisions over the previous 36 months must be used in the determination of this ratio. Engineering judgement must be used in determining which collisions can be considered in the determination of this ratio. For example, collisions with wildlife are unlikely to be mitigated by introducing a CSZ and would not typically be considered.

3.8 City of Toronto

The following is an outline of Toronto's proposed framework for evaluating new road segments for potential Community Safety Zone designation.

Using spatial analysis, The City's Transportation Services department would evaluate the selected road types to determine ones with the likelihood for higher volumes of vulnerable road users. Slowing traffic speeds in areas where there are higher numbers of vulnerable road users is an important measure to reduce the risk associated with collisions. School crossing guard locations at major and minor arterial roads have already undergone a safety risk evaluation and are known locations for higher volume of school-aged children. Seniors Safety Zones, roads close to retirement facilities, roads with non-separated bike lanes, road segments adjacent to community centres, parks with high visitor volumes, and locations near hospitals that meet the road type criteria will be selected for further evaluation. The intention of these areas is to include places where vulnerable road users are most likely to encounter a conflict with vehicles:

- **Seniors Safety Zones:** Areas with a higher proportion of seniors, identified through a formal process.
- **Retirement Facilities and Seniors' Centres:** Locations where a significant number of seniors reside, in addition to Seniors Safety Zones.
- **Parks with modelled visitor volumes greater than 500 people per day:** Parks where mobile movement data is used to estimate daily visitor numbers, excluding smaller parkettes (less than 0.5 hectares). Only parks with a raw visitor volume exceeding 500 people per day are included.
- **Hospitals:** Areas that serve vulnerable people including sick, injured, seniors, and children.
- **City-run Community Centres:** Facilities that serve the local community, offering activities for children, seniors, and the broader population.
- **Unprotected Bike Lanes:** Areas where cyclists are at higher risk of conflicts with vehicle traffic and could benefit from reduced road speeds.

Higher volume roads (major, minor, and collector roads with volumes of over 8,000 vehicles per day) will be considered for CSZ designation if they pass the following screening:

- Exclude any of the above roads with existing traffic calming
- Exclude roads that have an existing CSZ
- From the selected roads, identify road segments that are adjacent to active crossing guard locations

3.9 Town of Oakville

In order to provide more structure to the evaluation of proposed CSZ locations, Town of Oakville staff have developed an enhanced CSZ definition for Oakville as well as a quantitative assessment process. The proposed definition, which is included in the Town's Traffic By-law, for a CSZ is as follows:

"A Community Safety Zone (CSZ) is a section of a roadway designated through a by-law passed by Council to identify it as a road segment where public safety is of paramount concern. Community Safety Zones may include roadways near:

- Schools
- Day care centres
- Active parks
- Hospitals
- Senior citizen residences and/or
- May also be used for collision prone areas within a community."[3]

The proposed quantitative assessment method accounts for the presence of schools, active parks, level of pedestrian activity, operating speed, traffic volume, collision history on the road segment under evaluation. It should be noted that this assessment method would apply to all road classifications. The proposed point system is summarized in **Table 4**.

Table 4: Warrant 2 Scoring for CSZ in the Town of Oakville

Criteria	Points
Schools	30 per school
Active Parks/Recreation Centre	15 per facility
Heavy Pedestrian Activity	5 if the peak hour pedestrian volume is greater than 100
85th Percentile Speed	3.25 for every 1 km/h over the posted speed limit
24 Hour Traffic Volume	3 for every 1,000 vehicles per day
Collisions	3 collisions per year per kilometer over a 3-year period

In order to qualify as a CSZ, a road segment must achieve a minimum score of 50 points. If the CSZ threshold is met at a location where another Neighbourhood Traffic Safety component/measure (e.g. physical traffic calming) is already in place or is planned, staff would not recommend duplicate measures.

[3] Town of Oakville Traffic Control By-Law 1984-001 (2025)

3.10 Region of Waterloo

Similar to the City of Vaughan, the Region of Waterloo has a two-step warrant process to evaluate the need for a CSZ. The two warrants include:

- Step 1: Eligibility Assessment
- Step 2: Points-Based Risk Factor Assessment

Step 1 is a screening to assess if the section of the roadway is eligible for a CSZ. A roadway segment may qualify for a Community Safety Zone if it meets all of the following criteria:

- **Proximity to Community Features:** There must be at least one primary community feature (such as a school, park, community center, or hospital), or at least two secondary community features (such as a daycare, seniors' center, small park, or playground) near the roadway.
- **Speed Limit:** The posted speed limit must be 60 km/h or lower.
- **Driver Speed Compliance:** There should be evidence of poor driver compliance with the speed limit.
- **Appropriate Speed Limit:** The posted speed limit must be suitable for the specific roadway characteristics.
- **Traffic Calming Measures:** There should be no plans in place for other traffic calming measures on the roadway.
- **Physical Suitability:** The roadway must be appropriate for the installation of an Automated Speed Enforcement camera.

If a roadway segment meets all these eligibility criteria, it will proceed to the next step, a points-based risk factor assessment. Risk factors include:

- **Average Daily Traffic Volumes:** Higher traffic volumes increase the risk.
- **Pedestrian Volumes:** More pedestrian traffic increases the risk.
- **Presence of Pedestrian-Generating Facilities:** The presence of schools, community centers, parks, or hospitals raises the risk.
- **Presence of Heavy Trucks:** A higher percentage of heavy trucks increases the risk.
- **Observed Traffic Speeds:** Higher speeds observed in traffic correspond to higher risk.
- **Collision History:** A higher frequency of past collisions increases the risk.
- **Frequency of Intersections & Access Points:** More intersections or access points increase the risk.
- **Presence of Sidewalks:** Roadways without sidewalks are considered higher risk.

Each of these factors is evaluated for the roadway segment in question. If the segment's score reaches at least 70% of the maximum possible risk score, it qualifies for a Community Safety Zone designation.

Additionally, staff recommends the option for a more detailed engineering study to further assess sensitive locations that do not meet the full Community Safety Zone criteria.

In the Region of Waterloo, CSZs are typically recommended to extend 250 meters on either side of the critical land use. If two eligible CSZs fall within 500 meters of each other, they should be combined into a single, longer zone.

3.11 Key Takeaways

Common locations for CSZs include areas near schools, parks, playgrounds, residential neighborhoods, and locations with high foot or cyclist traffic. These zones are selected due to the elevated risk of collisions or the need for heightened safety awareness.

There are two main approaches for selecting candidate locations for CSZs. The first approach involves identifying mandatory requirements for CSZs and then applying a risk scoring matrix based on various risk factors to determine the locations. The second approach focuses solely on applying the risk scoring matrix to identify potential CSZs based on these factors. Where mandatory factors are identified, they always include sections of roadways where there are schools present. **Table 5** summarizes the factors identified in the environmental scan.

Table 5: Environmental Scan – Mandatory Requirements and Risk Scoring Matrix Factors

Municipality	Mandatory Requirements	Risk Scoring Matrix Factors
Halton Region	None	Annual Average Daily Traffic (AADT), number of lanes, bus stops, truck volumes, operating speed
York Region	Elementary and secondary schools, community centres, high pedestrian volumes, senior's centres and residences	Collision history, posted speed, AADT, number of lanes, length of sidewalks, truck volumes, pedestrian crossings, intersection/entrance per km
Durham Region	Elementary and secondary schools, community centres, high pedestrian volumes, senior's centres and residences	Collision history, operating speed, AADT, number of lanes, length of sidewalks, truck volumes, pedestrian crossings, intersection/entrance per km
Niagara Region	None	Excess speed, AADT, number of lanes, sidewalk coverage, truck volumes, pedestrian volumes, intersection/entrance per km, land use
City of Richmond Hill	All school zones (some private schools are included), community centres, senior's centres and community centres, hospitals, playgrounds and parks, residential neighbourhoods with cut through traffic, roadways with bicycle facilities	AADT, truck volume, pedestrian crossing volume, intersection/entrances per km, excess speed, collision history, bus stops
City of Vaughan	All school zones (some private schools are included), trail access points, retirement housing, community centres, parks, places of worship, neighbourhoods with cut-through traffic, roadways with bike facilities (e.g., on-road bike lanes, multi-use pathways)	AADT, number of lanes, length of sidewalk, truck volume, bus stops, intersections and entrances, operating speeds, collision history
Township of Innisfil	Elementary schools, secondary schools, hospital, senior's residences	Parks, playgrounds, community centres, day care centres, senior's centres

Municipality	Mandatory Requirements	Risk Scoring Matrix Factors
City of Toronto	None	AADT, crossing guard locations, high pedestrian volume locations, hospitals, community centres, unprotected cycling locations
Town of Oakville	None	Schools, parks, recreation centre, pedestrian volume, operating speed, AADT, collision history
Region of Waterloo	Primary and secondary community features, posted speed limit, speed compliance, traffic calming measures, and physical suitability	AADT, pedestrian volumes, presence of pedestrian-generating facilities, presence of heavy trucks, observed speeds, collision history, intersections and access points, sidewalks

4. Recommended Policy

To enhance safety around schools, the City of Markham has outlined a plan to establish Community Safety Zones at all schools within the municipality. This initiative aims to address growing concerns about traffic-related risks in school areas by implementing measures that encourage safer driving behaviors and provide additional protection for students, parents, and staff.

4.1 School Zones

It is recommended that the City of Markham implement Community Safety Zones (CSZs) at all existing and future School Zones, following the guidelines outlined below to ensure consistency, effectiveness, and safety:

- **Length:** The designated CSZs should cover a minimum length of 0.5 km and a maximum length of 2.5 km. This range allows for appropriate coverage of school zones while balancing the need for effective traffic management and enforcement.
- **Sign Placement:** CSZ signs (Rc-9) must be placed at the start and end of each zone, marked with "BEGINS" (Rb-84t) and "ENDS" (Rb-85t) tabs, as outlined in *the Ontario Traffic Manual Book 5 – Regulatory Signs*. For zones up to 1.0 km in length, a minimum of three CSZ signs per direction are required (typically placed at the start, midpoint (approximately 500 m), and end of the zone) with additional signs installed at the City's discretion to address multiple side streets and entrances. In longer zones, additional signs are placed every 300 metres for speed limits of 60 km/h or less and every 2 kilometres for higher speed limits, ensuring clear visibility and consistent enforcement.

  CSZ signs should be placed 100 meters upstream of the School Area signs (Wc-1) at the school area limits to ensure continuous enforcement and clear boundary marking. These distances align with the placement guidelines for warning signs outlined in the *Ontario Traffic Manual Book 6 – Warning Signs*. **Figure 2** provides an example layout of the recommended signage.
- **Posted Speed Limit:** Introduce speed limit signs on roadways with a speed limit equal to or less than 50 km/h. Speed limits should be set using the process outlined in the *Traffic Calming and Speed Management Policy*.
- **Zone Consolidation:** If two eligible Community Safety Zones (CSZs) are located within 500 metres of each other, it is recommended that they be merged into a single, extended zone. This consolidation would create a more continuous and effective safety zone, reducing the potential for confusion and ensuring consistent traffic management across the area.

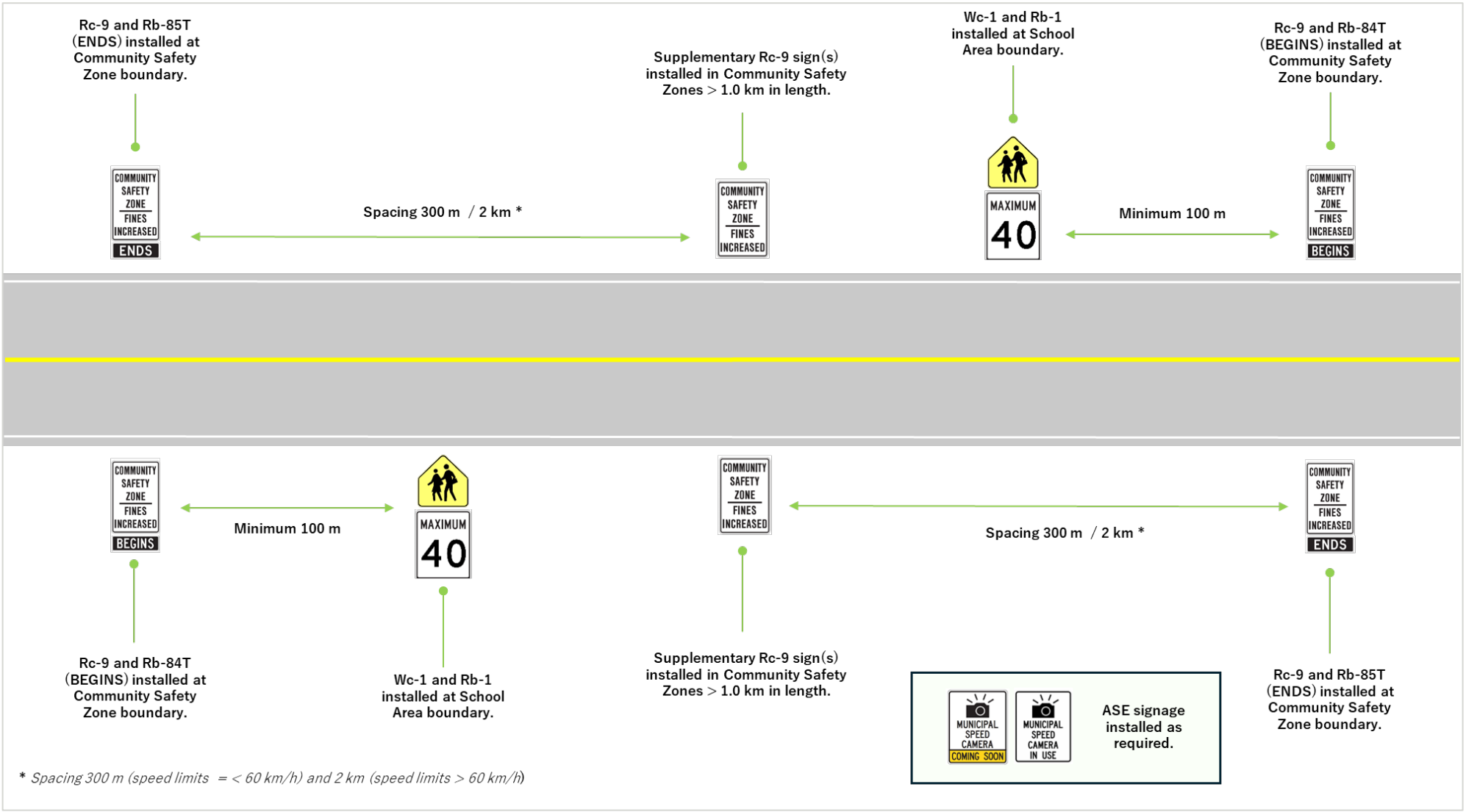


Figure 2: Example Layout for Recommended Community Safety Zone Signage

4.2 Future Considerations

In the long term, the City of Markham may consider undertaking a comprehensive review of additional roadway segments to evaluate the feasibility of implementing Community Safety Zones (CSZs). This process could be guided by a two-step warrant methodology, similar to the approach identified in the environmental scan. The two-step process would include:

Warrant 1: Special Area of Concern

This initial step would assess whether a specific area qualifies as a special concern for public safety, warranting lower speeds and/or enhanced traffic enforcement through a CSZ designation. Areas that may be considered include parks, recreational facilities, healthcare centres, daycare centres, senior living communities, and other locations frequented by vulnerable road users. Expanding CSZ implementation to include such areas would promote safer driving behavior and reduce speeding, thereby protecting children, seniors, and pedestrians.

Warrant 2: Safety Risk Scoring

The second step would involve a detailed assessment of specific risk factors to determine the appropriateness of a CSZ designation. The risk factors would be identified and analyzed to prioritize areas for potential CSZ implementation, allowing the City to allocate resources effectively and target locations where the introduction of a CSZ would have the greatest safety impact. The evaluation may include the following factors:

- Annual Average Daily Traffic (AADT)
- Number of lanes
- Daily truck volume
- Collision history
- Operating speed
- Pedestrian volume
- Number of pedestrian crossings
- Number of intersections, driveways, or access points
- Presence of sidewalks
- Number of bus stops

CIMA+ conducted a general systemic safety analysis for the City in 2020, which was subsequently updated in 2023 as part of the York Region Traveller Safety Study. This updated analysis identified risk factors associated with a higher incidence of fatal and injury collisions. **Table 6** presents example risk factors and corresponding scores based on the study findings as well as findings from the environmental scan.

Table 6: Example of Risk Factor Scoring for the City of Markham

Risk Factor	Risk Factor Scoring		Score
	2 Points	**1 Point**	
AADT	≥ 5,000 vehicles per day	< 5,000 vehicles per day	
Presence of Sidewalks	No sidewalk present	Sidewalk present	
Number of Lanes	4+ lanes	2 or 3 lanes	
Presence of Transit Stop(s)	Yes	No	
Presence of Horizontal Curve	Yes	No	
Presence of At-Grade Railway	Yes	No	
Presence of Centre Median	No	Yes	
Road Classification	Major Collector or Arterial	Local Road or Minor Collector	
Intersection or Driveway Accesses per Kilometre	> 10	0 to 10	
85th Percentile Speed	> 10 km/h above the posted speed limit	0 to 10 km above the posted speed limit	
Vulnerable Road User Collisions (5 Years)	≥ 2	0 to 1	
		Total Score	**/ 22**

The example scoring sheet may serve as a starting point for the City of Markham to identify potential locations for Community Safety Zones. However, it is recommended that the scoring matrix be refined based on a comprehensive systemic safety analysis specific to Community Safety Zones using the most recent collision data.

The City should establish a minimum score threshold that ensures the number of new Community Safety Zones remains realistic and feasible to implement.

City of Markham

Fatal and Serious Injury Collision Investigation Policy Paper

Vision Zero Road Safety Plan

CIMA+ file number: B001780
07 29 2025 – Review 03

City of Markham

Fatal and Serious Injury Collision Investigation Policy Paper

Vision Zero Road Safety Plan

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1. Introduction

The City has requested that CIMA assist them in updating their policy and procedure on conducting fatal and serious injury collision investigations based on best practices elsewhere in Ontario. Broadly speaking, the purpose of these investigations is to conduct a multi-faceted review that includes different service providers along with police in order to understand the circumstances surrounding the collision, causal factors that contributed to the collision and mitigating measures (if any) that would lessen the likelihood of the collision occurring in the future. Typically, these are low-cost treatments.

This policy paper is organized into the following sections:

- **Section 2** outlines the City's current approach to conducting fatal and serious injury collision investigations
- **Section 3** outlines the results of an environmental scan of neighbouring municipalities
- **Section 4** identifies enhancements to the City's approach to conducting fatal and serious injury collision investigations.

1.1 Need for Fatal and Serious Injury Collision Investigations

Conducting fatal and serious injury collision investigations is crucial in the context of Vision Zero. These investigations provide detailed insights into the causes of fatal crashes, helping to identify trends, systemic issues, and areas in need of improvement. By understanding the factors that contribute to these incidents—such as road design, traffic laws, vehicle safety, and driver behavior—authorities can implement data-driven solutions to prevent future fatalities. Thorough investigations also promote accountability, enhance public awareness, and support the creation of safer infrastructure, all of which are integral to achieving the City's Vision Zero's goals.

2. Current Procedures in the City of Markham

The following summarizes the current approach taken by the City. The City investigates fatal collision investigations with a focus on objective analysis and justifiable actions, rather than reacting impulsively to recent incidents. However, the City faces challenges due to inconsistent notification about fatal collisions, as there is currently no formal notification process in place. As a result, investigations are only being conducted when the City is informed.

York Region holds quarterly meetings with York Regional Police (YRP) to review fatal collisions, but the City has not yet been included in these discussions, despite expressing interest in participating.

The City wishes to improve communication and collaboration with YRP, recognizing that collective site meetings would provide valuable insights into what occurred during these collisions. The City is also open to having forms developed for City staff, which would include prompts to guide the office and field reviews. By enhancing communication and coordination with YRP and the Region, the City hopes to improve the effectiveness of its collision investigations and, ultimately, contribute to safer roads.

3. Environmental Scan

The environmental scan consisted of a review of the practices used by various road authorities across Ontario related to engineering investigations that are conducted when a fatal collision occurs on their road network along with collaboration with other stakeholders (i.e. police services). A summary of this review is provided below.

3.1 City of Ottawa

The City of Ottawa's engineering department investigates all fatal collisions occurring within the City. City staff have, in collaboration with Ottawa Police Services and the Coroner's Office, launched a multi-agency initiative (referred to as the Fatal Collision Review Committee) under the mandate of the Coroners Act, to share information on fatal collisions and collectively identify any recommendations that would prevent deaths in circumstances similar to those identified for the fatal collisions.

The goals of the Fatal Collision Review Committee are to:

- Review fatal collisions in a timely and confidential manner to help identify whether there are any systemic issues, trends, risk factors or problems leading to its occurrence
- Compile data for all fatal collisions in the City in an aggregate manner and provide it to those involved in traffic safety
- Make appropriate, practical recommendations to prevent deaths in similar circumstances, specifically education campaigns, enforcement initiatives, engineering modifications and other tools, as necessary.

This committee meets where practical within 10 days of a fatal collision to share relevant information, decide on any immediate recommendations and determine any further course of action, if required. The committee meets regularly at an interval of 2 months, if no collision occurs over this time period, to ensure continuity of follow-up. On a bi-annual basis, the committee meets to review aggregate data, identify trends and make any recommendations based on the trends. An annual report is produced as an output of these discussions. A copy of the Fatal Collision Review Committee's mandate is provided in **Appendix A**.

3.2 York Region

The following outlines the Region's current approach for investigating fatal collisions. The investigation is initiated when the York Region's Traffic Safety Group receive a notification from the York Regional Police's news feed concerning a fatal collision. This notification contains very basic information about the collision (date, time, general location, parties involved). Historically, York Region Police provided a copy of the Motor Vehicle Accident form which had additional valuable information; however, the police do not share this information now until their forensic investigation has been completed, which can take months.

Staff conduct a site visit to review the location of the collision, collect photos and videos, then complete the Fatal Operational Safety Review Field Sheet based on observations and other available information (i.e. news articles). This is supplemented by information gathered in the office (historical collision information, traffic data, etc.). Regional staff have shared that they have found the Fatal Operational Safety Review Field Sheet to be overly lengthy and cumbersome to complete.

Once the field and office reviews are completed, the Traffic Safety Group staff are expected to determine remedial measures in response to the identified safety issues, if any, and prepare work orders for any minor improvements. If major remedial measures are identified, the Traffic Safety Group staff prepares a "Project Definition Report" and circulates it among managers and directors for comment and potential implementation.

Senior Regional staff meet with York Regional Police, the Coroner's Office and School Boards on an ad hoc basis to discuss fatal and collisions that have occurred in the past quarter. At this meeting, the police provide further insights into the collisions. Regional staff have expressed a desire to formalize their own committee by means of developing a charter, setting out goals and establishing a meeting framework.

3.3 City of Toronto

City of Toronto staff review all collisions involving a serious injury or a fatality. Staff monitor press releases issued by Toronto Police Service and will complete a Major Collision Data Sheet that contains basic information about the collision (i.e date/time of occurrence, location, presence of vulnerable road users and a brief synopsis of the collision). At a later date, staff (as resources permit) conduct a site visit and complete a Safety Review Audit Sheet which is more detailed than the Major Collision Data Sheet. This sheet contains information on collision history, traffic data, road characteristics, sightlines, signage and traffic controls. On occasion, staff will make recommendations for improvements to signs, pavement markings and/or traffic signal timing.

Furthermore, City staff conduct site meetings together with City of Toronto Police Services and relevant internal City departments for any collision involving a vulnerable road user (identified as a pedestrian, cyclist or motorcyclist). At these site meetings, the circumstances surrounding the collisions are discussed and potential contributing factors are identified. Attendees are then invited to identify recommendations that would mitigate the risk of a similar collision happening at the location in the future. A report is then prepared summarizing the findings of the review and associated recommendations.

The City keeps a database of all recommendations identified at each of the site meetings and assigns them to the appropriate department along with a time frame for implementation.

3.4 City of Hamilton

The City of Hamilton recently adopted a more formal process for investigating fatal/serious injury collisions which consists of an office review and a field investigation. In the past, City staff in the Transportation Operations and Maintenance Group have expressed concern over the lack of communication with Hamilton Police Services (HPS), as they are learning about fatal/serious injury collisions via secondary sources (i.e. the media) rather than directly from the police.

Moving forward with fatal/injury collision investigations, they wish to more formally integrate their investigations with HPS. As part of the Vision Zero Update project, a meeting was held with HPS to understand better how the police conduct fatal/serious injury investigations and develop a better working relationship with HPS. Action items that came out of the meeting were to:

- Streamline the notification process
- Collaborate on future investigations (City participation)
- Identify causes and possible remedial measures associated with fatal/serious injury collisions as part of regularly scheduled meetings

3.5 Durham Region

Durham Region has developed a formal investigation process for fatal/serious-injury collisions independent of the police, involving field and office data reviews. Region of Durham staff work closely with Durham Regional Police; they are immediately notified of a fatal/serious injury collision, and staff will mobilize to undertake their parallel investigation as soon as practicable.

The tasks to be conducted by Durham staff as part of the field and office review are similar to those described in York Region's fatal collision investigation process.

Once the field and office review are completed, the Road Safety Section staff is expected to recommend remedial measures and document any actions taken (e.g. work orders). Any short-term and long-term recommendations are generally planned as future actions, and their implementation is coordinated to coincide with available programs.
To assist Durham staff in conducting and documenting the investigation, the Region has developed the following documents:

- **Collision Review Checklist:** Provides a detailed list of the information to collect on-site and from the office;
- **Fatal Collision Review Form:** Used to summarize the field and office review findings. The form is relatively short, and limited details can be included to describe the existing conditions and potential safety issues; and
- **Request for Sign and Pavement Marking Maintenance Form:** Submitted to obtain the details of the maintenance and inspection of the signs and pavement markings.

On a final note, Region of Durham staff hold regular meetings with Durham Regional Police and other stakeholders to collaborate on road safety-related matters. Recent fatal and serious injury collisions and lessons learned are discussed in those meetings.

3.6 City of Guelph

The City of Guelph currently has an informal investigation process of fatal collisions conducted independently of the police investigations. However, the City of Guelph works closely with the police to understand the collision circumstances and determine the potential contributing factors so that effective remedial measures can be implemented in a timely manner. The City of Guelph indicated that they are in the process of developing a standardized checklist that their staff will be able to use when collecting relevant background data and site conditions.

3.7 City of St. Catharines

The City of St. Catharines does not routinely undertake engineering investigations of fatal collisions. Engineering investigations of fatal collisions are only conducted when requested by councillors or City management. When an investigation is initiated, it consists of a site visit, a review of historical collision information, and the identification of remedial measures.

3.8 Region of Waterloo

The Region of Waterloo's practice is to investigate fatal collisions that occur within their jurisdiction. The investigation involves a quantitative analysis of the site by comparing observed collisions to predicted collisions using the Region of Waterloo's Safety Performance Functions (SPFs). They also identify the most frequent and over-represented collisions for a comparable location and determine if the site needs a safety improvement. The Regional staff undertake a field visit to determine if any deficiencies exist at the incident site and report on these conditions. No forms and/or checklists were received from the Region of Waterloo related to the investigation of fatal collisions.

3.9 Halton Region

The Region has implemented a formal investigation process that is initiated when a fatal and/or serious-injury collision occurs on their road network. The process involves an engineering investigation undertaken by Regional staff independent of any police investigations. The primary purpose of the investigation is to document the road environment conditions present at the time of the collision. The investigation includes a background data review and a site visit. The results of the investigation are documented in a Technical Memorandum.

3.10 Key Takeaways

The key findings from the practice review related to the engineering investigations of fatal/injury-related collisions are the following:

- **Type of investigations**: Road authorities of medium to large size have implemented a formal process to investigate fatal (and in some cases serious injury) collisions. The primary purpose of these investigations is to collect relevant background data and site conditions present at the time of the collision. Some road authorities are also assessing site conditions to determine the potential contributing factors and recommend potential remedial measures to address the identified safety issues. The City of Toronto is the only jurisdiction that does site meetings that involve different stakeholders, including the police.
- **Field and office reviews**: The investigation process used by the various road authorities all involve a field investigation and an office review.
- **Forms and checklists**: The City of Toronto, York Region and Durham Region have developed standard forms and checklists to assist staff conducting the investigations. The checklists summarize the key tasks that should be undertaken at

each step of the investigation process, and the forms are standard documents used to compile the collected data. Although the field and office checklists developed by both York and Durham Regions are very similar, the level of detail included in the forms is significantly different. The form used by York Region is extensive and would be useful for staff with little experience conducting safety reviews but could be cumbersome for experienced road safety staff. On the other hand, the form developed by Durham Region and the City of Toronto is brief and concise, and there is limited space available to describe the site conditions adequately.

- **Collaboration with police:** Information sharing with police was highlighted among several jurisdiction as an important step. The City of Toronto, Region of Durham and City of Ottawa regularly collaborate with police on information sharing.

Appendix B contains sample checklists and forms used by the Region of York, City of Toronto and Region of Durham.

3.11 Opportunities for Enhancement

The following recommendations were identified as opportunities to further enhance the current approach taken by City of Markham in conducting fatal and serious injury collision investigations:

- Streamline the existing form for conducting fatal/serious injury collision investigations
- Encourage more cross department collaboration
- Formally document findings and recommendations

Each of these recommendations are incorporated into the proposed policy as discussed below.

4. Recommended Policy

Figure 1 presents a flowchart providing an overview of the process for conducting fatal/serious injury collision investigations. An overview of the process is described after the flowchart.



Figure 1– Fatal/Serious Injury Collision Investigation Process

When the Manager receives the notification of a fatal or serious injury collision occurring, they should assign the investigation of the collision to their staff. Staff will then initiate the investigation engaging support staff as needed/available.

They will then complete and document the investigation using the proposed Fatal/Serious Injury Collision Investigation Form found in **Appendix C** along with a covering memo with all of the background materials identifying any actions to be taken. Steps included would be:

- Conduct an office review of collision and traffic data (Section 4.1)
- Conduct a field review (Section 4.2)
- Conduct a site meeting with affected parties and York Regional Police (Section 4.3)
- Identify follow-up actions to be taken (if applicable) and identify potential improvements (if applicable) and identify affected parties to be notified (Section 4.4)
- Submit completed Fatal/Serious Injury Collision Investigation Form to the Manager identifying any potential actions to be taken/potential improvements to be undertaken, parties to be notified along with a covering memo.

The Manager reviews the Fatal/Serious Injury Collision Investigation Form along with the covering memo and notifies any appropriate parties regarding any actions to be taken. The Manager then develops a short-, medium- and long-term action plan for the location and tracks in a spreadsheet.

Finally, the Manager participates in quarterly meetings with York Regional Police (and other affected parties). The above is used as input into the City's Road Safety Plan. Further information on each of the steps is discussed below.

4.1 Office Review

In the office, staff should undertake the following tasks:

- **Gather information/verify collision record in TES** – Copy of the Motor Vehicle Accident form (if available)
- **Gather supplementary information –** The following supplementary information may be gathered to form a complete picture of the collision and the general conditions at the collision site:
    - Media articles/videos/press releases obtained (digital or hard copy) relating to the collision
    - 5-year collision history/collision diagram
    - Network screening /over-representation results
    - Speed data (Average/85th percentile)
    - Turning movement count or automated traffic count data
    - Previous correspondence/public inquiries relating to the collision site
    - Past work orders/reports
    - Orthophoto of collision location
    - Planned improvements at the collision site as part of a capital/maintenance project

4.2 Field Review

In the field, staff should undertake the collision investigation as close as possible after the collision and, where practical, at a similar time of day so that the overall lighting and traffic conditions can be observed. The following items should be collected in the field:

- Video record all approaches to the location (ideally using a dashcam and driving on each approach to the location)
- Take digital photos of the site (on all approaches)
- Take digital photos of skid marks, evidence of vehicle going off-road, collision debris or damaged road infrastructure

While in the field, staff should observe and comment on the following items, filling in the appropriate box (as applicable):

- **Speed** – Record the posted speed and advisory speed (if applicable) and comment on the observed operating speeds at the site;
- **Illumination** – Note the presence, type and adequacy of illumination on site;
- **Pavement and Shoulder Condition** – Note the presence of potholes, a polished surface or rutting
- **Signs** – Note condition, location and suitability of regulatory, warning, guide or temporary construction signing in area. Note whether signs conform to applicable Ontario Traffic Manuals, are visible to approaching traffic, and have a retroreflective surface.
- **Pavement Markings** –Note the condition of centrelines, lane lines, edge lines, stop bars, crosswalks or symbols (as applicable).
- **Signals** – Note condition, location and visibility of traffic and pedestrian signals, countdown timers, and audible signals.
- **Roadside Protection** – Note the presence of any fixed object hazards or submergence hazards. Note the condition (if applicable) of roadside protection in the area.
- **Horizontal and Vertical Alignment/Sightlines** – Note if road geometry limits visibility on approaches to the collision site. Note the presence of vegetation that may be impacting sightlines for vehicles, pedestrians, and cyclists.
- **Environmental Factors** – Note any environmental factors that may have contributed to the collision, such as gravel or sand on the road, standing water, ice patches, or drifting snow.
- **Transit, Pedestrian and Cyclist Facilities** – Note the presence and condition of transit shelters, bus stops, sidewalks, curb cuts at crossings, trails, multiuse paths, or bicycle lanes.

The field investigation is not only an opportunity for the City to identify potential causal factors that may have contributed to the collision but also to identify potential non-related (to the collision) safety issues that require the City's attention.

4.3 Site Meeting

City of Markham staff should then arrange to conduct a site meeting with any affected parties alongside York Regional Police. The site meeting is an opportunity to bring everyone together to collectively discuss the circumstances of the collision, contributing factors and potential solutions. This site meeting will be key for staff to gain further insight into the collision, particularly if the MVA form has not yet been released by York Regional Police. Specific areas of interest would be the exact location of the collision, actions and condition of the involved parties and whether any charges were laid. Depending on the collision, aside from York Regional Police, the following parties may wish to attend the site meeting:

- York Transit
- Traffic Engineering (City)
- Roads Operations (City)
- Infrastructure Capital (City)
- Utility & Right-of-Way (City)

For efficiency, site meetings at multiple locations may be scheduled on the same day.

4.4 Documentation and Actions To Be Taken

Following the above, the following should be undertaken:

- **Identify follow-up actions –** Based on the information gathered, follow-up actions may be identified, including:
    - Requesting a signal operation review
    - Requesting repairs to damaged road infrastructure
    - Clearing/grubbing vegetation
    - Arranging for additional traffic count or speed study
    - Reviewing posted speed
    - Verify the need for a traffic signal/pedestrian signal/pedestrian crossover (warrant check)
    - Notify other departments
- **Identify improvements for consideration** – Finally, potential improvements for consideration may be identified, including:
    - Speed management/traffic calming
    - Pavement/shoulder improvements
    - Pavement marking improvements
    - Removing a fixed object/installing roadside protection
    - Illumination improvements
    - Sign improvements
    - Traffic signal improvements
    - Sightline improvements

- Transit, pedestrian and bicycle facility improvements
- Geometry improvements

The completed Fatal and Serious Injury Motor Vehicle Collision Investigation Form, along with a covering memo with all of the background information appended to the back, should be provided to the Manager.

The Manager then reviews the Fatal and Serious Motor Vehicle Collision Investigation Form along with the covering memo with the background information and notifies appropriate parties regarding any actions to be taken.

4.5 Quarterly Meetings

City of Markham staff should consider participating in regularly scheduled meetings with York Regional Police (and other affected parties) for the purposes of:

- Reviewing recent fatal collisions
- Identifying contributing factors and recommended course of action
- Identifying lessons learned
- Identifying and maintaining a list of action items (pending and completed)
- Identifying broader issues

Appendix A
City of Ottawa Fatal Collision Review Committee's Mandate

Fatal Collision Review Committee
Terms of Reference

The Fatal Collision Review Committee (FCRC) is a multi agency initiative under the mandate of the *Coroners Act*, comprised of the Ottawa Police Service, the City of Ottawa, the Eastern Regional Supervising Coroner's Office, and others as required, to promptly facilitate the sharing of information following fatal collisions within the municipality and determine if any recommendations are possible to prevent deaths in circumstances similar to those of the death.

1 Goals

The goals of the FCRC

a. Review a collision in a timely, confidential manner, to help identify whether there are any systemic issues, trends, risk factors or problems leading to its occurrence.
b. Compile data for all fatal collisions in the City of Ottawa in an aggregate manner and provide it to those involved in traffic safety
c. Make appropriate, practical recommendations to prevent deaths in similar circumstances, using the following:
   Education Campaigns
   Enforcement Initiatives
   Engineering Modifications
   Other tools, as necessary

The recommendations should provide insightful information while respecting privacy, so recipients can best consider them in the hope of reducing future fatal collisions.

2 Process

The FCRC will meet

a. Where practical, within 10 days of a fatal motor vehicle collision, to share relevant information, decide on any immediate recommendations and determine a further course of investigation, if required.
b. Regularly, at an interval of 2 months, if no collision occurs over this time period, to ensure continuity of follow up, regarding information requests, investigation findings, action items or responses to recommendations for a fatal motor vehicle collision.
c. Bi-annually to review aggregate data, identify any trends and make any recommendations based on this information. These meetings would also be used to produce an annual report. The annual report would include a review of all fatal collision

data, identification and documentation of trends, all recommendations, as well as any responses arising.

d. The projected timelines for the bi-annual meetings:

i. Mid-July (for the first half of the year)
ii. Mid-January (for the annual report)

3. Membership

The membership of the FCRC consists of the following:

Fatal Collision Review Committee (FCRC) Membership	
Organization	**Members**
Eastern Regional Supervising Coroner's Office	Regional Supervising Coroner (or designate)
Ottawa Police Service	Superintendent, Emergency Operations Divisions
	Staff Sgt. Collision Investigations (Chair)
	Staff Sgt. Traffic Escort and Enforcement
	Sgt. Collision Investigations Unit
City of Ottawa	Director of Traffic Services
	Associate Director of Traffic Services
	Program Manager of Traffic, Safety & Mobility
	Program Manager of Road Safety
	Senior Engineer, Road Safety Studies
	Program Coordinator, Safer Roads Ottawa
	Data Analyst, Safer Roads Ottawa
Ottawa Public Health	Associate Medical Officer of Health

Other ad hoc members, as required by the FCRC, may be added the membership list. These members will be required to sign the *Confidentiality and Privacy Requirements* in section 4 prior to attending their first meeting.

The Chair of the FCRC will be chosen by membership consensus and will ensure that all delegates of members or new members are made aware of these Terms of Reference and will comply with the *Confidentiality and Privacy Requirements*, including signing a confidentiality agreement.

4. Confidentiality and Privacy Requirements

FCRC members will receive and discuss information and/or documents that are both confidential and private. Members must use this information solely for the purpose of making effective recommendations for reducing future fatal collisions. Both during and after a member's term with the FCRC, the member must:

a. Respect the confidential and private nature of all information obtained from the FCRC, including the Minutes of FCRC Meetings, through holding this information in strict confidence;

b. Only disclose or share information obtained from the FCRC, after review and approval by the FCRC itself, for the purpose of explaining FCRC recommendations, unless otherwise required by law;

c. Take all reasonable precautions to protect information obtained from the FCRC from theft, loss, or other unauthorized disclosure (e.g. all confidential FCRC documents will be stored by the Regional Supervising Coroner office, in association with the specific death investigation files, and not reside in any other storage site);

d. Notify the Chair of the FCRC, the Eastern Regional Supervising Coroner's Office, the City of Ottawa, and the Ottawa Police Service ("the Agencies") in writing upon becoming aware of any breach to these confidentiality and privacy requirements; and

e. Notify the Agencies before disclosing information under the *Municipal Freedom of Information and Protection of Privacy Act, Freedom of Information and Protection of Privacy Act,* or any other applicable law.

f. Acknowledge that failing to comply with these confidentiality and privacy requirements will result in the member being removed from the FCRC and liable to further legal action.

Acknowledgement of confidentiality and privacy requirements

Name of FCRC member _____

Title & Organization _____

Signature of FCRC member _____ Date _____

Appendix B
Data Collection Forms

4.1 FATAL MOTOR VEHICLE COLLISION INVESTIGATION

Revision Date: March 5, 2018

York Region's Traffic Safety Group conducts detailed reviews at the locations of fatal motor vehicle collisions, as soon as practical after the occurrence. York Regional Police generally send out an email to notify Regional staff about a fatal incident. The review consists of a field and office review component (see following page). The following steps are involved:

- Traffic Safety Group staff notified of fatal collision occurrence
- Traffic Safety Group staff request MVAR as soon as possible from York Regional Police Traffic Department
- Regional staff conduct Fatal Motor Vehicle Collision Investigation
- Regional staff enter information into Fatal Collision spreadsheet
- Traffic Safety Group discuss opportunities to implement measures to address issue (if any)

The following pages contain a checklist to be completed when conducting a fatal collision review.

FATAL MOTOR VEHICLE COLLISION REVIEW	
Study Location:	
Date:	
Time:	
Reviewed By:	
Weather/Road Conditions:	

Field Review Component	Completed? (Y/N)
Videotape all relevant directions of the intersection or midblock section	
Conduct a digital photo inventory of the site and its approaches noting items such as skid marks/gouges, run-off-the-road marks, or collision debris	
Review and assess condition of pavement markings – make note of any deficiencies – make note of marking types in area (centerline, lane lines, edge lines, stop bars, crosswalks and symbols)	
Review and assess condition, location and suitability of all traffic control devices in the area: • Regulatory • Warning • Guide and information • Temporary conditions/construction) Make note of any deficiencies including signs (or signal heads) obscured by trees, buildings, etc., and advance placement distances	
Note of speed limit and advisory speed (if applicable)	
Note presence and location of any illumination	
Note presence and location of any roadside protection or delineation devices including roadside pavement markers	
Review intersection sightlines and note any impairment to driver visibility. Consider any trees, brush or tall grass that may not be filled out	
Note road geometry (horizontal and vertical) and note any potential impairments to road user visibility	
Assess pavement and shoulder condition in area including pavement edge drop-off, drainage, slope and the stability of the material	
Note any unusual surface conditions, such as potholes, gravel or sand on the road, standing water or ice, etc.	
Office Review Component	
Contact York Region Police to obtain copy of MVAR. If possible, discuss circumstances with investigating officer to gain additional information or insight regarding the collision specifics (i.e., sequence of events, medical episode, impairment, suicide, etc.)	
Obtain any media articles related to the collision in hard copy or from internet). Check www.yrps.ca and other major media sources	

Field Review Component	Completed? (Y/N)
Run a 7 year TES report for the collision location	
Run a TES analysis and Collision Characteristics Summary for location noting any patterns. Collision diagram/midblock summary not required unless already available and/or easily updated	
Print aerial photograph of area	
Print latest TMC for intersections or obtain most recent AADT value for midblock locations. Calculate AADT from TMC if required	
Report POI rank and value for the location	
Request signal operation review and follow-up memo from Traffic Signals Group for signalized intersection	
Note any recommendations for improvements for consideration	
Document any actions taken (e.g., work orders) and include copies in file	
Send work orders to Area Superintendents for any minor improvement (e.g. sign installation or removal).	
If major improvement is identified, prepare a Project Definition Report (PDR) and circulate among Managers and Director for comment, and then send to Capital Delivery and Project Management Office (PMO) for consideration and delivery.	

Due to privacy legislation compliance, only this page and the information below may be disclosed to the City of Toronto

☐ **Special Investigations Unit Collision**
(NOT TO BE RELEASED TO THE CITY OF TORONTO IF COLLISION INVOLVES THE SIU)

G.O#: 2022-145221 Patrol Area:121

Fatal #: PI#: Previous PI # if now fatal: Other Type: #

Date of collision: [redacted] Time: [redacted] Day of the week: [redacted]

Date of death: Time: Day of the week:

Type of collision ☐ -Cyclist Struck ☐ - Driver ☐ - Motorcyclist ☐ - Pedestrian ☐ - Passenger

Location: [redacted]

Involved person details: [redacted]

Involved Vehicle: Age: [redacted] Sex: [redacted]

Involved person details: [redacted]

Involved Vehicle: Age: Sex:

Involved person details: [redacted]

Involved Vehicle: Age: [redacted] Sex: [redacted]

Involved person details:

Involved Vehicle: Age: Sex:

Involved person details:

Involved Vehicle: Age: Sex:

Involved person details:

Involved Vehicle: Age: Sex:

[redacted]

TORONTO

City of Toronto Transportation Services
Safety Review Audit Sheet

Location:
Collision Date and Time:
Nature of Collision:
Motor Vehicle Collision (MVA#):

Condition Diagram / Aerial Map (below):

Existing Conditions:

Traffic Volume (Vehicle/day):

Pedestrian Volume: 8 hour study:

Radar Speed Study: Speed Limit:

Road Width/ # of lanes**:**

Pavement markings**:** Visible - ☐**,** Obscured/faded - ☐ , etc (list abnormalities)

Pavement condition**:** **S**mooth - ☐, Rutted - ☐**,** Large pot holes - ☐**,** C**r**acked - ☐**,** etc. (list abnormalities)

Horizontal or Vertical Curves: Yes ☐or No ☐

Concrete Sidewalks (CSW) if applicable: Yes ☐or No ☐
(Additional Comments to be listed)

Pedestrian Access Curb Depressions: Yes ☐ or No ☐
Location, which Side/Corner/Direction: midblock crossing

Zebra Markings: Yes ☐ or No ☐ or N/A☐

Other Amenities:

Street lighting: Yes ☒ or No ☐
(Yes or No and Operational)

Transit Stop Locations:

Transit Passenger Shelters: Yes ☐ or No ☐

TORONTO

City of Toronto Transportation Services
Safety Review Audit Sheet

School Zone: Yes ☐ or No ☐

Parking/ Stopping/ School Bus Loading Zone or Standing Regulations:
(Listing of Regulations)

Northbound:
Southbound:
Eastbound:
Westbound:

Sightline Review:

Sight Lines for Motorists re Visibility: Clear and unobstructed Yes ☐ or No ☐
Sight Line for Pedestrians re Visibility: Clear and unobstructed Yes ☐ or No ☐

Signage Review:

Any Missing Signage: Yes ☐ or No ☐:
Provide Listing:

Signage Condition: Good ☐ or Fair ☐ or Bad ☐

Traffic Control Type:
(Tick one or multiple)

TCS-displays - ☐ *Pedestrian Crossover*- ☐ *Stop Control* - ☐,
Pedestrian Refuge Island - ☐ *School Crossing* - ☐, *Non/Mid-block* - ☐

Adjacent Traffic Controls:

Road	Type	Location	Distance
	Traffic Control Signals	**South**	**metres**
	Traffic Control Signals	**North**	**metres**
	Traffic Control Signals	**East**	**metres**
	Traffic Control Signals	**West**	**metres**

Count Down Timers: Yes ☐ or No ☐

TORONTO

City of Toronto Transportation Services
Safety Review Audit Sheet

Audible Pedestrian Signal (APS), (if applicable): Yes ☐or No ☐

Pedestrians – Clearance Distances & Walk / FDW timings (if applicable)

North Side _____m.	**Observed Walk Display _____sec.**	**F.D.W. _____sec.**
South Side _____m.	**Observed Walk Display _____sec.**	**F.D.W. _____sec.**
East Side _____m.	**Observed Walk Display _____sec.**	**F.D.W. _____sec.**
West Side _____m.	**Observed Walk Display _____sec.**	**F.D.W. _____sec.**

Collision History:

Year	2017	2018	2019	2020	2021	Total
Pedestrian						
Other						
Total						

Charges:

Driver: Yes ☐ or No ☐ or Unknown ☐
Pedestrian: Yes ☐or No ☐ or Unknown ☐

Attachments:

Toronto Police Services News Release Yes ☐ or No ☐
Collision Diagram and Summary (5 year) Yes ☐ or No ☐
Collision Report Yes ☐ or No ☐
Plan View (1:500, preferably 11x17 size) Yes ☐ or No ☐
Scanned PX Drawing, (preferably 11 X17 size) Yes ☐ or No ☐
Intersection/Mid-block traffic counts Yes ☐ or No ☐
Vehicle Speed Studies Yes ☐ or No ☐
Digital Pictures of Field Conditions Yes ☐ or No ☐
Safety Review Prompt List: Yes ☐ or No ☐

Staff Comments/ Recommendations:

Prepared By:_____Date: _____

TORONTO

City of Toronto Transportation Services
Safety Review Audit Sheet

View #1

View #2

FATAL AND SERIOUS MOTOR VEHICLE COLLISION REVIEW

Field Review Checklist

Whenever practical, the field review should be completed as soon as possible after the event, and at a similar time of day.

- ❑ Videotape all relevant directions for intersection or midblock section
- ❑ Take digital photos of site – note items such as skid marks, run off the road marks or collision debris
- ❑ Review and assess condition of pavement markings – make note of any deficiencies – make note of marking types in area (centerline, lane lines, edge lines, stop bars, crosswalks and symbols)
- ❑ Review and assess condition, location and suitability of all signing in area (regulatory, warning, information, temporary construction) – make note of any deficiencies including signs (or signal heads) blocked by trees, etc. and advance placement distances
- ❑ Make note of speed limit and advisory speed (if applicable)
- ❑ Note presence and location of any illumination
- ❑ Note presence and location of any roadside protection or delineation devices including RPM's
- ❑ Review intersection sightlines and note any impairments to driver visibility – consider any trees or brush that may not be filled out or tall grass
- ❑ Note road geometry (horizontal and vertical) and note any associated impairments to driver visibility
- ❑ Assess pavement and shoulder condition in area
- ❑ Make note of any unusual conditions, such as potholes, gravel or sand on the road, standing water or ice, etc.

Office Review Checklist

- ❑ Date of Contact _____with DRP lead officer to obtain copy of MVAR – discuss circumstances with officer if possible to gain additional information or insight (medical episode, suicide)
- ❑ MVAR Copy and Data entry in Matrix
- ❑ Obtain any media articles on the collision (hard copy or from internet). Check www.drps.ca and www.durhamregion.com
- ❑ **Run 7 year Matrix report for the relevant location**
- ❑ **Run Matrix analysis and Collision Characteristics Summary (new) for location – note any patterns – *collision diagram/midblock summary not required unless already available and/or easily updated***
- ❑ **Print latest TMC for intersections or obtain most recent AADT value for midblock locations – calculate AADT from TMC if required**
- ❑ **Calculate 7-year PSI values for the location using new methodology**
- ❑ Request signal operation review and follow-up memo from Systems group for signalized intersection
- ❑ Print aerial photograph of area and print photos to include in file
- ❑ Send Depot Review form to Signs & Markings Supervisor sent: _____ returned: _____
- ❑ Note any recommendations for improvements for consideration
- ❑ Document any actions taken (e.g.: work orders) and include copies in file
- ❑ Complete file and return to OT5 and or Supervisor

Traffic Engineering and Operations Division

FATAL MOTOR VEHICLE COLLISION REVIEW

TO:

From:

Date: YYYYMMDD

Re: Privileged and Confidential Correspondence - MVAR 00-000000

MVAR #: 00-000000 **Date:** **Time:**
DRPS Lead Collision Investigator:
Road Name and Number:
Location Description:
Intersection/Midblock: **Traffic Control:**
Driver Impairment: **Area Municipality:**

Description of Circumstances:

‘

Injured Parties

Name	Age	Residency	Injury Type

Road Environment

Dusk/Dawn/Night/Day	**Alignment:**
Rural / Urban:	**Surface Condition:**
Posted Speed:	**Advisory Speed:**
Signalization:	**Signals Investigation**

Other Factors:

Traffic Engineering and Operations Division

FATAL MOTOR VEHICLE COLLISION REVIEW

Other Factors Cont'd.

Illumination:
Pavement Markings:
Driver Visibility:
Signage Quality
Signage Message:
Collision History
PSI Index:
AADT or 24h entering volume
Photos/Video of vicinity
Supplemental Plans:
Media and Police Releases

Recommended improvements to pavement markings, signage, roadside protection, illumination, or road geometry:

Site Investigation Lead by: Date:

Submitted By:

Date:

Appendix C
Fatal / Serious Injury Collision Data Collection Form

FATAL AND SERIOUS MOTOR VEHICLE COLLISION INVESTIGATION FORM *(Sheet 1 of 2: Field Review)*

Location

Street 1 ☐ At ☐ Near

Street 2

Light Condition at Time of Collision

☐ Day ☐ Night

Whenever practical, the field review should be completed as soon as possible after the event and at a similar time of day.

FIELD REVIEW CHECKLIST

☐ Video record all approaches to location

☐ Take digital photos of site (all approaches)

☐ Take digital photos of skid marks, evidence of vehicle going off-road, collision debris or damaged road infrastructure

Speed

☐ Posted ☐ Advisory (if applicable)

Observe and comment on operating speeds at collision site.

Pavement and Shoulder Condition

Note presence of potholes, a polished surface or rutting.

Pavement Markings

Note condition of centrelines, lane lines, edge lines, stop bars, crosswalks or symbols (as applicable).

Roadside Protection

Note presence of any fixed object hazards or submergence hazards. Note condition (if applicable) of roadside protection in area.

Environmental Factors

Note any environmental factors that may have contributed to the collision such as gravel or sand on road, standing water, ice patches, or drifting snow.

Illumination

Note presence, type and adequacy of illumination.

Signs

Note condition, location and suitability of regulatory, warning, guide or temporary construction signing in area. Note whether signs conform to applicable Ontario Traffic Manuals, are visible to approaching traffic, and have a retroflective surface.

Signals

Note condition, location and visibility of traffic and pedestrian signals, countdown timers, and audible signals.

Horizontal and Vertical Alignment/Sightlines

Note if road geometry limits visibility on approaches to collision site. Note presence of vegetation that may be impacting sightlines for vehicles, pedestrians and cyclists.

Transit, Pedestrian and Cyclist Facilities

Note presence and condition of transit shelters, bus stops, sidewalks, curb cuts at crossings, trails, multiuse paths, or bicycle lanes.

FATAL AND SERIOUS MOTOR VEHICLE COLLISION INVESTIGATION FORM *(Sheet 2 of 2: Site Meeting and Office Review)*

SITE MEETING

York Regional Police

☐ Site Meeting Conducted

Name of Officer

Date/Time

Note circumstances surrounding collision, apparent driver action(s) and extenuating circumstances

OFFICE REVIEW

☐ Copy of MVA report obtained

☐ Collision data in TES database verified

Media

☐ Media articles / videos / press releases obtained (digital or hard copy)

Background Review

☐ 5-year collision history/collision diagram

☐ Network screening results/over-representation

☐ Speed data (Average/85th percentile)

☐ TMC (intersection) or ATR (midblock)

☐ Previous correspondence/public inquiries

☐ Past work orders/reports

☐ Orthophoto of collision location

☐ **Note:** Police reports, media and background review information to be assembled and attached to back of memorandum

Follow up actions

☐ Request signal operation review from Traffic Signals Group

☐ Request repairs to damaged road infrastructure

☐ Clearing/grubbing vegetation

☐ Arrange for additional traffic count or speed study

☐ Review posted speed

☐ Apply traffic signal/pedestrian signal warrant

☐ Apply all-way Stop warrant

☐ Notify following affected parties (list below)

Note any other follow up actions identified as being required.

Improvements for Consideration

☐ Modify speed limit

☐ Pavement/shoulder improvements

☐ Pavement marking improvements

☐ Remove fixed object/install roadside protection

☐ Illumination improvements

☐ Sign improvements

☐ Traffic signal improvements

☐ Sightline improvements

☐ Transit, pedestrian and bicycle facility improvements

Provide any additional explanation on the improvements listed above

☐ Memorandum documenting the investigation, findings and actions taken with all background information appended completed

City of Markham

Protected-Permissive/Fully Protected Left-turn Phasing Policy Paper

Vision Zero Road Safety Plan

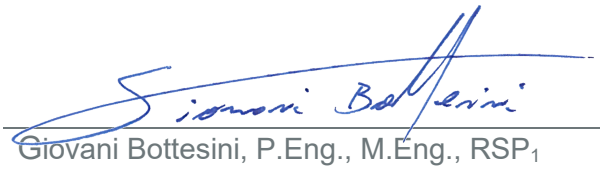
CIMA+ file number: B001780
July 2, 2025

City of Markham

Protected-Permissive/Fully Protected Left-turn Phasing Policy Paper

Vision Zero Road Safety Plan

Prepared by:



Giovani Bottesini, P.Eng., M.Eng., RSP$_1$

Verified by:

Soroush Salek

Soroush Salek, Ph.D., P.Eng.

400-3027 Harvester Road, Burlington, ON
Canada L7N 3G7

CIMA+ file number: B001780
July 2, 2025

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1. Introduction

The City of Markham (the City) has engaged CIMA Canada Inc. (CIMA+) to support the development of a comprehensive Road Safety Plan (RSP), aimed at enhancing road safety and reducing traffic-related risks across the community. As part of this larger initiative, the project will include the creation of seven detailed policy papers that will guide the City's efforts in improving road safety. These papers will address a range of key issues, including fatal and serious injury collision investigation, traffic inquiry process, and traffic calming and speed management.

This memorandum outlines the policy paper on Protected-Permissive/Fully Protected Left-turn Phasing, developed as part of *Task 4-6: Develop Policy Papers and Guidelines*.

1.1 Purpose

The purpose of this paper is to assess the City's current policies and practices for reviewing signal phasing for left turns at municipal signalized intersections. The assessment is based on intersection traffic operations (traffic volumes, delay, and queueing) and traffic safety (collisions) and will specifically address the process used to implement protected-permissive and fully protected left turn phasing by summarizing the following activities:

- An environmental scan;
- The City's current left turn phase implementation methodology;
- Best practices and recommendations; and
- Guidelines for justification, criteria and procedures for implementing protected-permissive and fully protected left turn phasing in Markham.

1.2 Overview

The development of the policy is documented in detail in the following sections:

- **Section 2: Types of Left Turn Phases**
- **Section 3: Current Practice in the City of Markham**
- **Section 4: Environmental Scan**
- **Section 5: Recommendations**
  - Determining the Need for Left Turn Phase
  - Determining the Type of Left Turn Phase
  - Determining Time of Day Operational Characteristics for Protected-Permissive Left Turn Phases

1.3 Need

Collisions involving left-turning vehicles and through vehicles in the opposing direction have a relatively high risk of resulting in injuries to vehicle occupants. One of the most effective ways of reducing the risk of these collisions is to temporally separate these movements through the use of fully protected or protected-permissive signal phasing.

However, this measure typically reduces the capacity of the opposing through movement, which may create or aggravate congestion and queues, potentially increasing driver frustration and aggression, which may increase the risk of other types of collisions.

For this reason, it is important to define certain criteria to guide the decision whether protected left turn phasing should be implemented at a specific intersection, and if so, which type is most appropriate.

2. Types of Left Turn Phases

There are three common types of left turn phases used in Ontario; permissive, protected-permissive, or fully protected. The definitions of each of these left turn phase types is listed below.[1,2,3]

Permissive Left Turn Phase

A permissive left turn phase requires left turning drivers to yield the right-of-way to conflicting vehicular and pedestrian traffic before completing the turn. In this mode, the left turn is served concurrently with the adjacent through phase/movement.

Protected-Permissive Left Turn Phase

This mode represents a combination of a protected and a permissive mode. In this mode the left turn movement is provided the right-of-way during a protected interval, then following, drivers can also complete the turn permissively when the right-of-way is given to the opposing through movement.

The interval that is protected acts as a “subordinate” phase within a parent through movement phase. This mode provides a compromise between mobility and safety as the left-turning movement is prioritized for a portion of each cycle, allowing for larger left-turn throughput without any conflicting movements.

[1] Ontario Traffic Manual (2012), Book 12: Traffic Signals, Ministry of Transportation Ontario.
[2] Manual of Uniform Traffic Control Devices for Canada, Sixth Edition (2021), Transportation Association of Canada.
[3] Federal Highway Administration (2008), Traffic Signal Timing Manual, US Department of Transportation.

Fully Protected Left Turn Phase

In a fully protected operation, the right-of-way is assigned to the left turning movement and left turning vehicles are not permitted to enter the intersection after the left turn phase has ended. This mode provides the safest left turn alternative as there is no conflicting traffic; however, the protected only left turn phase increases delay for left turn vehicles as well as increases the lost time in the cycle, thereby increasing delay for other movements.

3. Current Practice in the City of Markham

The City of Markham currently follows the City's and York Region's Design Guidelines and Transportation Mobility Guidelines, where the focus is mostly on geometric elements or minimum intervals for left turn phases. However, no criteria for where left turn phases are required are provided other than whether the need is identified based on operational analysis (for example, as part of transportation impact assessments).

4. Environmental Scan

An environmental scan was conducted, which included reviews of the Ontario Traffic Manual (OTM) Book 12 – Traffic Signals[1], Federal Highway Administration (FHWA) Traffic Signal Timing Manual[3], Highway Safety Manual (HSM)[4], Transportation Association of Canada (TAC) Manual of Uniform Traffic Control Devices[2], and academic studies by Dr. Hauer and Dr. Srinivasan et al. that discuss left turn operations and safety[5,6].

4.1 Objectives of Implementing Protected-Permissive/Fully Protected Left Turn Phases

The purpose of a traffic signal is to provide alternating right-of-way between competing movements.

A left turn movement in the permissive mode must yield to several conflicting/opposing movements in order to make a safe manoeuvre. This includes yielding to the opposing through and right turning movements and yielding to pedestrian traffic crossing the downstream receiving lanes. Often, a left turn movement begins from a rest state (stopped) and is performed at much lower speeds than through movements. For the aforementioned reasons, left turning vehicles take more time to clear the intersection compared to other movements as they must wait for a suitable gap to make a safe turn. Therefore, they are considered the riskiest and most disruptive movements in the operation of an intersection.

[4] Highway Safety Manual (2010), American Association of State Highway and Transportation Officials.
[5] Hauer, E. Left turn Protection, Safety, Delay and Guidelines: A Literature Review, 2004.
[6] Srinivasan, R., Council, F., Lyon, C., Gross, F., Lefler, N., Persaud, B., 2008. Safety effectiveness of selected treatments at urban signalized intersections. Transp. Res. Rec.: J. Transp. Res. Board 2056, 70–76.

As the volume of left turning traffic or the volume of the opposing traffic increases, it may become necessary to introduce a left turn protected-permissive phase to improve the traffic operations by increasing the capacity for vehicles making the left turn movement. This will result in reduced delay for left turns and can limit queueing to within the available storage bay. However, this might not always be justifiable from an operational efficiency perspective. Although the higher priority phasing will reduce left turn delays and queueing, it will usually increase the overall delay at the intersection since a portion of the cycle time is dedicated to a single lane left turn movement compared to time allocated to multiple through lane movements.

A fully protected phase may be introduced to address a specific safety issue. If there is the potential for collisions resulting from the left turn movement, a fully protected phase should be considered.

This increased collision potential could be the result of a long left turning travel path, complex gaps associated with 3 or more opposing through lanes, high opposing traffic and/or pedestrian volumes, constraints with sight lines or high opposing approach speeds. Fully protected left turn phases should be implemented only after careful consideration because they create the highest overall delays to both the left turning traffic and the intersection in general compared to any other type of left turn phase. These added delays are the result of restricting the movement of the left turning vehicles to their phase (at all times of day and in all traffic conditions) and allocating a portion of the cycle time to the clearance intervals for the protected only phase, which tend to be longer than those used for the protected-permissive phase.

There is inevitably a trade-off between safety and mobility. As discussed above, modifications that are intended to enhance safety for left turns in general will often negatively impact mobility. Road agencies have established different practices to help practitioners decide between these competing objectives when determining whether to implement left turn phases.

4.2 Measuring the Effect of Implementing Protected-Permissive/Fully Protected Left Turn Phases

Several studies in literature have attempted to quantify the safety impact of adding left turn protected-permissive and fully protected phases. Installing either of these left turn phases will reduce conflicts between the left turning movement and the opposing vehicular and pedestrian traffic. While this would likely reduce the number of left turn related collisions, the debate remains on how it impacts other types of collisions. In this regard, there has been conflicting evidence with some studies concluding that it has no effect and other studies demonstrating that it might increase other types of collisions such as rear-end collisions. The most reliable CMFs typically become part of the Highway Safety Manual.

Highway Safety Manual

The HSM[4], first published in 2010, is one of the leading references in road safety engineering. The HSM provides an estimate of the safety impact of adding a left turn phase to signalized intersections. The HSM refers to Collision Modification Factors (CMF) to estimate the potential change in the expected collision frequency at a site due to implementing a treatment on that site; in this case the treatment is the introduction of a left turn phase. Indeed, CMFs represent the relative change of collision frequency under two different conditions, typically these conditions are with and without the treatment in question.

$$CMF = \frac{Expected\ Average\ Crash\ Frequency\ with\ Site\ Condition\ b}{Expected\ Average\ Crash\ Frequency\ with\ Site\ Condition\ a}$$

Condition “a” serves as the base condition, while condition “b” serves as the condition after treatment is applied. This allows for a comparison of the treatment against the base condition. If the value of the CMF is:

- **Less than one**, the **treatment reduces the average collision frequency** in comparison to the base condition.
- **Equal to one**, the **treatment has no effect** on reducing the collision frequency in comparison to the base condition.
- **Greater than one**, the **treatment is expected to increase the collision frequency** in comparison to the base condition.

According to the HSM, the CMFs shown in **Table 1** could be used to estimate the effect of modifying the left turn phase at one or more approaches of a signalized intersection.

Table 1: CMFs of Modifying Left Turn Phase on One Intersection Approach

Treatment	Collision type	Collision Severity	CMF	Standard Error
Change from permissive to fully protected	Left-turn	All severities	0.01	0.01
	All types	All severities	0.94	0.10
Change from permissive to protected-permissive	Left-turn	Injury	0.84	0.02
	All types	All severities	0.99	Unknown

The CMFs in **Table 1** indicate that changing from permissive to fully protected left turns nearly eliminates left-turn collisions – an expected outcome given the separation, in time, of conflicts between left-turning vehicles and opposing through traffic. Additionally, this change has a CMF of 0.94 for all collision types, with a standard error of 0.10. This suggests that the change does not have a statistically significant effect on the overall collision frequency.[7]

[7] The 95% confidence interval for the CMF is calculated using the equation: CMF ± 1.96 * (standard error). Applying this formula results in a confidence interval of [0.74 – 1.14]. Therefore, the effect of changing from permissive to protected-only left turns on all collision types is inconclusive from a statistical perspective.

Regarding the change from permissive to protected- permissive, the CMF of 0.84 indicates an average reduction of 16% in left-turn collisions involving injuries and a minimal effect when considering all types and severities of collisions.

The FHWA CMF Clearinghouse

The CMF Clearinghouse[8] is a website which has compiled traffic safety research papers and reports on the safety effects of various collision countermeasures. The CMF Clearinghouse was reviewed to investigate how the change from permissive or protected-permissive to fully protected (**Table 2**) and from permissive to protected-permissive (**Table 3**) impacts collision frequency. The findings align with those reported in the HSM:

- Changing from permissive or protected-permissive to fully protected left turns nearly eliminates left-turn collisions.
- Changing from permissive to protected-permissive reduces the frequency of left-turn collisions (CMF = 0.86 in the Clearinghouse and 0.84 in the HSM).
- Both types of changes have minimal effect on the total collision frequency at the intersection, partly due to the potential increase in rear-end collisions (**Table 3**).

Table 2: Change from Permissive to Fully Protected

Treatment	Collision Type	CMF	Source
Change from permitted or protected-permissive to fully protected	Angle	0.01	Harkey et al., 2008[9]
	All	0.99	Harkey et al., 2008[9]
Replace permissive with fully protected	Angle	0.021	Srinivasan et al., 2008[6]

Table 3: Change from Permissive to Protected-Permissive

Treatment	Collision Type	CMF	Source
Change from permissive to protected-permissive phasing	All	0.99	Harwood et al., 2000 (HSM)[10]
Change permissive left turn phasing to protected-permissive	Left Turn	0.862	Srinivasan, et al., 2011 (HSM)[11]
	Rear End	1.075	
	All	0.962	

[8] https://cmfclearinghouse.fhwa.dot.gov/index.php
[9] Harkey, D.L., R. Srinivasan, J. Baek, F. Council, K. Eccles, N. Lefler, F. Gross, B. Persaud, C. Lyon, E. Hauer, and J. Bonneson. National Cooperative Highway Research Report 617: Accident Modification Factors for Traffic Engineering and ITS Improvements, NCHRP, Transportation Research Board, Washington, DC, 2008.
[10] Harwood, D. W., Council, F. M., Hauer, E., Hughes, W. E., and Vogt, A., "Prediction of the Expected Safety Performance of Rural Two-Lane Highways." FHWA-RD-99-207, McLean, Va., Federal Highway Administration, (2000).
[11] Srinivasan, R., Baek, J., Smith, S., Sundstrom, C., Carter, D., Lyon, C., Persaud, B., Gross, F., Eccles, K., Hamidi, A., and Lefler, N., "NCHRP Report 705: Evaluation of Safety Strategies at Signalized Intersections.", Washington, D.C., Transportation Research Board, National Research Council, (2011).

Reported Studies

In 2004, Hauer[5] conducted a detailed literature review of studies carried out on the safety impact of installing left turn phases. The review covered studies that were completed over a period of 24 years in several countries. He noted that while most studies indicate insufficient and sometimes contradictory evidence, the CMF for changing from permissive to protected-permissive or fully protected left- turn phasing most likely depends on the number of opposing lanes. Hauer concluded that the CMF for left turn collisions when changing from either permissive or protected-permissive to a fully protected phasing is around 0.3 (or a 70% reduction in left turn collisions). However, for other collisions the CMF is 1.0 (i.e., no effect). On the other hand, Hauer estimated that when the change is from permissive to protected-permissive, the CMF is around 1.0 for both left turn collisions and other collisions (i.e., no effect).

Later in 2008, Srinivasan et al.[6] conducted an evaluation by means of the Empirical Bayes methodology for signalized intersections with data from Winston-Salem, North Carolina. Their results indicated that changing to fully protected left turn phasing from permissive or protected-permissive phasing could lead to a virtual elimination of left turn collisions, however, other types of collisions, which are likely to be less severe, could increase.

With respect to vehicle-pedestrian collisions, a 2018 study by Goughnour et al.[12] on left-turn phasing showed many differences in the collision experience, with CMFs ranging between 0.718 and 1.136. A disaggregate analysis of the effect on vehicle-pedestrian collisions indicated that the CMF was smaller (i.e., the treatment was more beneficial) for higher levels of pedestrian and vehicle volumes, particularly pedestrian volumes above 5,500 pedestrians per day.

Safety Summary

A summary of available research and literature on the safety of left turn phasing concludes that fully protected left turn phasing can be effective in reducing collisions associated with left turn movements, but that the overall intersection safety performance will remain relatively unchanged due to an increase in other collision types (e.g., rear end). Further research is required to understand the safety implications for congested intersections.

One important aspect to consider is the severity of collisions and how it is affected by changing the left-turn phasing. Left-turn collisions are angled crashes involving vehicles traveling in opposite directions, which often result in a greater likelihood of severe injuries. In contrast, rear end collisions typically result in lower, as they generally occur at lower speeds. As such, a trade-off between reducing higher severity left-turn collisions and increasing lower severity rear end collisions can be considered acceptable in the context of a safe systems approach, in which the goal is to reduce major injury and fatal collisions.

[12] Goughnour, E., D. Carter, C. Lyon, B. Persaud, B. Lan, P. Chun, I. Hamilton, and K. Signor. "Safety Evaluation of Protected Left-Turn Phasing and Leading Pedestrian Intervals on Pedestrian Safety." Report No. FHWA-HRT-18-044. Federal Highway Administration. (October 2018).

4.3 Practices for Determining and Implementing Left Turn Phases

The transportation profession has developed a range of practices for implementing protected-permissive and/or fully protected left turn phases at signalized intersections. These practices range from methods that set quantitative thresholds, usually based on observed traffic volumes and collision frequencies at intersections, to practices that outline qualitative frameworks in the form of a series of considerations that could suggest the need to implement the protected-permissive or fully protected left turn phases.

Differences in these practices are further broadened when it comes to the subsequent step of determining whether protected-permissive left turn phasing or fully protected left turn phasing is more appropriate. While some practices ignore this subsequent step in their decision process and leave it to the engineering judgement of practitioners, other practices outline the recommended circumstances for each type. Still, other practices provide a more prescriptive procedure to determine the left turn phase type. The next section presents some of the main guidelines that address left turn phasing practices.

Transportation Association of Canada (TAC) - MUTCDC

In Canada, the Manual of Uniform Traffic Control Devices for Canada (MUTCDC)[2] published by the Transportation Association of Canada (TAC) provides a framework (three parts; A, B, and C) that helps determine if a protected-permissive or fully protected left turn phase is, or is not, required. While the process facilitates the decision to determine the need for a protected-permissive or fully protected left turn phase, there is no specific procedure outlined to determine the type of left turn phase to be implemented. Each of the three categories has a set of criteria, and if any criterion is observed in the study intersection then a specified action is recommended.

- Part A includes a set of criteria that, if observed, indicates that a left turn phase is recommended even if the warrants given in Part C are not triggered.
- Part B includes a set of criteria that, if observed, indicates that a left turn is undesirable.
- Part C includes a set of criteria that, if observed, warrants the need to implement a left turn phase.

According to this practice, warrants for a protected-permissive or fully protected left turn phase (Part C) are mainly based on two factors: the observed traffic volumes and the collision history. The method does not, however, put any emphasis on other factors that could influence the need for a left turn phase such as geometric or sight distance concerns.

A snapshot of a worksheet prepared by TAC-MUTCDC to facilitate the left turn phase assessment process is presented in **Figure 1**.

FORM FOR DETAILED ASSESSMENT OF THE REQUIREMENT FOR A PROTECTED LEFT-TURN PHASE	
Intersection:	
Street 1:	
Street 2:	
Date: Study Period: am peak / pm peak / other	
Analyst:	
Direction of travel under consideration:	

PART A: SPECIAL CONDITIONS CRITERIA	CRITERION SATISFIED ?	
	Yes	No
A1 Are railway or public transit vehicles operating in an exclusive right-of-way median which is parallel to the left-turn lane?		
A2 Are double left turns permitted where there is an opposing through movement?		
Is a protected left-turn phase recommended according to criterion A1 or A2? (Answer Yes if either A1 or A2 have a "Yes")		
If the answers to both A1 and A2 are "No", proceed to PART B – Negative Impact Criteria.		

PART B: NEGATIVE IMPACT CRITERIA	CRITERION SATISFIED ?	
	Yes	No
B1 Is there insufficient green time within the current cycle length to accommodate the proposed protected left-turn phase?		
B2 Will the protected left-turn phase encourage neighbourhood traffic infiltration?		
B3 Does an assessment of the proposed protected left-turn phase demonstrate that significant undesirable effects in terms of stops, delay, or increased fuel consumption will result?		
Are there any "Yes" answers in PART B – Negative Impact Criteria?		
If "Yes", protected left-turn phasing is undesirable.		
If the answers to all three of B1 to B3 are "No", proceed to PART C – Warrant Criteria.		

FORM FOR DETAILED ASSESSMENT OF THE REQUIREMENT FOR A PROTECTED LEFT-TURN PHASE	
Intersection:	
Street 1:	
Street 2:	
Date: Study Period: am peak / pm peak / other	
Analyst:	
Direction of travel under consideration:	

PART C: WARRANT CRITERIA	DATA	CRITERION	CRITERION SATISFIED?	
			Yes	No
(a) What is the average left-turn demand per cycle?		**≥ 3 pcu per cycle**		
(b) What percent of the left-turn volume is delayed more than one signal cycle?		**> 25% Delayed One Cycle**		
(c) What is the total number of left-turn collisions that have occurred:				
(i) during the two-hour left-turn study period within the past five years?		**> 6 within the past 5 years**		
(ii) during the two-hour left-turn study period within the past 12 months?		**> 2 within the past 12 months**		
(iii) on a daily basis within the past five years?		**> 20 within the past 5 years**		
(iv) on a daily basis within the past 12 months?		**> 5 within the past 12 months**		
(d) What is the average volume of left turns which clear during the intergreen per cycle?		**> 2 pcus per cycle**		
(e) Over the course of an hour, what is the percentage of cycles during which the queue from an exclusive left-turn lane spills back and blocks the adjacent through lane:				
(i) where there is only a single through lane?		**> 10%**		
(ii) where there are two or more through lanes?		**> 30%**		
(f) What is the left-turn in-service transit demand per hour?		**> 3 per hour**		
Are any of the following Warrant Criteria satisfied?				
C1 (a) and (b) (If "Yes", protected left-turn phase is warranted.)				
C2 (a) and (c) (If "Yes", protected left-turn phase is warranted.)				
C3 (a) and any two of (d), (e), or (f) (If "Yes", protected left-turn phase is warranted.)				
If the answers to all three of C1 to C3 are "No", left-turn phase is NOT warranted.				

Figure 1: TAC-MUTCDC Assessment Form for Protected Left-turn Phase

Ministry of Transportation Ontario (MTO) – OTM Book 12

Published by the Ministry of Transportation Ontario (MTO), the OTM Book 12 provides a general filter based on left turn volumes and on collisions as a starting point to consider whether a left turn phase might be needed. A left turn phase is justified as follows:

- If the left turning vehicles are not finding suitable turning gaps, volume exceeds at least two vehicles per cycle, and the Level of Service at the intersection will not be jeopardized; or
- If the left turning volume plus the opposing volume > 720 vehicles per hour; or
- If a field check shows that vehicles consistently require more than two cycles in the queue in order to turn left; or
- If an over-representation of left turning collisions is identified at the intersection.

Book 12 then provides an analytical method to determine the need for a separate left turn phase. The method particularly considers the requirement of a separate phase from a capacity perspective. If the observed number of left turning vehicles exceeds the calculated capacity of a permissive left turn lane, then a separate left turn phase is justified. The following formula is used to calculate the capacity of a permissive left turn phase at the intersection under study:

$$C_{LT} = 1400 * \frac{G}{C} - (f * V_o) + (Lt_a)$$

Where:

C_{LT} = Capacity of permissive left turn lane (vph)

f = Adjustment factor to account for number of opposing lanes (per **Table 4**)

V_o = Total opposing traffic flow, including shared lanes and right turn lanes (vph)

G/C = Green time interval (s) for opposing flow divided by the total cycle length (s)

Lt_a = Number of vehicles turning left on amber (vph)

= 7200/C assuming 2 vehicles per cycle

Table 4: Values of Factor "f" to Adjust Capacity after Accounting for Opposing Lanes

Number of Opposing Lanes	1	2	3	4
f	1.0	0.625	0.5	0.44

With regards to the mode of the left turn phase, the guide generally recommends maintaining the smallest practical number of phases in order to reduce the "lost time" due to clearance between phases. This might indicate the consideration of a protected-permissive mode as a default choice. The OTM, however, identifies the following specific cases where fully protected left turn phase should be considered:

- If there is a geometric or visibility concern that requires a fully protected left turn phase.
- If there is a historic pattern of collisions involving left turn vehicles.
- If the capacity analysis indicates that dual left turn lanes are required.
- If queuing requirements indicate that a fully protected left turn is needed.

The OTM guide, however, does not provide any specific thresholds for the number of collisions that would trigger the need for a protected-permissive or fully protected left turn phase.

Table 5 summarizes OTM Book 12's preferred and minimum interval times for left turn phases.

Table 5: Preferred and Minimum Interval Times for Left Turn Phases

Interval	Preferred (s)	Minimum (s)
Clearance for protected portion of protected-permissive	3.0	2.0
Fully protected left or right	7.0	5.0
Amber clearance for fully protected	3.0	3.0
All red	1.0	1.0

Ministry of Transportation and Infrastructure – British Columbia

In the province of British Columbia (BC), the Electrical and Traffic Engineering Manual[13] provides a framework of three guidelines (A, B, and C) for determining the need for a protected-permissive or fully protected left turn phase. Each guideline addresses a certain topic (peak

[13] Electrical and Traffic Engineering Manual (2019), Guidelines for the Design of Lighting, Signal, and Sign Installation. British Columbia Ministry of Transportation and Infrastructure.

hour volumes, delay, and collision history) and provides a set of criteria. If any criterion within a guideline is met, then a left turn phase might be worthwhile and further engineering assessment is needed.

It is important to note that the guide is meant to be used as a supporting framework and that engineering judgement is still required to fully determine the need for a protected-permissive or fully protected left turn phase.

As part of the evaluation criteria, the guide refers to a cross-product value that is calculated by multiplying the hourly left turn volume by the hourly opposing through movement. This cross-product value is generally used as a cost-effective substitution to a formal gap analysis since the value could be easily calculated using readily available count data. The higher the cross-product value, the fewer the available gaps per left turn vehicle and the greater the need for a left turn phase.

The three guidelines are presented below:

Guideline A

Guideline A addresses concerns related to observed left turn volumes during the peak hour. It is considered 'met' if any of the following conditions exist at the intersection:

- The product value resulting from multiplying the left turn volume and the opposing through volume exceeds 50,000 vehicles per hour squared (vph^2) in the case of one opposing lane.
- The product value resulting from multiplying the left turn volume and the opposing through volume exceeds 90,000 vph^2 in the case of two opposing lanes.
- The left turn volume exceeds 90 vph where the posted speed or the 85th percentile speed is 70 km/h or less.
- The left turn volume exceeds 65 vph where the posted speed or the 85th percentile speed exceeds 70 km/hr.

Guideline B

Guideline B addresses concerns related to the delay of left turn vehicles. The guideline is considered to be met if:

- Left turn vehicle delay equals or exceeds two vehicle-hours for any one hour of an average day.
  - As an example, if there is a volume of 300 vehicles on the minor street approach during the peak one hour, and the average delay per vehicle on that approach during that peak hour is 60 seconds per vehicle, then there would be 300 x 60 or 18,000 vehicle-seconds of delay. 18,000 vehicle-seconds divided by 3,600 seconds (one hour), equates to 5.0 vehicle-hours of delay.

Guideline C

Guideline C addresses concerns related to the collision history. The guideline is considered to be met if:

> Five or more collisions involving left turn movements that could be corrected by a separate left turn phase are recorded within a 12-month period. Personal injury or property damage collisions of $1,000 or more are to be considered.

Selecting the Type of Left Turn Phase

Once it is determined that a left turn phase is required, the next step is to determine the type of the proposed left turn phase. In this regard, the BC Traffic Engineering manual recommends that a protected-permissive phase be generally used except in the cases shown in **Table 6**, where a fully protected phase should be used. Some of these cases require the estimation of the unobstructed sight distance for left turning drivers and comparing it to a recommended sight distance value, as illustrated in **Figure 2**.

Table 6: Cases where Protected-Only Type Should be Used – BC Traffic Engineering Manual

Cases where Fully Protected Mode should be Used
1. Permissive left turning is deemed to be hazardous due to difficulties caused by high speed, geometry, or any other factor
2. There is more than one left turn lane for the approach under study
3. Intersection geometrics makes permitted turning confusing
4. High pedestrian volumes
5. The left turn phase is a lead-lag operation
6. The left turn phase is justified based on collision frequencies as described on Guideline C
7. The sight distance is less than shown in **Figure 2** for a left turning passenger car
8. The sight distance is less than shown in **Figure 2** for a left turning WB-15 truck

Federal Highway Administration (FHWA)

In the United States, the FHWA-Traffic Signal Timing Manual[3] developed a flowchart that could be used to determine the need for a separate left turn phase and to furthermore determine the type of left turn phase that is most appropriate. Some of the factors used in the decision procedure include the observed collision history, traffic volumes of the opposing and the left turning movements, number of opposing through lanes, and the speed of opposing traffic.

The procedure tends to provide a more prescriptive process with identified thresholds for every step in the process. The same flowchart also appears in the Traffic Signal Operations Handbook published by Texas Transportation Institute[14]. **Figure 3** illustrates the process for determining the need for and mode of a left turn phase.

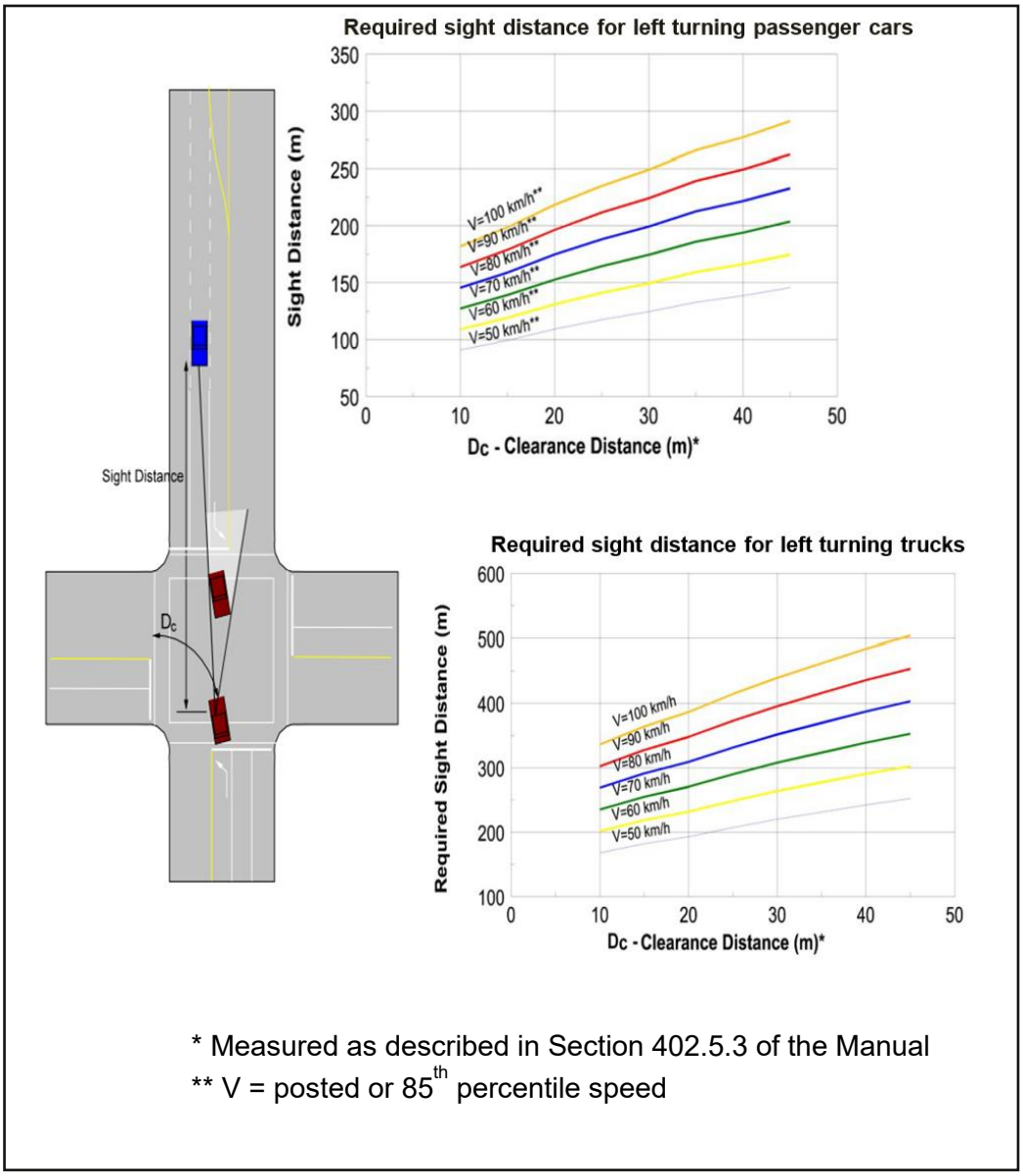
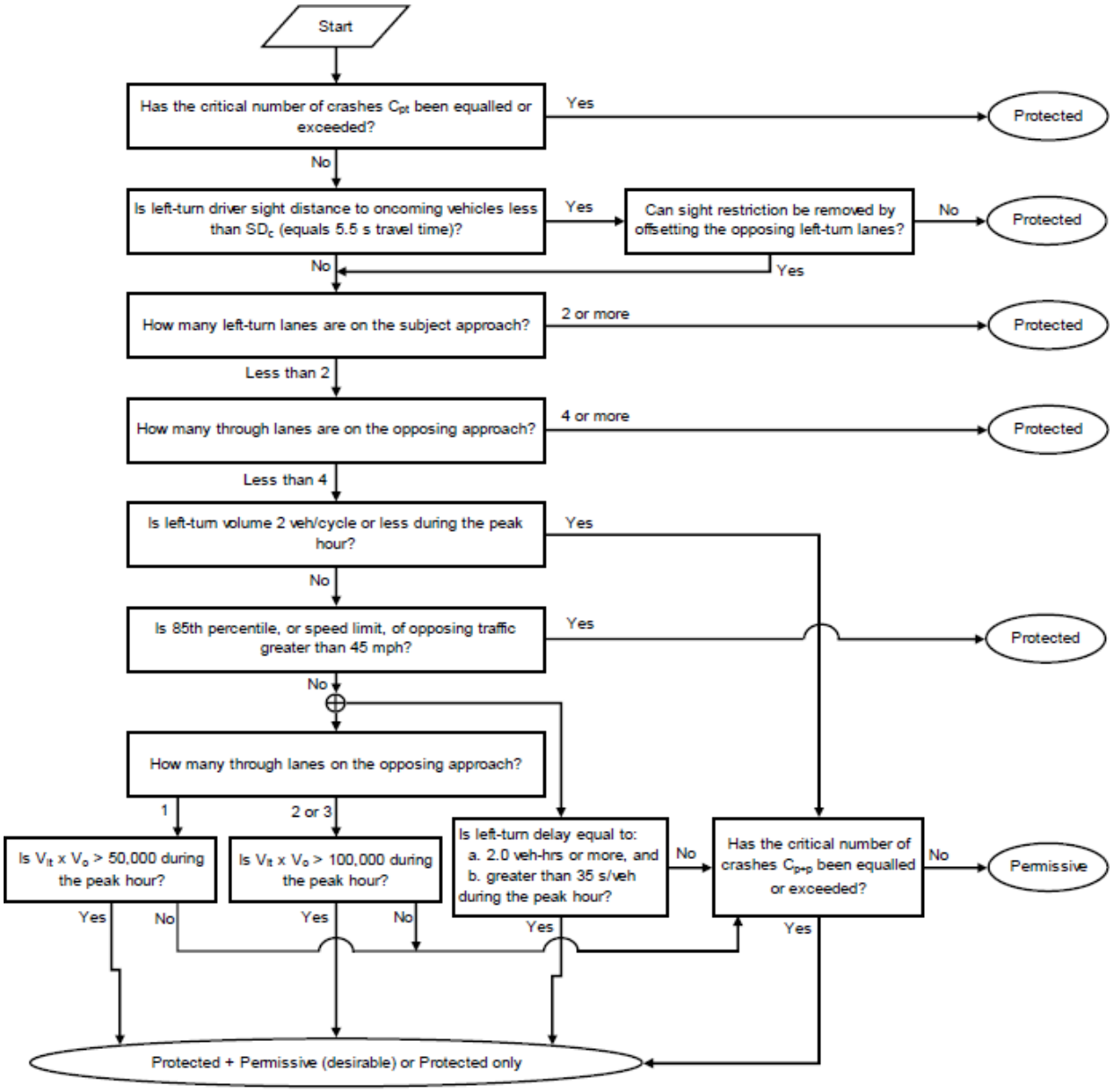


Figure 2: Required Sight Distance for Left Turning Cars and Trucks - BC Traffic Engineering Manual[13]

[14] Traffic Signal Operations Handbook (2009), Texas Transportation Institute.



Number of Left-turn Movements on Subject Road	Period During Which Crashes are Considered (years)	Critical Left-Turn-Related Crash Count When Considering Protected-only, C_{pt} (crashes/period)	When Considering Prot.+Perm, C_{p+p} (crashes/period)
One	1	6	4
One	2	11	6
One	3	14	7
Both	1	11	6
Both	2	18	9
Both	3	26	13

Oncoming Traffic Speed Limit (mph)	Minimum Sight Distance to Oncoming Vehicles, SD_c (ft)
25	200
30	240
35	280
40	320
45	360
50	400
55	440
60	480

Variables

V_{lt} = left-turn volume on the subject approach, veh/h

V_o = through plus right-turn volume on the approach opposing the subject left-turn movement, veh/h

Figure 3: Flowchart for Determining the Need for and Type of a Left Turn Phase – FHWA

5. Recommendations

5.1 Determining the Need for Left Turn Phase

Accommodating left turn movements at intersections is critical to the operational and safety performance of an intersection. Left turns, operating as permissive movements, are considered the riskiest movements at an intersection.

The various practices that have been developed to determine the need for a left turn phase are relatively consistent. Most practices are based on the observed left turn volume, the number of opposing through lanes, the volume of opposing through movement, and the collision history as the critical factors. However, the documented practices vary in terms of their approach to evaluate these critical factors. While some practices provide only guidance to help practitioners in their decision and leave more room to engineering judgement to be exercised, others provide a more prescriptive approach with quantitative thresholds and sometimes flowcharts to more precisely follow the process.

The consideration that seems to be missing from all the methodologies reviewed is the overall impact on capacity and throughput of the intersection. The methodologies consider the left turn in isolation, and do not consider the effect of dedicating additional signal timing to the left turn movement at the expense of the rest of the intersection movements – although it is common practice to conduct an overall assessment of the intersection operations. Undertaking this additional step, with the use of a macroscopic computer model (such as Synchro), is recommended for City of Markham, while still considering the trade-offs between reducing the risk of higher severity collisions versus increasing that of lower severity ones.

Intersection-Specific Issues Not Addressed by Typical Methodologies

When deciding on which approach to consider, it is worthwhile to acknowledge that no two intersections are identical and that differences between intersections do not exhibit themselves only in terms of traffic volumes, or the number of opposing through lanes and other similar operational measures. As indicated in a report published by Virginia Department of Transportation[15], there are many dissimilarities between intersections that could have implications on the need to implement a left turn phase. These differences could vary from intersection skew (which could obstruct the sight distance of turning vehicles), to lane channelization (i.e. the channelization of an opposing right turn lane might reduce potential conflicts with left turning vehicles as they merge into the same receiving lanes), to conflicts in turn paths of opposing left turns, and other factors.

[15] Guidance for Determination and Documentation of Left Turn Phasing Mode (2015), Virginia Department of Transportation-Traffic Engineering Division.

Consider for example the effect of the offset between opposing left turn lanes shown in **Figure 4**. A report published by the National Cooperative Highway Research Program (NCHRP)[16] explains that vehicles in opposing left turn lanes can limit each other's views of the approaching traffic. This limitation on sight distance is dependent on the amount and direction (positive or negative) of the offset between the opposing left turn lanes.

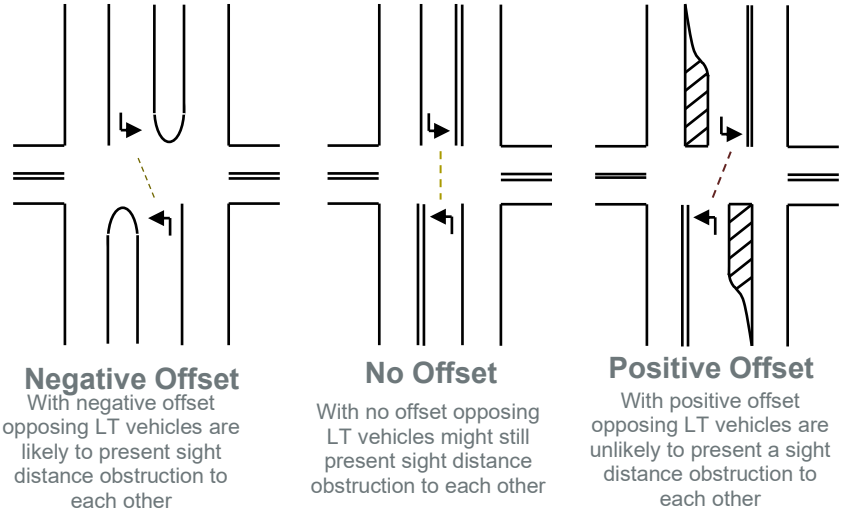


Figure 4: Types of Intersection Offsets (modified from NCHRP Report 500)

In this context and given all the differences that could collectively or independently distinguish one intersection from the other, it appears that practices that put weight on exercising engineering judgement on a case by case basis are more beneficial in capturing the particular details of an intersection.

While using strict quantitative evaluation or using flowcharts might appear to be a more objective approach to dealing with left turn issues, the shortcomings of this practice are highlighted in several studies and publications by road agencies which explain that using flowcharts could lead to an imbalanced decision process. This imbalance is caused by allowing a single variable to dominate, such as the left turn volume, which when considered alone may not be adequate to determine the need for a left turn phase. It also suggests that, in some cases, the optimal solution may not involve signal timing or phasing, but other engineering countermeasures. This optimal solution may involve reconstruction, and so it is recommended that the City use the opportunity of all planned reconstruction projects to review road safety opportunities in general, and left turn capacity and safety opportunities in particular.

Suggested Manual Method

For a basic, left turn movement-focused methodology, the guidance published by the OTM Book 12[1], as described earlier in this report, appears to provide a reasonable framework for

[16] National Cooperative Highway Research Program (NCHRP) (2004), Report 500 Volume 12: A Guide for Reducing Collisions at Signalized Intersections. Transportation Research Board.

practitioners when considering the implementation of a left turn phase. The guide provides a threshold related to the operational performance of the intersection; however, it still retains an important role for engineering judgement to be exercised in determining the type of the left turn phase. OTM Book 12 provides an approximation method and an analytical method to determine the justification of a separate left turn phase. However, this methodology still suffers from the issue of not recognizing the effects on overall intersection operation.

Preferred Method: Simulation

A more in-depth and balanced analysis can be conducted using simulation by using tools such as Synchro and SimTraffic. The use of simulation provides four major advantages:

a) the effects on the rest of the intersection of transferring right-of-way time from through movements to the left turn phase, including overall delay, will be fully understood;

b) left turn signal timing and phasing options can be tested to determine the best compromise for left turn phase lengths;

c) analysis using both Synchro and SimTraffic can allow for a more accurate estimation of the changes in queue lengths, which is important if left turn storage is a limiting factor (queuing results between the two methods may differ, therefore comparison with field observations can allow the selection of the most accurate model); and

d) the ability to adjust signal timing to minimize impacts is an option.

It is recommended that simulation be used to determine the value and impact of changing to protected forms of left turn phasing in order to visualize the traffic operations at the intersection and justify a separate left turn phase.

Analysis should be completed, at a minimum, for the AM and PM peak hours. Additional analysis periods (e.g., weekend, school pick-up and drop-off, special events, etc.) should also be reviewed depending on the specific site context. Required data includes:

- Intersection turning movement counts, including heavy vehicle percentages and pedestrian volumes;
- Signal timing plan, including mode of operation, phasing scheme, cycle length, phase splits, clearance intervals and program schedule; and
- Operational and geometric characteristics, including speed limit, lane configuration, lane widths, storage length, number of buses per hour, and number of pedestrian calls per hour.

Pedestrian Considerations

The research on the effects of left-turn phasing on vehicle-pedestrian collisions showed that this treatment is more effective at locations with pedestrian volumes above 5,500 pedestrians per day. It is recommended that, when considering the use of protected left turn phasing to improve pedestrian safety associated with vehicles turning left, Markham prioritize potential

treatment sites to give more preference to installing the fully protected or protected-permissive left turn phasing treatment at sites with higher pedestrian volumes.

The decision to implement fully protected or protected-permissive phasing should be based on engineering judgement, with consideration for the following factors:

- Volume and classification (i.e., high proportion of young children, seniors, mobility impaired, etc.) of pedestrians on the crosswalk under review;
- Volumes of left turning vehicles that conflict with the crosswalk under review;
- Volumes of through vehicles in the opposing direction of the left turn under review;
- Collision history involving left turning vehicles and expected reduction in collisions (CMF);
- Presence of geometric or visibility issues at the intersection; and
- Operational impacts (Synchro/SimTraffic simulation) resulting from implementing protected left turn phasing.

The use of fully protected phasing will be most beneficial at intersection that present a combination of multiple of the aforementioned factors. For example, if the volume of opposing through vehicles is very high, motorists attempting to make a left turn will need to focus more of their attention looking for gaps, which can lead them to overlook pedestrians on the crosswalk. This is aggravated if there are geometric or visibility issues, which further increase their cognitive workload and increases the risk of collisions.

5.2 Determining the Type of Left Turn Phase

Once it has been determined that a left turn phase is required, it is necessary to assess the type of operational characteristics required. The following issues must be considered in order to determine the left turn phase type:

1) Where the capacity analysis of equivalent turning volumes or queue end requirements indicates that dual left turn lanes are required, fully protected left turn phase should be considered.
2) If there is a geometric or visibility problem at the intersection or if there is a historical collision pattern involving left turning vehicles, then a fully protected left turn phase should be considered, particularly in the context of overall intersection safety, as per the HSM and other publications.
3) Simultaneous left turn operations should be considered wherever both opposing left turn lanes require separate phases and the geometry of the intersection allows. The left turn phases may be operated in the protected-permissive mode or the fully protected mode.
4) Delayed green or permissive-protected operation should be considered only where there is no opposing left turn movement that could create an unsafe trap situation. The

MUTCDC (B4.5.3) defines the trap as 'entrapment' and uses the following example: "*an entrapment could be created if Approach 1 rests in green and Approach 2 goes to amber. Left turn drivers on Approach 2 would expect that vehicles on Approach 1 also have the amber indication and, therefore, would be preparing to stop. Left turn drivers on Approach 2 may try to use the clearance interval to penetrate opposing traffic which would still have a green indication on Approach 1.*"

Based on the issues outlined above, an analysis which includes the traffic volume, collision history, and traffic operation is recommended for Markham to consider as their policy for determining the type of left turn phase.

5.3 Determining Time of Day Operational Characteristics for Protected-Permissive Left Turn Phases

The determination of whether to maintain a protected-permissive left turn phase throughout the day or only at times when it is needed should be viewed from the same perspective as determining the need for a left turn phase in the first place, particularly since research shows no significant safety advantages between permissive-only and protected-permissive left turn operations. A comprehensive report on left turn phases published by Virginia Department of Transportation[15] drew attention to this issue. The report recognizes that factors that influence left turn phasing selection may be dynamic depending on the ambient conditions and the traffic demand. In such cases the guide recommends that practitioners consider implementation of a left turn phase during the time(s) of day where one or more of these factors exist. The objective remains to maintain the smallest practical number of phases while keeping the operation sufficiently safe. If factors that influence the need for a separate left turn phase cease to exist during periods of the day, for example as the traffic volume drops at off-peak hours, then it is reasonable to avoid the unnecessary signal phase. Alternatively, if a left turn phase was needed to accommodate a sight distance or geometric concern that remains as a safety concern throughout the day, then it is reasonable to maintain the left turn phase. This approach is therefore recommended for Markham to consider as their policy.

5.4 Recommended Policy

This paper reviewed the advantages and disadvantages of several practices for determining the need for implementing separate left turn phasing. It is recommended that, as long as the basic volume data are available, the City use computer simulation to determine the value and impacts of adding protected left turn phasing while at the same time optimizing the rest of the intersection operation to minimize the overall effects.

As a starting point to determine the general need, it is recommended that the City adopt the initial filter as described in the OTM Book 12 as it provides a framework that allows for a quick assessment of whether a left turn phase might be needed.

When data for computer simulations are not available, or it is desired to manually calculate the need for a left turn protected phase, it is recommended that the City adopt the practice described in the OTM Book 12 as it provides a framework that allows for both quantitative evaluation and engineering judgement to be exercised rather than strict quantitative evaluation only, which could lead to imbalanced decisions. However, collecting the necessary data to run the computer simulation is preferable whenever possible.

If a separate left turn phase is implemented, then a protected-permissive mode is generally recommended because of its greater efficiency. However, specific cases identified in the OTM Book 12 should be considered where fully protected left turn phasing is to be implemented. These cases include situations where geometric or visibility problems are of concern. Preferred and minimum intervals from OTM Book 12 should be adhered to when designing signal timing plans with fully protected or protected-permissive left turn phases.

Given that there are no proven safety advantages between permissive-only and protected-permissive left turn operations, the implementation of a protected-permissive left turn phase should be considered only during those times of day when it meets the conditions originally identified for the left turn phase. The objective is to maintain the smallest practical number of phases while keeping the operation sufficiently safe.

Table 7 through **Table 9** provide a decision support tool to assist in determining when permissive-only left turn phasing is sufficient and when fully protected left turn phasing is required. The criteria used in the decision support tool are based on a combination of criteria from different practices and guidelines, as presented in Section 4.3. If permissive-only left turn phasing is appropriate (i.e., all criteria in Part A are satisfied), there is no need for any type of protected left turn phasing; if any conditions are present that require fully protected left turn phasing, the operational impacts of this type of phasing should be assessed; protected-permissive phasing is recommended when permissive phasing is not appropriate and fully protected phasing is not required, or as an interim option if fully protected phasing is required but would result in significantly compromised operations. **While this support tool provides a reference to assist in the decision to implement different types of left-turn phasing, it is not intended to replace engineering judgment.**

Table 7:Decision Support Tool Part A – Appropriate Conditions for Permissive-only Left Turns

PART A **Appropriate Conditions for Permissive-only Left Turns**	**Criterion Satisfied?**	
	Yes	**No**
A1. Single left turn lane		
A2. Number of opposing through lanes ≤ 3		
A3. Left turn volume ≤ 2 vehicles per cycle (for each movement) - Check if the peak hour volume exceeds [2 x 3,600 / cycle length in seconds]		
A4. Total left turn collisions with opposing traffic ≤ 10 in 5 years		
A5. Injury left turn collisions with opposing traffic ≤ 3 in 5 years - City-wide average for Turning Movement collisions resulting in injury: 35%		
A6. 85th %^{ile} speed of opposing through movement < 60 km/h		
A7. Visibility requirement for the left turn movement is met - Per TAC Geometric Design Guide for Canadian Roads (Chapter 9, Table 9.9.12): Design speed (km/h): 40 50 60 70 80 90 100 Required visibility (m): 65 80 95 110 125 140 155		
A8. Acceptable left turn movement operations: - Based on peak hour Synchro/SimTraffic simulation and field observations, all of the following conditions are met: - Level of Service D or better - v/c ratio of 0.85 or lower - No more than 10% of left turning vehicles require 2+ cycles to clear - Percentage of cycles during which the queue from the left turn lane spills back and blocks the through lane does not exceed 5% (1 through lane) or 15% (2+ through lanes)		
If there are any "No" answers in Part A, proceed to Part B. **Otherwise, permissive-only left turn phasing is considered appropriate (i.e., neither protected-permissive nor fully protected phasing are necessary).**		

Table 8: Decision Support Tool Part B – Conditions Requiring Fully Protected Left Turn Phase

PART B **Conditions Requiring Fully Protected Left Turn Phasing**	**Criterion Satisfied?**	
	Yes	**No**
B1. Two or more left turn lanes		
B2. Number of opposing through lanes ≥ 4		
B3. Total left turn collisions with opposing traffic ≥ 25 in 5 years		
B4. Injury left turn collisions with opposing traffic ≥ 9 in 5 years - City-wide average for Turning Movement collisions resulting in injury: 35%		
B5. Left turn volume > 2 vehicles per cycle (per movement) **and** 85th %^{ile} speed of opposing through movement ≥ 70 km/h		
B6. 85th %^{ile} speed of opposing through movement > 50 km/h **and** visibility requirement for the left turn movement is **not met** (and cannot be provided by removing obstruction) - Per TAC Geometric Design Guide for Canadian Roads (Chapter 9, Table 9.9.12): Design speed (km/h): 40 50 60 70 80 90 100 Required visibility (m): 65 80 95 110 125 140 155		
B7. Existing left turn phase is protected/permissive **and** left turning motorists frequently overlook pedestrians on the downstream crosswalk (motorist fails to yield, pedestrian aborts crossing, etc.)		
B8. Left turn volume > 2 vehicles per cycle (for each movement) **and** pedestrian volume on the conflicting crosswalk ≥ 5 during the permissive phase. - Check if the peak hour LT volume exceeds [2 x 3,600 / cycle length in seconds] - Check if the peak hour ped volume exceeds [5 x 3,600 / cycle length in seconds]		
If there are any "Yes" answers in Part B, Proceed to Part C. **Otherwise, implement protected-permissive left turn phase.**		

Table 9: Decision Support Tool Part C – Operational Impacts of Fully Protected Left Turn Phase

PART C **Operational Impacts of Fully Protected Left Turn Phasing**	**Criterion Satisfied?**	
	Yes	**No**
C1. Left turn movement and opposing through movement are expected to have significantly compromised operations under fully protected left turn phasing. - Based on peak hour Synchro/SimTraffic simulation, one of the following conditions exist: - Level of Service F and v/c ratio substantially above 1.0 - No more than 25% of left turning vehicles require 2+ cycles to clear - Percentage of cycles during which the queue from the left turn lane spills back and blocks the through lane does not exceed 10% (1 through lane) or 30% (2+ through lanes) - Percentage of cycles during which the queue from the opposing through movement spills back beyond an upstream signal does not exceed 10%		
If the answer to C1 is "No", implement fully protected left turn phase. **Otherwise, the intersection requires more substantial capacity improvements (protected-permissive left turn phase can be implemented as an interim measure).**		

City of Markham

Intersection Sight Distances Policy Paper

Vision Zero Road Safety Plan

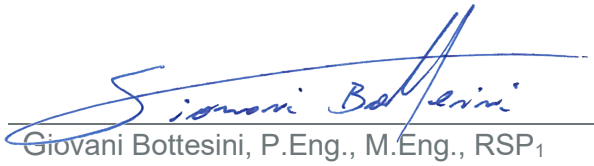
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August 8, 2025

City of Markham

Intersection Sight Distances Policy Paper

Vision Zero Road Safety Plan

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1. Introduction

The City of Markham (the City) has engaged CIMA Canada Inc. (CIMA+) to support the development of a comprehensive Road Safety Plan (RSP), aimed at enhancing road safety and reducing traffic-related risks across the community. As part of this larger initiative, the project will include the creation of seven detailed policy papers that will guide the City's efforts in improving road safety. These papers will address a range of key issues, including fatal and serious injury collision investigation, traffic inquiry process, and traffic calming and speed management. This memorandum outlines the policy paper intersection sight distances, developed as part of *Task 4-6: Develop Policy Papers and Guidelines*.

1.1 Purpose

The purpose of this paper is to review current practices in the City and discuss different types of intersection sight triangles, providing recommendations detailing minimum distances and dimensions required for sightlines and daylight triangles based on types of intersections and roads. Additional guidelines include sightline requirement for transit shelters and non-motorized road users, as well as signage for driveways and private accesses. Furthermore, this paper identifies procedures to measure sight distance and provides recommended mitigation measures for locations with insufficient sight distances, including those where removal of the obstructions is not feasible. A discussion on design exceptions / legal non-conforming situations is also.

The topics discussed herein, relating to sight distance, are established through a review of justifications, criterion and common procedures for the Intersection Sight Distance requirements from prevailing provincial, national, and international guidelines, as well as the application of human factors considerations.

1.2 Overview

The development of the policy is documented in detail in the following sections:

- **Section 2:** Current Procedures in the City of Markham
- **Section 3:** Sight Distances
- **Section 4:** Non-motorized Road Users
- **Section 5:** Driveways and Private Accesses
- **Section 6:** Transit Shelters
- **Section 7:** Warning Signs
- **Section 8:** Design Exceptions and Legal Non-conforming Situations
- **Section 9:** Recommended Procedures

1.3 Need

Providing sufficient sight distances at intersections is a critical element of a Vision Zero approach, which aims to eliminate traffic-related fatalities and serious injuries. Insufficient sight distances at intersections can contribute right angle and turning movement ('left-turn/across path') collisions which, due to their impact dynamics, typically have higher severity compared to other common collision impact types between motor vehicles at intersections, such as rear end and sideswipe. In the City of Markham, 454 angle and turning movement injury collisions were reported between 2017 to 2019, and 2022 to 2023. These collision types account for 45% of all injury collisions occurring in Markham, and 57% of injury collisions at intersections.

Insufficient sight distances can also contribute to increased cognitive workload for drivers, who may overlook the presence of pedestrians or cyclists when entering an intersection. Providing sufficient sight distances at intersections reduces the risk of collisions by allowing drivers to appropriately judge gaps in traffic and preventing conflicts with other road users.

2. Current Procedures in the City of Markham

Currently, the City of Markham assess stopping sight distances for existing intersections in accordance with Transportation Association of Canada's (TAC) guidelines. For new intersections (including in the development application review process), in addition to considering TAC guidelines, the City uses the minimum daylight triangles shown in **Table 1**.

Table 1: City of Markham Minimum Rounding/Daylight Triangle Requirements[1]

Road Type	Intersecting Road Type	Minimum Rounding Requirements
Laneways	All	3.0 m
Local	Local, Minor and Major Collectors	5.0 m
Minor and Major Collectors	Minor and Major Collectors	10.0 m x 10.0 m (triangle)
Major Collector	Major Collector	15.0 m x 15.0 m (triangle)
All City's Roads/Laneways	Regional Roads	As per the Region

Additionally, the City's design criteria specify a minimum distance of 15.0 m from a driveway to an intersection, measured from the tangent curb line of the adjacent road intersection, with no portion of the being located within a sight triangle. For retrofit situations, the minimum distance of a driveway from an intersection is reviewed by City staff.

It should be noted that the City's design criteria were undergoing updates at the time of the writing of this policy paper.

[1] City of Markham Engineering Department Design Criteria – Section B: Roads.

3. Sight Distances

The ability for drivers to have a clear view of the roadway ahead is essential for safe and efficient operation of the roadway. Sight distance is the length of roadway that is visible ahead to the driver. Given the importance of sight distance in road design, TAC's Geometric Design Guide[2] (GDG) considers minimum sight distance as one of four roadway design controls, along with human factors, speed, and design vehicles. It is noted that in Ontario, road agencies and designers refer to TAC's GDG or, until recently, to the MTO's Geometric Design Standards[3] (MTO adopted the TAC guide with a supplement document applicable to Provincial projects). Both references were derived from the American Association of State Highway and Transportation Officials' (AASHTO) Green Book[4] with minor modifications.

According to both TAC and AASHTO guidelines, there are four types of sight distances that are common in roadway design: Stopping Sight Distance (SSD), Passing Sight Distance (PSD), Decision Sight Distance (DSD), and Intersection Sight Distance (ISD). Below is a brief discussion on SSD, DSD, and ISD.

3.1 Stopping Sight Distance

Stopping Sight Distance (SSD) is the distance needed to sufficiently enable a vehicle travelling near the design speed of the road to stop before reaching a stationary object in its path.[4] SSD is applicable to every element of the roadway, including vertical and horizontal curves, intersections, and hazardous locations with fallen objects on the road.

SSD could be expressed as the sum of the distance travelled during the perception and reaction time and the braking distance. The formula below is typically used to estimate the Stopping Sight Distance.[4,5,6]

$$SSD = 0.278\,Vt + 0.039\frac{V^2}{a}$$

Where:

SSD = Stopping Sight Distance (m)

V = Design speed (km/h)

t = Brake reaction time, 2.5 seconds

a = Deceleration rate (m/s^2)

[2] Geometric Design Guide for Canadian Roads, 2017, Transportation Association of Canada (TAC).
[3] Geometric Design Standards for Ontario Highways, 1985, Ministry of Transportation Ontario (MTO).
[4] A policy on Geometric Design of Highways and Streets, 2011, American Association of State Highway and Transportation Officials (AASHTO).
[5] Geometric Design Guide for Canadian Roads, June 2017, Chapter 2, Page 38, Transportation Association of Canada.
[6] Traffic Engineering Handbook 7th Edition, 2016, Institute of Transportation Engineers (ITE).

When the roadway is on a grade, the formula is modified as follows:

$$d_b = \frac{V^2}{254\,[(a/9.81) + G]}$$

Where:

d_b = Braking Distance (m)

V = Design speed (km/h)

a = Deceleration rate (m/s^2)

G = Grade (m/m) (G > 0 uphill; G < 0 downhill)

The design values for the SSD are shown in **Table 2**.

Table 2: Design values for Stopping Sight Distance [5]

Design Speed (km/h)	Stopping Sight Distance (m)						
	Downgrade			Level	Upgrade		
	-3%	-6%	-9%		+3%	+6%	+9%
20	20	20	20	20	19	18	18
30	32	32	35	35	31	30	29
40	50	50	53	50	45	44	43
50	66	66	74	65	61	59	58
60	87	87	97	85	80	77	75
70	110	110	124	105	100	97	93
80	136	136	154	130	123	118	114
90	164	164	187	160	148	141	136
100	194	194	223	185	174	167	160
110	227	227	262	220	203	194	186
120	263	263	304	250	234	223	214
130	302	302	350	285	267	254	243

3.2 Decision Sight Distance

Decision Sight Distance (DSD) is the distance required for a driver to detect an unexpected or otherwise difficult to perceive information source or hazard in a roadway environment that may be visually cluttered. Drivers should recognize the hazard or its potential threat, select an appropriate speed and path, and initiate and complete the movement safely and efficiently.[4, 5] Under some conditions, the added complexity of traffic and local conditions and driver expectancy may require longer times and distances to accommodate normal vehicle manoeuvres of lane changing, speed changes and path changes. The DSD is estimated by the time required pre-manoeuvre, plus the time for the avoidance manoeuvre itself, converted into distances. Both TAC and AASHTO present the resulting distances in the form of a table. Different distances depending on the design speed and the expected type of avoidance manoeuvre are provided in **Table 3**.

Table 3: Decision Sight Distance values for different manoeuvres[7]

Design Speed (km/h)	Decision Sight Distance for Avoidance Manoeuvre (m)				
	A	B	C	D	E
50	75	160	145	160	200
60	95	205	175	205	235
70	125	250	200	240	275
80	155	300	230	275	315
90	185	360	275	320	360
100	225	415	315	365	405
110	265	455	335	390	435
120+	305	505	375	415	470
Notes:	Avoidance Manoeuvre A: stop on rural roadway. Avoidance Manoeuvre B: stop on urban roadway. Avoidance Manoeuvre C: speed/path/direction change on rural roadway. Avoidance Manoeuvre D: speed/path/direction change on suburban roadway. Avoidance Manoeuvre E: speed/path/direction change on urban roadway.				

3.3 Intersection Sight Distance

At intersections, there is potential for different types of conflicts between intersecting vehicles. The possibility of these conflicts occurring could be greatly reduced by providing proper sight distance and appropriate traffic control devices.

Intersection Sight Distance (ISD) is aimed to allow drivers to recognise the presence of conflicting vehicles. Adequate sight distance allows an unobstructed view of the intersection, including any traffic control devices, and provides sufficient lengths along the intersecting roadway to permit drivers to stop or adjust their speeds and avoid conflicting vehicles.

[7] Geometric Design Guide for Canadian Roads, June 2017, Chapter 2, Page 45, Transportation Association of Canada.

The methods used for determining the ISD approaches are based on the same principles of the SSD but with modifications based on observed driver behavior.

Types of Intersection Sight Triangles

At each intersection quadrant, a sight triangle represents an area of unobstructed sight distance. A sight triangle is formed by a distance required along each leg of the two approaches on an intersection quadrant and the sightline that connects between them. Sight triangles are required to be clear of obstructions that might block a driver's view of conflicting vehicles.

There are generally two types of sight triangles considered in intersection design: Approach Sight Triangles and Departure Sight Triangles. A third type of sight triangles, known as the Visibility Triangle or the Daylight Triangle, is also considered in some references. The requirements of a daylight triangle are, however, treated separately from the other two sight triangles as they mainly relate to the property lines near the intersection.

For approach and departure sight triangles, the dimensions of the sight triangle legs depend on the type of traffic control used at the intersection and the design speed of the intersecting roadways. For visibility triangles, the dimensions of the sight triangle depend on the width of the right-of-way on the intersecting roadways, the design speed, and the number of lanes on both roadways.

If the requirements of any sight triangle cannot be provided (e.g., cases where certain obstructions cannot be removed), the mitigation measures discussed in Section 9.3 should be considered.

3.3.1 Approach Sight Triangles

Approach sight triangles provide the driver of a vehicle approaching an intersection an area that is free of any obstructions that might block their view of potentially conflicting vehicles on the intersecting roadway. The legs of this sight triangle should be long enough so that drivers on the major road can see potentially conflicting vehicles and have sufficient time to slow or stop to avoid a collision.

At each intersection approach, there are generally a set of two approach sight triangles that are required to be considered. A left sight triangle which accounts for vehicles approaching from the left side, and a right sight triangle which accounts for vehicles approaching from the right. **Figure 1** below illustrates the two approach triangles required from the minor roadway on the south approach.

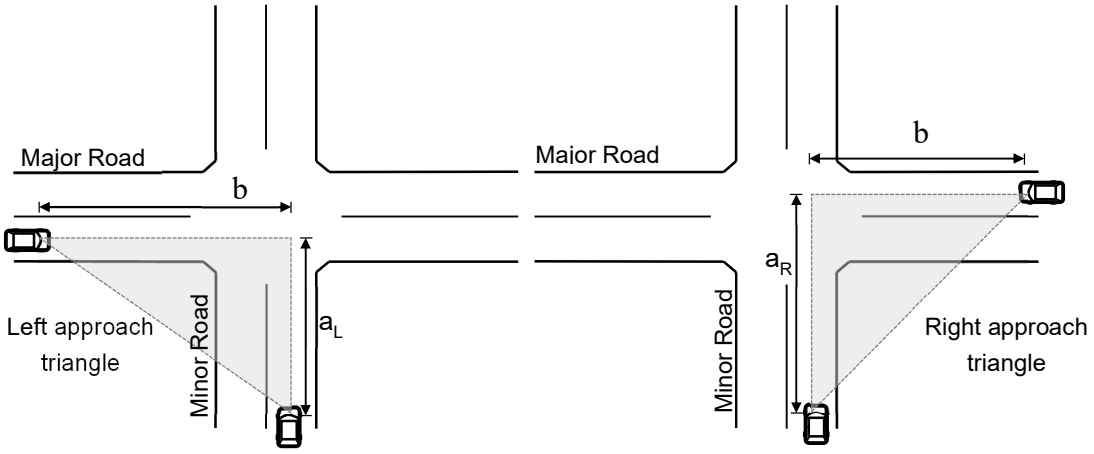


Figure 1: Left and right approach triangles[8]

Table 4 presents the required dimensions of approach sight triangles for an intersection with no control according to the TAC GDG. These distances are based on field observations indicating that vehicles approaching uncontrolled intersections typically slow to approximately 50% of their mid-block running speed.

Table 4: Dimensions of approach triangles for intersection with no traffic control.[9]

Design Speed (km/h)	**a_L and b (m)**	**a_R (m)**
20	20	$a_R = a_L$ + width of lane(s) and median
30	25	
40	35	
50	45	
60	55	
70	65	
80	75	
90	90	
100	105	
110	120	
120	135	
130	150	

For yield-controlled intersections, the required sight triangles for a crossing manoeuvre are determined based on the same assumptions as for no control, however 60% of the mid-block running speed; for turning manoeuvres, the length of the leg of the approach sight triangle along the minor road is 25 m.

[8] Geometric Design Guide for Canadian Roads, June 2017, Chapter 9, Page 61, Transportation Association of Canada.
[9] Geometric Design Guide for Canadian Roads, June 2017, Chapter 9, Page 64, Transportation Association of Canada.

However, in recent years, uncontrolled and yield controlled intersections have become very rare, particularly in mostly urban municipalities such as Markham. Typical exceptions include roundabouts and right-turn channels at signalized or stop-controlled intersections.

In theory, this type of sight triangle should not be needed at intersection approaches controlled by stop signs or traffic signals. The need for vehicles to stop at the intersection in this case is determined by the control devices at the intersection and not by the presence or absence of vehicles on the intersecting approaches. For this reason, AASHTO does not require approach triangles on stop-controlled approaches or signalized intersections. While the current version of the TAC and MTO guides do not require approach sight triangles for intersection approaches controlled by stop signs or traffic signals, they indicate that this type of sight triangle is desirable in the event that a driver violates these traffic controls, particularly at higher volume intersections. Furthermore, the TAC Geometric Design Revisions and Additions Committee is currently discussing reintroducing approach sight triangles as a requirement for all intersections, including stop-controlled and signalized. While the specific requirements are not finalized yet, the 1999 version of the GDGCR requirements were based on vehicles travelling for 3 seconds at the design speed on the major road and 30 km/h on the minor road, resulting in the distances summarized in **Table 5**.

Table 5: Dimensions of approach triangles for intersection with stop and signal control.[10]

Design Speed (km/h)	a_L and a_R (m)	b (m)
40	25 m	30
50		40
60		50
70		60
80		65
90		75
100		85
110		95

3.3.2 Departure Sight Triangles and Left Turns from Major Road

Departure sight triangles, also referred to as intersection sight distance (ISD), are needed to provide sufficient sight distance for a stopped driver at a minor road stop-controlled intersection approach to cross or enter (left turn or right turn) the intersecting roadway. Sufficient visibility should be available when looking left and right from the decision point, as illustrated in **Figure 2**.

[10] Geometric Design Guide for Canadian Roads, September 1999, Chapter 2.3, Pages 2.3.3.9 and 2.3.3.12, Transportation Association of Canada.

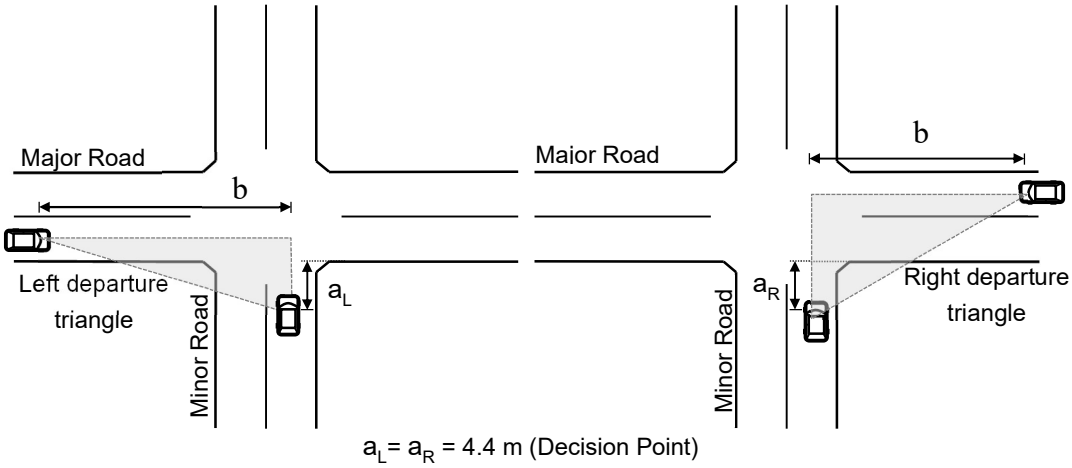


Figure 2: Left and right departure triangles[11]

ISDs (distance 'b' in Figure 2) are measured from a minimum setback of 4.4 m[12] from the edge of the closest travel lane (distance 'a' in Figure 2) and are determined by the following equation:

$$ISD = 0.278\, V_{major} t_g$$

Where:

ISD = Intersection Stopping Sight Distance (m)

V_{major} = Design speed of the major road (km/h)

t_g = Time gap for minor road vehicle to enter the major road (s)

Additionally, locations along a major road from which vehicles are permitted to turn left across opposing traffic (including intersections and driveways) should have sufficient sight distance to accommodate the left turn manoeuvre. The required sight distance is also determined by the equation above, however the decision point may not necessarily be at the 4.4 m setback and should be determined based on observations of typical driver behaviours at the site under review.

Table 6 provides the time gaps and **Table 7** provides the design values for each manoeuvre from a stopped condition. Graphical representations of various sight distance requirements are also provided in **Appendix A**.

[11] Geometric Design Guide for Canadian Roads, June 2017, Chapter 9, Page 62, Transportation Association of Canada.
[12] A setback of 5.4 m is preferred, where practical.

Table 6: Time gaps for departure sight distances from a stopped condition[13]

Design Vehicle	Manoeuvre			
	Left Turn from Stop (s)[a]	Right Turn from Stop (s)[b]	Crossing from Stop (s)	Left Turn from Major Road (s)
Passenger Car	7.5[c]	6.5[c]	Same as Right Turn from Stop, except for special cases.[f]	5.5[g]
Single-unit Truck	9.5[d]	8.5[d]		6.5[h]
Combination Truck (WB 19 and WB 20)	11.5[d]	10.5[d]		7.5[h]
Longer Truck	To be established by road authority[e]	-		-

Notes:
a: if the minor road approach is an upgrade that exceeds 3%, add 0.2 s for each percent grade.
b: if the minor road approach is an upgrade that exceeds 3%, add 0.1 s for each percent grade.
c: add 0.5 s for each additional lane, from the left, in excess of one, to be crossed by the turning vehicle.
d: add 0.7 s for each additional lane, from the left, in excess of one, to be crossed by the turning vehicle.
e: Alberta uses 22 s for very long trucks.
f: where crossing is the only legal maneuver;
where crossing the equivalent width of more than six lanes; or
where substantial volumes of heavy vehicles cross the highway and steep grades are present across the intersection.
g: if crossing more than one opposing lane, add 0.5 s for each additional lane to be crossed.
h: if crossing more than one opposing lane, add 0.7 s for each additional lane to be crossed.

Table 7: Design values for Departure Sight Distances (passenger car on level road)[13]

Design Speed (km/h)	ISD – Left Turn (m)	ISD – Right Turn and Crossing (m)	Left Turn from Major Road (m)
20	45	40	35
30	65	55	50
40	85	75	65
50	105	95	80
60	130	110	95
70	150	130	110
80	170	145	125
90	190	165	140
100	210	185	155
110	230	200	170
120	255	220	185
130	275	235	200

[13] Geometric Design Guide for Canadian Roads, June 2017, Chapter 9, Pages 67-79, Transportation Association of Canada.

3.3.3 All-way Stop Controlled and Signalized Intersections

At all-way stop controlled and signalized intersections, the first vehicle stopped on one approach should be visible to the driver of the first vehicle stopped on each of the other approaches. In other words, drivers at each stop bar should be able to see vehicles at all other stop bars.

At signalized intersections, left-turning drivers may experience restricted sight lines due to the horizontal alignment of the roadway and/or the offset of opposing left turn lanes. Similarly, drivers making a right turn on red may experience restricted sight lines due to the geometry of the roadway and/or inappropriate stop bar / crosswalk setbacks.

The requirements for these manoeuvres are the same as those indicated in **Table 6** and **Table 7** (Section 3.3.2), however the decision point may not necessarily be at the 4.4 m setback and should be determined based on observations of typical driver behaviours (**Table 8**).

Table 8: Signal Visibility Distance[14]

85th Percentile Speed (km/h)	**Minimum Distance from which Signal Must be Clearly Visible (m)**
40	65
50	85
60	110
70	135
80	165
90	200
100	230

[14] Ontario Traffic Manual Book 12 – Traffic Signals, March 2012. Page 114. Ministry of Transportation Ontario.

4. Non-motorized Road Users

The National Association of City Transportation Officials (NACTO)[15] indicates that intersection design should facilitate eye contact between street users, ensuring that motorists, bicyclists, pedestrians, and transit vehicles intuitively read intersections as shared spaces. Visibility can be achieved through a variety of design strategies, including intersection "daylighting," design for low-speed intersection approaches, and the removal of trees or amenities that impede standard approach and departure sight distances. Sight line standards for intersections should be determined using target speeds, rather than 85th percentile design speeds. This prevents wide setbacks and designs that increase speeds and endanger pedestrians.

According to NACTO, corners in urban areas frequently act as gathering places for people and businesses; they also often serve as the preferred locations for bus stops, bicycle parking and other transportation related elements. Design should facilitate eye contact between these users, rather than focus on the creation of clear sightlines for moving traffic only; wide corners with large sight triangles may increase visibility, but in turn may cause cars to speed through the intersection; this can make drivers lose the peripheral vision they might have retained at a slower and more cautious speed. This is consistent with TAC,[16] which states that, as motor vehicle speeds increase, the driver's visual field narrows and limits the perception of surrounding activity. Slower speeds promote visibility, increase awareness of potential conflict, and reduces stopping sight distances.

Fixed objects, such as trees, buildings, signs and street furniture deemed to inhibit the visibility of a given intersection and create safety concerns should not be removed without the prior consideration of alternative safety mitigation measures; these mitigation measures may include a reduction in traffic speeds, an increase in visibility through curb extensions (**Figure 3**) or geometric design, or the addition of supplementary warning signs. NACTO recommends removing parking within 20–25 feet (6–8 m) of an intersection. TAC recommends curb extensions to extend at least 1.5 m to 2.2 m out from the curb line but may extend to the edge of the travel lane.

[15] Urban Street Design Guide, January, 2013. National Association of City Transportation Officials.
[16] Geometric Design Guide for Canadian Roads, June 2017, Chapter 6, Page 10, Transportation Association of Canada.

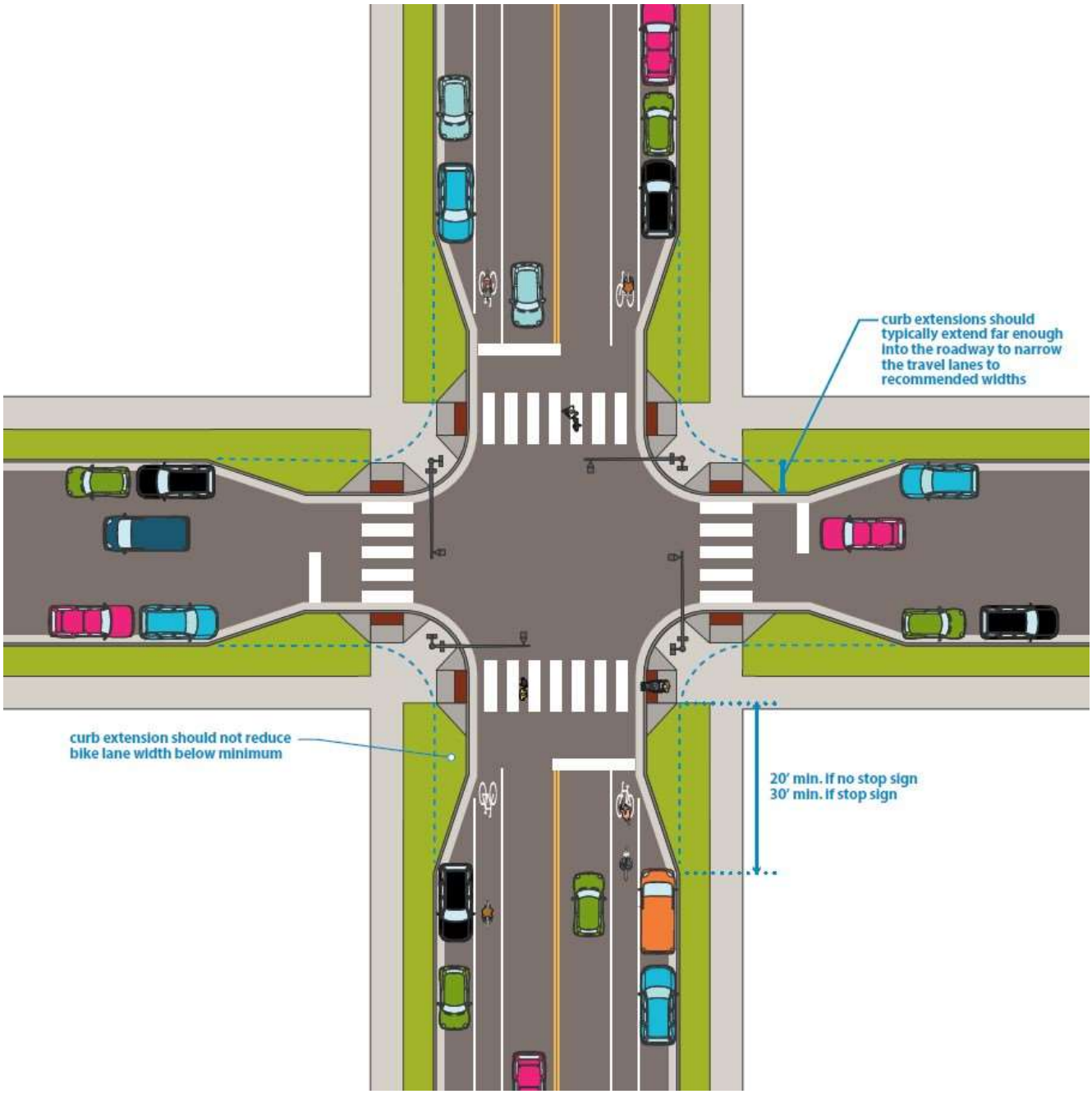


Figure 3:Intersection curb extensions[17]

[17] City of Minneapolis Street Design Guide. https://sdg.minneapolismn.gov, accessed on February 12, 2025.

Minimum stopping sight distance for cyclists is the distance required to bring a bicycle to a controlled full stop. Similar to motor vehicles, it is a function of the cyclist's perception and brake reaction time, the initial speed of the bicycle, the coefficient of friction between the tires and the bikeway surface, and the braking capability of the bicycle. Stopping sight distance can be greater for bicycles than motor vehicles, particularly in the case of steep downgrades, and should be considered in the design of all bikeways.[18]

The stopping sight distance is given by the following equation, and **Table 9** summarizes the minimum stopping sight distance for bicycles at different designs speeds and grades.

$$SSD = 0.694\,V + \frac{V^2}{255(f+G)}$$

Where:

SSD = Stopping Sight Distance (m)

V = Design speed or velocity (km/h)

f = Coefficient of friction

G = Grade (m/m) (G > 0 uphill; G < 0 downhill)

Table 9: Minimum Stopping Sight Distance for Bicycles[19]

Grade (%)	Design Speed (km/h)								
	10	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**
+ 12	8	13	18						
+ 10	8	13	18	24					
+ 8	8	13	19	25	32				
+ 6	8	13	19	25	32	40			
+ 4	8	13	19	26	33	41	49		
+ 2	8	14	20	26	34	42	51	61	
0	9	14	20	27	35	44	53	63	74
- 2	9	14	21	28	36	45	55	66	77
- 4	9	15	21	29	38	47	58	69	81
- 6	9	15	22	30	39	50	61	73	86
- 8	9	16	23	32	42	53	65	78	92
- 10	10	16	24	34	44	56	70	84	100
- 12	10	17	26	36	48	61	76	92	110

[18] Geometric Design Guide for Canadian Roads, June 2017, Chapter 5, Page 36, Transportation Association of Canada.
[19] Geometric Design Guide for Canadian Roads, June 2017, Chapter 5, Page 37, Transportation Association of Canada.

TAC also provides departure sight distance values for midblock (multi-use path) crossings, as illustrated in **Figure 4** and summarized in **Table 10**. The values assume a pedestrian walking speed of 1.2 m/s. In some situations, however, a walking speed of 1.0 m/s may be used (at crossings frequented by young children, seniors, and special needs persons), which results in the distances provided in **Table 11**. A lower walking speed, 0.8 km/h, is also preferable for improved accessibility, which results in the distances provided in **Table 12**.[20]

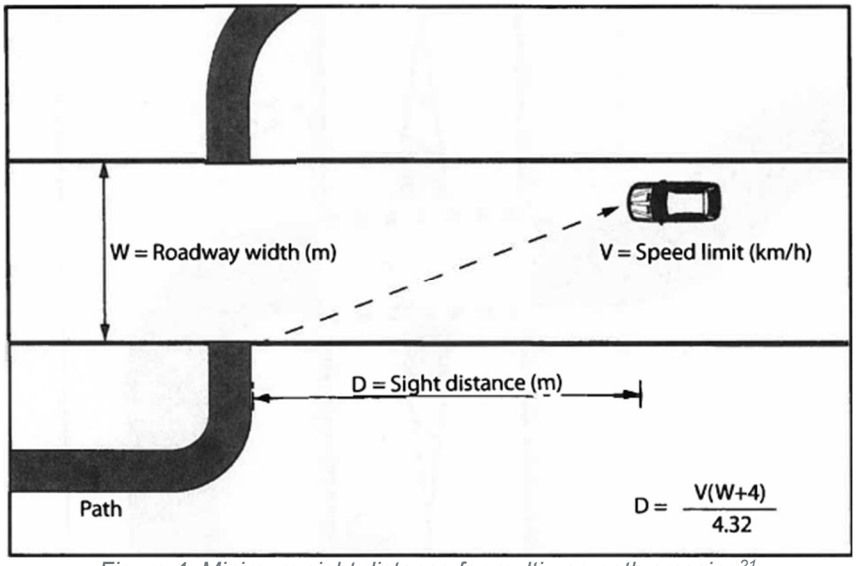


Figure 4: Minimum sight distance for multi-use path crossing[21]

Table 10: Minimum sight distance for multi-use path crossing (1.2 m/s walking speed)[22]

Minimum Sight Distance (D) to Approaching Vehicle (m)					
Type and Width of Roadway: W (m)		**Roadway Design Speed (km/h)**			
		50	**60**	**70**	**80**
Residential Locals	8.5	140	170	200	230
Residential Collector	9.5	160	190	220	250
	11.0	170	210	240	280
	12.5	190	230	270	310
Major Collector	14.0	210	250	290	330
	15.5	230	270	320	360
Industrial/Commercial Collector	10.0	160	190	230	260
	11.5	180	220	250	290
Residential Laneway	5.5	110	130	150	180
Non-residential Laneways	7.0	130	150	180	200
Note: Values for other roadway widths and/or design speeds may be derived from the formula in Figure 4.					

[20] Accessible design for the built environment (CSA/ASC B651:23). Accessibility Standards Canada, 2023.
[21] Geometric Design Guide for Canadian Roads, June 2017, Chapter 5, Page 58, Transportation Association of Canada.
[22] Geometric Design Guide for Canadian Roads, June 2017, Section 8.9.3, Page 48, Transportation Association of Canada – adapted for City of Markham standard roadway widths.

Table 11: Minimum sight distance for multi-use path crossing (1.0 m/s walking speed)

Minimum Sight Distance (D) to Approaching Vehicle (m)					
Type and Width of Roadway: W (m)		**Roadway Design Speed (km/h)**			
		50	**60**	**70**	**80**
Residential Locals	8.5	170	210	240	280
Residential Collector	9.5	190	230	260	300
	11.0	210	250	290	330
	12.5	230	280	320	370
Major Collector	14.0	250	300	350	400
	15.5	270	330	380	430
Industrial/Commercial Collector	10.0	190	230	270	310
	11.5	220	260	300	340
Residential Laneway	5.5	130	160	180	210
Non-residential Laneways	7.0	150	180	210	240
Note: Values for other roadway widths and/or design speeds may be derived from the formula in Figure 4 and multiplying the result by 1.2.					

Table 12: Minimum sight distance for multi-use path crossing (0.8 m/s walking speed)

Minimum Sight Distance (D) to Approaching Vehicle (m)					
Type and Width of Roadway: W (m)		**Roadway Design Speed (km/h)**			
		50	**60**	**70**	**80**
Residential Locals	8.5	220	260	300	350
Residential Collector	9.5	230	280	330	380
	11.0	260	310	360	420
	12.5	290	340	400	460
Major Collector	14.0	310	380	440	500
	15.5	340	410	470	540
Industrial/Commercial Collector	10.0	240	290	340	390
	11.5	270	320	380	430
Residential Laneway	5.5	160	200	230	260
Non-residential Laneways	7.0	190	230	270	310
Note: Values for other roadway widths and/or design speeds may be derived from the formula in Figure 4 and multiplying the result by 1.5.					

5. Driveways and Private Accesses

AASHTO defines a driveway as an access that is constructed within the public right-of-way to connect a public roadway with an adjacent property. A driveway could serve a high-activity land use such as a shopping centre, or low-activity land use such as a single residential house. The width of driveways could also vary from 3 m for residential land use, to 15 m for industrial land use. Driveways, therefore, are typically classified based on the type of land development they serve; residential, commercial, or industrial developments. Generally, the higher the volume served by the driveway, the more stringent the design requirements.

Driveways should be designed to minimize the impact on the roadway traffic while also providing safe entry and exit from the development served. One of the objectives in the design of driveways is to provide adequate sight distance for drivers using the driveway. Since the function of driveways is similar to that of public intersections, engineering guidelines such as TAC and AASHTO recommend that Intersection Sight Distance be used for driveway operations.

According to TAC GDGCR, sight distances at driveways should be determined considering sight triangle requirements of intersections. This is particularly important for commercial and industrial driveways (where a substantial amount of trucks are expected to use a driveway, the sight distance requirement should be determined based on the appropriate time gaps in **Table 6**); however, for minimum use driveways such as those serving single family residential units along local roads, TAC states that reduced sight distances are generally tolerable in these situations due to the low operating speeds and the caution typically exercised by drivers.[22].

To integrate the needs of the pedestrian into the design of driveways, TAC indicates that narrow driveways with small curb return radii, but still adequate to accommodate the design turning vehicle are preferred.[23] This is particularly important in situations where visibility is restricted, since this type of design encourages lower vehicular speed.

6. Transit Shelters

Transit (bus) shelters provide waiting passengers with a place of comfort and protection from weather conditions. Similar to bus stops, bus shelters could be located on the near- or far-side of the intersection. The specific location for each bus shelter should be examined separately, to make sure that it does not constitute a visibility obstruction to vehicular traffic. Although there are advantages and disadvantages to both near- and far-side locations, AASHTO[4] mentions that far-side locations might be favourable to attain the most free and clear sightlines, particularly at unsignalized intersections. This preference is based on the fact that, at near-side locations, the view of through drivers to their right may be blocked by a stopped bus.

[23] Geometric Design Guide for Canadian Roads, June 2017, Chapter 8, Page 59, Transportation Association of Canada.

The location of a bus shelter should be examined using the applicable intersection sight triangles to confirm that it does not constitute sightline obstruction.

Figure 5 illustrates the use of intersection sight triangles to study the location of bus shelters. It should be noted that the same principle should be applied to access roadways so that a driver entering the road from an access would have a sufficient, unobstructed view to make a safe manoeuvre.

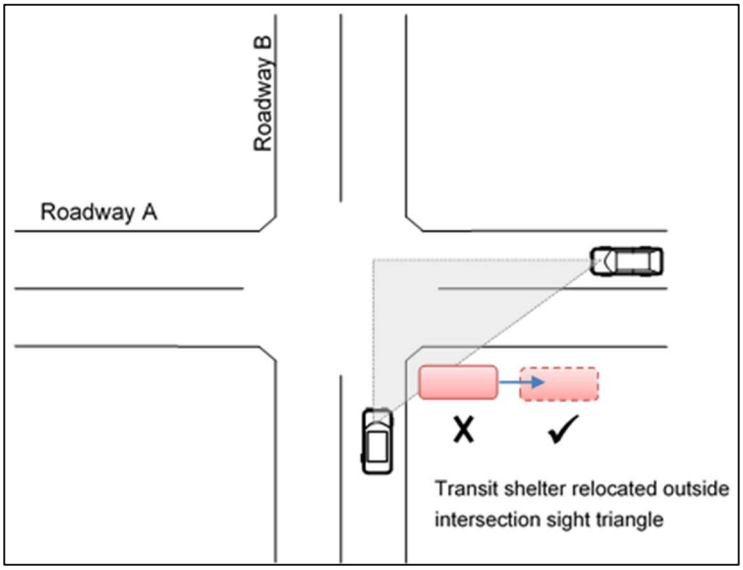


Figure 5: Transit shelter relocated outside intersection sight triangle.

7. Warning Signs

The HIDDEN INTERSECTION tab sign (Wa-18t) is used in combination with other controlled intersection signs (Wa-11A, Wa-12A, Wa-13A, Wa-15A) to warn drivers on the through road that side road traffic under stop or yield control does not have an adequate view of traffic approaching on the through road.[24]

The HIDDEN INTERSECTION tab is required where the available sight distance, measured from an assumed eye height of 1.05 m above the surface, at the vehicle stop location (4.4 m setback) to an assumed vehicle height of 1.05 m above the centreline of the through road, is less than the minimum distances specified in **Table 13**.

[24] Ontario Traffic Manual Book 6 – Warning Signs, July 2001. Pages 43 and 44. Ministry of Transportation Ontario.

Table 13: Minimum sight distances for HIDDEN INTERSECTION tab sign

Type of Roadway	Normal Regulatory Posted Speed on Major Highway (km/h)					
	50	60	70	80	90	100
Two-lane Roadway	95	115	135	150	170	-
Four-lane Divided Roadway (Median width > 5.5 m)	95	115	135	150	170	190
Other Four-lane Roadway	115	135	160	180	205	225

DISTANCE tab signs (Wa-23t) can also help drivers judge the location where they can expect to encounter a hazard, such as a vehicle entering their path from a minor road with insufficient visibility. This sign can be used to supplement the HIDDEN INTERSECTION tab sign.

At school bus stops with limited sight distances due to horizontal curves, vertical curves, foliage or other obstructions, SCHOOL BUS STOP AHEAD signs (Wc-26) should be used to indicate to drivers that they may encounter a hazard. The sign, which may be supplemented with the SCHOOL BUS STOP AHEAD tab sign (Wc-26t), should be installed where the available sight distance is less than the minimum distances specified in **Table 14**.

It should be noted, however, that warning signs should only be considered as mitigation measures for insufficient sight distances if they cannot be easily or immediately remedied. While warning signs provide a short-term solution, they do not relieve a road authority from its responsibility to eliminate the problem.[25]

Table 14: Minimum stopping sight distances for SCHOOL BUS STOP AHEAD sign

Posted Speed (km/h)	Minimum Stopping Sight Distance (m)
40	65
50	110
60	135
70	160
80	185
90	215
100	245

The use of HIDDEN DRIVEWAY warning signs is discontinued in the OTM Book 6. The sign was intended for driveways that have limited sight distance and could be considered unexpected by drivers. Due to the frequency of these situations, the use of this sign was discontinued. Similar to the OTM, there are no warning signs for hidden driveways specified in the current versions of either the TAC MUTCDC or the FHWA MUTCD.

[25] Manual of Uniform Traffic Control Devices for Canada, January 2011, Section 1.1, Transportation Association of Canada.

Generally, the use of warning signs should be kept to a minimum. The proliferation of warning signs tends to create disrespect/non-compliance to all the signs. In the United States, several road agencies have discontinued the use of the Hidden Driveway warning signs since the 1970's, when traffic observations revealed that drivers were ignoring the sign message and that the signs had little-to-no effect in altering drivers' behavior or in reducing their speeds. Some road agencies, such as Ohio Department of Transportation, noted that the sign could create a false sense of security for driveway users. Instead, the driveway traffic should be fully aware of the hazard of entering the roadway and should not be misled into thinking that the roadway traffic will be prepared to yield or stop.

8. Design Exceptions and Legal Non-conforming Situations

In many cases dealing with roadway design, meeting the guidelines may not be practical or desirable. The roadway design must respect controls and constraints to a greater or lesser degree depending on their nature and significance. Often, design engineers are faced with the dilemma of being unable to choose design dimensions or criteria that will satisfy all controls and constraints; in those instances, a compromise is required.

Some design criteria are inviolate, such as vertical clearance at structures. Others are less rigid, and some are chosen based primarily on considerations of safety, service, capacity, or economy. There is a continuous relationship between service, cost, and safety, and changes in the value of design dimensions. Deviations from the guidelines or less generous design dimensions may not necessarily lead to roadways that are not safe. Likewise, more generous design dimensions do not necessarily lead to safer roadways. Design is a process in which sound engineering judgement and experience considering service, cost, and safety play significant roles.

A Design Exception is a case where one or more design elements for one or more modes of transportation falls outside normal boundaries of the design domain for that design element. It is an extraordinary situation and one where the design needs to be tailored to its context through sound professional judgment.

Design exceptions should be supported by appropriate engineering judgment, and detailed documentation which includes a summary of mitigating strategies. The GDGCR has provided a six-step process for evaluating the design exceptions, which includes an evaluation of risks as a result of the design deviation, and the development of mitigation measures.

The TAC Geometric Design Guide for Canadian Roads (GDGCR) states that requiring a design exception evaluation for every design element is impractical, and identifies 12 key criteria having substantial importance to the operational and safety performance of any highway so that special attention should be paid to them in design decisions. These key criteria include Design Speed, Horizontal Alignment, Superelevation, Vertical Alignment, Grade, Stopping Sight Distance, Vertical Clearance, Cross Slope, Lane Width, Shoulder Width, Bridge Width, and Lateral Offset to Obstruction. Intersection Sight Distance (ISD) is not included among the referred key design criteria.

Most municipal jurisdictions have many local road intersections where trees or fences restrict the available sight distance below the minimum ISD requirements per the GDGCR. However, sometimes it may be unreasonable to remove a mature tree or a fence that has been in place for decades at low-risk locations (e.g., low volumes, low operating speeds, no historical collision patterns). These ”legal non-conforming” situations are very common, in which the available sight distance does not meet current requirements from design standards, but did meet the requirements in the past, when different design standards were in effect. In these cases, ISDs that do not meet current requirements may be acceptable if there is evidence that the restricted sight distance does not represent a safety risk to road users.

At low-speed (i.e., post speed limit of 50 km/h or less), low-volume (i.e., within low-density residential neighbourhoods), minor-road stop-controlled local road intersections, there might be situations where adequate ISD cannot be provided. In such cases, as long as the SSD can be maintained on the major road, when a driver on the minor road enters the intersection, the driver on the major road would have sufficient time to safely react and come to a complete stop before reaching the intersection. Therefore, if there is no clear evidence that the inadequate ISD is resulting in safety issues (i.e., road user collisions or conflicts), then City staff may decide not to remove the object(s) causing the obstruction and install warning signs as a mitigating measure.

9. Recommended Procedures

The following procedures are suggested as a minimum requirement for specific types of intersections within the City of Markham.

9.1 Sight Distance Requirements

Table 15 summarizes the recommended sight distance requirements for different scenarios, based on the discussions in the preceding sections.

Details for special cases (driveways, transit shelters and intersections with no control or yield control) are provided after the table.

Table 15: Sight Distance Requirements for Different Scenarios

Sight Distance Type	Intersection Control Type					
	No Control[a]	Yield Control[a]	PXO[b]	MRSC[c]	AWSC[d]	Signal
Stopping Sight Distance	**Target:** another passenger car stopped immediately before entering the intersection **Reference:** Table 2	**Target:** yield sign **Reference:** Table 2	**Target:** pedestrians waiting to cross the road **Reference:** Table 2	**Target:** stop sign **Reference:** Table 2	**Target:** stop sign **Reference:** Table 2	**Target:** at least one signal head **Reference:** Table 8
Decision Sight Distance[e]	**Target:** another passenger car stopped immediately before entering the intersection **Reference:** Table 3	**Target:** yield sign **Reference:** Table 3	**Target:** pedestrians waiting to cross the road **Reference:** Table 3	**Target:** stop sign **Reference:** Table 3	**Target:** stop sign **Reference:** Table 3	**Target:** at least one signal head[f] **Reference:** Table 8
Approach Sight Triangles	**Target:** vehicles approaching from the left and right along the other road **Reference:** Table 3	**Target:** vehicles approaching from the left and right along the other road **Reference:** Chapter 9 of the TAC design guide, pages 72 through 76	n/a	**Target:** vehicles approaching from the left and right along the minor road **Reference:** Table 5	**Target:** vehicles approaching from the left and right along the other road **Reference:** Table 5	**Target:** vehicles approaching from the left and right along the other road **Reference:** Table 5
Departure Sight Triangles	**Target:** vehicles approaching from the left and right along the major road **Reference:** Table 7	**Target:** vehicles approaching from the left and right along the major road **Reference:** Table 7	n/a	**Target:** vehicles approaching from the left and right along the major road **Reference:** Table 7	**Target:** vehicles stopped at the stop bar on the other approaches **Reference:** n/a	**Target:** vehicles approaching from the left and right along the major road **Reference:** Table 7
Left Turn from Major Road	**Target:** vehicles approaching from the opposing direction along the major road **Reference:** Table 7	**Target:** vehicles approaching from the opposing direction along the major road **Reference:** Table 7	n/a	**Target:** vehicles approaching from the opposing direction along the major road **Reference:** Table 7	**Target:** vehicles stopped at the stop bar on the other approaches **Reference:** n/a	**Target:** vehicles approaching from the opposing direction along the major road (for left-turning vehicles only) **Reference:** Table 7
Multi-use Path	**Target:** vehicles approaching from the left and right along the other road (from the perspective of vulnerable road users waiting to cross the road) ***Reference:*** *Table 10 and Table 11[g]*					

Notes:
a: The City of Markham has converted all known yield controls to stop control in the recent past. There are currently no known yield or uncontrolled intersections in the City.
b: PXO = pedestrian crossover.
c: MRSC = minor road stop control.
d: AWSC = all-way stop control.
e: To be provided where drivers must make instantaneous decisions, where information is different to perceive and interpret, or where unexpected manoeuvres are required. Examples include:
- Intersections or pedestrian crossings where several sources of information compete (visual clutter).
- Intersections or pedestrian crossings located beyond horizontal or crest vertical curves.

f: If a downgrade is present, stopping sight distance per Table 2 should also be provided.
g: The recommended distances apply to uncontrolled vehicle approaches. While also desirable at controlled approaches, they are likely impractical in many situations. Therefore, appropriate stopping or decision sight distance to the traffic control device is critical.

Driveways and Private Accesses

The requirements for well utilized (volumes greater than 25 vehicles per day) commercial, industrial and major residential driveways (e.g., condos) are the same as those for intersections, based on the driveway control type.

At single-family residential and other minimum use driveways (less than 25 vehicle vehicles per day), reduced sight distances are tolerable unless City staff identify a combination of high-risk conditions including severely restricted sight lines (less than 50% of the requirement) and extremely high volumes and or/speeds or a history of collisions associated with the subject driveway. Regardless, stopping sight distance on the major road should still be provided as a minimum.

Transit Shelters

Transit shelters should be located outside of the required intersection sight triangles.

Intersections with No Control or Yield Control

Intersections with no control or with yield control on the minor road should be avoided since they are rare (particularly in mostly urban jurisdictions such as Markham) and some motorists may not fully understand how they are supposed to operate. As such, at a minimum, minor road stop control should be provided at all intersections. The City has converted all known yield controls to stop control in the recent past. There are currently no known yield or uncontrolled intersections in the City.

Where yield control is provided at a roundabout, sight distances should be in accordance with applicable design standards for roundabouts (e.g., NCHRP Research Report 2043 (2023)).

Where yield control is provided at a right turn channel, the approach and departure sight triangle requirements for yield-controlled intersection should be provided, with the distance along the minor road measured along the channel and deceleration lane/taper, if provided. It should be noted, however, that traditional right turn channels force drivers into an uncomfortable position to look for gaps in traffic on the major road. Where feasible, right turn channels should be eliminated in favour of regular right turn lanes; alternatively, they should be converted to ‘smart channels’ to provide better visibility and improve safety for pedestrians (**Figure 6**).

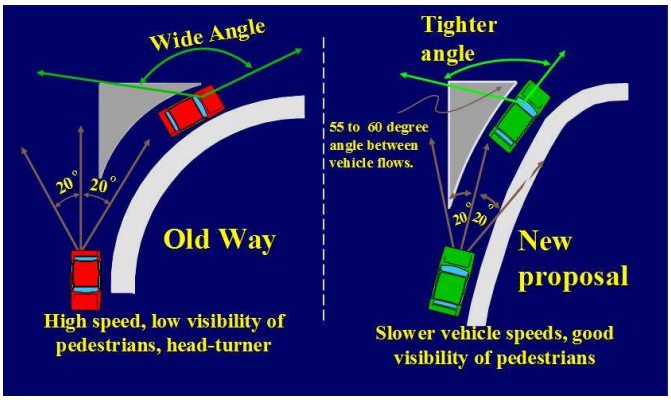


Figure 6: Traditional vs. Smart Channel[26]

9.2 Sight Distance Measurements

The three key criteria used in the measurement of Intersection Sight Distance in the field include driver's eye height, object height, and decision point, as summarized in **Table 16**.

Table 16: Driver's Eye and Object Heights

Criterion	Height (m)	Sight Distance	Application
Driver's eye height	1.08	All	All
Cyclist's eye height	1.37	All	All (lower if significant usage by children)
Object height	0.00	SSD, DSD	Risk of road washouts Pavement markings at critical locations
	0.15	SSD, DSD	Risk of fallen trees or rocks Risk of logs or debris fallen from trucks Risk of fallen person
	0.60 [a]	SSD, DSD	Vehicle taillight
	1.30 [b]	ISD	Top of Car
Notes:	a: Typical object height for most applications. b: Some jurisdictions use an object height of 1.15 m for the top of a car, based on the premise that a driver needs to see at least 150 mm of the vehicle to discern its presence.		

The decision point for departure sight triangles on the minor road should be a minimum of 4.4 m from the edge of the major road traveled way (a_L and a_R in **Figure 2**). This represents the typical position of the minor-road driver's eye when a vehicle is stopped relatively close to the major road. Where non-traveled portions of the major road are present, such as parking lanes or buffers, the decision point can be located further ahead compared to roads without these elements. However, if bicycle lanes are present, the decision point is not moved forward (**Figure 7**). Where practical, it is desirable to increase the distance from the edge of the major road traveled way from 4.4 m to 5.4 m.

Appendix B includes field forms to assist staff complete sight distance measurements.

[26] Region of Waterloo (www.regionofwaterloo.ca/en/living-here/traffic-safety.aspx#Right-turn-Smart-Channel).

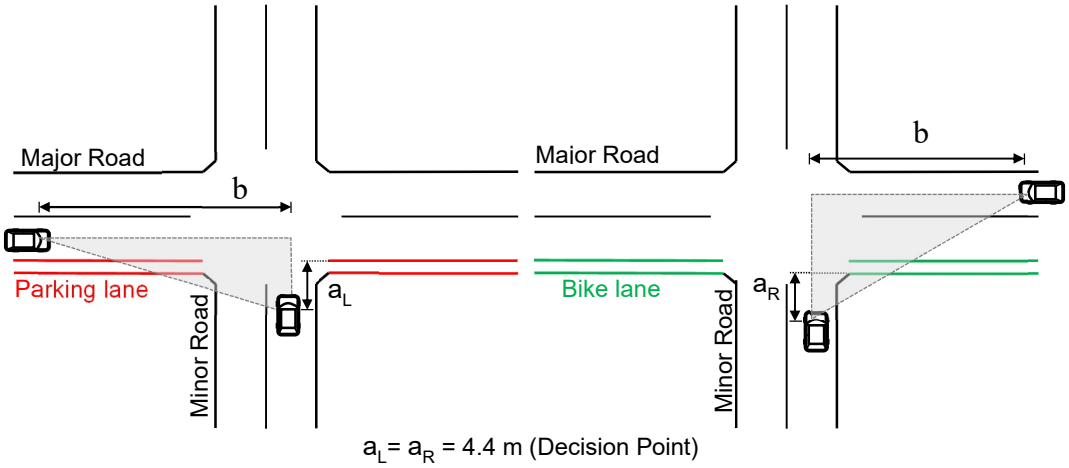


Figure 7: Decision Points with Parking Lane and Bike Lane

9.3 Mitigation Measures for Restricted Sight Distances

Existing Intersections

Ideally, any obstruction that result in available sight distances being shorter than the requirements outlined in the previous sections should be removed to provide completely clear sight triangles. This may include full or partial removal (pruning) of vegetation, including trees, shrubs and landscaping, removal/relocation of fixed objects or signs, or implementation / extension of parking restrictions.

However, it may not be feasible or desirable to remove some obstructions. For example, at residential streets where an intersection is located close to a horizontal curve, the obstruction may be caused by houses (**Figure 8**); removing mature trees may reduce the aesthetic appeal of the neighbourhood; decorative fences may have been in place for many decades; etc.



Figure 8: Example of Houses Obstructing Visibility

In these cases, the following strategies can be used, in order of preference:

1. **Implement all-way stop control.** The 2021 version of OTM Book 5 – Regulatory Signs introduced a Visibility Warrant for all-way stop control (AWSC). The warrant states the following:

   > *"Under some circumstances, sufficient sight distance is not available for traffic exiting the stop-controlled approaches of a two-way stop intersection, based on geometric design requirements. If all efforts to improve the sight distance have been exhausted and the sight distance cannot be brought up to the guidelines, conversion of the intersection to all-way stop operation may be considered. Special advance warning or overhead flashing lights may be necessary to augment the control if vertical or horizontal alignment is a factor."*

   Operational analysis of the intersection under all-way stop control must be undertaken to assess potential impacts on the road network. If unreasonable queues or delays are expected and the subject intersection does not meet the OTM Volume and Collision Warrants, AWSC should not be implemented.

2. **Install warning signs (where not feasible to remove obstruction).** If it is not feasible to remove the obstruction(s) and AWSC was determined not to be appropriate, warning signs should be installed as a mitigation measure, in accordance with OTM Book 6 guidelines.

3. **Install warning signs (where not desirable to remove obstruction).** If removing the obstruction(s) is feasible, but not desirable, and AWSC was determined not to be appropriate, City staff may decide not to remove the object(s) causing the obstruction if all of the following conditions are met:

   - No collisions have been reported, in the past ten (10) years, involving a driver on the subject minor road approach disobeying traffic control or failing to yield the right of way; and
   - The 95th percentile speed on the subject major road approach does not exceed 50 km/h; and
   - The available ISD is equal to or greater than the SSD based on the major road approach design speed; and
   - Field observations indicate that most drivers experience no difficulty or hesitation entering the intersection from the subject approach, and most drivers on the major road are not required to brake or swerve to avoid a collision.

   If these conditions are met, INTERSECTION warning signs (Wa-11A or Wa-13a) with HIDDEN INTERSECTION and DISTANCE tab signs (Wa-18t and Wa-23t) are to be installed on the affected major street approaches at local road intersections within residential neighbourhoods (speed limit ≤ 50 km/h).

   At other intersections (i.e., collector roads or not within residential neighbourhoods), HIDDEN INTERSECTION signage is to be installed if the available ISD is less than the minimum sight distance values specified in OTM Book 6 for these signs (refer to Table 13 in Section 7).

In both cases, sign placement should be in accordance with the current version of OTM Book 6.

4. **Install an intersection conflict warning system (rural locations).** If removing the obstruction is not feasible or desirable, AWSC was determined not to be appropriate, and the use of warning signs was attempted but not effective in addressing the visibility concern (e.g., the visibility restriction is extreme or drivers still experience no difficulty or hesitation entering the intersection), consideration should be given to installing an intersection conflict warning system to detect vehicles on the minor street and to warn approaching drivers on the major street (**Figure 9**). It should also be noted that the warning system shown in the figure is a combination of two systems: one on the major street, and the other on the minor street. To avoid potential confusion with or distraction from the STOP signs, the detection should occur on the minor street only and the warning on the major street only. The City may implement this type of system on a trial / pilot project basis.

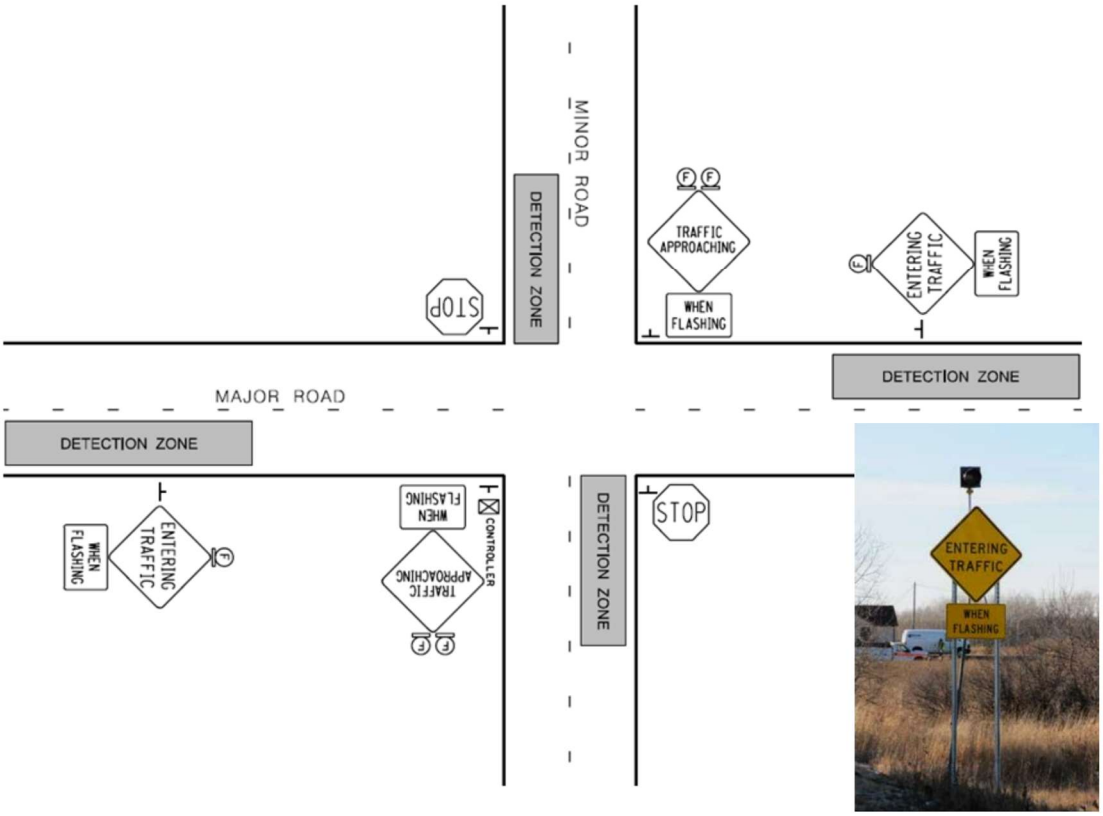


Figure 9: Typical Layout of Intersection Conflict Warning System[27]

[27] Rural Intersection Conflict Warning System (RICWS) Reliability Evaluation, 2014, Center for Transportation Studies University of Minnesota, Minnesota Department of Transportation, Minnesota.

New Intersections

The City should strive to meet the described intersection sight distances for all new construction. This may require traffic engineering staff to be consulted as early as possible in the development process so that substantial visibility restrictions that cannot be addressed after construction (for example, building houses too close to a horizontal curve next to an intersection should be avoided as it may not be feasible to remove them to provide appropriate sight distances post construction).

Non-motorized Road Users

If a currently uncontrolled pedestrian or cyclist crossing location has insufficient sight distances and it cannot be brought up to the guidelines, the following mitigation measures should be considered:

- If decision sight distance is available, install warning signs per guidance from OTM Books 6 – Warning Signs, 15 – Pedestrian Crossing Treatments, and/or 18 – Bicycle Facilities.
  - Sign type and location may vary, depend on the type of active transportation facility and its location relative to other intersections.
  - Note that certain warning signs may be required by OTM for certain types of crossings even if all sight distances are sufficient.
- If decision sight distance is not available but stopping sight distance is available, consider implementing traffic calming measures in advance of the crossing to reduce approach speeds and, consequently, the sight distance requirements.
- If stopping sight distance is not available, consider implementing some form of traffic control (pedestrian crossover, all-way stop or signal). Enhanced warning (DISTANCE tabs, flashing beacons) may be necessary to make drivers aware that they are approaching traffic controls.
  - Review warrants to determine most appropriate control type.
  - Warranted traffic controls should be implemented even if all sight distances are sufficient.

Hidden Driveway Signs

Old HIDDEN DRIVEWAY signs are still in place for some driveways; however, since this sign has been discontinued in OTM Book 6, it is recommended that the City does not reintroduce the Hidden Driveway warning sign as it would increase liability and would require the City to ensure that every potential case is signed equally. If existing HIDDEN DRIVEWAY signs are to be removed, best efforts should be made address the sight distance restriction or to implement the aforementioned mitigation measures.

Appendix A
Sight Distance Requirements Graphs

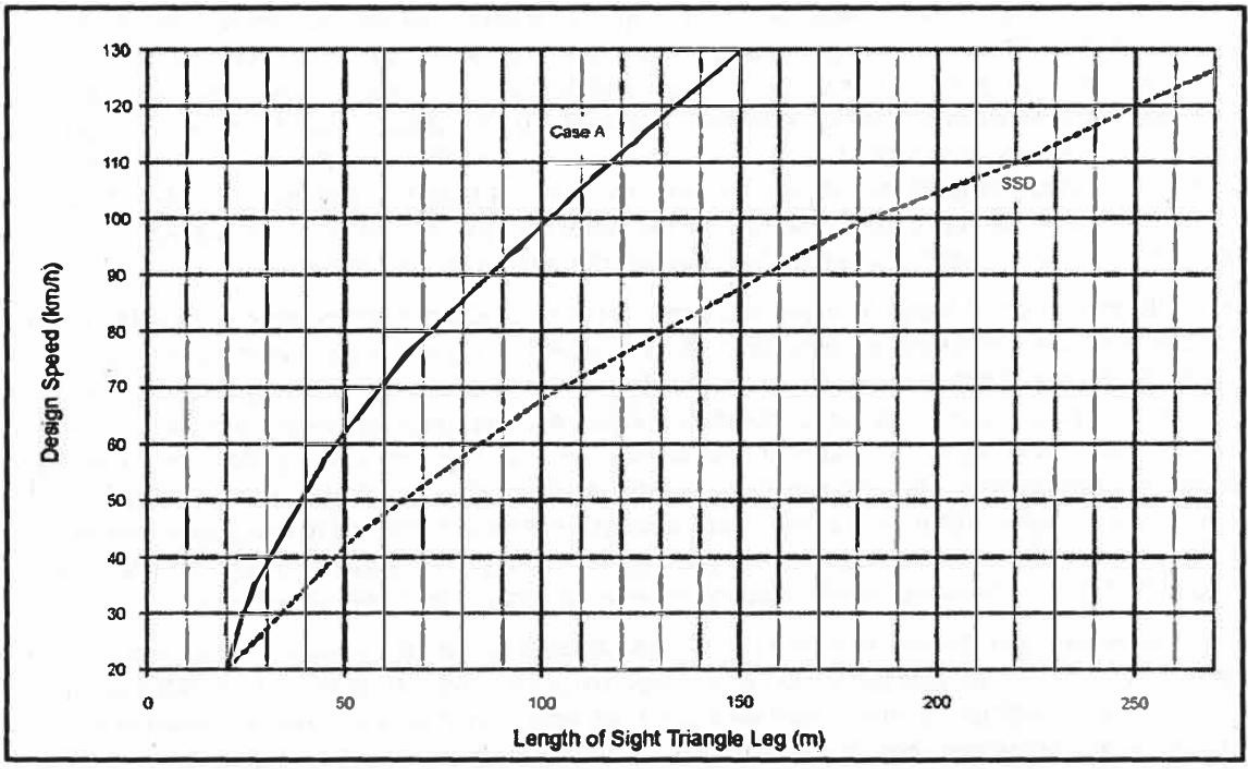


Figure 9.9.3: Length of Sight Triangle Leg – Case A, No Traffic Control

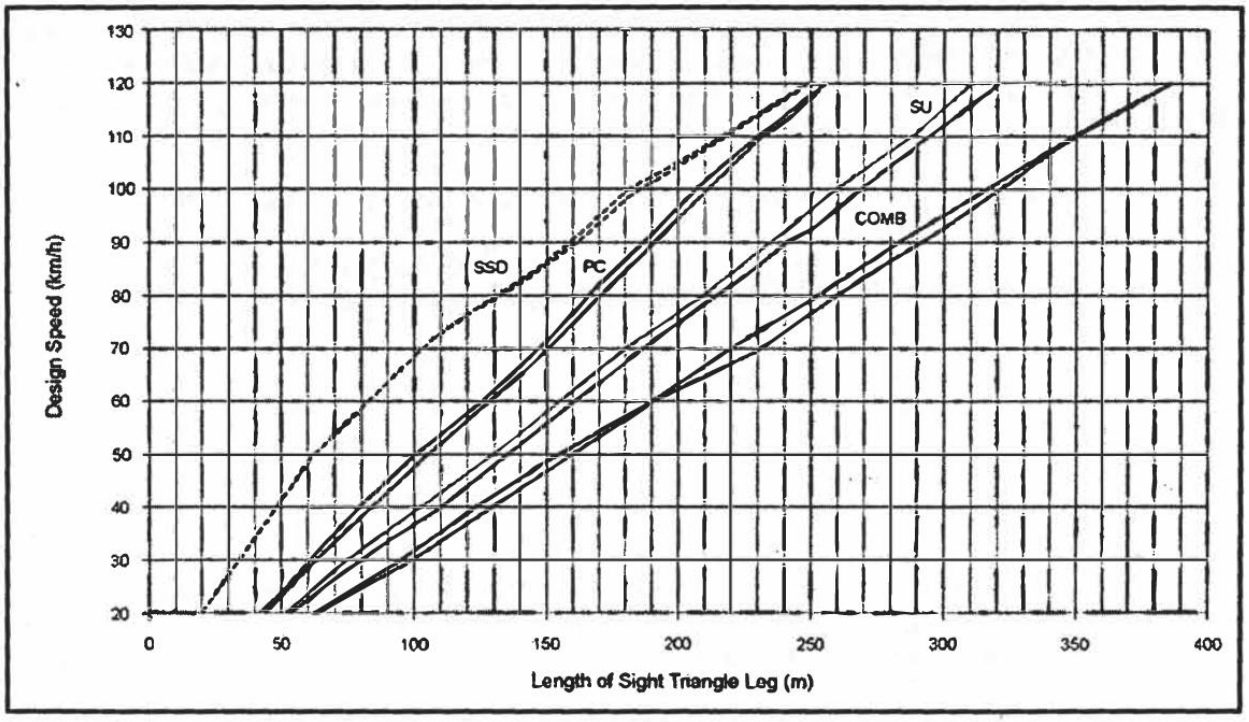


Figure 9.9.4: Intersection Sight Distance – Case B1, Left Turn from Stop (Calculated and Design Values Plotted)

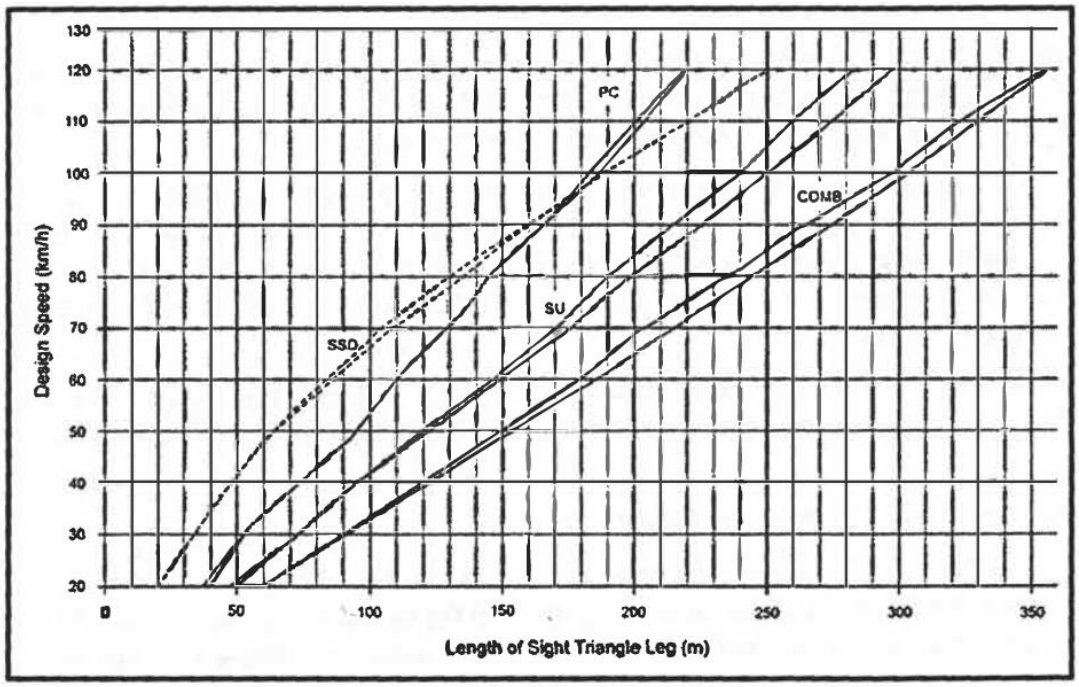


Figure 9.9.5: Intersection Sight Distance – Case B2, Right Turn from Stop, and Case B3, Crossing Maneuver (Calculated and Design Values Plotted)

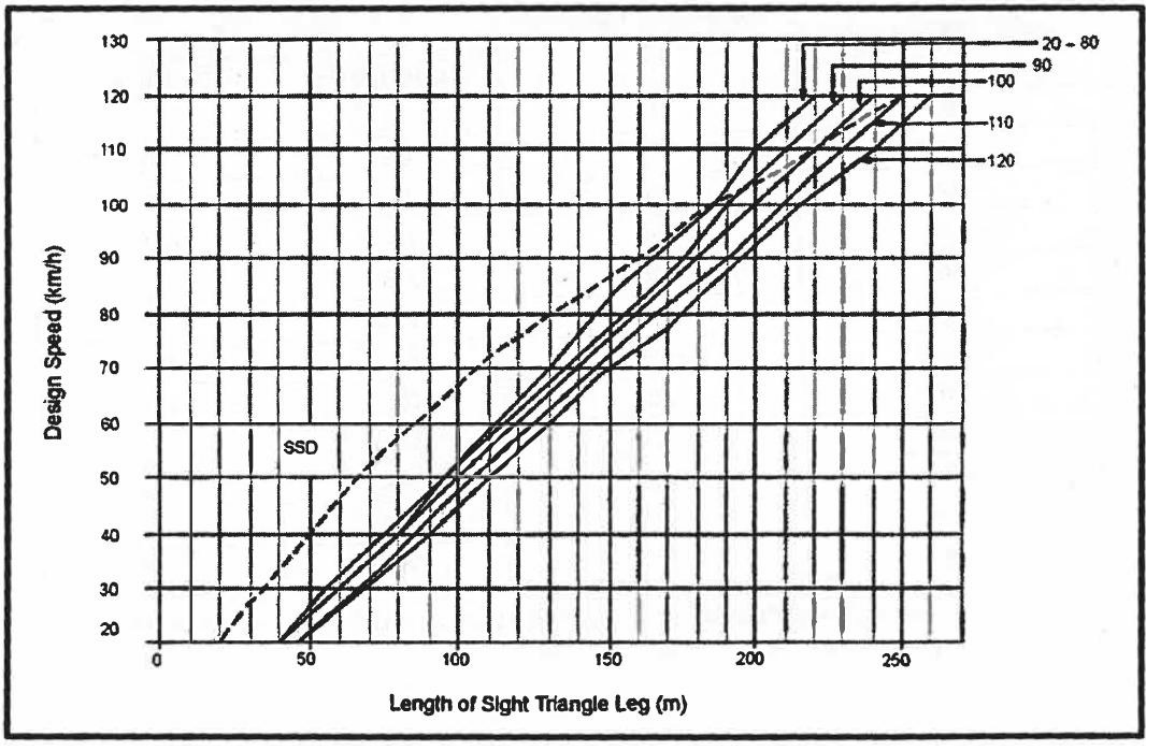


Figure 9.9.6: Length of Sight Triangle Leg along Major Road for Passenger Cars – Case C1, Crossing Maneuver

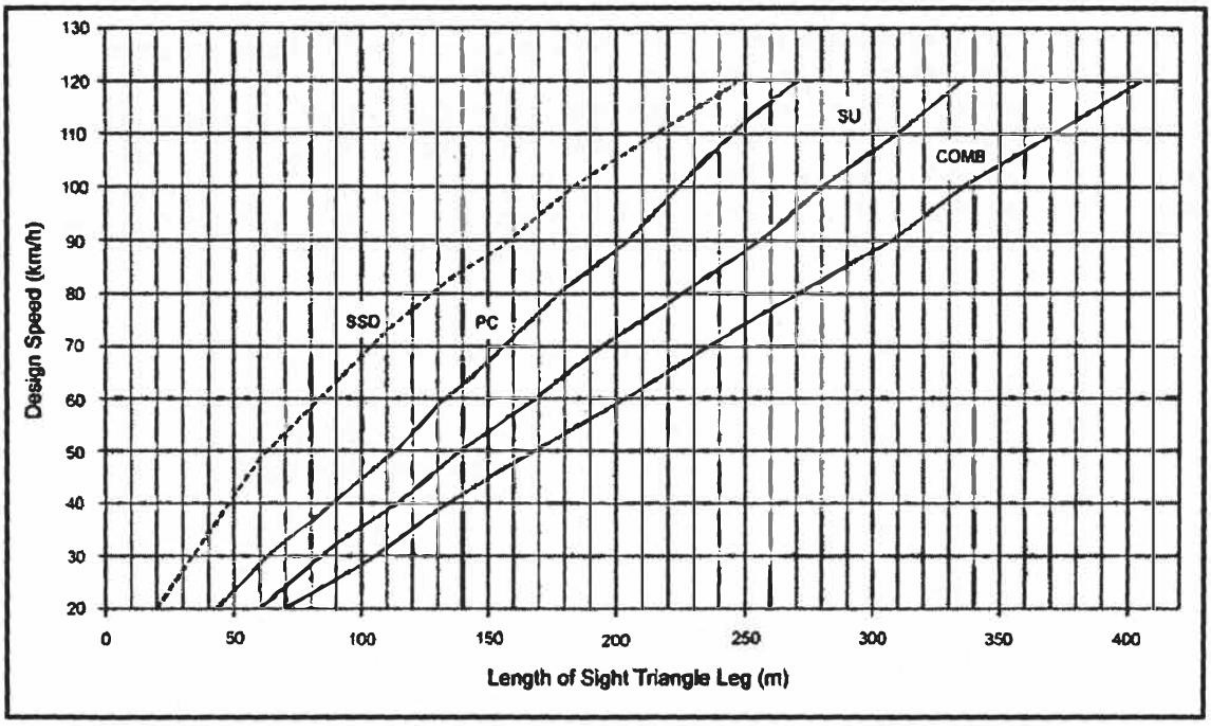


Figure 9.9.7: Intersection Sight Distance – Case C2, Yield-Controlled Left or Right Turn

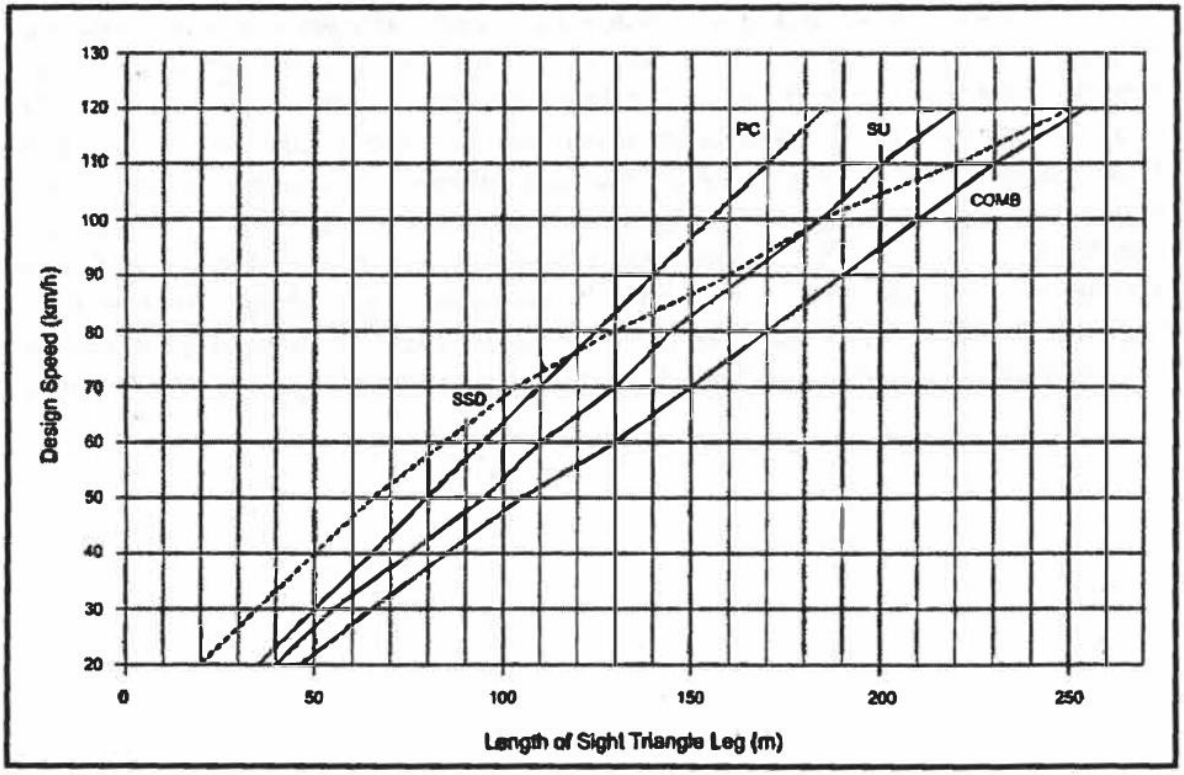


Figure 9.9.8: Intersection Sight Distance – Case F, Left Turn from the Major Road

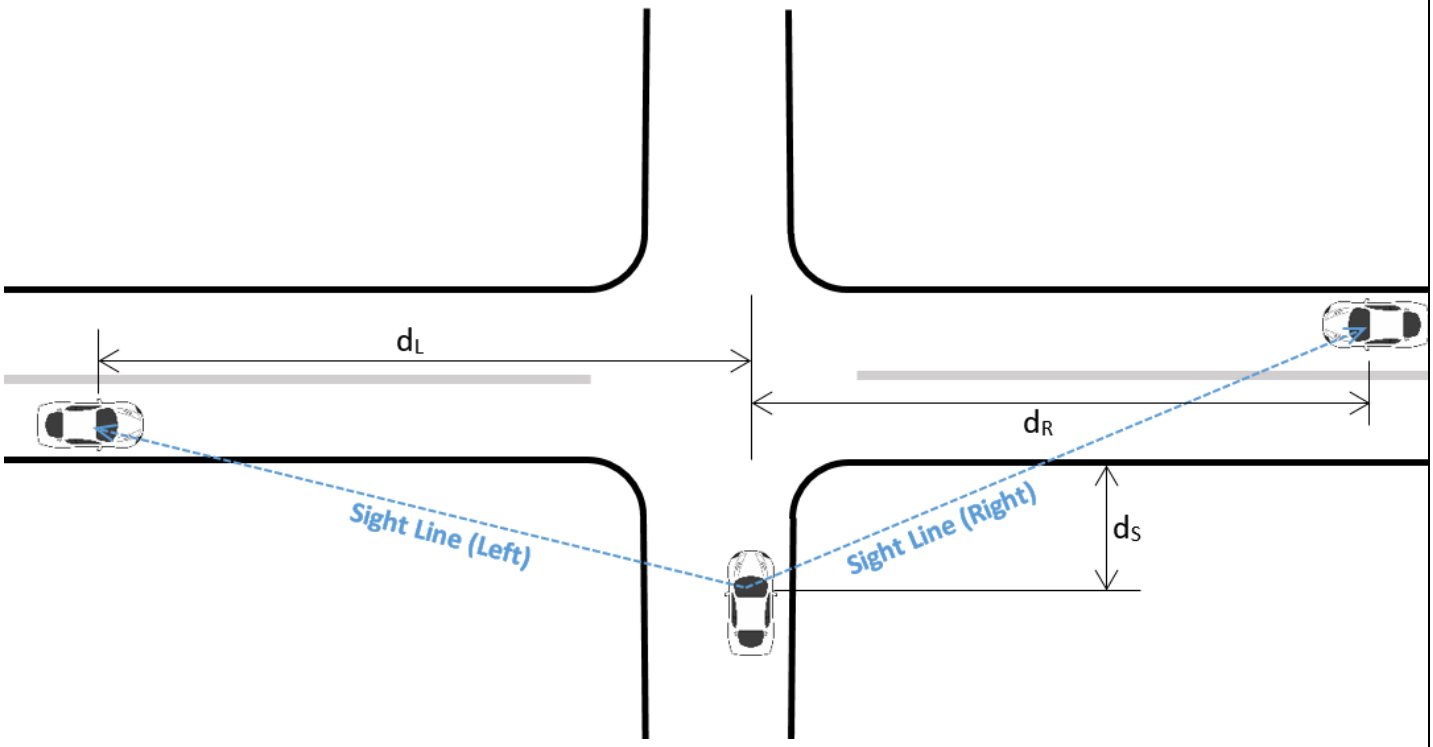
Appendix B
Sight Distance Field Forms

FIELD NOTES: INTERSECTION SIGHT DISTANCES

PROJECT:	DATE:	LOCATION:

DEPARTURE SIGHT DISTANCE

APPROACH:	☐ NB	☐ SB	☐ EB	☐ WB	☐ NB	☐ SB	☐ EB	☐ WB
d_S	3.0 m	4.4 m	5.4 m	Custom:	3.0 m	4.4 m	5.4 m	Custom:
d_L								
d_R								

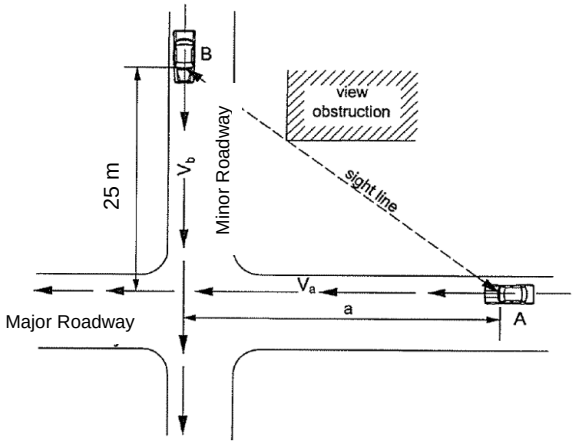


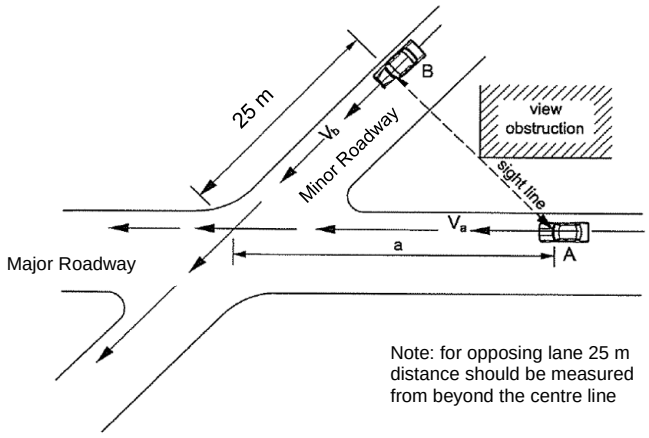
d_S 3.0 m = 1999 TAC; d_S 4.4 m = 2017 TAC Minimum; d_S 5.4 m = 2017 TAC Desirable

STOPPING / DECISION SIGHT DISTANCE

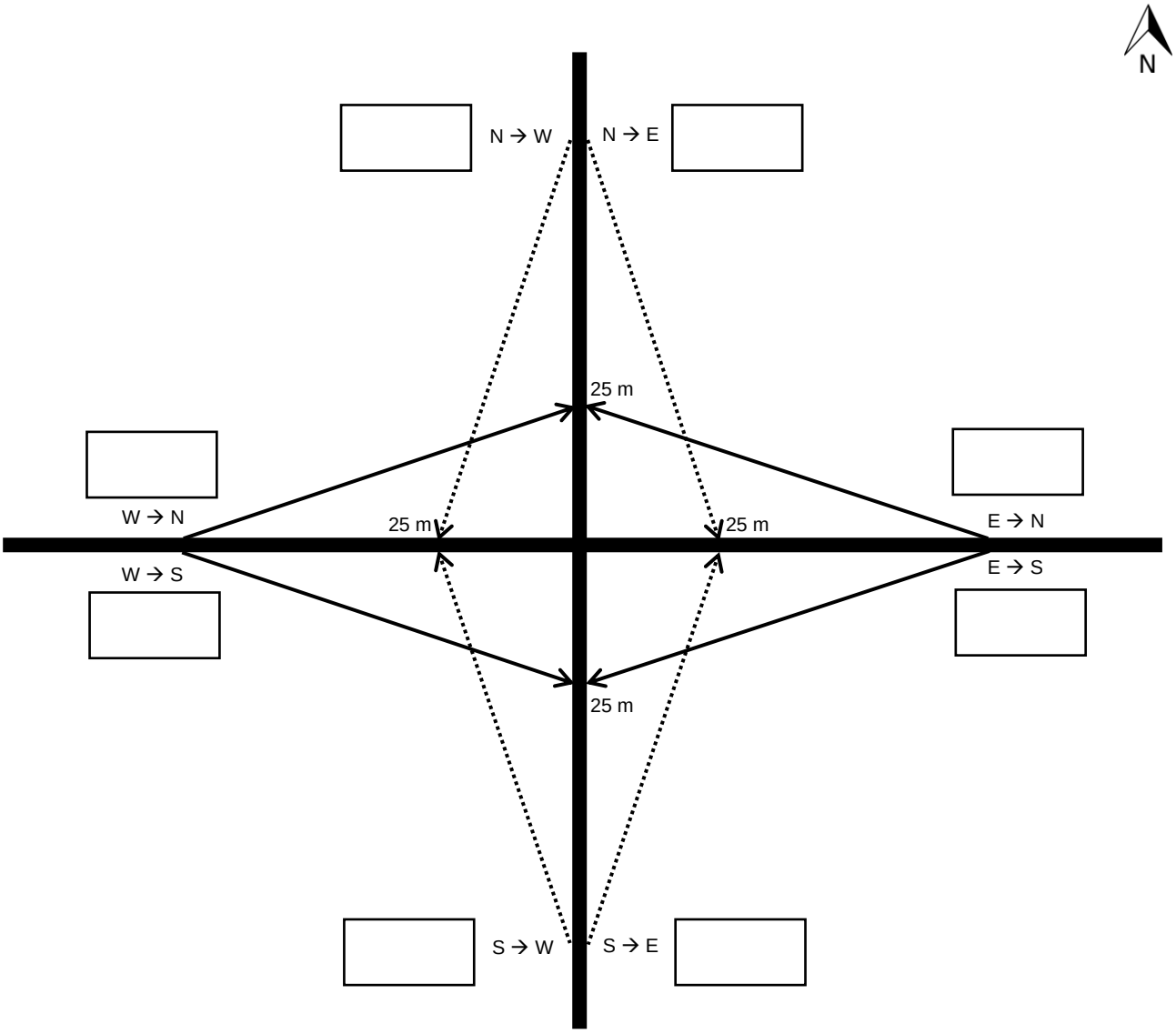
TARGET	NB	SB	EB	WB
Centre of closest lane on minor road				
Stop sign				
Traffic Signal primary / secondary				
Other:				

SIGHT TRIANGLES Stop Control





Note: for opposing lane 25 m distance should be measured from beyond the centre line



City of Markham

Speed Management and Traffic Calming Policy Paper

Vision Zero Road Safety Plan

CIMA+ file number: B001780
September 15, 2025

City of Markham

Speed Management and Traffic Calming Policy Paper

Vision Zero Road Safety Plan

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CIMA+ file number: B001780
September 15, 2025

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1. Introduction

The City of Markham (the City) has engaged CIMA Canada Inc. (CIMA+) to support the development of a comprehensive Road Safety Plan (RSP), aimed at enhancing road safety and reducing traffic-related risks across the City. As part of this larger initiative, the project will include the creation of five detailed policy papers that will guide the City's efforts in improving road safety. These papers will address a range of key issues, including fatal and serious injury collision investigations, traffic inquiry process, and traffic calming and speed management.

This memorandum outlines the policy paper on traffic calming and speed management, developed as part of *Task 4-6: Develop Policy Papers and Guidelines*.

1.1 Purpose and Overview

The purpose of this memo is to present recommendations for the refinement of the process used by the City of Markham for Traffic Calming and Speed Management related policies.

This initiative involves a structured and systematic approach to identify, prioritize, and implement effective traffic calming measures. The development of the policy is documented in detail in the following sections:

- **Section 2:** Current Procedures in the City of Markham
- **Section 3:** Environmental Scan
- **Section 4:** Proposed Policy

1.2 Need

Speed management and traffic calming are critical elements of a Vision Zero approach, which aims to eliminate traffic-related fatalities and serious injuries. By reducing vehicle speeds and implementing calming measures, the severity of collisions is significantly diminished, making roads safer for all users, particularly vulnerable road users such as pedestrians and cyclists.

Evidence of the urgency for such measures can be seen in the collision analysis for Markham, where 538 aggressive driving collisions (including speed-related collisions) occurred between 2017 to 2019, and 2022 to 2023. This collision type accounts for 53% of all injury collisions occurring in Markham.

Aggressive driving and speeding not only increases the likelihood of collisions but also escalates the severity of injuries when they do occur. Implementing effective speed management strategies, such as lowering speed limits in high-risk areas, deploying speed cameras, and introducing physical traffic calming measures like speed bumps, curb extensions, and roundabouts, can help mitigate these risks. By slowing down traffic, particularly in areas with high pedestrian and cyclist activity, the potential for fatal or serious injury collisions is reduced, aligning with the City's Vision Zero goal of achieving safer, more equitable streets for all.

1.3 Council Workshop

A Council Workshop was held in November 2024, to discuss the overall Road Safety Plan. During the Workshop, Councillors emphasized the importance of a structured and transparent process for implementing traffic calming and speed management measures. A recurring recommendation was the development of a decision or approval matrix that clearly delineates the roles and responsibilities of City staff, Council, and other stakeholders. This matrix would define the level of authority required for different categories of interventions – ranging from low-impact, low-cost measures (e.g., pavement markings, flexible bollards) that can be implemented at the staff level, to more substantial infrastructure changes (e.g., road diets, lane reconfigurations) that would require Council approval. Councillors also supported embedding this matrix within an overarching policy to streamline approvals while ensuring consistency, accountability, and alignment with strategic safety goals.

Councillors expressed a strong preference for a proactive, data-driven approach to traffic calming, supported by enhanced resourcing and a balanced integration of public consultation. They encouraged prioritizing locations with high pedestrian activity (particularly near hospitals, parks, community centres, and transit nodes) and advocated for measures to be piloted in new subdivisions where implementation is expected to be less complex. In parallel, they underscored the importance of educating the public on the purpose and benefits of traffic calming to foster greater understanding and acceptance. While opinions on public involvement varied, there was consensus that residents should be kept informed and engaged – ideally through clear communication, targeted outreach, and post-implementation feedback opportunities. Overall, the directives highlighted a desire for a flexible yet principled approach that balances technical evidence, community needs, and Council oversight.

2. Current Procedures in the City of Markham

The following sub-sections outline the City of Markham's current procedures relating to speed management and traffic calming.

2.1 Base Speed Limits

The City uses specific criteria to set base speed limits on its roads. All local residential streets, including residential collector streets, are posted with a speed limit of 40 km/h. School zones also adhere to this 40 km/h limit. However, a 50 km/h speed limit may be considered for residential areas if the road in question is a four-lane collector road. In general, a 50 km/h speed limit is reserved for commercial and industrial areas along both local and collector roads. Additionally, a 60 km/h speed limit is typically applied to rural roadways.

2.2 Speed Data Collection

The City's speed data collection program involves subjective classifications for high and low growth areas, which are reassessed annually. Similarly, street categorizations are updated on an annual basis to ensure accuracy and relevance. The City has expressed an interest in receiving recommendations for formalizing their speed data collection process to enhance the consistency and effectiveness of the program.

The City is currently exploring the potential for new technologies in speed data collection, including connected vehicles and crowdsourcing data. However, the City indicated that their existing data collection program is limited in scale, and any investment in new technologies would require a clearer understanding of the cost-benefit ratios. To inform their decision-making, the City is collaborating with the City of Mississauga to gather insights on data collection technologies and vendors.

2.3 Traffic Calming

The City implements traffic-calming treatments such as signage, edge line markings, urban shoulders, road diets, and in-road flexible posts, at locations with known speeding issues. When introducing traffic calming measures, the City considers collision history and additional context such as operating speeds, cross-section, existing signs and pavement markings, and more. However, complaints are most commonly received from residential areas, where the collision history may not always suggest a significant issue based on reported incidents.

Currently, the City does not implement vertical deflection measures (e.g., speed humps, speed cushions, raised crosswalks) due to historical concerns raised by Fire and Emergency Services, York Regional Transit (YRT), and the City's Operations department. There are numerous locations in the City where vertical traffic calming measures have been installed but pre-date 2012.

If the City wishes to consider the reintroduction of vertical measures into its traffic calming toolbox, their feasibility must be carefully considered in light of these concerns. New treatments, such as speed cushions, which permit emergency vehicles to pass over them, have been widely used in other municipalities in recent years with minimal impacts to emergency response times.

Finally, the City has expressed support for conducting a systemic review of the entire network, adopting a proactive approach to address areas with elevated risks. However, concerns were raised regarding the City's capacity to investigate and assess public complaints while simultaneously carrying out a comprehensive, proactive evaluation of the network.

2.4 Corridor Safety Reviews

The City of Markham has completed numerous corridor safety reviews, which included the review of the existing posted speed limit and need for traffic calming measures, at the following locations:

- Copper Creek Drive (between Box Grove By-pass to Donald Cousens Parkway)
- Apple Creek Boulevard (between Woodbine Avenue and Warden Avenue)
- Main Street Markham (between Bullock Drive and 16th Avenue)
- Carlton Road (Kennedy Road to McCowan Road)

These reviews led to the design, recommendation, and in some cases, the implementation of traffic calming measures (most notably, road diets). These interventions aim to enhance safety and comfort for all road users by reducing vehicle speeds, reallocating roadway space, and improving conditions for vulnerable road users.

2.5 Public Input

In response to public inquiries concerning speeding, the City follows a structured approach. If field investigations and assessments reveal elevated speeds (i.e., 10 km/h above the posted speed limit) on a roadway, the first course of action is to utilize the City’s speed management program, which includes the deployment of speed display boards. The City currently has 24 speed display boards, which are rotated quarterly across various locations that meet specific criteria. To warrant the use of these boards, operating speeds must be 10 km/h or more above the posted speed limit. Additionally, the City has implemented other traffic-calming treatments, such as signage, edge line markings, urban shoulders, and in-road flexible posts, at locations with known speeding issues. While the primary focus is on school zones, special circumstances, such as the absence of sidewalks, may also justify the installation of in-road flexible posts.

2.6 Active Transportation Master Plan

The City’s 2021 Active Transportation Master Plan (ATMP) included recommendations for speed limits to improve safety for vulnerable road users. These recommendations are included in Section 8.2.2. of the Active Transportation Master Plan and are summarized below:

- Reduce design speeds for collector roadways to match posted speed limits
- Introduce a policy to cap design and posted speeds within urban areas to 50 km/h

These recommendations have been incorporated into the proposed policy.

2.7 Safe Streets Strategy

In 2004, the City developed the Safe Streets Strategy to address concerns about speeding and aggressive driving, particularly in residential neighborhoods. The strategy included an Action Plan with road safety countermeasures across the three "E's": Education, Enforcement, and Engineering. Key measures included the Road Watch Program, Red Light Cameras, a Speed Education and Awareness Program, and Traffic Calming initiatives. The Strategy also outlined specific criteria for the implementation of traffic calming measures, which included:

- **Major Collector Roads (4 lanes)**: No traffic calming, except in heritage districts, focusing on enforcement and education.
- **Industrial/Commercial Park Roads**: No traffic calming, with an emphasis on education and enforcement.
- **Priority Routes (Emergency Services and Public Transit)**: Horizontal traffic calming considered if operating speeds are 55 km/h or higher; otherwise, enforcement and education strategies apply.
- **All Other Roads**: After enforcement and education, roads with average speeds of 50 km/h or higher may qualify for traffic calming measures.

While the vision behind the Safe Streets Strategy was ambitious, it was not fully realized. Over time, other stakeholders became less engaged, staffing resources were constrained, and the focus shifted to implementing speed humps and tables based primarily on technical criteria.

3. Environmental Scan

An environmental scan was conducted based on the information collected from CIMA+'s past project experience, which includes information from the following municipalities:

- City of Vaughan
- City of Richmond Hill
- Town of Newmarket
- Town of Oakville
- City of Burlington
- Town of Milton
- City of Mississauga
- City of Ottawa
- York Region
- City of Cambridge
- Region of Waterloo
- City of London

Many of the municipalities reviewed have fully developed policies on speed management, speed limits, traffic calming and pilot studies with a number of those being fully endorsed by their council with a small subgroup that have adopted an industry standard (*Transportation Association of Canada's 2009 Canadian Guidelines for Establishing Posted Speed Limits and the 2018 Canadian Guide to Traffic Calming*).

3.1 Basic Principles of Speed

The following presents definitions of key concepts that reflect current understanding as it relates to speed.[1]

- **Design Speed:** The speed used to determine the various geometric design features of the roadway. From a safety perspective, key elements are stopping sight distance, intersection sight distance and visibility to traffic control devices (mainly stop signs and traffic signals). Previously, the design speed was typically set higher than the speed limit to account for variability in operating speeds. However, more recently, there has been a push to align the design speed with the posted speed limit;
- **Operating Speed:** The speeds at which vehicles are observed (measured) operating during free flow conditions. Free flow conditions mean that vehicles are unimpeded by other vehicles or by traffic control devices such as traffic signals;
- **85th Percentile Speed:** The speed at or below which 85 percent of vehicles travel;
- **Posted Speed Limit:** The maximum lawful speed for a particular location as displayed on a regulatory sign;
- **Speed Limit:** The maximum lawful vehicle speed for a specific location;
- **Statutory Speed Limit:** The numerical speed limits established by the province that apply to various classes or categories of roads in the absence of posted speed limits. Within a local municipality (such as Markham), the statutory speed limit is 50 km/h. May also be referred to as Default Speed Limit.
- **Speed Zone:** A speed zone is a section of roadway with a single speed limit throughout its length, which should be applied to a homogeneous roadway section; and
- **Advisory Speed:** A recommended speed where the need to reduce speed below the speed limit is advised due to a specific road condition (e.g., curves, traffic calming measures, etc.).

The relationship between operating speed, speed limit and safety is complex. The following should be considered when setting speed limits.[2]

- As travel speeds increase, the pressure on the environment from higher noise levels and greater exhaust emissions also rises;
- Collision severity increases with higher travel speeds;
- Mobility increases with higher travel speeds and most drivers tend to operate at the highest speed that they are comfortable with under the prevailing roadway and environmental conditions;

[1] Adapted from https://www.ite.org/technical-resources/topics/speed-management-for-safety/setting-speed-limits/
[2] Adapted from Town of Milton, *Speed Limit Policy*

- The potential for collisions is lowest when speed differentials between vehicles in the traffic stream are smallest (i.e., more uniform travel speeds reduce the risk of collisions);
- Setting the posted speed limit at the 85th percentile speed will generally result in a low dispersion in travel speeds in the traffic stream however this needs to be considered in the context of the presence of pedestrians and cyclists;
- The strongest influence on a driver's selection of travel speed is the physical appearance of the road which is directly influenced by the design speed selected for that particular road section;
- Speed control aimed at encouraging drivers to travel at an appropriate speed for prevailing conditions encompasses enforcement, education, and engineering techniques;
- While police enforcement has been the traditional approach to controlling speeds, significant increases in enforcement levels are required to influence driver behavior (i.e., Police impact on speeds is relative to the degree of enforcement);
- Based on extensive research, it has been concluded that simply raising or lowering the posted speed limit, without physical interventions to change drivers' perception of the road, has little overall effect on the operating speed of a road, and does not lead to any statistically significant changes in total or severe collisions;
- A posted speed limit that is set too low will make a significant number of "reasonable" drivers operate illegally, place unnecessary burdens on law enforcement personnel, lead to a lack of credibility and compliance in the posted speed limit, and result in increased tolerance by enforcement agencies; and
- Given the functional hierarchy of a road network (arterial, collector and local roads), speed limits should be set in accordance with the function of each road which it is designed to serve.

3.2 Identifying and Setting Appropriate Speed Limits

Many municipalities in Ontario have a general policy of setting base speed limits for their entire road network and then reviewing specific roads as the need arises as discussed in Section 3.2. Base speed limits are set based on road classification (local, collector and arterial) and land use (urban versus rural). The City of Markham primarily has local and collector roads, with nearly all arterial roads falling under the jurisdiction of York Region.

The following paragraphs provide general guidance, typically used in Ontario municipalities, to identify appropriate speed limits, outlining how base posted speeds are identified, as well as when to modify posted speed limits.

3.2.1 Base Speed Limits

Under the Ontario Highway Traffic Act (HTA):

- The posted speed is 50 km/h on a highway (road) within a local municipality or within a built-up area (referred to as the statutory speed limit);
- The posted speed is 80 km/h on a highway (road) not within a built-up area or within a local municipality that has the status of a township (referred to as the statutory speed limit);
- The general interpretation of the above is all municipalities considered to be towns or cities in the Province or townships with a built-up area have a statutory speed limit of 50 km/h;
- The implication of the above is that, in the City of Markham, all roads should be considered to have a speed limit of 50 km/h unless otherwise signed;
- Relating to the above, some towns and cities have posted signs on all entry roads into their jurisdiction stating that the speed is 50 km/h on all roads unless otherwise posted; and
- Posted speed limits may be set between 30 km/h and 100 km/h in increments of 10 km/h.

3.2.2 Modifying Base Speed Limits

In some circumstances, the base speed limit has to be modified. The speed limit should ideally be set at a value that is consistent with the physical characteristics of the road and therefore is more likely to result in the 85th percentile speed being equal to the speed limit (i.e., the speed limit is credible to drivers). Most municipalities in Ontario use the 2009 Transportation Association of Canada's *Guidelines for Establishing Posted Speed Limits* as a basis for evaluating individual speed limits. In some circumstances, the base speed limit may be lowered due to:

- Physical characteristics of the road
- Constraints by adjacent land uses and associated activities
- Requirements for heightened driver awareness in sensitive areas such as school zones or a demonstrated conflict between vulnerable road users (bicyclists and/or pedestrians) and motorists
- The posted speed is higher than the inferred design speed

In highly unusual circumstances, the posted speed limit may be set above the recommended level if justified through a review of the 85th percentile speed, the collision record, and the inferred design speed and no presence of vulnerable road users. The difference in posted speed limits between adjacent road sections should not exceed 20 km/h, unless there is a drastic change in the physical characteristics of the road such as a sharp curve. The latter should be accompanied by appropriate warning signs (i.e. advisory speed signs with tabs).

3.3 Approaches to Speed Management

As outlined in the City's 2004 Safe Streets Strategy, speed management is addressed through various approaches categorized under the three key "E's". Further details are available in the following sub-sections.

3.3.1 Education

Education is a key component of speed management, aiming to increase awareness of speed limits and the risks associated with speeding. These initiatives may involve community outreach campaigns, the distribution of informational materials, and the use of speed awareness programs. By emphasizing the importance of safe driving behaviors and encouraging compliance with posted speed limits, education efforts aim to foster long-term cultural change. Some examples of education countermeasures include:

- **Slow Down Campaign:** The Slow Down Campaign is a current York Region campaign that identifies strategies and measures to change driver behaviour and stop speeding to keep pedestrians and cyclists safe, especially when travelling through school areas, residential areas, and near playgrounds.
- **Road Watch Program:** Administered by York Regional Police, the Road Watch Program is a community-driven program created to allow individuals to report aggressive driving in their community.
- **Speed Display Boards:** Administered by the City, the purpose of this program is to encourage motorists to reduce speeding in high-risk areas by displaying their operating speed on the board and prompting them to comply with the posted speed limit. City currently has 24 boards (3 per ward) that are deployed to candidate locations on a quarterly basis.

3.3.2 Enforcement

Enforcement plays a critical role in ensuring compliance with speed limits and reducing unsafe driving behaviors. This approach typically involves the use of law enforcement officers to monitor speed, issue citations for violations, and deploy technology such as automated speed enforcement. Enhanced enforcement strategies, such as targeted speed enforcement during peak traffic times or in high-risk areas, help deter drivers from speeding. Some examples of enforcement countermeasures include:

- **Police Enforcement:** Traditional police enforcement includes police targeting speeding drivers in problematic areas using speed radar guns.
- **Community Safety Zones:** A designated stretch of roadway, recognized under provincial legislation, marked with community safety zone signs allowing the doubling of fines associated with speeding.

- **Automated Speed Enforcement:** An automated system that uses a camera and a speed measurement device to help enforce posted speed limits in community safety zones only.

3.3.3 Engineering

Engineering measures modify the road environment to encourage safer driving. This includes traffic calming techniques like speed cushions, rumble strips, and roundabouts, as well as road design changes such as lane narrowing to reduce speeds. Signage, such as speed limit signs and radar speed displays, further supports safe driving by providing real-time feedback to drivers. Examples of engineering countermeasures are included in Section 3.5 (Traffic Calming Toolbox).

3.4 Establishing a Successful Traffic Calming Program

Traffic calming measures can be implemented through proactive or reactive approaches, depending on community needs. A proactive approach anticipates traffic safety issues using data analysis and traffic studies, addressing potential problems before they arise to prevent collisions and improve road safety. In contrast, a reactive approach addresses existing problems identified through public complaints or incident reports, focusing on immediate issues rather than long-term prevention. Combining both approaches provides a comprehensive solution, addressing both current concerns and potential risks.

The following sub-sections summarize the key findings of the environmental scan in relation to traffic calming.

3.4.1 Principles of Traffic Calming

Traffic calming and/or automated speed enforcement can help reduce vehicle speeds and increase road safety for all road users, including pedestrians and cyclists. The following principles are commonly applied by municipalities in Ontario when selecting and implementing traffic calming measures. Application of these general principles ensure that appropriate traffic calming measures are selected, that they are compatible with the community's needs, and that any potential negative impacts are minimized. While each situation is unique, the principles of traffic calming are relevant to each situation. Application of these principles will maximize effectiveness of the traffic calming plans and help build community acceptance and support of final traffic calming plans.[3]

- **Establish whether the problem is real or only perceived:** It is very important to identify the real problem, so the appropriate traffic calming measures are selected. Traffic issues or road safety issues are always emotional subjects for many people; it is important to keep the problems in perspective to maximize the effectiveness of the limited available resources

[3] Adapted from Town of Ajax, *Traffic Calming Policy Update*, 2020

by allocating them towards solving demonstrated problems and not perceived-only problems (i.e., adopting a data-driven approach).

- **Quantify the Problem:** To select the appropriate measures, it is important to quantify the extent of the problem. This normally requires gathering data, including traffic counts, speeds, collision data, and pedestrian usage while also taking into consideration the adjacent land uses of the subject road, including the presence of schools, parks and other pedestrian generators.
- **Maintain and Minimize Impacts on Delivery of Fire and Emergency Services, Police and Transit:** Consideration of these services when identifying appropriate traffic calming measures for implementation will minimize delays/impacts to these services. This will also aid in building support for traffic calming in general. When selecting traffic calming measures, staff should strive to balance the needs of these services with slowing traffic on residential streets, while ensuring that traffic calming objectives are still adhered as much as possible. Additionally, the road authorities should work with Fire and Emergency Services, Police and Transit to ensure that the negative impacts resulting from the implementation of traffic calming measures are minimized (particularly vertical measures), again, ensuring that traffic calming objectives are still adhered as much as possible.
- **Maintain and Minimize Impacts on Delivery of Public Services:** Consideration of snow plowing, street sweeping, drainage, waste collection and school bus services when identifying appropriate traffic calming measures for implementation will minimize delays/impacts to these services.
- **Use Cost Effective Measures:** The cost of traffic calming measures can vary greatly depending on the materials used, labour involved and the cost of the process to implement certain alternatives. For cost control reasons, only appropriate traffic calming measures will be implemented, and a phased approach should be implemented when determined to be appropriate. Traffic calming measures can, generally, be upgraded after initial installation; therefore, over design of the initial implementation must be avoided to allow distribution of funds throughout the municipality rather than concentrating limited funds on one or two neighbourhoods only.
- **Minimize Impacts on Adjacent Residential Streets:** Prior to considering traffic calming, any potential negative impacts on adjacent streets should be considered. Impacts may include traffic diverted to another street, or changes in turning movements with increase delays with other intersections. These effects will be considered in advance of approval, so traffic calming solutions do not create or exacerbate existing problems.
- **Target Automobiles While Accommodating Non-Motorized Modes:** The purpose of traffic calming is to reduce the negative effects of motor vehicles while improving conditions for other road users. Traffic calming measures should be designed to permit cyclists and pedestrians to travel unaffected (and/or to have an improved travel experience), while slowing down motor vehicles.

3.4.2 Initial Screening

In context of the above, the general approach taken by municipalities in Ontario is to evaluate the need for traffic calming through a two-tiered system. The first 'tier' involves an initial screening of the location to determine if it would be suitable for traffic calming. The second 'tier' involves evaluating the short-listed requests based on a point-based system that is then used to establish a minimum threshold and a means of ranking different candidate locations.

The initial process is usually initiated by a request for traffic calming via phone, email, and/or mail by the public, councillor, or city staff. The request for traffic calming entails the specific concerned location, and a description of the traffic concern.

The following is a list of preliminary screening criteria used by different municipalities to justify if traffic calming is suitable, based on the environmental scan. Out of 12 traffic calming policies reviewed:

- 12 (100%) use road classification as a screening criterion
- 11 (92%) use block length
- 10 (83%) use daily traffic volume
- 9 (75%) use speed limit
- 8 (67%) use grade
- 6 (50%) use previous evaluation
- 4 (33%) use collision history
- 3 (25%) use previous implementation

Based on the environmental scan, the following represents general guidance noted in the initial screening:

- **Road Classification:** The road must be local or collector road to be considered for traffic calming
- **Block Length:** The distance between traffic control devices (i.e., stop signs or traffic signals) must exceed a threshold to be eligible for traffic calming (i.e., 110 metres)
- **Daily Traffic Volume:** The road must carry more traffic than a given threshold. For example, for a local road, the road must carry more than 750 vehicles per day and at least 1,500 for a collector road
- **Speed Limit:** Speed limits generally must not be greater than 50 km/h
- **Grade:** The grade of the road must be less than 8% for traffic calming to be permitted
- **Previous Evaluation:** No evaluations in the last 24 months
- **Collision History:** If the number of collisions on the roadway is above a specified threshold, a full safety review of the location is advised

- **Previous Implementation:** No traffic calming measures have been installed on the street in the last 5 years. Additionally, the location has not been reviewed for traffic calming within that time frame.

If any of the criteria is not met during the preliminary screening process, the location is not considered suitable for traffic calming.

3.4.3 Evaluation of Requests

Following the initial screening process is the evaluation of the application which includes traffic calming warrant criteria and a scoring system. The determination of whether traffic calming will be required is based on the total number of points (score). The concerned road/location will not qualify for traffic calming if it scores below the minimum point threshold . The following list outlines criteria typically included in scoring locations on the need for traffic calming, and an example points system (note the scoring varies for location to location):

- **Traffic Speeds:** 1 point for every 1 km/h the 85th percentile speed is above the speed limit
- **Traffic Volumes:** For local roads: 1 point for each 50 vehicles above the specified threshold, and for collector roads: 1 point for each 100 vehicles above the specified threshold
- **Collision History:** 5 points at any location with collisions in the last 3 years or specified period, regardless of the contributing factors
- **Pedestrian Generators or Facilities:** 5 points per designated pedestrian crossing, park, or school in the area of interest
- **Sidewalks:** 10 points if there are no sidewalks, 5 points if there is a sidewalk on only 1 side of the street in the concerning area, and 0 points for sidewalk on both sides
- **Bicycle Facilities or Routes:** 10 points where in the study area there is a presence of bicycle lanes, designated routes or trails, or multi-use trails

An example of Ajax's point-based system is provided in Table 1. Ajax's policy specifies that, for the road segment to qualify for traffic calming, it must score a minimum of points according to the corresponding road classification:

- 35 points for a Local Road
- 40 points for a Collector Road
- 45 points for a Type 'C' Arterial Road

Table 1 - Town of Ajax Traffic Calming Points System

Criteria	Minimum Threshold	Points	Maximum Points
Operating Speed	85th percentile speed is higher than 10km/h above the posted speed limit	1 point for each km/h above posted speed PLUS 1 point for each 1% of vehicles over 15 km/h above posted speed	25
Traffic Volume	900 vehicles/day for Local roads 2,000 vehicles/day for Collector roads 5,000 vehicles/day for Type 'C' Arterial roads	1 point for each 50 vehicles above local threshold 1 point for each 100 vehicles above collector threshold 1 point for each 200 vehicles above arterial threshold	20
Collision History	Less than 6 (local) or 12 (collector / arterial) within the last 3 years	5 points for each qualifying collisions in excess of 3 *Qualifying collisions include collisions with vulnerable road users (pedestrians, cyclists) and collisions for which 'exceeding speed limit' or 'speed too fast for condition' is reported in the MVAR.	20
Pedestrian Generator		5 points for each school or park within the study area *Other Pedestrian Generators may be defined by Ajax and the study area includes the frontage of the road segment or within 300m	15
Pedestrian Facilities		10 points if there are no sidewalks in the study area 5 points if only on one side	10
Bicycle Facilities or Routes		5 points if bicycle lanes, sharrows, or routes are present on the road segment	5

3.4.4 Public Input

Aside from the initial public inquiry, municipalities involve the public to varying degrees throughout the process of determining the need for traffic calming and selecting appropriate measures. Public consultation typically plays a central role, with municipalities often requiring clear community support before proceeding.

A common practice is to initiate a formal petition process or a public consultation phase to gauge interest and support. For example, in the City of Mississauga, a minimum of 51% of affected households must respond positively to a petition in order to initiate a traffic calming study. Similarly, the City of Burlington specifies that a traffic calming plan can only proceed if a minimum of 80% of the residents within the study area are notified and at least 60% of the survey responses are in support of the proposed measures. When not using petitions, municipalities often employ public meetings, online surveys, or mailed questionnaires.

After preliminary assessment and identification of potential traffic calming measures by municipal staff, public information centres (PICs) or online engagement platforms are utilized to present the proposed plan and gather feedback. This feedback may influence the final design, but ultimate decision-making authority typically remains with municipal staff or council.

Overall, the goal of these public consultation processes is to ensure that traffic calming interventions reflect both technical assessments and community consensus, thereby enhancing their effectiveness and public acceptance.

3.4.5 Annual Review of Posted Speed Limits

When addressing public or councillor concerns about the posted speed limit on a specific road, the current speed limit should be reviewed for appropriateness using the *Transportation Association of Canada (TAC) Guidelines for Establishing Posted Speed Limits*.

Additionally, it is important to assess how the operating speeds on that road compare to the posted speed limit. Rather than increasing the posted speed on a roadway, traffic calming and/or ASE should be implemented on a road to manage operating speeds if they significantly differ from the posted speed limit. Any increase in posted speeds is strongly discouraged and should be subject to a comprehensive engineering review.

When reviewing the annual speed data, it is important to compare the operating speeds with the posted speed limit to determine if there are significant discrepancies. Based on this analysis, a thorough review of the posted speed limit should be conducted to assess its suitability. Adjustments to the speed limit may be necessary if the current limit is found to be too high or too low for the given road conditions.

3.5 Traffic Calming Toolbox

Table 2 outlines various types of traffic calming measures, including pavement markings, vertical deflection, horizontal deflection, and education and enforcement. It provides an overview of the advantages and disadvantages of each method, along with their effectiveness and suitability in different contexts and estimated cost.

The traffic calming countermeasures included in Table 2 have been carefully selected to ensure both effectiveness and minimal disruption to essential services. Each measure was chosen based on its suitability for the specific road types and traffic conditions in the City. Additionally, a key consideration in the selection process was to avoid any interference with fire and emergency services or operation and maintenance activities. The measures selected will help reduce vehicle speeds and improve safety, while ensuring that fire trucks, ambulances, and other emergency vehicles can navigate the streets efficiently without delay or obstruction.

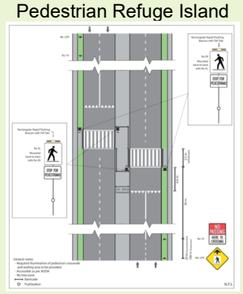
Table 2 - Traffic Calming Toolbox

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost[4]
Pavement Markings	Full-Lane Transverse Bars 	Full-lane transverse bars are a series of parallel pavement markings which extend across the majority of the travelled lane width. The series of markings may be placed closer together with distance to create the illusion that a vehicle's speed is increasing to alert the driver of the need to reduce speed.	> Vehicle Speeds: Reduction in 85th percentile speed between 5 and 15 km/h > Environment: No increase in noise > Other: - Can be implemented rapidly - No impact to emergency vehicles, snow plowing, street sweeping, and police enforcement - No adverse effect on vehicle operations	> Maintenance: - Pavement markings will require regular maintenance; increased costs if placed in the wheel path of vehicles - May be less effective in winter months due to snow/ice cover > Other: Pavement markings are not visible from significant distances upstream	> Road Classification: All roadways - Freeway off-ramps; approaches to intersection and bridges; deficient horizontal curves > Traffic Conditions: All traffic volumes > Roadway: Primarily rural cross-section; can be considered in urban areas	> Speed reduction enhanced if used in conjunction with rumble strips, but speed variability tended to increase > It is unknown if the effect on speeds can be sustained over time	> Low - Pavement markings are low cost, with the initial cost to lay markings and cost of subsequent maintenance - Durable markings have higher initial cost, but require much less regular maintenance, which avoids the traffic impacts of lane closures while repainting the transverse bars
Pavement Markings	On-Road Messaging 	On-road messages provide information that would typically be shown to drivers through signage but are painted on the roadway to provide a larger image, and one that is directly in the driver's line of sight. Some examples could be speed limit, 'SLOW', 'Stop ahead, etc.	> No increase or changes to noise > Quick implementation / installation; > No impact to emergency response vehicles, snow plowing, and police enforcement; No adverse effects on traffic operations	> Motorists may neglect on-road messaging when implemented on its own. May require additional safety mitigation measures to be applied in tandem if issue persists. > Regular maintenance and reapplication required for pavement markings > Reduced effectiveness during Winter months due to snow / ice coverage or seasons with expected heavy rainfall	> Road Classification: Local, collector and arterial streets > Traffic Conditions: All traffic volumes > Roadway: Urban and rural cross-section > Advance of hazards/curves > Entrance treatment to urban and rural communities	> Refer to provincial legislation and guidelines, if available, to ensure standards for traffic control devices are met > If there is no provincial guidance for placement, speed limit on-road 'sign' pavement markings should be placed in the same location as speed limit signs to reinforce regulatory environment > May be used as part of gateways to alert drivers that they are entering a rural community	> Paint: $50 per letter > Durable material: $160 per letter
Pavement Markings	Peripheral Transverse Bars 	Peripheral transverse bars are a series of parallel pavement markings along the edge of the travelled lane widths. The series of markings may be placed closer together with distance to create the illusion that a vehicle's speed is increasing. This is done to alert the driver's awareness of the need to reduce speed. Peripheral transverse bars are similar to full-lane transverse bars but require less maintenance of pavement markings.	> Vehicle Speeds: Reduction in 85th percentile speed up to 8 km/h > Environment: No Increase in noise > Other: - Can be implemented rapidly - No impact to emergency vehicles, snow plowing, street sweeping, and police enforcement - No adverse effect on vehicle operations	> Maintenance: - Pavement markings will require maintenance but not as frequently compared to full-lane transverse bars - May be less effective in winter months due to snow/ice cover > Other: Pavement markings are not visible from significant distances upstream	> Road Classification: All roadways > Traffic Conditions: All traffic volumes > Roadway: Primarily rural cross-section; can be considered in urban areas - Preferred where edge and centerlines are provided > Freeway off-ramps, bridge approaches, approach to an intersection, deficient horizontal curves	> Enhanced effect on speeds when used with speed display boards > Effect on speeds may be reduced over time > Avoid overuse so visual effect of the treatment is not jeopardized (restrict use to known accident locations or situations requiring traffic to significantly reduce speed)	> Low - Pavement markings are low cost, with the initial cost to lay markings and cost of subsequent maintenance - Durable markings have higher initial cost, but require much less regular maintenance, which avoids the traffic impacts of lane closures while repainting
Roadway Narrowing	On-street parking	On-street parking is the reduction of the roadway width available for vehicle movement by allowing motor vehicles to park adjacent and parallel to the curb. Angled parking is not appropriate as a traffic calming measure, due to the increased potential for conflicts.	> Conflicts: Parked vehicles provide a buffer between traffic and pedestrians on sidewalks > Environment: Traffic noise may be reduced due to a reduction in traffic volumes or speeds	> Active Transportation and Transit: - On-street parking may reduce mutual visibility for pedestrians crossing the roadway - Requires a minimum width to allow for safe passing of cyclists around opened car doors	> Road Classification: Local and collector streets; urban commercial streets > Traffic Conditions: All traffic volumes > Roadway: Urban cross-section – curb and gutter	> Narrower roadway widths may not be appropriate in municipalities with significant snowfall, or for streets with relatively high two-way traffic volumes (use with caution on roads	Cost per 1 km (one side): $2,000

[4] Costs have been estimated using information from sources such as the TAC CITE - Traffic Calming Guide and data from other municipalities.

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost[4]
		The effect of using on-street parking to narrow the effective roadway space is to reduce vehicle speeds and to reduce possible short-cutting or through traffic.	> Other: No effect on resident access and police enforcement	> Maintenance: Parked vehicles may obstruct street sweeping and snow removal operations, unless parking restrictions are applied for these operations > Other: - Parked vehicles may obstruct driveways, or reduce visibility for motorists entering the roadway from driveways - Could increase rear-end or sideswipe collisions	> May be used in combination with speed cushions, curb extensions, etc. > Due to varying jurisdictional guidelines and regulations, on-street parking should not be implemented if it results in substandard roadway widths which conflict with lane width, transit or emergency services requirements > Locations to Avoid: Driveways, areas with limited sight distance, bus zones, designated school zones, unfenced playgrounds, and poorly illuminated streets	> 10,000 veh/day) > Required Pavement Width: 2.0m to 2.5m Where transit routes operate, remaining lane width should be a minimum of 3.1 m, preferably 3.3 m.	
Roadway Narrowing	Lane Narrowing 	Lane narrowing is the process of reducing lane widths using pavement markings (for example, centreline, urban shoulders, bicycle lanes). The intention is for drivers to perceive the roadway to be less comfortable at higher speeds due to the narrowing of the lanes and ultimately reduce operating speeds.	> Vehicle Speeds: Reduction in 85th percentile speed up to 10km/h > Conflicts: If lanes are physically narrowed and space is not allocated to other modes, the reduced crossing distance at pedestrian crossings may reduce pedestrian-vehicle conflicts > Other: - Can be implemented rapidly if using pavement markings and no physical change is required - Space can be allocated for urban amenities and activities such as bicycle lanes - No effect on emergency vehicles, resident access, snow plowing, street sweeping, and police enforcement	> Active Transportation and Transit: Cyclists can feel squeezed closer to vehicles if no bicycle lanes are provided > Maintenance: - Pavement markings require regular maintenance - Pavement markings may be less effective in winter months due to snow/ice cover > Other: Reduced separation between oncoming vehicles	> Road Classification: Local and collector streets > Traffic Conditions: All traffic volumes > Roadway: Urban cross-section; typically applied on two- and four-lane roadways	> Physical lane narrowing tends to provide better results than simple pavement markings, which have minimal effect > Low cost when implemented using pavement markings only, however, studies show this is less effective than narrowing roadways using physical measures as speeds did not appear to be affected > Ensure consistency in application to avoid driver confusion > Required Pavement Width: - Urban shoulder (one side): 1.2m to 2.0m - Conventional bike lane (one side): 1.5m to 1.8m - Buffered bike lane (one side): 1.8m to 2.8m Where transit routes operate, remaining lane width should be a minimum of 3.1 m, preferably 3.3 m.	Cost per 1 km: - Centreline: $6,000 - Urban shoulder (one side): $6,000 - Conventional bike lane (one side): $7,000 - Buffered bike lane (one side): $20,000 Note: For pavement marking installation on a short road segment (i.e., less than 500m), instead of estimating the cost based on the unit price, a minimum cost of $3,000 is expected.
Roadway Narrowing	Road Diet	where the number of travelled lanes and/or the effective width of the road is reduced in order to allocate the reclaimed space for other uses, such as wider sidewalks, turning lanes, bus lanes, pedestrian refuge islands, bike	> Vehicle Speeds: Reduction between 5 and 12 km/h > Conflicts: Reduction of 25% in the number of collisions per kilometre (collision density) and of 18% in the collision rate (controlled for volume)	> Emergency Response: May affect emergency vehicle response times due to added congestion, however vehicle can bypass congestion and there is a space for vehicles to pull to side of the road	> Road Classification: Most appropriate for four-lane collector and arterial roads > Traffic Conditions: Moderate traffic volumes (subject to before/after capacity analysis)	> Effective for widening sidewalks, adding bicycle lanes, and creating friendly streets for pedestrians and transit users > Preferred to be combined with other traffic calming devices and “complete street” elements	> Variable depending on the extent and scope of the project - Lower if just pavement markings, signs, and potential adjustment of signals at intersections - Cost can be reduced if implemented at the same

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost[4]
		lanes, parking, etc. Typically, a Road Diet involves converting an existing four-lane, undivided roadway segment to a three-lane segment consisting of two through lanes, a centre two-way left-turn lane, and two bicycle lanes. However, other conversions are possible, such as 4-lane to 5-lane, 2-lane to 3-lane, 3-lane to 3-lane, and 5-lane to 3-lane.			> Roadway: Urban cross-section – curb and gutter	> Refer to FHWA Road Diet Informational Guide for safety, operational, and quality of life considerations from research and practice, as well as guidance for decision-making process and post-implementation evaluation	time as a repaving project or road repairs
Roadway Narrowing	Curb Extension 	A curb extension (also known as neckdown, choker, curb bulb, or bulb-out) is a horizontal intrusion of the curb into the roadway resulting in a narrow section of roadway. The curb is extended on one or both sides of the roadway to reduce its width to as a little as 6.0 m for two-lane, two-way traffic. In urban environments, it is possible to implement curb extensions by removing existing parking spaces. The purpose of a curb extension is to reduce vehicle speeds, reduce crossing distance for pedestrians, increase visibility of pedestrians, and prevent parking close to an intersection.	> Vehicle Speeds: Reduction between 2 and 8 km/h > Conflicts: - Reduced pedestrian crossing distance at intersections may reduce pedestrian-vehicle conflicts - Better mutual visibility between pedestrians and motorists if crosswalks are installed between curb extensions > Environment: Landscaped curb extensions, can improve the appearance of a street > Other: - No effect on resident access, snow plowing, street sweeping, and police enforcement - Can provide additional storage for snow, however, height of windrow should not negatively impact pedestrian visibility	> Active Transportation and Transit: - Not compatible with bicycle lanes - Can be hazardous for drivers and cyclists if not designed and maintained properly - Cyclists can feel squeezed closer to vehicles as motorists attempt to overtake them at the narrowing points > Parking: Potential loss of on-street parking > Maintenance: Increased snow removal cost and snowplow damage to grass, trees and curb extensions > Other: - Long trucks, buses and other large vehicles may need to cross into oncoming travel lanes to negotiate turns at intersections with curb extensions - Between snow removals in winter environments, the roadway's effective width can be significantly reduced	> Road Classification: Local and collector streets; urban arterial streets > Traffic Conditions: All traffic volumes > Roadway: Urban cross-section – curb and gutter	> The effectiveness of a curb extension can be increased when used in combination with other traffic calming measures (speed cushions, raised crosswalks, raised intersections, textured crosswalks, curb radius reductions, raised median islands) > Used often with on-street parking to create bays and increase pedestrian visibility at crossings - Keeps road narrow when parked vehicles are not present - On urban arterial streets, applicability may not be recommended if the arterial street has a parking lane that can be needed to carry occasional traffic volume increases (e.g., Emergency Detour Route (EDR), evacuation route, ceremonial route, flexibility of flow management during road repair, etc.) > Drainage system adjustments may be required where curb extensions are needed > Should be marked with signs or other objects to be visible to motorists and plow operators > Sight lines should be respected if there is landscaping > Required Pavement Width: 2.0m to 2.5m Where transit routes operate, remaining lane width should be a minimum of 3.1 m, preferably 3.3 m.	$13,000 per pair

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost[4]
Roadway Narrowing	Centreline Flexible Signs and Edge Line Flexible Bollards 	The use of vertical treatments such as flexible post-mounted delineators or raised pavement markers to create a centre median. This could be used to give drivers a perception of lane narrowing and create a sense of constriction. Flexible post-mounted delineators are similar in appearance to bollards. They are commonly used in work zones, high-occupancy vehicle (HOV) lanes, and on-ramp exits to direct vehicles or prevent particular movements.	>Vehicle Speeds: Reduction in 85th percentile speed up to 5 km/h >Conflicts: Separation of traffic has the potential to reduce collisions >Other: Collapsible design is able to withstand impact with a vehicle	> Maintenance: - May require regular maintenance with collection of debris around posts and repeated impacts from vehicles - Permanent installation may cause difficulty of snow removal > Other: - In rural areas, wider vehicles or farm equipment may have difficulty passing if post-mounted delineators excessively narrow the roadway - May cause confusion as measure can be perceived as temporary or as an indication of a construction zone	> Road Classification: Local and collector streets > Traffic Conditions: All traffic volumes > Roadway: Urban or rural cross-section; two-lane roadways in order to achieve lane narrowing > Locations to Avoid: Where it may block driveways or cross streets > Separation of conflicting movements when barriers are too costly or impractical	> Typically, are between 45 and 90 cm tall, spaced 30m to 50m apart > May also be installed at the start and end of a speed reduction zone (e.g., a School Zone) along with other traffic calming measures (e.g., speed cushions, raised islands, bump outs/curb extensions) to increase the visibility of traffic calming measures and create "gateway-like" features > May also be installed within a speed reduction zone between other traffic calming measures Where transit routes operate, remaining lane width should be a minimum of 3.1 m, preferably 3.3 m.	$125 per bollard $275 per in-road flexible sign
Roadway Narrowing	Pedestrian Refuge Island 	A pedestrian refuge island is constructed on the centreline of a two-way street at midblock or unsignalized intersections to help protect pedestrians cross a multilane road and reduce the overall width of the adjacent travel lanes. A pedestrian refuge island allows pedestrians to focus on one direction of traffic at a time provides a waiting spot for adequate gaps in oncoming traffic in the other direction. This may assist students to safety cross at wide multilane roads where controlled pedestrian crossing is not warranted.	> Delineating pedestrian activity and encourage crossing at more desirable locations. > Narrows the travel lane to provide centreline friction to reduce vehicle speed. > Assists pedestrians crossing to reduce pedestrian vehicle conflicts. > Provides space that can be used to visually improve the streetscape. > No effect on snow plowing (islands are visible due to signing), street sweeping, or police enforcement.	> Presence of marked pedestrian crossing at uncontrolled intersections may create discrepancy between pedestrians' expectations and the expectations of approaching drivers who may not expect to find a pedestrian crossing at an uncontrolled location. > Cyclists may feel squeezed where insufficient room has been left between a central median and the adjacent curb.	> Desirable for four lane cross sections > Desirable for midblock pedestrian crossing on multilane roads with significant mix of pedestrian vehicle traffic. > Use with caution at locations with no dedicated cycling facility as it can cause cyclists to feel "squeezed" > Consider impacts on access to private driveways.	> Design may vary in terms of geometry and approach end treatment. > Must adhere to accessibility guidelines. > Must be supplemented with crosswalk. > Stopping sight distance must be sufficient to accommodate the design speed of vehicles approaching the pedestrian refuge island. > If landscaping is used, it should not obstruct the pedestrian pathway and the visibility of pedestrians and motorists. > Implement signage to reflect the hazard of the island and the presence of the pedestrian crossing. > Use continuous pavement markings to guide vehicles away from refuge island. > Where applicable, supplement refuge island with appropriate barricades to channelize pedestrians so they can view oncoming traffic. > Design requirements for pedestrian refuge islands are provide in OTM Book 15 - Pedestrian Crossing Treatments and TAC's Geometric Design Guide for Canadian Roads.	> Cost is a direct function of length and width of the pedestrian refuge island. > Estimated average cost: $25,000 (2024 CAD from Costs for Pedestrian and Bicyclist Infrastructure Improvements)

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost[4]
						Relevant Signage > KEEP RIGHT Sign (Tb-25R) should be used at pedestrian refuge islands at the approach end of obstruction to indicate vehicles must keep to the right. > OBJECT MARKER Sign (Wa-33L) should be used to mark the pedestrian refuge island to warn road users that they are approaching hazard objects so they can adjust paths and reduce speed. > PEDESTRIAN AHEAD Sign (Wc-7) should be used to provide advanced warning to motorists of pedestrian presence.	
Horizontal Deflection	Traffic Circle/ Roundabout 	A traffic circle/traffic button/mini roundabout is an island located at the centre of an intersection, which requires vehicles to travel through the intersection in a counterclockwise direction around the island. Mini roundabouts are designed in accordance with full-size roundabout design principles presenting splitter islands and deflection of vehicles on all approaches, except that they have a smaller diameter and traversable islands. A traffic circle is typically smaller than a mini-roundabout and does not have splitter islands on the approaches. A traffic button is similar to a traffic circle; however, the former is typically made of coloured asphalt while the latter is landscaped. The turning radius for left-turning trucks, buses, or emergency vehicles may require a diameter which would be larger than the intersection space commonly available. Consequently, vehicles may turn in left in front of the traffic circle or mount the centre raised island rather than travelling around it. Yield traffic control is recommended.	>Vehicle Speeds: Reduction in 85th percentile speed up to 14km/h >Traffic volumes: Reduction of up to 20% >Conflicts: Collision rate reductions of approximately 30% compared to signalized intersections >Environment: - Traffic noise reduction of 3 dBA due to lower speeds (benefits may be offset by increased noise due to braking and accelerating) - Environmental benefit through reduced delay, fuel consumption, and vehicle emissions - When landscaped, can improve the appearance of a street >Other: No effect on resident access, street sweeping, and police enforcement	> Emergency Response: Delay between 1.3 and 10.7 seconds for emergency vehicle response times > Active Transportation and Transit: May force vehicles into crosswalk area increasing potential for pedestrian-vehicle conflicts > Parking: May require removal of some on-street parking in vicinity of traffic circle > Maintenance: “Minor” effects on winter maintenance by increasing snow plowing time > Other: - Restricted access for trucks and longer school buses - Traffic may be diverted to parallel streets without traffic calming measures	> Road Classification: Local and collector street intersections > Traffic Conditions: - Posted speed limit ≤ 50 km/h - < 1500 vehicles per day; Use with caution for low-volume collectors with 1500 to 5000 vehicles per day > Roadway: Urban cross-section – curb and gutter; rural cross-section; maximum two traffic lanes (one each direction) > Locations to Avoid: - Designated emergency access routes and transit routes - Intersections with high pedestrian volumes - Intersections where collector street traffic volumes are significantly higher than the intersecting street	> Preferred with textured crosswalks and most effective when used in series > Sight lines should be respected if there is landscaping > Mini roundabouts are often more suitable for collector roads, and traffic circles are more suitable for local roads	Average $85,500.00 each
Horizontal Deflection	Curb Extensions	A curb extension is used to narrow the roadway to reduce pedestrian crossing distance, reduce speed, and increase visibility of pedestrians. A curb extension is a horizontal treatment of the curb into the roadway resulting in a narrow section of roadway. The	> Reduce vehicle speeds > Reduce pedestrian crossing distance at intersections which may reduce pedestrian-vehicle conflicts > Improved visibility between pedestrians and motorists if	> Not compatible with bicycle lanes > Can be hazardous for drivers and cyclists if not designed and maintained properly > Cyclists can feel squeezed closer to vehicles as motorists	> Curb extensions are best suited for use at intersections and pedestrian crossovers > May be used holistically in conjunction with other traffic calming treatments such as urban shoulders	> Should be marked with signs or other objects to be visible to motorists and plow operators. > If providing landscaping, maintain appropriate sight lines. > For maximum effectiveness, the lane width approaching an intersection is typically reduced to	$25,000 per pair of curb extensions

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost[4]
	 	curb is extended on one or both sides of the roadway to reduce its width.	crosswalks are installed between curb extensions > Landscaped curb extensions can be used to visually improve the streetscape > No effect on resident access, street sweeping, and police enforcement > Can provide additional storage for snow given that snow pile height does not negatively impact pedestrian visibility	attempt to overtake them at the narrowing points > Could impact snow maintenance operations, causing difficulties for snowplows to clear snow around them, potentially creating snow piles on sidewalks and reducing pedestrian accessibility, while also increasing time and effort required for snow removal		3.0 m. The departure lane width, should remain 3.0 m for a minimum total width of 5.5 m. > The effectiveness is improved if the lane width beyond the intersection and in the opposite direction is also reduced. > When curb extensions are used on diagonally opposite corners of an intersection, a minimum clear offset of 5.0 m is required. > Each curb extension at the intersection should be 5.0 to 7.0 m in length. > Curb extensions which are intended to also serve as bus stops must be long enough to accommodate the longest bus likely to use the street. > Provision for turning manoeuvres by service, emergency and transit vehicles (including school buses) must be made. Signage and Pavement marking guidance > Object Markers are optional, depending on the visibility of the curb extension. > Delineation markers or bollards with reflective striping may be acceptable alternatives to Object Markers in some jurisdictions. > Object Markers should be used in areas of heavy snow accumulation at the leading edge of each curb extension and at locations where there is any degree of concern about the sudden introduction of a curb extension into the roadway.	
Vertical Deflection	Raised Crosswalk 	A raised crosswalk is a marked pedestrian crosswalk at an intersection or mid-block location constructed at a higher elevation than the adjacent roadway. The purpose of a raised crosswalk is to reduce vehicle speeds, improve pedestrian visibility, and reduce pedestrian–vehicle conflicts.	> Vehicle Speeds: Reduction in 85th percentile speed from 5 km/h to 13 km/h > Traffic volumes: Reduction of up to 26%, and increase of up to 7% on neighbouring streets > Conflicts: - 53% of drivers yielding to pedestrians compared to 13% before - Pedestrian crossing area better	> Emergency Response: Impacts and delays to emergency vehicles; Fire vehicles – 3.8 seconds' delay per raised crosswalk > Active Transportation and Transit: - May result in a false sense of pedestrian security - Visually-impaired pedestrians may have difficulty differentiating between the curb and the travelled portion of the street (can be mitigated with appropriate design elements for accessibility requirements such	> Road Classification: - Local and collector streets; commercial collector streets > Traffic Conditions: Posted speed limit ≤ 50km/h; all traffic volumes > Roadway: Urban cross-section – curb and gutter > School zones > Locations to Avoid: - Designated emergency access routes	> Not recommended unless there is an existing marked crosswalk > Not recommended in limited right-of-way > There must be a sidewalk on at least one side of the road and landing areas on each end of the raised crosswalk > May cause discomfort for transit users > Consistent configuration throughout a community is desirable to facilitate safe use by those with mental impairment	$8,000.00 each

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost[4]
			defined; vehicles are forced to slow through pedestrian conflict zone > Environment: Traffic noise may be reduced due to lower speeds (benefits may be offset by increased noise due to braking and accelerating) > Other: - No effect on bicycles riding at moderate speeds - No effect on resident access, street sweeping (small amount of debris may remain at edges of raised crosswalk), and police enforcement - Pedestrians using assistive devices are able to cross more easily and with increased comfort due to no accumulation of rain or snow at the bottom of the curb	as tactile walking surface indicators) - Some cyclists may experience loss of control at speeds over 40 km/h - May slightly affect transit routes; a series of vertical deflection measures may increase travel time > Maintenance: - Snow clearing time may be increased - Raised crosswalks interfere with pavement overlays > Other: - Catch basins may be required to provide drainage depending on location of raised crosswalk and site specific conditions - If catch basins become blocked, ponding may occur on uphill edge of crosswalk - Increased traffic noise levels due to braking and accelerating - Increased gas consumption and emission levels if there are significant variations in speed, especially if there are multiple devices within close proximity on the same street - Pavement markings and signing could detract from the appearance of a street - Traffic may be diverted to parallel streets without traffic calming measures	- Small turning radius curves and other areas with limited sight distance, intersections, and driveways - Transit routes where articulated buses are used due to potential decoupling - Bus stops – locate at least 25 m in advance to minimize potential stability problems - Traffic signals – locate at least 75 m distance from traffic signals so that the crosswalk is not within the decision or braking zones - Grades over 8%	> Snow removal personnel may require special training in raised crosswalk areas > Raised crosswalks with gentle approach and exit gradients, flush leading edges and smooth surfaces pose a less significant hazard to cyclists	
Vertical Deflection	Speed Cushion 	A raised area on a road, similar to a speed hump, but does not cover the entire width of the road. The width is designed to allow a large vehicle, such as a bus, to “straddle” the cushion, while light vehicles will have at least one side of the vehicle deflected upward. Speed cushions are intended to produce sufficient discomfort to limit passenger vehicle travel speeds yet allow the driver to maintain vehicle control, while allowing larger vehicles such as buses and emergency vehicles to pass without difficulty.	> Vehicle Speeds: Reduction in 85th percentile speed up to 8km/h > Traffic Volumes: Reduction of approximately 30% > Environment: Traffic noise may be reduced due to lower speeds (benefits may be offset by increased noise due to braking and accelerating) > Other: - No effect on bicycles riding at moderate speeds - No effect on resident access, street sweeping (small amount of debris may remain at edges	> Emergency Response: May slightly affect emergency vehicle response times but not as much as speed cushions or speed tables > Active Transportation and Transit: May slightly affect transit routes; a series of vertical deflection measures may increase travel time > Maintenance: Negative effects on snow plowing/ removal; plow operators must use caution to avoid damaging speed cushion surface > Other:	> Road Classification: Local and collector streets > Traffic Conditions: Posted speed limit ≤ 50 km/h; all traffic volumes > Roadway: Urban cross-section – curb and gutter > Locations to Avoid: - Small turning radius curves and other areas with limited sight distance, intersections, and driveways - Traffic signals – locate at least 75 m distance from traffic signals so that the speed	> Allows greater access for transit and emergency services compared to other traffic calming devices could be considered as an alternative to speed cushions on emergency routes > Speed cushions are more effective in reducing speeds > Snow removal personnel may require special training in removing snow from speed cushion areas > A series of speed cushions is more effective than a single installation; spacing can range from 60 m to 250 m depending on the desired 85th percentile speed	$6,000 each location (assumed based on cost for speed bump)

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost[4]
			of speed cushion), and police enforcement	- More difficult to construct compared to speed humps requiring more precise hand work - Increased traffic noise levels due to braking and accelerating - Increased gas consumption and emission levels if there are significant variations in speed, especially if there are multiple devices within close proximity on the same street - Pavement markings and signing could detract from the appearance of a street - Traffic may be diverted to parallel streets without traffic calming measures	cushion is not within the decision or braking zones - Grades over 8%	> Installation of WA-50 Speed Hump sign is considered mandatory > Speed cushions are not to be implemented together with raised median island	

3.6 Key Takeaways

The key takeaways from the environmental scan are listed below:

1. **Municipal Practices and Policies:** Many municipalities in Ontario follow established guidelines and best practices for speed management, traffic calming, and speed limit adjustments, with several adhering to industry standards like the Transportation Association of Canada's guidelines.
2. **Key Speed Management Principles:** Speed management is influenced by various factors, including road design, operating speeds, collision history, and the presence of vulnerable road users. Effective speed control requires a combination of enforcement, education, and engineering measures. Simply adjusting speed limits without physical changes to the road environment typically has limited impact on reducing speeds.
3. **Appropriate Speed Limits:** Base speed limits in municipalities are typically set according to road classification and land use. Modifying these limits may be necessary based on road characteristics, land use, or areas with high pedestrian activity, such as school zones.
4. **Annual Speed Limit Reviews:** Speed limits should be regularly reviewed to ensure they are appropriate for current road conditions. This includes comparing operating speeds to posted limits and considering traffic calming measures where operating speeds significantly differ from the limit.
5. **Traffic Calming Approaches:** A two-tiered approach is commonly used for evaluating traffic calming requests, beginning with a preliminary screening and followed by a more detailed evaluation. Factors like road classification, traffic volume, speed limits, and collision history are key criteria in determining the need for traffic calming measures.
6. **Public Involvement:** Public engagement is critical in the traffic calming process. Municipalities often seek community input through petitions or consultations before proceeding with traffic calming projects. This helps ensure the measures address community concerns while maintaining support for implementation.

4. Recommended Policy

Figure 1 illustrates the process described in Sections 4.1 and 4.2 for setting base speed limits and conducting a network review of posted speeds in a flow chart, with four major components:

- Set base speed limit;
- Collect speed data;
- Network review of speed limits; and
- Monitoring and evaluation.

Figure 2 illustrates the process described in Sections 4.3 through 4.6 for conducting a traffic calming program, with four major components:

- Traffic calming location selection/systemic network screening;
- Developing a tiered approach to implementing traffic calming;
- Public input; and
- Monitoring and evaluation.

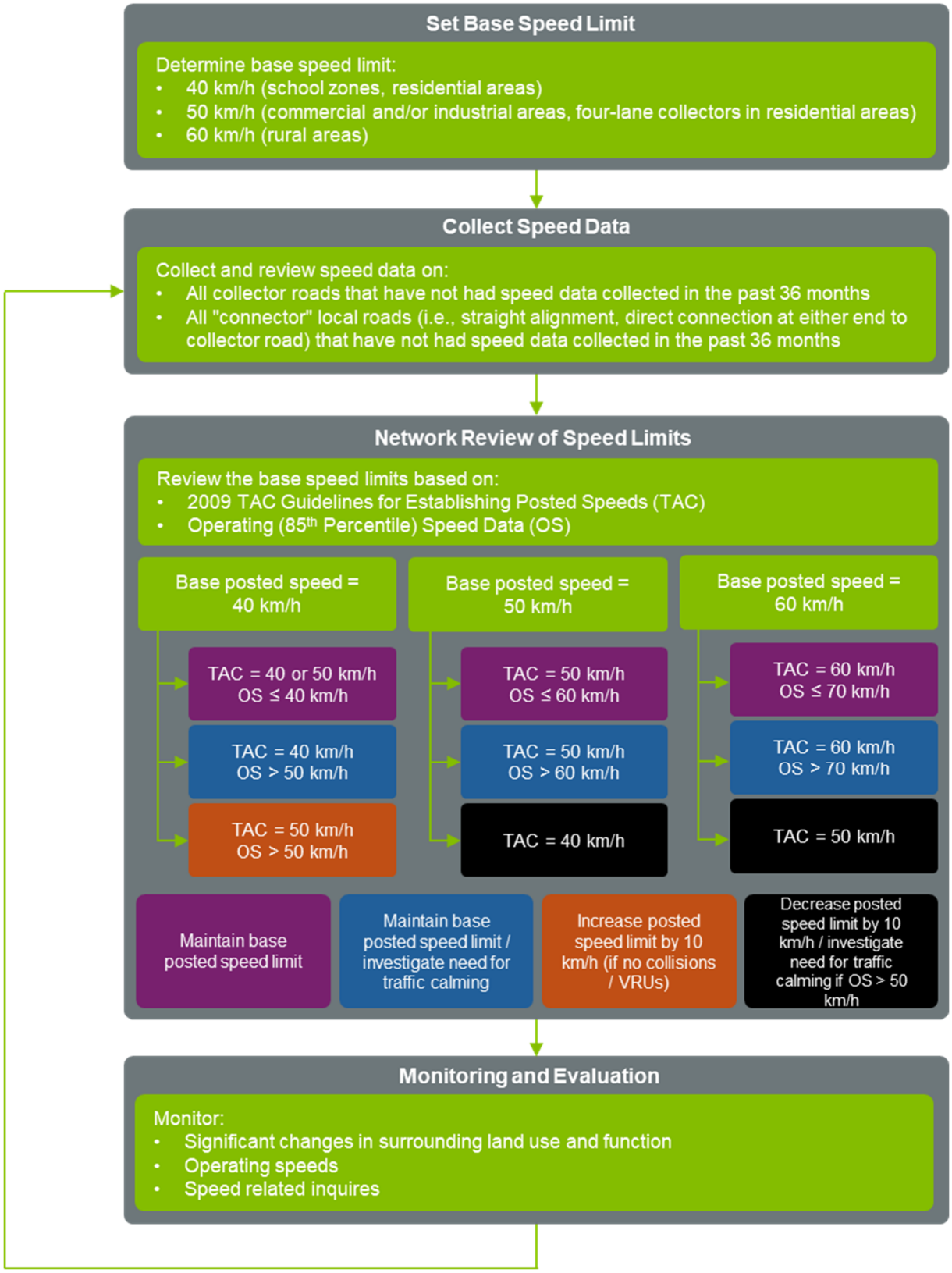


Figure 1 - Speed Limit Selection Process

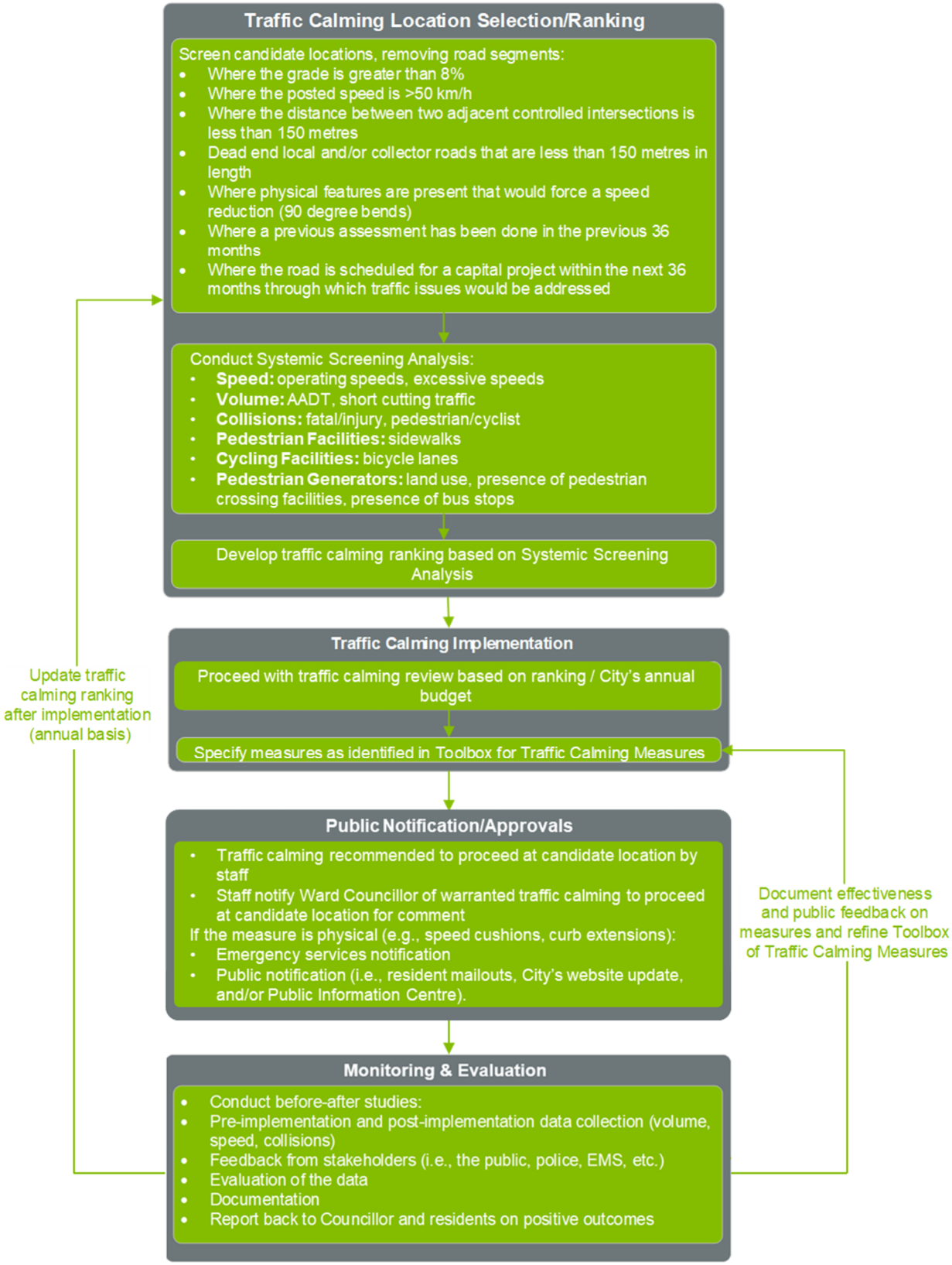


Figure 2 - Traffic Calming Program Process

4.1 Setting Base Speed Limits

It is proposed that the City apply the following criteria outlined in Table 3 as base speed limits throughout Markham.

Table 3 - City of Markham Recommended Base Speed Limits

Base Speed Limit	Characteristics
40 km/h	> All school zones > Roads classified as local in residential areas > Two-lane roads classified as collector in residential areas
50 km/h	> Four-lane roads classified as collector in residential areas > Roads classified as local in commercial and/or industrial areas > Roads classified as collector in commercial and/or industrial areas
60 km/h	> All roadways in rural areas

The above classification will ensure overall consistency in how speed zones are being applied in the City of Markham. However, these base speed limits would be subject to further refinement as discussed in the following section.

The City of Markham's School Zone Safety Guide includes a recommendation to reduce the posted speed limit within all school zones to 30 km/h, a measure designed to enhance safety for students and pedestrians. This recommendation aligns with proven traffic safety practices and helps reduce the risk of collisions in school areas. However, implementing this change will require further investigation, including a thorough assessment of its impact on traffic flow and community feedback. Additionally, approval from City Council will be necessary before any modifications to the speed limits can take effect. Therefore, all school zones are noted to have a base speed limit of 40 km/h, consistent with existing practices.

4.2 Speed Data Collection

The City should establish a schedule of regularly collecting speed data along all urban collector roadways and "connector" local roadways, which are local roads that are straight in alignment and connect two collector or arterial (Regional) roadways, in order to support the speed management policy and the need for traffic calming. Gathering this data is essential for accurately assessing current speed trends and identifying areas where speed reductions or other traffic calming measures may be necessary. By collecting speed data on these key roadways, the City can make informed decisions about how to effectively manage speeds, enhance safety, and ensure that the road network meets the needs of all users.

4.3 Network Review of Speed Limits

As a further refinement to the above, it is recommended that the City of Markham conduct a review of all roads in their network (i.e., local, collector, and arterial roads managed by the City) to verify that the base speed limit is appropriate and identify areas where operating speeds differ from the speed limit. Priority should be given to roads with a history of speeding concerns, collision occurrences, proximity to schools or other vulnerable road users, and those under consideration for traffic calming measures.

Table 4 summarizes the recommended approach.

Table 4 - Network Review of Speed Limits

Base Speed Limit	TAC Recommended Speed Limit	Operating (85th percentile) Speed	Action
40 km/h	**40 km/h**	**≤50 km/h**	> Maintain speed limit at 40 km/h
	40 km/h	**>50 km/h**	> Maintain speed limit at 40 km/h > Investigate need for traffic calming measures
	50 km/h	**≤50 km/h**	> Maintain speed limit at 40 km/h
	50 km/h	**>50 km/h**	> Review collision history and increased presence of vulnerable road users and posted speed on surrounding roads > If no reported collisions and/or increased presence of vulnerable road users, increase posted speed to 50 km/h * > If reported collisions and/or increased presence of vulnerable road users, maintain speed limit at 40 km/h and investigate need for traffic calming measures.
50 km/h	**40 km/h**	**≤50 km/h**	> Reduce speed limit to 40 km/h
	40 km/h	**>50 km/h**	> Reduce posted speed to 40 km/h > Investigate need for traffic calming measures
	50 km/h	**≤60 km/h**	> Maintain speed limit at 50 km/h
	50 km/h	**>60 km/h**	> Maintain speed limit at 50 km/h > Investigate need for traffic calming measures
60 km/h	**50 km/h**	**≤60 km/h**	> Reduce speed limit to 50 km/h
	50 km/h	**>60 km/h**	> Reduce posted speed to 50 km/h > Investigate need for traffic calming measures
	60 km/h	**≤70 km/h**	> Maintain speed limit at 60 km/h
	60 km/h	**>70 km/h**	> Maintain speed limit at 60 km/h > Investigate need for traffic calming measures

** It would be very rare for the City to increase speed limits, and any increases to existing posted speed limits should be approached with caution.*

For all roads, the 2009 *TAC Guidelines for Establishing Posted Speed Limits* should be applied.

The following is noted:

- In all instances, where the existing speed limit and the TAC recommended speed limit are in agreement, the base posted speed is to be maintained;
- Where the base speed limit and the TAC recommended speed limit are in agreement, but the operating speeds are greater than 10 km/h above posted, the City should investigate the need for further physical restrictions to the roadway to reinforce the speed limit (if the location qualifies); and
- Where the existing speed limit is 40 km/h, but the TAC recommended speed limit is 50 km/h and the operating speeds are greater than 50 km/h, the City should conduct a study to evaluate whether the posted speed can be increased to 50 km/h by reviewing the collision history and the presence of vulnerable road users.

Following the network review of speed limits, the City only needs to repeat this process under the following circumstances:

- Within new subdivisions; and
- Existing roads with a significant change in land use or function (i.e. opening of an elementary school, senior's centre, cycling facilities or a trail crossing or changes in parking regulations)

In particular, when evaluating speed limits in these areas, Automated Speed Enforcement (ASE) considerations must be explicitly addressed. For all existing and potential ASE locations the posted speed limits should be reviewed to ensure alignment with provincial guidelines and maintained at appropriate levels to support enforcement, safety, and program integrity.

The above exercise will help streamline the approach taken by City staff, establish realistic and defensible posted speed limits, and account for the road network and the presence of vulnerable road users in alignment with the ATMP.

4.4 Proactive Approach to Selecting Candidates for Traffic Calming

Other municipalities in Ontario take a reactive approach to selecting locations for traffic calming stemming from public inquiries/complaints. It is recommended that a proactive approach be taken to the implementation of traffic calming measures by identifying and ranking candidate locations in a manner that is objective, evidence based and defensible. The proposed process is outlined in the following sub-sections.

4.4.1 Roles and Responsibilities

The roles and responsibilities of key stakeholders in the traffic calming process are outlined below.

- **Technical Staff:** Conducts data collection, site assessments, warrant analysis, and supports design and implementation of traffic calming measures.
- **Manager:** Leads program implementation, reviews technical assessments, coordinates public consultation, approves passive or minor measures, and recommends physical measures for approval.
- **Director:** Provides oversight, ensures policy and budget alignment, and approves physical measures for approval.
- **Council:** Provides input on recommended traffic calming measures, represents community interests, and engages with public feedback.

Different types of countermeasures will require different levels of approval, either a Manager, Director or Council. Table 5 shows the approval authority for different countermeasures.

Table 5 - Approval Authority

Type	Countermeasure	Approval Authority	Notes
Pavement Markings	Full-Lane Transverse Bars	Manager	--
	On-Road Messaging	Manager	--
	Peripheral Transverse Bars	Manager	--
	Lane Narrowing (pavement markings)	Manager	--
Roadway Narrowing	Introduce on-street parallel parking	Council	At minimum, requires administrative by-law amendment, or report to Council (at most)
	Lane Narrowing (physical)	Council	--
	Road Diets	Council	--
	Centreline Flexible Signs and Edge Line Flexible Bollards	Manager	--
Horizontal Deflection	Traffic Circle/ Roundabout	Council	--
	Pedestrian Refuge Island	Manager	--
Vertical Deflection	Curb Extensions	Manager	--
	Raised Crosswalks	Director	Subject to Council endorsing the use of the raised crosswalks, in principle
Speed Management	Speed Cushions	Director	Subject to Council endorsing the use of the speed cushions, in principle
	Automated Speed Enforcement (ASE)	Director	--
	Radar Speed Display Boards	Manager	--

4.4.2 Pre-Screening

As noted in other jurisdictions, it is recommended that the City screen out locations where traffic calming would not be feasible and/or would have limited effectiveness, as follows:

- Roads passing through exclusively rural, commercial and/or industrial areas;
- Roads where the grade exceeds 8%;
- The distance between two traffic control devices along a road segment is less than 100 metres;
- Distance[5] to geometric features that would force a speed reduction such as 90-degree bends in the roadway; and
- The road carries less than 750 vehicles per day (for local roads) or less than 2,000 vehicles per day (for collector roads).

The City may also wish to screen for roads which have existing or planned active transportation infrastructure, to ensure traffic calming measures are effectively integrated. Coordinating traffic calming with any active transportation improvements allows for a safer, more cohesive design. For example, implementing speed cushions or curb extensions that are compatible with cycling facilities. Where possible, traffic calming should be considered before or alongside active transportation projects to manage vehicle speeds and enhance safety for all road users, while avoiding future retrofits.

Furthermore, the City may consider undertaking proactive traffic calming evaluations during the review of development applications. By assessing forecasted traffic volumes at the planning stage, the need for traffic calming measures can be identified early, allowing for their integration into the design and construction process. This approach enables the installation of traffic calming features by the developer as part of the initial road infrastructure, promoting long-term traffic safety and operational efficiency.

4.4.3 Systemic Screening and Ranking

For the remaining roads, it is proposed that the City of Markham use a systemic approach in identifying which road sections would be the best candidate locations for traffic calming through the collection and review of the data presented in Table 5. This assessment would be undertaken every five (5) years.

[5] The City may wish to use 100 m distance to be consistent with the distance between traffic control devices.

The general approach would be to collect the data identified in Table 5 and identify risk factors that contribute to the risk of a collision in residential neighbourhoods through an examination of the relationship between variables relating to speed, volume, road classification, land use, vulnerable road users and collisions (this can be done either by following the FHWA systemic approach to road safety or by developing specific Safety Performance Functions for collisions involving speeding while including the above potential risk factors into the model). Factors demonstrated to have an elevated risk of a collision (i.e., 85th percentile speed) will be identified. Based on this exercise, a risk index would be developed for those factors identified as having an elevated risk of a collision. Using the risk index, locations would be ranked from highest to lowest in terms of locations having the greatest potential for an improvement in safety due to traffic calming. A yearly schedule for the implementation of traffic calming treatments can then be developed, dependent on the City's annual budget for traffic calming treatments.

Table 6 - Recommended Variables for Network Review

Category	Data
Speed	> Speed limit > Base speed limit or Recommended speed (2009 TAC guidelines) > Operating (85th percentile) speed
Volume	> Vehicle volumes (ATR) > Truck percentages
Road classification	> Local > Collector
Land Use	> Presence of schools, playgrounds, hospitals, seniors' centres, or community centres
Vulnerable Road Users Facilities	> Sidewalks (none, one side, both sides) > Cycling facilities (none, shared, bicycle lane, off road) > Crossings (pedestrian crossings, trail crossings)
Collisions	> PDO collisions > Injury or fatal collisions > Collisions involving vulnerable road users (pedestrians and cyclists)

In the short term, prior to the systemic review being carried out, the City could rank the screened locations (eliminating those based on road classification, land use, traffic control, grade) based on excess speed above the speed limit and implement traffic calming as noted in later sections.

4.4.4 Treatment Selection and Implementation

Previously, City Council placed a moratorium on vertical traffic calming measures, such as speed humps and tables, due to community opposition and concerns from Fire Services, Operations, and York Region Transit (YRT). Recently, however, City staff have received public feedback seeking vertical measures be re-introduced. The countermeasures included in the Traffic Calming Toolbox included vertical deflection (i.e., speed cushions and raised crosswalks), these measures are recommended to be introduced with careful consideration of their design and placement to minimize disruption to essential services. By tailoring these measures to limit their impact on Fire, Emergency, and transit vehicles, it is possible to balance the need for traffic calming with the operational requirements of these services. The City will ensure that any reintroduction of vertical measures is done in a way that addresses both community safety and service efficiency.

The selection of the measure is based on the applicability of these measures on the type of road being evaluated. This includes road classification (local or collector, urban or rural), speed limits, cross-sections, maintenance requirements, impacts to emergency services and environment. For example, some measures are only recommended to be implemented on two-lane cross-sections (one lane per direction) rather than on roads with a four-lane cross-section (two lanes per direction). This applicability is based on research completed by other jurisdictions through monitoring on the effectiveness of these measures.

Further, it is recommended that the City assess the feasibility of maintaining in-road flexible signs at select locations year-round, including during the winter months. This review should focus on locations where snow clearing operations and road geometry allow for the safe retention of the signs without impacting maintenance activities. Prioritizing areas such as school zones or pedestrian crossings with high year-round activity may enhance visibility and driver compliance with posted speed limits.

Implementation of the measures will be completed based on the City’s annual budget. As previously mentioned, locations will be implemented based on the priority ranking developed earlier in the process. Implementations will be planned for the non-winter months and will be completed depending on the weather and availability of staff. Larger projects will be added to draft capital and/or operating budgets for Council consideration.

4.5 Public Notification

Prior to planning for the implementation of the selected measures, City staff should provide notifications to the residents in the immediate area where the traffic calming will be implemented of the proposed work. For more passive measures, such as pavement markings, flexible bollards, centreline flexible signs, and radar boards, public notification is not required. For other measures, notifications can be provided using the City's website, mailout, or through hosting in-person information sessions. The selected method of communication will be at the discretion of City staff. Once the public notifications have been given, the City will provide a set period for residents to provide feedback on the proposed work. City staff will incorporate the feedback received and adjust, whenever possible, the proposed work.

Different types of countermeasures will require public consultation. Table 7 shows the public consultation required for different countermeasures.

Table 7 – When Public Notification is Required

Type	Countermeasure	Public Consultation
Pavement Markings	Full-Lane Transverse Bars	No
	On-Road Messaging	No
	Peripheral Transverse Bars	No
	Lane Narrowing (pavement markings)	No
Roadway Narrowing	Introduce on-street parallel parking	Yes
	Lane Narrowing (physical)	Yes
	Road Diets	Yes
	Centreline Flexible Signs and Edge Line Flexible Bollards	No
Horizontal Deflection	Traffic Circle/ Roundabout	Yes
	Pedestrian Refuge Island	No
Vertical Deflection	Curb Extensions	No
	Raised Crosswalks	Yes
Speed Management	Speed Cushions	Yes
	Automated Speed Enforcement (ASE)	No
	Radar Speed Display Boards	No

4.6 Supporting Activities

To support its traffic calming program, the City of Markham can implement education and enforcement strategies (as described in Section 3.3). Education efforts in Markham can include community-based outreach campaigns, public service announcements, and speed awareness programs to raise awareness about the dangers of speeding and to promote safe driving habits. Markham's education efforts may build on existing initiatives such as the "Slow Down" lawn sign campaign and the Road Watch Program. Additional educational efforts may include:

- **School Safety Outreach Program:** Partner with local school boards (York Region District School Board and York Catholic District School Board) to deliver classroom presentations or safety assemblies focused on pedestrian safety, crossing guard etiquette, and responsible driving near schools.
- **Neighbourhood Safety Toolkits:** Provide residents and neighbourhood associations with materials such as flyers, posters, and digital templates that educate the community on traffic calming goals, benefits, and how to report concerns.
- **Traffic Safety Open Houses / Pop-Up Booths:** Host in-person or virtual events where City staff and police provide education on traffic calming strategies, enforcement practices, and how residents can participate in local safety initiatives.
- **Social Media Traffic Safety Campaign:** Implement a diverse range of social media campaigns (e.g., #DriveSafeMarkham with videos, polls, and infographics) designed to promote safe driving, especially in school zones and high-risk areas.
- **Digital Billboards and Transit Ads:** Utilize digital advertising on Markham Transit buses, shelters, and community centers to push key safety messages such as "Speed is no accident. It's a choice", "Slow down. Save lives", or "Drive like your neighbours live here".

These initiatives aim to foster long-term cultural change toward safer driving behaviors. Education efforts may be prioritized in areas with high pedestrian activity, schools, or locations with frequent speeding complaints. Community outreach campaigns, informational materials, and speed awareness programs would be tailored to these areas, targeting both residents and drivers. The City can partner with local schools, community centers, and neighborhood associations to maximize engagement and effectiveness. Regular evaluations will ensure that education efforts are reaching the right audiences and having the desired impact.

Enforcement is equally important, with law enforcement monitoring speeds in high-risk areas, issuing citations, and using automated speed enforcement technology. Targeted enforcement during peak traffic times or in areas with frequent speeding can further deter unsafe driving. Combining education and enforcement will enhance Markham's traffic calming efforts and improve overall road safety. Enforcement strategies may be prioritized based on data-driven insights, focusing on high-risk areas with a history of speeding or traffic incidents. Law enforcement officers will monitor these areas regularly, especially during peak traffic times. Automated speed enforcement could be deployed at key locations, and mobile speed cameras could be rotated to maintain effectiveness. The City may also work with law enforcement to implement targeted enforcement campaigns in areas identified through traffic studies or resident feedback.

4.7 Evaluation and Monitoring

Following implementation of the traffic calming measures, staff will monitor their effectiveness, refine the installation (if required) and remove measures no longer serving their intended purpose. Evaluation of the effectiveness of the implemented measures will be completed by collecting before and after data that includes traffic volumes, speed and collision data.

For collision-based before-after evaluations, the Highway Safety Manual (HSM) recommends a minimum of three to five years of collision and traffic volume data for both the before and after periods to ensure statistical reliability and account for variability in annual collision trends. This duration supports more robust conclusions regarding the effectiveness of a safety countermeasure. However, it is acknowledged that in practice, many transportation agencies conduct before-after collision analyses using shorter timeframes (most commonly three years of "before" data and one year of "after" data), particularly when longer post-implementation data is not yet available. While this may reduce the statistical power of the results, such an approach can still provide useful preliminary insights.

For before-after studies focusing on other performance indicators, such as operating speed, traffic violations, and conflict events, a shorter evaluation period may be appropriate. In general, a minimum of three months of data is recommended for both the before and after periods, provided that the conditions remain consistent and representative during the evaluation timeframe. However, for interventions involving educational or enforcement-based countermeasures, which aim to influence attitudes and long-term behavioural change, a longer after-period is necessary to capture meaningful impacts. In such cases, a minimum of one year of post-implementation data is recommended to allow sufficient time for cultural and behavioural shifts to occur and stabilize.

City of Markham

Traffic Inquiry Process Policy Paper

Vision Zero Road Safety Plan

CIMA+ file number: B001780
June 24, 2025

City of Markham

Traffic Inquiry Process Policy Paper

Vision Zero Road Safety Plan

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Appendix A: Recommended Traffic Inquiry Process

1. Introduction

The City of Markham (the City) has engaged CIMA Canada Inc. (CIMA+) to support the development of a comprehensive Vision Zero Road Safety Plan (RSP), aimed at enhancing road safety and reducing traffic-related risks across the City. As part of this larger initiative, the project will include the creation of five detailed policy papers that will guide the City's efforts in improving road safety. These papers will address a range of key issues, including fatal and serious injury collision investigations, traffic inquiry process, and traffic calming and speed management.

This memorandum outlines the policy paper on the traffic inquiry process, developed as part of *Task 4-6: Develop Policy Papers and Guidelines*.

1.1 Purpose and Overview

The purpose of this memo is to present recommendations for the refinement of the process used by the City of Markham for traffic inquiries. The development of the policy is documented in detail in the following sections:

- **Section 2:** Current Procedures in the City of Markham
- **Section 3:** Environmental Scan
- **Section 4:** Proposed Policy
- **Section 5:** Conclusion

1.2 Need

By streamlining the traffic inquiry process and ensuring timely and efficient responses, the City of Markham can significantly enhance its ability to address safety concerns in a proactive and data-driven manner. A more efficient process will allow the City to quickly identify patterns or recurring issues related to traffic safety, such as high-incident locations or frequent types of traffic violations. This information is crucial for implementing targeted interventions and making informed decisions about infrastructure improvements, traffic enforcement, and public education initiatives.

Additionally, by addressing inquiries in a timely manner, the City can foster greater community trust, ensuring that residents feel their concerns are heard and that their safety is a priority. This approach supports the Vision Zero commitment, where the ultimate goal is to create a transportation environment where fatalities and serious injuries are preventable, contributing to a safer and more sustainable road network for all Markham residents.

2. Current Procedures in the City of Markham

The City of Markham currently manages a substantial number of traffic-related inquiries, averaging approximately 500 per year. Each inquiry is acknowledged and addressed, ensuring that all residents' concerns are handled appropriately. The following sub-sections provide further details on the current procedure for traffic inquiries.

2.1 Record Keeping

The City currently uses an Active Citizen Request (ACR) system to manage these traffic inquiries. However, plans are underway to replace it with a new system through Corporate Services. The new CRM system will deliver enhanced tools and seamless integration with the City's other platforms, boosting efficiency and productivity.

2.2 Prioritization

The City identifies emergency or urgent inquiries, where immediate action is necessary to mitigate potential risks, including traffic signal maintenance or repair. Additional urgent inquiries (e.g., knocked down signs, road failures) may be identified and assigned to the City's Roads Operations department.

The City currently treats all other traffic inquiries with equal urgency, without establishing a formal ranking or prioritization system based on the nature or severity of the concerns. However, there are challenges in obtaining essential information from the Contact Centre, which is critical for effectively addressing the inquiries. The ACR system includes prompts (i.e., case types) to help categorize issues accurately. However, if clarifying questions are not asked or if the client provides limited information (particularly in email inquiries) there is a risk of assigning an incorrect case type. This may result in delays and require additional follow-up with the client for clarification.

To address this challenge, it is recommended that the City enhance the intake process by developing more targeted and detailed prompts tailored to different types of traffic inquiries. These enhanced prompts would support Contact Centre staff in collecting key information at the initial point of contact, helping to improve issue categorization, streamline the response process, and reduce the need for follow-up communication.

2.3 Response Times

The City has set a target of five (5) business days to respond to all urgent signal maintenance and repair activities and ten (10) business days to respond to all other traffic inquiries. These targets are currently met approximately 70% of the time, and efforts are being made to improve the consistency of meeting this service level.

3. Environmental Scan

CIMA+ conducted a targeted environmental scan focusing on the inquiry processing procedures of other municipalities within Ontario. Information from the environmental scan was obtained as part of a brief jurisdictional scan survey. The municipalities included in the environmental scan survey are listed below. Those who responded to the survey are shown in bold font:

- **City of Richmond Hill**
- **City of Mississauga**
- **City of Burlington**
- City of Brampton
- **Town of Milton**
- Town of Newmarket
- Town of Oakville
- **Region of York**
- City of Hamilton
- **City of Vaughan**

The information obtained as part of the environmental scan is provided in the sub-sections below.

3.1 Region of York

3.1.1 Response Times

The Region of York's response times for traffic inquiries are as follows:

- **Initial Response:** The timeframe for an initial response depends on the nature of the inquiry and the identified Service Level Agreement (SLA) times.
- **Data Collection and Analysis (if required):** The time required for data collection and analysis also varies by inquiry type. For urgent items, contractors are available to provide same-day turnaround based on the level of urgency.
- **Final Response:** The final response time is influenced by the level of approval required for reviewing draft responses. There are multiple triage levels depending on factors such as the stakeholders involved and the content of the inquiry. For example, if the inquiry involves a political figure, such as a communication from the mayor or a situation involving a fatality, the response may undergo review by three or more different groups before being finalized.

3.1.2 Prioritization

The Region of York identifies emergency or urgent inquiries as those typically driven by safety concerns, where immediate action is necessary to mitigate potential risks. For example, a malfunctioning traffic signal would be categorized as an urgent request, requiring prompt attention to ensure the safety of drivers, pedestrians, and the general public. These types of requests are prioritized to address situations that may pose immediate hazards.

3.1.3 Record Keeping

The Region of York uses a combination of Customer Relationship Management (CRM) tools, including Salesforce and Cityworks, to manage and track traffic inquiries. Cityworks, an ArcGIS-based software, integrates inquiry tracking, workload management, and record-keeping, offering features like customizable dashboards, real-time maps showing inquiry locations, and mobile access for field staff to update inquiries. Salesforce, a cloud-based CRM, provides a centralized platform to track inquiries, manage workflows, and automate tasks, with powerful reporting and analytics tools to support data-driven decision-making.

Additionally, the Region uses Microsoft 365 tools such as MS Lists, Planner, and Project to track traffic inquiry workplans, while Power BI dashboards offer real-time insights into Service Level Agreement (SLA) performance. The team holds regular meetings to ensure effective management and continuous improvement in handling the volume of inquiries.

3.2 City of Vaughan

3.2.1 Response Times

The City of Vaughan's response times for traffic inquiries are outlined below:

- **Initial Response:** The City aims to provide an initial response within 48 hours of receiving the inquiry.
- **Data Collection and Analysis (if required):** For general or standard inquiries, data collection is managed through the City's contract with Ontario Traffic Inc. (OTI). The typical timeline for data collection is three to five weeks from the request date to the data return date. In more urgent cases, OTI can expedite studies and provide data within one to two weeks. To further support urgent requests, the City has recently acquired five Armadillo traffic counters, which can provide real-time data in critical situations.
- **Final Response:** The City strives to provide a final response within two weeks after receiving the necessary data, depending on the complexity of the data analysis. In general, the complete process may take six to eight weeks. The timing of responses can also be influenced by the season, as inquiries received during the winter months may be delayed until the Fall or Spring when conditions are more suitable for data collection.

3.2.2 Prioritization

Prioritization of traffic inquiries is determined by the nature, urgency, and potential political involvement of the issue. Urgent safety concerns, such as knocked-down stop signs or malfunctioning traffic signals (e.g., flashing red), are given immediate attention and are promptly reported to the relevant traffic signal contractors or the City's Roads department for swift resolution.

Most inquiries handled by the team, such as those related to excessive speeds or non-compliance with stop signs, do not fall under emergency response criteria. These requests are typically addressed based on their level of urgency and the availability of resources.

3.2.3 Record Keeping

The City of Vaughan uses a combination of Customer Relationship Management (CRM) software, Excel, and Power BI to efficiently manage and track traffic inquiries. CRM software centralizes inquiry data, ensuring easy access and communication with residents. Excel is utilized for detailed tracking, categorizing requests by type, priority, and status. Power BI is employed for data analysis and reporting, providing interactive dashboards to assess trends and performance. Together, these tools ensure streamlined record-keeping, timely responses, and informed decision-making for traffic-related issues.

3.3 City of Richmond Hill

3.3.1 Response Times

The City of Richmond Hill's response times for traffic inquiries are as follows:

- **Initial Response:** While no set timelines are established, the City typically provides an initial response within two business days.
- **Data Collection and Analysis:** The City conducts an annual data collection program. If traffic counts are needed for an inquiry, the analysis may be delayed by approximately six months, depending on the type of data required and the timing of the request.
- **Final Response:** A final response is issued once all necessary findings and analyses are completed. In some cases, the initial final response may include a notice stating that counts will be completed followed by further assessment. If the situation is not urgent, the City may not follow up unless the resident reaches out again, or the location in question is considered particularly sensitive.

3.3.2 Prioritization

The prioritization of traffic inquiries is based on the urgency of the situation. Inquiries related to recent collisions or near-miss incidents, as well as those involving malfunctioning traffic signals or missing stop signs that create unsafe conditions, are given the highest priority. These issues are addressed immediately to ensure public safety and prevent further risk.

3.3.3 Record Keeping

The City of Richmond Hill's record-keeping process for traffic inquiries involves assigning a unique number to each inquiry, which is then tracked using a spreadsheet within the team. Additionally, an administrative staff member is responsible for tracking all inquiries and related correspondence in EnerGov, a system used for managing municipal operations. The EnerGov system plays a key role in centralizing and managing the documentation and communication associated with each inquiry.

3.4 City of Mississauga

3.4.1 Response Times

The City of Mississauga's response times for traffic inquiries are structured as follows:

- **Initial Response:** The typical timeframe for an initial response, including inspection period, is approximately two weeks. For more urgent requests, such as emergencies or status updates, the response time ranges from 24 hours to three days.
- **Data Collection and Analysis (if required):** Data collection and analysis timelines align with the inspection and resolution periods mentioned above. These timelines are adhered to depending on the complexity and urgency of the request.
- **Final Response:** The final response is typically provided within six months, though this may vary depending on the specifics of the inquiry and any additional factors that may influence the resolution process.

3.4.2 Prioritization

The prioritization of traffic inquiries in the City of Mississauga is determined by the management staff of the relevant business units in collaboration with the 311 service. Together, they establish service level dates, codes, and processes for handling inquiries. For emergencies, specific processes are outlined in the knowledge base (KB), which includes direct communication with staff for immediate action, rather than submitting a service request through the inquiry management system. Management can provide additional details regarding these processes as needed.

3.4.3 Record Keeping

The City of Mississauga uses INFOR to manage and track their traffic inquiries. INFOR is an integrated enterprise resource planning (ERP) software platform designed to help organizations manage a wide range of operations, including service requests, asset management, and workflow automation. It allows municipalities like the City of Mississauga to streamline their operations by enabling the tracking, monitoring, and resolution of service requests in a centralized system. INFOR facilitates efficient communication between departments, supports real-time data entry, and improves visibility into the status of inquiries.

3.5 City of Burlington

3.5.1 Response Times

The City of Burlington's traffic inquiry response times are managed as follows:

- **Initial Response:** While the expectation is to acknowledge the request as soon as possible, this acknowledgment is not actively tracked within the system.
- **Data Collection and Analysis (if required):** The timeline for data collection and analysis depends on the specific type of request and the complexity of the required data.
- **Final Response:** The final response time varies depending on the nature of the inquiry. In some cases, the inquiry may be closed while work is still pending, whereas in other instances, the inquiry remains open until all necessary work has been completed. The time taken for staff to assign and begin working on a case, as well as the time required to complete the inquiry, is tracked. However, this data is not currently used for active performance monitoring.

3.5.2 Prioritization

Based on the information received in the request, the City's customer service team will triage the inquiry and prioritize it accordingly. If the team determines that the request is urgent, they will proactively reach out to address the issue. Additionally, staff will review and triage incoming cases to ensure they are properly assigned for further action.

3.5.3 Record Keeping

All traffic inquiry data is stored in a CRM software used corporately, Granicus CRM/CMS. This centralized system enables the organization to efficiently manage and track all inquiries, ensuring that relevant information is easily accessible and up to date. Granicus CRM/CMS is designed to streamline communication, track the progress of each inquiry, and provide comprehensive reporting capabilities. By using this software, the City ensures that all data related to traffic inquiries is securely stored, organized, and available for analysis, contributing to improved decision-making and service delivery.

3.6 Town of Milton

3.6.1 Response Times

The Town of Milton's response times for traffic inquiries are categorized by inquiry type and as follows:

- Turning Movement Counts: Six weeks
- Left Turn Queue / Origin-Destination Studies / Pedestrian Crossings (PXO): Four weeks
- Speed Studies: Two and a half weeks
- Parking Surveys: Two and a half weeks
- Signal Timing Intersection Review: Four to six weeks
- Street Parties: Two weeks

These timelines are in place to ensure efficient processing and resolution of traffic-related requests.

3.6.2 Prioritization

If a traffic inquiry involves an immediate safety issue, it is reviewed and addressed immediately. The appropriate manager will assess the situation and prioritize actions accordingly. Issues such as leaning poles, hanging signal heads, malfunctioning pedestrian buttons, or signals cycling incorrectly are treated as urgent and are investigated immediately to ensure public safety.

3.6.3 Record Keeping

All traffic inquiries are logged into an access log for record-keeping and tracking purposes. Additionally, physical copies of relevant documents are printed and organized by the designated areas in which the town is divided, ensuring that records are easily accessible and systematically filed for future reference.

3.7 Key Takeaways

A summary of the environmental scan findings is outlined in **Table 1**. Some key takeaways from the environmental scan are noted below:

- **Response Timelines Vary Significantly by Municipality and Inquiry Type:** Initial response times range from same day for urgent matters to up to two weeks for standard inquiries. Final resolutions can extend from a few weeks to several months, depending on the municipality and the complexity of the case.

- **Urgent vs. Non-Urgent Prioritization Is Common Practice:** All municipalities differentiate between urgent and non-urgent matters. Urgent safety-related issues (such as malfunctioning traffic signals, knocked-down signs, or recent collisions) are universally prioritized for immediate or accelerated response.
- **Diverse Data Collection and Analysis Practices:** The timelines for data collection and analysis vary widely. Some municipalities resolve urgent inquiries within days, while others may require up to six months for full analysis, particularly for non-urgent cases.
- **Variation in Tools and Systems Used for Record Keeping:** There is a diverse range of software platforms in use, including Salesforce, Cityworks, Power BI, Excel, INFOR, EnerGov, Granicus, and others. Some municipalities rely heavily on digital CRMs, while others incorporate manual or hybrid record-keeping systems.
- **Customer Service Teams Play a Critical Role in Triage:** Several municipalities emphasize the role of their customer service teams in assessing urgency and managing inquiry prioritization effectively.

Table 1: Environmental Scan Key Takeaways

Municipality	Response Times	Prioritization	Record Keeping
Region of York	> **Initial Response:** Varies by inquiry type and SLA > **Data Collection and Analysis:** Varies; urgent cases can be same day > **Final Response:** Dependent on approval levels and complexity	> **Urgent:** Urgent inquiries, such as traffic signal malfunctions, are prioritized immediately. > **Non-Urgent:** Standard inquiries are handled according to SLA timelines.	> Salesforce and Cityworks CRM tools > Microsoft 365 tools > Power BI
City of Vaughan	> **Initial Response:** Aims for 48 hours > **Data Collection and Analysis:** 3-5 weeks (expedited 1-2 weeks for urgent) > **Final Response:** Final response 2 weeks after data collection; complete process takes 6-8 weeks	> **Urgent:** Safety issues like malfunctioning signals or knocked-down stop signs receive immediate attention. > **Non-Urgent:** Inquiries related to excessive speeds or non-stop compliance are handled based on their level of urgency.	> CRM software > Excel > Power BI
City of Richmond Hill	> **Initial Response:** Typically within 2 business days > **Data Collection and Analysis:** Up to 6 months depending on inquiry type > **Final Response:** Follows data collection; may take months	> **Urgent:** Inquiries related to recent collisions, near-misses, and unsafe conditions (e.g., malfunctioning signals or missing stop signs) are identified as urgent. > **Non-Urgent:** Non-urgent inquiries may not be followed up unless the resident contacts again or the location is particularly sensitive.	> EnerGov > Excel
City of Mississauga	> **Initial Response:** Typically 2 weeks; urgent in 24 hours to 3 days > **Data Collection and Analysis:** Follows inspection and resolution timelines > **Final Response:** Typically within 6 months; varies by inquiry	> **Urgent:** Crucial safety issues are addressed through established emergency processes for immediate action. > **Non-Urgent:** Non-urgent inquiries are processed according to established service levels, with management collaboration for prioritization.	> INFOR
City of Burlington	> **Initial Response:** Acknowledgment ASAP, not tracked > **Data Collection and Analysis:** Dependent on request type and complexity > **Final Response:** Varies; some remain open until work is completed	> **Urgent:** Customer service team triages urgent inquiries proactively. > **Non-Urgent:** Non-urgent inquiries are prioritized based on available resources and customer service team triage.	> Granicus CRM/CMS
Town of Milton	> **Initial Response:** Varies by inquiry type > **Data Collection and Analysis:** Varies by inquiry type > **Final Response:** Varies by inquiry type	> **Urgent:** Urgent safety issues like leaning poles or malfunctioning signals are prioritized immediately. > **Non-Urgent:** Inquiries are prioritized according to type, with timelines varying by inquiry.	> Inquiries are logged in an access log and physically filed by geographical zones.

4. Recommended Policy

While the City's current traffic inquiry process is functional, there are areas for improvement. The recommended traffic inquiry process is detailed in the following sub-sections. The complete traffic inquiry process can be found in **Appendix A**.

4.1 Traffic Inquiry Process Flowchart

Based on the review of the existing traffic inquiry process and the findings from the environmental scan, the following traffic inquiry process outlined in **Figure 1** is recommended.

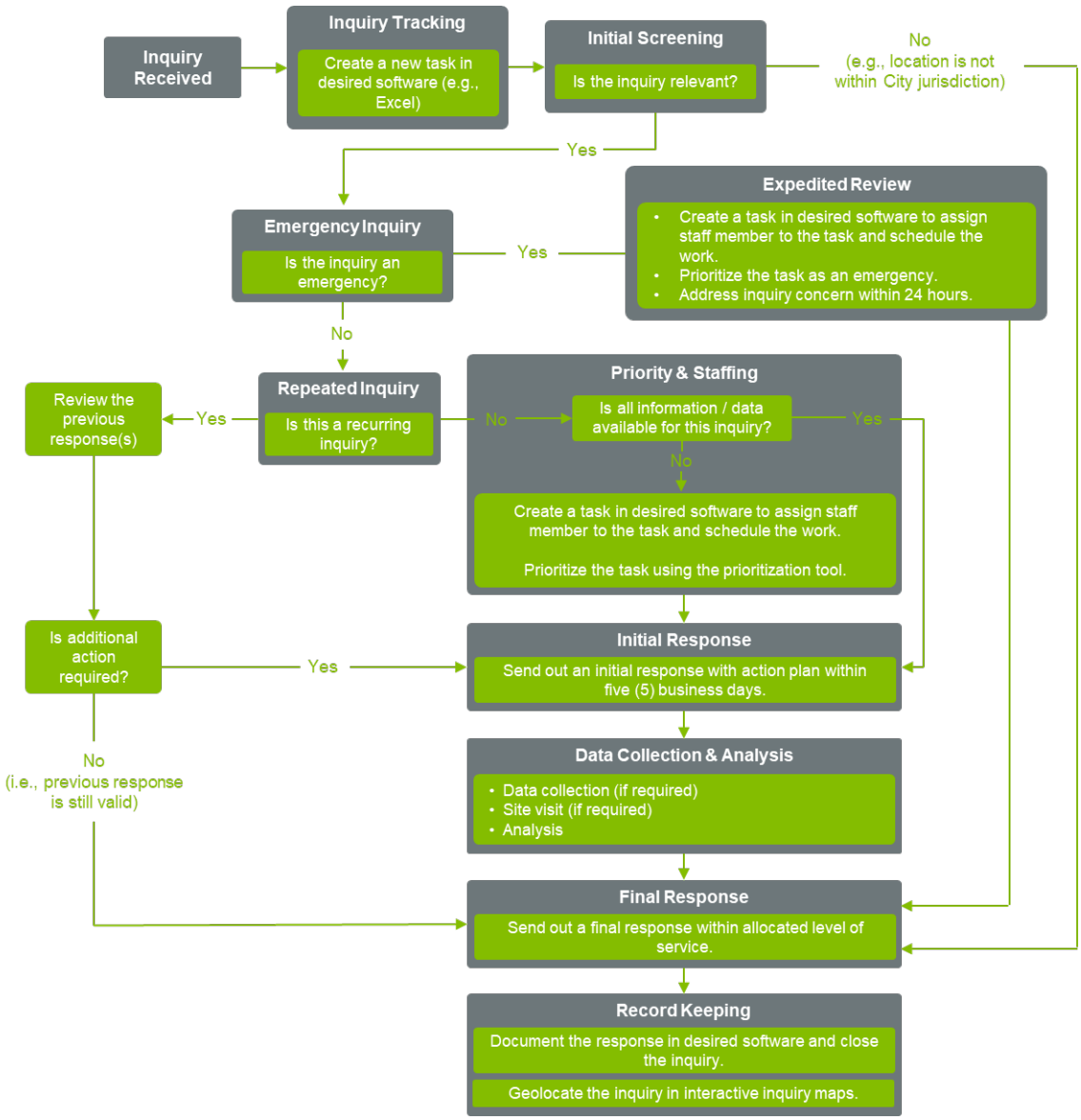


Figure 1: Traffic Inquiry Process Flowchart

4.2 Record Keeping

The review and potential replacement of the City's existing record-keeping software is currently being handled by Corporate Services as a separate initiative from this task, ensuring that any changes to the system are aligned with broader organizational goals and technical requirements.

To optimize workload management and ensure consistency in addressing traffic inquiries, it is recommended that the City collect and record the standard information outlined in **Table 2** for all traffic inquiries.

Table 2: Recommended Information Collected for All Traffic Inquiries

Item	Description
Dates	> Date the inquiry is received > Expected completion date > Actual completion date
Location	> The location of the inquiry
Citizen Contact Information	> Inquirer's contact information including phone number and/or email address
Task Assignment The team member who leads the investigation	> Engineer > Technologist > Field Staff
Inquiry Source The nature of the inquiry	> **Public Inquiry:** inquiries from the public through citizen request forms, telephone calls, email, etc. > **Internal Inquiry:**[1] inquiries from other City departments > **Council Inquiry:** inquiries from City Councillors
Inquiry Type Common inquiries that the City often receives	> All-Way Stop Request > Community Safety Zone Request > Cycling > Parking > Pedestrian Safety > School Safety > Sight Distance > New Traffic Signal Request > Signs/Pavement Markings > Speed > Stop Sign Compliance > Traffic Control Device/Equipment Malfunction > General Questions > Other

[1] Internal inquiries were not reviewed as part of this study, but they follow the same process as public inquiries.

Progress: The current status of the inquiry	> **Not Started:** The inquiry was received but has not been worked on it yet > **Initial Response Sent:** Preliminary reply has been sent to the inquirer (either automatic reply via Contact Centre or follow-up email from staff). > **Task Assigned:** The inquiry has been assigned to a responsible team member for follow-up and resolution > **In Progress:** Currently working on the inquiry > **On-hold:** Waiting on additional information/data to complete the analysis for the inquiry > **Final Response Sent:** Final response has been sent to the inquirer, pending closure > **Completed:** Final response is sent out, the inquiry is closed in the Excel tracking sheet, and all correspondences are documented
Priority	> Urgent > Moderate > High > Normal
Notes	> A brief description of the inquiry > Internal record keeping file path

Furthermore, enhancing the information-gathering process at the Contact Centre through the use of targeted prompts for common inquiry types could significantly streamline the entire process by ensuring that all necessary details are collected right from the start. By implementing specific prompts tailored to common traffic-related concerns (e.g., speed, parking, school safety, etc.), the Contact Centre staff can capture more accurate and complete information. This would reduce the likelihood of delays caused by the need for follow-up questions and ensure that inquiries are assigned to the appropriate staff members more efficiently.

For example, in addition to the standard information outline in **Table 2**, in an inquiry related to cycling safety may contain the following prompts to help gather additional details:

- **Cycling Infrastructure:** Is there a designated cycling infrastructure (e.g., bicycle lanes, multi-use pathway) in the area?
- **Specific Safety Concern:** What specific cycling safety issue are you experiencing (e.g., lack of cycling infrastructure, unsafe intersections for cyclists, cycling infrastructure maintenance request, etc.)?
- **Specific Event:** Have you experienced any recent incidents, near misses, or collisions in the area?
- **Time of Day:** Are there specific times when cycling feels especially unsafe due to traffic patterns or visibility issues? When do you usually cycle in this area (e.g., during peak hours, early mornings, evenings, weekends)?

A standardized approach to data collection would improve consistency in responses, allowing the City to identify recurring issues more easily, prioritize urgent matters, and take more proactive measures in addressing traffic concerns across the community.

In the future, the City may wish to develop online dynamic and interactive inquiry maps using software programs with geolocating features such as ArcGIS and Microsoft Power BI to visually present the inquiries across Markham. The inquiry maps would provide a visual representation of the inquiry data and would be highly customizable to:

- Show the number of inquiries at each location in the form of a bubble, where the size of the bubble reflects the number of inquiries;
- Filter certain types of inquiries (e.g., by date, by status, by inquiry type, etc.); and
- Show the distribution of inquiries across Markham.

This tool would also provide the opportunity to identify locations where multiple inquiries are received. For these locations, the City might wish to initiate a study to examine and address the issues collectively instead of individually (i.e., a neighbourhood study).

As a value-add, software programs such as Microsoft Power BI can also be used for record keeping as it can display customized and detailed information of the inquiry, as long as the information is stored in a consistent format in a database (e.g., Excel spreadsheet).

4.3 Prioritization

The City receives hundreds of traffic-related inquiries each year. While the City identifies and prioritizes urgent inquiries (such as traffic signal malfunctions), all other inquiries are currently treated with the same level of priority. This uniform approach presents challenges in maintaining consistent response times and contributes to backlogs in the system.

It is recommended that the City continue to categorize any traffic inquiry that presents an immediate risk to public safety, such as a downed stop sign or malfunctioning traffic signal, as an emergency inquiry. These types of inquiries should be flagged for immediate review and addressed promptly to mitigate potential hazards and ensure the safety of the public. Prioritizing these issues for swift resolution will help prevent collisions and ensure timely intervention in critical situations.

It is also recommended that a tool be developed to prioritize all other inquiries using a data-driven approach while still taking the nature of the inquiry into consideration. The purpose of the tool is to help the City prioritize the inquiries in a consistent manner, and to use the priority level to manage workload and workflow internally.

The first step of the prioritization process is to determine the preliminary priority of each inquiry using the prioritization matrix as shown in **Table 3**.

Table 3: Recommended Inquiry Type Prioritization

Prioritization Matrix		Specific Event Reported?	
		Yes	**No**
Inquiry Type	> Pedestrian Safety > Cycling Safety > School Safety > Speeding > Sight Distance > Traffic Control Device/Equipment Malfunction	**Urgent**	**Moderate**
	> General Questions > All-Way Stop Control Request > Stop Sign Compliance > Parking > New Traffic Signal Request > Sign/Pavement Marking > Community Safety Zone Request > Other	**High**	**Normal**

As shown in **Table 3**, there are four priority levels (i.e., urgent, high, moderate, and normal) which can be determined for each inquiry using the prioritization matrix. In the matrix, the vertical axis includes inquiry types, and each inquiry would be assigned with a priority level depending on whether a specific event is reported by the inquirer. A specific event is one that may trigger immediate corrective action includes, although is not limited to the following:

- A recent collision;
- A change in road or traffic conditions that is causing unsafe road user behaviour; and/or
- A defective traffic control device.

Inquiries that do not mention a specific event are those that do not trigger, or that are not feasible for, immediate corrective action. For example, all-way stop requests require further analysis and, if an all-way stop is recommended, additional work in the form of budgeting, design, Council approval, and by-law amendments are required.

The second step of the prioritization process involves a preliminary review of the inquiry. This process assesses the inquiry comprehensively based on a list of relevant data and information for the inquiry location, such as speed data, traffic volume data, historical collision data, network screening results, systemic risk-based results, anecdotal observations, previous history, construction plans/history, etc. This preliminary review of the inquiry will help the City make data-driven decisions on the priority of the inquiries, such that the preliminary priority level assigned in the first step can be adjusted accordingly when appropriate.

As a long-term enhancement, the City may consider developing a dashboard that can improve the efficiency of the preliminary review process. This dashboard would connect to the City's various data sources, where the above-noted data and information can be easily filtered out by location. Such a dashboard can be developed in software programs such as Microsoft Power BI or ArcGIS based software such as Cityworks.

Additionally, the City may wish to consider developing an algorithm to automate the above-noted prioritization process. This algorithm can be embedded with a methodology that applies a weighting factor to each relevant data, which will calculate an overall priority score for each inquiry. The City can then use these scores to prioritize their work.

4.4 Response Times

The City currently aims to respond to all urgent traffic maintenance and repair activities within five (5) business days and all other traffic inquiries within ten (10) business days. **Table 4** outlines the recommended timelines for initial response, data collection and analysis, and a final response for all traffic inquiries.

Table 4: Recommended Timelines and Levels of Service

Key Step	Level of Service / Timeline for Completion
Emergency Inquiry	24 hours upon receipt of inquiry.
Initial Response	Immediately (if inquiry received through Contact Centre) Five (5) business days upon receipt of inquiry (all other inquiries)
Data Collection & Analysis	<u>All data available:</u> Ten (10) business days upon initial response. <u>New data collection required:</u> Standard: 30 business days / six (6) weeks upon initial response. Inclement Weather[2]: 120 business days / six (6) months upon initial response.
Final Response	Five (5) business days upon completion of data collection and analysis.

[2] If inquiries are received during winter months, the LOS for data collection and analysis is to be extended to allow data collection to occur during the spring to ensure data is accurate and representative of normal driving conditions and patterns.

4.4.1 Emergency Inquiries

Traffic inquiries identified as emergencies (i.e., those which pose a risk to public safety and require immediate attention due to their potential to cause harm or disruption) must be prioritized to ensure timely intervention. An expedited review and response within 24 hours upon inquiry receipt are crucial to mitigate risks, protect the public, and restore normalcy to affected areas as quickly as possible.

4.4.2 Initial Response

An initial response should be provided to the inquirer within five (5) business days of receiving the inquiry. This prompt acknowledgment ensures the inquirer is aware that their request is being processed. The initial response may include the following key information:

- **Confirmation of Receipt of the Inquiry:** Confirm that the inquiry has been successfully received and logged into the system and notify the inquirer that their request is in process.
- **Acknowledgement of the Inquiry's Importance:** Acknowledge the significance of the inquiry to demonstrate that the City values public input and takes all requests seriously.
- **Inquiry Scope and Next Steps:** Outline the scope of the inquiry by restating the key issue or question raised and provide a brief explanation of the general process and an overview of the next steps.
- **Estimated Timeline for Response:** Provide an estimated timeframe for when a more detailed response will be given.
- **Reference to Relevant Policies or Guidelines:** Provide a reference to any policies, procedures, or guidelines that are relevant to the inquiry.
- **Contact Information:** Provide clear and accessible contact information in case the inquirer has additional questions, concerns, or requires further clarification.

Currently, all inquiries submitted through the City's Contact Centre receive an automated response. This message acknowledges receipt of the request and provides a case order number. This automated email may act as the initial response for all inquiries received through the Contact Centre. The City may consider updating the automated message to include additional information, as outlined above, to enhance communication and manage client expectations more effectively.

If an inquiry is received regarding the same location within two (2) years of a previous review, and there have been no significant changes to the area (e.g., new developments or substantial shifts in traffic patterns), no further data collection and analysis is necessary. In this case, the City should provide the same response as was given during the last review, as the conditions and circumstances remain largely unchanged. This approach ensures efficiency while maintaining consistency in responses. In these cases, the initial response will also be the final response.

4.4.3 Data Collection and Analysis

The timelines for data collection and analysis vary depending on the availability of existing data. If all necessary data is readily available, the process should be completed within ten (10) business days following the initial response. However, if new data collection is required, a standard timeline of thirty (30) business days (or approximately six (6) weeks) from the initial response should be set. In cases where inclement weather may delay data collection, it is advisable to extend the timeline to one hundred twenty (120) business days (or six (6) months) to ensure the collection of accurate and comprehensive data.

4.4.4 Final Response

A final response should be provided to the inquirer within the designated level of service. The final response may include the following information:

- **Assessment Process:** Outline the steps taken to assess the request
- **Previous Data/Studies:** If applicable, provide information about any recent traffic studies or reviews that were conducted in the area.
- **Decision or Recommendation:** Clearly state the decision or recommendation of the City and provide specific rationale based on policies and procedures.
- **Timeline for Implementation:** If countermeasures are required, provide information about the expected timeline for the changes to be implemented.
- **Contact Information**: Provide clear and accessible contact information in case the inquirer has additional questions, concerns, or requires further clarification.

By clearly defining the timelines for each phase (initial response, data collection and analysis, and final response), this process promotes transparency and accountability. The recommended timelines not only improve service delivery but also ensure that the City maintains a consistent and efficient approach to managing traffic inquiries.

5. Conclusion

Efficiently managing the influx of traffic inquiries is pivotal for ensuring public safety and maintaining operational effectiveness within the City of Markham. This memo outlines the imperative need for a streamlined and standardized process to address public, Councillor, and internal inquiries regarding traffic safety and operations. By considering the adoption of these recommendations, the City of Markham may enhance its responsiveness to traffic inquiries and potentially improve workflow efficiency. Furthermore, embracing standardized procedures and innovative software solutions could help the city make more informed decisions based on data-driven insights. Looking ahead, incorporating these practices into existing processes could play a vital role in enhancing public service delivery and supporting road safety initiatives within the City.

Appendix A: Recommended Traffic Inquiry Process

Appendix A: Traffic Inquiry Process

1.1 Traffic Inquiry Process Overview

The step-by-step traffic inquiry process is outlined in the **Figure A-1** below.

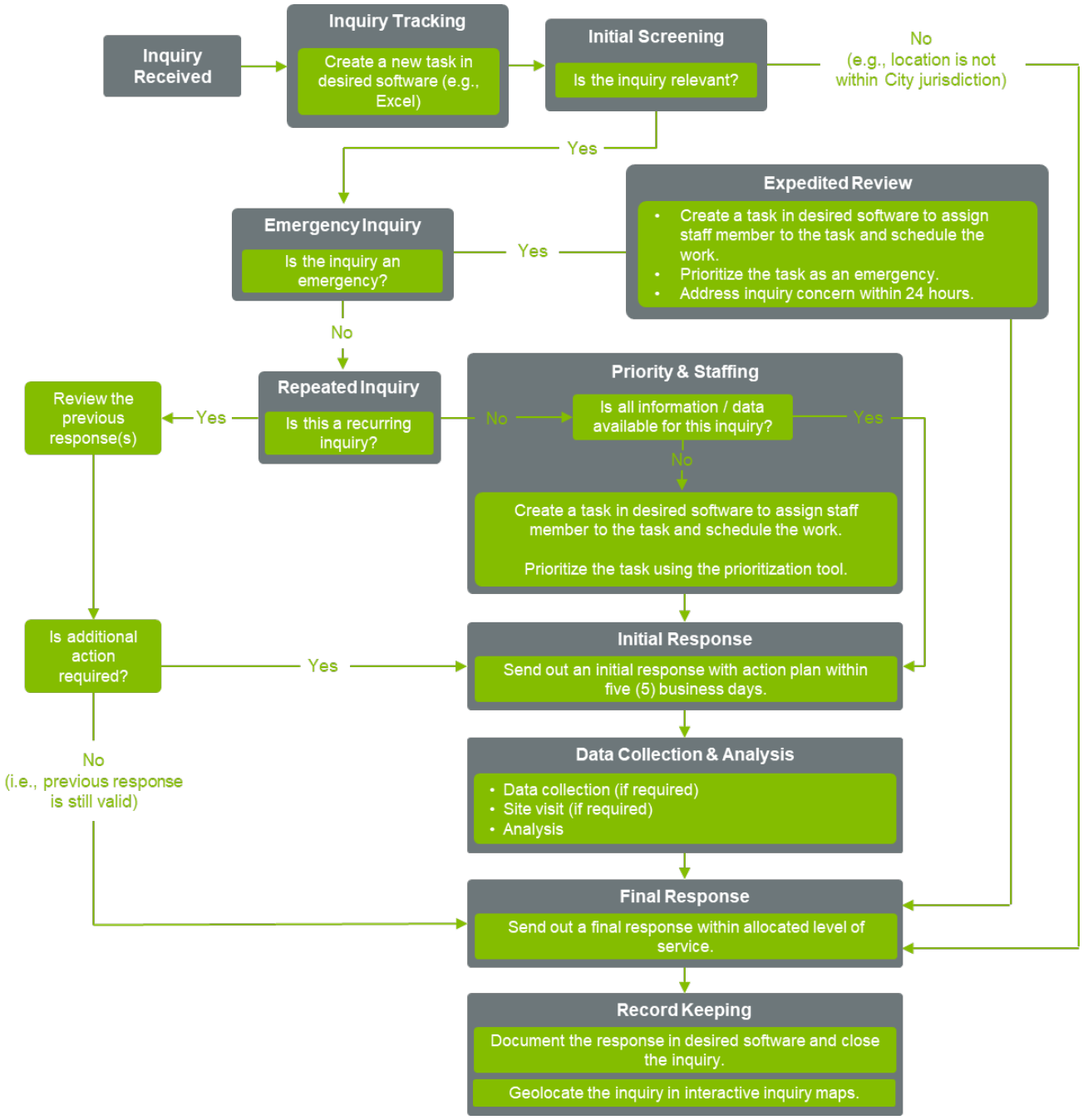


Figure A-1: Traffic Inquiry Process Flow Chart

1.2 Record Keeping

Table A-1 outlines the standard information to be recorded for all traffic inquiries.

Table A-1: Recommended Information Collected for All Traffic Inquiries

Item	Description
Dates	> Date the inquiry is received > Expected completion date > Actual completion date
Location	> The location of the inquiry
Citizen Contact Information	> Inquirer's contact information including phone number and/or email address
Task Assignment The team member who leads the investigation	> Engineer > Technologist > Field Staff
Inquiry Source The nature of the inquiry	> **Public Inquiry:** inquiries from the public through citizen request forms, telephone calls, email, etc. > **Internal Inquiry:**[1] inquiries from other City departments > **Council Inquiry:** inquiries from City Councillors
Inquiry Type Common inquiries that the City often receives	> All-Way Stop Request > Community Safety Zone Request > Cycling > Parking > Pedestrian Safety > School Safety > Sight Distance > New Traffic Signal Request > Signs/Pavement Markings > Speed > Stop Sign Compliance > Traffic Control Device/Equipment Malfunction > General Questions > Other
Progress: The current status of the inquiry	> **Not Started:** The inquiry was received but has not been worked on it yet > **Initial Response Sent:** Preliminary reply has been sent to the inquirer (either automatic reply via Contact Centre or follow-up email from staff).

[1] Internal inquiries were not reviewed as part of this study, but they follow the same process as public inquiries.

	> **Task Assigned:** The inquiry has been assigned to a responsible team member for follow-up and resolution > **In Progress:** Currently working on the inquiry > **On-hold:** Waiting on additional information/data to complete the analysis for the inquiry > **Final Response Sent:** Final response has been sent to the inquirer, pending closure > **Completed:** Final response is sent out, the inquiry is closed in the Excel tracking sheet, and all correspondences are documented.
Priority	> Urgent > Moderate > High > Normal
Notes	> A brief description of the inquiry > Internal record keeping file path

1.3 Prioritization

All traffic inquiries are to be prioritized using the prioritization matrix as shown in **Table A-2**.

Table A-2: Recommended Inquiry Type Prioritization

Prioritization Matrix		Specific Event Reported?	
		Yes	**No**
Inquiry Type	> Pedestrian Safety > Cycling Safety > School Safety > Speeding > Sight Distance > Traffic Control Device/Equipment Malfunction	**Urgent**	**Moderate**
	> General Questions > All-Way Stop Control Request > Stop Sign Compliance > Parking > New Traffic Signal Request > Sign/Pavement Marking > Community Safety Zone Request > Other	**High**	**Normal**

A specific event is one that may require immediate corrective action, such as a recent collision, unsafe behaviour due to road or traffic changes, or a defective traffic control device.

The second step in prioritization is a preliminary review of the inquiry using relevant data (e.g., speed, volume, collisions, network risk, observations, construction history). This ensures data-driven decisions and may adjust the initial priority level assigned.

1.4 Response Times

Table A-3 outlines the recommended timelines for initial response, data collection and analysis, and a final response for all traffic inquiries.

Table A-3: Recommended Timelines and Levels of Service

Key Step	Level of Service / Timeline for Completion
Emergency Inquiry	24 hours upon receipt of inquiry.
Initial Response	Immediately (if inquiry received through Contact Centre) Five (5) business days upon receipt of inquiry (all other inquiries)
Data Collection & Analysis	<u>All data available:</u> Ten (10) business days upon initial response. <u>New data collection required:</u> Standard: 30 business days / six (6) weeks upon initial response. Inclement Weather[2]: 120 business days / six (6) months upon initial response.
Final Response	Five (5) business days upon completion of data collection and analysis.

If a similar inquiry was reviewed within the past two years with no significant changes in the area, the previous response may be reused. In such cases, the initial response also serves as the final response, ensuring efficiency and consistency.

[2] If inquiries are received during winter months, the LOS for data collection and analysis is to be extended to allow data collection to occur during the spring to ensure data is accurate and representative of normal driving conditions and patterns.

CIMA+ project number: B001780
January 2026

Appendix I
Community Engagement Strategies

MEMO

TO	:	**City of Markham**
FROM	:	**CIMA+**
DATE	:	**August 11, 2025**
SUBJECT	:	**Vision Zero Road Safety Plan: Enhancement of Community Engagement Strategies**

1. Introduction

The City retained CIMA Canada Inc. (CIMA+) to develop a Vision Zero Road Safety Plan. Phase 5 of the project focuses on enhancing the City's existing operational programs, standards, and community engagement initiatives. This memo contains the deliverable for *Task 5.3: Enhancement of Community Engagement Strategies* and presents considerations and recommendations for improving the City's existing practices. The memo is comprised of the following sections:

- **Section 2: Existing Community Engagement Program**
- **Section 3: Potential Improvements**
- **Section 4: Conclusion**

2. Existing Community Engagement Program

An overview of the City's existing community engagement program is summarized in the following sub-sections.

2.1. Communication Tools

The City uses a variety of communication tools, including digital media, in-person events, signage, and traditional communications methods. Your Voice Markham is the City's primary online community engagement platform, where webpages are developed for each individual project, and interactive maps can be used to gather public feedback. Additionally, the City has a monthly blog called MarkhamNOW and a SurveyMonkey account for publishing public surveys. The City also posts project information on its website and promotes initiatives through multiple communication channels which are inclusive of digital and print.

The City hosts a variety of events throughout the year, including Canada Day, Markham Cycling Day, and the Markham-Milliken Children's Festival, whereby staff can share information with the public. For in-person public information sessions, City facilities such as community centres can be reserved. The City utilizes digital billboards on Highway 407, digital signs at railway crossings, on-hold messaging for phone calls, and digital boards at City facilities to disseminate information. The City's communications department also has relationships with media and other key external stakeholders for further communication amplification.

2.2. Messaging

The City primarily conducts seasonal messaging relating to road safety through its digital and social media channels. Topics include work zone safety, pedestrian safety, cycling etiquette, and education and awareness around the City's radar speed display program and York Regional Police's Road Watch program. The City makes data-driven decisions using insights from social and digital media, website traffic, and federal census data to guide communications initiatives. Further, the City analyzes demographic trends after each major event (such as Canada Day).

2.3. Monitoring and Evaluation

The City evaluates its communications strategies using a variety of tools and metrics. This includes tracking social media performance indicators such as reach, engagement, and impressions, as well as monitoring website traffic and user behaviour.

In addition to digital analytics, the City actively monitors media coverage and engages in media pitching to help shape public narratives and amplify key messages. Social media listening is also conducted to gather feedback from residents, identify emerging concerns, and adjust messaging as needed.

These monitoring and evaluation efforts help ensure that communications are responsive, effective, and continuously improved based on data and community input.

2.4. Staff

The City's Corporate Communications team is a full-service department that serves the City's external and communications efforts. The department provides the following services: communications support including strategic guidance and counsel, brand reputation and crisis management, graphic design, photography, media relations, marketing, sponsorship, and digital and social media support.

2.5. Collaboration

The City's Corporate Communications team often collaborates with both internal and external stakeholders as appropriate to both share and disseminate messaging and further public awareness efforts. The team also has close relationships with York Region and local municipalities where they often share ideas and information. With respect to road closures and construction notices in Markham, the City currently amplifies messaging that is provided by York Region's communications department.

Regarding events, the Communications team works closely with the Special Events department to support both small- and large-scale City-hosted events (internal and external).

3. Recommended Improvements

The following sub-sections outline the improvements needed to support the City's proposed Vision Zero Road Safety Plan communications and engagement strategies.

3.1. Objective and Goal

It is important to clearly define the objectives and goals of any community engagement effort and ensure that these are aligned with broader City policies and approaches. The Vision Zero Road Safety Plan communications strategy should include timelines (e.g. when to launch certain messages or communications), as noted in the accompanying communications plan to keep the project on track,

and to support objectives and goals. Community engagement tactics should also be considered and built into the plan if collecting public feedback and commentary is desired.

3.2. Communication Tools

Based on the objectives outlined in the City's Vision Zero Road Safety Plan communications strategy, the most effective communications channels and engagement tactics should be identified to reach the targeted audiences and segments of the community. Existing tools currently used by the City as outlined in **Section 2.1**, including digital and social media, local contacts, billboards and signage, and in-person outreach should continue or expand as appropriate. Other communications tools such as community meetings, community bulletin boards, public radio and television, and printed materials can be explored based on demographic trends and demonstrated effectiveness. The City promotes accessibility and equity by ensuring all communications are written in plain language and comply with AODA standards (e.g., high contrast colours, alternative text for images, etc.), the City's Diversity Action Plan, and the City's Language and Translation Policy.

3.3. Messaging

The City's road safety messaging should be grounded in data-driven insights and focused on education and raising awareness. By analyzing traffic patterns, collision statistics, and behavioral trends provided by the Traffic Engineering team, messaging can be tailored and geo-targeted to address specific risks and target high-priority areas. Demographic data such as age, gender, and language spoken as well as travel pattern data such as peak travel times, mode of transportation, and destination types can be used to target communications and engagement appropriately, including tailoring the tone, message, content, and communication tool to the correct audience. The City can also continue to expand its collaboration with York Region and local municipalities to ensure consistent messaging and to reduce duplicate work.

3.4. Monitoring and Evaluation

Continuous monitoring and evaluation of the effectiveness of the City's community engagement efforts should be included in the formal Vision Zero Road Safety Plan communications strategy. This can include establishing clear key performance indicators (KPIs) such as event participation, website traffic, and social media analytics; and public feedback gathered through formalized channels.

3.5. Staff & Training

When looking at other municipalities and how they are supporting communications for Vision Zero Road Safety Plan efforts, it is industry best practice, and CIMA+'s recommendation, to dedicate 1.0 full-time equivalent (FTE) team member to work on the communications plan and strategy.

In addition, Corporate Communications staff can attend training to expand their road safety knowledge, including TAC Road Safety Training and webinars on Vision Zero, the Safe System Approach, and community engagement and education techniques. This will provide staff with an enhanced background understanding to tailor road safety messaging appropriately. The City can also continue partnering with external consultants as necessary to develop targeted, data-driven communications strategies.

3.6. Collaboration Opportunities

It is recommended that the City continue to partner with both internal and external stakeholders to expand the reach of its engagement activities and leverage existing messaging and communications initiatives. Additional stakeholders which the City can collaborate with include the Ministry of Transportation of Ontario, local school boards, other departments within the City, and non-profit organizations specializing in road safety.

Increased collaboration with various departments in York Region, such as York Regional Police, York Region Transit, Public Health, and Traffic Safety, provides opportunities for consistent and effective messaging. Opportunities to expand existing collaboration with the communications teams at other local municipalities within the Region should also be explored.

4. Conclusion

Given the City's existing community engagement strategies, there are opportunities to expand and improve upon the program to leverage existing resources, ensure consistent messaging, increase collaboration with both internal and external groups, and monitor and assess the effectiveness of the program. The recommendations outlined in this memorandum are intended to help the City develop a robust and formalized communications strategy to be used in support of its road safety initiatives.

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CIMA+ project number: B001780
January 2026

J

Appendix J
Design Guidelines Update

City of Markham

Vision Zero Road Safety Plan

B001780

ENHANCEMENT OF ENGINEERING STANDARDS



CIMA+ project number: B001780
August 21, 2025



City of Markham

Vision Zero Road Safety Plan

B001780

ENHANCEMENT OF ENGINEERING STANDARDS

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August 21, 2025

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Appendix A Enhancement of the City of Markham Engineering Design Standards

1. Introduction

The City of Markham has engaged CIMA Canada Inc. (CIMA+) to support the development of a comprehensive Road Safety Plan, aimed at enhancing road safety and reducing traffic-related risks across the City. As part of this larger initiative, the project includes the review and recommendations for enhancement of the City of Markham's Design Engineering Standards and Practices, to guide the City of Markham towards creating safer travel and reducing the number of fatal and serious injury collisions, following the Safe System Approach.

1.1 Purpose and Overview

The purpose of this memo is to present recommendations to enhance the guidelines, standards and practices followed by the City of Markham to integrate road safety through all steps of the Planning and Design process of transportation and infrastructure projects.

This initiative adopts a systematic approach to identify gaps and areas of improvement in the City of Markham's existing processes and Planning and Design framework. The development of the recommendations is documented in detail in the following sections:

- **Section 2**: Current Procedures in the City of Markham
- **Section 3**: Road Safety Principles and Countermeasures
- **Section 4**: Proposed Recommendations

1.2 Need and Justification

In Canada, road safety remains a top priority, with millions of people travelling on the road everyday. A key objective in planning and design of current and future road infrastructure is to create a safer environment for all road users. While it is standard practice to adhere to established engineering standards and guidelines when designing roads, this approach can often place enhanced safety considerations in the final stages of the process or through a reactive stance.

Therefore, it is beneficial that road safety engineering principles are integrated from the onset of all infrastructure projects and are consistently applied throughout the project life cycle. This ensures that safety is proactively addressed and that appropriate measures are implemented at every stage.

2. Current Procedures in the City of Markham

2.1 Existing Policies, Procedures, and Plans

Building on that completed by the York Region Traveller Safety Plan, a comprehensive strategic review of the City of Markham's existing policies, procedures, and guidelines pertaining to road safety within the planning and design framework was conducted.

Table 2-1 presents the summary of the review of existing policies, procedures, and guidelines for the City of Markham. The review included a desktop background review as well as consultations with key stakeholders, such as Traffic Engineering, Transportation Planning and Infrastructure & Capital Projects staff.

Table 2-1: Summary of City of Markham's Existing Policies, Procedures, and Plans

	Official Plan	TMP	ATMP	Road Safety Plan	Safety Report	Engineering Design Guidelines	Other Relevant Documents
Status	✓	D	✓	D	✗	✓	▪ Engineering Standard Drawings ▪ (2022) Design Guidelines for Separated Facilities, MUPs, and Trails ▪ (2022) Accessibility Design Guidelines ▪ (2023) TIA Terms of Reference / Guidelines ▪ (2024) Corporate Asset Management Plan ▪ School Zone Safety Guide (Ongoing) Citywide Parking Strategy (Ongoing)

✓ = Reviewed, D = In Development, ✗ = Not available

As outlined in **Table 2-1**, the City of Markham has an Official Plan that provides a detailed strategy for both short-term and long-term development growth of the community, with a significant focus on transportation and infrastructure. The City's Mobility for All: The Markham Transportation Master Plan (MTMP) is currently under development and having completed Phase 1, the main objectives of this document is to plan for all transportation modes through 2051 and beyond, develop a 5 to 10 year transportation infrastructure

capital program, develop a micromobility strategy, and establish a complete street guideline. It is currently in Phase 2 to identify the vision and opportunities for improvement The Active Transportation Master Plan (ATMP), created in 2021, outlines a long-term strategic approach to enhance walking, cycling, and other active transportation modes for Markham residents. Additionally, Markham has its Engineering Design Criteria for Roadways, recently updated in July 2024, and Standard Drawings. Supporting design documents and other industry references (i.e. TAC, OTM, Ontario Provincial Standards Drawings) are not specifically referenced, therefore the City's Design Criteria and Standard Drawings must be read in conjunction with other relevant documents. Other pertinent documents include a Design Guideline for Separated Facilities, Multi-use Pathways (MUPs), and Trails, an Accessibility Design Guideline and a Corporate Asset Management Plan, Terms of Reference for Traffic Impact Assessments (TIA), and the School Zone Safety Guide and Citywide Parking Strategy that are currently in development.

The Corporate Asset Management Plan provides important information on the capital budgets and assets allocations. Based on the background review, there appears to be an opportunity to strengthen the plan by more clearly outlining the workflow processes followed during the planning, design and delivery stages of capital infrastructure projects. In addition, the plan currently does not reflect how both major and minor infrastructure projects and the safety considerations associated with them, are integrated. These elements tend to be addressed separately at a higher level, which may limit the plan's effectiveness in guiding project-level decisions.

Major transportation infrastructure projects include new road constructions, road widening, road extensions, intersection signalization, and lane reconfigurations. Minor projects, on the other hand, tend to focus on improvements to existing road infrastructures, such as surface rehabilitation and retrofit, and the provision or refreshment of pavement markings, signages, bollards, and other similar elements.

City of Markham staff confirmed that projects under the Capital Infrastructure program, are typically generated through a "Request For Proposal" process. However, there is currently no centralized document that provides a high-level overview of ongoing projects, that includes both major and minor infrastructure projects, across various departments. Instead, coordination tends to happen on a project-by-project basis. For example, the Project Manager may contact other departments (i.e. Environmental Services, Operations) by email to identify any anticipated or future work within the same area that could be coordinated or included in the project scope.

2.2 Road Safety Planning and Design Principles

This review applied relevant elements of the Safe System Approach checklist as outlined in the Ontario Traffic Council (OTC) Vision Zero Guide, to assess how road safety conditions are integrated into the planning and design decision-making process.

The following questions guided the review of documents and policies:

- Is the functional road hierarchy clear?
- Does the road hierarchy promote standards that are consistent with the intended function?
- Are all modes of transport accommodated and are there facilities for pedestrians and cyclists?
- Is there an emphasis / guidance on minimizing exposure of pedestrians/cyclists to vehicular traffic (i.e. physically separating major pedestrian and bicycle lanes from motorized traffic)?
- Is there an emphasis / guidance on designing intersections that minimize collisions and speed?
- Is there an emphasis on access management control?
- Is there an emphasis on accessibility?

These considerations helped evaluate how existing City of Markham policies, procedures, and plans align with Safe System principles. **Table 2-2** summarizes key Road Safety Planning and Design Principles referenced from both the OTC Vision Zero Guide and the Australian Guide for Safe System in the Planning Process.

Table 2-2: Summary of Findings - Road Safety in Planning and Design Policies

Road Safety Planning and Design Principles	Status
Clear and functional road hierarchy?	✓
Accommodation and/or facilities for all transport modes?	✓
Guidance on minimizing traffic conflicts at a higher-level?	✓
Guidance on minimizing pedestrians/cyclist exposure to vehicular traffic?	✓
Emphasis on physically separating pedestrian/cyclist facilities from motorized traffic?	✓
Guidance designing intersections that minimizing conflicts and speed?	A
Guidance on access management control?	A
Guidance on accessibility?	✓
Is curbside parking restricted or suitably designed?	✗
Do schools have easy and direct access to other modes of transportation?	A

✓ = Reviewed, A = Exists but have areas of improvement, ✗ = Notably lacking in detail and/or missing

As per **Table 2-2**, The City of Markham has established a clear and functional road hierarchy that accommodates all modes of transportation. At a broader level, the City ensures adequate guidance to minimize traffic across various modes. Additionally, the City emphasizes reducing pedestrian and cyclist exposure to vehicular traffic, particularly through the Design Guidelines for Separated Facilities, MUPs and Trails, which focus on separating vulnerable road users from motorized vehicles. The City also has a comprehensive Accessibility Design Guideline that fosters the creation of inclusive design for transportation infrastructures. However, the key areas of improvement in the existing guidelines and standards include a stronger focus on minimizing collisions and controlling speeds at intersections, the adoption of more effective access management and control practices, and the safety of school zones and its accessibility to different transportation modes.

2.3 Summary of Key Observations

The review of policies and planning guidance highlighted several recurring themes and areas of opportunity to consider related to safety integration within design approaches and engineering standards:

- Consideration of Integrating Road Safety Analysis into Technical Studies, Capital Projects (Major and Minor Capital Projects), Planning, Development and Subdivision Projects
  - While the City of Markham references Traffic Impact Studies (TIS), Traffic Impact Assessments (TIA), and similar tools, there is no clear guidance on how to incorporate road safety tools, such as collision data reviews or risk assessments, into these processes.
- Consideration of Applying Road Safety Analysis in Planning and Design
  - Road safety tools such as Road Safety Audits or Road Safety Impact Assessments are not currently applied during the planning, design, or delivery phases of major or minor infrastructure projects.
  - At present, safety reviews only occur at the end of a project as part of a quality control process—typically when an internal review of consultant-submitted designs is requested.
- Consideration of Coordinating Major and Minor Capital Infrastructure Projects
  - There is limited high-level integration between major and minor capital projects, which can lead to missed opportunities for coordination and shared safety outcomes.
- Consideration of Emphasizing Road Safety within Engineering Design Practices
  - The City draws on a combination of industry standards and guidance from other municipalities when developing design practices. However, traffic calming measures, which are essential to road safety, are often underrepresented in the planning and design stages, reflecting a broader trend seen in other jurisdictions as well.
- Consideration of Consistent Use of Formal Engineering Design Standards and Guidelines
  - For smaller or lower-complexity projects, high-level functional designs are often used to streamline delivery. These may not consistently reference formal engineering standards, which can lead to variability in outcomes.
  - Without a standardized approach to referencing design standards, there can be inconsistencies in project quality and review processes.

3. Road Safety Principles and Countermeasures

As identified in **Section 2.1**, a key objective of this project is to provide guidelines for integrating road safety through the Safe System principles within the City's Planning and Design process. This section presents a literature review of relevant road safety design principles and countermeasures, drawn from research studies, design manuals and standards, reports, regulations, and guidelines, and industry best practices.

3.1 Literature Review of Industry Best Practices

The literature review focused on the Emphasis Areas identified by the City of Markham for the Road Safety Plan, as listed below. The goal was to identify planning and design strategies that enhance roadway safety while addressing the needs of all road users. The emphasis areas include:

- Intersections
- Vulnerable Road Users
- School Zones
- Aggressive Driving
- Distracted Road Users
- Young Drivers

The references that were reviewed include:

- NCHRP
  - NCHRP 500 Series Reports
    - A Guide for Reducing Collisions Involving Pedestrians
    - A Guide for Reducing Collisions Involving Bicycles
    - A Guide for Addressing Unsignalized Intersection Collisions
    - A Guide for Reducing Collisions at Signalized Intersections
    - A Guide for Addressing Aggressive-Driving Collisions
    - A Guide for Reducing Collisions Involving Drowsy and Distracted Drivers
    - A Guide for Reducing Collisions Involving Young Drivers
    - A Guide for Reducing Collisions on Horizontal Curves
  - NCHRP Publications
    - NCHRP Report 785: Performance-Based Analysis of Geometric Design of Highways and Streets
    - How to Measure and Communicate the Value of Access Management
    - Roadway Cross-section Reallocation Guide

    - Pedestrian and Bicycle Transportation Along Existing Roads: ActiveTrans Priority Guidebook
- US Federal Highway Administration
  - Guidance for Incorporating Data-Driven Safety Analysis (DDSA) into:
    - Traffic Impact Analysis
    - Road Diets
    - Intersection Analysis
  - Performance-Based Practical Design
  - Bicycle Safety Guide and Countermeasure Selection System (BIKESAFE)
  - Pedestrian and Bicycle Crash Analysis Tool (PBCAT, version 3)
- TAC Publications:
  - Access Management: Synthesis of Practice
  - Safety Performance of Bicycle Infrastructure in Canada
- OTC
  - Vision Zero Guide
  - MMLOS Guide
- Other Publications
  - City of Ottawa: Protected Intersection Design Guide
  - City of Regina: Design Standard Transportation Guide
  - Town of Innisfil: Transportation Master Plan – Appendix N Roundabout Implementation Guidelines
  - The Effects of Left-Turn Traffic Calming Treatments on Conflicts and Speeds in Washington, D.C
  - Analyzing the Impact of Median Treatments on Pedestrian / Bicyclist Safety
  - NACTO: Optimizing Large Vehicles for Urban Environments

Table 3-1 outlines the summary of the findings from the literature review that was conducted.

Table 3-1: Literature Review of Industry Standards, Guidelines & Publications

Source	Emphasis Area(s)	Road Safety Planning Principles and/or Design Element	Comments/Notes
NHCRP 500 Series Reports			
A Guide for Reducing Collisions Involving Pedestrians (2004)	▪ VRU ▪ Intersections ▪ School Zones ▪ Distracted Road Users	Other design elements to improve safety: ▪ Eliminate screening by physical objects (i.e. profile consideration, parked cars, consideration of locations of signages, utility polies, bus stops etc.) ▪ Reduce pedestrian exposure to vehicular traffic (i.e. pedestrian refuge islands, raised medians, sidewalks/walkways) ▪ Improve sight distance and/or visibility to other users (i.e. crosswalk enhancements, illumination) ▪ Implement road narrowing measures, traffic calming within road sections and intersections Other planning elements to improve safety ▪ Provide improvements to school routes within school zones	Potential areas of improvement for the City of Markham's AT guidance / design standards
A Guide for Reducing Collisions Involving Bicycles (2008)	▪ VRU	Other design elements to improve safety: ▪ Restrict right turn on red (RTOR) movements ▪ Bicycle tolerable shoulder rumble strips ▪ Bicycle accommodation at roundabouts	Potential areas of improvement for the City of Markham's AT guidance / design standards
A Guide for Addressing Unsignalized Intersection Collisions (2003)	▪ Intersections ▪ Vulnerable Road Users ▪ Distracted Road Users	Other design elements to improve safety: ▪ Improve management of access (i.e. driveway closures, driveway turn restrictions) ▪ Improve geometric design improvements (i.e. longer right- and left-turn lanes, offset right- and left-turn lanes, full-width paved shoulders, channelization, closing median openings, reduce intersection skew) ▪ Improve sight distance (i.e. clear sight triangles, restrict parking), signage and delineation with pavement marking (i.e. turning path markings, double yellow centreline for medians) ▪ Improve adjacent traffic signals to create gaps at stop-controlled intersections and ▪ Flashing beacons / warning signages ▪ Roundabouts and Traffic Calming	Potential areas of improvement for the City of Markham's AT guidance / design standards
A Guide for Reducing Collisions at Signalized Intersections (2004)	▪ Intersections ▪ Vulnerable Road Users	Other design and planning elements to improve safety: ▪ Emergency vehicle pre-emption ▪ Bike signals ▪ Right- and left-turn channelization ▪ Improving VRUs facilities (i.e. continuous sidewalks, median refuge areas, widening outside through lanes or adding bike lanes)	Potential areas of improvement for the City of Markham's AT guidance / design standards
A Guide for Addressing Aggressive Driving Collisions (2003)	▪ Aggressive Driving	Other planning elements to improve safety include improving driving environments to minimize the "triggers" of aggressive driving ▪ Identify a process to identify process that may contribute to aggressive driving and improve driving behaviour (i.e. poor traffic signals coordination, extremely low posted speed)	Enforcement is the typical solution for aggressive driving. Potential areas of improvement include: ▪ Considering proven countermeasures in the Planning / Design phase ▪ Enhancing the City's design guidance can be another potential solution.
A Guide for Reducing Collisions Involving Drowsy and Distracted Drivers (2005)	▪ Distracted Road Users	Other design elements to improve safety for distracted drivers include: ▪ Installing shoulder and/or centreline rumble strips ▪ Enhancing pavement markings (i.e. higher contrast / wider markings / raised pavement markings, refreshing on a regular basis)	Potential areas of improvement for the City of Markham's AT guidance / design standards.

Source	Emphasis Area(s)	Road Safety Planning Principles and/or Design Element	Comments/Notes
		Other elements to improve safety for distracted drivers include: • Conducting education and awareness programs targeting the general driving public	
A Guide for Reducing Collisions Involving Young Drivers (2007)	• Young Drivers	Other elements to improve safety for distracted drivers include: • Conducting education and awareness programs targeting the general driving public	Enforcement is the typical solution for young drivers. Potential areas of improvement include: • Considering proven countermeasures in the Planning / Design phase • Enhancing the City's design guidance can be another potential solution.
A Guide for Reducing Collisions on Horizontal Curves (2004)	• Distracted Road Users	Other design elements to improve safety for distracted drivers include: • Delineation, rumble strips for shoulders and centreline, edge drop offs • Prohibit long trucks movement	Potential areas of improvement for the City of Markham's AT guidance / design standards
NCHRP Publications			
NCHRP Report 785: Performance-Based Analysis of Geometric Design of Highways and Streets (2014)	• Intersections • All Roadway Users	Provides a framework to integrate performance-based analysis into planning and geometric design • Use of flexible design approaches to adapt to unique needs (if not fiscally possible or limited ROW to construct roadways to meet design standards) Provides performance measures for design elements and suggests assessing for each design alternatives that are being considered • Presence of bike facility • Crash frequency and severity • Conflict points management • Speed related to crash severity	Potential areas of improvement for the City of Markham's AT guidance / design standards
How to Measure and Communicate the Value of Access Management Guide (2023)	• Intersections • All roadway users •	Provides an Access Management safety toolkit (Access Management Toolkit) • The MedianType.xlsx spreadsheet allows the user to estimate the impacts of median type to safety performance. The tool estimates the number of driveway and non-driveway related crashes that may be expected on four-lane urban/suburban arterials, per median type (i.e. raised / depressed / median crossover / two way left turn lanes etc.) Provides a right- and left-turn lane safety toolkit The right- and left-turn lane safety tool estimates the safety performance of turn lanes and the potential crash reduction when installing a turn lane at intersections, median opening, or driveway. The tool accommodates three- and four-leg intersections	Potential areas of improvement for the City of Markham's AT guidance / design standards
Roadway Cross-section Reallocation Guide (2023)	• VRU • All roadway users	Provides a Cross-Section Decision-Making Toolkit • The Decision-Making.xlsx spreadsheet allows users to evaluate cross-section reallocations for safety. The tool can assess cross-section design alternatives • Outlines streamline process (stepwise) to consider all roadway users by selecting a cross-section that serves everyone from a safety-first perspective. Considers reallocation of roadway space	
Pedestrian and Bicycle Transportation Along Existing Roads ActiveTrans Priority Tool Guidebook (2015)	• VRU	Provide ActiveTrans Priority Tool. • A flexible and data-driven methodology for prioritizing bicycle and pedestrian improvements along existing roads. • The final product is a ranked list and tool that includes community priorities	Potential areas of improvement for the City of Markham's AT guidance / design standards • Can potentially supplement findings of active transportation masterplans by incorporating community inputs

Source	Emphasis Area(s)	Road Safety Planning Principles and/or Design Element	Comments/Notes
US Federal Highway Administration: Guidance for Incorporating Data-Driven Safety Analysis			
Guidance for Incorporating Data-Driven Safety Analysis (DDSA) into: Traffic Impact Analysis, Road Diets, Intersection Analysis (2024)	▪ Intersections ▪ All Roadway Users	Provides high-level overview of how to conduct safety analysis using readily available tools and data, and incorporate into the design process of TIA's, Road Diets and Intersection Operational Analysis ▪ Compare design alternatives from a safety perspective ▪ Cost-Benefit Analysis Some of the Predictive Analysis Tools (guides, softwares, and spreadsheets) ▪ AASHTO HSM and Software ▪ Agile Assets Safety Analysis Software ▪ Crash Modification Factors Clearinghouse ▪ FHWA Interactive Highway Safety Design Model ▪ Numeric ▪ OnSafety Portal ▪ SPF tool	Potential areas of improvement for the City of Markham's AT guidance / design standards
Performance-Based Practical Design (2025)	▪ Intersections	Provides an approach that helps designers to "design-up" and exercise engineering judgement and avoid sacrificing safety for short-term cost savings. ▪ Uses performance-analysis tools to consider short- and long-term project goals and impact to safety, operational performance, and life-cycle costs.	Potential areas of improvement for the City of Markham's AT guidance / design standards
Bicycle Safety Guide and Countermeasure Selection System (BIKESAFE) (2014)	▪ VRUs	Other design elements to improve safety: ▪ Bike-activated signal detection ▪ Signal timing optimization for bicycles ▪ Transit access (i.e. front mounted bike racks for buses)	Further consideration of pedestrians and cyclists in the City of Markham's AT guidance / design standards
Pedestrian and Bicycle Crash Analysis Tool (PBCAT, version 3) (2024)	▪ VRUs ▪	Example of a specific active transportation analysis tool. Crash types (i.e. pre-crash actions) are frequently missing or not well-defined in existing crash databases when motorized road users are involved in collisions with motorists. PBCAT 3 uses information on the pre-crash maneuvers into variables that capture proximal events and conflict types. Provides an approach to identify and target effective safety measures for preventable crash types and develop new safety measures Encourage use of active transportation safety analysis tools in decision-making	Potential areas of improvement for the City of Markham's AT guidance / design standards Emersion of active transportation safety analysis tools that can be implemented in design policies.
Transportation Association Canada Publications			
Access Management: Synthesis of Practice (2024)	▪ Intersections ▪ VRUs	Provides indicators that can be used to incorporate safety in access managements: ▪ Crash Modification Factors ▪ Collision Rate Correlations with Access Configurations with consideration of Operating Speed – Proven improvements after changing from two-way left turn lane into a non-transverasable median ▪ Conflict Point Diagrams (i.e. different driveway alignments, within right-turn lanes) ▪ Collision History Includes effect of factors and its effect on operational performance for cyclists, transit and trucks ▪ I.e. add/increase right-turn deceleration lane, increase signal cycle length, allow RTOR, increase bus dwell time	Potential areas of improvement for the City of Markham's AT guidance / design standards

Source	Emphasis Area(s)	Road Safety Planning Principles and/or Design Element	Comments/Notes
Safety Performance of Bicycle Infrastructure in Canada (2020)	• VRUs • Intersection	Provides safety performance of different bicycle infrastructure facilities (collision risk, collision severity, perceived severity). Facility types include: • Off-road bicycle facility, Off-road multi-use path, Protected bicycle lane (one-way and two-way), Buffered bicycle lane, Painted bicycle lane, Bicycle accessible shoulder, Major street shared lane, Bicycle boulevard, Advisory bike lanes Bicycle intersection treatment types include. Bike box, protected intersections, two-stage turn queue box, and cross-rides have positive outcomes on safety • Protected Intersection • Bike Box • Two-stage turn queue box • Intersection crossing markings • Cross-rides • Bend-in, bend-out approach • Protected signal phase • Gates, fencing, bollards	Potential areas of improvement for the City of Markham's AT guidance / design standards Further consideration of pedestrians and cyclists in the City of Markham's AT guidance / design standards
Ontario Traffic Council Publications			
Vision Zero Guide (2022)	• VRUs • Intersections • Aggressing Driving • Young Drivers • Distracted Road Users	Provide background information and steps required to lead municipalities through the steps required to develop a Vision Zero program. • Adoption of Vision Zero and Safe System approaches require all levels of government to put a priority on road safety. • The shift in culture will enable systematic changes and eliminate road-caused fatalities and serious injuries	City of Markham is currently working on adopting Vision Zero Principles through the creation of the Markham Vision Zero Road Safety Plan
MMLOS Guideline (2022)	• All Roadway Users	Provide a framework to assess the performance of all roadway users within different streets in Ontario.	Not clear in existing plans, policies and guidance is how to approach trade-offs between different modes
Others			
City of Ottawa: Protected Intersection Design Guide (2021)	• VRUs • Intersections	Provides traffic signalization countermeasures for protected intersection implementation: • Leading Pedestrian/Bicycle Intervals • No Right Turn on Red (NRTOR) • Fully protected left-turn phase • Permissive right-turn and right turn overlap phase	
The Effects of Left-Turn Traffic Calming Treatments on Conflicts and Speeds in Washington, D.C. (Hu and Cicchino, 2020)	• Intersections • VRUs	Provides case study showcasing benefits of a hardened centerline treatments • Reduce conflicts between left turning vehicles and pedestrians • Reduce speed of left-turn traffic at intersections	Potential areas of improvement for the City of Markham's AT guidance / design standards
Analyzing the Impact of Median Treatments on Pedestrian / Bicyclist Safety (Zhang et al., 2017)	• VRU	Provide research to quantify the effectiveness of installed median treatments (i.e. fencing) on preventing illegal mid-block crossing behaviour and collision • Significant reduction in total crash count and fatalities • Effective in discouraging the 50% of VRUs that are likely to cross mid-block	Potential areas of improvement for the City of Markham's AT guidance / design standards

Source	Emphasis Area(s)	Road Safety Planning Principles and/or Design Element	Comments/Notes
NACTO: Optimizing Large Vehicles for Urban Environments	▪ VRU ▪ Intersections	Provide Direct Vision approach improvements (high-vision cabs, peep windows) to enhance driver's direct field of vision by reducing large blind spots. ▪ Vehicle downsizing for cities and private businesses ▪ Or retrofit existing fleet with Direct Vision tools	Potential areas of improvement for the City of Markham's policies / standards to incorporate Direct Vision tools
City of Regina: Design Standard Transportation Guide (2022)	▪ Intersections ▪ School Zones	Provide guidance on driveway access permissions based on road classification ▪ Driveways not permitted within 10m of an intersection ▪ Raised centre median is required for collector roads with traffic volume of 15,000 vehicles per day and driveways within 25m of an intersection ▪ Rapid Transit Corridor and School access and HOV corridors guides to access	Potential areas of improvement for the City of Markham's AT guidance / design standards
Town of Innisfil: Transportation Master Plan -Appendix N Roundabout Implementation Guidelines (2022)	▪ Intersections	Provide guidance on planning, design, and implementation of roundabouts in existing and future intersections: ▪ Initial Screening Process (i.e. safety and operation benefits, traffic volume, preliminary life cycle cost estimate, proximity to other signalized intersections / significant environmental areas / VRU areas ▪ Operational Analysis (i.e. based on CRDG and NCHRP Report 672 guidelines, ARCADY, performance measures) ▪ Engineering Design	Provide areas of improvement for the City of Markham's policies / standards to incorporate a standard Roundabout Implementation process

3.2 General Road Safety Countermeasures

Building on the literature review presented in Section 3.1, which discusses industry-established safety countermeasures planning and design, this section presents road safety countermeasures identified through the York Region Vision Zero Traveller Safety Plan (2024) and the City of Markham Active Transportation Master Plan (ATMP) (2021).

These countermeasures have been cross-referenced with the Emphasis Areas outlined in the Section 3.1. **Table 3-2** summarizes the most relevant measures and highlighted are those already identified recommended by the City through the ATMP.

Table 3-2: General Road Safety Countermeasures for each Emphasis Area

Emphasis Area	Countermeasures
Intersections	• *Curb extensions to reduce crossing distances* • *Reducing curb radii to reduce turning speed* • *Narrower lane widths to reduce operating speed (i.e. through lanes, and right- and left-turn lanes)* • Illumination Review and Improvements • Traffic and pedestrian signals • Turn prohibitions • High friction pavement • Sightline improvements • Left-turn signal • Flashing beacons • Offset right-turn lanes • Bike and Pedestrian Signals (i.e. leading pedestrian/bicycle intervals) • Full protected left-turn phase • Permissive right-turn phase • Single Radius with Mountable Zone • Dual Radius with Defined Apron Area • Median Design/Access Management Safety Analysis • Traffic Calming (i.e. left- and right- turn traffic calming) • TIA/TIS Safety Analysis Incorporation • Intersection Control Study (i.e. Roundabout feasibility)
Vulnerable Road Users	• *Increasing the standard sidewalk width* • *Midblock crossing for pedestrians* • *Incorporating curb extensions at side streets* • *Incorporating traffic calming measures in shared cycling facilities to ensure operating speed is less than 30 km/hr* • *Traffic calming measures including diagonal diverters, partial lane closures, traffic circles or mini roundabouts, right-in and right-out diverters, chicanes, etc. as appropriate*

Emphasis Area	Countermeasures
	■ *Horizontal traffic calming measures (i.e. curb extensions or chokers) paired with new midblock pedestrian crossings* ■ Accessible intersection improvements ■ Senior zones and extended walking time at signals ■ Transit pedestrian warning and stop review ■ Safety campaigns ■ Cycling facilities (protected on- and off-road) ■ Target safety and accessibility upgrades at key intersections ■ Enhance pedestrian priority areas (i.e. AODA upgrades, streetscape) ■ Safe crossings for pedestrians (i.e. MPS for high pedestrian volume, pedestrian cross overs PXO for low pedestrian crossing volume) ■ Connecting school sites with accessible pathways ■ Implement linear upgrades to existing cycling facilities to enhance pavement markings, signage and overall comfort ■ Proposed cycling facility types: shared roadway, bike lanes, buffered bike lanes, paved shoulder, protected bike lane or cycle track, MUPs, off road trails ■ Median Treatments (i.e. fencing) ■ Develop an Active Transportation Safety Analysis Tool ■ Regular Use of Cycling Facility Selection Tool (ATMP 2021)
School Zones	■ Narrower lane widths to reduce operating speed ■ School speed reduction and community safety zone ■ School crossings ■ Crossing guards ■ Vehicle exclusion zones within school zones ■ School area and school zone signs ■ Community safety zone signs ■ Traffic calming pavement markings ■ Roadway narrowing traffic calming (i.e. centreline and Edgeline flexible posts and signs) ■ Horizontal deflection (i.e. curb extensions, reduced corner radii, chicanes) ■ Vertical deflection (i.e. speed cushions or humps, raised crosswalks) ■ Ladder crosswalks ■ Crossrides ■ Pedestrian refuge island ■ Pedestrian cross overs (PXOs) within school crossings ■ Parking restrictions and no stopping prohibitions ■ Speed display board ■ Crossing guard program

Emphasis Area	Countermeasures
	▪ Active School Travel (AST) Program
Aggressive Driving	▪ *Narrower lane widths to reduce operating speed* ▪ Automated speed enforcement ▪ Radar speed boards ▪ Red light cameras ▪ Road markings ▪ Warning signs ▪ Safety campaign ▪ Targeted enforcement ▪ Matching design speed and posted speed
Distracted Road Users	▪ Shoulder and/or centreline rumble strips ▪ Enhanced pavement markings (i.e. higher contrast / wider markings / raised pavement markers or RPM) ▪ Guiderail upgrade / installation ▪ Real time data collection for autonomous vehicle readiness ▪ Targeted enforcement ▪ Safety campaign
Young Drivers	▪ Education and enforcement for school-aged children and youth to and from school safety

The range and depth of applicable countermeasures highlight the importance of integrating safety principles across all stages of planning and design, as some could require consideration from the outset. **Section 4** provides recommendations to strengthen how the City of Markham integrates safety considerations throughout the planning and design process.

4. Recommendations

This section outlines the recommendations for the City to consider when enhancing road safety through integrating best practices and safety principles in its planning and design processes. These recommendations build on the findings from the literature review and analysis of current policies and guidelines from the previous sections. The proposed changes are designed to align with the City's long-term goals and create redundancy through the Safe System approach, so that every stage within the planning and design process integrates safety principles.

4.1 General Recommendations to Planning and Design Approaches and Standards

Key areas of improvement in the City of Markham's policies and planning guidelines were identified in **Section 2**. General recommendations to bridge these gaps include:

- Consideration of Integrating Road Safety Analysis into Technical Studies, Capital Projects (Major and Minor Capital Projects), Planning, Development and Subdivision Projects
  - Incorporate road safety analysis tools (i.e. Road Safety Audits and Road Safety Reviews) when conducting Traffic Impact Study and/or Traffic Impact Assessment procedures.
  - Consider other proven safety analysis tools used in the industry or other municipalities, such as Crash Modification Factors, Cycling Modification Factors and Data-Driven Safety Analysis for studies and projects that are applicable (see **Table 3-1** for more examples).
  - Consider updating the City's current TIS Guidelines to incorporate these changes.
- Consideration of Applying Road Safety Analysis in Planning and Design
  - Have a clearer set of policies and/or guidelines that incorporate safety at the onset of every project and further integrate it within each stage of the process instead of conducting a general check at the end of the lifecycle of a project. The proposed addition of the "Road Safety Practices" in **Section 4.6** to the City of Markham's Engineering Design Criteria could serve as a starting point for outlining more specific and actionable guidelines and policies. Road Safety Audits can be considered on a case-by-case basis, but it is generally recommended that it is applied during multiple stages of the project life cycle (i.e., planning or feasibility, preliminary design, detailed design, and construction or pre-opening) considering that the depth and specificity of recommendations will vary with each design milestone. Refer to **Section 4.2** for more information.
- Consideration of Emphasizing Road Safety within Engineering Design Practices

  - Include other road safety aspects that provide value in the Planning and Design process. These includes a regular consideration of protected intersections within existing or future intersections, traffic calming in community safety zones or school safety zones, provision of active transportation facilities in areas of demand, transit-oriented design for dedicated bus lanes, roundabouts and/or traffic circles, enhancement pf signage placement and pavement markings.
  - Include latest industry recommendations in the Engineering Design Standards and Criteria / provide regular criteria updates. These include the consideration of lowering design speed and posted speed, reducing curb radii, narrowing lane widths of curb lanes and general-purpose lanes, sight distance requirements for various scenarios, where applicable. Mitigation measures for scenarios where there are specific restrictions should also be taken into consideration.
- Consideration of Referencing and Citing Engineering Design Standards and Guidelines
  - Use/cite the Engineering Design Criteria Standards and Guidelines and establish a requirement for a Design Criteria Summary Sheet per project when preparing designs for both capital and minor projects moving forward
  - Having clear and consistent references between the guidelines through various iterations will ensure that municipalities are conforming to design policies and standards.

4.2 Major and Minor Capital and Development Project Processes

The City of Markham is recommended to develop a process that integrates Road Safety Audits or In-Service Road Safety Reviews into the planning and design phases for both major and minor capital infrastructure projects.

These projects can be categorized into five main categories:

- New road construction projects
- New transportation construction projects
- Subdivision projects
- Traffic calming projects
- Existing road improvements (rehabilitation and retrofit) projects

There are typically four key stages within the planning and design stages where road safety audits and/or in-service road safety reviews can be conducted for infrastructure projects of all sizes:

1) Feasibility Stage 2) Preliminary Design 3) Detailed Design 4) Pre-Opening

Although additional opportunities exist during the design and construction stages, they are not included in this recommendation.

The following types of road safety audits are identified for major infrastructure projects including new road construction (i.e. road widening, extensions, lane configurations); minor infrastructure projects including existing road improvements (i.e. road rehabilitation and retrofit) and traffic calming measures (i.e. pavement markings, signages, bollards, horizontal and vertical deflections, etc.); and development driven projects (i.e., subdivisions).

Major Capital Infrastructure and Development Projects

1. Planning / Feasibility Stage
2. Preliminary Design
3. Detailed Design
4. Pre-opening

Minor Capital Infrastructure Projects

1. Preliminary Design
2. Detailed Design

4.2.1 Planning / Feasibility Audit

Planning and feasibility audits are conducted at the earliest stage of the design and subdivision process when fundamental aspects of the project are still being developed. At this point, many major elements of the project are flexible, allowing for significant changes that can improve road safety. These audits are designed to identify potential safety risks early on, when modifications can be most easily incorporated into the design.

Key elements of the project that can still be modified at this stage include:

- Road alignment – adjusting the curvature or straightening the road to improve safety
- Intersection spacing – ensuring proper distances between intersections
- Transit needs – identifying existing transit facilities and determine if new/improved infrastructure are needed
- Active Transportation needs – identify existing AT facilities and determine if new/improved facilities are needed
- Number of lanes – deciding the number of lanes and appropriate arrangement
- Stop control – determining appropriate locations for stop signs or traffic signals
- Access management – planning entry and exit points to prevent accidents and minimize conflict points
- Design criteria – deciding on road classification, right-of-way width, design speed, and stopping sight distances to ensure safe operation for all roadway users

4.2.2 Preliminary Design Audit

The Preliminary Design Audit takes place after the initial project concepts have been established, during the development of the preliminary design drawings. At this point, a more detailed examination of the proposed design elements is necessary to assess their safety performance. This audit focuses on how different design features, such as road geometry and traffic controls, interact with each other and affect overall safety.

Key design elements reviewed during this stage include:

- Cross-section dimensions – ensuring proper lane widths, shoulder widths, and medians
- Lane channelization and configuration – assessing the arrangement of lanes and if designated lanes are appropriate for turning and through traffic
- Horizontal and vertical alignments – evaluating the curvature and slopes of the road to improve vehicle visibility
- Sight distances – Analyzing if sightlines are adequate on crest and sag curves to ensure drivers see potential hazards in advance
- Design consistency – ensure all elements of design are consistent with each other and conform to industry standards and guidelines
- Roadside hazard management – identify potential roadside hazards (i.e. trees or utility poles) and consider mitigation measures like barriers or clear zones
  - City confirmed potential interest in developing a formal Roadside Hazard Management policy or guideline
- Transit facilities – identify design options to support transit services (access, routing, stop locations)
- Active transportation facilities – identify design options and configurations to support pedestrians and cyclists (i.e., sidewalks, multi-use paths, shared roads, on-road bike lanes, in-boulevard cycle tracks), with reference to the City's MTMP and ATMP.
- Road user interaction – assess how different types of road users (i.e. drivers, pedestrians, cyclists, transit) are accommodated and how might they react with the design elements

4.2.3 Detailed Design Audit

The Detailed Design Audit is conducted once the preliminary design elements have been reviewed and finalized. This stage is focused on refining the design to enhance road safety and operational efficiency. While the design elements from the preliminary stage are typically set, the detailed design audit provides an opportunity to incorporate additional safety measures and fine-tune the project.

Key design elements that are reviewed in the detailed design audit include:

- Delineation and pavement markings – ensuring lane markings, pavement markings, warning and regulatory signages follow standards

- Traffic signal timing and phasing – optimize and ensure that risk of accidents is minimized, particularly at intersections
- Traffic calming measures – consider and/or evaluate the placement of traffic calming measures (i.e. horizontal and vertical deflections) to improve safety and reduce vehicle speeds
- Illumination – ensuring that intersections and corridors are adequately illuminated at the appropriate locations
- Transit design – finalize transit-related facilities (transit stops, amenities, accessibility, and multimodal integration)
- Active transportation design – finalize the design and configuration for the recommended AT facilities

4.2.4 Pre-Opening Audit

Pre-opening audits is conducted once construction is complete, but before the project is opened to the public. This on-site inspection serves to verify that all safety design elements, as outlined in the final design plans, have been properly constructed and are functioning as intended. The audit ensures that the project is fully prepared to operate safely for all road users once it is open.

Key activities in this audit include:

- Verification of construction accuracy – ensuring all safety features specified in the final design are correctly installed and meet the required standards
- Identification of any on-site safety issues – some safety concerns may not have been apparent during the design or earlier stages of construction. This audit provides an opportunity to spot potential safety issues (i.e. unnoticed hazards)
- Review of design changes – Any modifications made to the design based on the prior audits should be re-examined to confirm they have been effectively implemented
- Confirm design compliance – ensure that design components meet the applicable standards and align with the proposed detailed design drawings and specifications.

Table 4-1 summarizes a suggested practice for the range of planning and design project types and the corresponding recommended stages of audits excerpt from TAC The Canadian Road Safety Guide (2021). The safety audits performed for minor projects can be combined for the preliminary and detailed design phase, depending on the scale of the project. Major roads consist of arterial and major collector roads while minor roads consist of minor collector and local roads.

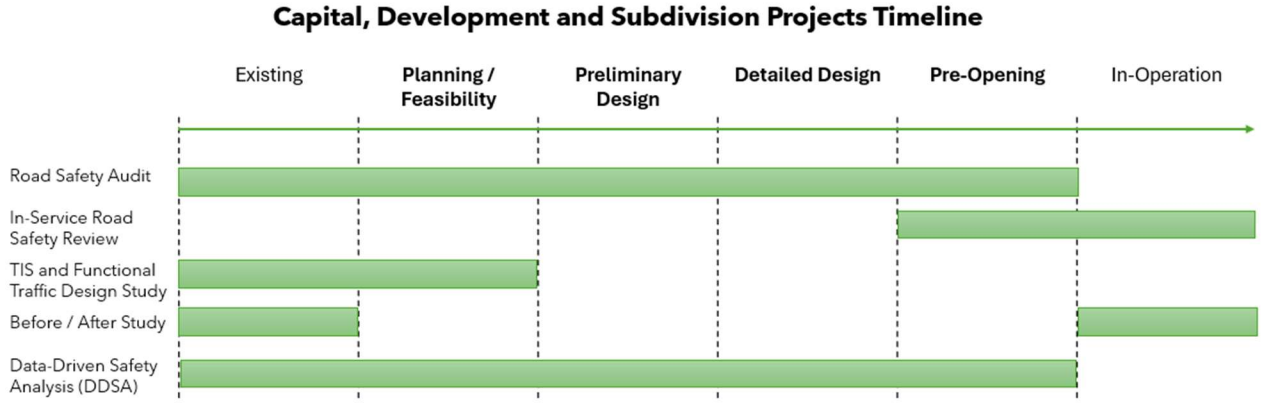
Table 4-1. Recommended Practice for Safety Audit Implementation for Various Projects

Project Type	Audit Stage			
	Planning / Feasibility	Preliminary Design	Detailed Design	Pre-Opening
Major New Road	✓	✓	✓	✓
Minor New Road		✓		
Major Rehabilitation / Retrofit		✓	✓	✓
Minor Rehabilitation / Retrofit		✓		
Major Development (e.g., Subdivision)	✓	✓	✓	✓
Minor Development		✓		
Traffic Calming		✓		✓
Existing Road Improvement		✓		✓

4.3 Capital Project Timeline

A recommended capital project timeline has been developed to assist the City of Markham in identifying suitable road safety analysis tools for each stage of the planning and design process found in **Table 4-2**. It also highlights how complimentary studies or analysis (i.e. Traffic Impact Studies) can effectively integrate into the timeline. This timeline and process will be able to cover all unique requirements and considerations at each design level and phase.

Table 4-2 Recommended Capital, Development, and Subdivision Projects Timeline



4.4 Intersection Control Study Process

An Intersection Control Study Process is a data-driven, performance-based framework that is utilized to identify and screen intersection alternatives and identify the optimal solution for a specific intersection. The City of Markham currently does not follow an Intersection Control Study Process, which can result in inconsistent decision-making when it comes to selecting and implementing the appropriate intersection control measures.

It is recommended that the City of Markham also establish an Intersection Control Study (ICS) process to assess various alternatives for both new and existing intersection locations. This structured approach would provide a systematic way to evaluate the potential benefits and challenges of different intersection control options and ensure that the most effective solutions are based on data and performance measures. It has been proven that roundabouts improve road safety and traffic operations efficiency, therefore, there should be a stronger emphasis on the consideration of roundabouts where feasible and applicable.

The City also lacks established policies and guidelines for the implementation of roundabouts. In the existing City's Engineering Design Criteria (Roads), there is general guidance that roundabouts are permitted but subject to suitability in each situation and should be addressed by a TIS. It is further recommended that criteria for roundabouts should be added to Engineering Standards as they are developed.

Therefore, it is recommended that the City develops a clear criterion for roundabouts to ensure that they are deployed at the most appropriate locations and provides a consistent approach to their implementation. Integrating these criterias into the City's Engineering Standards would further formalize the process. This proactive approach would reinforce the City's commitment to enhancing road safety for all users, while aligning with modern traffic management strategies.

The following breakdown gives a description of the process and steps undertaken under an ICS process.

For new intersections, the study should evaluate alternatives such as stop-control, signalization, or roundabouts. For existing intersections, alternatives may include upgrading stop-controlled intersections to signalized intersections, modifying existing signalized intersections, or converting either stop-controlled or signalized intersections to roundabouts.

Feasibility Planning and Conceptual Designs

The first phase of an ICS involves evaluating the feasibility of constructing or upgrading the intersection. This begins with an initial capacity analysis to assess future peak hour traffic volumes and turning movement counts, which are crucial for identifying the key elements of each alternative. The results of this analysis inform the development of various intersection alternatives, including the determination of required number of lanes, lane configurations, and other key design features.

The conceptual designs for each alternative should be tailored to support traffic operations for a defined horizon year, ensuring adequate capacity during peak hours while avoiding excessive capacity that could lead to unnecessary costs. Safety considerations for all road users should remain a top priority throughout the design process. For roundabouts, the design should prioritize functionality, incorporating appropriate speed control measures and the accommodation of relevant design vehicles. Additionally, the roundabout footprint should be similar in scale to that of other alternatives to ensure consistency and minimize disruptions.

Quantitative and Qualitative Performance Measures

Once a conceptual design for each intersection alternative is developed and approved by the City of Markham, the comparison is recommended to be based on several quantitative and qualitative performance measures that incorporate safety factors.

Quantitative Performance Measures

Quantitative performance measures are measurable and consist of peak hour capacity performance, safety performance, construction cost, and operation/maintenance cost.

- Peak hour capacity performance can be compared using Synchro for stop and signal control, and ARCADY or SIDRA for roundabout control, and using metrics such as predicted delays for motorists, level of service (LOS), 95th percentile vehicle queues in microsimulation models, etc.
- Safety performance can be compared in terms of expected motorist collision rates by using City's latest safety performance functions (SPFs) for stop and signal control, and by using Crash Modification Factors (CMFs) from the Highway Safety Manual or CMF Clearinghouse website to convert either of them to roundabout control. How this is accomplished should be explained in some detail in each individual ICS, as the procedure can be quite complex.
- Construction costs can be estimated for each alternative based on the conceptual designs, and operation/maintenance costs can be assumed. Construction costs should also include estimates for property acquisition. The unit cost estimate approach is a common approach used in Environmental Assessment (EA) and Preliminary Design Studies to compare the high-level costs of each alternative that is being considered.
- Operation/maintenance costs can be compared using typical rates from experience within the City or elsewhere.

Safety performance can be converted into a societal cost. One possible means is to convert motor vehicle collisions by severity to present costs (PC) using a certain discount rate and study period. The formula for a 6% discount rate over 20 years is as follows:

$$\text{PC} = (\text{collision rate})(\text{collision cost})\left(\frac{1.06^{20}-1}{(0.06)(1.06^{20})}\right)$$

The City can use societal costs of $9,200,000 for a fatal collision, $300,000 for a non-fatal injury collision, and $15,000 for a PDO collision, as per the latest industry guidelines in Canada. Over the typical life cycle of an intersection, like 20 years, the accumulated cost of the fatal, non-fatal injury and PDO collisions can be significant.

The rationale for converting safety performance into a societal cost is to monetize as many quantitative criteria as possible so they can be compared directly. The outcome at a high-volume intersection might then look something like what is presented in **Table 4-3**. Here, the hypothetical comparison is widening an already-signalized intersection versus converting it to a multi-lane roundabout.

In this case the roundabout alternative has a higher construction cost by a margin of $600,000, but a lower 20-year study period cost by a present cost (PC) margin of $350,000.

Table 4-3: Typical Quantitative Criteria Results in an ICS

Quantitative Criteria	Signalized Intersection	Roundabout
Peak hour traffic operations	LOS 'C'	LOS 'A'
Collision cost (present cost, over 20 years)	$1,255,000	$345,000
Operation / maintenance cost (present cost, over 20 years)	$60,000	$20,000
Construction / property acquisition cost	$1,250,000	$1,850,000

In a typical assessment, a roundabout alternative will have a lower operation / maintenance cost compared to signalized intersection. Roundabouts require landscape maintenance, and generally require a greater degree of signage, pavement marking and illumination maintenance. However, municipalities must follow Minimum Maintenance Standards with respect to maintaining traffic signals. This means making sure signals are functioning properly and angled so that drivers and pedestrians can see them clearly, promptly replacing malfunctioning or damaged signal infrastructure, and periodically updating signal timing plans in response to changing traffic patterns. The present cost in **Table 4-3** assumes a typical cost associated with traffic signal maintenance of about $5,000 per year. This does not include full replacement after 20 years.

The more significant costs are associated with construction, and the societal costs of motor vehicle collisions over 20 years. It is often the case that a roundabout will cost more upfront to construct, but less in the long run because of fewer expected collisions, and in particular fewer expected fatal and non-fatal injury collisions.

These quantitative criteria are one component to an ICS. It is recognized the peak hour delay has not been monetized. Although some studies do put a cost to motorist delay, it is thought that doing so here would attach undue importance to this one criterion. Off-peak delay is important as well. Also, pedestrian and cyclist safety have not been monetized, mainly because associated societal costs are not available.

Qualitative Performance Measures

Qualitative performance measures are non-measurable and can include broader transportation considerations. These measures include pedestrian and cyclist safety, transit system compatibility, speed control, etc. **Table 4-4** summarizes suggested qualitative performance measures tailored for rural and urban/suburban intersections.

Table 4-4: Recommended Qualitative Performance Measures

Rural Intersections	Urban / Suburban Intersections
▪ Speed control ▪ Environmental considerations ▪ Streetscaping / gateway potential	▪ Pedestrian accommodation ▪ Cyclist accommodation ▪ Transit accommodation ▪ Speed control ▪ Access management ▪ Environmental considerations ▪ Streetscaping / gateway potential

A recommended approach for the City of Markham to compare the qualitative performance measures is by providing descriptions of various alternatives. **Table 4-5** presents a hypothetical comparison between two alternatives: widening an existing signalized intersection and upgrading to a multi-lane roundabout. This comparison highlights the potential outcomes of each alternative, providing insight into their relative effectiveness in terms of traffic flow, safety, and overall operational performance.

Table 4-5: Recommended Qualitative Performance Measures

Qualitative Criteria	Signalized Intersection	Roundabout
Pedestrian accommodation	There will be accessible pedestrian signals (APS), although pedestrians crossing the major road may not be comfortable with longer crossing distances than before and minimum Walk intervals.	There will be pedestrian crossovers (PXOs), although not all pedestrians may be comfortable walking in front of entering and exiting traffic despite having priority. Rapid flashing beacons (RFB's) may be installed at opening or as a later option.
Cyclist accommodation	The widened intersection will incorporate bike lanes and crossrides on the major road. Left turns to the minor roads (i.e., minor collector and local roads) will be via bike boxes.	Bike lanes will terminate before and resume after the roundabout, with ramps connecting to widened sidewalks.
Transit accommodation	Nearside bus stops. Neither corridor is a future candidate for transit priority.	Nearside bus stops.
Speed control	Motor vehicle speeds controlled only during red signal indication.	Motor vehicle speeds controlled at all times due to the geometry of the roundabout. This will influence speeds a certain distance upstream and downstream.
Access management	There are 2 driveways close to the intersection that are right-turns-only because of a centre median.	The 2 driveways will shift closer to the intersection because of the roundabout footprint, but vehicle speeds past them will be lower.

Qualitative Criteria	Signalized Intersection	Roundabout
Environmental considerations	Moderate vehicle fuel consumption and emissions, as a function of delays, start/stop cycles and idling.	Lower vehicle fuel consumption and emissions due to lower delays and uniform traffic speeds. Slightly lower impermeable pavement area.
Accessibility and Equity	Pedestrian crosswalks in signalized intersections are in accordance with AODA standards, including tactile plates, pushbuttons located no more than 1.5m from curbs and with locator tone / vibro-tactile feedback.	The configuration and less commonality of roundabouts can be less accessible for people with disabilities and harder to navigate for pedestrians and cyclists without the provision of proper design.
Streetscaping/gateway potential	Status quo.	More opportunities for decorative paving materials and landscaping because of roundabout central island.

Decision Matrix

The final step of an ICS is to apply a Decision Matrix to synthesize both the quantitative and qualitative comparisons. This will help the City to lead to a conclusion on the preferred alternative. The Decision Matrix follows a structured approach, which can be completed using the following steps:

1. **Identify Intersection Context**: Determine whether the intersection is in a rural or urban/suburban area and, if the former, eliminate the irrelevant rows in the Decision Matrix.
2. **Assign Weights to Performance Measures**: At the outset of the ICS, assign a weight to each performance measure on a scale from 1 to 4 based on its relative importance to the specific intersection. A weight of 1 indicates the performance measure is "important enough to be considered," while a weight of 4 signifies that the performance measure is "very important for intersection control selection." Below is a suggested weighting scheme, with a focus on prioritizing safety and user experience; however, these weights can be adjusted as needed for each location:
    - Weight 4: for collision cost (PC), construction/property acquisition cost, and speed control.
    - Weight 3: for peak hour LOS for motorists, pedestrian accommodation, cyclist accommodation, and transit accommodation.

- Weight 2: for access management, environment considerations, and streetscaping/ gateway potential.
- Weight 1: for operation/maintenance costs (PC).

3. **Assign Scores to Alternatives**: Throughout the ICS process, assign a score of 1 to 5 for each alternative based on the specific performance measure. For quantitative performance measures, scores should reflect the relative differences between alternatives. If two alternatives are being evaluated, the total score for each criterion should add to 6; if three alternatives are being evaluated, the total should add to 9. These scores should be based on the results of both quantitative and qualitative comparisons.

An example of a Decision Matrix for the same urban/suburban intersection discussed in the previous scenario is shown in **Table 4-6**.

Table 4-6: Example Decision Matrix for Urban / Suburban Intersection

Criteria		Weight	Signalized Intersection	Roundabout
Quantitative	Peak hour traffic operations	3	2	4
	Collision cost (PC)	4	1	5
	Operation/maintenance cost (PC)	1	2	4
	Construction/property acquisition cost	4	5	1
Qualitative	Pedestrian accommodation	3	3	3
	Cyclist accommodation	3	4	2
	Transit accommodation	3	3	3
	Speed control	4	2	4
	Access management	2	3	3
	Environmental considerations	2	2	4
	Streetscaping/gateway potential	2	2	4
Total			**84**	**102**

4.5 Recommended Revisions to Engineering Design Guidelines

We have reviewed the City's engineering standards and provided annotated suggestions to include road safety design and design enhancements. An annotated of the engineering standards is attached in **Appendix A** for City review and consideration in next iteration of Design Standards.

Table 4-7 below summarizes the comparative analysis between the findings from the findings from the review of the City's Engineering Design Standards and existing external and industry guidelines to identify next steps and propose recommendations for incorporating safer planning and design principles into the City's guidelines, policies, and procedures.

Table 4-7 Comparative Analysis and Recommendations for the City of Marham's Engineering Design Standards

Emphasis Area	Review of Existing Engineering Design Criteria (Chapter 2)	Literature Review (Chapter 3)	Recommended Revisions
Intersections	Expand or add section as per additional sections below. - Roundabouts (guidance/references). - Access management with cross-reference to TIA/TIS as part of development application and process. - Reference to TIA/TIS Guidelines as outlined in the 2023 TIA Terms of Reference.	- Curb extensions - Curb radii reduction - Narrower lane widths - Turn prohibitions - Provide offset right turn lanes at intersections - Emergency vehicle pre-emption - Bike signals - Leading Pedestrian/Bicycle Internals - No Right Turn on Red (NRTOR) - Fully protected left-turn phase - Permissive right-turn and right-turn overlap phase - Single Radius with Mountable Zone - Dual Radius with Defined Apron Area - Median Design Safety Analysis - Access Management Safety Analysis - Traffic Calming (i.e. left- and right-turn)	Emphasize on incorporating road safety policy and regular practices for safer intersections. Include safety analysis in intersection operation analysis. Expand sections based on the subsections below: - Roundabouts (guidance/references i.e. TAC 2017 Roundabout Guide, NCHRP) - Intersection lighting - Access Management and cross reference to TIA/TIS in development applications Key countermeasures also include: - Roundabouts (guidance/references i.e. TAC 2017 Roundabout Guide, NCHRP) - Protected intersections - Intersection lighting - Access Management and cross reference to TIA/TIS in development applications - Provide offset right turn lanes at intersections - Emergency vehicle pre-emption - Bike signals - Leading Pedestrian/Bicycle Internals - No Right Turn on Red (NRTOR) - Fully protected left-turn phase - Permissive right-turn and right-turn overlap phase - Single Radius with Mountable Zone

Emphasis Area	Review of Existing Engineering Design Criteria (Chapter 2)	Literature Review (Chapter 3)	Recommended Revisions
		▪ TIA / TIS Safety Incorporation ▪ Intersection Control Study Process	▪ Dual Radius with Defined Apron Area ▪ Median Design Safety Analysis ▪ Access Management Safety Analysis ▪ Traffic Calming (i.e. left- and right-turn) ▪ TIA / TIS Safety Incorporation ▪ Intersection Control Study Process
Vulnerable Road Users	Expand on the existing "Sidewalk" section: ▪ Reference City's current ATMP 2021 and Accessibility Design Guidelines 2022 Expand on the existing "Bike Lanes" section: ▪ Reference City's current ATMP 2021 and Accessibility Design Guidelines 2022 ▪ Reference to Signage and Pavement Marking Guidelines for On-Road Cycling Facilities 2019, and Separated Facilities Design Guidelines 2022.	▪ Vehicle Restriction / Diversion Measures ▪ Leading Pedestrian / Bicycle Intervals ▪ Develop Cross-Section / Trade-off Tool (A Guide to Roadway Cross-Section Reallocation) ▪ Median Treatments ▪ Develop an Active Transportation Priority Tool	Emphasize on incorporating road safety policy and regular practices so that the safety of vulnerable road users (pedestrians and cyclists) is included in every key decision point of a project. Expand sections based on the subsections below: ▪ Roundabouts (guidance/references i.e. TAC 2017 Roundabout Guide, NCHRP) ▪ Intersection lighting ▪ Access Management and cross reference to TIA/TIS in development applications Key countermeasures also include: ▪ Protected intersection ▪ Increase of sidewalk width ▪ Midblock pedestrian crossings ▪ Curb extensions ▪ Incorporating traffic calming measures in shared cycling facilities to ensure operating speed is less than 30 km/hr ▪ Traffic calming measures including diagonal diverters, partial lane closures, traffic circles or

Emphasis Area	Review of Existing Engineering Design Criteria (Chapter 2)	Literature Review (Chapter 3)	Recommended Revisions
			mini roundabouts, right-in and right-out diverters, chicanes, etc. as appropriate - Horizontal traffic calming measures (i.e. curb extensions or chokers) paired with new midblock pedestrian crossings - Accessible intersection improvements - Senior zones and extended walking time at signals - Transit pedestrian warning and stop review - Cycling facilities (protected on- and off-road) - Target safety and accessibility upgrades at key intersections - Enhance pedestrian priority areas (i.e. AODA upgrades, streetscape) - Bike-activated signal detection - Leading pedestrian/bicycle intervals - Safe crossings for pedestrians (i.e. MPS for high pedestrian volume, pedestrian cross overs PXO for low pedestrian crossing volume) - Implement linear upgrades to existing cycling facilities to enhance pavement markings, signage and overall comfort - Median Treatments (i.e. fencing) - Transit Access (i.e. Front-mounted bike racks on buses) - Regular Use of Cycling Facility Selection Tool (ATMP 2021)
School Zones	The City has high-level planning documents that provide emphasis	- Narrower lane widths to reduce operating speed	Emphasize on incorporating road safety policies, practices, and a clearer outline of the safety

Emphasis Area	Review of Existing Engineering Design Criteria (Chapter 2)	Literature Review (Chapter 3)	Recommended Revisions
	on Active Transportation to and from school. No dedicated section on School Zones in the Engineering Design Criteria Although, there are brief mentions of: • Posted speed limit within school zones • Recommendation of curb and gutter along school zones • Consideration of school zones when identifying sidewalk locations • Increase of sidewalk width ranging from 2.0m to 3.0m within school zones	• School speed reduction and community safety zone • School crossings • Crossing guards • Vehicle exclusion zones within school zones	countermeasures that should be implemented in school zones. Add a section on: • School Zone Traffic Calming Measures to emphasize road safety Key countermeasures include: • Connecting school sites with accessible pathways • Speed Radar Boards • Gateway Treatments (i.e. signages, pavement marking stencils) • Setback pedestrian crosswalks where applicable (i.e. positioned a short distance away from the intersection for improved visibility) • Advance warning measures (i.e. yield lines, crosswalk warning signs) • Raised crosswalks where applicable • Use of ladder crosswalks and crossrides • Include a regular practice of TIA / TIS for all new school developments
Aggressive Driving	No dedicated section on Aggressive Driving. There are also no brief mentions of aspects of aggressive driving in any other sections	• Narrower lane widths to reduce operating speed • Automated speed enforcement • Radar speed boards • Red light cameras • Road markings	Emphasize on incorporating road safety policy that demotes aggressive driving by applying relevant traffic calming measures. Reference of existing industry guidelines (The Canadian Guide to Traffic Calming) is recommended to provide guidance on the implementation of different traffic calming measures.

Emphasis Area	Review of Existing Engineering Design Criteria (Chapter 2)	Literature Review (Chapter 3)	Recommended Revisions
		▪ Warning signs ▪ Safety campaign ▪ Targeted enforcement ▪ Matching design speed and posted speed	Key countermeasures include: ▪ Implement a process that may contribute to aggressive driving and modify as necessary (i.e. posted speed that is too low, poor traffic signal coordination) ▪ Adoption of planned Vision Zero Road Safety Plans into the design guidance
Distracted Road Users	No dedicated section on Distracted Road Users. There are also no brief mentions of distracted road users in any other sections..	▪ Guiderail upgrade / installation ▪ Real time data collection for autonomous vehicle readiness ▪ Targeted enforcement ▪ Safety campaign	Recommendation to add Clear Zone Requirements to mitigate distracted road users. Key countermeasures include: ▪ Shoulder and/or centreline rumble strips ▪ Enhanced pavement markings (i.e. higher contrast / wider markings / raised pavement markers or RPM) ▪ Guiderail upgrade / installation ▪ Real time data collection for autonomous vehicle readiness ▪ Targeted enforcement
Young Drivers	No dedicated section on Young Drivers	▪ Education and enforcement for school-aged children and youth to and from school safety	Key ideas and countermeasures to consider: ▪ Ensure provision of proper signage and pavement markings ▪ Implementation of advance warning signages ▪ Traffic-calming measures (i.e. vertical and horizontal measures) ▪ Advance intersection warning systems (i.e. flashing beacons or dynamic signages)

Emphasis Area	Review of Existing Engineering Design Criteria (Chapter 2)	Literature Review (Chapter 3)	Recommended Revisions
			▪ Wide shoulder and centreline pavement markings ▪ Dedicated right-turn lanes with channelization islands

4.6 Recommended Road Safety Practices

Appendix A includes an annotated version of the City of Markham Engineering Standards, resulting from culminating the findings and recommendations of the above sections. While these recommendations are made, it is important to acknowledge that there must be a cognizant push to implement road safety practices in the planning, design and construction process. Ultimately knowledge and best practices in the field of road safety are constantly evolving and to that end, while the standards are prescriptive to minimum, there should be the push to exceed expectations and/or use of latest industry standards and approaches. This was recently spoken to in the Implementation section of the City's Active Transportation Masterplan (2021) and to this end, it is recommended the City's Design Standards include a philosophy subsection to outline how practitioners should approach a road design. A draft section has been provided in **Appendix A** and is copied below for consideration by the City.

ROAD DESIGN PHILOSOPY

The City of Markham considers safety as a paramount importance for all travellers on the City's roadways. Whether through road reconstruction projects and within new construction, all City infrastructure should consider the needs of all modes of transportation, be it truck, car, walking, cycling, or other modes. In particular, the way urban streets are designed has a significant impact on how vulnerable road users experience the space. Roadways designed from the perspective of accommodating motor vehicles and traffic flow are often hostile spaces for cyclists and pedestrians.

It is recommended that road design practitioners approach all road design with a specific lens of enhancing safety for vulnerable road users. This approach is not to inhibit or detract from the provision for the needs of motorized vehicles; however, designing through this approach will increase the comfort and safety of those travelling by foot or cycling and in turn holistically improve safety on the transportation network for all. This is because many countermeasures to improve the safety and comfort of vulnerable road users relate to the speed of automobile traffic, which is also a significant factor in the consideration of vehicular safety, due to a direct correlation between speed and the severity of crashes. Reducing speed can significantly reduce the risk of collisions and injuries.

The following Engineering Standards include minimum City standards that have been based on past established City practices and standards, with notes/recommendations for the inclusion of latest industry design guidance and tools where applicable; however, as is always the case, knowledge in these fields is constantly evolving and societal demands for certain mobility opportunities change between modes. Therefore, it is expected that when using these standards, practitioners be cognizant to also review the latest applicable industry guidance for consideration by the City.

The following sections provide specifics on each element of road design, however there are certain key overarching design criterion that practitioners are recommended to consider with every project. These will help implement safer road design practices from the outset of a project, rather than trying to retrofit/implement later in a project when there is potentially less opportunity:

- *Designing roadways for a target speed = posted speed = design speed.*
- *Implementing vehicular lane widths that are as narrow as practicable.*
- *Providing dedicated facilities / physical separation for all active transportation.*

- *Implementing corner radii that are as small as practicable.*
- *Reducing crossing distances wherever feasible through the introduction of curb extensions at intersections; and,*
- *Protected movements at intersections.*

A

Appendix A
Annotated City of Markham Engineering Design Standards

Recommendation to include:

Dedicated section on design philosophy prior to the following sections that are specific to specific elements of road construction. This will help establish a founding consideration of road safety even at the very beginning of a design. Draft example section is as follows:

ROAD DESIGN PHILOSOPY

The City of Markham considers safety as a paramount importance for all travellers on the City's roadways. Whether through road reconstruction projects and within new construction, all City infrastructure should consider the needs of all modes of transportation, be it truck, car, walking, cycling, or other modes. In particular, the way urban streets are designed has a significant impact on how vulnerable road users experience the space. Roadways designed from the perspective of accommodating motor vehicles and traffic flow are often hostile spaces for cyclists and pedestrians.

It is recommended that road design practitioners approach all road design with a specific lens of enhancing safety for vulnerable road users. This approach is not to inhibit or detract from the provision for the needs of motorized vehicles; however, designing through this approach will increase the comfort and safety of those travelling by foot or cycling and in turn holistically improve safety on the transportation network for all. This is because many countermeasures to improve the safety and comfort of vulnerable road users relate to the speed of automobile traffic, which is also a significant factor in the consideration of vehicular safety, due to a direct correlation between speed and the severity of crashes. Reducing speed can significantly reduce the risk of collisions and injuries.

The following Engineering Standards include minimum City standards that have been based on past established City practices and standards, with notes/recommendations for the inclusion of latest industry design guidance and tools where applicable; however, as is always the case, knowledge in these fields is constantly evolving and societal demands for certain mobility opportunities change between modes. Therefore, it is expected that when using these standards, practitioners be cognizant to also review the latest applicable industry guidance for consideration by the City.

The following sections provide specifics on each element of road design, however there are certain key overarching design criterion that practitioners are recommended to consider with every project. These will help implement safer road design practices from the outset of a project, rather than trying to retrofit/implement later in a project when there is potentially less opportunity:

- *Designing roadways for a target speed = posted speed = design speed.*
- *Implementing vehicular lane widths that are as narrow as practicable.*
- *Providing dedicated facilities / physical separation for all active transportation.*
- *Implementing corner radii that are as small as practicable.*
- *Reducing crossing distances wherever feasible through the introduction of curb extensions at intersections; and,*
- *Protected movements at intersections.*

B1 ROAD CLASSIFICATION

Roadway classification is established through the Draft Plan approval process, Municipal Class Environmental Assessment process and the transportation studies. A Transportation Study and Traffic Functional Design Study shall be required by the City in order to help determine the roadway requirements. All new roadways within the City's Urban Service Area shall be fully urbanized.

Recommendation to include:

Roads are designed based on geometric standards established by the City of Markham described herein. In situations not covered by the enclosed standards and specifications, the following documents must be referenced:

- *Engineering Design Standard Drawings (City of Markham)*
- *Geometric Design Guide for Canadian Roads (TAC 2017, 2020 with MTO Design Supplement, 2023)*
- *Ontario Traffic Manuals (OTM)*
- *Roadside Safety Manual (MTO, 2023)*
- *Ontario Provincial Standards and Drawings*

Note:
As per the Official Plan 2014, the road classifications listed are:

- *Provincial Highways*
- *Arterial Roads*
- *Collector Roads*

Engineering Design Criteria and the most up to date Official Plan should be consistent and/or build from the Official plan.

Table 1: Road Classifications

Category	Drawing No.	R.O.W. (m)	Pavement (m)	Boulevards (m)	TYPE
Residential Locals	MR2	16.0	8.5	5.0/2.5	Single Loaded
	MR3	17.0	8.5	5.0/3.5	Sidewalk on one side
	MR4	18.5	8.5	5.0/5.0	Sidewalks on both sides
Residential Collectors	MR5	21.5	9.5	6.0/6.0	1-Side Parking
	MR6	23.0	11.0	6.0/6.0	1-Side Parking; shared bike lane
	MR7	24.5	12.5	6.0/6.0	1-Side Parking, bike lanes
Major Collectors	MR8	26.0	14.0	6.0/6.0	Without Central Median
	MR9	27.5	15.5	6.0/6.0	With Central Median
Residential Laneways	MR10	8.5	5.5	1.5/1.5	With Utilities
Industrial/Commercial Collectors	MR11	22.0	10.0	6.0/6.0	Shared Bike Route
	MR12	23.5	11.5	6.0/6.0	Centre Left Turn Lane
Non-residential Laneways	MR13	10.5	7.0	1.75/1.75	Non-Residential

B2 GEOMETRIC DESIGN – HORIZONTAL AND VERTICAL

Residential/Industrial Streets

The following table summarizes the geometric design standards for roadways, based on road classification and design speed. Any deviations shall be accepted by the Director of Engineering.

Recommendation for changes to Table 2:
Consider reducing design speeds for collectors and industrial roadways to match (rather than exceed) posted speeds.

Consider a policy to cap design and posted speeds within the urban area to 50 km/h rather than 60 km/hr.

Consider narrowing the minimum lane width for right- and left-turn lanes from 3.3m to 3.0m, except where YRT will make use of the auxiliary turn lane.

Table 2: Residential/Industrial Streets

Item	Residential Local	Minor Collector	Major Collector/ Industrial
Annual Average Daily Traffic (AADT)	< 2,500	2,501 - 5,000	5,001 - 8,000
Design Speed (km/hr)	40	50	60
Posted Speed (km/hr) - recommended	40	40 - 50	50 - 60
Minimum Stopping Sight Distance (m) **(e)**	45	65	85
Minimum Pavement Width (face-to-face of curb)	Refer to **Table 1**		
Minimum Longitudinal Grade (Urban) **(c)**	0.7%	0.7%	0.7%
Desirable Minimum Sag Curves (K Values)	7	11	20
Minimum Sag Curves (K Values) for Stop Conditions **(a)**	4	6	10
Desirable Minimum Crest Curves (K values)	5	10	20
Minimum Crest Curves (K Values) **(a)**	4	7	15
Minimum Centerline Curve Radius (m) of the travel portion of the roadway (no superelevation) **(c), (d)**	120	150	200
Desired Maximum Grade	6.0%	6.0%	6.0%
Minimum Crossfall	2.0%	2.0%	2.0%

Minimum Lane Widths

	Residential Local	***Minor Collector***	***Major Collector / Industrial***
Through Lane (m)	**-**	*3.0,* *3.3, if buses or larger trucks are expected to use regularly*	*3.0* *3.3, if buses or larger trucks are expected to use regularly*
Right Turn Lane (m)	*-*	*3.3*	*3.3*
Left Turn Lane (m)	*-*	*3.3* *3.0, if adjacent to a center island*	*3.3* *3.0, if adjacent to a center island*

Maximum Lane Widths

	Residential Local	***Minor Collector***	***Major Collector / Industrial***
Through Lane (m)	**-**	*3.7*	*3.7*
Right Turn Lane (m)	**-**	*3.5*	*3.5*
Left Turn Lane (m)	**-**	*3.5*	*3.5*

Notes:

a) *Applicable only if roadway is illuminated.*

b) *"Saw-toothing" of roads or 0.5% road grades is discouraged and shall only be used under specific circumstances with the acceptance of the Director of Engineering.*

c) *0.5% road grade may be considered on a limited basis, if required, subject to accceptance by the Director of Engineering. 0.5% may also be considered in retrofit situtations, if 0.7% cannot be achieved.*

d) *For 90° bends, see detailed drawings.*

e) *Smaller centerline radii may be considered on a site-by-site basis subject to provision of acceptable engineering support information addressing all applicable safe sight line and traffic movement criteria.*

School zones are posted at 40 km/hr.

Vertical Curves

All grade changes for local roads in excess of 1.5% shall be designed with vertical curves. All grade changes for collector (minor/major) roads in excess of 1.0% shall be designed with vertical curves. All intermediate grade points shall be calculated every 10.0 m and shown on the profile along with vertical curve data such as K-value, length and station of tangent intersection (See Table 2). Minimum length of grade changes for 1.5% or less shall be separated by minimum 6.0 m tangents for a local road and 10.0 m for a collector road.

Retaining Walls on Public ROW

Refer to Design Criteria (F2.7) for details regarding retaining walls requirements.

Minimum Gutter Grades

The minimum gutter grade shall be 0.7%, except for bulbs, turning circles and curb radii where it shall be 1.0%. Where 1.0% cannot be achieved in bulbs or turning circles, catchbasins shall be placed at the direction of the Director of Engineering.

Boulevard Grades

Boulevard grades shall generally be 2.0% and may range from 2.0% to 5.0% for all new roads. For retrofit situations, boulevard grades shall be discussed on a project-by-project basis as accepted by the Director of Engineering.

Cul-de-Sacs

Cul-de-sacs shall be designed in accordance with the Standard Drawings. Minimum grade from the centre of the bulb to the curb shall be 1.0%. Minimum grade around curb, within the bulb, shall be 1.0%.

Curb Radii at Intersections

The following table indicates the minimum curb radii at intersections, unless otherwise required by a Traffic Study for specific situations:

Recommendation to include a subsection on 'Intersections' under B2 Geometric Designs:
Intersection spacing shall be established based on providing safe stopping, turning, and crossing sight distances in accordance with the design speed.

An intersection angle of 90 degrees is preferred, but a minimum allowable angle of 70 degrees shall be acceptable.

Gradients on through streets are to have a continuous profile. Maximum and minimum grades at an intersection are 4% and 0.5% respectively.

Recommendation to include a subsection on 'Proposed safety countermeasures at intersections':

- *Protected intersections (i.e. pedestrian refuge areas, protected signal phases, and setback)*
- *Offset right-turn lanes*
- *Median design and access management safety analysis*
- *FHWA incorporation of Data Driven Safety Analysis (DDSA) into intersections*
- *left turn traffic calming*
- *TIA/TIS Safety Analysis Incorporation*
- *Intersection Control Study Incorporation (Roundabouts)*
- *Traffic signal installation*
- *Illumination at intersections*
- *Intersection Control Study Process Incorporation (i.e., roundabout consideration)*
- *Sightline improvements by removing obstructions within pedestrian waiting areas and daylighting triangles (i.e. 2-way stop controlled and high-speed areas)*
- *Left turn lane offset*
- *Left turn signal phases (protected / protected + permissive)*
- *Left turn lanes*
- *Driveway access management (i.e. avoid and remove driveways close to intersections, especially traffic signals)*
- *Left turn traffic calming (i.e. median modification, reduce curb radii)*
- *Turn prohibitions*

Table 3: Curb Radii at Intersections

Intersecting Streets	Minimum Curb Radius
Laneway* with All roadways	6.0* m
Local Roads with All roadways	7.5 m
Residential Collectors with All roadways	7.5 m
All Others including Commercial/Industrial/Institutional roadways	15.0 m or as per Traffic Study

** Laneways designated as 'Fire Access Routes' shall have a minimum curb radii of 7.0 m*

Recommendation for changes to Table 3:
Consider reducing the minimum curb radius for local roads to 4.0-7.0m

Consider the effective corner radius when determining minimum curb radius where feasible based on anticipated truck turning / emergency vehicle requirements

Minimum Sight "Triangle" Requirements

The following table indicates the minimum sight "triangle" requirements, in the form of street line roundings and triangles, for various intersecting roadway situations under ideal conditions. Sight "triangles" shall otherwise be sized according to safe sight distance requirements when conditions dictate.

Table 4: Minimum Rounding/Day-light Triangle Requirements

Road Type	Intersecting Road Type	Minimum Rounding Requirements
Laneways	All	3.0 m
Local	Local, Minor and major Collectors	5.0 m
Minor and Major Collectors	Minor and Major Collectors	10.0 m x 10.0 m (triangle)
Major Collector	Major Collector	15.0 m x 15.0 m (triangle)
All City's Roads/Laneways	Regional Roads	As per the Region

Recommendation to include a subsection on 'Access Management':
Include cross reference to updated TIA TOR / guideline (2023), that incorporates safety consideration in planning and design phases, as part of development applications and projects.

Include reference to available median design / access management safety analysis tools (i.e. NCHRP Paper: How to Measure and Communicate the Value of Access Management).

Avoid/remove access close to intersections especially in 2-way stop control areas and high speed.

Driveways and Driveway Entrances

Driveway entrances and curb cuts shall be in accordance with the Standard Drawings and Curb Cut By-Law 158-93 or latest version thereof. Driveways shall be indicated on the Plan and Profile drawings, Grading Plans and Composite Utility Plans of Subdivisions. For Site Plans, driveway entrances shall be

shown in Site Servicing and Grading Plans.

Driveway slopes shall range from 2.0% and 8.0%.

Residential driveways shall drain towards the street.

Residential driveways shall be straight and perpendicular to the curb and centred opposite the garage door as much as possible.

The location of the residential driveways shall be situated to maximize on-street parking.

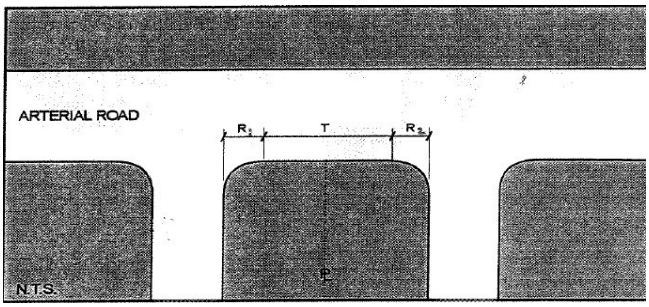
Curb cuts and driveway edges shall be located with a minimum of 1.2 m clearance from all street furniture including light poles, trees, hydro transformers, hydrants, watermain valves and utility pedestals. Deflection of the driveway to accommodate utilities shall not be permitted.

Water boxes shall have a minimum 0.3 m clearance from the driveway edge.

Industrial/Commercial/Institutional driveways shall be graded to ensure that the site drainage is self-contained.

Minimum distance of driveway from an intersection shall be 15.0 m measured from the tangent curb line of the adjacent road intersection and no portion of driveway shall be located within a sight triangle. For retrofit situations, minimum distance of driveway from an intersection shall be checked with City's Traffic Operations staff.

Driveway Spacing: consecutive driveways shall maintain a minimum tangent (T) length between the curb radii (R1 and R2). In general, minimum tangent length varies from 1.0 m to 6.0 m depending on the curb radii. For a standard radii of 9.0 m, tangent length (T) must be 6.0 m or greater. For a standard radii of 15.0 m, tangent length (T) must be 1.0 m or greater.



Driveway Alignment: if there are two driveways opposite and in close proximity to each other, every effort shall be made to align the proposed driveway to the existing or other proposed driveways.

Angle of Intersection: driveways shall intersect with the City's roads as close to 90 degrees as possible.

Radius Encroachment: the curb returns of a proposed driveway shall not encroach/pass the adjacent property line. An imaginary extension of a property line to the curb may be necessary to determine an appropriate limit for the curb returns.

B3 PAVEMENT DESIGN (ROADWAYS AND LANEWAYS)

A Geotechnical investigation shall be conducted by a licensed Geotechnical Engineering firm. Copies of the soil analysis, along with proposed road designs, shall be submitted to the Director of Engineering. (See Section I)

Minimum thicknesses of asphalt and granular materials are outlined in the following table that may be increased on a situational basis on the recommendations of a qualified Geotechnical Engineer. Thickness is measured in a compacted state.

Table 5: Minimum Pavement Thicknesses

Category	Surface Course Asphalt	Base Course Asphalt	Granular 'A' or 20 mm CRLS* Base	50 mm CRLS* Sub-base**

Residential	40 mm HL3	75 mm HL8 (1 lift)	150 mm	300mm
Collector and Industrial	50 mm HL3	100 mm HL8 (2 lifts)	150 mm	450 mm

** **CRLS** means crusher run limestone.*

*** Granular 'B' materials, if specified in place of 50 mm CRLS, will require Geotechnical Report specifying Granular 'B' depth*

In all cases:

- Asphalt job mix designs, approved by the Owner's Geotechnical Engineer, shall be submitted to the Director of Engineering a minimum of fourteen (14) working days prior to the commencement of paving for review

In all cases:

- Asphalt job mix designs, approved by the Owner's Geotechnical Engineer, shall be submitted to the Director of Engineering a minimum of fourteen (14) working days prior to the commencement of paving for review
- Full pavement structural strength shall be achieved at the base asphalt stage

B4 CURBS AND GUTTERS

- All new streets shall have poured concrete curb and gutter construction
- Curbs and gutters shall be designed and constructed to the most recent City Standards and Ontario Provincial Standards
- Curb depressions are required at each intersection or pedestrian road crossing and at all driveway locations. The width and location of all driveway curb depressions shall conform to the City's Curb-cut By-Law 158-93 (Single Driveway = maximum 3.7 m, Double Driveway = maximum 6.0 m; slopes included, Triple Driveway maximum = maximum 7.0 m, Mutual Driveway = maximum 6.0 m)
- A minimum sub-base of 150 mm of granular material compacted to 98.0% Standard Proctor Density and extending 300 mm beyond back of curb shall be required as a base for all types of curb installations
- A two-stage curb shall be used on residential streets with driveway entrances and rear lanes
- A single-stage curb and gutter may be used along section of roads without driveway entrances, adjacent to parks or school sites, or in industrial Subdivisions
- Roll curbs shall be used for lanes and may be used for site plan developments in low speed applications. The use of roll curb for any other application shall be accepted by the Director of Engineering
- Barrier curb at islands/center medians may be used for parking lot areas and where the use of reverse grades is prevalent
- A 150 mm diameter perforated single wall corrugated (rigid) HDPE subdrain coupled with geotextile sock shall be installed continuously under all curb and gutter
- Concrete shall be a minimum of 35.0 MPA @ 28 days. All concrete shall follow the requirements of OPSS.MUNI 1350 and CSA A23.1 Exposure Class C-2

B5 SIDEWALKS

Recommendation to include:

Reference to the City of Markham's Active Transportation Master Plan (2021) and Accessibility Design Guidelines (2022).

Reference to the recommendation from the City's ATMP (2021) Report that designated Intensification Areas are required to have a minimum 2.0m sidewalks, where practical and feasible, to support higher pedestrian demand. It is also recommended that the City's standard design drawings be updated to reflect this policy change.

Location

Sidewalks shall be constructed as shown on the City's Road Cross-section Standards. The location and extent of sidewalks shall be finalized with the City prior to commencing detailed engineering design. In particular, a sidewalk location plan shall be prepared and submitted for City's acceptance prior to pre-sales of homes and posted in the sales office accordingly.

Sidewalks may also be located in front of homes fronting parks or open spaces. The design of the sidewalk and adjacent grass area may be required to accommodate service, emergency, and fire vehicles (refer to Standard Drawing MP4A).

Generally sidewalks shall be located on the North and East side of the roadways.

In determining which side to locate a single sidewalk, factors influencing pedestrian destinations such as locations of existing and proposed parks, schools, malls and transit routes shall also be considered. Sidewalks shall be constructed on both sides of the roadways surrounding schools, parks, ICI and medium/high density residential areas.

Specification

- Concrete sidewalks shall be a minimum of 125 mm thick with minimum 50 mm granular base and 175 mm thick across driveways with minimum 150 granular base
- Standard width of a sidewalk is minimum 1.5 m. For high density areas, sidewalk width may be in the range of 2.0 m to 3.0 m as per the accepted plans, e.g. sidewalk width shall be increased to 2.4 m when adjacent to a curb, on collector roadways, schools, bus stops, high pedestrian areas and major collectors or arterials roadways as directed by the Director of Engineering
- Concrete shall be a minimum of 35.0 MPA @ 28 days. All concrete shall meet the requirements of OPSS.MUNI 1350 and CSA A23.1 Exposure Class C-2
- Concrete sidewalks that cross commercial and industrial use driveways shall be minimum 200 mm thick
- Sidewalks shall be constructed with a minimum 2.0% cross-fall towards curb. Maximum grades across sidewalks shall be 4.0%; in some circumstances, maximum grades may be 5.0% with the acceptance of the Director of Engineering
- No special bedding requirements are normally necessary where sidewalks are constructed upon earth which has been properly consolidated to 98.0% Standard Proctor Density and has a bearing capacity of at least 75.0 KPA, unless otherwise recommended by a qualified Geotechnical Engineer
- A 6.0 mm plastic underlay sheeting shall be placed on the ground prior to placing concrete
- Sidewalks shall not be constructed on organic soils
- Where fill is required to bring the sidewalk to accepted grade, the fill shall be OPSS- Granular 'A' material compacted to a minimum of 98.0% Standard Proctor Density
- Sidewalks that intersect with a street, cross walk or traffic intersection shall be ramped for accessibility including dropped curb, a clearance slope of 5.0% and maximum of 8.0% and directional lines all in accordance with MR 20, or latest version

B6 TRANSIT CONCRETE PADS AND PLATFORMS

Transit pad and platform locations shall be accepted by the Director of Engineering and the Region of York Transit. The pads shall be shown on all Engineering Drawings, including CUP.

Concrete shall be a minimum of 35.0 MPA @ 28 days. All concrete shall meet the requirements of OPSS.MUNI 1350 and CSA A23.1 Exposure Class C-2.

B7 WALKWAYS

Location of walkways, where required, shall be determined by the City's Planning and Urban Design Department and shall be shown on all Engineering Drawing. Longitudinal grade of walkway shall be 5.0% maximum and cross falls shall range from 2.0% to 4.0%.

B8 LANEWAYS

- Length of laneways shall not exceed 90 m for townhouses (with detached garages) and shall not exceed 120 m for singles (with detached garages)
- If a laneway length exceeds 120 m, then a snow storage notch (as per MR37) is required. The maximum length of laneways shall not exceed 150 m
- Laneways shall be straight. If any deviation such as slight curvature is proposed, the Applicant must provide a turning template (Swept Path Analysis) to the satisfaction of the Director of Engineering
- Laneways shall start and end with public streets. Laneways shall not intersect with laneways
- Public streets shall not end in laneways
- Refer to ML10 for grading details at the intersection of laneway and public street
- No laneway unit shall front onto Parkland without local street frontage
- No municipal services, except for local storm sewers, shall be allowed in laneways
- No utilities, except for Hydro for streetlights, shall be allowed in laneways
- Streetlights shall be provided on lot lines and they shall not be within the shared driveways
- Garages to be set back a minimum of 0.6 m from Street line
- Typical minimum depth for utilities crossing shall be 1.0 m (to clear subdrains)
- Parking is not permitted on laneways

B9 CYCLING FACILITIES

Recommendation to include:

References to the City of Markham's Active Transportation Master Plan (2021), Accessibility Design Guidelines (2022), Signage and Pavement Marking Guidelines for On-Road Cycling Facilities (2019), and Separated Facilities Design Guidelines (2022).

- Refer to Bicycle Facility Selection Guide for details
- Bike routes shall be provided as per the latest "Cycling, Pathways and Trails Master Plan" or as directed by the Director of Engineering

References to types of cycling facilities:

- *Bicycle lanes – a portion of the roadway that is designated for cyclists where pavement marking is*

the separation used (i.e., can be conventional (solid white line) or buffered (additional horizontal separation)

- *Physically separated cycling lanes – a portion of the roadway that is designated for exclusive cyclist use and is separated from adjacent motor vehicles by a horizontal and separation elements to restrict traffic encroachment*
- *Cycle tracks – physically separated bikeway "in-boulevard" that is horizontally and vertically separated from the travelled portion of the roadway by a curb and buffer*

Recommendation to further emphasize cyclist safety:
References to industry standards OTM Book 12, 15, and 18 should be included when applicable when providing design guidance.

Recommendation to include a subsection on 'Proposed safety countermeasures for cyclists':

- *Bike-activated signal detection*
- *Signal optimization for bicycles*
- *Leading pedestrian/bicycle intervals*
- *Cross section decision / trade off tool*
- *Encouragement of physically separated bike lanes*
- *Transit access (i.e. island platforms)*
- *Active Transportation (AT) priority tool*

Recommendation to material specifications designing cycling facilities:

- *Lane width for a shared bike route shall be 4.5 m*
- *Lane width for a dedicated bike lane, along curb lane, shall be 1.5 m*
- *Lane width for a dedicated bike lane, adjacent to a parking bay, shall be 1.8 m*
- *Lane width for cycle track shall be a minimum of 1.5 m and a desired of be 2,0 – 2.5 m*
- *Buffer width for cycle tracks within a posted speed limit of less than or equal to 50 km/h shall be a minimum of 0.3 m and a desired of 0.6 – 1.0 m.*
- *Buffer width for cycle tracks within a posted speed limit of 60 km/h shall be a minimum of 0.3 m and a desired of 0.6 – 1.0 m.*

Recommendation to include Cycling Facilities Design Criteria

- *Should include reference to the City's 2021 ATMP and Accessibility Design Guidelines 2022, Signage and Pavement Marking Guidelines for On-Road Cycling Facilities 2019, Design Guidelines for Separated Facilities, MUP, and Trail*
- *Recommendation to further expand on cyclist safety*
- *Cross-section design should emphasize separation of vehicular traffic and cyclist / buffered bike lanes or cycle tracks (from existing City of Markham guidelines).*
- *Sample design sheets / standard drawings should be added and referenced.*
- *Include other industry references: OTM Book 12, 15, and 18.*

Refer to the following City's guidelines:

- *ATMP Cycling Facility Selection Tool (2024)*
- *Bicycle Facility Selection Guide (January 2012)*
- *Bicycle Facility Design: Guideline Toolbox for Intersections (May 2012)*
- *Update reference to City Design Guidelines for Separated Cycling Facilities, Multi-use Paths and Trails*

(February 2022)

Recommendation to include new section 'TIA/TIS'

- *Reference existing TIA 2023 Terms of Reference (TOR) / Guidelines.*
- *Can implement the proposed procedure into a formal policy that this document may reference.*
- *Include implementation of safety reviews at intersections for all new school developments*

B10 IN-BOULEVARD MULTI USE PATHWAYS (MUP)

- *MUP shall be provided as per the latest "Cycling, Pathways and Trails Master Plan" or as directed by the Director of Engineering*
- Standard MUP width shall be 3.0 m unless otherwise accepted by the Director of Engineering
- MUP shall be concrete
- Concrete shall be a minimum of 35.0 MPA @ 28 days. All concrete shall meet the requirements of OPSS.MUNI 1350 and CSA A23.1 Exposure Class C-2.
- MUP shall be constructed with a minimum 2.0% cross-fall towards curb. Maximum grades across MUP shall be 4.0%; in some circumstances, maximum grades may be 5.0% with the acceptance of the Director of Engineering
- Where fill is required to bring the MUP to accepted grade, the fill shall be OPSS- Granular 'A' material compacted to a minimum of 98.0% Standard Proctor Density

Recommendation to include:
References to the City of Markham's Active Transportation Master Plan (2021), Accessibility Design Guidelines (2022), Separated Facilities, MUP, and Trail Design Guidelines (2022).

B11 TEMPORARY TURNING CIRCLES

Temporary turning circles are required where a road will be continued for future phasing of development, but currently dead ends. Temporary turning circles shall be designed in a manner that will minimize future pavement removal, i.e. reverse grade on pavement beyond standard pavement width. Land easements shall be dedicated to the City to facilitate installation of temporary turning circles.

Requirements
- Right-of-way radius - as dictated by temporary grading requirements
- Curb radius: - 14.0 m (residential)
  - 16.0 m (commercial/industrial/institutional)

Permanent sidewalk shall terminate short of the temporary turning circle with a temporary asphalt ramp connecting the sidewalk to the bulb.

Permanent Stage 1 of two stage curb and gutter shall, in general, be installed through the temporary bulb and the permanent position of roadway paved with normal crown elevation and crossfall.

B12 FIRE ACCESS & FIRE LOT

- To ensure access for Fire Department vehicles under all conditions, two access roads, independent of one another shall be provided for subdivision or condominium townhouse developments.
- To ensure water supply reliability, two remote water supply connections are required to the subdivision or condominium townhouse developments.

- If a second access cannot be provided due to landlocked areas or any other reasons, the entire subdivision units to be provided with fire protection sprinklers as per the Ontario Building Code.
- Fire break lots are:
  - every seventh lot, for detached
  - every fourth unit, for semi detached
  - every other block, for townhouse blocks
  - any combination of the above, for a mixed subdivision with detached, semis and townhouse blocks
- Where houses (detached, semis, or townhouse) front a park or open space, each unit is required to have a door at the laneway side that opens directly in the living area of the unit and not the garage.
- Where detached or semis front a park or open space where fences are installed in the laneway, a fire access route is to be installed on the park side adjacent to the access doors to the houses. The fire route is to be 4.0 m of any type of hard surface such as concrete, stone, etc. and 1.0 m on either side of turf stone that will support the fire trucks. These access will require a depressed sidewalk for vehicle access.
- Where detached, semis or townhouse blocks face a street that the distance from the face of the building to the street curb is less than 15.0 m and the area is generally flat with no swales, slopes, holes, or uneven ground, access to these units will be required from the street and not the laneway.
- Where detached, semis or townhouse blocks face a street that the distance from the face of the building to the street curb is more than 15.0 m and /or the area has any swales, steep slopes, holes, or uneven ground, access to these units will be required from the Lane and not the street. Man doors will be required at the laneway as mentioned above.
- Fire hydrants are to be spaced 120.0 m for detached residential units and 90.0 m for townhouse blocks, semi-detached residential units, and commercial/industrial units.
- Where residential laneways exceed 90.0 m in length, and since the City does not permit municipal servicing or hydrants in a laneway, perpendicular streets at 90.0 m apart are required to be introduced to the laneway in order that hydrants can be installed on perpendicular streets at 90.0 m apart to cover the laneway.

B13 STREET NAME AND TRAFFIC SIGNS

The proposed location of signs to be installed shall be included on the Composite Utility Pans (CUP) and Pavement Marking and Signage Plans (PMSP).

Street Name Signs and Mounting of Street Signs

Street name signs shall be placed at every intersection and shall be double sided. These signs shall be placed in the locations and shall be as per the Standard Drawings.

Temporary street name signs, accepted by the Director of Engineering, shall be erected at intersections upon completion of rough grading of the roadways at base asphalt. These signs shall be double-sided and maintained in legible condition until such time as the permanent street name signs are in place.

The mounting of street signs shall be in accordance with the Standard Drawings. Single Post Mount shall be used on all roads, except of mast mounted street signs at signalized intersection.

Traffic Signals

Traffic signal handwells, power service pedestals and conduit shall be designed in accordance with the Standard Drawings. Refer to Section 3.1 of Annex 4 (Traffic Signal Design and Installation Standards).

Traffic signal power service pedestals are also to be indicated on the electrical drawing and the Composite Utility Plan.

Traffic Control Signs

All regulatory signs shall be constructed in accordance with the following specifications, as described in the "Ontario Traffic Manual" (OTM).

Sign Faces

All facing shall be OTM standard reflective sheeting unless otherwise specified.

Colours

OTM standard

Lettering

OTM standard

Sign Blanks

- Ra-1 stop blank (60 cm x 60 cm) 1.63 mm thick 5052H34, 1200S alodine aluminum
- Ra-101 stop blank (75 cm x 75 cm) 2.06 mm thick 5053H34, 1200S alodine aluminum
- Ra-101, stop blank (90 cm x 90 cm) 2.06 mm thick 5052H34, 1200S alodine aluminum
- Rb-1, maximum speed (60 cm x 90 cm) 2.06 mm thick 5052H34, 1200S alodine aluminum
- Rb-51, 52, 53, parking restriction, 1.63 mm thick utility grade aluminum, mill baked white enamel both sides
- All other sign blanks shall be mini spangle galvanized 1.60 mm steel
- All sign blanks shall have appropriate radius corner (40 mm)
- All sign blanks shall have 15 mm x 10 mm slotted holes to accept metric or imperial mounting

Posts

- All posts shall be per Standard Drawings. Metal pole bases, if used, are not to be anchored in concrete
- Existing street light posts may be used where appropriate
- U channels can be used for No Parking, Speed Limit signs, etc.
- Stop signs and street names shall be installed on 75 mm diameter galvanized steel posts

Size

- 60 cm x 60 cm stop signs shall be installed at intersections where the travelled portion of the road allowance is less than 11.0 m
- 75 cm x 75 cm stop signs shall be installed at intersections where the travelled portion of the road allowance is 11.0 m or greater
- 75 cm x 75 cm stop signs (Ra-101) and all-way tabs (Ra-1t) shall be installed at all all-way stop controlled intersections, regardless of the width of the travelled portion of the road

Location

All traffic signs shall be shown on PMSPs and CUPs and installed according to:

- Highway Traffic Act
- Markham By-laws and Standards
- Ontario Traffic Manual, or as accepted by the Director of Engineering

B14 PAVEMENT MARKINGS

Durable pavement markings (Cold Plastic) shall be provided for all permanent stop bars, stop lines, crosswalks, turning arrows, and other traffic control measures as required. Painted pavement markings are required for lane separations, road centerline, turning lanes, bike lanes, island markings, railway crossings, school zones, speed bumps, and other traffic control measures as required.

Pavement markings and signages shall be shown on Pavement Marking and Signage Plans and Composite Utility Plans and shall be in accordance with the latest OPSS requirements.

All road markings shall be maintained by the Owner at no cost to the City until the Assumption of the Subdivision.

All temporary pavement markings shall be provided using Water Base or Organic Solvent Latex paint (dependent on the time of year) and maintained by the Owner following installation of base course asphalt.

For removal of pavement markings, no-abrasive road blasting shall be used.

Yellow centre lines shall also be in cold plastic (do not use traffic paint).

All roads intersecting a collector road shall be provided with a stop bar and crosswalk (if a sidewalk is present) to supplement the stop sign.

All approaches to an all-way stop controlled intersection shall be provided with a stop bar. Crosswalks shall also be provided at each approach, where a sidewalk crossing exists.

Paint Specification for Line Painting

All pavement markings shall be reflective unless otherwise specified.

Water based latex paint shall be homogeneous and shall be well ground to a uniform smooth consistency. It shall be free from skin, dirt and other foreign particles, and shall be capable of being sprayed at the temperature intended for application. These products shall conform to all applicable sections and sub-sections of OPSS 1712, OTM Book 11. Water based paint to be applied between May 1 and October 15 of each calendar year.

Organic solvent based paint (Oil Base) shall be homogeneous and shall be well ground to a uniform smooth consistency. It shall be free from skin, dirt, and other foreign particles, and shall be capable of being sprayed at the temperature intended for application. These products shall conform to all applicable sections and sub-sections of OPSS 1712, OTM Book 11. Organic solvent based paint can be applied between October 16 and April 30 should applications be required.

Durable pavement markings (Cold Plastic) shall be a two-component cold-curing material applied by either spray or extrusion process. These products shall conform to all applicable sections and sub-sections of OPSS 1712, OTM Book 11.

Traffic Paint Reflective Glass Beads shall conform to OPSS Standard 1750-1 and its sub-sections. The pavement markings shall be retroreflective white or yellow, and shall be readily visible as white or yellow when viewed at night.

All products and materials used on the City's roads shall be on the Ministry of Transportation approved list and shall conform to the latest specifications within OPSS and OTM Books 7 & 11.

Recommendation to include the following countermeasures:
Enhanced pavement markings (i.e. higher contrast / wider markings / raised pavement markers RPM)

B15 TRAFFIC CALMING MEASURES

Traffic calming measures may be required as part of the original design of roadways where traffic calming issues are anticipated and in accordance with an accepted Traffic Impact Study. Further, the Owner shall be responsible to implement traffic calming measures up until Assumption of Subdivision, should unanticipated requirements arise after a development becomes occupied.

Markham traffic calming implementation requirements shall be followed according to the "Guidelines for Neighbourhood Traffic Improvement Projects" – September 22, 1998.

For the design and application of traffic calming measures, the "Canadian Guide to Traffic Calming – Second Edition (2018)" by the Transportation Association of Canada, shall be followed.

Recommendation to include a subsection on 'Proposed traffic calming measures' for major (e.g., new road) and minor (retrofit and rehabilitation) projects:

- *Left-turn traffic calming*
- *Traffic calming pavement markings (i.e. stencils, flush medians, edge lines, centrelines, and peripheral transverse bars at appropriate locations).*
- *Roadway narrowing traffic calming (i.e. in road flexible bollards and signs, and road diets where appropriate).*
- *Horizontal deflection traffic calming (i.e. curb extensions, reduced corner radii, chicanes, and traffic circles or roundabouts where appropriate).*
- *Vertical deflection traffic calming (i.e. speed cushions and raised crosswalks at appropriate locations).*
- *Shoulder and/or centerline rumble strips*
- *Speed humps*

Speed display boards

Recommendation to include a subsection on 'Clear Zone Requirements':

Provide guidance on clear zone requirements to mitigate consequences of distracted and errant road users with guidance or reference to TAC 2017 Geometric Design Guide, Chapter 7 – Roadside Design

- *Shoulder and centreline rumble strips*
- *Enhanced pavement markings (i.e. higher contrast / wider markings / raised pavement markings (RPM)*
- *Install or upgrade guiderails and include reflectors and signages*

Recommendation to include a subsection on 'School Zone Traffic Calming':

- *Connecting school zones or school sites with accessible pathways*
- *Vehicle exclusion zones within school zones*
- *Speed radar boards*
- *Provision of ladder crosswalks instead of traditional crosswalk design*

- *Gateway treatments (i.e. signages, pavement marking stencils)*
- *Setback pedestrian crosswalks where applicable (i.e. positioned a short distance away from the intersection)*
- *Raised crosswalks where applicable*

B16 ROUNDABOUTS (TRAFFIC CIRCLES)

Roundabouts are generally permitted, subject to suitability in a given situation as addressed by an accepted Traffic Impact Study. City's criteria for roundabouts shall be added to Engineering Standards as they are developed.

Recommendation to include:

- *Highlight use of Intersection Control Study Process for existing and development projects to identify the cost and benefit of implementing a roundabout.*

B17 PARKING

On-street parking is generally established through the Draft Plan approval process and will be agreed upon prior to submission of Engineering Drawings.

B18 TRAFFIC SIGNAL DESIGN AND INSTALLATION STANDARDS

Refer to Annex 4 for details.

B19 Off-Road Trails and Pathways

- *Trails shall be provided as per the latest Cycling, Pathways and Trails Master Plan, 2009 and Separated Facilities, MUP, and Trail Design Guidelines (2022) or as directed by the Director of Engineering.*
- *Primary and secondary multi-use town wide pathways shall be 3.0 m unless otherwise accepted by the Director of Engineering.*
- *Park pathways shall be 2.0 m unless otherwise accepted by the Director of Engineering.*
- *Informal trails shall be 1.0 m unless otherwise accepted by the Director of Engineering.*

Recommendation to include:
References to the City of Markham's Active Transportation Master Plan (2021), Accessibility Design Guidelines (2022).