

APPENDIX

D TRANSPORTATION AND TRAFFIC STUDY



APPENDIX

D-2 SAFETY REVIEW OF EXISTING CONDITIONS

City of Brampton

**Environmental
Assessment Study of
Arterial Roads Within
Highway 427 Industrial
Secondary Plan Area
(Area 47)
Safety Review of Existing
Conditions**

DRAFT

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CIMA
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1. Introduction

In 2009, the City of Brampton (City) completed a Transportation and Transit Master Plan (TTMP) which was initiated to assess existing and future transportation services within and around the City, including the Area 47, which is bounded by Mayfield Road to the north, Castlemore Road to the south, Regional Road 50 (RR50) to the east and The Gore Road to the west. The recently completed Area 47 Transportation Master Plan Study has supplemented the TTMP and the Peel-Highway 427 Extension Area Transportation Master Plan and recommended an arterial road network within Secondary Plan Area 47. Additionally, the study recommended widening the following corridors:

- + Widening of Coleraine Drive from Arterial A2 to Mayfield Road including realignment at Arterial A2 west of RR50;
- + Widening of Clarkway Drive from Castlemore Road to E-W Arterial to four lanes and urbanizing Clarkway Drive between E-W arterial and Mayfield Road with potential continuous centre turn lane; and
- + Widening of Countryside Drive to four lanes from Clarkway Drive to RR 50 including realignment at RR50.

This report outlines the details of the safety assessment conducted as part of the Environmental Assessment Study of the roadway segments and intersections along the above-noted corridors. The objective of the traffic safety assessment was to highlight any potential high-risk areas and examine any potential impacts that might be expected as a result of widening existing arterials. In addition, mitigation measures for any identified deficiencies were recommended. The safety assessment of the existing corridors includes the following tasks:

- + Descriptive collision analysis to understand the historical patterns and number of collisions occurring within each corridor;
- + Potential for Safety Improvements (PSI) analysis to understand the extent of potential for safety improvements and to identify high risk locations within each corridor; and
- + Field investigation to identify safety concerns within the study area and confirm findings of the collision analysis.

It should be noted that the review of access management along each corridor with reference to the Region of Peel's Access Control By-Law and Road Characterization Study will be provided in a separate Technical Memorandum. This report presents the findings of the safety assessment only. The study methodology, findings, conclusions, and recommendations are documented in this report.

2. Study Area

The study area of Area 47 is bounded by Castlemore Road to the south, The Gore Road to the west, Mayfield Road to the north and Regional Road 50 to the east. A map of the study area is presented in Figure 1.



Figure 1: Study Area Map

Detailed safety assessments were conducted for the corridors subject to roadway widening, including Coleraine Drive, Clarkway Drive, and Countryside Drive. A high-level field investigation was also conducted for Regional Road 50, Castlemore Road, Mayfield Road, and The Gore Road.

3. Data Collection and Review

As a part of this assignment, the City provided the following data:

- + Historical collision data from 2010 to 2014 based on the Motor Vehicle Accident Reports (MVAR) in electronic spreadsheet format;
- + 24-hour traffic volume data for road segments within the study area during the Spring of 2014;
- + Turning Movement Counts (TMCs) for the intersections within the study area during the Spring and Fall of 2009 to the Spring and Fall of 2014. The traffic counts for intersections included classification for three vehicle types (i.e. cars, heavies, and trucks), as well as pedestrian counts; and



- + Monthly and daily factors used to convert the TMCs to Annual Average Daily Traffic (AADT) from Traffic Engineering Software (TES).

As part of this assignment, the above data obtained from the City underwent a rigorous review process for accuracy and completeness.

4. Collision Analysis

One of the essential components of this study was to review and analyze the provided collision data. CIMA undertook the following tasks to complete the collision analysis:

- + Descriptive collision analysis; and
- + Application of Empirical Bayes (EB) method.

The descriptive analysis provides an overview of predominant collision types that have occurred at a specific site, while the EB method is used to: a) quantify the expected safety improvements at a location, and b) establish a priority system to rank a location among other locations with similar characteristics (e.g. 4-legged signalized intersections). The details of the EB methods are provided in Section 4.2 and **Appendix A**.

4.1 Descriptive Collision Analysis

Historical collision data were reviewed to gain an in-depth understanding of any collision patterns and potential contributing factors within the study area. The collision data was analyzed to identify any collision patterns and safety concerns. The results of this analysis are provided in the following sections.

4.1.1 Coleraine Drive Corridor

A total of 100 collisions were identified from January of 2010 to December of 2014 for the roadway segments and intersections along Coleraine Drive. The midblock segments and intersections along this corridor are illustrated in Figure 2, and the total number of observed collisions within this corridor is summarized in Table 1 .

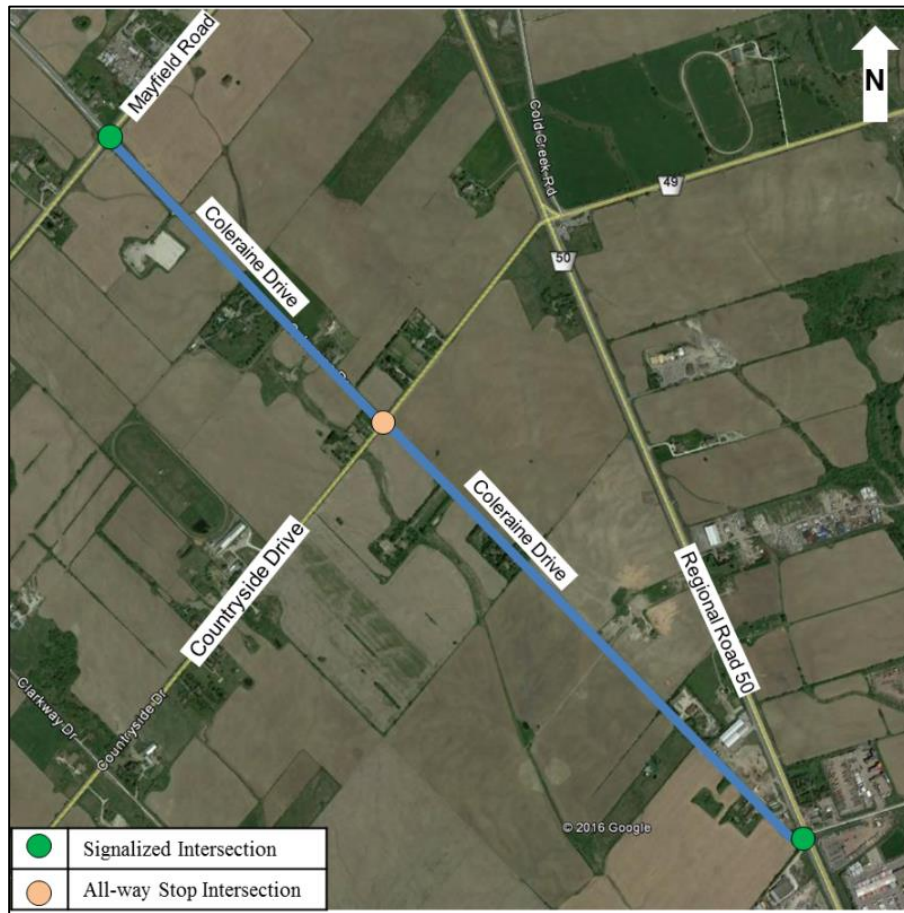


Figure 2: Coleraine Drive Corridor

Table 1: Coleraine Drive Corridor Observed Collisions Summary

Description	Collision Severity			Total Observed Collisions (2010-2014)
	Fatal	Injury	PDO ¹	
Intersection of Coleraine Drive and Regional Road 50	1	22	47	70
Road Segment Between Regional Road 50 and Countryside Drive	0	1	1	2
Intersection of Coleraine Drive and Countryside Drive	0	2	8	10
Road Segment Between Countryside Drive and Mayfield Road	0	0	1	1
Intersection of Coleraine Drive and Mayfield Road	0	4	13	17
Total	1	29	70	100

¹PDO=Property Damage Only

The collision data was further analyzed by intersections and roadway segments to identify any collision patterns. The results of this analysis are provided in the following sub-sections.



Intersection of Coleraine Drive and Regional Road 50

The total number of collisions by impact type is illustrated in Figure 3 while Figure 4 presents the collisions impact type by direction of travel.

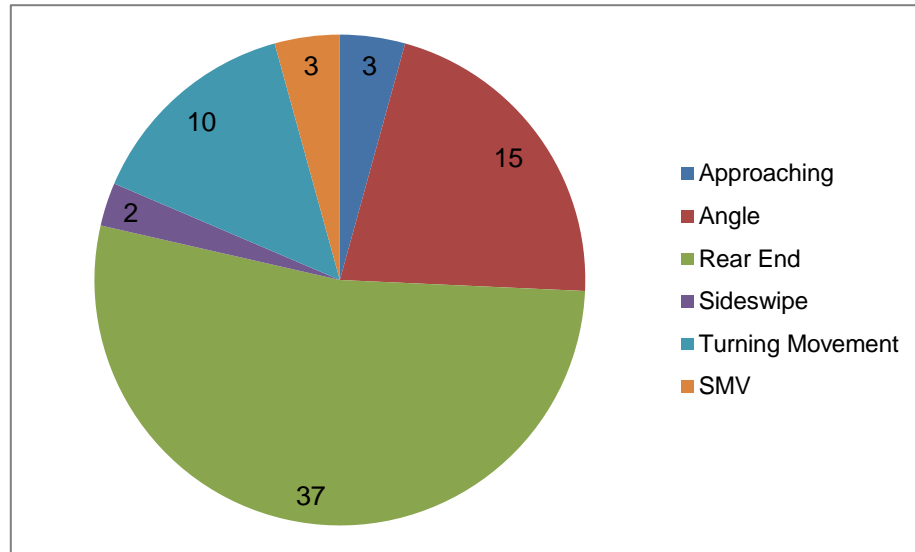


Figure 3: Collision Impact Type (Coleraine Drive and Regional Road 50)

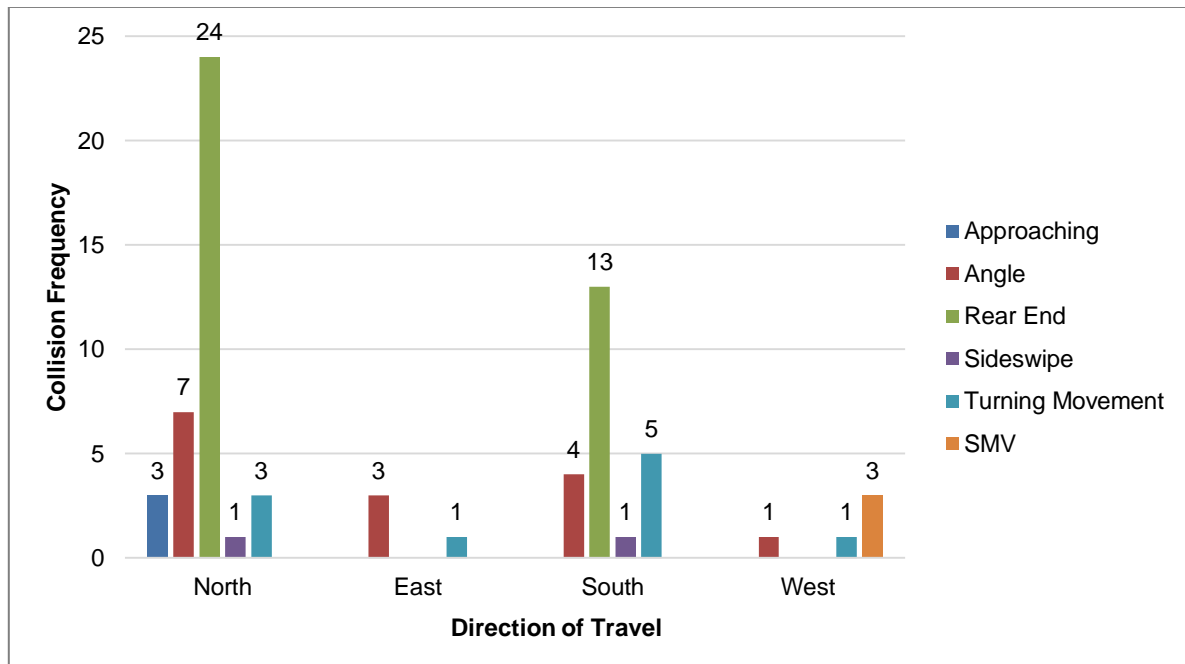


Figure 4: Collision Impact Type by Direction of Travel (Coleraine Drive and Regional Road 50)

Based on the results on the historical collisions at the intersection of Coleraine Drive and Regional Road 50, the following observations and inferences can be made:

- + Rear-end collisions was the predominant collision impact type, with 37 out of 70 collisions (53%), followed by 15 angle (21%), and 10 (14%) turning movement collisions;
- + All of the rear-end collisions occurred on Regional Road 50 along the northbound and southbound directions. 24 collisions occurred in the northbound direction, while 13 collisions occurred in the southbound direction;
- + Further analysis of the collision database revealed that the highest frequency of angle collisions involved northbound vs. westbound vehicles (7 out of 15 collisions). “Disobeyed traffic control” was reported as the main cause of incidents in 9 angle collisions; and
- + Most of the turning movement collisions (8 out of 10) involved a northbound vehicle turning left and a southbound vehicle going through the intersection, and vice versa. “Improper turn, Disobeyed traffic control, and Failed to yield right-of-way” driver actions were reported in 7 turning movement collisions.

Roadway Segment of Coleraine Drive between Regional Road 50 and Countryside Drive

The section of Coleraine Drive between Countryside Drive and Highway 50 experienced 2 collisions within the study period: one approaching and one Single Motor Vehicle (SMV) collision. The collision data did not reveal any collision patterns.

Intersection of Coleraine Drive and Countryside Drive

SMV collisions were the predominant collision type, with 4 out of 10 collisions, followed by 3 angle collisions as illustrated in Figure 5. The majority of collisions (8) occurred during dark condition. It should be noted that 3 out of 4 SMV collisions occurred on wet surface condition.

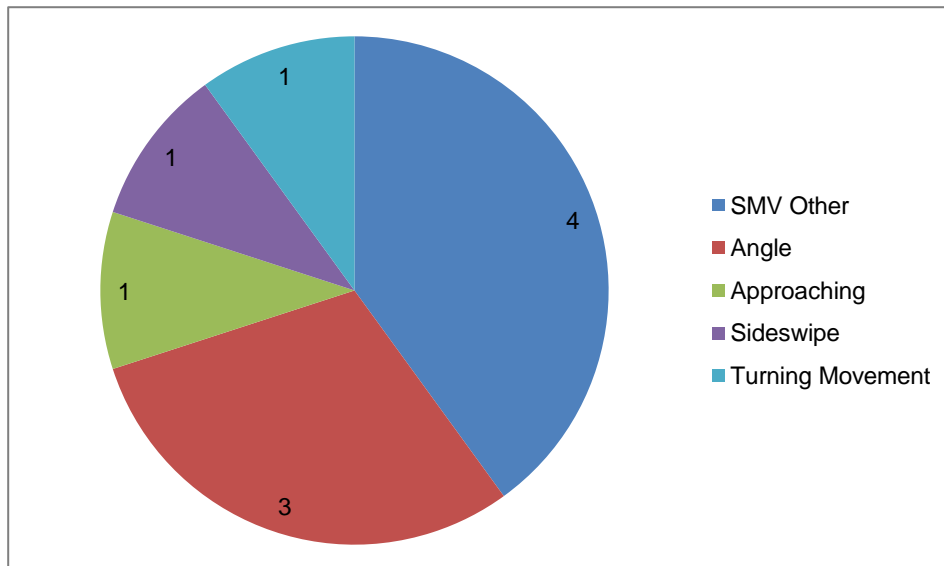


Figure 5: Collision Impact Type (Coleraine Drive and Countryside Drive)



Roadway Segment of Coleraine Drive between Countryside Drive and Mayfield Road

The section of Coleraine Drive between Countryside Drive and Mayfield Road experienced 1 rear-end collision within the study period. The collision data did not reveal any collision patterns.

Intersection of Coleraine Drive and Mayfield Road

The total number of collisions by impact type at the intersection of Coleraine Drive and Mayfield Road is illustrated in Figure 6

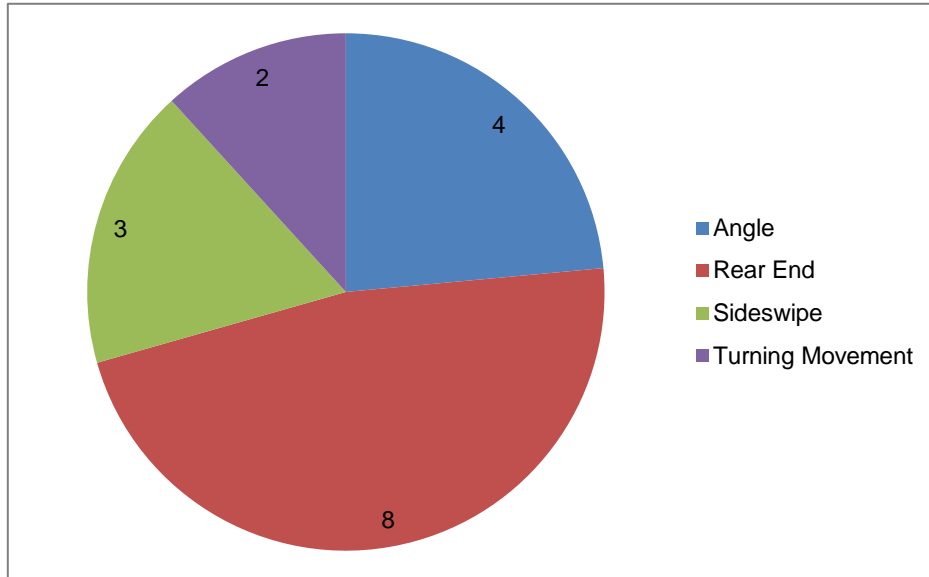


Figure 6: Collision Impact Type (Coleraine Drive and Mayfield Road)

Based on the results on the historical collisions at the intersection of Coleraine Drive and Mayfield Road, the following observations and inferences can be made:

- + Rear-end collisions were the highest collision frequency, with 8 out of 17 collisions (47%), followed by 4 angle (23%), and 3 sideswipe collisions (18%);
- + Wet surface collisions were found to be higher than typically expected, with 8 out of 17 collisions (47%);
- + The majority of rear-end collisions (7) occurred in the eastbound and westbound directions. ‘Following too close’ apparent driver action was reported in 4 collisions. 3 of those 4 collisions occurred on wet surface condition; and
- + “Disobeyed traffic control” apparent driver action was reported in 3 of the 4 angle collisions.

4.1.2 Clarkway Drive Corridor

A total of 13 collisions were identified from the City’s collision database for the roadway segments and intersections along the Clarkway Drive corridor. The midblock segments and intersections along this corridor are illustrated in Figure 7, and the total number of observed collisions within this corridor are summarize in Table 2

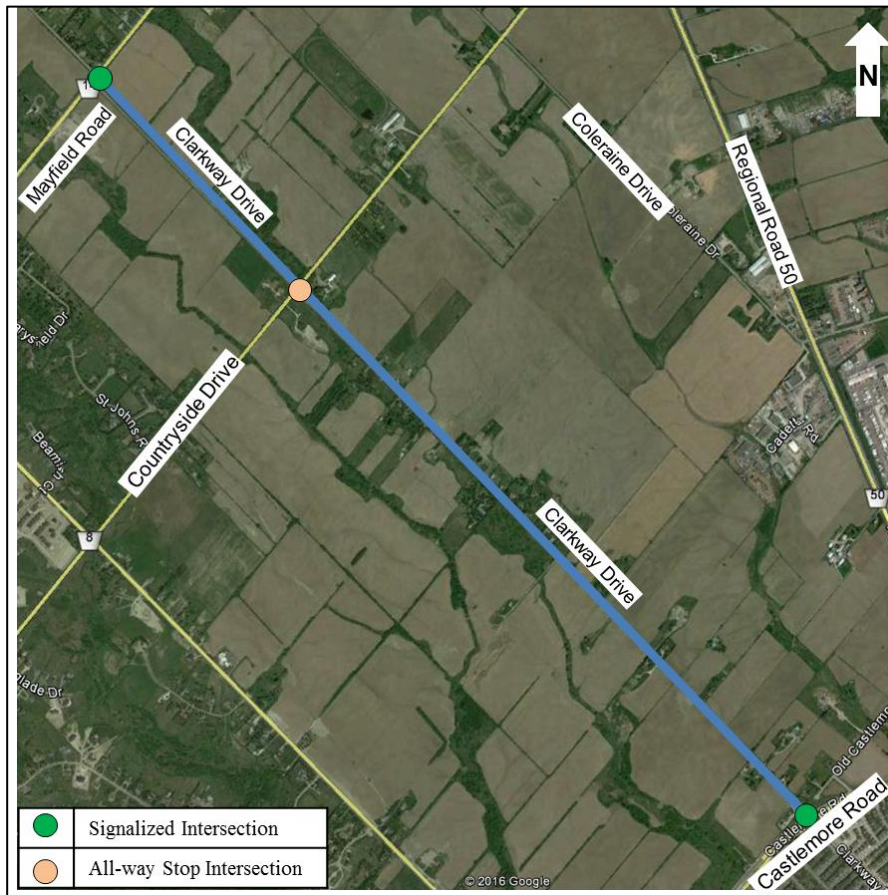


Figure 7: Clarkway Drive Corridor

Table 2: Clarkway Drive Corridor Observed Collisions Summary

Description	Collision Severity			Total Observed Collisions (2010–2014)
	Fatal	Injury	PDO	
Intersection of Clarkway Drive and Castlemore Road	0	2	1	3
Road Segment Between Castlemore Road and Countryside Drive	0	1	1	2
Intersection of Clarkway Drive and Countryside Drive	0	2	4	6
Road Segment Between Countryside Drive and Mayfield Road	0	0	0	0
Intersection of Clarkway Drive and Mayfield Road	0	0	2	2
Total	0	5	8	13

The collision data was further analyzed to identify any collision patterns and safety concerns. In summary, the following observations were made for the midblock and intersections along the Clarkway Drive:

- + *Intersection of Clarkway Drive and Castlemore Road:* In recent years, the intersection of Clarkway Drive and Castlemore Road has undergone major reconstruction. Since the reconstruction of

Clarkway Drive and Castlemore Road, the intersection experienced a total of 3 collisions, all occurring in 2014; however, no other patterns were identified;

- + *Clarkway Drive between Castlemore Road and Countryside Drive:* this section experienced 2 collisions within the study period. The collision data did not reveal any collision patterns;
- + *Clarkway Drive between Countryside Drive and Mayfield Road:* There were no reported collisions during the study period for this section of the roadway;
- + *Clarkway Drive and Mayfield Road Intersection:* This intersection experienced 2 collisions within the study period. The collision data did not reveal any collision patterns; and
- + *Intersection of Clarkway Drive and Countryside Drive:* Approaching and sideswipe collisions presented the highest collision frequency, with 2 out of 6 collisions, followed by the other collision impact types of collisions as illustrated in Figure 8. The collision data did not reveal any collision patterns.

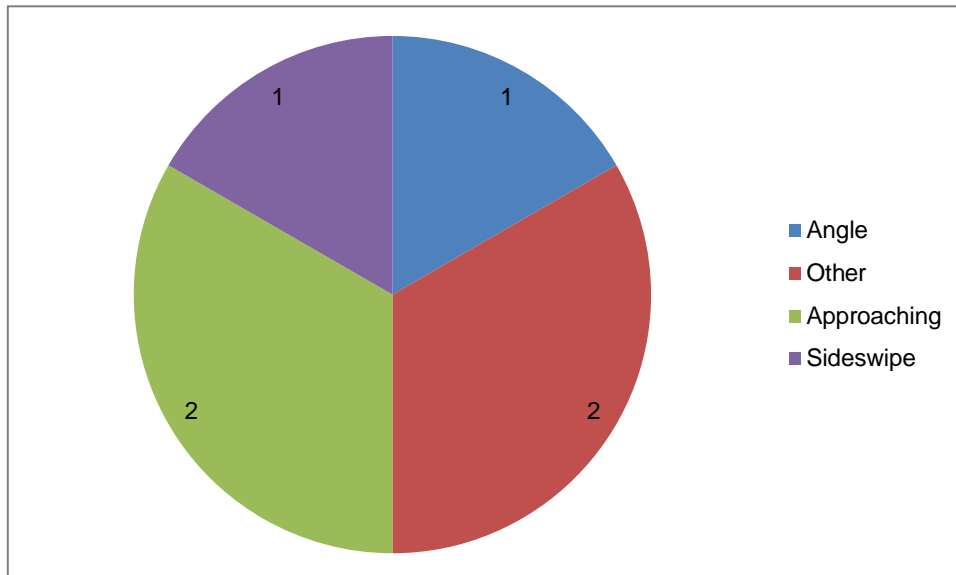


Figure 8: Collision Impact Type (Coleraine Drive and Countryside Drive)

4.1.3 Countryside Drive Corridor

A total of 34 collisions were identified from the City's collision database for the roadway segments and intersections along the Countryside Drive corridor. The midblock segments and intersections along this corridor are illustrated in Figure 9, and the total number of observed collisions within this corridor is summarized in Table 3. It should be noted that the descriptive analyses of the following two intersections along this corridor were discussed in the previous sections:

- + Coleraine Drive and Countryside Drive; and
- + Clarkway Drive and Countryside Drive.

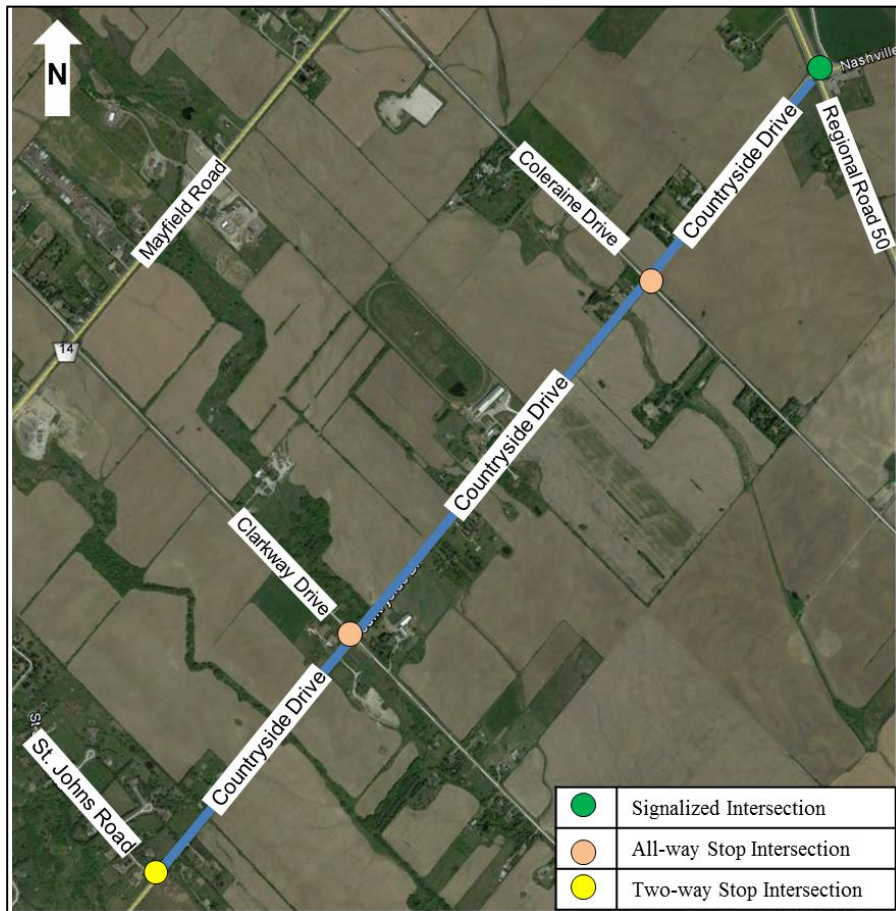


Figure 9: Countryside Drive Corridor

Table 3: Observed Collisions Summary along Countryside Drive

Description	Collision Severity			Total Observed Collisions (2010-2014)
	Fatal	Injury	PDO	
Intersection of Countryside Drive and St. Johns Road	0	0	0	0
Road Segment Between St. Johns Road and Clarkway Drive	0	0	0	0
Road Segment Between Clarkway Drive and Coleraine Drive	0	0	1	1
Road Segment Between Coleraine Drive and Regional Road 50	0	0	0	0
Intersection of Countryside Drive and Regional Road 50	0	12	21	33
Total	0	12	22	34

The collision data was further analyzed to identify any collision patterns and safety concerns. In summary, the following observations were made for the midblock segments and intersections along Countryside Drive:

- + There were no reported collisions during the study period for the following intersection and midblock segments:



- Intersection of Countryside Drive and St. Johns Road;
 - Countryside Drive between St. Johns Road and Clarkway Drive; and
 - Countryside Drive between Coleraine Drive and Regional Road 50.
- + Countryside Drive between Clarkway Drive and Coleraine Drive: This section experienced only 1 collision within the study period; and
- + Intersection of Countryside Drive and Regional Road 50: The total number of collisions by impact type at this intersection is presented in Figure 10, while Figure 11 presents the collision impact types by direction of travel.

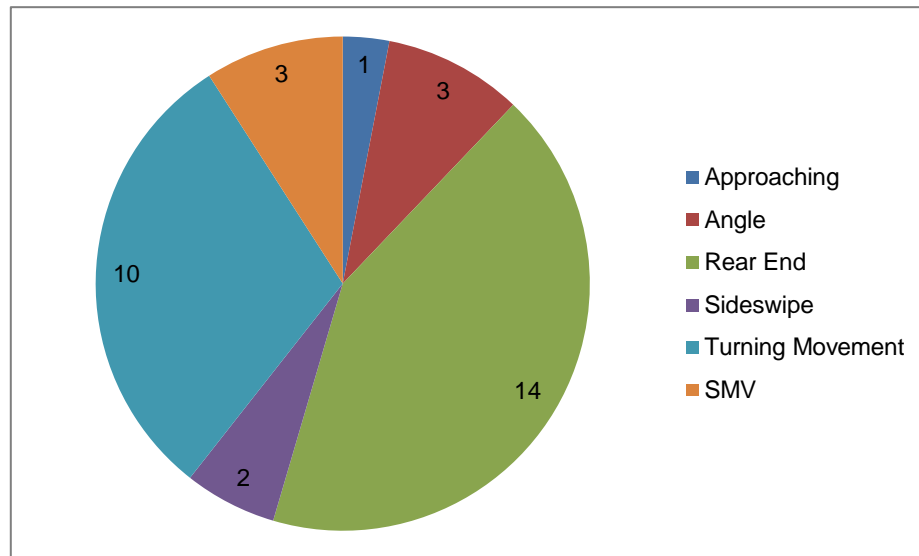


Figure 10: Collision Impact Type (Countryside Drive and Regional Road 50)

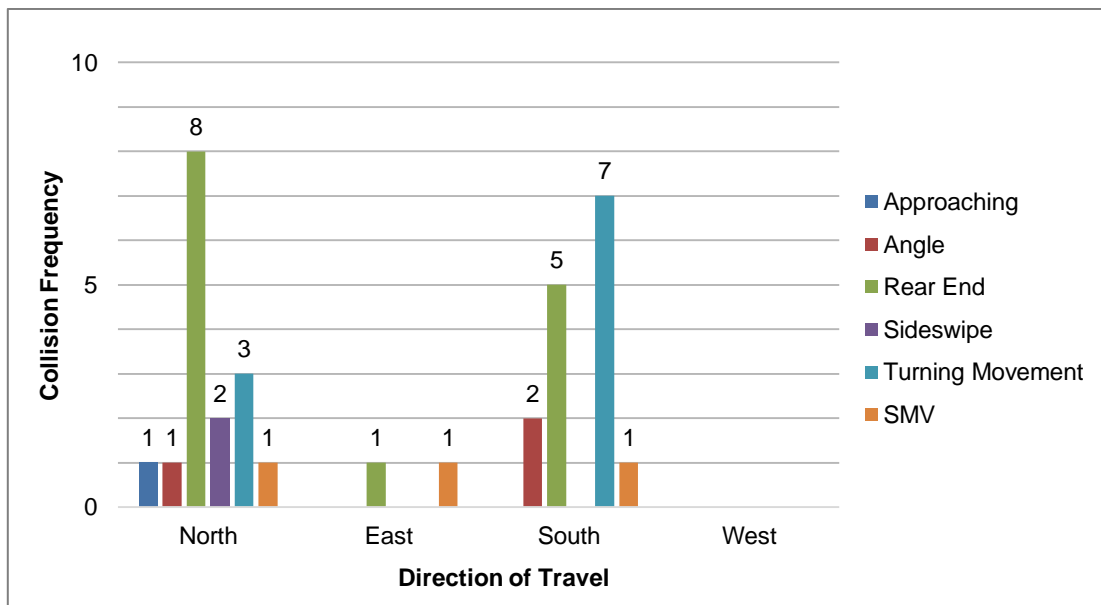


Figure 11: Collision Impact Type by Direction of Travel (Countryside Drive and Regional Road 50)

The following observations can be made from the above figures and the detailed analysis of collisions:

- + Rear-end collisions were the highest collision frequency, with 14 out of 33 collisions (42%), followed by 10 turning movement collisions (30%);
- + All rear-end collisions occurred on Regional Road 50 along the northbound and southbound directions. 8 collisions occurred in the northbound direction while 6 collisions occurred in the southbound direction;
- + The majority of turning movement collisions (8 out of 10 collisions) involved southbound vehicles making a left turn and northbound vehicles going through the intersection; and
- + “Improper turn, Disobeyed traffic control, and Failed to yield right-of-way” apparent driver actions were reported in all turning movement collisions.

While the above descriptive analysis provides a better understanding of the collision attributes within the study area, it is essential to quantify the impact of the collisions on roadway safety. The following sections of the report focus on the quantitative collision analysis using EB method.

4.2 Empirical Bayes Method

The EB method provides an indication of the level of safety at a location by taking into account both the observed number of collisions at the location and the expected number of collisions, based on local available Safety Performance Functions (SPFs). It also accounts for the regression to the mean phenomenon; therefore, providing a better estimate than the number of collisions or the collision rate. The Potential for Safety Improvement (PSI) is then calculated as the difference between the expected number of collisions and the predicted number of collisions from SPFs. The difference of these two values, if positive, indicates that a site can benefit from the safety improvements. PSI analysis was conducted using SPFs developed for Peel Region for the intersections and roadway segments within the study area. **Appendix A** provides the details of the EB method and the adopted SPFs, while the results of the PSI analysis for crash severity and impact type are shown in Table 4 and Table 5, respectively.

Table 4: PSI Calculations based on Crash Severity

Corridor	Location	PSI (5 years)		
		Severe	PDO	Total
Coleraine Drive	Intersection of Coleraine Drive and Highway 50	10.18	21.62	31.80
	Midblock between Highway 50 and Countryside Drive	0	0	0
	Intersection of Coleraine Drive and Countryside Drive	0	0	0
	Midblock between Countryside Drive and Mayfield Rd	0	0	0
	Intersection of Mayfield Road and Coleraine Drive	0.21	0	0.21
Clarkway Drive	Intersection of Castlemore Road and Clarkway	0.10	0	0.10

Corridor	Location	PSI (5 years)		
		Severe	PDO	Total
	Drive			
	Midblock between Castlemore Road and Countryside Drive	0	0	0
	Intersection of Clarkway Drive and Countryside Drive	0.25	0.75	1.00
	Midblock between Countryside Drive and Mayfield Road	0	0	0
	Intersection of Clarkway Drive and Mayfield Road	0	0	0
Countryside Drive	Midblock between Clarkway Drive and Coleraine Drive	0	0	0
	Intersection of Countryside Drive and Highway 50	3.26	0	3.26

Table 5: PSI Calculations based on Impact Type

Corridor	Location	PSI (5 years)					
		Angle	Approach	Rear-end	Sideswipe	Single Motor Vehicle (SMV)	Turning Movement
Coleraine Drive	Intersection of Coleraine Drive and Highway 50	6.13	0.46	20.92	0	1.11	3.32
	Midblock between Highway 50 and Countryside Drive	0	0	0	0	0	0
	Intersection of Coleraine Drive and Countryside Drive	0.13	0	0	0.17	0	0
	Midblock between Countryside Drive and Mayfield Road	0	0	0	0	0	0
	Intersection of Mayfield Road and Coleraine Drive	0	0	1.77	0.55	0	0
Clarkway Drive	Intersection of Castlemore Road and Clarkway Drive	0	0	0	0	0	0
	Midblock between Castlemore Road and Countryside Drive	0	0	0	0	0	0
	Intersection of Clarkway Drive and Countryside Drive	0	0.28	0.22	0.30	0	0
	Midblock between Countryside Drive and Mayfield Road	0	0	0	0	0	0
	Intersection of Clarkway Drive and Mayfield Road	0	0	0	0	0.20	0
Countryside Drive	Midblock between Clarkway Drive and Coleraine Drive	0	0	0	0	0	0
	Intersection of Countryside Drive and Highway 50	0	0	1.07	0	0	1.90



Based on the results of the PSI analysis in Table 4 and Table 5, the following observations can be made:

- + The intersection of Coleraine Drive and Highway 50 can significantly benefit from safety improvements to reduce severe and PDO collisions as well as angle, rear-end, and turning movement collisions;
- + The intersection of Mayfield Road and Coleraine Drive can benefit from safety improvements to reduce rear-end collisions; and
- + The intersection of Countryside Drive and Highway 50 can benefit from safety improvements to reduce severe collisions as well as rear-end and turning movement collisions.

Additionally, the results of the PSI calculations suggest that the intersection of Clarkway Drive and Countryside Drive can marginally benefit from safety improvements. Finally, the PSI values associated with various midblock segments were found to be negligible. It should be noted that the results of the EB collision analysis were found to be consistent with the predominant collision types from the descriptive collision analysis.

5. Field Investigation

CIMA undertook a field investigation on Tuesday February 2, 2016 and Tuesday February 23, 2016 to identify any contributing factors to collisions and/or other potential safety risks not necessarily related to collision patterns. During the field investigation, the study team closely observed conformance, consistency and conditions of site geometrics, traffic control devices, site operations, road user interactions and positive guidance, physical characteristics and roadside safety within the study area. Major findings from the field investigation are summarized below, and further details can be found in **Appendix B**.

- + **Roadside Slopes:** The side slopes of the roadways generally were found to be irregular. Slopes appeared to be steep and unrecoverable within clear zone at some locations;
- + **Roadside Fixed Objects:** The field review identified a significant number of non-breakaway utility poles and fire hydrant within the clear zone;
- + **Narrow Shoulders:** The field investigation noted sub-standard shoulder widths. The widths of shoulders should be made consistent with applicable standards during the upcoming road widening;
- + **Inadequate Guide Rail Protection:** The field investigation noted some existing steel beam guide rail without energy attenuators at approach and/or leaving-ends. Presence of some 3-cable guide rail systems is outdated and should be replaced. Existing steel beam guide rail are lacking in length of need (LON). The guide rail should be extended during the upcoming road widening to protect the vehicles from the water body hazards;
- + **Lack of Pedestrian Facilities:** Limited sidewalks for pedestrians attempting to cross at most signalized intersection; and



- + **Alignment of Pedestrian Signal Heads:** Existing pedestrian signal heads not properly aligned with the crosswalks.

In addition to the above-noted general findings, the results of the field investigation for specific sites are summarized below. Readers are referred to **Appendix B** for detail findings of the field investigation.

- + **Coleraine Drive and Regional Road 50:**

- The intersection is elevated for motorists travelling in the eastbound and westbound directions, which reduced the visibility to upcoming traffic for vehicles turning left going through the intersection;
- A 90-degree turn is located on the west leg of the intersection, which creates a potential safety hazard for unfamiliar motorists with the intersection due to the sudden change in road alignment;
- The right turn radius from Regional Road 50 to Coleraine Drive is not sufficient for heavy truck vehicles;
- A large warehouse driveway is in close proximity of the intersection. During peak hours, heavy vehicles attempting to access the private driveway end up blocking the intersection, causing an extensive queue, and increasing potential turning on red for the waiting vehicles;
- The culverts and the ditches located on both sides of the Coleraine Drive are protected by steel beam guiderails. The steel beam guiderail on the southeast corner has a turned down approach end which can become a vaulting hazard to errant vehicle; and
- Pedestrian facilities do not meet Ontarians with Disabilities Act (AODA) standards.

- + **Coleraine Drive and Mayfield Road:**

- The left-turn lane offsets of east and west legs of the intersection create visibility restrictions to drivers attempting to make a left turn. This is aggravated when large vehicles are in the opposing left-turn lanes attempting to perform the same manoeuvre.

- + **Clarkway Drive and Countryside Drive:**

- The downgrades on different approaches to the intersection could be a potential contributing factor to rear end and angle collisions due to potentially higher speeds. Also, the presence of the crest vertical curve in the north and south legs could restrict the sightlines to upcoming traffic or stopping vehicles while departing the intersection;
- Existing vegetation located on the northwest corner of the intersection reduces sight triangles for motorists travelling in the southbound and eastbound directions;
- The existing steel beam guiderail along the southeast corner do not provide sufficient length of need (LON) to protect motorists from the existing water hazard; and
- The leaving-ends of the existing steel beam guide rails are located within the clear zone for vehicles in the opposite direction of travel without energy attenuators.

+ Clarkway Drive and Mayfield Road:

- Existing pedestrian signal heads on all approaches are not properly aligned with the existing pedestrian crosswalks and sidewalks;
- The intersection of Clarkway Drive at Mayfield Road contains limited sidewalk infrastructure for pedestrians attempting to cross at any of the approaches; and
- Pedestrian facilities do not meet Ontarians with Disabilities Act (AODA) standards.

+ Countryside Drive and St. John Road:

- Missing Checkerboard Sign (Wa-8LR) at St. Johns Road southbound; and
- Missing Intersection Ahead (uncontrolled) (Wa-13) in the eastbound and westbound approach. This sign is used at unexpected or unseen intersections that may present a hazard to through and turning traffic, which most often are needed on rural roads.

+ Countryside Drive and Regional Road 50:

- No concrete bus pad and sidewalk to access existing GO Transit Bus stop;
- Pedestrian facilities do not need AODA standards;
- Malfunctioning pedestrian signal head on the northeast corner;
- Offset alignment of the eastbound and westbound approaches, which creates a potential safety hazard for unfamiliar motorists due to the sudden change in road alignment; and
- Cold Creek Drive is within 30 meters of the subject intersection in the northeast corner. High volumes of heavy vehicles travelling southbound along Cold Creek Drive and attempting to make a right turn into the Nashville Road end up blocking the intersection.

+ Regional Road 50:

- Motorists were observed to be exceeding the posted speed limit of 80 km/h; and
- The existing guide rails located along Regional Road 50 from Castlemore Road to Mayfield Road contain outdated guide rail end treatments, including an eccentric loader and a turned down steel beam. Energy attenuators are preferable.

+ Gore Road:

- Major development and construction are present at the north end of this corridor; and
- Fixed object and exposed culverts appears to be outside the clear zone.

6. Findings and Recommendations

6.1 Summary of Collision Analysis

In order to achieve the objectives of this project, the historical collision data were reviewed to identify the hazardous locations throughout the study area. In summary, the results of the descriptive collision analysis and the PSI analysis revealed the following:



- + Intersection of Coleraine Drive and Highway 50 can significantly benefit from safety improvements to reduce the severe and PDO collisions as well as the angle, rear-end, and turning movement collisions;
- + Intersection of Mayfield Road and Coleraine Drive. can benefit from safety improvements to reduce the rear-end collisions; and
- + Intersection of Countryside Drive and Highway 50 can benefit from safety improvements to reduce the severe collisions as well as rear-end and turning movement collisions;
- + Intersection of Clarkway Drive and Countryside Drive can marginally benefit from safety improvements to reduce the approach, rear-end, and sideswipe collisions as well as severe and PDO collisions; and
- + The PSI values associated with various midblock segments were found to be negligible.

Based on the results of the collisions analysis and our detailed field investigations, the following deficiencies and suggested corrective action were identified.

6.2 Corrective Actions

Corrective actions are opportunities for improvement based on the identification of potential non-conformities, potential inconsistencies, and/or potential shortcomings, relative to prevailing guidance and standards, which exist within the study area but have no direct association with collisions. The following corrective actions are recommended to be implemented during the future construction works.

6.2.1 Flatten and/or Shield Roadside Slopes

The side slopes of the roadway at some locations appeared to be steep and unrecoverable within clear zone. Existing side slopes were considered to be substandard. This means that vehicles encroaching on these slopes would not be able to recover.

A consideration should be given to providing roadside slopes 4:1 or flatter along the entire roadway during the upcoming road widening. Roadside slopes of 4:1 or flatter are known as recoverable slopes and could assist a driver in regaining the control of the vehicle if the vehicle should run off the road, thereby providing additional opportunity for a driver to avoid a collision or reduce the collision severity. As an alternative, shielding slopes using roadside barriers could also be examined in sections where the flattening of slopes is either not feasible or cost prohibitive.

6.2.2 Treatment of Roadside Fixed Objects

The field review identified a significant number of non-breakaway utility poles and fire hydrants within the clear zone. The possible options to treat the fixed objects include replacing the poles with a breakaway base pole, relocating the poles and fire hydrants outside the clear zone, or protecting them with a roadside barrier. Given that the review of the collision history does not reveal any collisions involving fixed objects, we do not recommend any treatment in the short term. However,

during the upcoming road widening, the fixed objects should preferably be located outside the clear zone.

The field review identified some exposed culvert ends and some vertical culvert headwalls within the clear zone. Ideally, culverts and headwalls should not be present within the clear zone. Culverts should be extended outside the clear zone or they could be protected by a guide rail. Headwalls should be made traversable. A slope of 4:1 or flatter is recommended for embankments of intersecting roadways or entrances. The inlet and outlet slope of the culvert should be matched to the embankment slopes, which will result in a smaller target area for an errant vehicle.

The section of the 3-cable guide rail system is installed at the start of the slope. The surface behind the posts should be flattened or the culvert could be extended beyond the clear zone.

6.2.3 Widen the Shoulders

The field investigation noted sub-standard shoulder widths. The widths of shoulders should be made consistent with applicable standards during the upcoming road widening.

6.2.4 Improvement of Guide Rail Systems

The field investigation noted some existing steel beam guide rail without energy attenuators at approach and/or leaving-ends. Energy attenuators should be provided to reduce the severity of potential collisions with the guide rail ends, which may result in spearing or vaulting the vehicles.

The field investigation noted the presence of some 3-cable guide rail system. These systems are outdated and should be replaced, where possible, by steel beam guide rails.

The field review revealed that the length of need (LON) for existing steel beam guide rails are not adequate. The guide rail should be extended during the upcoming road widening to protect the vehicles from the water body hazards. It is noted that the need for guide rails in the long term should be evaluated during the design stages of the upcoming road widening. By widening the road, clear zones will be laterally shifted and may include new hazards requiring protection, or currently existing hazards may be eliminated, either by removal or by introducing proper cross section design.

6.2.5 Improvement of Pedestrian Facilities

The field investigation review revealed some sidewalk limitations for pedestrians attempting to cross at most signalized intersection. The pedestrian facilities should be improved and made consistent with standards during the upcoming road widening.

6.2.6 Improvement of Pedestrian Signal Heads

The field investigation noted some pedestrians signal heads were not properly aligned with the crosswalks. The signal heads should be aligned and made consistent with Ontario Traffic Manual Book 12 Traffic Signals during the upcoming road widening.



6.2.7 Improvement Related to Specific Sites

- + Coleraine Drive and Regional Road 50:
 - Flatten the slope of east and west legs of Coleraine Drive at Regional Road 50;
 - Realign the west leg of Coleraine Drive to improve the existing 90 degree turn located on the west leg;
 - Improve the turning radius for facilitating the northbound and southbound right turn movement for heavy vehicles; and
 - Upgrade pedestrian signals and pushbuttons to meet the Accessibility for Ontarians with Disabilities Act (AODA).
- + Coleraine Drive and Mayfield Road:
 - Improve left-turn lane offset of east and west legs of Coleraine Drive at Mayfield Road (introduce positive offset).
- + Clarkway Drive and Countryside Drive:
 - Reduce the gradient through and approaching to the intersection, consistent with standards, during the upcoming road widening.
- + Clarkway Drive and Mayfield Road:
 - Upgrade pedestrian signals and pushbuttons to meet the AODA standards.
- + Countryside Drive and St. Johns Road:
 - Install Checkerboard Sign (Wa-8LR) at St. Johns Road for southbound motorists approaching the intersection; and
 - Install Intersection Ahead (uncontrolled) (Wa-13) warning signs in the eastbound and westbound approach towards the intersection of Countryside Drive and St. Johns Road.
- + Countryside Drive and Regional Road 50:
 - Install concrete bus pad and sidewalk at the existing GO Transit bus stop for pedestrian accessibility;
 - Improve accessibility of the pedestrian pushbutton located along the southwest in order to meet the AODA standards;
 - Repair the broken pedestrian signal head located on the northeast corner of the intersection;
 - Realign the eastbound and westbound approaches of Countryside Drive at Regional Road 50 to improve visibility of motorists attempting to make simultaneous turns at the intersection; and
 - Realign the Cold Creek Drive due to its close proximity to the intersection of Countryside Drive and Regional Road 50 to provide sufficient space for heavy vehicles attempting to turn right to be serviced by the intersection of Countryside Drive and Regional Road 50.

- + Regional Road 50:
 - Conduct a comprehensive speed study to confirm the benefits and drawbacks of reducing the operating speed on the corridor.

6.3 Closing Remarks

The purpose of this study was to prepare a traffic safety report for existing conditions as part of the EA Study project for the arterial road network within the Highway 427 industrial secondary plan area (Area 47). The report presents a list of safety concerns based mainly on the collision analysis and field investigation. Recommendations proposed for the study area are also documented in the report. Major recommendations for the study area include: flatten roadside slopes, treatment of roadside fixed objects, widen the shoulders, improve guide rail systems, and improve pedestrian facilities. Also, the report provides recommendations related to specific sites within the study area.

As a result of the review, some corrective actions are recommended to be considered during development of design alternatives. The deficiencies identified within the existing corridors would further assist in the selection of the preferred design by assessing the comparative level of effort required to remove these deficiencies from the different alternatives.



Appendix A: Empirical Bayes Method

Empirical Bayes Method: Theoretical Basis

The EB method provides an indication of the level of safety at a location, by taking into account both the observed number of collisions at the location, and the expected number of collision, based on local Safety Performance Functions (SPFs). It also accounts for the regression to the mean phenomenon, therefore providing a better estimate than the number of collisions or the collision rate.

The EB method uses the following equation to calculate the Expected number of collisions:

$$Exp = w \times Pr + (1 - w) \times Obs \quad \text{Eq. 1}$$

Where:

Exp is the total expected number of collisions for the study period (2010 – 2014);

Pr is the total predicted number of collisions obtained from SPFs for the study period which is the sum of predicted number of collisions for each year in the study period;

Obs is the total observed number of collisions for the study period;

w is a weight factor calculated by:

$$w = \frac{1}{1+k \times Pr} \quad \text{Eq. 2}$$

Where:

k is the over-dispersion parameter associated with the SPF used.

The Potential for Safety Improvement (PSI) is then calculated as the difference between the expected number of collisions and the predicted number of collisions. This is shown in Figure 1.

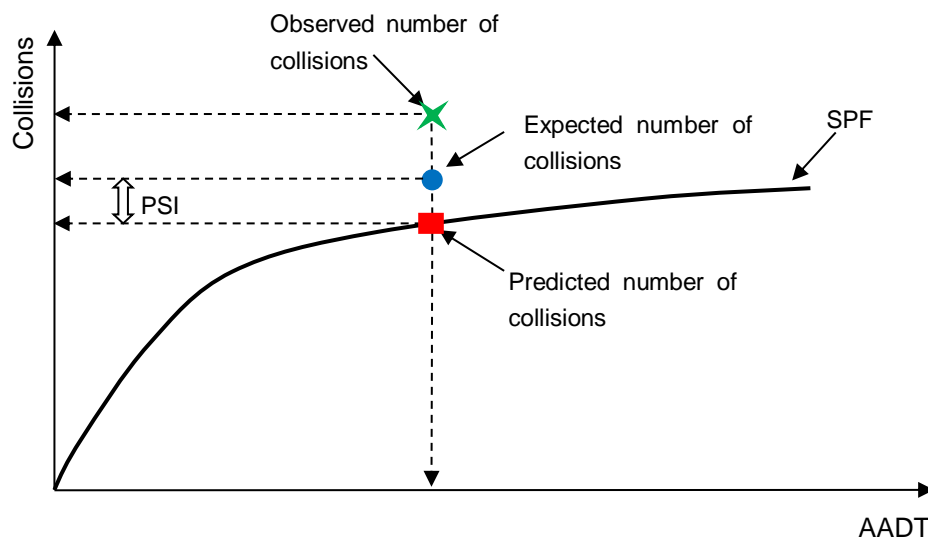


Figure 1: Empirical Bayes Method

Safety Performance Functions

The SPFs were developed for the different intersection and roadway types of the Peel Region network. The adopted SPFs for the four-leg signalized intersections, unsignalized intersection and tow-lane rural roadways are summarized in Table 1, Table 2, and Table 3 respectively.

Table 1: Safety Performance Functions for 4-Legged Unsignalized Intersection

Equation	Collisions	Ln(α)	b	c	k
$E(Y) = \alpha \times F_{maj}^b \times F_{min}^c$	All	-11.6363	0.6546	0.7817	0.2820
$E(Y) = \alpha \times F_{maj}^b \times F_{min}^c$	Severe	-11.2613	0.5507	0.6644	0.2604
$E(Y) = \alpha \times F_{maj}^b \times F_{min}^c$	PDO	-12.4550	0.6950	0.8049	0.2856
$E(Y) = \alpha \times F_{maj}^b \times F_{min}^c$	Angle	-10.9602	0.4368	0.7701	0.3189
$E(Y) = \alpha \times F_{maj}^b \times F_{min}^c$	Head-On	-11.0456	0.4381	0.6691	0.4330
$E(Y) = \alpha \times F_{maj}^b \times F_{min}^c$	Rear-End	-15.3016	0.9250	0.7728	0.3549
$E(Y) = \alpha \times F_{maj}^b \times F_{min}^c$	Side Swipe	-16.0999	0.8155	0.8438	0.4017
$E(Y) = \alpha \times F_{maj}^b \times F_{min}^c$	SMV	-4.3578	-0.29323	0.6810	1.2403
$E(Y) = \alpha \times F_{maj}^b \times F_{min}^c$	Turning Movement	-14.3986	0.7325	0.8134	0.3888

F_{maj} is the major road AADT, i.e. the approach with the higher AADT

F_{min} is the minor road AADT, i.e. the approach with the lower AADT

k , the over-dispersion parameter, is estimated as a constant

Table 2: Safety Performance Functions for 4-Legged Unsignalized Intersection

Equation	Collisions	Ln(α)	b	c	k
$E(Y) = \alpha \times F_{maj}^b \times F_{min}^c$	All	-7.8473	0.3259	0.7619	0.7525
$E(Y) = \alpha \times F_{maj}^b \times \left(\frac{F_{min}}{F_{tot}}\right)^c$	Severe	-5.1151	0.5821	0.5006	0.6490
$E(Y) = \alpha \times F_{maj}^b \times F_{min}^c$	PDO	-9.6164	0.3824	0.8974	0.8633
$E(Y) = \alpha \times F_{tot}^b$	Angle	-2.3965	0.2047	-	1.6857
$E(Y) = \alpha \times F_{tot}^b \times \left(\frac{F_{min}}{F_{tot}}\right)^c$	Head-On	-13.0123	1.3390	0.6135	0.6375
$E(Y) = \alpha \times \left(\frac{F_{maj}}{F_{tot}}\right)^b \times \left(\frac{F_{min}}{F_{tot}}\right)^c$	Rear-End	-5.4444	-5.8408	-1.2946	3.2005
$E(Y) = \alpha \times F_{tot}^b$	Side Swipe	-7.5965	0.6412	-	4.6567

F_{maj} is the major road AADT, i.e. the approach with the higher AADT

F_{min} is the minor road AADT, i.e. the approach with the lower AADT

k , the over-dispersion parameter, is estimated as a constant

Table 3: Safety Performance Functions for King Rural Less Than 4 Lanes

Equation	Collisions	Ln(α)	b	c
$E(Y) = \alpha \times F^b \times L^c$	All	-6.1626	0.7072	0.6637
$E(Y) = \alpha \times F^b \times L^c$	PDO	-13.8163	1.3307	0.6813
$E(Y) = \alpha \times F^b \times L^c$	Severe	-5.6000	0.626	0.6484
$E(Y) = \alpha \times F^b \times L$	Head-On	-16.7758	1.5867	
$E(Y) = \alpha \times F^b \times L^c$	Rear-End	-9.7368	0.9816	0.6665

L is the length of the mainline segment in kilometres

F is the average annual daily traffic

k the over-dispersion parameter, is estimated as a constant

Appendix B: Field Investigation Details

1. Coleraine Drive Corridor

1.1 Roadway geometrics

1.1.1 Elevated intersection

The intersection of Coleraine Drive and Regional Road 50 is elevated for motorists travelling in the eastbound and westbound directions. The presence of this condition reduces visibility to upcoming traffic for vehicles turning left from both eastbound and westbound directions or going through the intersection during the green phase as illustrated in Figure 1.



Figure 1: Elevated Intersection (Coleraine Drive and Region Road 50)

1.1.2 Limited Turning Radius for Heavy Vehicles

At the intersection of Coleraine Drive and Region Road 50, heavy vehicles attempting to make a right turn are forced to drive over the sidewalk due to the limited available turning radius. This situation creates a potential safety hazard for pedestrians at the intersection. For illustration purposes, Figure 2 shows eroded surface along with a heavy vehicle clipping the shoulder due to the limited turning radius.



Figure 2: Limited Turning Radius (Coleraine Drive and Region Road 50)

1.1.3 Skewed Intersection Alignment

The eastbound approach of Coleraine Drive is aligned with Regional Road 50 at a 90-degree angle for approximately 30 metres from the intersection, where it turns towards the north. This situation creates a potential safety hazard of running off the road for unfamiliar motorists due to the sudden change in road alignment. This situation is illustrated in Figure 3.



Figure 3: Skewed Intersection (Colerain Drive and Region Road 50)

1.1.4 Offset Intersection Approaches

Existing left-turn lanes in all directions at the intersection of Coleraine Drive at Mayfield Road presents negative offsets. This configuration can create visibility restrictions to drivers attempting to turn left during the permissive phase when drivers in the opposite direction are attempting to perform the same manoeuver. This is aggravated when large vehicles, such as trucks, or in some cases large pick-up trucks, are in the opposing left-turn lanes as illustrated in Figure 4. This could be a contributing factor to turning movement collisions.



Figure 4: Offset Intersection Approaches (Colerain Drive and Region Road 50)

1.1.5 Private Driveway

A large warehouse driveway is in close proximity of the intersection of Coleraine Drive and Regional Road 50. During peak hours, heavy vehicles turning into Coleraine Drive from Regional Road 50 are attempting to access the private driveway, which may end up blocking the intersection. Motorists queued in the east leg of the intersection block access to the private driveway during the all red phase. Heavy vehicles are required to stop and wait for a gap in-between these queued motorists to enter the property. Due to the close proximity of the private driveway and intersection, this scenario may cause queue spill back onto Regional Road 50 and increase the potential turning on red for the waiting vehicles in Figure 5.



Figure 5: Access to Private Driveway (Colerain Drive and Region Road 50)

1.1.6 Shoulder Widths

Shoulder widths were found to be narrow at several locations for along the Coleraine Drive compared to guidance from the TAC Geometric Design Guide. These shoulders are not wide enough to accommodate a stopped vehicle. TAC recommends a shoulder width of 2.5 meters for undivided rural roads with a design speed of 80 to 100 km/h¹ and design hour volume between 250 and 450. A typical shoulder along the corridor is illustrated in Figure 6.

¹ 1999 TAC Geometric Design Guide for Canadian Roads, Table 2.2.4.1, Shoulder Widths for Rural Roads



Figure 6: Narrow Shoulders along the Coleraine Drive Corridor

1.1.7 Clear Zones

The review of the roadside identified some issues related to slopes and fixed objects within the clear zone along Coleraine Drive. These issues are summarized in this section:

- + **Side Slopes:** The side slopes of the roadway generally were found to be irregular. Slopes appeared to be steep and unrecoverable within clear zone at some locations. Vehicles encroaching on these

slopes may not be able to recover and at some locations are likely to overturn. Recoverable slopes are generally the slopes flatter than 4:1 on which a driver can retain or regain the control of the vehicle in a run-off the road event. Non recoverable slopes are generally the slopes from 4:1 to 3:1. These slopes may be traversable, but the vehicle will continue to the bottom. Slopes steeper than 3:1 are known as critical slopes and are considered outside of the recovery zone. Vehicles encroaching on these slopes are likely to overturn. TAC notes that if critical slopes begin within the clear zone distance, a traffic barrier may be warranted if the slope cannot be readily flattened². Figure 7 illustrates a typical roadside slope within the clear zone.



Figure 7: Side Slopes along the Coleraine Drive Corridor

- + **Fixed Objects:** CIMA examined fixed objects along the roadside and found a considerable number of non-breakaway utility poles within the clear zone. Additionally, other objects such as culverts, culvert headwalls at private driveways, and some breakaway fire hydrant were found to be located within the clear zone. Figure 8 illustrates a non-breakaway wood pole, a culvert headwall, and fire hydrant within the clear zone.

It is important to note that the collision history review did not indicate any collisions associated with fixed objects and roadside slope along the corridor.

² 1999 TAC Geometric Design Guide for Canadian Roads, page 3.1.4.2, Applying Clear Zone Concepts



Figure 8: Fixed Objects along the Coleraine Drive Corridor

1.2 Traffic Control Devices

1.2.1 Pedestrian Signals

Existing pedestrian signal heads at two intersections of Coleraine Drive and Regional Road 50 and Coleraine Drive and Mayfield Road are not properly aligned with the existing painted pedestrian crosswalks and sidewalks as illustrated in Figure 9.



Figure 9: Offset Pedestrian Signals

The pedestrian pushbutton located at the southwest corner of the intersection of Coleraine Drive and Regional Road 50 is obstructed by tree branches. During the spring and summer seasons once branches bloom, it may be difficult for pedestrians to locate the push button and safely operate the intersection as shown in Figure 10.



Figure 10: Obstructed Pedestrian Push Button (Coleraine Drive and Regional Road 50)

1.3 Pedestrians Facilities

At the intersection of Coleraine Drive and Regional Road 50, existing pedestrian signal heads and painted crosswalks located on all four approaches of the intersection do not contain any pedestrian sidewalks for accessibility of the intersection and approaches. Existing road shoulders for Regional Road 50 and Colerain Drive are used as sidewalks by pedestrians attempting to cross any of the approaches of the intersection which are approximately 1 meter in width with mountable curbs. The existing geometry of the intersection creates a potential safety hazard for pedestrian at all legs of the intersection attempting to cross. This issue is due to the lack of sidewalks and the possibility of heavy vehicles encroaching the mountable shoulders due to the limited turning radius as demonstrated in Figure 11.



Figure 11: Pedestrian Sidewalks (Coleraine Drive and Regional Road 50)

1.4 Guide Rail End Treatment

At the intersection of Coleraine Drive and Region Road 50, the culverts and the corresponding ditch located on both sides of the roadway are protected by steel beam guide rails. The steel beam guide rail on the southeast corner has a turned down approach end, as illustrated in Figure 12, which can become a vaulting hazard to errant vehicles.



Figure 12: Turned Down Approach Treatment Colerain Drive and Region Road 50

2. Clarkway Drive Corridor

2.1 Roadway geometrics

2.1.1 Downgrades on Approaches to Intersection

The northbound, southbound and eastbound directions at the intersection of Clarkway Drive at Countryside Drive present a downgrade on approaches to the intersection. The presence of downgrade on approaches to the intersection could be a potential contributing factor to rear end and angle collisions due to potentially higher speeds. Also, the presence of the crest vertical curve in the north and south legs could restrict the sightlines to upcoming traffic or stopping vehicles while departing the intersection. The intersection is demonstrated in Figure 13. It should be noted that the collision history review indicated one rear-end and one angle collision at this intersection.



Figure 13: Intersection at Clarkway Drive and Countryside Drive

2.1.2 Sightlines

Existing vegetation located on the northwest corner of Clarkway Drive and Countryside Drive reduces sight triangles for motorists travelling in the southbound and eastbound directions as shown in Figure 14. It should be noted that the subject intersection is all-way stop control and the requirement for clear sight triangles is not applicable for this type of intersection.



Figure 14: Limited Sight Triangles (Clarkway Drive and Countryside Drive)

2.1.3 Shoulders

The usable widths of shoulders for the road sections along Coleraine Drive appeared to be substandard at several locations in accordance to the TAC Geometric Design Guide. These shoulders are not wide enough to accommodate a stopped vehicle. The TAC Guide has recommended a shoulder width of 2 meters for undivided rural roads for a design speed of 80 to 90 km/h³. Figure 15 illustrates a typical shoulder along the corridor.

³ 1999 TAC Geometric Design Guide for Canadian Roads, Table 2.2.4.1, Shoulder Widths for Rural Roads

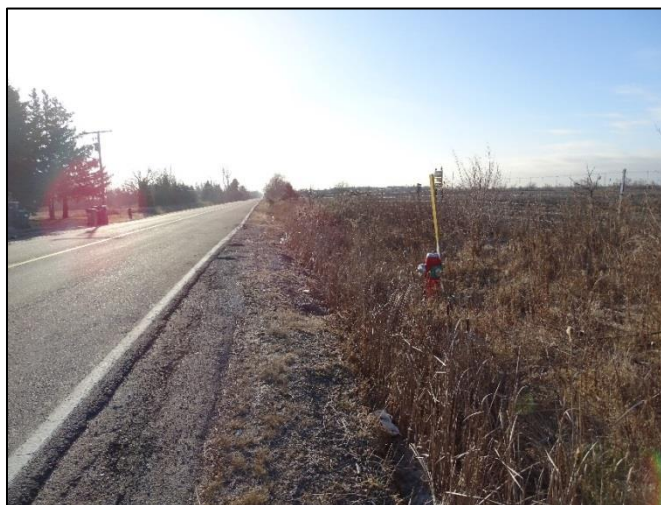


Figure 15: Narrow Shoulders along the Clarkway Drive Corridor

2.1.4 Clear Zone

The review of the clear zone identified the following issues related to roadside slopes and fixed objects within the clear zone along the Clarkway Drive:

- + **Side Slopes:** The side slopes of the roadway generally were found to be irregular. Slopes appeared to be steep and unrecoverable within clear zone at some locations. Vehicles encroaching on these slopes may not be able to recover and at some locations are likely to overturn. Recoverable slopes are generally the slopes flatter than 4:1 on which a driver can retain or regain the control of the vehicle in a run-off the road event. Non recoverable slopes are generally the slopes from 4:1 to 3:1. These slopes may be traversable, but the vehicle will continue to the bottom. Slopes steeper than 3:1 are known as critical slopes and are considered outside of the recovery zone. Vehicles encroaching on these slopes are likely to overturn. TAC notes that if critical slopes begin within the clear zone distance, a traffic barrier may be warranted if the slope cannot be readily flattened⁴. A typical roadside slope within the clear zone is illustrated in Figure 16.



⁴ 1999 TAC Geometric Design Guide for Canadian Roads, page 3.1.4.2, Applying Clear Zone Concepts



Figure 16: Side Slopes along the Clarkway Drive Corridor

- + **Fixed Objects:** CIMA examined fixed objects along the roadside and found that a significant number of non-breakaway utility poles that do not meet the clear zone requirement. Additionally, other objects such as a culvert headwalls of private driveways and some breakaway fire hydrant were found to be located within the clear zone. A non-breakaway wood pole, a culvert headwall, and fire hydrant within the clear zone is illustrated in Figure 17.



Figure 17: Fixed Objects along the Clarkway Drive Corridor

It is important to note that the collision history review did not indicate any collisions associated with fixed objects and roadside slope within the corridor.

2.2 Traffic Control Devices

2.2.1 Pedestrian Signal Heads

Existing pedestrian signal heads on all approaches located at Clarkway Drive and Mayfield Road are not properly aligned with the existing pedestrian crosswalks and sidewalks as demonstrated in Figure 18.



Figure 18: Offset Signal Heads (Clarkway Drive and Mayfield Road)

2.3 Pedestrians Facilities

The intersection of Clarkway Drive at Mayfield Road contains limited sidewalk infrastructure for pedestrians attempting to cross at any of the approaches. The intersection contains existing painted pedestrian crosswalks with limited sidewalk infrastructure. The existing sidewalks are only located within a small proximity and length of the intersection, creating limited accessibility for pedestrians to reach the intersection.

Existing pedestrian sidewalks do not have a mountable curb to assist pedestrians with disabilities to access the sidewalks and painted pedestrian crosswalks, and therefore do not meet the Accessibility for Ontarians with Disabilities Act (AODA) as demonstrated in Figure 19.



Figure 19: Lack of Pedestrian Infrastructure (Clarkway Drive and Mayfield Road)

2.4 Guide Rail system

Sections of 3-Cable guide rail systems were found to be installed within the corridor. Most 3-Cable guide rail systems present within the corridor appeared to be old and damaged. The 3-Cable was installed to protect vehicles from the water body hazards and the deep slope. The damaged 3-cable is illustrated in Figure 20.



Figure 20: Damaged Cable Guide Rail along the Clarkway Drive

The leaving-end of the existing steel beam guide rail is located within the clear zone for vehicles in the opposite direction of travel. The leaving-end is missing an energy attenuator, as illustrated in Figure 21. An improper end treatment may pose a spearing hazard in the event of a head-on collision with the guide rail.



Figure 21: Steel Guide Rail Leaving-End (Clarkway Drive and Countryside Drive)

Existing steel beam guide rails located at the intersection of Clarkway Drive and Countryside Drive along the southeast corner do not provide sufficient length of need (LON) to protect motorists from the existing water hazard. Based on the speed of the road and depth of hazard, the guide rails are required to be further extended to protect motorist travelling in the northbound and southbound directions.

The steel beam guide rail is lacking in length of need (LON) as shown in Figure 22. According to the MTO standard⁵ for protection of water body hazards with barrier, the installation length of the barrier shall be the maximum encroachment distance.



Figure 22: Inadequate Steel Beam Length along the Clarkway Drive

3. Countryside Drive Corridor

3.1 Roadway geometrics

3.1.1 Existing Skewed Alignment of Intersection

The west Leg of Countryside Drive and Regional Road 50 is skewed. Vehicles travelling westbound through the intersection need to veer right in the middle of the intersection to align their vehicles to the

⁵ Guide Rail Protection on Inside of Horizontal Curves and Length of Barrier Protection for Water Hazards” memo dated November 18, 2002.

receiving lane downstream of the intersection. This situation creates a potential safety hazard for motorists who are unfamiliar with the approach due to the sudden change in road alignment. In addition, the existing configuration can create visibility restrictions to drivers attempting to turn left or right during the permissive phase when drivers in the opposite direction are attempting to perform the same maneuver. This is aggravated when large vehicles, such as trucks, or in some cases large pick-up trucks, are in the opposing left-turn lanes as demonstrated in Figure 23. This may be a potential contributing factor to turning movement collision located at this intersection.



Figure 23: Skewed Intersection Approach (Countryside Drive and Regional Road 50)

3.1.2 Proximity of Adjacent Intersection

The intersection of Cold Creek Drive and Nashville Road is located immediately east of Countryside Drive at Regional Road 50. High volumes of heavy vehicles were observed travelling southbound along Cold Creek Drive and attempting to make a right turn onto Nashville Road to be serviced by the intersection of Countryside Drive and Regional Road 50. Due to the close proximity of the two intersections, heavy vehicles attempting to turn right onto Nashville Road block the right and through lanes along the east leg

of Countryside Drive and Regional Road 50. The through and right turn vehicles will use the shoulder and/or the north leg of Cold Creek Drive intersection to make the maneuvers around the trucks. This may be a potential safety concern due to the reduced sightlines created by heavy vehicles blocking the through and right turn lanes and impatient motorists stuck behind the heavy vehicles as shown in Figure 24.



Figure 24: Proximity of the Two Intersections (Cold Creek Drive at Nashville Road and Countryside Drive at Regional Drive 50)

3.1.3 Shoulders

The usable widths of shoulders for the road section of Coleraine Drive within the corridor appeared to be substandard at several locations as identified in the TAC Geometric Design Guide. These shoulders are not wide enough to accommodate a stopped vehicle. The TAC Guide has recommended a shoulder width of 2.5 meters for undivided rural roads for a design speed of 80 to 100 km/h⁶ and design hour volume between 250 and 450 vehicles. Figure 25 illustrates a typical shoulder along the corridor.

⁶ 1999 TAC Geometric Design Guide for Canadian Roads, Table 2.2.4.1, Shoulder Widths for Rural Roads



Figure 25: Narrow Shoulders along Countryside Drive

3.1.4 Clear Zone

The review of the clear zone identified the following issues related to roadside slopes and fixed objects within the clear zone along the Countryside Drive:

- Side Slopes:** The side slopes of the roadway generally were found to be irregular. Slopes appeared to be steep and unrecoverable within clear zone at some locations. Vehicles encroaching on these slopes may not be able to recover and at some locations are likely to overturn. Recoverable slopes are generally the slopes flatter than 4:1 on which a driver can retain or regain the control of the vehicle in a run-off the road event. Non recoverable slopes are generally the slopes from 4:1 to 3:1. These slopes may be traversable, but the vehicle will continue to the bottom. Slopes steeper than 3:1 are known as critical slopes and are considered outside of the recovery zone. Vehicles encroaching on these slopes are likely to overturn. TAC notes that if critical slopes begin within the clear zone distance, a traffic barrier may be warranted if the slope cannot be readily flattened⁷. A typical roadside slope within the clear zone is illustrated in Figure 26.



Figure 26: Side Slopes along Countryside Drive

- Fixed Objects:** CIMA examined fixed objects along the roadside and found that a significant number of non-breakaway utility poles that do not meet the clear zone requirement. Additionally, other objects such as a culvert headwalls of private driveways and breakaway fire hydrant were found to be located within the clear zone. A non-breakaway wood pole, a culvert headwall, and fire hydrant within the clear zone is illustrated in Figure 27.



Figure 27: Fixed Objects along Countryside Drive

⁷ 1999 TAC Geometric Design Guide for Canadian Roads, page 3.1.4.2, Applying Clear Zone Concepts

It is important to note that the collision history review did not indicate any collisions associated with fixed objects and roadside slope within the corridor.

3.2 Traffic Control Devices

The intersection of Countryside Drive and St. Johns Road is missing a Checkerboard sign (Wa-8LR) for motorists travelling southbound on St. Johns Road. The checkerboard sign must be used where a road terminates, and there is no option to proceed straight ahead, but there are options to proceed to the left or to the right as illustrated in Figure 28. The sign should be used where posted speed is 60 km/h or less.



Figure 28: Missing Checkerboard Sign (Countryside Drive and St. Johns Road)

Intersection warning signs (uncontrolled) (Wa-13) are not present in the eastbound and westbound approaches along Countryside Drive towards St. Johns Road. These signs are used at unexpected or unseen intersections that may present a hazard to through and turning traffic, which most often are needed on rural roads.

The existing pedestrian signal head located on the northeast corner of the intersection of Countryside Drive and Regional Road 50 contains a broken pedestrian signal head facing the eastbound pedestrians. The pedestrian signal head is open with the internal wiring exposed, pedestrians attempting to cross the north approach are not aware of the current signal phase as shown in Figure 29.



Figure 29: Broken Pedestrian Signal Head (Countryside Drive and Regional Road 50)

Existing pedestrian push button on the southwest corner of Countryside Drive and Regional Road 50 is located in the ditch as illustrated in Figure 30. This creates a falling hazard for pedestrians attempting to activate the push button without knowing the change in elevation between the edge of roadway and slope.



Figure 30: Accessibility of Pedestrian Push Button (Countryside Drive and Regional Road)

3.3 Pedestrians Facilities

Existing pedestrian signal heads and painted crosswalks are located on three approaches at the intersection of Countryside Drive and Regional Road 50 with no sidewalks for pedestrians located on any of the approaches. The existing right-turn channelization island located on the northeast corner of the intersection also functions as a pedestrian refuge; however it does not contain a mountable curb to provide access for any pedestrians with disabilities as shown in Figure 31.



Figure 31: Lack of Pedestrian Infrastructure (Countryside Drive and Regional Road 50)

3.4 Public Transportation

The GO Transit bus stop on the northwest corner of the intersection of Countryside Drive and Regional Road 50 is not accessible to pedestrians attempting to reach the bus stop safely. In addition, a concrete pad or pedestrian shelter is not available for pedestrians waiting at the bus stop. The intersection contains existing painted crosswalks located along all approached of the intersection; however, due to the lack of sidewalks, there is no accessibility for pedestrians to reach the GO Transit bus stop as shown in Figure 32.



Figure 32: Limited Bus Stop Access (Countryside Drive and Regional Road 50)

3.5 Guide Rail system

Sections of 3-Cable guide rail systems were found to be installed within the corridor. The 3-Cable guide rail systems present within the corridor appeared to be old. The 3-Cable was installed at the start of the slope and at the edge of the culvert. To avoid reduced lateral post restraint on shoulder installations, the shoulder rounding width behind the posts should be maintained at a minimum of 0.5 meter⁸. Figure 33 illustrates the 3-cable guide rail.

⁸ Roadside Safety Manual 1993, Page 0402-6.



Figure 33: 3-Cable Guide Rail along Countryside Drive

The existing steel beam guide rail leaving-end is located within the clear zone for vehicles in the opposite direction of travel and is missing an energy attenuator. An improper end treatment may pose a spearing hazard in the event of a head-on collision with the guide rail. Energy attenuators are also missing at both approach and leaving-ends of the steel beam guide rail at a field entrance. Figure 34 illustrates the steel guide rail leaving-ends.



Figure 34: Steel Guide Rail Leaving-End along Countryside Drive

4. High-Level Field Investigation

The CIMA safety team completed an additional high-level field investigation for Regional Road 50, Castlemore Road, Mayfield Road, and Gore Road to identify any potential safety hazards located along these corridors. A drive through of the above corridors was undertaken on Tuesday February 23, 2015.

4.1 Regional Road 50 Corridor

4.1.1 High Operating Speed

While driving along Regional Road 50 in both the northbound and southbound directions at the posted speed limit of 80 km/h, it was observed that multiple motorists travelling alongside were exceeding the posted speed limit and passing the CIMA safety team.

All rear-end collisions that occurred at the intersections of Regional Road 50 with Coleraine Drive and with Countryside road involved vehicles travelling in the northbound and southbound directions. High operating speed could be a contributing factor for these rear-end collisions.

The northbound and southbound left-turn movements operate with protected-permissive phasing, which, at each cycle, requires that some drivers wait for gaps in the opposing direction through traffic. The high speed of through vehicles reduces the gap for the turning vehicles and this becomes a potential contributing factor to turning movement collisions.

4.1.2 Guide Rail system

The existing guide rails located along Regional Road 50 from Castlemore Road to Mayfield Road contain outdated guide rail end treatments, including an eccentric loader and a turned down steel beam, as shown in Figure 35. Energy attenuators are preferable.



Figure 35: Missing Crash Cushion along Regional Road 50

4.2 Castlemore Road Corridor

The City has completed major reconstruction of the corridor of Castlemore Road from Regional Road 50 to The Gore Road around the year 2012 as shown in Google Street View historic data. CIMA's safety

team performed a high level review of the corridor and did not identify any areas of concern regarding transportation safety.

4.3 The Gore Road Corridor

Major development and construction are present at the north end of this corridor. CIMA's safety team performed a high level review of the corridor for any potential roadside safety improvements. In summary, the fixed object and exposed culverts appears to be outside the clear zone with no other areas of concern being identified from a high level safety review of the corridor.

4.4 Mayfield Road Corridor

CIMA's safety team performed a high level review of the corridor for any potential roadside safety improvements. Similar to Gore Road, the fixed object and exposed culverts appears to be outside the clear zone with no other areas of concern being identified from a high level safety review of the corridor.

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